



Operating Instructions

for vented stationary FNC Nickel Cadmium batteries with fibre structured electrodes FNC A series with partial internal gas recombination

Specifications:

Nominal voltage U_N :	1.2 V x number of cells connected in series
Nominal capacity $C_N = C_5$:	5-hr discharge, with nominal current to nominal final discharge voltage (See type plate and technical data in these instructions)
Nominal discharge current $I_N = 1_5$:	$C_N/5$ h
Nominal final discharge voltage U_f :	1.0 V/c
Nominal temperature T_N :	20°C

Installed by: _____ on: _____
Start-up by: _____ on: _____
Safety marking affixed by: _____ on: _____

Safety precautions:



Observe operating instructions and affix close within sight of the battery! Work on batteries only under instructions of skilled personnel!



Smoking prohibited!
Do not expose battery to open flame, heat or sparks as explosion and fire hazard exists!



When working on batteries wear protective glasses and clothing!
Observe the accident prevention rules as well as EN 50272 - 2, VDE 0105 - 1



Lye splashes in the eyes or on the skin must be washed out or off with plenty of water. Then see a doctor immediately!

Lye splashes on clothing must be washed out with water!



Explosion and fire hazard, avoid short circuits!
Caution! Metal parts of the battery cells are always live, do not place items or tools on the battery



Electrolyte is strongly corrosive!



Ensure secure installation of the cells!
Only use suitable transport equipment !



Dangerous voltage.

Note:

Non-compliance with operating instructions, repairs made with other than original parts, tampering or use of additives for the electrolyte render the warranty null and void.

Warning:

Never use acid or dilute acid solutions for topping up. Acid destroys the battery.

Caution:

During and after charging, the battery produces explosive gases. Ensure adequate ventilation under EN 50272, Part 2. Up to 1 h after charging electric connections must not be touched. No open flame, heat, electric installations or carriers of static electricity which could produce sparks must come near the battery! Metal parts of the battery installation could be live. Use insulated tools and suitable clothing. Do not wear rings, watches or metal objects when working on the battery installation.

General hints

1.1 Before commissioning all cells must be inspected for mechanical damage and correct polarity connection. Connectors must be firmly seated. The following torques apply for screw connectors:

Thread size M8: 16 Nm +/- 1 Nm
Thread size M10: 20 Nm +/- 1 Nm

Note: When assembling the cells the HOPPECKE assembly instructions for stationary batteries must be observed.

1.2 With charger off and loads isolated connect battery to the d.c. power supply maintaining correct polarity (positive terminal to positive post).

2. Preparing unfilled batteries for initial use

2.1 Before filling with electrolyte remove the transport plugs. After a waiting period of at least 6 hours the cells are filled with electrolyte up to a level of half between the min. and max. marks. See the separate instructions on preparing and handling of electrolyte. After filling the supplied standard vent plugs are fitted onto the cells.

2.2 After filling and a waiting period of 12 hours check the electrolyte level again and if necessary adjust with electrolyte. Carry out initial charging as described under section 3.2 and 3.3.

2.3 Not less than two hours after completion of initial charge the electrolyte level in the cells must be filled to the max. mark with electrolyte.

3. Preparing filled cells for use

3.1 Replace the transport plugs with standard vent plugs (flip-top vent plugs)

3.2 Initial charging is carried out at the battery's constant nominal charging current for 7 hours. The nominal charging current (in A) is calculated as $C_N/5h$. Initial charging is not necessary if the cells are delivered in a filled and charged state (gug) and are put into operation as described under section 4 within 2 months of delivery. Following long transport or storage periods the filled and charged cells should undergo an equalizing charge as under section 4.3.5.

Note: Constant charging currents of up to 50% of the nominal charging current are permissible for initial charging, if the charging duration is set so that a quantity of electricity of $1.4 \times C_N$ is charged into the battery.

During initial charging with constant current, cell voltages of up to 1.8 V may occur. The load must therefore be disconnected from the battery, see section 1.2.

During initial charging a higher quantity of water is decomposed (gassing) than during normal battery operation. Sufficient ventilation must therefore be ensured according to EN 50272 – 2.

3.3 After long battery transport or storage periods of over 36 months, three to four battery charges and discharges are recommended. Charging is carried out with the constant nominal charging current and a charge coefficient of 1.2 V/cell. Discharging is carried out with a nominal current to a voltage of 1.0 V/cell. The final charge is a charge for initial use as described above (section 3.2).

3.4 At least two hours after completion of the charge the electrolyte level in the

cells must be topped up to the max. mark with distilled or deionized water according to IEC 993. After cleaning the cells, see section 5.2, the battery is ready for operation.

4. Operation

4.1 For the assembly and operation of stationary batteries EN 50272 Part 1 and Part 2 as well as DIN VDE 0100 and VDE 0105 apply.

4.2 Discharging

Unless the manufacturer has specified otherwise, as in the case of diesel start engines, the battery may only be discharged up to the nominal final discharge voltage.

