

OWNER'S MANUAL



HAWKER FLEX[®] Li³
THE POWER OF LITHIUM





OWNER'S MANUAL

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1. SCOPE

The information contained in this document is critical to the safe handling and proper use of the HAWKER FLEX® Li3 lithium battery for powering of electrical industrial trucks. It contains a global specification of the system as well as related safety measures, code of behavior, a guideline for commissioning and recommended maintenance. It 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 use.

While HAWKER® has used reasonable endeavors towards the application of legal requirements, this documentation is not legal advice and should not be relied upon as such. It is the users' responsibility to ensure the use of the documentation and any activities related thereto to follow all legal requirements applicable to themselves and the applications in the respective countries.

This document is also not intended to substitute any training for handling and operating the industrial truck or HAWKER FLEX® Li3 lithium battery that may be required by local laws and/or industry standards. Proper instruction and training of all users must be ensured prior to any contact with the battery system.

HAWKER FLEX® Li3 lithium batteries are designed for industrial truck traction applications only. Only HAWKER® approved chargers are to be used to charge HAWKER FLEX® Li3 lithium batteries. Refer to the abbreviations and terms at the end of this document.

2. OPERATIONAL DATA AND LIMITS

Nominal capacity: C_1 – see APPENDIX A: List of Batteries

Nominal voltage: 25.55V, 36.50V, 51.10V – see APPENDIX A: List of Batteries

Discharge current (continuous): $1 \times C_1$ [A] up to a max of 320A (limited by traction cable harness)

2. OPERATIONAL DATA AND LIMITS (CONTINUED)

Max charge current (continuous): $1 \times C_1$ [A] up to max of 640A (limited by charging cable harness(s))

Rated operational battery temperature range: 14°F (-10°C) to 131°F (55°C) (battery temperature)

Rated charging battery temperature range: 32°F (0°C) to 122°F (50°C) (battery temperature)

This battery must not be used under conditions where it becomes immersed in water.

This battery must not be installed on the underbody of an electrical industrial truck.

Usage of this battery in cold store applications must be verified and approved in writing by HAWKER® Engineering.

Storage of this battery at cold temperatures below the battery operating temperature must not be allowed.

When the products are intended to be stored for a prolonged period of time (more than one month), product SoC should be between 30%-70%SoC and optimal storage temperature should be lower than 35°C.

Product is neither intended to be permanently stored, nor used exclusively outdoors unless truck is designed for it.

The battery is designed to be charged indoors and while in the truck.

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 HAWKER FLEX® Li3 lithium battery warranty.

These batteries are virtually maintenance-free.

Only HAWKER® approved fasteners, connectors, cabling and plugs are to be used.

3. ENVIRONMENTAL OPERATION LIMITS

The battery (excluding harness) is rated to IP54, therefore do not clean the battery with pressurized water.

Do not use the battery outdoors without suitable weatherproof protection.

The battery must not be operated or stored in conditions where it can get immersed.

The battery storage temperatures are -40°F (-40°C) to 140°F (60°C).

The battery operating temperatures are 14°F (-10°C) to 131°F (55°C).

Keep the battery away from fire, sparks and heat.

Battery must not be exposed to extend periods of direct sunlight that allow the temperature of the battery to rise above the storage and operating temperatures of the battery.

Batteries must not be operated in condensing environments.

4. SAFETY

This battery is designed to be a drop-in replacement of a lead-acid battery used to power an electric industrial truck. Modifications of truck firmware, truck settings or truck hardware may be necessary with the substitution of the lead acid battery to accommodate the lithium battery. Consult with Truck OEM for required modifications. Depending on the intended application, connectors, ballast, tray size, etc., must be customized in order to ensure the drop-in compatibility. The instructions of the operational manual of the industrial truck must be followed.

WARNING: Installing the battery in a non-compliant truck is a fire risk due to a potential for improperly sized cable harnesses (Refer to Section 12: Electrical Power Connection to Industrial Truck for full compliance requirements).

Each battery is designed to be stable and tolerant to the applications within the scope laid out in the operating conditions, however, battery systems have an inherent hazard due to the nature of stored energy.

All limits of the vehicle including operating and handling for the vehicle must be followed in addition to the battery limits as documented in the following sections for a safe operation, handling and storage.

4. SAFETY (CONTINUED)

Anybody involved in handling or usage of the battery must completely understand and be trained on all aspects of the battery systems as required by local laws and regulations.

The battery is an electrical storage system. During operation and charging the DC voltage will be 19.6 to 29.4, 28.0 to 42.0 or 39.2 to 58.8 volts for the 24V, 36V and 48V batteries respectively.

In case the battery shuts down with a message that indicates "Battery Lockout" HAWKER® must be contacted for service as the pack is locked out until a service person is able to inspect the battery and then return it to HAWKER® Service.

