OPERATION AND MAINTENANCE

MANUAL

NICKEL-CADMIUM POCKET TYPE
ALKALINE STORAGE BATTERY

CAUTION: NEVER ACTIVATE OR TOP OFF WITH ACID

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CONTENTS

1.General

Nickel-cadmium pocket type alkaline storage batteries can be divided into low, medium and high rate based on their discharge current (discharge rate). Max discharge rate of low rate battery is 0.5C_5A (C_5 is the capacity) and medium rate battery is 3.5 C_5A and high rate battery is 7.5 C_5A..They are widely used in telecom, lighting & UPS as the standby or DC power supply. They can also be used for starting, in transport vehicles and solar energy cells.

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 more than 500; The service life is more than 15 years when the battery is used in the float charge state.

3.2 Good endurance ability of overcharge and discharge. It cannot be caused by overcharging and discharging to make the battery lose effectiveness.

3.3 Wide operation temperature The battery can be used at the ambient temperature of -40~+45°C after charge at the ambient temperature of 15~30°C。

3.4 Excellent discharge performance and strong charging acceptance ability. Charge at 0.2 C_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 Higher reliability.

3.7 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:

$$2Ni(OH)_2+Cd(OH)_2 \underset{\text{discharge}}{\overset{\text{charge}}{\rightleftharpoons}} Cd+2\beta NiOOH+2H_2O$$

4.2 Main electrical performance

4.2.1 The normal voltage of the cell is 1.2V.

4.2.2 Discharge performance at 20°C.

The cell should be charged for 8h at 0. 2C5A.The discharge performance at various discharge rate specified in Table 1.

Table 1

Discharge conditions		Minimum discharge duration		
Rate constant of current(A)	Final voltage(V)	Low rate	Medium rate	High rate
$0.2C_5$	1.0	≥5h	≥5h	≥5h
$1\ C_5$	1.0	/	≥40min	≥50min
$5\ C_5$	0.8	/	/	≥4min

4.2.3 Discharge performance at -18°C The cell should be charged for 8h at $0.2C_5$A and ambient temperature of 20°C. The cell shall be then discharged at temperature of –18°C, the discharge performance specified in Table 2.

Table 2

Discharge conditions		Minimum discharge duration		
Rate of constant current(A)	Final voltage(V)	Low rate	Medium rate	High rate
$0.2\ C_5$	1.0	≥2h 30min	≥3h	≥3h30min
$1\ C_5$	0.9	/	≥15min	≥25min
$2\ C_5$	0.9	/	/	≥7min30s

4.2.4 Self-discharge performance of the cell

The cell can be charged at $0.2\ C_5$A for 8h at ambient temperature of 20±5°C, then store it in the same conditions for 28 days and nights. Then discharge it at $0.2C_5$A to end voltage of 1.0V/cell. Its discharge duration should not be less than 4h.

4.2.5 Cycle life

According to IEC Standard, it should be 500 cycles at least. In case of float charge application, its cycle life more than 15 years.

4.2.6 Storage

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

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.

5.1.2 Check the nut 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 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 3

Type	Float charge voltage
Low rate	1.45～1.50V/cell
Medium rate	1.42～1.45V/cell
High rate	1.39～1.41V/cell

6. Battery maintenance

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

6.1.1 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.

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

6.1.3 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 4.

Table 4

Charge method	Charge current (A)	Charge voltage (V)	Charge duration (H)	Charge temperature (°C)
Overcharge	$0.2C_5$	……	12	20±5°C
Complementary charge	$0.2C_5$	…… v	3-5	20±5°C
Equilibrium charge	……	1.60-1.75V/cell	12	20±5°C

6.2 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 flowing:

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 5).

Table 5

The reason of level decreasing	Trouble shootings
Water is brined electrolysis when charge it.	Add distilled water or purified water

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

6.4 Attention

6.4.1 If the battery is used at the temperature of 20±10°C, its electrolyte should be NaOH electrolyte contained with LiOH. Otherwise, its service life will be reduced.

If the battery is used at the temperature of above 35°C, its electrolyte should be NaOH electrolyte contained with LiOH, it will be good for battery's capacity and life.

6.4.3 If the battery is used at the temperature of below 0°C, the electrolyte of No.3 and No.4 in Table 7 should be used.

