CONTENTS

CAUTION: NEVER ACTIVATE OR TOP OFF WITH ACID

1. General

Nickel-iron pocket type alkaline storage batteries he discharge current (discharge rate). Max discharge rate is $1.0C_5A$(C_5 is the capacity).They are widely used in tele-communications ,lighting&UPS as the standby or DC power supply. They can also be used for starting, in transport vehicles and solar energy cells.

The Nickel-iron battery is friendly for the Environmental Science . It is the green energy .

2. Construction of the cell

The positive and negative active materials are pocketed respectively in the perforated steel strips and pressed into the plates which forms into positive and negative electrodes. There is a separator between the positive and negative electrodes. The electrode groups are firmly mounted in the plastic container.The lid and container are welded together. The positive and negative terminal respectively pass through the hole of lid and are tightened by the nuts.This is the positive and negative of the cell.There is a electrolyte filling hole in the cover. This hole is usually equipped with a plastic gas-plug.It can be opened at any time when it is needed to fill electrolyte. The plug can release the gas which generated inside the battery and also can keep the impurities and dust from entering the battery.

3. Main performance of the battery

3.1 Long service life Test according to the service life test method specified in IEC,charging and discharging cycles are 500~4000 times ;The service life is more than 20 years when the battery is used in the float charge state.

3.2 Good endurance ability of overcharge and discharge It can not be caused by over charging and discharging to make the battery lose effectiveness.

3.3 Wide operation temperature The battery can be used at the ambient temperature of -25~+45℃ after charge at the ambient temperature of 15~30℃。

3.4 Excellent discharge performance and strong charging acceptance ability.Charge at $1.2C_5A$ only for 8h,the deep discharge can be reached 100%.

3.5 Excellent mechanical performance It can be used in the shock and vibration condition.

3.6 Maintenance is very simple and it is low maintenance battery.

4. The operating principle and electrical performance of the battery

4.1 Operating principle of the battery

On charge, oxide reaction takes place in the positive electrode,and reduction occurs in the negative electrode.On discharge, the opposite reactions take place.The reactions of charge and discharge can be illustrated by the following

simplified equation:

$$3Fe+8NiOOH+4H_2O \underset{\text{充}}{\overset{\text{放}}{\rightleftharpoons}} 8Ni(OH)_2+Fe_3O_4$$

4.2 Main electrical performance

4.2.1 The normal voltage of the cell is 1.2V.

4.2.2 Discharge performance at 20℃.

The cell should be charged for 8h at $0.2C_5$A.The discharge performance at various discharge rate specified in Table 1.

Table 1

Discharge time	Discharge current (A)	End voltage (V)	Discharge time
1hour	$1\ C_5$	≥0.5	≥1h
2hours	$0.5C_5$	≥0.7	≥2h
3hours	$0.33C_5$	≥0.9	≥3h
5hours	$0.2C_5$	≥1.0	≥5h
8hours	$0.125C_5$	≥1.10	≥8h
10hours	$0.1C_5$	≥1.10	≥10h
20hours	$0.05C_5$	≥1.15	≥20h

Mark : The normal discharge time is 5hours .

4.2.3 Storage

The cell can be stored for long time.During the storage period,taking effective measures to prevent plated parts from rusty.

5 Starting use of the battery

5.1 Preparation before start using

The battery leaves factory in discharged state without electrolyte. Before start using, it is needed to do following preparation:

5.1.1 Measure the cell's open circuit voltage one by one. If the value is lower than 0.5V, a small amount of electrolyte can be filled in, and then measure it again. If the voltage goes up to 0.5V,it will be regarded as the qualified.

5.1.2Check the nuts one by one whether are tightened enough.

5.1.3 Filling with the electrolyte

Unscrew the vent plug, fill the electrolyte into the battery in time(electrolyte standard and preparation method is shown in Appendix 1.) Adjust electrolyte level between two limit lines.Screw the vent plug again,move the sealer on the hole of the vent plug and clean the battery. The battery must be soaked for 4 hours after filling with

electrolyte then adjust electrolyte level again

5.1.4 Place the battery in its location and connect the battery in series with connector. In the end, connect the last positive terminal with the positive lead of charger, and the negative terminal is connected with the charger's negative lead. Mistake connection is forbidden.

5.2 Starting use

5.2.1 The battery which has been stored for 3-6 months should be charged at $0.2C_5A$ for 12-15 hours, then they can be put into operation.

