UNIKOR BATTERY CO.,LTD.

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MXVOLTA BATTERY TECHNICAL & HANDLING MANUAL

CONTENTS

1. WHAT IS MXVOLTA BATTERY ?

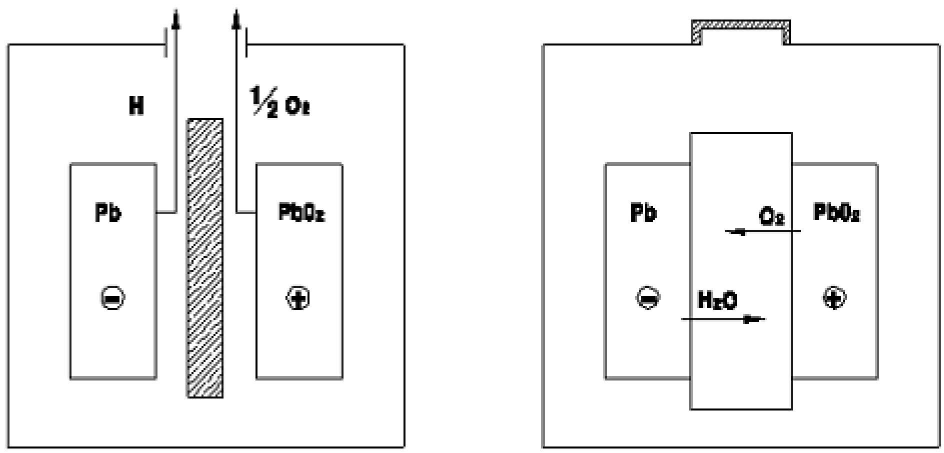
MXVOLTA battery is a kind of sealed batteries with maintenance free.
Generally, it still needs to add pure water regularly in order to keep a battery efficiency. Even though the capacity of battery having been reduced due to self discharge, MXVOLTA battery has a circulation system to re-fill in its function automatically and will not get any bad influence in spite of using a long period of time.
As it is, no need to add pure water for MXVOLTA battery because we made MXVOLTA battery minimized to generate gas such as H2, O2 in the battery, which are changed into water automatically.

2. CHARACTERISTICS OF SEALED BATTERY

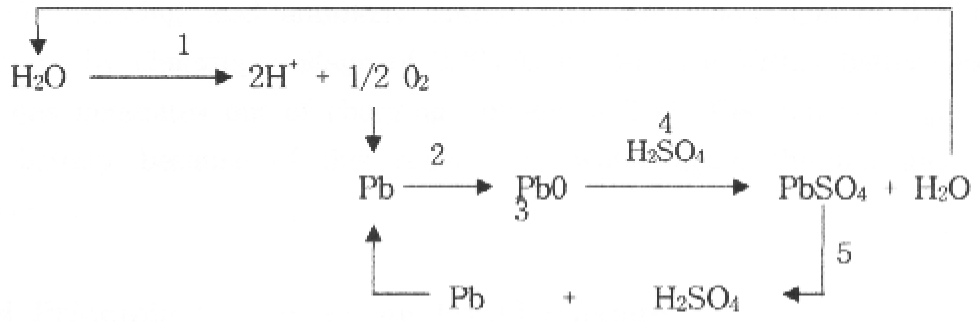
2.1 Oxygen recombination reaction.

It is to solve the problems of the gas generated in charging the sealed lead acid battery, incidental acid mist, liquid leakage and refill water and its theory is as follows:

Flooded Recombination



Reaction Formula



① Oxygen is produced in the positive plate in overcharge.
$H_2O \rightarrow 2H^+ + 1/2\ O_2 + 2e$

② The oxygen is diffused to the negative plate thorough the separator.

③ The oxygen combination with lead in the negative plate
$Pb + 1/2O_2 \rightarrow PbO$

④ The oxidized lead in the negative plate makes water by bonding with sulphuric acid for a certain amount of lead to be in the discharged condition.
$PbO + H_2SO_4 \rightarrow PbSO_4 + H_2O$

⑤ The discharged lead is to be in the new charged condition electrically and chemically to form a complete cycle.
$PbSO_4 + 2H^+ + 2e \rightarrow Pb + H_2SO_4$

Offsetting the right and the left, it become the original condition. That is, water disappeared in the ＋pole, is produced in －pole.