6.4.4 If the battery has to be charged at the temperature of above 30°C and below 10°C, 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.

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-free, and well-ventilated room.

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-free and well ventilated room.

8. Main troubles and Trouble shootings

Table 6 Troubles and trouble shootings

Troubles	Causes	Trouble shootings
	1.The electrolyte has been used for a long time and the carbonate content in it is too high.	Replace the electrolyte

The capacity of the battery decreases	2.The electrolyte is improperly used.	Replace the electrolyte
	3.The electrolyte isn't enough, and the level of the electrolyte is below the top of the plates.	See Table 5
	4.Harmful impurities contained in the electrolyte is too high.	Replace the electrolyte
	5.The charge/discharge method is not correct.	See the 5.2 and 6
	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 impurities	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.
Creeping 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. Electrolyte selection, preparation, and storage.

1. The selection of electrolyte and technical requirement.

1.1The selection of electrolyte are determined by operating temperature of the battery. See Table 7.

Table 7

No.	Operating temp. (°C)	Density (g/cm^3)	Composition of electrolyte	Solid alkali content in the electrolyte	Weight ratio (alkaline : water)
1	10~45	1.18±0.02	NaOH+10g/L $LiOH•H_2O$	201	1 : 5
2	-10~35	1.20±0.02	KOH+15g/L $LiOH•H_2O$	265	1 : 3
3	-25~10	1.25±0.01	KOH	329	1 : 2
4	-40~15	1.28±0.01	KOH	374	1 : 2

1.2 The technical requirements of electrolyte, see Table 8.

(The reference density is 1.20±0.02g/cm^3)

Table 8

Items	Technical requirements	
	New electrolyte	Limiting value during operation
Outward appearance	Colorless, transparent, no	
Density(15°C)	1.20±0.02	1.20±0.02
Content(g/L)	KOH : 240~270,NaOH : 215~240	KOH :240~270,NaOH :215~240
Cl^-(g/L)	< 0.1	0.2
K_2CO_3(g/L)	< 20	60
$Ca^{2+}•Mg^{2-}$(g/L)	< 0.19	0.3
Fe/KOH(NaOH)(%)	< 0.05	0.05

1.3 Technical requirements for raw material

KOH: chemical pure

NaOH: chemical pure

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

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

2. Vessels and implements

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

3. Preparation and storage

3.1 According to Table 7 and Table 8, 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°C. 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. Safety 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 low rate battery

Cell Type	Nominal Voltage (V)	Rated Capacity (Ah)	Dimension (mm)			Thread of pole	Weight (filled) (Kg)	Electrolyte Volume (L)	Container Material
			L	W	H				
KPL10	1.2	10	85	39	156	M8	0.7	0.10	PP
KPL11	1.2	11	85	39	156	M8	0.75	0.15	PP
KPL20	1.2	20	114	52	266	M10	2	0.6	ABS
KPL20-(2)	1.2	20	82	43	258	M10	1.3	0.3	ABS
KPL20-(3)	1.2	20	135	54	265	M10	1.8	0.58	ABS / PP
KPL22	1.2	22	112	31	220	M8	1.2	0.3	ABS
KPL30	1.2	30	114	52	266	M10	2.2	0.5	ABS
KPL30-(2)	1.2	30	135	54	265	M10	2	0.5	ABS / PP
KPL40	1.2	40	114	52	266	M10	2.3	0.42	ABS
KPL40-(2)	1.2	40	135	54	265	M10	2.4	0.5	ABS / PP
KPL40-(3)	1.2	40	141	66	226	M10	2.6	0.5	PP
KPL45	1.2	45	138	61	266	M10	3	0.85	ABS
KPL45-(2)	1.2	45	141	66	226	M10	2.8	0.7	PP
KPL50	1.2	50	138	61	266	M10	3.2	0.7	ABS
KPL50-(2)	1.2	50	141	71	295	M10	3.5	0.9	PP
KPL60	1.2	60	143	76	275	M10	4	1.1	ABS
KPL60-(2)	1.2	60	135	53	370	M10	3.9	1.0	PP
KPL60-(3)	1.2	60	141	71	295	M10	4	0.9	PP
KPL60-(4)	1.2	60	139	79	295	M10	4.3	1.13	ABS
KPL65	1.2	65	143	76	295	M10	4.7	1.1	ABS
KPL70	1.2	70	139	79	295	M10	4.4	1	ABS
KPL70-(2)	1.2	70	141	71	295	M10	4.3	0.8	PP
KPL70-(3)	1.2	70	143	76	275	M10	4.3	1	ABS
2KPL70	2.4	70	195	79	331	M8	8.3	2.5	PP
KPL80	1.2	80	143	76	275	M10	4.7	0.95	ABS
KPL80-(1)	1.2	80	141	71	295	M10	4.6	0.9	PP
KPL80-(2)	1.2	80	139	79	295	M10	4.7	1	ABS
KPL90	1.2	90	139	79	362	M10	5.9	1.4	ABS / PP
KPL100-(2)	1.2	100	139	79	362	M10	6	1.4	ABS / PP
KPL100-(3)	1.2	100	143	100	280	M10	6	1.4	ABS
KPL110	1.2	110	139	79	362	M10	6	1.4	ABS / PP

