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LEAD ACID

 **HAWKER**

perfect plus[®]

Battery



OWNER'S MANUAL

Traction batteries with positive tubular plates type PzS / PzB

EnerSys[®]

Power/Full Solutions

CE UK
CA

www.enersys.com

CONTENTS

Introduction	3
Rating Data	4
Safety Precautions.....	4
Commissioning Filled and Charged Batteries.....	5
Operation	6
Discharging	6
Charging	6
Equalising Charge.....	6
Temperature	6
Electrolyte	7
Maintenance	7
Care of the Battery	8
Storage	8
Malfunctions	8
Optional Accessories	8

INTRODUCTION



The information contained in this document is critical for safe handling and proper use of the Perfect Plus™ batteries. 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 the sections on safety and operation of the battery before operating the battery and the equipment into which it is installed.

It is the owner's responsibility to ensure the use of this documentation and all related activities comply with applicable legal requirements in their respective countries.

This owner's manual is not intended to substitute for any training on handling and operating the Perfect Plus™ batteries 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.

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Your Safety and the Safety of others is Very Important

⚠ WARNING You can be killed or seriously injured if you don't follow these instructions.

RATING DATA & SAFETY

Rating Data

1. Nominal capacity C_5 :	See type plate
2. Nominal voltage:	2.0 V x No of cells
3. Discharge current:	$C_5/5h$
4. Nominal S.G. of electrolyte*: Type PzS/PzB	1.29 kg/l
5. Rated temperature:	30°C
6. Nominal electrolyte level:	up to electrolyte level mark "max."

*Will be reached within the first 10 cycles.

Safety Precautions



- Pay attention to the operation instruction and keep them close to the battery.
- Work on batteries to be carried out by skilled personnel only!



- Wear protective glasses and wear safety clothing when working on batteries.
- Pay attention to the accident prevention rules as well as DIN EN 50272-3 and DIN EN 50110-1.



- No smoking!
- Do not expose batteries to naked flames, glowing embers, or sparks, as these may cause the battery to explode.



- Acid splashes into the eyes or on the skin must be washed immediately with an abundance of clean water. After abundant flushing, consult a doctor immediately!
- Clothing contaminated by acid should be washed in water.



- Risk of explosion and fire! Avoid short circuits.
- **Caution:** Metal parts of the battery are always live. Do not place tools or other metal objects on the battery!



- Electrolyte is highly corrosive.



- Batteries are heavy.
- Ensure secure installation! Use only suitable handling equipment, e.g. lifting gear in accordance with VDI 3616.

Safety Precautions (cont.)



- Dangerous electrical voltage!



- Pay attention to the hazards that can be caused by batteries.

Ignoring the operating instructions, repairing with non-original parts, or using additives for the electrolyte will render the warranty void.

For batteries, according to ATEX directive 94/9 EC, the instructions for maintaining the appropriate protection class during operation must be complied with (see relevant certificate).

Commissioning Filled and Charged Batteries

For commissioning of unfilled batteries, see separate instructions! The battery should be inspected to ensure it is in perfect physical condition. The charger cables must be connected to ensure a good contact, taking care that the polarity is correct. Otherwise, battery, vehicle, or charger could be damaged.

For the assembly of harness cables or in case of the replacement of a connector, the following torque must be applied:

M10 perfect connector	25 ± 2 Nm
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In case the interval between delivery (see manufacturing date on type plate) and commissioning is longer than 8 weeks or the electrolyte level sensor is indicating low electrolyte level (see table in Filling Level Sensors section), the electrolyte level has to be checked. If the battery is equipped with a single-point water topping-up system (optional), for the removal of the BFS plugs only, the appropriate tool must be used. Otherwise, the floats of plugs may be permanently damaged, which can cause overflow of the cells. If the electrolyte level is below the top of the separator, it must first be topped up to this height with purified water (DIN EN 43530-4). The battery is then charged as in the Charging section.

The electrolyte should be topped up to the specified level with purified water.

OPERATION & CHARGING

Operation

DIN EN 50272-3 "Traction batteries for industrial trucks" is the standard which applies to the operation of traction batteries in industrial trucks.

Discharging

Be sure that all ventilation holes are not sealed or covered. Electrical connections (e.g. plugs) must only be made or broken in the open circuit condition. To achieve the optimum life for the battery, operating discharges of more than 80% of the rated capacity should be avoided (deep discharge). This corresponds to an electrolyte-specific gravity of 1.14 kg/l at 30°C at the end of the discharge. Discharged batteries must be recharged immediately and must not be left discharged. This also applies to partially discharged batteries.