For this, the generation of hydrogen gas in －pole should be controled. It is possible by reducing the hydrogen generation voltage(hydrogen overvoltage), which is possible by using the calcium alloy as the existing antimony alloy cannot perform it.

2.2 Prevents generation of hydrogen gas from negative pole

The existing lead-antimony battery generates much hydrogen from negative pole when charging it and this is due to less excessive voltage by generation of hydrogen on alloy plate of lead and antimony. When charging VRLA battery the over voltage of hydrogen generating was largely reduced by use of alloy grid of lead & calcium instead of alloy of lead & antimony and with this the generation of hydrogen could be largely reduced.

2.3 Prevention of gas generation by adjustment of charging voltage.

To restrain or prevent from gas generation by causing not to be enhanced to the gas generating point by charging voltage by setting forth ceiling of charging voltage of VRLA battery. The ceiling voltage of charging VRLA battery is 2.46V/Cell (maximum 2.50V/Cell) and prevent from gas generation so that charging voltage of any more may not be enhanced and that takes in-charge of decisive role to enable this is the grid used lead & calcium.

The existing lead antimony battery generates more gas of 5-8 times than the VRLA battery by charging voltage of 2.46V/Cell. In case VRLA battery extremely small amount of gas generates out of charging voltage of 2.50V/Cell however, gas is not emitted outside of battery because of this reduces to water again through gas recombination reacting process.

2.4 Principle of preventing liquid leakage

a. Complete sealed structure

VRLA battery is structurally completely airtight under the normal atmosphere. Especially, vent hole is mechanically tight by valve and the safety valve was mounted with pressure adjusting function if excessive pressure is filled inside of the battery taking into account of safety.

b. Free move prevention structure of electrolyte

The electrolyte inside of battery is completely absorbed by glass fiber mat or gel which absorption of liquid is very good and cannot freely move within the battery. Since therefore, there is no worry about leakage of liquid as there is no electrolyte freely move even if the battery is laid down or upside down.

2.5 Principle of self-electric discharge

The self-electric discharge phenomenon of lead-acid battery is by interaction between active material of negative pole and electrolyte and the element incurs self-electric discharge are largely classified into two(2) sorts as follows:

(a) Constituents consist electrolyte (hydrogen ion in sulfuric acid)

(b) Impure substances contained in electrolyte

Out of the two sorts above a is unremovable element but (b) is removable but (a) that is to say the electrolyte itself cannot be eliminated and so, the electric discharge phenomenon by lead battery cannot completely be restrained. However, electric discharge volume may be reduced. VRLA battery has very small electric discharge volume than the existing lead antimony battery and this is because of use of alloy of lead & calcium in lieu of alloy of lead & antimony as the grid material. The plate alloyed by lead & calcium has very big resistance against electric discharge. On the alloy grid surface of lead & calcium the sponge lead which is negative pole active material is not easily discharged electricity since hydrogen is difficult to be generated (high hydrogen over voltage)

For your information the electric discharge principle by hydrogen ion in electrolyte is as follows:

(-) pole - hydrogen ion in electrolyte

$2H^+ + 2e \longrightarrow H_2(gas)$ -------------------------- (1)

(-) pole - lead which is active material

$Pb + H_2SO_4 \longrightarrow PbSO_4 + 2H^+ + Ze$ --------------- (2)

To sum up (1) reaction & (2) reaction

$Pb + H_2SO_4 \longrightarrow PbSO_4 + H_2 \uparrow$

(charged condition) (discharge condition)

3. BEFORE USING

Please read following specification before using.

When we release the battery to the users, the battery keep initial charged state which can be generated of flammable gas. Don't short each connection before sufficient ventilation of Installed places and just keep it away from fire in order to prevent dangerous factors.

3.1 Unloading and checking

3.1.1. When unloading the batteries, check the batteries in appearance and secure the batteries firmly to protect it from impact.

