Operating conditions of VRLA batteries in HVCBS and LVDBS Systems

1 GENERAL INFORMATION

It is required to mandatorily adhere to these Conditions of Operation.

This document should be filled in (the last two pages) upon acceptance of a HVCBS/LVDBS system and put in a visible place near the batteries.

Only authorised persons may service the battery bank. Failure to comply with these conditions of operation, attempt to carry out repair by an unauthorised person and unauthorised modifications to the installation void this warranty.

Batteries may be used in rooms with natural gravitational ventilation.
During correct use batteries do not require attention and there is no possibility of a leak of electrolyte from them.

Compliance with these *Conditions of Operation* will allow for long and safe use of the product. The batteries meet the requirements of EN 60896-21:2004 and EN 60896-22:2004 standard concerning VRLA batteries.

To ensure correct operation of HVCBS and LVDBS systems as well as optimal performance and life of batteries, they must operate in the temperature range from 20 to 25^{O}C. An increase in temperature of a battery by each 10^{o}C above 25^{o}C results in the reduction of its operational life by half.

Ambient temperature and temperature between individual cells may not differ by more than 3^{o}C. Operation and storage of batteries in temperatures below 0^{o}C in a partially or fully discharged condition may cause freezing of electrolyte and in the result cracking of casing or a loss of battery capacity.

2 OHS RECOMMENDATIONS

It is forbidden to place batteries in tightly sealed containers (without the possibility of ventilation).

In case of overcharging, during incorrect operating conditions and after activation of safety valves hydrogen released from batteries creates an explosive atmosphere with oxygen contained in air. It is required to use effective ventilation, avoid open flames and frequently discharge static electricity from clothing by touching an earthed element with it.

There is a risk of electric shock, thus, during operation it is necessary to have proper skills and training, tools and personal protection equipment such as tools with insulated handles, protective goggles, protective clothing, fire-fighting equipment. To avoid electric shock it is necessary to exercise special care, follow warning symbols and avoid all non-insulated parts of the system.

HYBRYD sp. z o.o.
ul. Sikorskiego 28
44-120 Pyskowice
POLAND

Tax Identification Number - NIP: 648-000-14-15
National Court Register Number - KRS: 000010606
National Business Registry Number - REGON 008135290
tel. +48 32 233-98-83 fax. +48 32 233-98-84
www.hybryd.com.pl

It is necessary to use clothing and footwear not accumulating electrostatic charges, in line with relevant standard.

Do not drop a battery and do not touch its poles with metal items. Before starting work it is necessary to take off metal elements of clothing and other items such as: watch, chain, wedding ring, etc.

In case of any leak of electrolyte, places of leakage must be carefully cleaned, avoiding short-circuiting poles of a battery and getting skin burns. In case of a contact with electrolyte, burned places must be immediately rinsed with a large amount of water and medical advice must be obtained.

Batteries are delivered in a charged condition. It is forbidden to short-circuit poles of a battery due to high short-circuit currents, potential damage to a battery and causing a hazard to life and health.

3 STORAGE

Batteries must be stored in a stable position in a dry and cold place, far away from sources of fire, metal elements and other conductive materials, heat, sunlight and water. During transport batteries should be in vertical position and may not be exposed to heavy shocks and vibrations.

Each increased temperature causes self-discharge of a battery, consequently, it shortens its life and decreases its parameters. A room should be clean and have correctly functioning natural gravitational ventilation. Batteries may not be stored in humid rooms.

Recommended storage temperature is within the range from +5 to +35°C.

Time of storage causes self-discharge of a battery, hence, after the expiry of indicated time it is necessary to perform refresh charging with parameters stated in the below table. Irrespective of the time criterion, the voltage criterion applies – if voltage falls below 2.1V/cell (12.6V for 12V battery), refresh charging must be performed.

Storage temperature	**Duration of storage**
20°C or less	9 months
20°C - 30°C	6 months
30°C - 40°C	3 months

4 INSTALLATION

Batteries should be installed by trained and authorized personnel. Before starting work it is necessary to carry out an inspection of batteries for possible mechanical damage of a battery and its clamps.

Care should be taken that no battery connected in battery bank has been charged in different time frames. All batteries have to be charged at the same time and not later then one month before installation. Otherwise equalization charge should be performed on all batteries.

To ensure proper ventilation of a battery bank, it is required to maintain distance of 10 – 20 mm between batteries. It is forbidden to place batteries in tightly sealed casings (without the

possibility of ventilation) due to the possibility of accumulation of hydrogen creating an explosive atmosphere with oxygen from air.