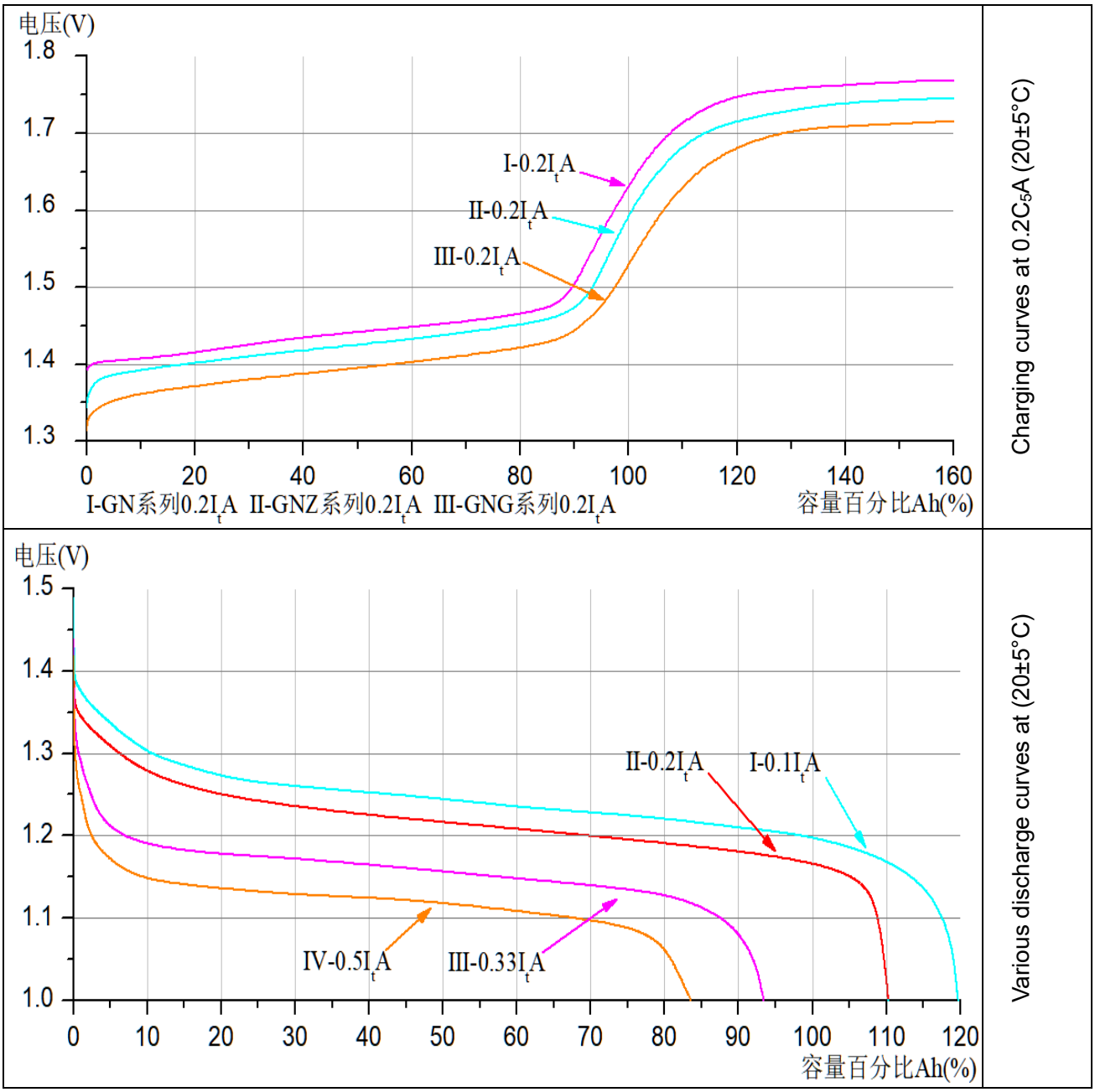
KPL110-(3)	1.2	110	143	100	280	M10			ABS
KPL120	1.2	120	139	79	362	M10	6.2	1.3	ABS/PP
KPL120-(3)	1.2	120	143	100	280	M10			ABS
KPL125	1.2	125	139	79	362	M10	6.4	1.17	ABS / PP
KPL150	1.2	150	167	162	345	M20×1.5	12	3	ABS
KPL150-(2)	1.2	150	164	104	345	M20×1.5	9.3	2	ABS / PP
KPL175	1.2	175	167	162	345	M20×1.5	12.5	3.25	ABS
KPL200	1.2	200	167	162	345	M20×1.5	14	3.3	ABS
KPL250	1.2	250	167	162	345	M20×1.5	14	3.4	ABS
KPL300	1.2	300	282	170	348	M20×1.5	22.5	5	ABS
KPL300-(2)	1.2	300	176	161	540	M16/20			ABS
KPL300-(3)	1.2	300	277	145	450	M16	21	5.2	PP
KPL400	1.2	400	282	170	348	M20×1.5	24	4.5	ABS
KPL500	1.2	500	285	172	490	M20×1.5	33.6	7.8	ABS
KPL600	1.2	600	285	172	490	M20×1.5	34	7.5	ABS
KPL700	1.2	700	285	172	490	M20×1.5	40	9.4	ABS
KPL800	1.2	800	395	185	560	M20×1.5	57.5	15.5	ABS
KPL900	1.2	900	395	185	560	M20×1.5			ABS
KPL1000	1.2	1000	395	185	560	M20×1.5			ABS
KPL1100	1.2	1100	395	185	560	M20×1.5			ABS
KPL1200	1.2	1100	395	185	560	M20×1.5			ABS