5.2.2 The new battery which stored for more than 6 months should be charged at $0.2C_5A$ for 12 hours,then discharged 5 hours. When the voltage is less than1.0V/cell within 5 hours,it can be stopped. Repeat the above charge and discharge for 3-5 cycles until the discharge duration is 5 hours and the battery voltage isn't less than 1.0V/cell,charge it at $0.2C_5A$ for 8h,and then the battery can be put into operation.

5.2.3 Float charge application

After charge in accordance with condition 5.2.1 or 5.2.and then float charge.The float charge voltage specified in Table 3.

Table 2

Charge way	Charge current	Charge time	Reference temperature
Normal charge	$0.2C_5A$	8	20±5℃
Overcharge	$0.2C_5A$	12	
Fast charger	$0.5C_5A$	4	

Mark :

1. **The best temperature of charge is** 20±5℃ .

2. The way of charge : constant current or according to the requirements of the equipment, the constant pressure limit .

2.1 Constant current : The voltage of the battery is 1.9V/cell*n . It will be keep 2.2V/cell*n with the temperature less then 0℃ .

2.2 Constant current limit pressure

The voltage is 1.55V/cell*n ~1.65V/cell*n , the current is 0.2C5A .

The voltage will be change to 1.42V/cell*n~1.45V/cell*n in floating once the current less than 0.02C5A . The current will be only 4mA/Ah~6mA/Ah .

Normally , According to the temperature at 25℃, the voltage will be less 0.003V once the temperature up 1℃. It will be add 0.003V once it less 1℃ .

3. The capacity of the battery mean the charge time is 5hours at 20℃ . End voltage is1.0V . Which we show it C5 . It is the normal voltage for the battery .

4. Normally , the charge time is 8hours , the over charge is 12hours . The fast charge time : 4hours .

5. Battery maintenance

5.1 When there are such following case during the using period, the charge method should be as the following.

5.1.1 The battery must be overcharged when it is over discharged,reverse charged, or when the capacity is not enough in case of long time use.

5.1.2 When battery is stored for 1-3 months after charge, it is needed to charge by complementary method before its operation.

5.1.3 If the battery operated at float charge condition,when the load supply is stopped,equilibrium charge should be used and then change into float charge.If the battery operated at float charge condition for a long time,equilibrium charge should be adopted 1-3 times every year.

The charge method is shown in Table 3.

Table 3

Charge method	Charge current (A)	Charge voltage (V)	Charge duration (H)	Charge temperature (℃)
Overcharge	$0.2C_5$	……	12	20±5℃
Complementary charge	$0.2C_5$	……	3-5	20±5℃
Equilibrium charge	……	1.55-1.65V/cell	12	20±5℃

5.2 The electrolyte density should be kept in specified scope during operation period(See table 7).So check the electrolyte level often whether is on the original level(Between the two limit line).The time which is specified to check the level is as the following:

If the battery used by constant current charge method,check it before charge every time.

If the battery used by float charge method,check it every 6 months.

The reason why the level decrease is different,so the trouble shootings are different(See Table 4).

Table 4

Reason of level decreasing	Trouble shootings
Transformed electrolysis when charge it.	Add distilled water or purified water
Electrolyte leaks out	Add electrolyte
Unknown reason	Measure the electrolyte density (See Table 7). When it is below the provisions, add the electrolyte, otherwise, add distilled water or purified water.

6.3 Replace electrolyte

6.3.1 Time of replace electrolyte

Replacement of electrolyte in use, electrolyte in the accumulator to absorb in the air of carbon dioxide to form carbonates, when the carbonate content more than 60g / L or find electrolyte due to some reason contaminated, resulting in capacity decreased. Please replace electrolytes

6.3.2 Replacement method

Discharge of the battery to 1.0V, open the vent -plug and shake, the internal dust deposition with the electrolyte to drop . if necessary, can be used with liquid water wash 1-2 times and timely injection new electrolyte.

6.4 Clean the electrolyte which is leaked out in time to keep the battery clean

6.5 **Inspect the** performance

Battery in the use of the process, such as the discovery of individual battery capacity decreased, should be replaced, otherwise, will affect the performance of the battery module.

Battery in the use of professional personnel should be responsible for the charging current accurate and sufficient charging time, otherwise, the battery will be charged with electricity.

6.6 Instrument calibration

The instrument should be calibrated regularly, such as voltage meter, current meter, thermometer, meter and so on.

6.7 If the battery is used at the temperature of 20±10℃,its electrolyte of KOH electrolyte contained with LiOH. Otherwise, its service life will be reduced.

6.8 If the battery have to be charged at the temperature of above 30℃ and below 10 ℃ ,it will be reduced charge efficiency and service life.So heat preservation measure is necessary.In the special case overcharge method should be adopted,but it is not good to use often.

