HOPPECKE

Operating Instructions

for vented stationary FNC nickel-cadmium batteries with fibre-structured electrodes

Specifications:

Nominal voltage U_N:	1.2 V x number of cells connected in series
Nominal capacity $C_N = C_5$:	5 h discharge (see type plate and technical data in these instructions)
Nominal discharge current: $I_N = I_5$:	C_N / 5 h
Nominal final discharge voltage U_S:	1.0 V / cell
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 DIN VDE 0510, VDE 0105 Part 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!
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 VDE 0510, 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.

1. 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

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/cells for initial use

2.1 The cells are filled with electrolyte up to a level between the min. and max. marks. See the separate instructions on preparing and handling of electrolyte. Before filling with electrolyte remove the yellow transport plugs.
After filling, the supplied flip-top vent plugs are fitted onto the cells.
Note: If AquaGen® vent plugs are supplied do not fit onto the cells until after initial charging.

2.2 After filling and a waiting period of 12 hours carry out initial charging as described under Sections 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. If AquaGen® vent plugs are supplied they are then fitted onto the cells.

3. Preparing filled cells for use

3.1 Replace the yellow 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 (in A) for 12 hours. The nominal charging current is calculated as C_N / 5 h (in A).
Initial charging is not necessary if the cells are delivered filled and charged 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 batteries should undergo an equalizing charge as under Section 4.3.5.
Note: Constant charging currents 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 2.4 x C_N is charged into the battery.
During initial charging with constant current cell voltages of up to 1.9 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 DIN VDE 0510.

3.3 After battery transport or storage periods of over 12 months three to four battery charges and discharges are recommended. Charging is carried out with the constant nominal charging current and a charge factor of 1.2, discharging with a nominal current to a voltage of 1.0 V/cell. The final charge is a charge for initial use as described above (3.2.).

3.4 Two hours after completion of the charge the electrolyte level in the cells must be topped up to the max. mark with distilled water. 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 battery installations DIN VDE 0510 Part 1 and Part 2 apply. VDE 0100 and VDE 0105 must also be observed.

4.2 Discharging
Unless the manufacturer has specified otherwise, as in the case of dieselstart installations, the battery may only be discharged 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)
DIN 41775 (W-characteristic)
DIN 41776 (I-characteristic)
Depending on battery application the following methods of operation can be employed:

4.3.1 Continuous battery power supply
Here the load, d.c. source and battery are continuously connected in parallel. Charging takes place under IU-characteristic. The charge voltoge should be set at 1.40 to 1.45 V x number of cells connected in series measured at the battery's terminals (float charge voltage).
To reduce recharging time a charging stage can be applied in which the charging voltage is 1.55 to 1.65 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. After 8 to 12 hours boost charging automatically switches to the float charge voltage.

4.3.2 Float operation
With the floating operation the battery, d.c. source and load also run parallel. The d.c. source only supplies the average load current while the battery supplies the current peaks 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 1.45 to 1.5 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 4.3.1. Charging under W-characteristic or I-characteristic is also possible. These charging processes must be monitored and ended based on secure criteria.

4.3.4 Cycle operation (charge/discharge operation)
The load is supplied only by the battery. The battery is charged under IU-characteristic, see 4.3.1, W-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
Under DIN VDE 0510 it is recommended that nickel-cadmium batteries which are operated under stand-by parallel operation or floating operation undergo an equalizing charge every 6 months to maintain capacity and to stabilize voltage when discharging. The equalizing charge is carried out as follows:
The battery is charged at constant current as in initial charge, see Section 3.2. The equalizing charge is completed when the cell voltages no longer increase within 4 h.
As it is possible that the permissible load voltages are exceeded, 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 (a.c. content of the d.c. battery current)
Alternating currents superimposed on the battery's direct current lead to additional warming of the battery. When recharging a battery using the methods described under 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 the gassing voltage of 1.55 V/cell has been reached. On reaching this voltage the current should not exceed the battery's nominal current. Constant charging with the nominal current in the gassing phase must be monitored and switched off as under Section 3.2.
For stationary installations the following charging currents are recommended:
IU-characteristic: 0.5 x to 1.5 x nominal charging current
W-characteristic: 1 x to 3.5 x nominal charging current at 1.3 V/cell to 0.5 to 1 x nominal charging current at 1.65 V/cell
I-characteristic: 1 x nominal charging current
Higher charging 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 +45°C. On written approval of the manufacturer it can be increased to +55°C for specific operating conditions. 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 should be made at an operating temperature above 30°C. The temperature correction factor is -0.002 V/cell per K.

4.8 Electrolyte
The electrolyte consists of diluted caustic potash solution (KOH) with a lithium hydroxide (LiOH) additive, see the instructions for mixing electrolyte and DIN IEC 993 for permissible impurities. The nominal electrolyte density of 1.19 kg/l ± 0.02 kg/l is based on 20°C and an electrolyte level up to the max. mark in the battery's fully charged state.
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 battery's service life.

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

5. Battery maintenance and control (servicing)

5.1 Electrolyte level
The electroyte level must be checked regularly. If it has dropped to the min. mark while in a charged state, distilled water must be added under DIN IEC 993, maximum conductivity 30 S/cm. See Section 4.8 on electrolyte density. If the electrolyte level drops due to water decomposition, the electrolyte density will increase slightly.
Measuring electrolyte density should not take place just after topping up with distilled water.

