GasTon

VALVE REGULATED SEALED LEAD ACID BATTERY

Marathon Purpose(F, M) Series

OPERATION MANUAL

Version:V3.0

GASTON BATTERY INDUSTRIAL LTD

Contents

Chapter One Product Introduction

1. Features

1.1 Basic Characteristics

1.1.1 Adopt the design of barren electrolyte and utilizes AGM (microporous glass fiber) separator. Thus there is an oxygen path existing between the positive and the negative plates. Also non-antimony grid is chosen to increase hydrogen evolution over-potential on the negative plate, which prevents generation of hydrogen, and as a result, no water loss. So during the service life, there will be no need to add acid and water, nor to adjust the density of the solution.

1.1.2 Reliable seal performance, no acid spillage to cause equipment erosion.

1.1.3 The design life of 10 years and low self-discharge.

1.1.4 Compact structure, shock-proof and high specific energy design.

1.2 Reliable Seal Technology

1.2.1 Container and lid made of reinforcing ABS plastic. Adopt new-type glue which can combine to ABS strongly. The glue conquers epoxy's weaknesses of aging and brittleness. And ensures no leakage of solution between container and lid.

1.2.2 Explosive proof valve with an acid filtering structure. If the pressure inside the battery exceeds a certain value, the safety valve will automatically open to decrease the pressure. And it will not close until the pressure is normal. The acid filtering structure in the safety valve prevents emission of acid mist when the safety valve opens.

1.2.3 The patented post seal technology ensures the reliability of post seal..

1.3 Excellent high rate discharge performance

1.3.1 Adopt side posts with large sectional area, and this construction made internal resistance very low

1.3.2 Superior design grid construction, raise the high rate discharge performance.

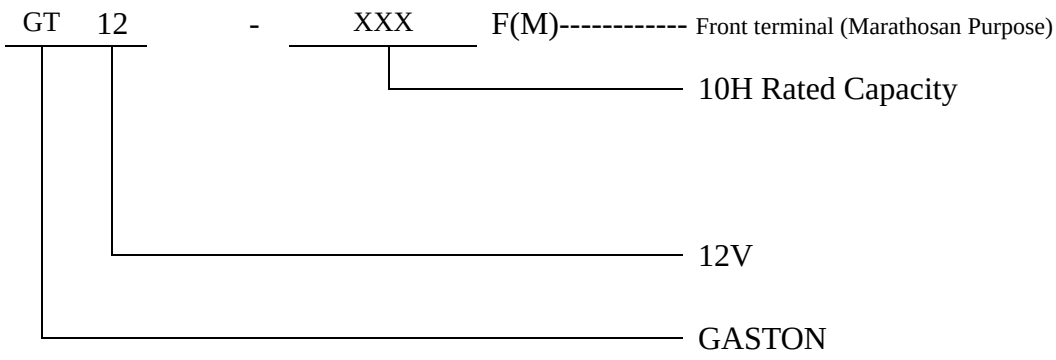
1.4 Unique Construction Design Created by Gaston in China (12-100F, GT12-155F,GT-200M)

1.4.1 Long and narrow construction design, good heat dispersing ability

1.4.2 Both positive and negative post are in one side of the battery, easy for monitoring and maintenance.

1.4.3 Flexible connectors

2. Indication of Type

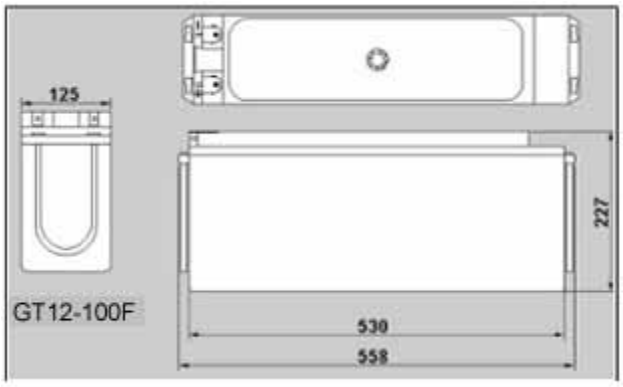


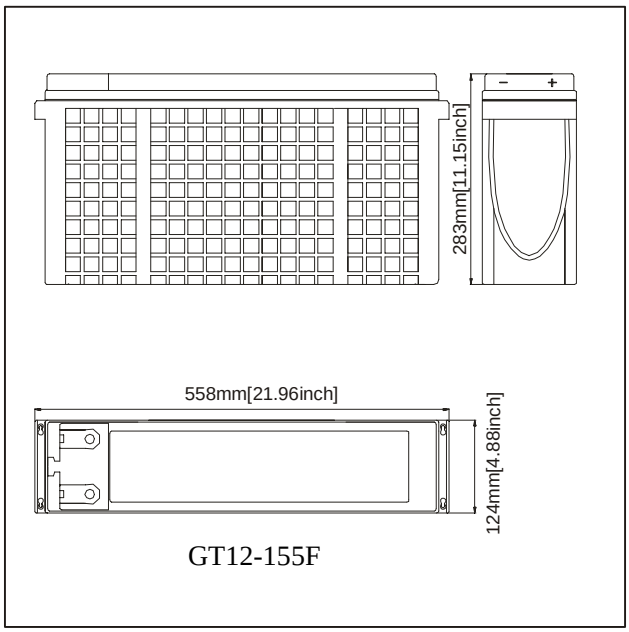
3. Types & Dimensions

Table 1-1 Capacity and Weight

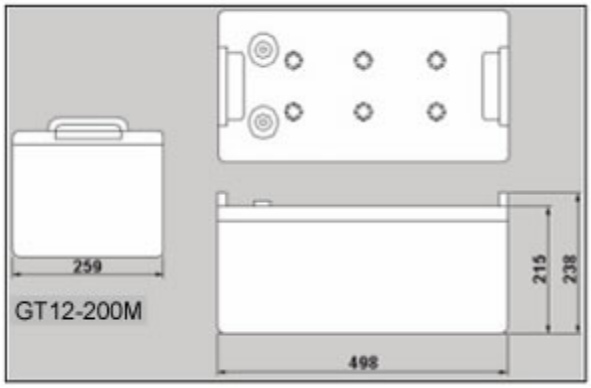
Type	Rated Voltage(V)	Rated Capacity C_{10} (Ah)	Dimension(mm)			Weight (Kg)
			Length	Width	Height	
GT12-100F	12	100	558	125	227	39
GT12-155F	12	160	558	124	283	54
GT12—200M	12	200	498	259	238	74.5