6.9 The battery should be operated in good ventilation condition to prevent the accumulation of hydrogen.

7. Storage of the battery

7.1 Long-time storage

If the battery is stored for a long time,it is advisable to spill out the electrolyte and screw the vent plug tightly at once after normal discharge, then clean it. If there is a hole on the vent plug,seal it with medical glue.Coat the metal parts with vaseline oil and store them in a dry,acid less,and well-ventilated room . The temperature is below 35℃, Indoor humidity less then 75% .

7.2 Short-time storage

The battery which is stored within one year can be stored with electrolyte in charge or discharge state. Adjust the electrolyte level and screw the vent plug before storing.Clean the battery and keep it in a dry,acid less and well ventilated room.

8. Main troubles and Trouble shootings

Table 5 Troubles and trouble shootings

[illegible]	Causes	Trouble shootings
The capacity of battery decreases	1.The electrolyte has been used for a long time and the carbonate content in it is too high.	Replace the electrolyte
	2. The wrong way to use the electrolyte	Replace the electrolyte
	3.The electrolyte isn't enough,and the level of the electrolyte is below the top of the plates.	See Table 4
	4.Harmful impurities contained in the electrolyte is too high.	Replace the electrolyte
	5.The charge/discharge method is not correct.	See the 6.1
	6.Short-circuit or slight-short circuit in the cell	Replace the short-circuit cell.
	7.Short-circuit or slight-short circuit occurs out of the cell.	Keep the cells in a dry temperature
	8.The instruments used is not correct.	Check and rectify the ampere meter and voltmeter.
Voltage is incorrect	1.The inner circuit of the cell is short or cut,the electrolyte has been run out.	Clean the cell, or change the electrolyte
	2.The out circuit of the battery is short or cut.	Keep the cell dry,and check
	3.Contact fault	Check and repair
Bubbles appear in the inside of the cell	The electrolyte contains organic impurites	Replace the electrolyte
The cell container swells	1.The positive plate swells.	If necessary,change the cell.
	2.The vent is blocked up.	Clean with hot water or replace it.
Seeping of electrolyte	1.The level of electrolyte is too high	Drain out the superfluous electrolyte.
	2.The vent plug and terminal is unsealed	Replace the sealing parts and screw tightly.
	3.Too much electrolyte overflows.	Clean and keep dry

Appendix 1. The electrolyte selection,preparation,and storage.

1. The selection of electrolyte and technical requirement.

1.1The selection of electrolyte are determinded by operating temperature of the

battery.See Table 6.

Table 6

Operating temp. (℃)	Density (g/cm^3)	Composition of electrolyte	Solid alkali content in the electrolyte	Weight ratio (alkaline : water)
-10~45	1.20±0. 02	KOH+20g/L $LiOH \cdot H_2O$	265	1 : 3

1.2 The technical requirements of electrolyte,see Table 7.

(The reference density is 1.20±0. 02g/cm^3)

Table 7

Items	Technical requirements	
	New electrolyte	Limiting value during operation
Outward appearance	Colorless,transparent,no suspended substance	
Density(15℃)	1.20±0. 02	1.20±0.02
Content(g/L)	KOH : 240~270,	KOH : 240~270,
Cl^-(g/L)	< 0.1	0.2
K_2CO_3(g/L)	< 20	60
$Ca^{2+} \cdot Mg^{2-}$(g/L)	< 0.19	0.3
Fe/KOH (%)	< 0.05	0.05

1.3 Technical requirements for raw material

KOH: chemical pure

$LiOH \cdot H_2O$: industrial pure,LiOH content should not be less than 50%.

Water: distilled water,ion-exchange water,softened water or electroosmosis water

2. Vessels and implements

The vessels for preparation of the electrolyte should be plastic, porcelain enamel wares or restless steel. The tools indude: hydrometer(1.10~1.30), thermometer, graduate cylinder, funnel, plastic scoop, platform scal e, stirrer or plastic rod.

3. Preparation and storage

3.1 According to Table 6and Table 7 weigh the needed amount of alkaline.

3.2 Put water into the vessel, add alkali slowly with constant stirring, then add the required lithium hydroxide into the vessel, stir to dissolve thoroughly. Cool to 20±5℃. Finally, determine the density and adjust to the required value.(Filter if necessary).

3.3 Storage

The prepared electrolyte must be well-sealed in plastic or porcelain vessels. Keep away from acid or other impurities.