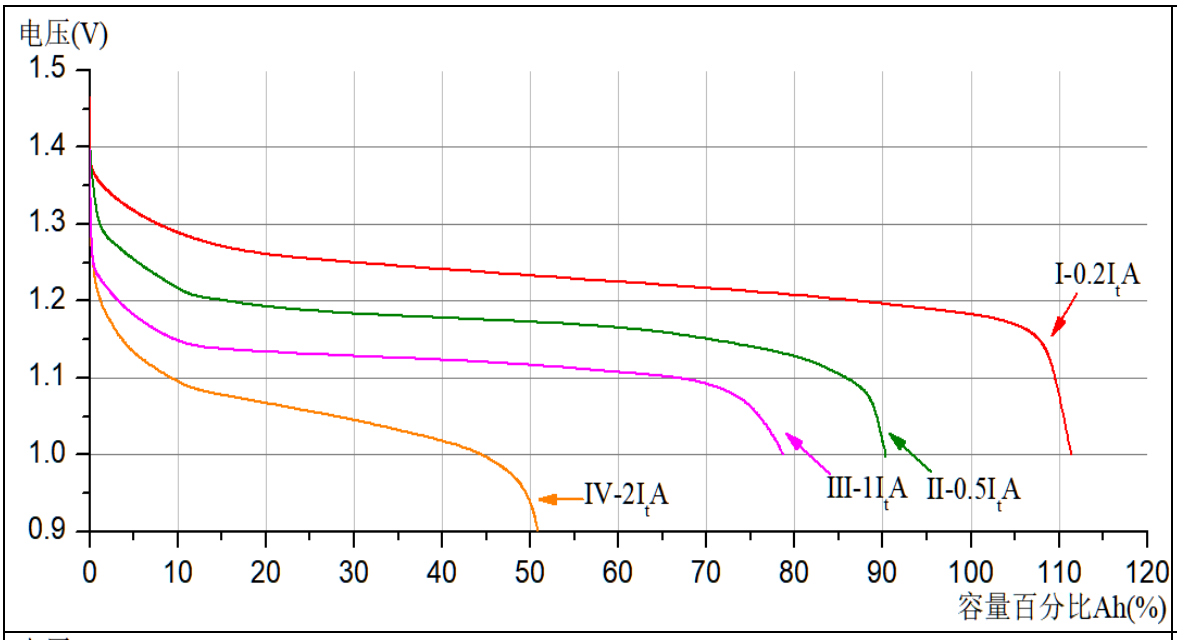
Appendix 3 External dimensions, weight of medium rate battery