The main potential dangers of this battery are:

Thermal Events: An event with high temperatures within the cell(s) which can possibly include release of flammable, corrosive and toxic liquids/gasses, smoke containing components such as hydrofluoric acid and carbon monoxide. Avoid prolonged exposure. In case of fire, Refer to Section 7: Fire Extinguishing.

Short Circuits with Arc: A shorting event with a high current may occur because of the low internal resistance of the Li-ion battery. A resulting arc flash may emit an intense hot flash of infrared, visible and ultraviolet light. Molten and vaporized metal may be ejected. Components may become extremely hot.

Mechanical Hazards: An event with dropping, crushing, pinching or impact due to the heavy weight of the battery if improperly handled or restrained.

The battery features design-specific mechanical, electrical, and electronic / software based provisions to minimize any expected risks.

These measures include:

- A functional safety qualified electronic monitoring and control system to ensure safe electrical operation (voltage, current and temperature limits).
- A safe shut-off strategy to respond if limits have been violated (voltage, current and temperature).
- Contactor and fusing strategy to minimize the impact of external short circuits on the battery. However, arcing cannot be prevented in the most extreme cases.
- Dedicated handling / lifting points.
- Dedicated venting solution to respond to potential cell failure in order to mitigate the impacts of the resulting outgassing.

To ensure safety, follow the safety guidelines below:

- Operation must only be done in accordance to the limitations within this document.
- Stop the usage of the battery if there is a crush, pinch, cut or other damage to the power cables or power connectors.
- Keep the battery away from heat sources.
- Keep the battery away from ignition sources.
- Do not operate the battery in a hazardous location, such as a flammable or explosive environment.
- Store only in monitored areas with suitable fire control and protection per local requirements, e.g. local fire regulation and building insurance requirements.
- Operate only in monitored areas with suitable fire control and protection per local requirements, e.g. local fire regulation and building insurance requirements.
- Operation must only utilize HAWKER® qualified hardware and software as delivered and installed by HAWKER® personnel (no customizations are allowed).
- Charging must only be performed with HAWKER® approved chargers for HAWKER FLEX® Li3 lithium batteries.
- Handling and storage must be in a dry environment.
- Prevent immersion of the battery into water.
- Handling and service of the battery requires proper training of HAWKER® approved technicians with appropriate rated tools and Personal Protective Equipment (PPE).
- In the case in which the battery has been operated or store outside of the allowable limits as stated in the document, cease operation and contact HAWKER®.
- In the case of any error that cannot be reset, do not continue operation of the battery until support and direction is provided by HAWKER®.

The HAWKER FLEX® Li3 lithium battery is a sealed product, however in case of cell damage within the battery, there is still the chance of electrolyte leakage. Please follow the directions below if any of the following incidents take place. Additional information can be found in the Lithium-ion Battery (Module) Safety Data Sheet (SDS): 829515H.

4. SAFETY (CONTINUED)

- If leaked electrolyte comes into contact with a person's skin or eyes, rinse the affected areas with clean water for at least 15 minutes. In the event of any bodily contact with electrolyte (either to the skin and/or eyes, and/or inhalation), seek immediate medical attention.
- If leaked electrolyte comes into contact with the mouth, or is swallowed, rinse out the mouth as well as the area around the mouth. Seek immediate medical attention.
- If thermal burns are caused, treat them accordingly. Seek immediate medical attention.

5. USAGE

The HAWKER FLEX® Li3 lithium battery must be used, operated and serviced in accordance with these operating instructions. The operating instructions of the truck and battery charger are required to be respected in addition to these operating instructions. In case the permissible operation parameters of the industrial truck are stricter, the truck limits must be respected for usage. For example, the permissible range of the battery application temperature does not increase the permissible range of the truck's application temperature.

When the battery is installed into the truck, the traction connector of the battery has to remain connected to the truck at all times. Never charge via the traction connector. For charging, the charging plug(s) single or dual must be connected to the HAWKER® approved charger. Upon plugging in the first charge plug, the traction contactor is opened so that the industrial truck cannot be operated inadvertently. For charging instructions, refer to Section 17: Charging Battery.

In the event of discharging below the usable energy, resulting in the battery shutting down due to low SoC, there is a feature to allow the truck to be operated on a very limited capacity and performance in order to immediately return to a matching charger. When a low SoC related tripping of the battery occurs, a restart (same as turning the pack on) is allowed to reset the pack once. Refer to Section 14: Operator Interfaces. If the battery is not placed on charge as soon as possible and allowed to discharge this limited capacity, the battery will once again shut down. **This time it will be locked out and require a service visit.** This limited capacity is intended to only allow for the truck to be driven a limited distance and not be used for any lifts.

Opportunity charging is highly recommended in order to maximize the daily runtime capability of the battery. It will also optimize the service life of the battery by decreasing the discharge window of the battery during discharge.