3.1.2. After unloading, it needs to check followings.

a. Check the number of batteries, accessaries and its status in appearance.

b. Check open circuit voltage (over 2.1 Volt / cell)

3.2 Installation and connection

3.2.1. The installation places should be clean and keeping the temperature between IO℃ and 35℃.(Read the reference Figure 2. which shows the capacity of battery depends on temperature)

3.2.2. When placing the battery, take suitable places and right upside in equipment.

3.2.3. Make sure to clean the battery connections before joining it with electric wire.

3.2.4.

a. In case using several batteries in series,the terminals should be correctly connected
To pay keen attention is needed not to short each other while connecting it.

b. When series connection, take the positive plate(+) to the negative plate(-) of next connection battery. Never short it as batteries furnished with charged status.

#. Recommended torque for connecting bolts and nuts are :

Size of Bolt & Nut		Torque
M6	Bolt	11±1 N.m
M8	Bolt	20±2 N.m
M10	Bolt	30±3 N.m
M10	Nut	18±2 N.m

c. After connecting, painting anti rust material slimly, having putted on safety cover on the plate battery.

d. And then, take to connect the battery to a load or a charger.
The positive plate(+) of battery should be joined with the positive plate(+) of a load or a charger and the same way to join it with negative parties.

3.3 OPERATIONAL TEST AND RECHARGE

3.3.1. Operation test
Please test the battery efficiency after joining with a load or a charger.

3.3.2. Recharge
As the battery can be in self discharge while transportation or storage period, the battery should be recharged as following way.

a. After Charging on 2.4 Volt / Cell of 3 hours to 5 hours,

b. The charge should be changed to float charging voltage.

4. DAILY INSPECTION AND SERVICING

In order to maintain battery life span long and to use high power battery efficiently, to pay heed is needed as below points.

4.1 Treatment

4.1.1. Maintain the numerical value of the regulations for float charging voltage.

4.1.2. Avoid operation of the battery with over 45℃

(The battery life span will be shorten in high temperature like over 45"C)
4.1.3. We recommend providing a vent hole to ensure ventilation.
4.1.4. keeps clean and dry conditions.
Never use any flammable liquid such as gasoline, benzene, etc to wash the container of battery.

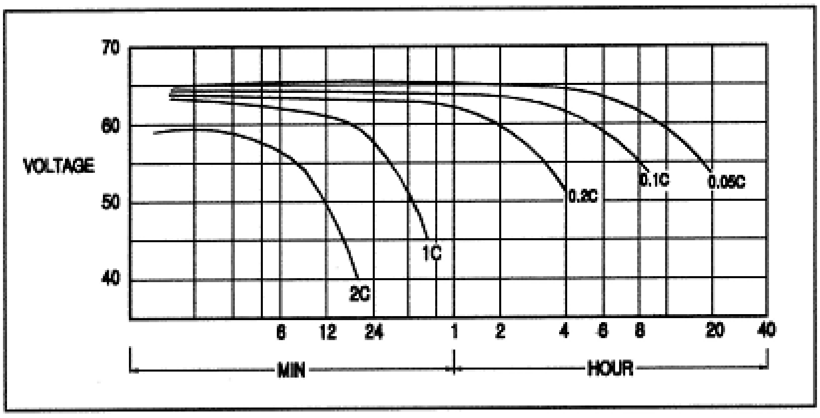
4.2 Discharge

4.2.1 DISCHARGE CHARACTERISTICS

a. The variation of time of duration according to discharge current

The capacity fully charged state effects 100% of capacity with law current discharge of. 20 hours case. Increasing voltage causes shorten time duration of discharge as Figure I shows.
* Note : C means nominal capacity with 20 hours rate. (Figure shows 6 Volt battery)