4. Outline of the battery

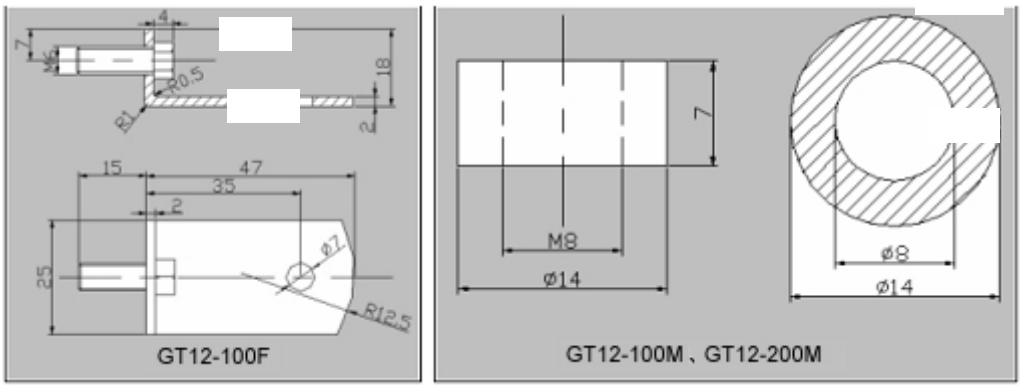




GT12-155F



5. Terminals



Chapter Two Technical Characteristics

1. Capacity and influence factors

1.1 The capacity of battery is the capacity that battery can be discharged under certain conditions, expressed as signal C. The usual unit of capacity is ampere hour, shortened as Ah.

The capacity can be expressed in Rated Capacity or Actual Capacity. The Rated Capacity please see Table 1-1. The Actual Capacity is the product of the discharge current and the discharge time, the unit is Ah.

1.2 The Influence Factor of Actual Capacity

The actual capacity is mainly related with the battery's construction, manufacturing process and operation circumstance. During operation, the factors that influence the actual capacity are discharge rate, end voltage, ambient temperature and discharge time.

1.2.1 Discharge Rate

If the discharge rate (hour rate) is smaller, the discharge current is larger, and the discharge time is shorter, then the capacity which can be discharged is less. For example, the discharge current of 3 hours rate is larger than that of 10 hours rate; and the capacity of 3 hours rate is smaller than that of 10 hours rate.

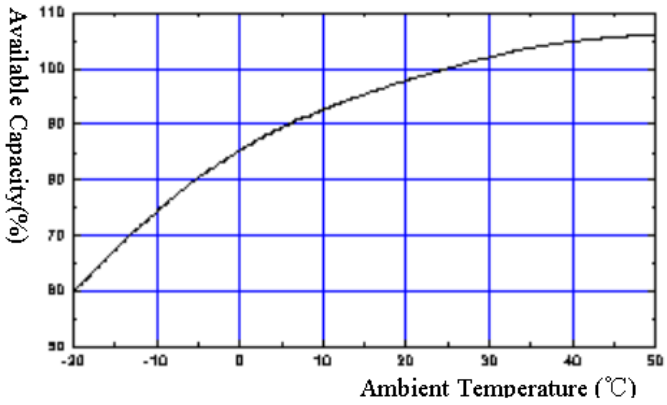
1.2.2 End Voltage

The end voltage is the lowest working voltage below which the battery cannot be discharged any more. Usually the end voltage of (F&M) battery is 10.5V per piece. The capacity cannot be discharged more even if the end voltage drops, because of the characteristics of lead acid battery. The lower end voltage will harm the battery, especially when the voltage drops to 0V and the battery cannot be recharged in time. This will shorten life of the battery greatly.

2. Ambient Temperature, Capacity and Life

VRLA batteries can be used in very low or high temperature (below-15C or above 45C). Yet all standard data (such as capacity, life, floating voltage) are measured under standard temperature of 20C-25C. The capacity will decrease under lower temperature as Fig. 2-1:

Fig.2-1: Ambient Temperature VS Available Capacity



We may see that the capacity will decrease if the temperature is too low. For example, if the temperature decrease 20C, the capacity will decrease 16%. Meanwhile, the low temperature will

make the battery always in a less-charged state, then it may cause the battery fail to discharge and the active material in negative plates saltilize.

The capacity will increase when the temperature increases. The capacity will increase 6% when the temperature increase 10C. However, the high temperature will accelerate the corrosion of the grid and cause water loss inside the battery, thus shorten the life of the battery.

So it is important to strictly control the ambient temperature. Please keep the room ventilate and use airconditioner when the temperature is too high.

3. Charge Performance

3.1 The batteries should be recharged in time after discharge. The method is recommended as follows:

— The batteries first should be charged on the constant current of $0.15C_{10}A$ till the average voltage of the batteries increases to 14.1V, then the batteries should be charged with constant voltage of 14.1V, till the charge is finished.

3.2 Whether the batteries are fully charged can be decided according to any one of two standards as follows:

A. Please refer to the table 2-1 Depth of Discharge VS Charging time

Table 2-1 DOD VS Charging time

DOD (%)	Constant Current (A)	Constant Voltage (V)	Fully Charged Time (h)
20	$0.15C_{10}$	14.1V/Pc	10
	$0.20C_{10}$		8
50	$0.15C_{10}$	14.1V/Pc	15
	$0.20C_{10}$		12
80	$0.15C_{10}$	14.1V/Pc	16
	$0.20C_{10}$		14
100	$0.15C_{10}$	14.1V/Pc	20
	$0.20C_{10}$		18

B. Under condition of constant voltage, the value of charge current hasn’t varied for continuous three hours.

Notes:

On special occasions, the batteries need to be fully charged immediately, then fast charge could be adopted: the value of limit current should not be larger than $0.30C_{10}A$, and the charge voltage should be 14.1-14.4V per unit. When the charging current and voltage is larger, the charge time is shorter. The ambient temperature should not be too high during fast charge.