4.3 Charging

All charging methods with their limit values may be employed as under DIN 41773 Part 2 (IU characteristic) constant current/constant voltage characteristic
DIN 41776 (I characteristic) constant current characteristic

Depending on battery application the following methods of operation can be employed:

4.3.1 Stand-by parallel operation

(Continuous battery power supply) Here the load, d.c. source and battery are continuously connected in parallel. The charge voltage is the battery's operating voltage as well as the system voltage. Charging takes place under IU characteristic. The charge voltage should be set at 1.37 V to 1.38 V x number of cells connected in series measured at the battery's terminals (float charge voltage).

To reduce recharging time a charge stage can be applied in which the charge voltage is 1.50V to 1.55 V x number of cells connected in series (boost charge stage). Until the set voltage is reached charging occurs with a constant current (see section 4.5), after that the charging current sinks at a constant voltage. 0.25h after reaching the boost charge voltage, the boost charge automatically switches to the float charge voltage.

4.3.2 Floating operation

With the floating operation the battery, direct current source and load also run in parallel. The d.c. source only supplies the average load current while the battery supplies the peak currents of the load. The battery is therefore not always fully charged. Depending on the load profile, the charging voltage - charging under

IU-characteristic - is set to 1.38 V to 1.4 V x number of cells connected in series, measured at the battery's terminals.

4.3.3 Switch operation

When charging, the battery is separated from the load. It can be charged under IU-characteristic as described under section 4.3.1. Charging under I-characteristic is also possible. This charging processes must be monitored.

4.3.4 Cycle operation

(charge/discharge operation)
The load is supplied only by the battery. The battery is charged under IU-characteristic or I-characteristic. The charging process must be monitored. On reaching a fully charged state the charging process must be ended. The battery can then be switched to float charge. The battery can be switched to the load as necessary.

4.3.5 Equalizing charge

It is recommended to carry out an equalizing charge every 6 months for nickel-cadmium batteries which are operated under stand-by parallel operation or floating operation in order to maintain capacity and to stabilize voltage when discharging. The equalizing charge is carried out as follows:

The battery is charged at constant current $C_N/5h$ as in initial charging, see section 3.2. The equalizing charge is completed when 1.4 times the nominal capacity has been charged into the battery.

0.5 h before completion of the equalizing charge the voltages of the individual cells must be measured and recorded. The cell voltages should be >1.5V.

As it is possible to exceed the permissible load voltages, appropriate measures must be taken, e.g. disconnect the load from the battery.

On exceeding the maximum charge temperature of 45°C, charging must be stopped to allow the battery to cool down.

4.4 Superimposed alternating currents

Alternating currents superimposed on the battery's direct current lead to an additional warming of the battery. When recharging a battery using the methods described under sections 4.3.1 to 4.3.4 the actual value of the alternating current should not exceed a value of 20 A per 100 Ah battery capacity.

4.5 Charging currents

The charging currents are not limited until reaching the voltage of 1.45 V/cell. On reaching this voltage the current should not exceed 1.0 times the battery's nominal current. Constant current charging with the nominal current in the gassing phase must be monitored and switched off as under section 3.2.

The following charge currents are recommended for stationary batteries:

I_U-characteristic: 1 x to 1.5 x nominal charge current

I-characteristic: 1 x nominal charge current
Higher charge currents are also possible when observing section 4.6.

4.6 Temperature

The optimal operating temperature range for nickel-cadmium batteries is 0°C to 30°C. The technical data apply for the nominal temperature of 20°C. The operating temperature range lies between - 25°C and + 50°C for the operating methods under sections 4.3.1 and 4.3.2, with the restriction that a boost charge is only permitted up to 45°C. Charges under the I-characteristics are also only permissible up to 45°C.

The operating temperature range can be increased to - 40°C if original HOPPECKE special electrolyte is used. Higher temperatures result in reduced charge acceptance and shorten the service life. Lower temperatures reduce the available capacity.

4.7 Temperature-related charge voltage

A temperature-related adjustment of the charge voltage must be made. The temperature correction factor is - 0.003 V/cell per °K

4.8 Electrolyte

The electrolyte consists of dilute caustic potash solution (KOH) with a lithium hydroxide (LiOH) additive, see the instructions for mixing electrolyte and IEC 993 for permissible impurities. The nominal electrolyte density of 1.25 kg/l +/-0.02 kg/l is based on 20°C and an electrolyte level up to the max. mark in the fully charged state of the battery. Higher temperatures reduce the electrolyte density, lower temperatures increase the electrolyte density. The correction factor is -0.0005 kg/l per °K.

Important: The electrolyte maintains efficiency throughout the entire battery life. The electrolyte never needs changing during the service life of the battery.

Important: With nickel-cadmium batteries the electrolyte density is no measure for the state of charge.