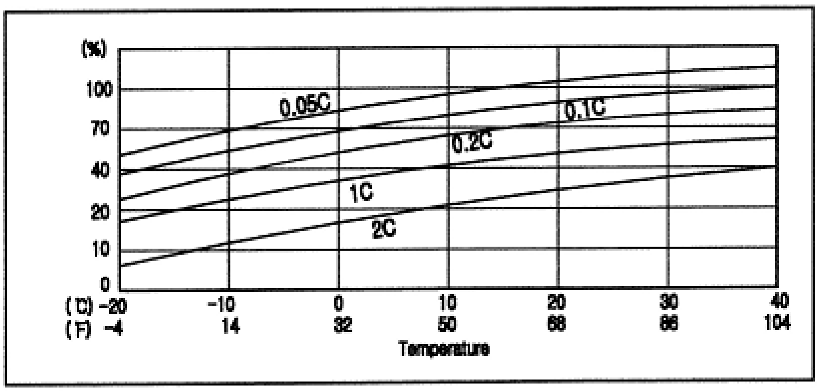
Figure 1. The variation of time of duration according to discharge current



b. Temperature and variation

The battery capacity beyond 20℃ caused increase in the apparent capacity, having decreased the capacity below 20℃.
Figure 2 shows 100% capacity when 20 Hours rate discharge at 20℃, 106% capacity at －20℃.

Figure 2. Temperature and the variation of capacity



c. For discharge current and final discharge voltage, please refer catalogue.
d. Precaution when discharging

Take discharging at an ambient temperature of -20℃ to +35℃.

The capacity to hold a charge may not be recovered if the battery is left discharged for a long period.

The battery should be immediately recharged if discharged deeply and or after using it.

The discharge capacity is affected by the discharge current. Evidently, increasing discharge current causes decrease in the capacity, decreasing discharge current causes increase in the capacity. (Refer Figure 1.)

4.3 Charge

4.3.1 CONSTANT VOLTAGE CHARGE (Recommend to use constant voltage charger)

This type of charging generally employs a constant voltage constant current method with current limitation to prevent the initial current from increasing, using a charger which controls electric current by transistor.

As a lot of electric current needs during charging of initial current to the middle current, electric current redcoats rapidly because being charge constant voltage at the last period of charging.

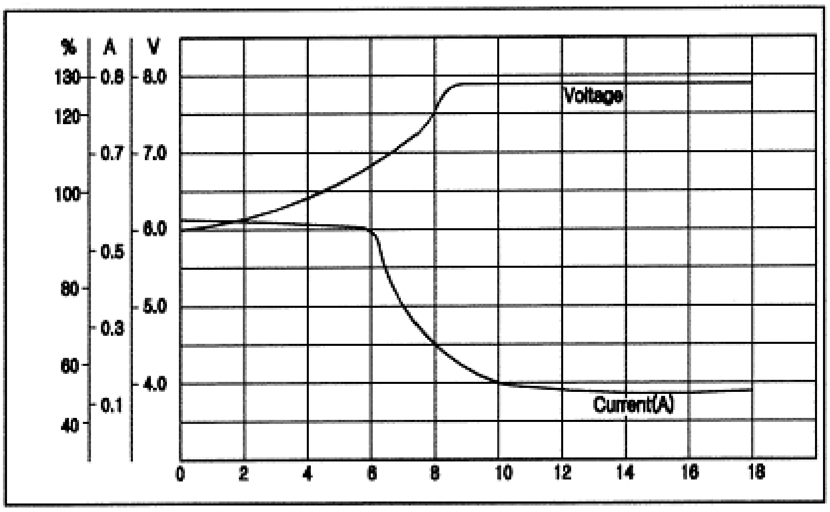
At the last period of charging, keeps to charge constant voltage with reduced electric current rapidly.

The setting value of constant voltage Is 2.4 Volt/Cell for cycle service.

The zone between 2.24 Volt/cell and 2.28 Volt/Cell are adopted for float charging.

The 2.23 Volt/Cell is a minimum charge value in order to maintain battery capacity after fully charging.

Figure 3. Characteristics of constant voltage charging



Note : A charge quantity of 120% of discharge quantity is needed to fully charge the battery

a. Float charge

? Keep charging constant voltage with 2.23 Volt - 2.28 Volt/Cell at 25℃

Numeral value of temperature ; Vc, t = Vc, 25- 0.00033 (t - 25)

Vc,t ; Charging voltage at t℃

Vc. 25 ; Charging voltage at 25℃

? Initial current charging Is below 0.4 C

C : Nominal capacity A : Ampere

Ex) In case of 100 AH as battery capacity : 100 × 0.4 = 40 A

? Ambient temperatures are between 0℃ and 35℃
? Battery life will be shorten if high temperature charging.

b. cycle
? The constant voltage charge method is recommended to charge this battery.
? The charging voltage is between 2..4V and 2.5V/Cell as average.
? Constant current charge initially is with current remitted to 0.4C.
? As it is hardly possible to check the .tine charged full, we recommended using a timer to be automatically stopped or the charger to be changed to float charging.

c. Precaution when charging
? The vent value should not be sealed.
? Always take the nominated voltage .
? Over Charging : shorten battery life
? When the temperature is over 45℃, please reduce electric current or ventilate the room where is stored of battery.