4. Storage

All lead acid batteries experience self-discharge in open circuit. The result is that the voltage of open circuit is decreased, and the capacity also decreased. During storage period, please note:

4.1 The self-discharge rate is related with ambient temperature. The self-discharge degree is

smaller when the ambient temperature is lower, otherwise is larger. The requirement temperature of Gaston batteries' storage environment is from 0C to 35C. The storage place must be clean, ventilated and dry.

4.2 An important parameter in storage is open circuit voltage, which is related with density of electrolyte. In order to avoid permanent damage to the plate caused by self-discharge, the batteries should be supplemental charged if they have been stored for three months. The equalization charge method should be adopted.

4.3 During storage, if the open circuit voltage is lower than 12.6V/Unit, the batteries should be supplemental charged before use. The equalization charge method should be adopted.

4.4 All batteries, which are ready to store, should be fully charged before storage. It's suggested record the storage time in the periodic maintenance record and note the time when next necessary supplemental charge should be made.

5. Discharge Performance

The telecommunication customers please refer to: Fig.2-2; 2-3; 2-4; 2-5.

The power supply customers please refer to: fig.2-6; 2-7; 2-8; 2-9.

Fig.2-2; 2-3 are the discharge performance curves at different current ($0.1C_{10}$~$1.0C_{10}$) at 25C. The end voltage is 10.5V.

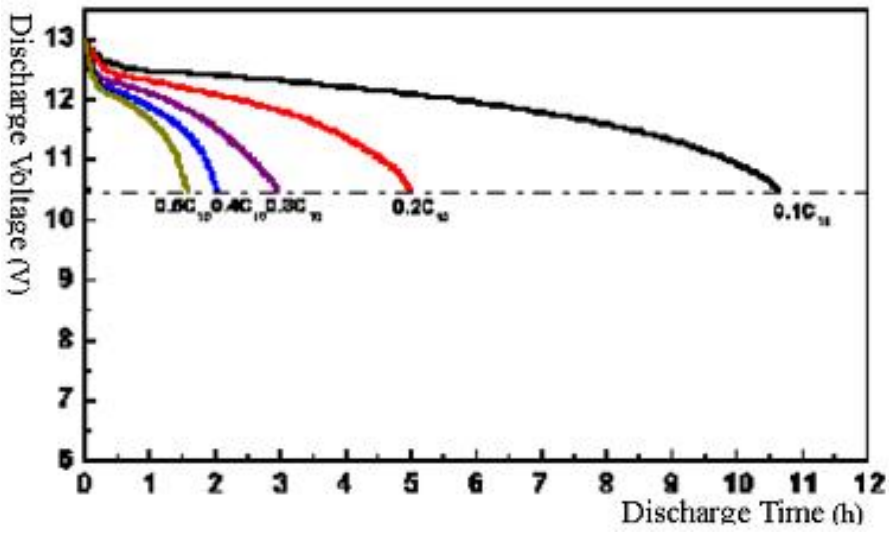
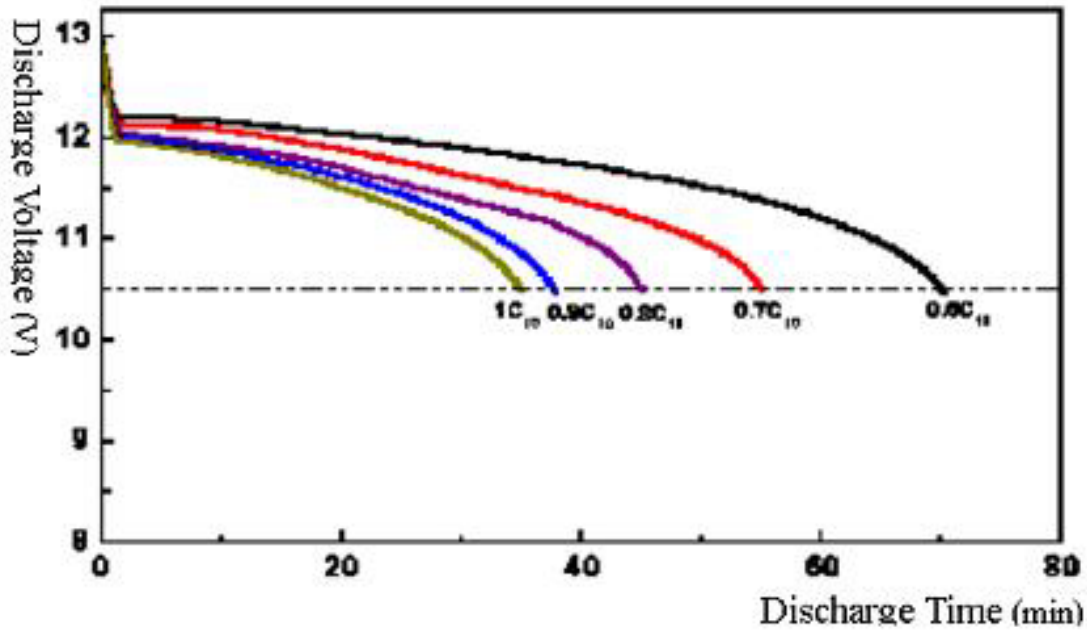


Fig. 2-2 Discharge Curve with the current of 0.1 C_{10}~0.5 C_{10}A (25C)



Explanation for fig..2-2: let us make GT12-100F battery as an example. The C_{10} of GT12-100F is 100Ah, so when discharge at 0.2C_{10} , i.e.0.2 x100=20A, The discharge voltage and discharge time is shown by 0.2C_{10} curve.

Fig. 2-3 Discharge Curve with the current of 0.6 C_{10}~1.0 C_{10}A(25C)

Explanation for fig. 2-3:let us make GT12-100F battery as an example. The C_{10} of GT-100F is 100Ah, so when discharge at 0.8C_{10} , i.e.0.8 x 100=80A, The discharge voltage and discharge time is shown by 0.8C_{10} curve.