Operating the HAWKER FLEX® Li3 lithium battery in partial SoC is acceptable and beneficial for the lifetime of the battery.

The battery temperature has an effect on the capacity of the battery. For example, runtime may be reduced at lower temperatures.

Battery temperatures at extreme ends of the temperature limits as stated in this manual will have an effect on performance, possibly resulting in an unexpected shutdown.

All visual and audible warnings are to be respected and reviewed (Refer to Section 23: Troubleshooting).

The battery will go into a hibernation mode after a default of 8h when there is less than a default of 3A current draw. It can be reactivated by restarting the battery by the various start methods (Refer to Section 14: Operator Interfaces).

6. SAFETY VENTING

In the case of a thermal event, the battery is specially designed with a venting aperture to ensure any hot gases are vented AWAY FROM THE OPERATOR in a safe manner.

7. FIRE EXTINGUISHING AND EMERGENCY RESPONSE

In the unlikely event of a thermal runaway, which may result in a visible release of gas and/or intensive smoke build-up from the battery, **evacuate the location immediately and contact Emergency Responders.** 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: 829515H 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 event (gas, heat, vapors or smoke) requires fire suppression methods to be applied. **Absence of flame is not sufficient to consider the thermal runaway event stopped or extinguished.**

Large amounts of spray water and/or complete immersion into water can be used effectively to cool the battery and contain a Li-ion battery thermal event.

7. FIRE EXTINGUISHING AND EMERGENCY RESPONSE (CONTINUED)

In the case of the battery outgassing or after suppression of the fire, store the battery in a safe place outside (access restriction, hazard indications) for a minimum of 24 hours. Additional local regulations and requirements must be observed. It is recommended to monitor the temperature frequently to detect any potential new heat generation. In the instance that a thermal event reoccurs follow the same firefighting methods.

8. HANDLING

Handling of the battery is only allowed by instructed personnel that are familiar with the potential risks of Lithium-ion batteries for industrial trucks and for lifting heavy loads.

The battery must be handled avoiding sudden accelerations, decelerations, drops and other mechanical abuse conditions.

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 by utilizing one of the various 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.

All connectors and cables must be placed inside of the perimeter of the tray during handling and movement operations to avoid inadvertent crushing, pinching or cutting of the cables.

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 the weight. Recommended lifting method is for vertical lifts.

Prior to lifting the battery, the truck must be secured in order to not move during the battery install or removal operation.

After removal of the sealing bolts, the HAWKER® supplied lifting attachments for the battery must be fitted on the battery.

The rated lifting capacity of the lifting gear, e.g. a lifting hoist, must be appropriate for the battery weight and the lifting configuration. Lifting must only be performed by trained personnel. The operational and safety instructions of the lifting gear manual must be respected.

After handling of the battery, the lifting interface on the four points connection on the battery must be removed and the sealing bolts must be fitted again to seal the thread holes.

Hazards:

- Crush
- Pinch

9. BATTERY ARCHITECTURE

The battery is a modular design with power modules defining the standard building block. 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 Li-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.

Various operator interface accessories are used to provide the operator feedback on conditions within the battery (Refer to Section 14: Operator Interfaces).

Cabling is mounted directly on the battery to connect to the truck and to the charger. (Refer to Section 12: Electrical Power Connection to Industrial Truck and Section 17: Charging Battery).

Various LV (Low Voltage) cabling to connect to charger, operator interfaces, truck and debug port (Refer to Section 13: Battery Communication Interfaces with Charger, Truck and Operator Interfaces).

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

When assembling a battery, the power modules are connected in parallel along with a control module. Standardized battery sizes contain all required electrical connections.

The batteries are generally placed into protective trays meeting weight, dimensional and functional requirements for the application, ensuring compliance with both industrial truck and regional safety requirements. Special applications are managed through the HAWKER® sales department.



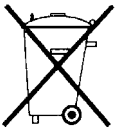


The battery does not have any liquid cooling.

10. BATTERY AND SAFETY LABELING

The battery monitors all external currents to the vehicle and to the charger and protects itself in real time based on cell voltage, current and temperature. In addition, the charge current is optimally controlled based on the battery temperatures.

The continuous charge and discharge limits allowed are listed in Section 2: Operational Data and Limits. The minimum, maximum and nominal battery voltage, nominal energy and nominal capacity are listed in APPENDIX A: List of Batteries.