< The following points are needed to check regularly and please take note as record >

A. MONTHLY CHECKING (or 1 time per bi-week in case sensitive equipments needed for high quality electric powers)

Check point	Description	Standard	Arrangement
Total voltage of battery while float charging	The voltage of volt meter	Flat voltage × the number of cell ex) 6cell for 12V	Arrange the number of cell by the float voltage charging
Battery room Subsidiary Facilities	Battery room a. Condition b. Ventilation equipment	1. Keep dry & clean with 10 ~ 35℃ 2. Operate normally	a. To keep it dry and clean as temperature with 10 ~ 35℃ b. Abnormal operation cases, take mending or change

B. 6MONTHLY CHECKING

Checking point	Description	Standard	Arrangement
Battery room & subsidiary facilities	a. State of vent valve b. Safety facilities like fire extinguisher c. State of connection	a. Never close vent valve remove dust b. State of connection between charger and connect cable	a. Remove dust from vent valve and vent hole b. Check the rafty facilities c. Tighten connection never short the terminals
Appearance	a. Broken container crack & damage b. Dust of container in appearance		a. In case broken container, crack & damage, please contact us b. Remove dust with water, not gasoline or flammable liquid

C. CHECKING ANNUALLY

Checking point	Description	Standard	Arrangement
Connections	State of connection	Normal operation	Checking tight state of connection as well as removing rust on the terminals

D. SAFETY OF HANDLING

VT batteries are maintenance-free electrochemical systems designed to provide years of trouble-free electrical energy. The performance and service life of these batteries can be maximized by observing the following guidelines:

① Heat kills batteries. You must avoid placing batteries in close proximity to heat sources of any kind. You will enjoy longer service life, if batteries are operated in ambient temperature ranges of 20℃(68° F)

② Since the batteries may generate ignitable gas, please do not install them close to any item that produces sparks.

③ If the battery is to be used in an enclosed space or in a container, provision should be made for adequate ventilation.

④ As the battery containers and covers are made of ABS plastic resin, placing batteries in an atmosphere of, or in contact with organic solvents or adhesive materials should be avoided.

⑤ Permissible operating temperature range of battery is -20℃ to 50℃, but using within an operating range of 5℃ to 35℃ will extend service life.

⑥ Use shock absorber and fasten battery firmly when heavy vibration of shock is expected during service.

⑦ When connecting the batteries, free air space must be provided for each battery. The recommended minimum space between batteries is 0.02 inches(5mm) to 0.04(10mm)

⑧ Clean the battery with a piece of wet cloth. Never have the battery splashed of deposited with oils or organic solvents such as gasoline or paint thinner, nor have it cleaned with cloths impregnant with these materials.

⑨ Dismantling the battery is not advisable. If sulphuric acid is deposited on skin or clothes, please wash well with sufficient amount of fresh water and obtain immediate medical attention.

⑩ A battery is liable to rupture if thrown into fire. Please avoid such conduct at all times.

⑪ Touching electrically conductive parts might result in an electric shock. Be sure to wear rubber gloves before inspection or regular service.

⑫ Mixed use of batteries with different capacities, histories and/or manufactures is liable to cause damage to the battery or the equipment. If this is unavoidable, please consult manufacturer beforehand.