Batteries must be installed with their clamps upwards.

Use anti-corrosion agents (e.g. technical Vaseline) on battery clamps.

Before installation check all batteries for mechanical damage.

The battery protection fuses of the HVCBS/LVDBS system should be removed before connecting the batteries to the system unit/cabinet. First, extreme batteries should be connected to the unit/cabinet, next, connections between individual batteries should be made, maintaining at the same time correct polarization (connecting positive pole of one battery with negative pole of another battery).

Screws fixing eye terminals to battery clamps must be tightened with a torque wrench – with torque consistent with the below table.

Screw	Torque
M5	2.0 – 2.9Nm
M6	4.1 – 5.2Nm
M8	8.2 – 9.9Nm
M10	14.7 – 19.2Nm

After connecting all batteries, correct polarization should be checked. Only after this verification the protection fuses may be put back into their sockets.

5 REQUIREMENTS CONCERNING ROOMS

A room designated for operation of VRLA batteries should meet all requirements of EN IEC 62485-2 standard which is directly referred to in EN 50172 standard concerning Emergency escape lighting systems. Several most important issues related to ensuring safety of operation of batteries pertaining to rooms in which the batteries are operated are presented below.

In conditions of abnormal operation VRLA batteries release hydrogen accumulating below ceiling zone and together with oxygen from air are forming a mixture which at hydrogen concentration over 4% (lower explosion limit – LEL) becomes explosive. Small energy, for example from static electricity, is sufficient to initiate an explosion. To ensure safety during service operation in a battery room, anti-electrostatic floor should be made, within arm's length from batteries, meeting the condition of $50K\Omega < R < 10M\Omega$, where R is the floor resistance compared to earth point.

Hydrogen concentration in below ceiling space depends on intensity of battery gas discharge and intensity of air exchange in a room. To neutralise the mixture appropriate ventilation of a room should be ensured which basic requirements are set out in EN IEC 62485-2 standard. The below table contains the required minimum air flow and minimum free section of ventilation openings (inlet, outlet) for natural ventilation.

HYBRYD sp. z o.o.
ul. Sikorskiego 28
44-120 Pyskowice
POLAND
Tax Identification Number - NIP: 648-000-14-15
National Court Register Number - KRS: 000010606
National Business Registry Number - REGON 008135290
tel. +48 32 233-98-83 fax. +48 32 233-98-84
www.hybryd.com.pl

C_{10} [Ah]	Q [m^3/h]	A [cm^2]	C_{10} [Ah]	Q [m^3/h]	A [cm^2]
7	0.04	1.2	70	0.38	10.7
9	0.05	1.4	75	0.41	11.5
12	0.07	2.0	80	0.44	12.4
18	0.10	2.8	90	0.49	13.8
20	0.11	3.1	100	0.54	15.2
26	0.15	4.2	120	0.65	18.2
28	0.16	4.5	135	0.73	20.5
33	0.18	5.1	150	0.81	22.7
40	0.22	6.2	180	0.98	27.5
45	0.25	7.0	200	1.08	30.3
55	0.30	8.4	225	1.22	34.2
60	0.33	9.3	240	1.30	36.4
65	0.36	10.1	260	1.41	39.5

where: C_{10} – VRLA battery capacity for 10h of discharge time, Q – required minimum air flow in m^3/h, A – free air inlet and outlet section area in cm^2

Attention should be paid to ensure air inlet and outlet are situated in a way creating optimal exchange conditions, i.e. were situated at the opposite walls or when openings are located on the same wall, the minimum distance between them is 2m.

Temperature in a room must be maintained in the range of 20 – 25°C, unless it was decided otherwise in an electric installation and building design. A change of the above temperature range makes it necessary to increase the capacity reserve of batteries in HVCBS/LVDBS systems.

Each 10°C of an increase in temperature over 25°C shortens life of batteries by half. Reduction of temperature below 20°C results in a decrease of battery capacity which for 0°C will be reduced by 15%.

Reduction of temperature below 20°C may in extreme cases (if the situation was not provided for in a design and a relevant battery capacity reserve was not planned) cause failure to maintain rated emergency operating time of a HVCBS/LVDBS system.

6 MAINTENANCE

VRLA batteries do not require periodical refilling of distilled water. Throughout operation battery surface should be dry, clean and dust-free. Cleaning of a battery casing should be carried out with a dry cotton cloth. Avoid contact with clamps. Cleaning with substances such as petrol or solvent is forbidden. It is recommended to keep battery service records in which measured values, discharge tests, power supply interruptions, etc. are recorded. Once a year it is necessary

to perform a test of battery capacity of a battery bank with a proper test of a HVCBS/LVDBS system.