Fig.2-4 are the curves at different discharge rate (20~50 hours rate) at 25C. The end voltage is 11.1V and 10.8V

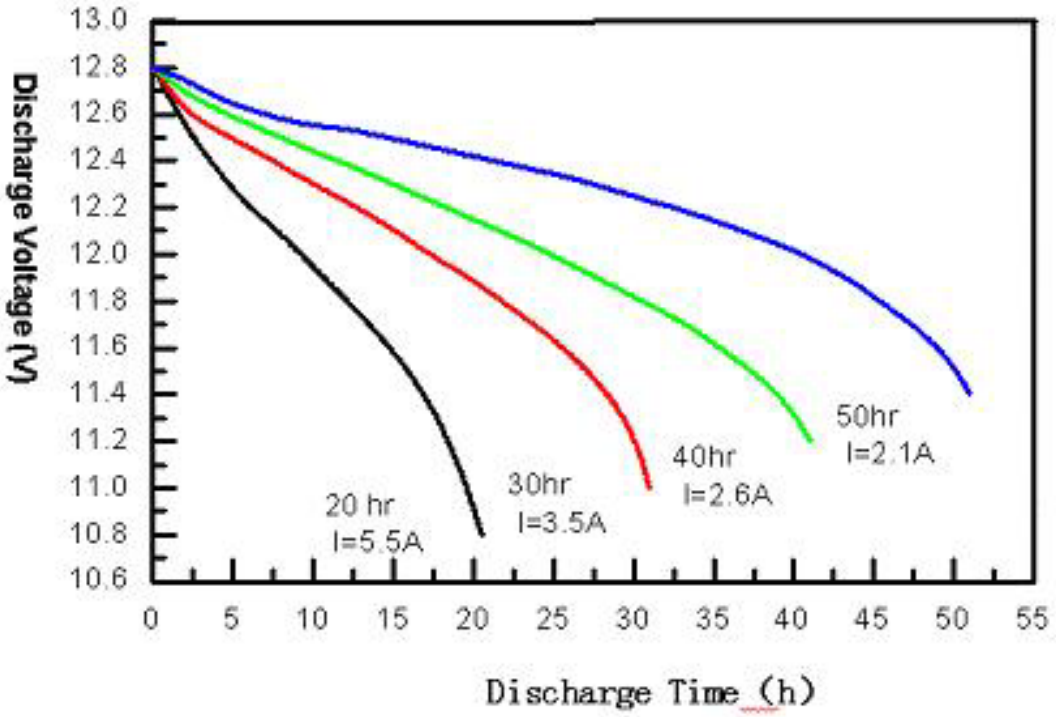


Fig.2-4 Discharge Curve at 20~50 hours rate (25C)

Fig.2-5 are the discharge time curves at different discharge current (10A~5A) at -15C. The end voltage is 10.5V.

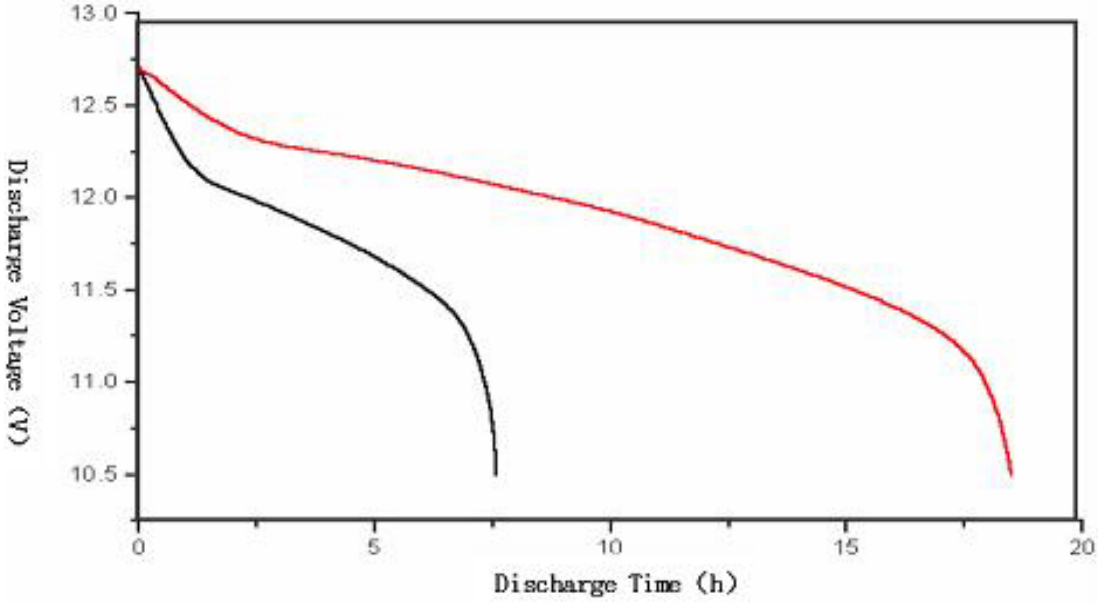
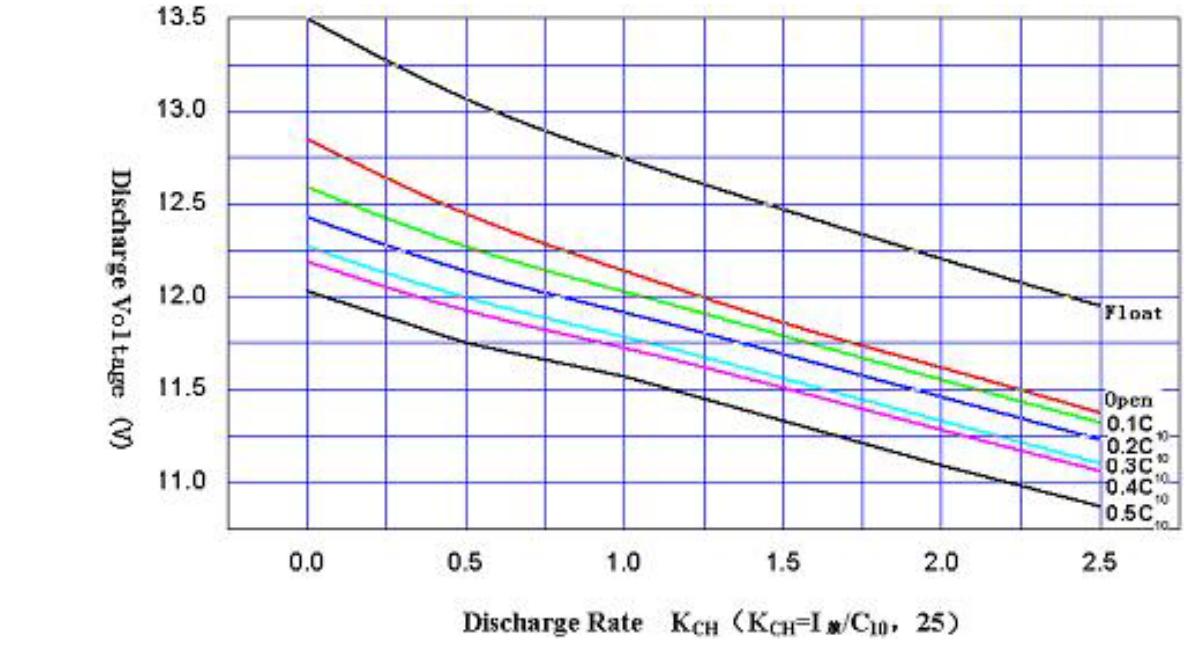