Charging

Only direct current must be used for charging. All charging procedures following DIN EN 41773-1 and DIN EN 41774 are permitted. Connect the battery assigned to a charger, suitable for the size of the battery, to avoid overloading of the electric cables and contacts, unacceptable gassing, and the escape of electrolyte from the cells. In the gassing stage, the current limits given in DIN EN 50272-3 must not be exceeded. If the charger was not purchased together with the battery, it is best to have its suitability checked by the manufacturer's service department. When charging, proper provision must be made for venting of the charging gases.

Doors, battery container lids, and covers of battery compartments must be opened or removed. During the charge, the battery must be removed from the closed battery compartment on the truck. The ventilation must comply with the DIN EN 50272 standard. The vent plugs

should stay on the cells and remain closed. With the charger switched off, connect up the battery, ensuring that the polarity is correct (positive to positive, negative to negative). Now switch on the charger. When charging, the temperature of the electrolyte rises by about 10°C; so charging should only begin if the electrolyte temperature is below 45°C. The electrolyte temperature of batteries should be at least +10°C before charging; otherwise, a full charge will not be achieved. A charge is finished when the specific gravity of the electrolyte and the battery voltage have remained constant for 2 hours. Batteries fitted with an electrolyte circulation system: if the warning light on the pump controller is illuminated or if a defect signal on the electrolyte mixing system appears, check that the piping system is connected and examine the piping circuit for leaks or defects. (see Annual Maintenance section). The air pipe should never be removed during the charge.

Equalising Charge

Equalising charges are used to safeguard the life of the battery and to maintain its capacity. They are necessary after deep discharges, repeated incomplete recharges, and charges to an IU characteristic curve. Equalising charges are carried out following normal charging. The charging current must not exceed 5A/100Ah of rated capacity (see Charging section). **Pay attention to the temperature!**

Temperature

An electrolyte temperature of 30°C is specified as the rated temperature. Higher temperatures shorten the life of the battery; lower temperatures reduce the capacity available. 55°C is the upper-temperature limit and is not acceptable as an operating temperature.

Electrolyte

The rated specific gravity (S. G.) of the electrolyte is related to a temperature of 30°C and the nominal electrolyte level in the cell in a fully charged condition.

Higher temperatures reduce the specified gravity of the electrolyte; lower temperatures increase it. The temperature correction factor is -0.0007kg/l per °C, e.g. an electrolyte specific gravity of 1.28kg/l at 45°C corresponds to an S.G. of 1.29kg/l at 30°C. The electrolyte must conform to the purity regulations in DIN EN 43530-2.

Maintenance

Daily

Charge the battery after every discharge. Perfect Plus™ battery with electrolyte circulation: towards the end of the charge the electrolyte level should be checked and, if necessary, topped-up to the specified level with purified water (according to DIN EN 43530-4). The electrolyte level must not fall below the top of the separator or the electrolyte "min" level mark.

NO WATERING IN THE FIRST 10 CYCLES.

Filling Level Sensors

In the case of batteries with filling level sensors, the illuminated LED should be observed daily.

LED green	level OK
LED red blinking	level too low

Do not top-up the cells even when the electrolyte level sensor shows a red blinking LED during the first 10 cycles.

Check the electrolyte level (visual inspection by opening the vent plug or by the position of the float indicator of the aquamatic plug) and top-up with demineralised water at the end of the charge. Since the display always refers to a selected reference cell, please also pay attention to the additional instructions under the Monthly Maintenance section.

Weekly

Visually inspect after recharging for signs of dirt and mechanical damage to all component parts of the battery. Pay particular attention to the battery charging plugs and cables.

For special applications having a charge with an IU characteristic curve, an equalising charge must be carried out (see Equalising Charge section).

Monthly

At the end of the charge, the voltages of all cells or bloc batteries should be measured with the charger switched on, and recorded. After charging has been completed, the electrolyte density, and electrolyte temperature, as well as the filling level (when filling level sensors are used) of all cells, are to be measured and recorded. If significant changes from earlier measurements or differences between the cells or bloc batteries are found, further testing and maintenance by the service department should be requested. This should be done following a complete charge and a minimum of 2 hours rest time.

Measure and record:

- total voltage
- voltage per cell
- if the voltage readings are irregular, also check the S.G. of each cell

Annually

Following DIN EN 1175-1 at least once per year, the insulation resistance of the truck and the battery must be checked by an electrical specialist. The tests on the insulation resistance of the battery must be conducted following DIN EN 1987-1. The insulation resistance of the battery thus determined must not be below a value of 50Ω per Volt of nominal voltage, in compliance with DIN EN 50272-3. For batteries up to 20 V nominal voltage, the minimum value is 1000Ω. **Batteries fitted with an electrolyte circulation system:** the filter of the air pump has to be checked during the annual maintenance and eventually be cleaned or replaced. Earlier replacement of the filter is necessary if, for undefined reasons (no leaks in the air pipes), the defect signal of the air-mixing system on the charger or the battery (on the DC air pump or remote signal) is illuminated. During the annual maintenance, check for correct operation of the air pump.