Cell Type	Nominal Voltage (V)	Rated Capacity (Ah)	Dimension(mm)			Thread of pole	Weight (filled) (Kg)	Electrolyte Volume (L)	Container Material
			L	W	H				
KPM10	1.2V	10	82	43	258	M10			ABS
KPM20	1.2V	20	135	54	265	M10	1.9	0.6	ABS / PP
KPM20-(2)	1.2V	20	114	52	266	M10	2.1	0.7	ABS
KPM30	1.2V	30	135	54	265	M10	2.4	0.6	ABS / PP
KPM40	1.2V	40	141	71	295	M10	3.6	1.0	PP
KPM40-(2)	1.2V	40	143	76	275	M10	3.4	0.9	ABS
KPM45	1.2V	45	86	86	273	M10	3.2	0.7	PP
KPM50	1.2V	50	139	79	295	M10	5	1.3	ABS
KPM50-(2)	1.2V	50	143	76	275	M10	4.3	0.9	PP
KPM50-(3)	1.2V	50	141	71	295	M10	5	1.3	ABS
KPM60	1.2V	60	139	79	295	M10	5.3	1.2	ABS
KPM60-(2)	1.2V	60	141	71	295	M10	4.4	1.0	PP
KPM60-(3)	1.2V	60	143	76	275	M10	4.6	1.1	ABS
KPM70	1.2V	70	139	79	295	M10			ABS
KPM70-(3)	1.2V	70	143	76	275	M10	4.9	1.0	ABS
KPM75	1.2V	75	139	79	362	M16	6.5	1.4	ABS / PP
KPM80	1.2V	80	139	79	362	M16	6.5	1.4	ABS / PP
KPM80-(3)	1.2V	80	143	100	280	M10	5.8	1.5	ABS
KPM90	1.2V	90	164	104	345	M20	8.2	1.62	ABS / PP
KPM90-(2)	1.2V	90	139	79	362	M16	6.5	1.3	ABS / PP
KPM100	1.2V	100	164	104	345	M20×1.5	9.3	1.8	ABS / PP
KPM120	1.2V	120	164	104	345	M20×1.5	9.5	1.8	ABS / PP
KPM120-(4)	1.2V	120	139	89	362	M16	7.5	1.5	PP
KPM150	1.2V	150	167	162	345	M20×1.5	12.5	2.7	ABS
KPM160	1.2V	160	167	162	345	M20	12.8	2.99	ABS
KPM200	1.2V	200	167	162	345	M20×1.5	13.5	2.7	ABS
KPM250	1.2V	250	282	170	348	M20×1.5	22	5	ABS
KPM250-(2)	1.2V	250	176	161	540	M16	20.6	4.5	ABS
KPM300	1.2V	300	282	170	348	M20×1.5	26	6.0	ABS
KPM300-(2)	1.2V	300	176	161	540	M20×1.5	22.6	5.0	ABS
KPM400	1.2V	400	285	172	490	M20×1.5	34	8.0	ABS