Fig.2-5. Discharge Curves with Current of 5A; 10A at low temperature (-15C)

Fig.2-6 are shock discharge curves at different current after the batteries are predischarged for 1h



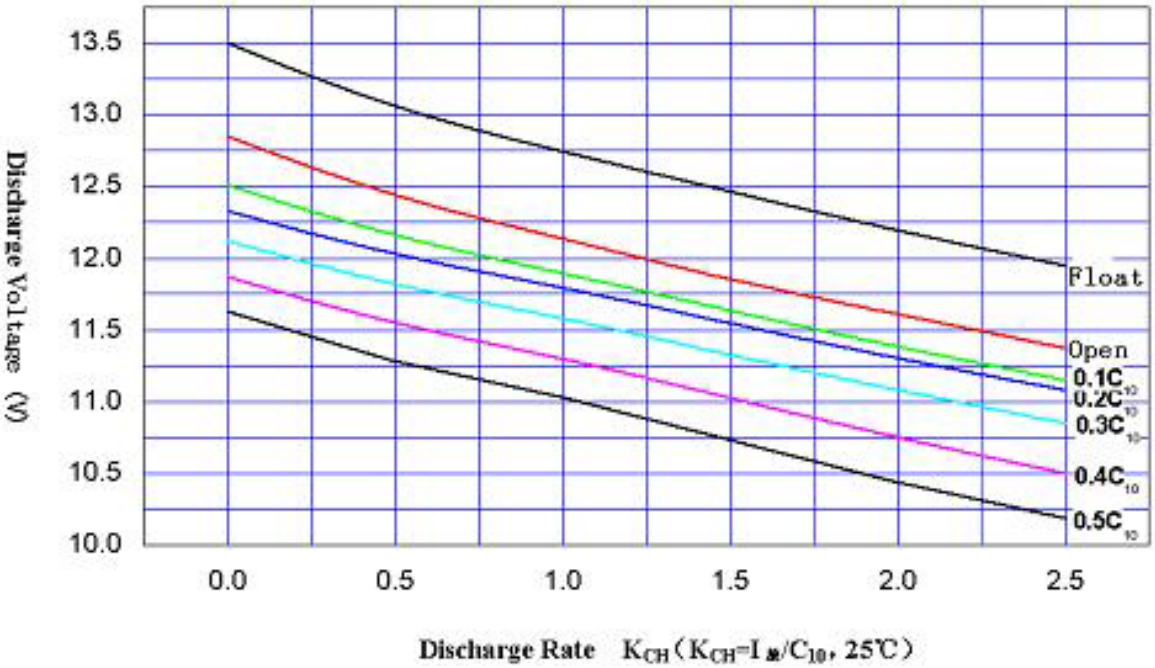


Fig.2-6 Shock Discharge Curves after the batteries are predischarged for 1h

Fig.2-7 are shock discharge curves at different current after the batteries are predischarged for 0.5h