5.2 Cleaning/maintenance
To avoid leakage currents keep the battery 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 with warm water.

5.3 Equalizing charge
See Section 4.3.5.

5.4 Regular checks
At least every six months the following must be measured 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 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 of 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 EN 60896 complemented by DIN 43539 Part 14 or also IEC 623. Special testing instructions, e.g. under DIN VDE 0107 and DIN VDE 0108 must also be observed.

7. Faults

Should faults be detected in the battery or charging device, customer services must be called in immediately. Measurement data under Section 6.4 facilitate fault detection and removal.

8. Storage and taking out of operation

Should cells/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 voltage.

Note: Observe safety precautions.

For storage in excess of six 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 re-using stored cells follow instructions as under Section 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 stationary batteries may 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.
The following table shows the different FNC cell types according to capacity class:

11.1 FNC type range for very high loads at discharge times ranging from split seconds to 10 minutes

FNC type X	Nominal capacity/Ah	Nominal current/A	Cell weight/kg with electrolyte
FNC 103 X	10	2.0	1.4
FNC 106 X	19	3.8	2.5
FNC 110 X	33	6.6	3.7
FNC 114 X	45	9.0	5.0
FNC 118 X	58	11.6	6.2
FNC 203 X	13	2.6	1.8
FNC 206 X	25	5.0	3.2
FNC 210 X	43	8.6	4.8
FNC 214 X	60	12.0	6.3
FNC 218 X	77	15.4	7.8

11.2 FNC type range H for high loads at discharge times ranging from a few seconds to 30 minutes

FNC type H	Nominal capacity/Ah	Nominal current/A	Cell weight/kg with electrolyte
FNC 201 H	12	2.4	1.5
FNC 202 H	23	4.6	1.8
FNC 203 H	35	7.0	2.7
FNC 204 H	46	9.2	2.9
FNC 205 H	58	11.2	4.1
FNC 206 H	69	13.8	4.3
FNC 207 H	80	16.0	4.5
FNC 208 H	93	18.6	5.6
FNC 209 H	104	20.8	5.8
FNC 210 H	115	23.0	6.9
FNC 211 H	125	25.0	7.1
FNC 307 H	140	28.0	8.7
FNC 308 H	160	32.0	9.0
FNC 309 H	180	36.0	9.3
FNC 310 H	200	40.0	11.0
FNC 311 H	220	44.0	11.3

11.3 FNC type range M for average loads at discharge times ranging from 20 minutes to 1 hour

FNC type M	Nominal capacity/Ah	Nominal current/A	Cell weight/kg with electrolyte
FNC 201 M	20	4.0	1.5
FNC 202 M	40	8.0	2.6
FNC 203 M	60	12.0	2.9
FNC 204 M	80	16.0	4.0
FNC 205 M	100	20.0	4.3
FNC 206 M	120	24.0	5.2
FNC 207 M	140	28.0	5.5
FNC 208 M	160	32.0	6.9
FNC 209 M	180	36.0	7.2
FNC 306 M	200	40.0	8.3
FNC 307 M	233	46.6	8.8
FNC 308 M	266	53.2	10.6
FNC 309 M	300	60.0	11.1
FNC 404 M	150	30.0	7.5
FNC 405 M	185	37.0	7.9
FNC 406 M	225	45.0	10.6
FNC 407 M	265	53.0	11.0
FNC 408 M	300	60.0	11.5
FNC 409 M	340	68.0	15.5
FNC 410 M	375	75.0	15.9
FNC 411 M	415	83.0	16.3
FNC 412 M	450	90.0	16.7

11.4 FNC type range L for small loads at discharge times in excess of 10 hours

FNC type L	Nominal capacity/Ah	Nominal current/A	Cell weight/kg with electrolyte
FNC 201 L	20	4.0	1.6
FNC 202 L	40	8.0	2.6
FNC 203 L	60	12.0	2.8
FNC 204 L	80	16.0	3.9
FNC 205 L	100	20.0	4.2
FNC 206 L	120	24.0	5.2
FNC 207 L	140	28.0	5.5
FNC 208 L	160	32.0	6.7
FNC 209 L	180	36.0	7.0
FNC 306 L	200	40.0	8.2
FNC 307 L	233	46.6	8.6
FNC 308 L	266	53.2	10.5
FNC 309 L	300	60.0	10.9
FNC 404 L	150	30.0	7.3
FNC 405 L	185	37.0	7.8
FNC 406 L	225	45.0	10.2
FNC 407 L	265	53.0	10.6
FNC 408 L	300	60.0	11.0
FNC 409 L	340	68.0	11.5
FNC 410 L	375	75.0	15.4
FNC 411 L	415	83.0	15.9
FNC 412 L	450	90.0	16.4
FNC 413 L	490	98.0	16.9

Back to the manufacturer!
Used batteries with the recycling sign are recycable economic goods and should be returned for recycling. Used batteries which are not returned for recycling must be disposed of as separate waste observing all regulations.

HOPPECKE Batterien

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