4. Safty recommendation

When preparing electrolyte,the alkali should be put into water slowly. It is prohibited to put water into alkali. In preparation of electrolyte,one should put on goggles, rubber gloves, rubber overshoes and work clothes to protect one's skin from being harmed by alkali. If one's skin is touched by alkali, he must wash it off at once with 3% boric acid solution.

Appendix 2 External dimensions,weight of Nickel-iron pocket type battery

Cell Type	Nominal Voltage (V)	Rated Capacity (Ah)	Max.Dimension(mm)			Thread of pole	Weight (filled) (Kg)	Electrolyte Volume (L)	Container Material
			L 长	W 宽	H 高				
TN 10	1.2	10	85	39	150	M8	1	0.2	ABS /PP
			82	33	235	M10*1.5	0.95	0.2	ABS
TN 20	1.2	20	114	52	266	M10*1.5	2	0.6	ABS
			82	43	258	M10*1.5	1.3	0.3	ABS /PP
			135	54	265	M10*1.5	1.8	0.6	ABS / PP
TN 30	1.2	30	114	52	266	M10*1.5	2.2	0.5	ABS
			135	54	265	M10*1.5	2.2	0.6	ABS / PP
TN 40	1.2	40	135	54	265	M10*1.5	2.5	0.6	ABS / PP
			141	66	226	M10*1.5	2.6	0.5	PP
			138	61	266	M10*1.5	2.9	0.7	ABS / PP
TN 45	1.2	45	138	61	266	M10*1.5	3	0.9	ABS
			141	66	226	M10*1.5	3	0.8	PP
TN 50	1.2	50	138	61	266	M10*1.5	3.2	0.7	ABS / PP
			141	71	295	M10*1.5	3.5	0.9	PP
TN 60	1.2	60	141	71	295	M10*1.5	4	1.1	PP
			139	79	295	M10*1.5	4.3	1.1	ABS
TN 70	1.2	70	139	79	295	M10*1.5	4.4	1.0	ABS
			141	71	295	M10*1.5	4	0.9	PP
TN 80	1.2	80	141	71	295	M10*1.5	4.6	0.9	PP
			139	79	295	M10*1.5	4.6	1.1	ABS
TN 90	1.2	90	139	79	362	M10*1.5	5.9	1.4	ABS / PP

TN100	1.2	100	139	79	362	M10*1.5	6	1.4	ABS / PP
TN110	1.2	110	139	79	362	M10*1.5	6	1.4	ABS / PP
TN120	1.2	120	139	79	362	M10*1.5	6.2	1.3	ABS/PP
TN130	1.2	130	165	105	345	M20×1.5	9	1.9	ABS / PP
TN150	1.2	150	167	162	345	M20×1.5	12	3.0	ABS / PP
			165	105	345	M20×1.5	9.3	2.0	ABS / PP
TN180	1.2	180	167	162	345	M20×1.5	13	3.3	ABS / PP
			165	105	345	M20×1.5	9.4	1.8	ABS / PP
TN200	1.2	200	167	162	345	M20×1.5	14	3.3	ABS / PP
TN230	1.2	230	167	162	345	M20×1.5	13.7	3.3	ABS / PP
TN250	1.2	250	167	162	345	M20×1.5	14	3.4	ABS / PP
			277	140	420	M16	15.7	2.6	PP
TN300	1.2	300	282	170	348	M20×1.5	22.5	5.0	ABS
			176	161	540	M16/20	20.5	4.7	ABS
			277	140	450	M16	21	6.0	PP
TN400	1.2	400	282	170	348	M20×1.5	25	5.0	ABS
			277	140	450	M16	22.6	6.0	PP
TN500	1.2	500	285	172	490	M20×1.5	33.6	7.8	ABS
			277	140	490	M20×1.5	22.6	6.0	PP
TN600	1.2	600	285	172	490	M20×1.5	34	7.5	ABS
TN700	1.2	700	285	172	490	M20×1.5	39	8.4	ABS
TN800	1.2	800	395	185	560	M20×1.5	57.5	15.5	ABS
TN900	1.2	900	395	185	560	M20×1.5	59	15.0	ABS
TN1000	1.2	1000	395	185	560	M20×1.5	60	14.0	ABS
TN1100	1.2	1100	395	185	560	M20×1.5	62	12.0	ABS
TN1200	1.2	1200	395	185	560	M20×1.5	62	11.3	ABS

Remarks:

1. The above specifications may be modified without prior notice.
2. The above dimensions are only a part of our standard products range,we may design and, develop any other battery model ,according to specific end-user s requirements.

Appendix 3

Discharge curves of Ni-fe (nickel-iron) battery at 20±5℃