Fig.2-7 Shock Discharge Curves after the batteries are predischarged for 0.5h

Fig.2-8.is discharge performance curve for 1min

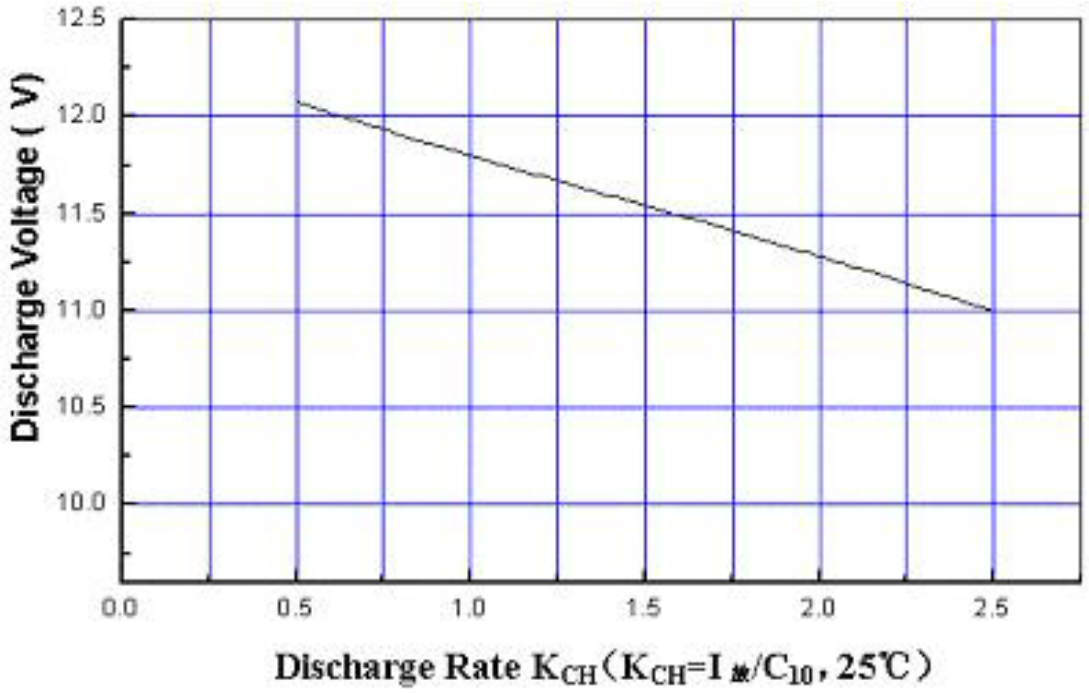


Fig.2-8.Discharge Curve for 1min

Fig.2-9.is discharge performance curve for 5S

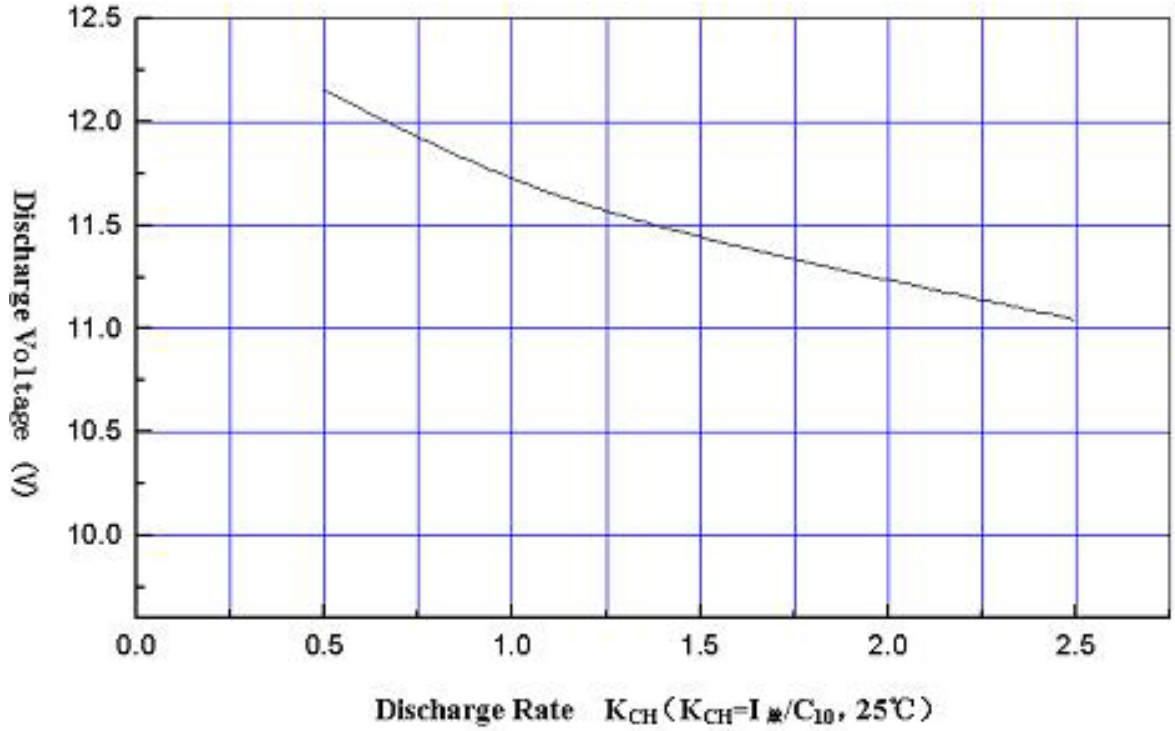


Fig.2-9. Discharge Curve for 5S

Table 2-2 Discharge current at different end voltage and different time (Amperes. 25C)

End Voltage	type	1 Min	5 Min	15 Min	30 Min	1h	2h	3h	4h	5h	8h	10h	20h
9.60V	GT12-100F	387	350	175	110	65	38	28	22	20	13	11	5.7
	GT12-155F	597	551	275	173	102	72	43	37	31	20.5	17.3	8.7
	GT12-200M	774	700	350	220	130	76	56	44	40	27	22	11.5
9.90V	GT12-100F	371	322	167	105	63	37.5	27	21.5	19.5	13.2	10.8	5.6
	GT12-155F	572	507	218	161	97.3	71.1	41.7	36	30.1	20.4	16.6	8.6
	GT12-200M	742	644	335	210	127	75	54	43	39	26.4	21.7	11.3
10.20V	GT12-100F	356	298	162	101	62	37	26	21	19	12.8	10.7	5.5
	GT12-155F	550	469	255	156	95	68.7	40.1	35.5	29.4	19.7	16.5	8.4
	GT12-200M	712	598	324	202	124	74	52	42	38	25.7	21.5	11
10.50V	GT12-100F	312	266	150	98	60	36.8	25	20.8	18.5	12.5	10.5	5.3
	GT12-155F	482	411	232	152	93	65	38.7	32.7	28.5	19.3	16.2	8.1
	GT12-200M	624	532	300	196	120	74.6	50	41.6	37	25	21	10.6
10.80V	GT12-100F	278	240	142	95	55	36.5	24	20.5	18	12	10	5
	GT12-155F	429	370	219	149.6	86.6	63	38	32.2	27.8	18.5	16.0	7.7
	GT12-200M	556	480	284	190	110	73	48	41	36	24	20	10
11.10V	GT12-100F	240	212	133	90	50	35	23	20	17.6	11.5	9.6	4.7
	GT12-155F	370	327	205.	139	77	57.8	35.5	31.5	27.2	17.7	15.0	7.2
	GT12-200M	480	424	266	180	100	70	46	40	35.2	23	19.2	9.5
11.40V	GT12-100F	200	182	122	86	45	31	22	15	11.8	10.8	8.6	4.4
	GT12-155F	309	281	188	132	69.5	54.1	33.9	23.6	22.3	16.7	13.3	6.8
	GT12-200M	400	364	244	172	90	62	44	30	33.6	21.6	17.2	8.8

Explanation for Table 2-2: 6-GT12-200M discharge for 1min end voltage is 9.60V, the discharge current is 774A.