The battery features the following labels:

	Type Label: Manufacturer Name & Logo Part & Serial Number Nominal Voltage Nominal Capacity Nominal Mass "Do not dispose in household waste" "Li-ion battery" "Warning" "Electrical Hazards" "Read safety instructions"
	<ul style="list-style-type: none">• Lithium Batteries Class 9 Miscellaneous• UN3481 when shipped installed in equipment
	<ul style="list-style-type: none">• Universal Waste and not to be disposed of as household waste
	<ul style="list-style-type: none">• Recycle and dispose of battery according to local regulations
	<ul style="list-style-type: none">• HAZARDOUS VOLTAGE: RISK OF SHOCK• DO NOT TOUCH UNINSULATED TERMINALS OR CONNECTORS

DANGER

In case of fire: Use large quantities of water. CO₂ dry chemical or foam may be used to slow fire until first responders arrive.
Store in a secured cool environment.
Use only approved chargers.
This product should only be serviced by qualified personnel and according to the service manual.
Do not short circuit or deep discharge.
Do not damage or perforate.
Do not tear down.
Do not heat above the allowed limits. (see instructions of use).
Cells in Lithium-Ion batteries are sealed and are not hazardous as long as use of all manufacturer's instructions are applied.
Violation of manufacturer's instructions may lead to a release of ingredients of cells.
In case of damage to the cell, corrosive and poisonous liquid can be released.
In case of fire, corrosive and poisonous vapors and gases may be released.
In the event of contact with internal substances, wash exposed skin thoroughly.

Recycle and dispose of battery according to Hazardous Material Regulations for Class 9 Miscellaneous



HAZARDOUS VOLTAGE: RISK OF SHOCK.
DO NOT TOUCH UNINSULATED TERMINALS OR CONNECTORS

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11. MECHANICAL INSTALLATION INTO INDUSTRIAL TRUCK

When substituting a lead acid battery with a Li-ion battery in an industrial truck, mechanical adjustments of the truck may become necessary. This must be performed according to the guidance the industrial truck manufacturer or representative has provided. 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.

Upon receipt of the battery, it must be checked for any obvious signs of damage to the battery and all cables, plugs and accessories.

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 (Refer to Section 8: Handling).

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 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.

12. ELECTRICAL POWER CONNECTION TO INDUSTRIAL TRUCK

The battery must be connected with the appropriate cables and connectors to the industrial truck per truck manufacturer's recommendations. Truck harness to be used is dictated by the truck OEM and shall be in compliance with all UL 583 / UL 2580 and EN 1175 requirements for current carrying capability and truck interface requirements.

WARNING: Installing the battery in a non-compliant truck is a fire risk due to a potential for improperly sized cable harnesses.

The cable dimensioning and DC connecting plug will vary depending on the truck and end user requirements.

Connection will come from a single connector that is attached to the internal pack (Refer to Figure 1: Electrical Interfaces).

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® Representative using correct factory replacement parts. No substitution is allowed.

13. BATTERY COMMUNICATION INTERFACES WITH CHARGER, TRUCK AND OPERATOR INTERFACES

There are multiple low power connections required to the outside of the CONTROL MODULE that must be connected during commissioning, depending on the end user requirements.

The position of the electrical interfaces on the control module is shown in Figure 1: Electrical Interfaces.

Figure 1: Electrical Interfaces



LV Charge Interface: This is a required connection for all batteries. This interface connects the Charge Adapter to Control Module allowing for the required CAN communication between the battery and the charger.

Truck Interface: This 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 discrete signal to the truck 10s before battery shutdown.
- External Key Signal: Truck key actuation allows the turning on of battery.

13. BATTERY COMMUNICATION INTERFACES WITH CHARGER, TRUCK AND OPERATOR INTERFACES (CONTINUED)

NOTE: In case use of this signal as interface with the truck is necessary and it was not previously discussed with HAWKER®, please contact service for support as prequalification and a specific cable are required.

Operator Interface: Connection point for Y-harness that connects to CAN Data Interface (CDI) and the optional user interfaces (Refer to Section 14: Operator Interfaces).

NOTE: The current of the interface must not exceed 0.5A.

LV-Debug Interface: Debug interface used for HAWKER® service purposes.

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

14. OPERATOR INTERFACES

All batteries will be supplied with the CDI, which is attached directly to the battery. 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 SoC. This operator in-truck interface can be either the BDI or the HAWKER® Advanced Battery Interface (ABI) smart battery dashboard. This requirement of an in-truck interface can only be eliminated if full OEM integration options are utilized allowing the truck's existing operator interfaces to be utilized. OEM integrations require prequalification and approval from both HAWKER® and the truck manufacturer.

All operator interfaces are equipped with a pushbutton in order to ACTIVATE and DEACTIVATE the battery.

The operator interfaces will emit audible beeping alarms and visual warnings when SoC limits are reached. 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 (Refer to Section 13: Battery Communication Interfaces).

CDI (CAN Data Interface):

This device is installed on EVERY battery.

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

In most cases the CDI will be hidden once the battery is installed into an industrial truck. However, it does feature an ACTIVATION / DEACTIVATION button and LED display to allow interaction of the battery if accessible or when a battery is outside of industrial truck.

