

OPERATION AND MAINTENANCE INSTRUCTIONS FOR FLEX™ AND FLEPAK™ BATTERIES

Hawker® FLEX™ batteries are for traction applications. The batteries are Valve Regulated Lead Acid (VRLA) utilizing our Thin Plate Pure Lead (TPPL) technology.

RATING DATA

Nominal capacity C ₆	: see type plate
Nominal voltage	: see type plate
Discharge current	: C ₆ / 6h
Rated temperature	: 77°F (25°C)

Unlike conventional batteries with liquid electrolyte, FLEX™ batteries have immobilized electrolyte. Instead of a vent plug, a valve is used to regulate the internal gas pressure, which prevents the ingress of oxygen and allows the escape of excess charging gasses should an overcharged condition occur. When operating VRLA batteries, the same safety requirements apply as for vented batteries. This will help protect against hazards from electric current from explosion of electrolytic gas and corrosive electrolyte.

Battery valves should never be removed. These batteries do not require watering with distilled or demineralized water.

Flexible connectors must be used for all battery connections. Hawker® approved fasteners must be used.

SAFETY PRECAUTIONS

DANGER Contains: Lead, Electrolyte (Sulfuric Acid), Lead Compounds
High Voltage: Risk of shock. Do not touch uninsulated terminals or connectors.

Harmful if swallowed, inhaled, or in contact with skin. Acid causes severe skin burns and eye damage. May damage fertility or the unborn child if ingested or inhaled. May cause harm to breast-fed children. May cause cancer if ingested or inhaled. Causes skin irritation, serious eye damage. Contact with internal components may cause irritation or severe burns. Causes damage to central nervous system, blood and kidneys through prolonged or repeated exposure if ingested or inhaled. Irritating to eyes, respiratory system, and skin. May form explosive air/gas mixture during charging. Extremely flammable gas (hydrogen).
 Explosive, fire, blast or projection hazard. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wash thoroughly after handling. Do not eat drink or smoke when using this product. Avoid contact during pregnancy/while nursing. Wear protective gloves/protective clothing, eye protection/face protection.

Use only outdoors or in a well-ventilated area. Avoid contact with internal acid. Do not breathe dust/fumes/gas/mist/vapors/spray. Keep away from heat/sparks/open flames/hot surfaces. No smoking IF SWALLOWED OR CONSUMED: rinse mouth. Do NOT induce vomiting. Call a poison center/doctor if you feel unwell.
 IF ON CLOTHING OR SKIN (or hair): Remove/Take off immediately all contaminated clothing and wash it before reuse. Rinse skin with water/shower. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor/physician.
 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If exposed/concerned, or if you feel unwell seek medical attention/advice. Store locked up, in a well-ventilated area, in accordance with local and national regulation. Dispose of contents/container in accordance with local and national regulation. Keep out of reach of children.

PROPOSITION 65 WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Batteries also contain other chemicals known to the State of California to cause cancer. WASH HANDS AFTER HANDLING.

WARNING: Risk of fire, explosion or burns. Do not disassemble, heat above 60°C or incinerate. Ventilate spaces where used or charged.

WARNING - Do NOT use any type of oil, organic solvent, alcohol, detergent, strong acids, strong alkalis, petroleum-based solvent or ammonia solution to clean the jars or covers. These materials may cause permanent damage to the battery jar and cover and will void the warranty.



Failure to follow these Operation and Maintenance Instructions or using parts that are non-original will void the FLEX™ battery warranty.

1. Putting in Service

FLEX™ batteries are supplied in a charged condition. The battery should be inspected to ensure it is in good physical condition.

Check:

- The battery compartment and the battery should be in a clean condition
- The battery end cables should have a good contact with the terminals and the polarity is correct

Use special coding systems for maintenance-free batteries for charging plug and socket devices to prevent accidental connection to the wrong type of charger. Never directly connect an electrical appliance (i.e. warning beacon) to a part of the battery. This could lead to an imbalance of the cells during the recharge (i.e. a loss of capacity), the risk of insufficient discharge time, damage to the cells and voids the FLEX™ battery warranty.

Charge the battery (see Section 2.2) before the first discharge. Only batteries with the same state of discharge should be connected together.