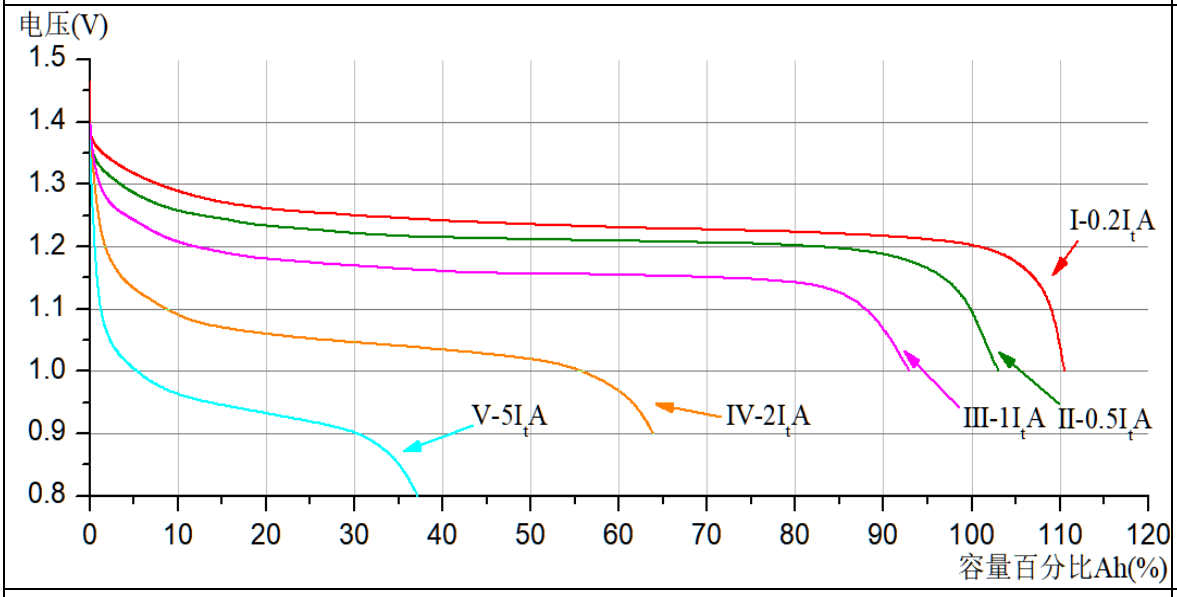
KPM500	1.2V	500	285	172	490	M20×1.5	36.3	8.5	ABS
KPM600	1.2V	600	285	172	490	M20×1.5			ABS
KPM700	1.2V	700	395	185	560	M20×1.5	55	11.5	ABS
KPM800	1.2V	800	395	185	560	M20×1.5	66	15.0	ABS
KPM900	1.2V	900	395	185	560	M20×1.5	66	15.0	ABS
KPM1100	1.2V	1100	395	185	560	M20×1.5	68	12.5	ABS
KPM1200	1.2V	1200	395	185	560	M20×1.5	70	12.5	ABS