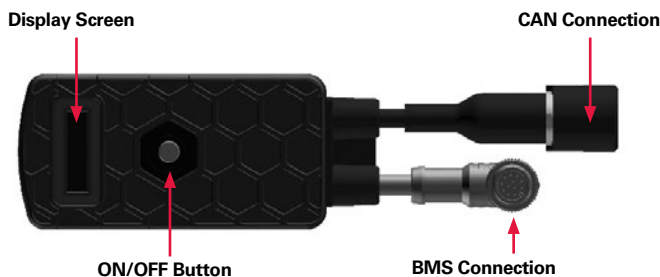
The buzzer and LED behavior for the CDI is as follows:

- Warning Depth of Discharge (DOD) ON 0.5 s / OFF 0.5 s
- Alert DOD ON 0.5 s / OFF 0.5 s (+ red LED)
- BMS error ON 0.5 s / OFF 0.5 s (+ red LED)

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

NOTE: In the cases of full OEM integration, the battery will cease to function if the CDI or wires to the CDI are broken. Contact Service for repair or replacement.

Figure 2: CDI



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

14. OPERATOR INTERFACES (CONTINUED)

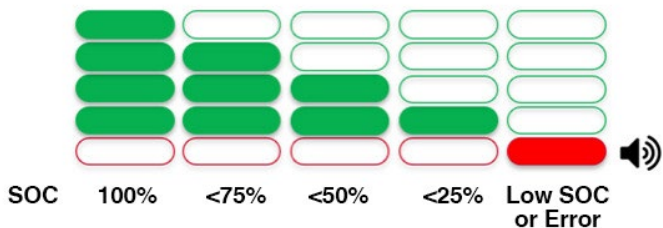
Figure 3: HAWKER® MOD-ifi™ smart device app



BDI (Battery Discharge Indicator):

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 (Refer to Figure 4: BDI). The series of lights will indicate SoC (Refer to Figure 5: State of Charge Indicator Screen), while audible alarms will notify the operator that battery requires recharging or that there are the battery errors. Continued operation after the BDI indicated low SoC will ultimately result in 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 to access the ACTIVATION / DEACTIVATION button, as well as hear the audible alerts.

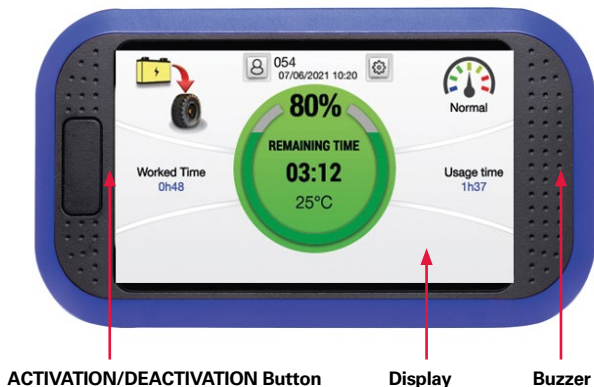
Figure 4: BDI



HAWKER® Advanced Battery Interface (ABI)

The HAWKER® ABI 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 device. The HAWKER® ABI device must be permanently and securely fixed in a position for the operator to view the information and to access the ACTIVATION / DEACTIVATION button.

Figure 6: Screen One



Switching to Screen Two provides additional detailed information. Refer to the HAWKER® ABI manual for further information.