Table 2-3 Discharge power at different end voltage and different time (Watts. 25C)

End Voltage	Type	1 Min	5 Min	15 Min	30 Min	1h	2h	3h	4h	5h	8h	10h	20h
9.60V	GT12-100F	3715	3360	1680	1056	663	420	277	270	205	142	119	61.5
	GT12-155F	5767	5216	2608	1639	1029	692	430	425	318	220	184	95.4
	GT12-200M	7430	6720	3360	2112	1326	840	554	540	410	284	238	123
9.90V	GT12-100F	3673	3188	1658	1039	654	415	272	246	202	138	115	59
	GT12-155F	5702	4949	2569	1609	1014	658	422	387	313	214	178	91.5
	GT12-200M	7346	6376	3316	2079	1308	830	545	492	405	277	231	119
10.20V	GT12-100F	3631	3050	1652	1030	645	411	269	243	200	135	114	58
	GT12-155F	5625	4726	2560	1596	999	642	416	748	310	209	177	90
	GT12-200M	7262	6100	3305	2060	1290	822	538	486	399	270	227	116
10.50V	GT12-100F	3332	2840	1602	1047	640	409	267	240	197	133	112	56
	GT12-155F	5163	4400	2482	1592	992	635	414	378	305	206	173	86.7
	GT12-200M	6664	5681	3204	2093	1281	818	534	480	395	267	224	113
10.80V	GT12-100F	3002	2592	1533	1026	594	400	259	237	195	130	108	54
	GT12-155F	4652	4016	2375	1580	952	627	401	373	300	201	167	83.6
	GT12-200M	6005	5184	3067	2052	1188	800	518	474	391	259	216	108
11.10V	GT12-100F	2664	2353	1476	999	555	390	255	234	193	127	106	52
	GT12-155F	4128	3645	2287	1547	860	589	395	369	299	197	164	80.5
	GT12-200M	5328	4706	2952	1998	1110	78—	510	468	387	255	213	105
11.40V	GT12-100F	2280	2075	1390	980	513	380	250	228	191	123	98	50
	GT12-155F	3533	3215	2154	1518	795	542	387	359	295	190	151	77
	GT12-200M	4560	4150	2781	1961	1026	760	500	456	383	246	196	100

Explanation for Table 2-3: GT12-200M discharge for 1min End voltage is 9.60V, the discharge power is 7430W.

6. Internal resistance and short circuit current

The internal resistance of the battery is a dynamic nonlinear parameter that is continuously changed along with the temperature and discharge state. The internal resistance is the lowest when battery is fully charged. The table 2-4 shows the internal resistance and short circuit current of Narada battery in fully charged state according to the DL/T 637-1997 standard of Chinese Electric Power Department.

Table 2-4. Internal resistance and short circuit current (25C)

Type	Internal resistance (mOhm)	Short circuit current (A)
GT12-100F	4.88	2534
GT12-155F	3.87	3883
GT12-200M	2.80	4200

Note: Short circuit current will decrease the voltage of the battery to 0V, and damage the internal components of the battery.

Chapter Three Installation

1. Installation Mode and Occupied Area of Battery Group

Table 3-1 Installation Mode and Occupied Area of F & M series

Type	Installation Mode			
	Layer(s)	Voltage (V)	Total WT (Kg)	Occupied Area LxWxH(mm^3)
GT12-100F	1	48	178	558x500x250
	4	220	802	558x500x1500
GT12-155F	1	48	240	558x500x417
	4	220	1022	558x500x1800
GT12-200M	1	48	330	1186x601x417
	4	220	1481	1450x601x1670