Appendix 4 Reference charge & discharge curves

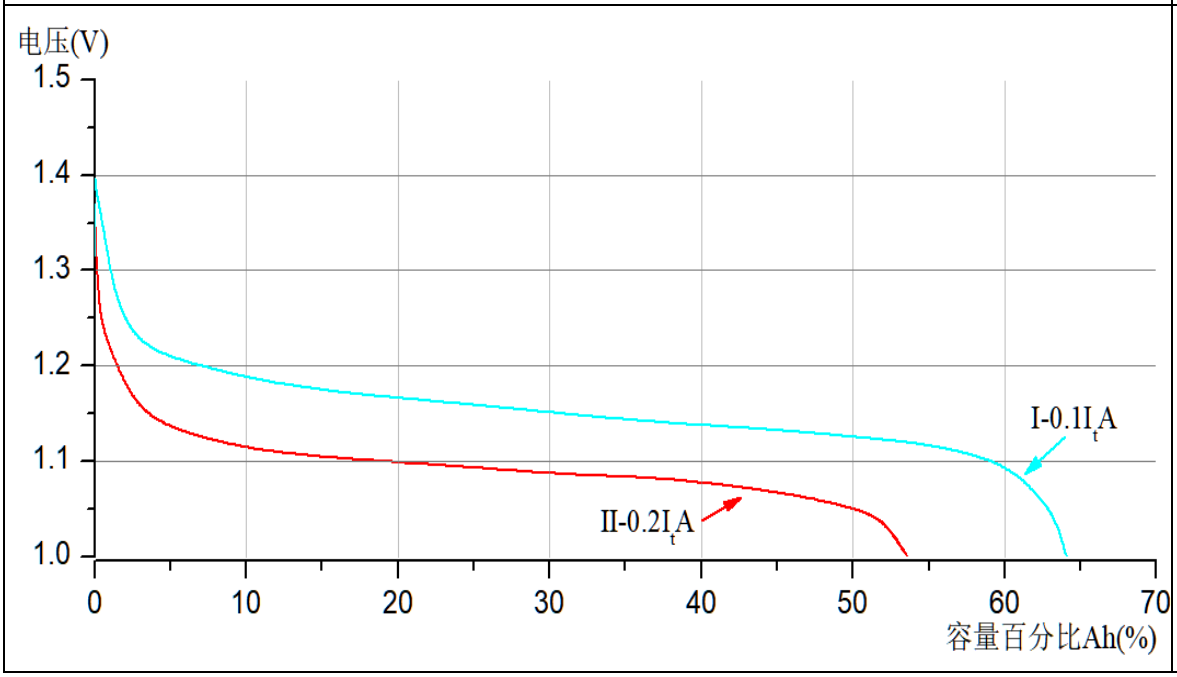




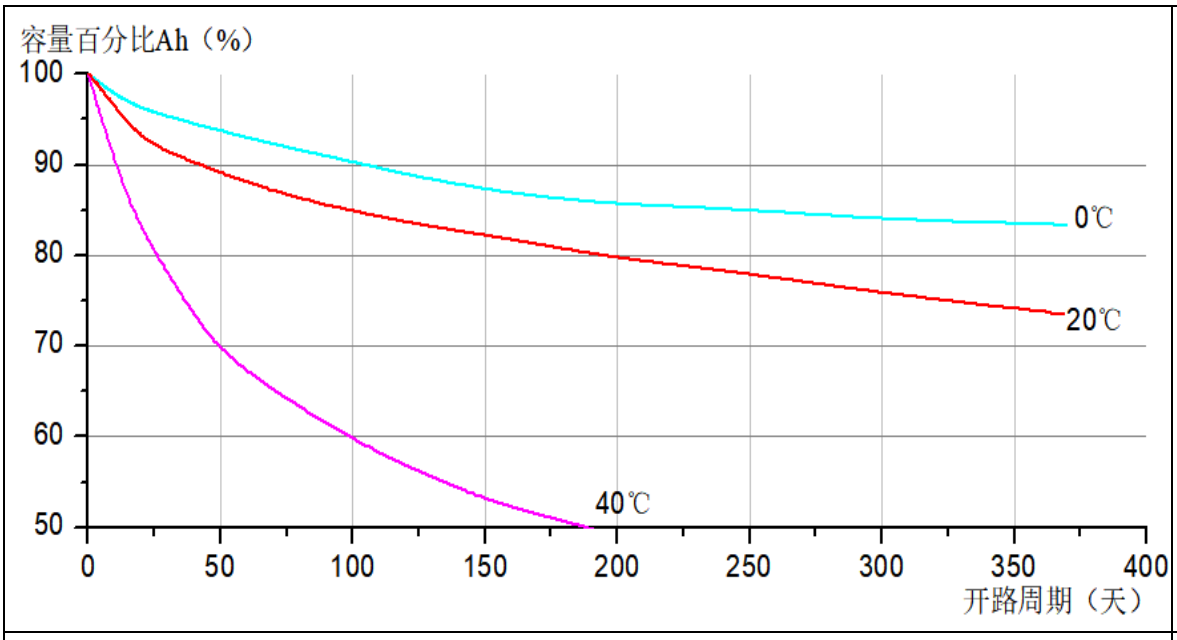
Discharge curves
Medium rate Ni-Cd battery at 20±5°C