14. OPERATOR INTERFACES (CONTINUED)

Figure 7: Screen Two – Battery Details

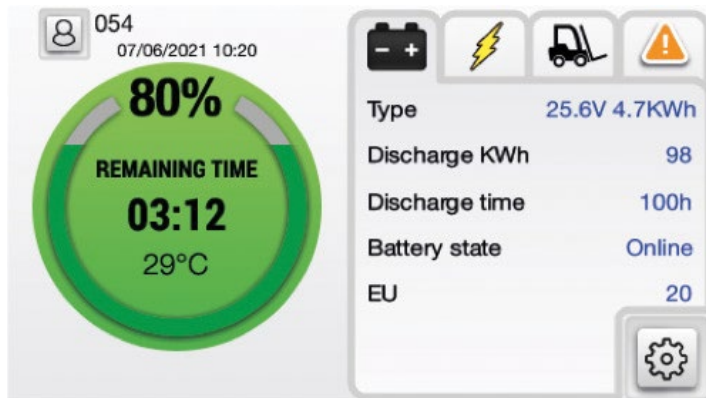


Figure 8: Screen Two – Cycle/Trip Details

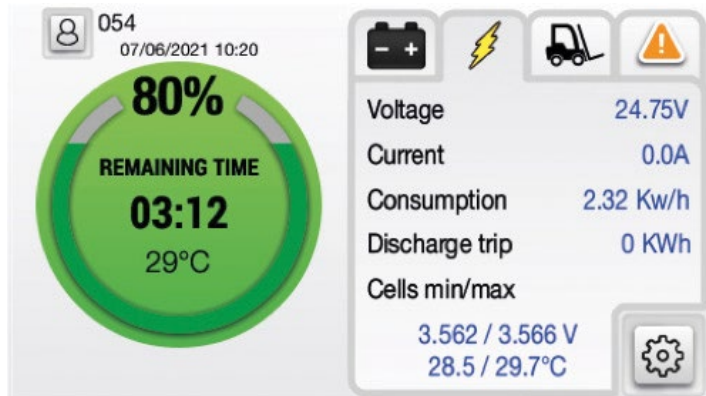


Figure 9: Screen Two – Truck Details

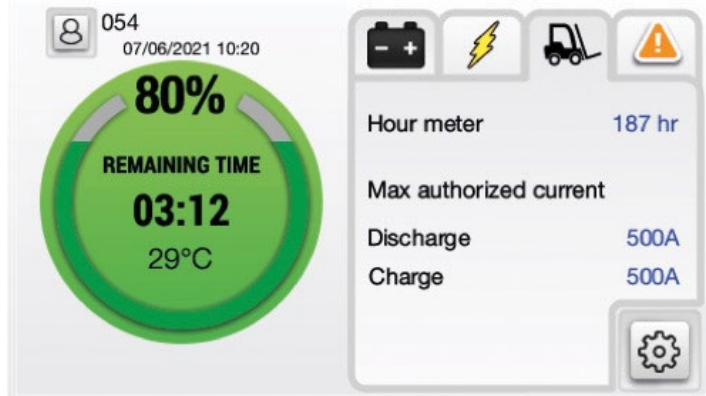
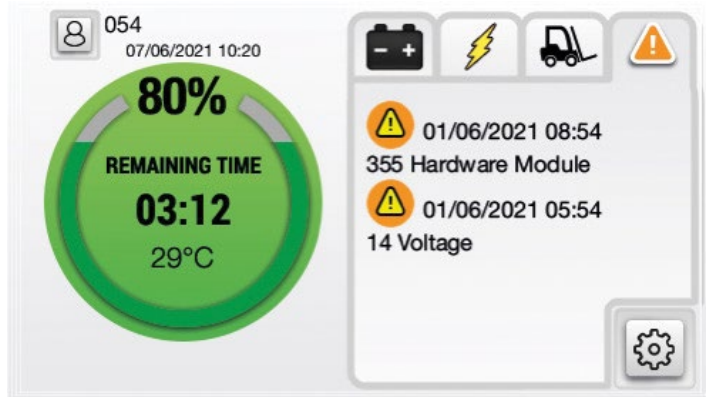


Figure 10: Screen Two – Active Warning



14. OPERATOR INTERFACES (CONTINUED)

Figure 11: Remaining State of Charge

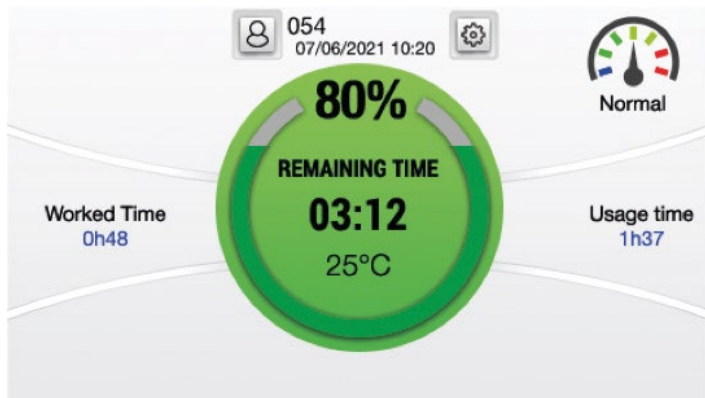


Figure 12: Remaining State of Charge

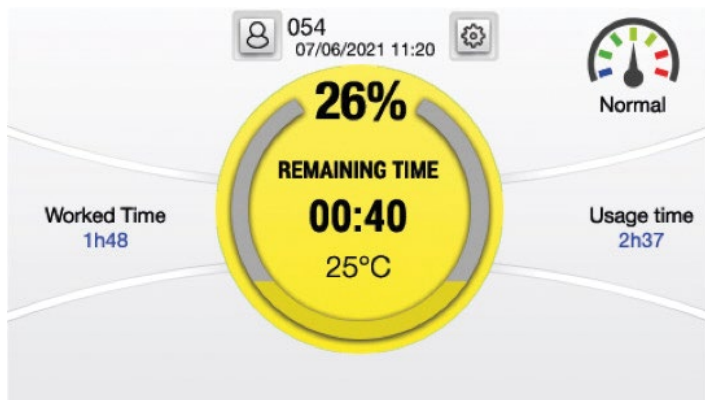


Figure 13: Alert to Charge Battery



15. CAN-BUS CONNECTIVITY

The HAWKER FLEX® Li3 lithium battery has the ability to be integrated into an OEM industrial truck CANbus system which allows battery information to be displayed on the truck user interface (Refer to Section 13: Battery Communication Interfaces with Charger, Truck and Operator Interfaces for making the connection between the battery and the truck).