CARE & STORAGE

Care of the Battery

The battery should always be kept clean and dry to prevent tracking currents. Cleaning must be done following the ZVEI code of practice "The Cleaning of Vehicle Traction Batteries". 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 ensure that the insulation value complies with DIN EN 50272-3 and to prevent tray corrosion. If it is necessary to remove cells, it is best to call our service department.

Storage

If batteries are taken out of service for a lengthy period, they should be stored in the fully charged condition in a dry, frost-free room. To ensure the battery is always ready for use, a choice of charging methods can be made:

1. a monthly equalising charge (see the Equalising Charge section), or
2. float charging at a charging voltage of 2.27V x the number of cells.

The storage time should be taken into account when considering the life of the battery.

Malfunctions

If malfunctions are found on the battery or the charger, call our service department should be called in without delay. The measurements taken in the Monthly Maintenance section will help find and eliminate faults. A service contract with us will make it easier to detect and correct faults promptly.

Optional Accessories

Aquamatic Water Refilling System (optional Accessory)

Application

The water refilling system is used to automatically maintain the nominal electrolyte levels. The charging gases escape through the vent on each cell. **NO WATERING IN THE FIRST 10 CYCLES.**

Function

A valve and a float together control the topping-up process and maintain the correct water level in each cell. The valve allows the flow of water into each cell and the float closes the valve when the correct water level has been reached. For fault-free operation of the water refilling system, please note the instructions that follow.

Manual or Automatic Connection

The battery should be topped-up shortly before the completion of a full charge, as at this point the battery has reached a defined operational state resulting in satisfactory electrolyte mixing. Filling takes place when the connector (7) from the tank is connected to the coupling (6) on the battery.

If manual connection is used the Perfect Plus™ battery should only be connected to the filling system once a week.

If automatic coupling is used, (with a magnetic valve controlled by the charging apparatus) the charger main switch selects the correct moment for filling.

NOTES: In this case, we recommend a water refilling of the Perfect Plus™ battery at least once a week to ensure the right level of the electrolyte.

ACCESSORIES

Optional Accessories (cont.)

In multiple shifts and warm ambient temperature operations, it may be necessary to have shorter topping-up intervals.

Filling Time

Filling time depends on the utilisation rate and the corresponding battery temperature. Generally speaking, the top-up process takes a few minutes and can vary according to the battery range; after this, if manual filling is being used, the water supply to the battery should be turned off.

Working Pressure

The water refilling system should be installed in such a way that a water pressure of 0.2 to 0.6 bar is obtained (with at least 2 m height difference between the upper edge of the battery and the lower edge of the tank). Any deviation from this will cause the system to not function properly.

Purity

The topping-up water must be purified. The water used to refill the batteries must have a conductance of not more than 30 $\mu\text{S}/\text{cm}$. The tank and pipes must be cleaned before operating the system.

Pipe System on the Battery

The pipe system to the individual battery cells must follow the battery's electrical circuit. This reduces the risk of current leakage in the presence of electrolytic gas causing an explosion (DIN EN 50272-3). A maximum of 20 cells may be connected in a series.

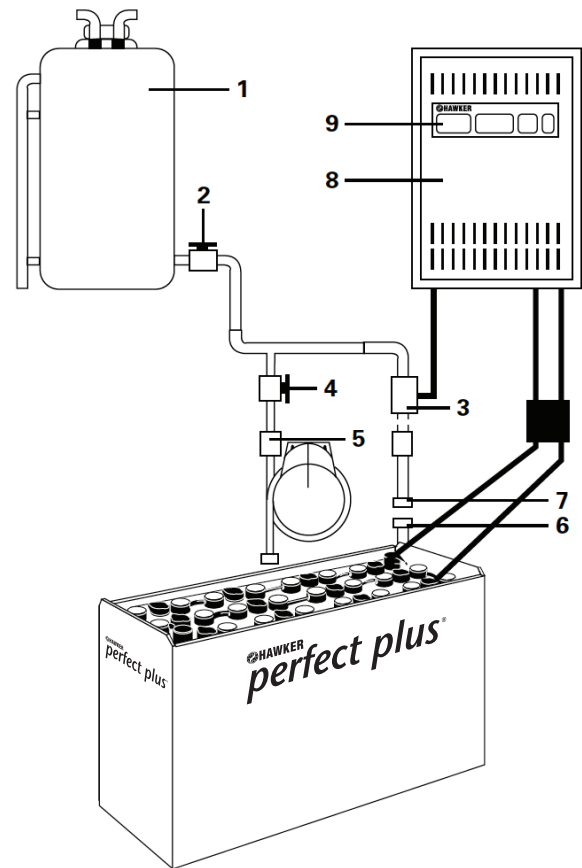
The system should not be modified in any way.