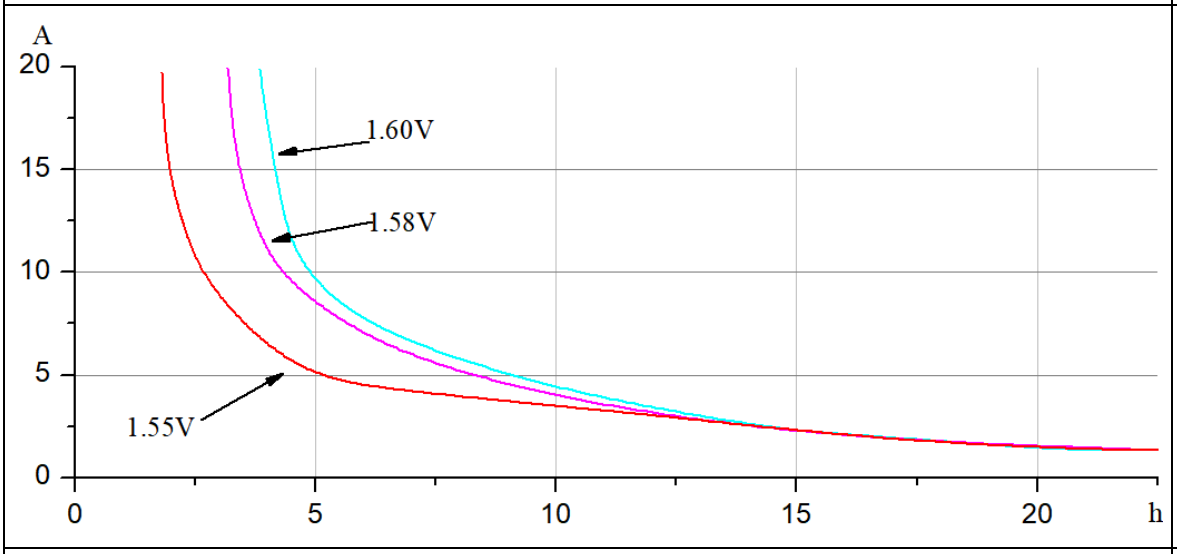
Discharge curves
High rate Ni-Cd battery at 20±5°C



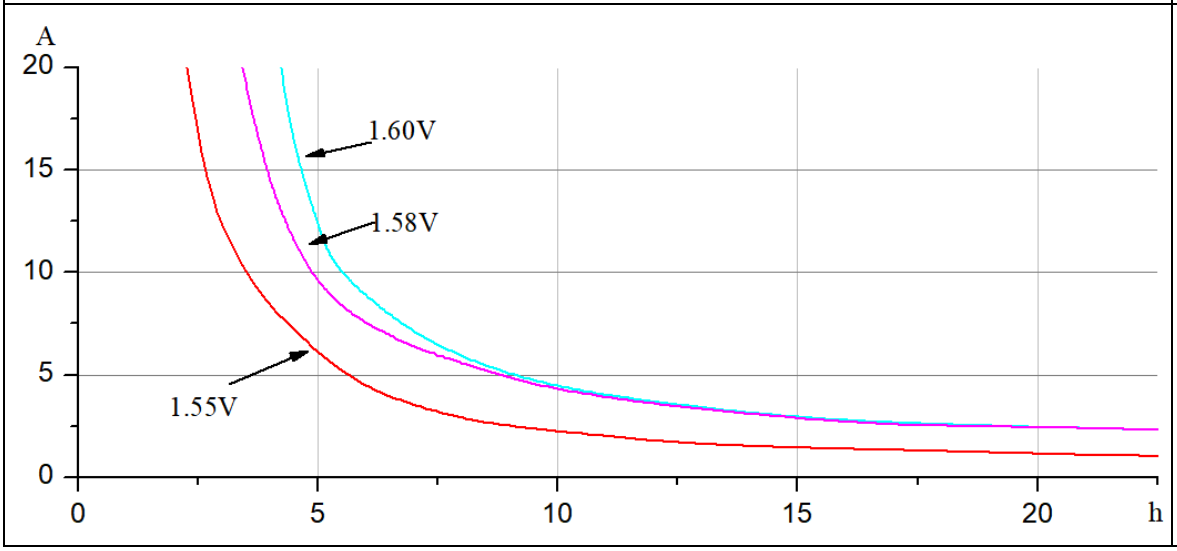
Low temperature(-18°C) discharge curve
0.2C_5A of Ni-Cd battery series.



Low temperatures Discharge curves
0.2C_5A at various of medium rate Ni-Cd



Constant voltage charging A-h curves
Ni-Cd battery at 20±5°C



Constant voltage charging A-h curves
Medium rate battery at 20±5°C