Should you have any other question, please feel free to contact UNIKOR BATTERY CO., LTD. at any time of your convenience. www.ukbkorea.com

REFERENCE GUIDE

* MXVOLTA battery dischagre performance data
* Storage and manage MXVOLTA batteries
* Troubleshooting flowchart
* List of material for MXVOLTA batteries
* Discharge capacity varies depending on the discharge current & hour rate
* STORAGE AND MANAGE OF MXVOLTA BATTERIES

A. O.C.V manage during storage at 25℃

Passed period after manufactured	VT2100 to VT23000	VT12012 to VT1224	VT1231 to VT12200
1 day – 1 month	2.12 ~ 2.11 V	12.90 V	12.80 V
1 month – 2 month	2.11 ~ 2.10 V	12.85 V	12.78 V
2 month – 3 month	2.11 ~ 2.10 V	12.80 V	12.75 V
3 month – 4 month	2.10 ~ 2.09 V	12.70 V	12.65 V
4 month – 5 month	2.10 ~ 2.09 V	12.65 V	12.60 V
5 month – 6 month	2.09 ~ 2.08 V	12.60 V	12.55 V

When passed more than 6 months, refresh charge must be carried out

B. When passed more than 6 months after manufactured, refresh charge methods are two following

(1) Constant voltage

setting voltage	Initial limit current	Charging time
2.45V/cell	0.25 C	6±1 hour

(2) Constant current

setting current	Charging time
0.05 C	6 ± 1 hour
0.1 C	3hour ± 30min.

GENERAL CHARGE RANGE

A suitable method of charging is the constant voltage characteristics method, whereby the current intensity is initially held constant while the battery voltage rises until a voltage of 2.23 or 2.40V/cell respectively is reached. From this point onwards. the voltage is held constant and charging proceeds with tapering current when the voltage reaches 2.40V/cell one most switch over to 2.23V/cell.

% of C_{10} DCHG.	CHRG period	2.23 V/CELL				2.40 V/CELL			
		0.5x I_{10}	1x I_{10}	1.5x I_{10}	2x I_{10}	0.5x I_{10}	1x I_{10}	1.5x I_{10}	2x I_{10}
25 %	3 h	87.5	94.0	95.0	96.0	87.5	96.0	98.0	98.0
	6 h	94.0	96.0	97.0	97.0	98.0	99.0	99.0	100.0
	10 h	96.0	97.0	97.5	97.5	100.0	100.0	100.0	–
	20 h	97.0	98.0	98.0	98.0	–	–	–	–
50 %	3 h	62.5	75.0	82.0	85.0	62.5	75.0	87.5	90.0
	6 h	75.0	89.0	90.0	92.0	75.0	93.0	96.0	97.0
	10 h	90.0	93.0	93.0	94.0	91.0	98.0	98.0	98.0
	20 h	97.0	95.0	95.0	95.0	100.0	100.0	100.0	100.0
75 %	3 h	37.5	50.0	62.5	68.0	37.5	50.0	62.5	75.0
	6 h	50.0	73.0	80.0	83.0	50.0	75.0	88.0	90.0
	10 h	66.0	86.0	88.0	89.0	66.0	91.0	96.0	96.0
	20 h	93.0	93.0	93.0	93.0	95.0	100.0	100.0	100.0
100 %	3 h	12.5	25.0	37.5	47.0	12.5	25.0	37.5	50.0
	6 h	25.0	50.0	65.0	70.0	25.0	50.0	76.0	80.0
	10 h	41.5	73.0	78.0	80.0	41.5	83.0	87.0	90.0
	20 h	80.0	91.0	91.0	91.0	83.0	98.0	100.0	100.0

The table shows the % capacity once more available after each relevant period given, taking the charging factor(1.20) into consideration.

* List of material for VRLA battery

No.	Part's Name	Material of Construction	MFG. Method
1	Container & cover & top cover	* ABS synthetic resin * Retains sufficient mechanical strength to withstand battery internal pressure	Injection molding
2	Rubber vent cap	* Synthetic rubber with acid resistance No leakage at 2.5psi	Injection molding
3	Ceramic filter	* Vent plug provided with builtin Ceramic filter * Prevents ignition entering battery * Prevents acid fumes from escaping from the battery	Injection molding *Appication : More than 12V 65Ah to 2V3000Ah
4	Separator	* Absorptive glass mat with heat oxidation resistance and enough water absorbed height	
5	Positive plate a)Grid b)Active material	* Ca-Sn-Al alloy lead * Pure lead * Sulfuric acid * Water * Fiber flock	Casting milling/ mixing pasting
6	Negative plate a)Grid b)Active material	* Ca-Sn-Al alloy lead * Pure lead * Sulfuric acid * Water * Fiber flock * Expander(Mixed:Lignin, Carbon, Barium sulfate)	Casting milling/ mixing pasting