The specified torque loading for the bolts/screws of the end cables and connectors for FLEX™ blocks are detailed in the table below:

FLEX™ Battery Type	Standard Terminal	Terminal Torque [in/lbs]	Terminal Adapter	Terminal Torque [in/lbs]
12NXS26 12NXS36 12NXS38 12NXS50 12NXS62 12NXS90 12NXS120	M6 Female	60	SAE	60
12NXS61 12NXS85	M6 Female	80	N/A	N/A
12NXS86	3/8 - 16" Female	60	SAE	60
12NXS137 12NXS157	M6 Female	80	M6 Front Terminal	80
12NXS166 12NXS186	M8 Female	80	M6 Front Terminal	80

The specified torque loading for the bolts/screws of the end cables and connectors for FLEX™ 2V cells is 210 in/lbs. This is done at the manufacturing facility and should not have to be re-torqued in the field.

2. Operation

The nominal operating temperature is 77°F (25°C). The optimum lifetime of the battery depends on the operating conditions (temperature and depth of discharge). The ambient temperature range for block products is between 41°F (5°C) and 113°F (45°C); for 2V products the temperature range is between 32°F (0°C) and 104°F (40°C) - any use outside of this range must be approved by Hawker®. Optimal battery life is obtained with the battery at a temperature between 77°F (25°C) and 86°F (30°C). Higher temperatures shorten the life of the battery; lower temperatures reduce the available capacity. The upper temperature limit for block product is 113°F (45°C); the upper temperature limit is 104°F (40°C) for 2V product and batteries should not be operated above this temperature. The capacity of the battery changes with temperature and falls considerably under 41°F (5°C). The optimum lifetime of the battery depends on the operating conditions (moderate temperature and discharges equal to or lower than 60% of the nominal capacity C₆ are optimum). The battery obtains its full capacity after about three charging and discharging cycles.

2.1 Discharging

The valves on the top of the battery must not be sealed or covered. Electrical connections (i.e. plugs) must only be made or broken in the open circuit condition. Discharges over 80% of the rated capacity are categorized as deep discharges and are not acceptable as they reduce the life of the battery. Discharged batteries MUST be recharged immediately and MUST not be left in a discharged condition.

Partially discharged and fully discharged batteries can freeze. Limit the discharge to a maximum of 80% DOD. The cycle life of the battery will depend on the DOD; the higher the DOD, the shorter the cycle life.

The battery is fitted with a Low Voltage Alarm device (LVA) and visual and audible warning signals must be observed, as the battery has reached its maximum discharge level and must be charged immediately.

The following energy cut-off settings must be used:

- 60% DOD set at 1.96 Volts per cell; or
- 80% DOD set at 1.92 Volts per cell; or

When discharged with currents in the range of I₁ to I₆.

At lower currents, please seek advice from Hawker®.

2.2 Charging

FLEX™ batteries MUST be charged using an approved FLEX™ charging profile. Failure to do so will affect the performance and life of the battery and invalidate any warranty. The specific charging profile developed for recharging the FLEX™ block batteries allows a rapid recharge in three hours from 60% DOD and opportunity charging as often as needed without damaging the batteries. Charge rate must be maintained between 0.20C₆ and 0.70C₆. FLEX™ 2V batteries are suitable for both standard duty applications as well as heavy duty applications. In standard duty applications the charger (0.2-0.25 charging rate) will recharge the battery from 80% depth of discharge in 6 hours and short opportunity charges are allowed (up to 20% extra energy reintegrated in 1 hour). The specific charging profile developed for fast charging FLEX™ 2V batteries allows a fast recharge (0.26-0.4 C₆) in less than 4 hours 60% DOD. Opportunity charge can be performed up to 80% extra energy reintegrated (reintegration rate 40% in 1 hour). FLEX™ batteries have an extremely low gas emission. Nevertheless, provisions must be made for venting of the charging gases. Doors, battery container lids and the covers of battery compartments must be opened or removed. With the charger switched off, connect the battery to the charger, ensuring that the polarity is correct. (Positive to positive, negative to negative). Now switch the charger ON. FLEX™ chargers include specific features to ensure that the battery remains charged and equalized.

3. Maintenance

The electrolyte is immobilized. The density of the electrolyte cannot be measured. Never remove the safety valves from the battery. In case of accidental damage to the valve, contact your Hawker® representative for replacement.

