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 check the electrolyte level again and if necessary adjust. 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. If Aqua Gen® vent plugs are supplied they are then fitted onto the cells.

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 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 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 factor 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. 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 DIN VDE 0510 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 dieselstart 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 41775 (W characteristic) declining current characteristic
DIN 41776 (I characteristic) constant current 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. The charge voltage is the battery's operating voltage as well as the installation voltage. Charging takes place under IU characteristic. The charge voltage should be set at 1.37 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 1.45 x 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. 0.25 h 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 parallel. The d.c. source only supplies the average load current while the battery supplies the load's peak currents. 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 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 W-characteristic or I-characteristic is also possible. These 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, see section 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 an equalizing charge must be carried out every 6 months for nickel-cadmium batteries which are operated under standby 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 charge, 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
> 1.5 V.
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 charge currents are not limited until reaching the voltage of 1.45 V/cell. On reaching this voltage the current should not exceed 1.5 times 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.
The following charge currents are recommended for stationary installations:
IU-characteristic: 1 x to 1.5 x nominal charge current
W-characteristic: 1 x to 3.5 x nominal charge current at 1.2 V/cell to 0.5 to 1 x nominal charge current at 1.65 V/cell
I-characteristic: 1 x nomimal 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 50°C. Charges under the I or W-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 should be made at an operating temperature above 30°C. 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 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 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, DIN VDE 0510 specifies an equalizing charge every 6 months. See section 4.3.5.

5.4 Regular checks
At least every 6 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 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 (cleannes, rack)
- ventilation in the battery room
- proper function of charger.

6. Tests

Tests must be conducted according to EN 60 896, complemented by DIN 43 530 or also IEC 623. Special testing instructions, i.e under DIN VDE 0107 or DIN VDE 0108 must also be observed.

7. Faults

Should faults be detected in the batteries or charging devices, customer services 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 may 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 re-using 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 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 = C5) 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 32 X	32	6.4	3.0
FNC-A 48 X	48	9.6	3.7
FNC-A 64 X	64	12.8	4.6
FNC-A 80 X	80	16.0	5.3
FNC-A 95 X	95	19.0	6.2
FNC-A 110 X	110	22.0	6.8
FNC-A 125 X	125	25.0	7.5
FNC-A 140 X	140	28.0	8.1
FNC-A 150 X	150	30.0	8.5
FNC-A 160 X	160	32.0	8.9
FNC-A 170 X	170	34.0	9.3

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 the regulations.

HOPPECKE Batterien

Accumulatorenwerke HOPPECKE
Carl Zoellner & Sohn GmbH & Co KG
P.O.Box 11 40 · D-59914 Brilon (Hoppecke

Phone (0 29 63) 61-0 · Fax (0 29 63) 6 14 49
http: / / www.HOPPECKE.de
e-Mail: hoppecke.IO@t-online.de

TeilNr. 4140203021 / 0700 / 1 H Printed in Germany

HOPPECKE

Operating Instructions

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

Specifications:

Nominal voltage U_N:	1.2 V x number of cells connected in series
Nominal capacity $C_N = C_5$:	5-hr 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/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 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 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 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 +/- 1Nm

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 After a waiting period of at least 6 hours 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 transport plugs.
After filling the supplied standard vent plugs are fitted onto the cells.