No.	Part's Name	Material of Construction	MFG. Method
7	Intercell strap	* Sn-alloy lead	Casting
8	Electrolyte	* Dilute sulpuric acid in quantity to preclude free elctrolyte	
9	Post terminal	* Sn-alloy lead * Terminal Section employs dual complete seal construction of O-ring and sealing of epoxy resin	Casting
10	O-ring	* Synthetic rubber	Injection molding
11	Container & cover boding agent	* Epoxy resin with acid resistance and high adhesion strength	
12	Bolt,nut and washer	* SUS-304 material with acid resistance	
13	Connector	* Cable wire or copper bar with lead coating	Application : only 2V series cell
14	Connector cover	* Synthetic resin (Injection molding)	ditto
15	Post terminal cover	* Synthetic rubber (Injection molding)	ditto
16	Battery rack	* Rack made of steel * Vertical or horizontal type * Acid-proof painting * Earth quake - Proof and vibration - proof construction	Application of horizontal type : up to 2V600Ah cell

DISCHARGE CAPACITY VARIES DEPENDING ON THE DISCHARGE CURRENT & HOUR RATE (MxVolta 12V Medium & 2V Milenia large size battery)

HOUR-RATE	DCHG CURRENT	BATTERY EFFICIENCY
10 HRS	0.1000000 C	10 x 0.1000000 = 1 x 100 = 100.0000%
9 HRS	0.1089375 C	9 x 0.1089375 = 0.9804375 x 100 = 98.0438%
8 HRS	0.1190500 C	8 x 0.1190500 = 0.9524 x 100 = 95.2400%
7 HRS	0.1336200 C	7 x 0.1336200 = 0.93534 x 100 = 93.5340%
6 HRS	0.1514500 C	6 x 0.1514500 = 0.9087 x 100 = 90.8700%
5 HRS	0.1733000 C	5 x 0.1733000 = 0.8665 x 100 = 86.6500%
4 HRS	0.2092000 C	4 x 0.2092000 = 0.8368 x 100 = 83.6800%
3 HRS	0.2740000 C	3 x 0.2740000 = 0.822 x 100 = 82.2000%
2 HRS	0.3676000 C	2 x 0.3676000 = 0.7352 x 100 = 73.5200%
1 HRS	0.6494000 C	1 x 0.6494000 = 0.6494 x 100= 64.9400%
45 MIN	0.8248000C	45/60 x 0.8026000 = 0.6019 x 100 = 60.1950%
30 MIN	1.0000000 C	30/60 x 1.0000000 = 0.5 x 100 = 50.0000%
20 MIN	1.2410000 C	20/60 x 1.2410000 = 0.413667 x 100 = 1.3667%
10 MIN	1.6180000 C	10/60 x 1.6180000 = 0.2696667 x 100 = 26.9667%
5 MIN	1.8900000 C	5/60 x 1.8900000 = 0.1575 x 100 = 15.7500%
1 MIN	2.1410000 C	1/60 x 2.1410000 = 0.0356833 x 100 = 3.5683%
0.5 MIN	2.1650000 C	0.5/60 x 2.1650000 = 0.0180417 x 100 = 1.8042%
"C" stands for discharge current equivalent to the rated capacity at 10 hour rate.		

RELATIONSHIP OF DISCHARGE CURRENT TO FINAL DISCHARGE VOLTAGE

DCHG CURRENT	CUT OFF VOLTAGE		
	12V SERIES	6V SERIES	2V SERIES
0.1C or below current	11.40V	5.70V	1.90V
0.1C or current close to it	10.80V	5.40V	1.80V
0.16C or current close to it	10.50V	5.35V	1.75V
0.23C or current close to it	10.20V	5.10V	1.70V
0.6C or current close to it	9.60V	4.80V	1.60V
From 0.6C to 3C	9.00V	4.50V	1.50V
Current in excess of 3C	7.80V	3.90V	1.30V