Working Temperature

In winter, batteries fitted with the Aquamatic Water Refilling System should only be charged or refilled in a room temperature above 0°C.

Flow Control

A flow indicator built into the water supply pipe to the battery monitors the filling process. During filling, the water flow causes the built-in disc in the flow indicator to turn. When all the plugs are closed, the disc stops, indicating that the filling process is complete.



#	Description
1	Tank
2	Outflow Connector with Ball Valve
3	Plug with Magnetic Valve
4	Plug with Ball Valve
5	Flow Control
6	Coupling
7	Connector
8	Battery Charger
9	Charger Main Switch

ACCESSORIES

Optional Accessories (cont.)

Electrolyte Circulation System (optional Accessory)

Application

The electrolyte circulation system is based on the principle of pumping air into the individual battery cells. This system prevents electrolyte stratification and the battery charge is optimised using a charge factor of 1.07. Electrolyte circulation is particularly beneficial for heavy-duty use, short charge times, boost or opportunity charging, and in high ambient temperatures.

Function

Electrolyte circulation consists of a pipe system fitted in the cells. The Aeromatic diaphragm pump is fitted in the charger or separately mounted on the battery or vehicle. This diaphragm pump sends a low-rate airflow into each cell which creates a circulating air stream inside the cell box. The air stream is continuous or pulsed depending on the battery voltage and pump type. The air supply is adjusted in accordance with the number of cells in the battery. The pipe system to the individual battery cells must follow the existing electrical circuit. This reduces the risk of current leakage in the presence of electrolytic gas causing an explosion (DIN EN 50272-3).

Use with Automatic Connection of the Pipe System

Connecting the charge plug with an integrated air supply automatically supplies air to the battery.

Maintenance of Air Filter

Depending on the working conditions, the pump air filter should be changed at least once a year. In work areas with high levels of air pollution, the filter should be checked and replaced more frequently.

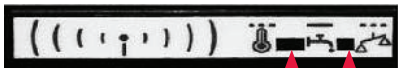
Repair and Maintenance

The system must be checked for leakage. The charger will display an error message to indicate leakage. Sometimes in the case of leakage, the characteristic charging curve is switched over to the characteristic standard curve (without electrolyte circulation). Faulty parts and faulty

pipe sections must be replaced. Only original spare parts may be used, as these are designed for the pump air supply and will ensure correct functioning of the pump.

Wi-iQ® Battery Monitoring Device (optional Accessory)

The Wi-iQ battery monitoring device will provide indications according to the table below:


Tricolour LED
Green blinking = hardware OK Blue rapid blinking = wireless identification Red blinking = temperature warning > 55° C
Blue LED
Rapid blinking = wireless identification Slow blinking = voltage balance warning OFF - flashing = electrolyte level is OK Light is constantly on = electrolyte level is low – please top-up

The Wi-iQ battery monitoring device is an electronic device that communicates wirelessly to download the battery key information for better diagnostics and service. The device is fitted to a main DC cable on the battery to monitor and record data of current, voltage, temperature, and electrolyte level (via an optional external sensor). The LEDs on the Wi-iQ battery monitoring device provide real-time status of the battery's condition. The information is transferred to the PC via USB by wireless communication.

Operation

The Wi-iQ battery monitoring device is suitable for use on all battery technologies with a voltage range of 24V – 80V. The device records global data during the life of the battery. It will store data for 2,555 cycles (complete history stored by PC). The data can be analysed by the PC software program: state of charge, temperature warnings, and low electrolyte level warnings.

ACCESSORIES

Optional Accessories (cont.)

Clear Visibility

Selecting the Exception & Detailed Reports will provide information on the condition of your battery and any necessary actions. Wi-iQ Report or E-Connect app will quickly enable you to get a handle on your battery fleet charging and discharging characteristics. With information by battery family (truck type), you can see the depth of discharge charts, cycles, charging, and much more.

Very Easy to Use

Plug-in USB modem to the PC, scan the Wi-iQ battery monitoring device, and up-load the data. Wi-iQ Report is PC Software running on Windows 7, 8, XP, or Vista. A USB wireless key is used for downloading Wi-iQ data into a SQL database.



Pb

Battery must be recycled



Environmental Risk!

Risk of lead pollution.

Back to the manufacturer!

Batteries with this sign must be recycled.

Batteries which are not returned for the recycling process must be disposed of as hazardous waste!

When using motive power batteries and chargers, the operator must comply with the current standards, laws, rules, and regulations in force in the country of use!

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