7 INSPECTIONS

On each inspection a report containing measured value and additional service activities should be drawn.

Reports should be carefully stored to make them available during periodic inspections of HVCBS/LVDBS systems.

Inspections must be conducted in accordance with the below maintenance plan.

MONTHLY INSPECTION

- Checking whether batteries are not damaged, leaking, dirty or have bulges. In case of dirt, clean with a cotton cloth.

SEMI-ANNUAL INSPECTION

- Checking whether batteries are not damaged, leaking, dirty or have bulges. In case of dirt, clean with a cotton cloth.
- Measurement of operating voltage of individual batteries in a battery bank. Every battery in a battery bank should have a voltage in range of 13.5 to 13.8V when fully charged and in an ambient temperature of 25°C. In case a battery voltage is outside of this range equalization charge should be performed. If after equalization charge the battery voltage is outside of this range, service centre should be contacted.
- Measurement of internal resistance of individual batteries in a battery bank. Resistance should not differ by more than ±20% from the average value. If the difference is greater, perform equalisation charging and repeat measurement of resistance of every battery. If internal resistances still differ by more than ±20% from the average value, contact the service centre.
- Checking battery clamps for signs of corrosion and if necessary covering with silicone grease or technical Vaseline, next, tightening with proper torque as stated in the Installation section in this document.
- Checking correctness and reliability of cable connections and tightening loose connections.

ANNUAL INSPECTION

- Carry out all activities as for a semi-annual inspection and additionally perform a test of emergency operating time of a system allowing to determine battery capacity. Additionally it is recommended to perform an equalization charge of all batteries.

A report of an inspection must be prepared on the basis of *HVCBS/LVDBS VRLA Battery Inspection Report*. The document prepared as ActivePDF is available for downloading from manufacturer website. It is recommended to fill in the document electronically and keep it in safety in electronic and paper form.

8 CHARGING

A charging system being a part of HVCBS or LVDBS system is responsible for battery charging which charges a battery bank of series-connected batteries in line with the requirements of EN IEC 62485-2 standard. Consequently, this information is not presented here.

9 EQUALISATION CHARGING

VRLA batteries operate in HVCBS and LVDBS system in series-connection, hence, when individual values of battery voltage are outside range (see: inspections of batteries) or their internal resistances have too large spread, batteries require annual equalisation charging.

The charging should take place outside working hours of a facility to ensure fire safety.

Parameters of equalisation charging:

- Maximum charging current: 0.1 x C_{10} (capacity for 10h of discharge current).
- Voltage of equalisation charging: 2,36V/cell in temperature of 25°C.
- Voltage temperature compensation co-efficient: -3mV/°C/cell.
- Maximum time of equalisation charging: 10h.

10 DISCHARGING

A HVCBS/LVDBS system is responsible for supervision of a discharging process and cutting off current consumption from batteries at a correct threshold, in accordance with the requirements of EN IEC 62485-2 standard or relevant standards for batteries. Therefore, this information is not presented here.

11 LIQUIDATION AND RECYCLING

According to Directive 2006/66/EU on Batteries and Accumulators and Waste Batteries and Accumulators, VRLA batteries when worn out constitute hazardous waste and should be collected and recycled by authorized companies.

HYBRYD sp. z o.o.
ul. Sikorskiego 28
44-120 Pyskowice
POLAND

Tax Identification Number - NIP: 648-000-14-15
National Court Register Number - KRS: 000010606
National Business Registry Number - REGON 008135290
tel. +48 32 233-98-83 fax. +48 32 233-98-84
www.hybryd.com.pl

12 SUPPLIER

HYBRYD Sp. z o.o.
44-120 Pyskowice, ul. Sikorskiego 28
Tax Identification No. (NIP): 648-000-14-15, National Court Register (KRS) No.: 0000106064

13 TYPE OF BATTERIES

(Fill in on the basis of goods dispatch note)

14 RATED VOLTAGE OF BATTERIES

Rated voltage of battery banks is:

- 216V DC for a HVCBS system,
- 24V DC for a LVDBS system.

(Fill in on the basis of a system)

15 RATED CAPACITY OF BATTERIES

(Fill in on the basis of goods dispatch note)

Mode of discharging/operation: reserve (LVDBS), in a response system (HVCBS).

16 NAME OF FITTER

17 DATE OF ACCEPTANCE