3.1 Daily

- Recharge the battery after every discharge.
- Check the condition of the plugs, cables and make sure that all insulation covers are in place and are in good condition.

3.2 Weekly

- Recharge the battery after every discharge. Allow up to six hours for a full charge at least once per week.
- Visually inspect for signs of dirt and mechanical damage to all component parts of the battery, paying particular attention to the battery charging plugs and cables.

3.3 Quarterly

At the end of the charge, take end of charge voltage readings, measure and record:

- The voltage of the complete battery.
- The voltages of each battery, or each cell for 2V cell batteries.

If significant changes from earlier measurements or differences between the cells are found, please contact a Hawker® representative.

If the run time of the battery is not sufficient, check the following:

- That the required work is compatible with the battery capacity
- The settings of the charger

3.4 Annually

Remove internal dust from the charger. Electrical connections: test all connections (sockets, cables and contacts). Check the torque loading of the bolts/screws. Test the insulation resistance of the battery. Insulation resistance of the battery thus determined must not be below a value of 50 per Volt of nominal voltage. For batteries up to 20V nominal voltage the minimum value is 1000 Ω.

4. Care of the Battery

The battery should always be kept clean and dry. Any liquid in the battery tray must be extracted and disposed of in the prescribed manner. Damage to the insulation of the tray should be repaired after cleaning to prevent corrosion.

5. Storage

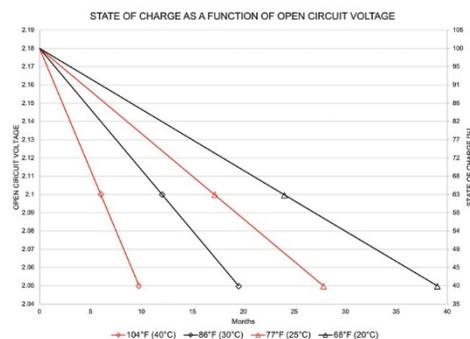
Batteries are shipped from the manufacturer fully charged. The state of charge will decrease with storage. All batteries lose their stored energy when allowed to be in open-circuit, due to parasitic chemical reactions. The rate of self-discharge is non-linear and decreases with decreasing state of charge. It is also strongly influenced by temperature. High temperatures greatly reduce storage life. It is recommended that the fully charged battery should be stored in a cool dry place, ideally below 68°F (20°C).

If the truck/vehicle is going to be unused for periods in excess of 48 hours, the ignition key must be removed and any auxiliary equipment (such as lights, beacons, on-board computer etc.) must be switched off. If the truck or battery is going to be decommissioned for a period of 1 month or longer, all electronic devices (such as BBWC, LVA) must be professionally disconnected by a Hawker® service representative.

The battery is fitted with a Protection from a Low Voltage Alarm device (LVA) and visual and audible warning signals must be observed, as the battery has reached its maximum discharge level and must be charged immediately.

The block product has a maximum inspection-free storage time of two years, if stored at or below 68°F (20°C), after which a refresh charge should be administered. However, it is advisable to conduct an inspection and open circuit voltage check after 12 months and recharge if the OCV is less than 2.10 Volts per cell. The battery may be stored for up to five years without degradation of performance provided that an open circuit voltage (OCV) check is conducted every 12 months. When stored in temperatures in excess of 86°F (30°C), the battery should be OCV checked every six months. The graph below shows the relationship between temperature, storage time and OCV.

The 2V assembled product has a maximum inspection-free storage time of six months, if stored at or below 68°F (20°C) (provided the battery is fully charged when put into storage and that all electronic devices (LVA, BBWC) or other equipment that could cause the battery to discharge are disconnected), after which a refresh charge should be administered. However, it is advisable to conduct an inspection and open circuit voltage check after three months and recharge if the OCV is less than 2.10 Volts per cell.



6. Malfunctions

If malfunctions are found on the battery or the charger, please contact a Hawker® representative. The measurements taken in Section 3.3 will identify problems and help establish a base to correct them.

7. Disposal

FLEX™ batteries are recyclable. Scrap batteries must be packaged and transported in accordance with prevailing transportation rules and regulations. Scrap batteries must be disposed of in compliance with local and national laws by a licensed or certified lead acid battery recycler.



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