5. Battery maintenance and control (servicing)

5.1 Electrolyte level

The electrolyte level must be checked regularly. If it has dropped to the min. mark while in a charged state, it must be topped up with deionised or distilled water under IEC 993, maximum conductivity 30 µS/cm.

See section 4.8 on electrolyte density. If the electrolyte level drops due to water decomposition, the electrolyte density will increase slightly. Electrolyte density should not be measured just after topping up with distilled water.

5.2 Cleaning/maintenance

To avoid leakage currents the battery must be kept dry and clean. Cleaning the battery should be carried out as specified in the ZVEI pamphlet on battery cleaning. The cell plugs must be closed.

Caution: Dangerous contact potential possible.

Plastic battery components, in particular the cell containers, must only be cleaned with water containing no additives. The vent plugs can be cleaned in warm water.

5.3 Equalizing charge

For batteries operating under float charge, an equalizing charge every 6 months is recommended. See section 4.3.5.

5.4 Regular checks

At least every 6 months the following must be measured / checked and recorded:

- battery voltage
- output current of the d.c. supply
- voltage of a few cells
- electrolyte temperature of a few cells

The following must be measured / checked and recorded annually:

- battery voltage
- output current of the d.c. supply
- voltage of all cells
- electrolyte temperature in a few cells
- ambient temperature
- electrolyte level in the cells

Should the float charge voltage of individual cells lie more than 0.05 V below the average cell voltage, calculated as battery voltage/number of cells connected in series, an equalizing charge should be carried out.

An annual check comprises the following additional points:

- check that bolted connectors are firmly secured with the specified torques, see also section 1.1.
- general condition of the battery installation (cleanliness, rack)
- ventilation in the battery room
- proper function of charger.

6. Tests

Tests must be conducted according to DIN IEC62259 / IEC 623. Special testing instructions, i.e under DIN VDE 0107 or DIN VDE 0108 must also be observed, if applicable.

7. Faults

Should faults be detected in the batteries or charging devices, customer service must be called in immediately. Measurement data under section 5.4 facilitate fault detection and removal.

8. Storage and taking out of operation

Should cells or batteries be stored or taken out of operation for longer periods, they must be placed in a dry room. The cells can be stored unfilled or filled with electrolyte. Before storing, the filled cells must be discharged with nominal current up to the nominal final discharge voltage.

Note: Dangerous contact potential possible. Only insulated tools must be used. Never place tools on connectors: short circuit and fire hazard.

For storage in excess of 6 months the cells are discharged as described above. The electrolyte is then emptied out and the standard vent plugs (flip-top vent plugs) are replaced by transport plugs. Following these preparations the cells can be stored indefinitely. Before reusing stored cells follow instructions as under sections 1 and 2.

9. Transport

Batteries which do not show any damage are not treated as dangerous goods under the German dangerous goods regulations –roads- or dangerous goods regulations –railways- as long as they are secured against short circuits,

slipping, falling over or damage and are stacked and secured appropriately onto pallets. (German dangerous goods regulations –roads- GGVS, Rand No 2801 a).

There must be no external traces of electrolyte solution detectable on the goods to be transported.

10. Dismantling, disposal, recycling of batteries

The dismantling and disposal of batteries should only be carried out by trained personnel.

The EC Directives 91156 (EEC) and 9386 (EEC) must be observed.

11. Technical data

The battery's nominal voltage, the number of cells, the nominal capacity ($C_N = C_5$) and the battery type are obtained from the type plate. Other capacities at different discharge currents can be obtained from the manufacturer's type lists.

Type		Capacity Ah	Current A	Weight kg with electrolyte
FNC-A	32X	32	6.4	3.0
FNC-A	48X	48	9.6	3.7
FNC-A	64X	64	12.8	4.6
FNC-A	80X	80	16.0	5.3
FNC-A	95X	95	19.0	6.2
FNC-A	110X	110	22.0	6.8
FNC-A	125X	125	25.0	7.5
FNC-A	140X	140	28.0	8.1
FNC-A	150X	150	30.0	8.5
FNC-A	160X	160	32.0	8.9
FNC-A	170X	170	34.0	9.3

Type		Capacity Ah	Current A	Weight kg with electrolyte
FNC-A	38H	38	7.6	3.3
FNC-A	50H	50	10.0	3.4
FNC-A	63H	63	12.6	3.5
FNC-A	75H	75	15.0	4.5
FNC-A	88H	88	17.6	5.0
FNC-A	100H	100	20.0	5.2
FNC-A	113H	113	22.6	6.2
FNC-A	125H	125	25.0	6.4
FNC-A	138H	138	27.6	6.6
FNC-A	150H	150	30.0	7.9
FNC-A	163H	163	32.6	8.1
FNC-A	175H	175	35.0	8.3
FNC-A	190H	190	38.0	8.5

Used batteries with this sign are recyclable economic goods and must be collected for recycling. Used batteries which are not collected for recycling are to be disposed of as separate waste observing all local regulations.



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