Please contact your local HAWKER® Representative for this option.

This option will require engineering consultation between HAWKER® and the industrial truck OEM to ensure correct data and functions are enabled.

16. ACTIVATION / DEACTIVATION OF BATTERY

The battery will deactivate automatically when a no load condition (<3Amps) is detected for a default setting of 8 continuous hours to ensure that an unused battery is not deeply discharged accidentally.

16. ACTIVATION / DEACTIVATION OF BATTERY (CONTINUED)

Activation:

ACTIVATE the battery for truck operation using one of the external sources listed below. The battery will automatically switch to the traction state (provided the pack is not connected to a charger and there are no battery errors) applying power to the truck. In all cases, a short press of ~0.5s is required.

- Activation via push button operator interface, CDI, BDI or HAWKER® ABI dashboard (Refer to Section 14: Operator Interfaces).
- Activation via External Key Signal (Refer to Section 13: Battery Communication Interfaces with Charger, Truck and Operator Interfaces).

ACTIVATE the battery for charge operation (when battery is OFF prior to plugging in)

An activation signal is sent to the battery when it is plugged into the charger. This allows battery activation and charging even without previous activation of the battery by other measures above (Refer to Section 17: Charging Battery).

NOTE: Shut Down at Low SoC

Once the battery falls below 0% SoC the CDI, BDI and/or HAWKER® ABI device will send both visual and audible alarms to the operator for 10 seconds before disconnecting power indicating the operator to slow down and move the truck to a safe location (Refer to Section 14: Operator Interfaces for details on other non-disconnecting SoC warning levels).

Once this Low SoC level is reached, the battery can be reactivated to allow travel to the nearest charger. If the product continues to be used, at 0% SoC, and the limited capacity is depleted, the operator interface will again provide a 10 second warning before disconnecting power and locking out. It is highly recommended to drive at slow speeds and not to perform any additional lifts before having recharged the battery as it may shut off again due to low SoC or reduced current limits. The performance in this mode is very limited.

NOTE: If the battery shuts down again when in the LOW mode and a simple press of the activation button does not reactive that battery, HAWKER® personnel with a service tool will be required to unlock the product.

Deactivation:

In order to turn the battery OFF press the push button on the CDI, BDI or HAWKER® ABI device 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 turning the pack OFF there is a ~20s shutdown sequence in which an audible alarm will be heard.

17. CHARGING BATTERY

The battery must only be charged by an HAWKER® approved charger for Li-ion chemistry, which is 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 User Manual of the charger must be followed.

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

The battery system is equipped with drive away protection that will disconnect the traction power, disabling the truck if any battery charging plug is connected to charger. This mitigates the risk of an operator accidentally driving away when the charger is still connected which can cause chargers to be pulled from their mounted locations.

The battery should be charged in an appropriate environment (Refer to Section 3: Safety) including a clean and dry environment keeping in mind the requirements of charging location as described in the Charger User Manual.

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.

Ensure that connectors are free of contamination prior to connecting.

Depending on the battery there is dual or single connector charging capability.

At present communication options such as Ethernet, PLC and remote lights cannot be optioned on the charger.

Charging must be done with the battery inside of a vehicle except in the case of storage.

When in the industrial truck the battery must not be disconnected from the industrial truck nor is it required to open lids and covers on the battery compartment.

17. CHARGING BATTERY (CONTINUED)**Charging Sequence**

- Ensure that the battery and charger cables have no damage prior to connecting.
- Connect the charger to the battery charging ports in plugs. **The battery will either have a SINGLE or DUAL charging port, depending on the part number of battery and application charge rate.**
- Once a charge cable is connected, the traction contactor will open removing power from the truck for drive away protection.
- If battery is OFF the charger will automatically awake 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 charge cable with the CAN connector is connected. The optimal charge current will be determined automatically 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 optimal lifetime of the product. If the BMS detects a fault condition, the charging will stop.
- If required to stop charging prior to completing 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.

18. TRANSPORT

Because of their inherent stored energy and flammability, Li-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 the Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria. Anyone shipping batteries must be trained as required by local regulations in order to ship hazardous goods.

UN "Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria", chapter 38.3 (known as UN38.3) has been applied and product tested to UN 38.3 with test summaries 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 HAWKER® 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: 829515H 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 depending upon a given location. It is required for all persons shipping to become familiar with the application regulations.

19. STORAGE

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).

Storage area must be compliant with local fire, safety and building regulations for Lithium-ion batteries and in accordance with the building's insurance.

Battery must only be stored in upright position (comparable to the installation 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.

19. STORAGE (CONTINUED)

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 30%-70% SoC. In addition, processes and recharge methodology must be in place to ensure that battery does not discharge to 5% SoC in storage. It is recommended to turn the pack on and check the SoC every six months and recharge to greater than 30% SoC if the SoC has dropped below 30% SoC. Maximum temperature of long term storage location should be less than 95°F (35°C).

20. SERVICE AND MAINTENANCE

The battery has been designed to be virtually maintenance-free. However, external cabling, connectors, etc. (including operator interfaces) must be examined periodically as required to ensure there is no damage to such parts. If any of these parts are damaged or show signs of serious wear, they need to be replaced. Please contact your local HAWKER® service center for all repairs and replacements. All repairs must be done by an 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 any mechanical stresses such as crushing.

21. DISMANTLING

Dismantling of the battery is not authorized except by qualified HAWKER® personnel due to the numerous hazards involved with dismantling a battery (e.g. recycling, service).

22. DISPOSAL AND RECYCLING

NOTE: Disposal must be in accordance with local regulations. Do not dismantle, incinerate, or crush battery systems.

In case of irreparable failure or end of life, the battery must be taken out of operation in a controlled manner (contact HAWKER® for more details). The battery should not be dismantled by the customer. Specialized handling and recycling are required for damaged products. Do not dispose of waste batteries as unsorted municipal waste.

HAWKER®, in line with Local Regulations, will accept HAWKER FLEX® Li3 lithium battery products at specific facilities for disposal. Contact your local HAWKER® Representative for specific recycling instructions per region.

23. TROUBLESHOOTING

If the battery is inoperative, please be sure that the battery traction connector is either connected to the vehicle, or in a Safe state to avoid potential damages or short circuits.

No Power to the Truck

Check the following items:

1. Press activation button
2. No active errors are listed by the display. If "Lockout" is displayed, contact HAWKER® Service.
3. Ensure the battery is turned on (Refer to Section 14: Operator Interfaces)
4. Power cycle the battery.
5. Ensure charger is not plugged in as power to the truck is turned off in order to prevent drive away from the charger.
6. Inspect power cables to truck to ensure there is no damage.
7. In case of an active error, review error ID checklist below.

23. TROUBLESHOOTING (CONTINUED)**Battery will not Charge**

Check the following items:

1. Ensure charge is powered and charger indicates "Connect Battery".
2. No active errors listed by the display.
If "Lockout" is displayed, contact HAWKER® Service.
3. Power cycle the battery.
4. Ensure charge cables are properly connected to charger.
5. Ensure battery is connected to a HAWKER® Li-ion enabled charger.
6. Check connectors, auxiliary pins and CAN wires for damage.

In Storage Battery Will Not Power On

Check the following items:

1. Power cycle the battery.
2. Review error ID checklist below.

Error ID Checklist and Recommended Actions

- If battery still does not operate, review the CDI, HAWKER® ABI device or HAWKER® MOD-ifi™ smart device app for the most recent error ID(s) which will be given simply as a number. Below is an indication of the reason for the displayed error ID(s).
- If any of the devices display error ID 401, contact HAWKER® Service as the battery has been locked out and the battery will not operate without a service visit.
- If the following error ID is displayed, ensure the proper shutdown/start up procedure for battery and truck is being followed according to Section 16: Activation / Deactivation of Battery
 - **3** – Battery shutoff time exceeded due to too large of a current draw by industrial truck 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 external device at higher than allowable voltage
 - **62/63** – Battery error due to excessively noisy current from truck
- If one or more of the following error ID(s) are displayed, the battery should be charged.
 - **39/481** – Discharge current limit exceeded due to reduced performance limits at low SoC
 - **45/477** – Lower cell voltage limit exceeded
 - **49** – Lower pack voltage limit exceeded
 - **70** – Lower SoC limit exceeded
 - **169** – Low SoC, charging needed
- If one or more of the following error ID(s) are displayed, the battery should be placed in an environment to rest and allow the battery to return to allowable operating temperatures.
 - **39/481** – Discharge current limit exceeded due to reduced performance limits at temperature extremes

In case of any other error ID, resulting in a non-operational battery, contact HAWKER® Warranty Department.

24. APPENDIX A: LIST OF BATTERIES

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
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	45.5	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

25. TERMS AND ABBREVIATIONS

Term/Abbreviation	Explanation/Description
ABI	Advanced Battery Interface
BDI	Battery Discharge Interface
BMS	Battery Management System
CDI	CAN Data Interface
DOD	Depth of Discharge
EWS	Early Warning Signal
Li-ion	Lithium-ion
LV	Low Voltage (may also refer to communication)
OEM	Original Equipment Manufacturer
PPE	Personal Protective Equipment
SDS	Safety Data Sheet
SoC	State of Charge
Cable Harness	DC cable and plug that connects to the industrial truck or battery charger

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AM-HFL3-OM REV AA May 2022

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