*Total weight and occupied area are for reference only

2. Installation Drawings

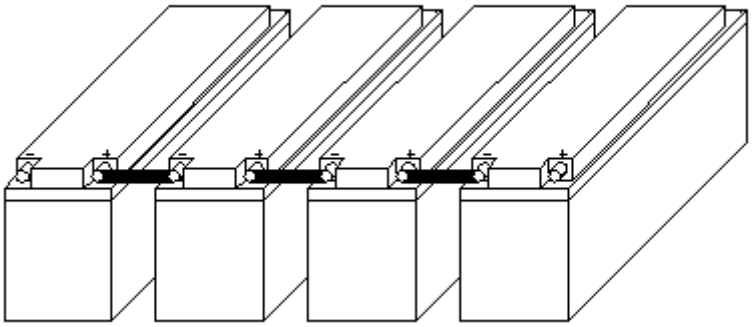


Fig.3-1 GT12-100F,GT12-155F / 48V System

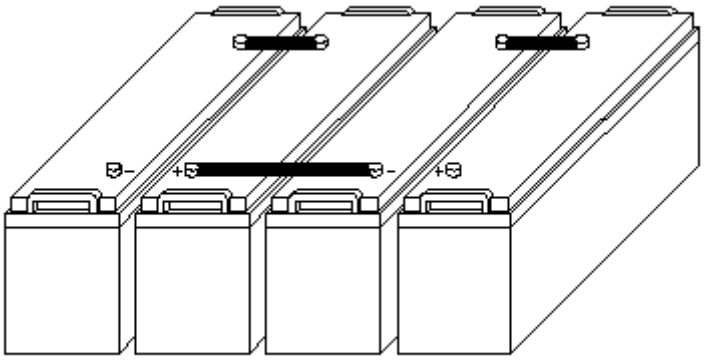


Fig. 3-2 GT12-200M/48V System

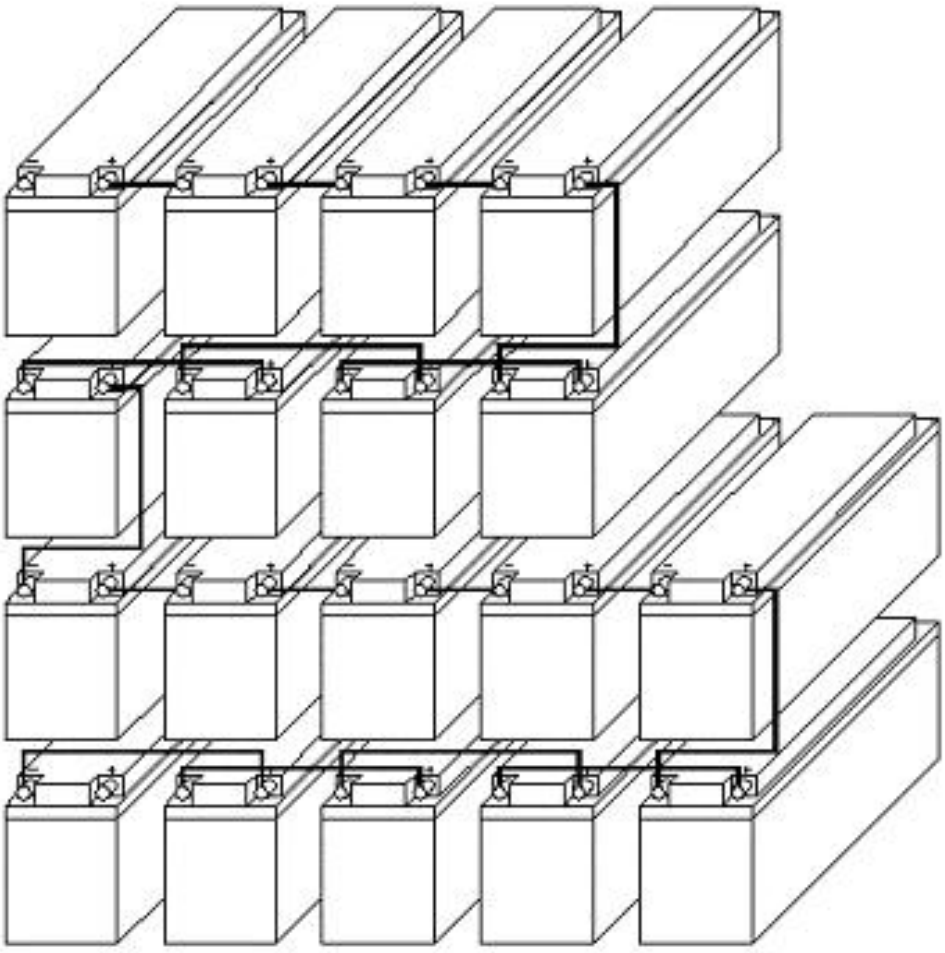


Fig.3-3　GT12-100F,GT12-155F / 220V GT12-200M/220V System

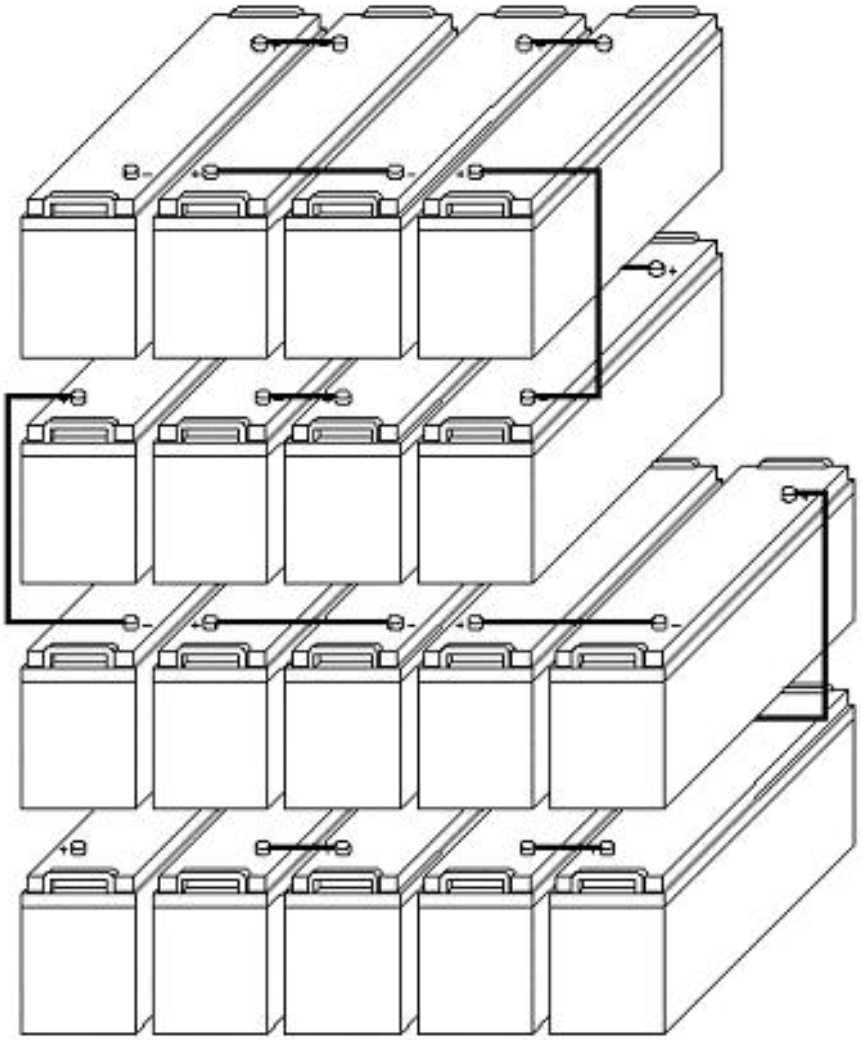


Fig.3-4 GT12-100M/220V System

3. Installation Precautions

-- Please make the installation according to the drawing strictly.
-- Do not connect the batteries of different capacity or different performance
-- Use insulting instruments in installation.
-- Do not use large torque to connect the battery. The torque shall not be larger than 20Nm
-- Do not install abnormal batteries.
-- The batteries are sealed, so there is no danger under normal conditions. If the batteries are broken during transportation, and the skin contact with the acid, please wash immediately with large amount of water and send the injury to hospital.
-- Please install the battery near the load, as near as possible to avoid any voltage-drop increase.
-- Check again the total voltage, positive and negative voltage to ensure that installation is correct when the installation is finished.

Chapter Four Operation

1. Condition

1.1 The battery can be used at ambient temperature of-15C~50C. The best temperature is 20C~25C.

1.2 The reference parameter for switch is:

Table 4-1 The reference parameter for switch

Parameter	220V/18 units	48V/4 units
*Float Voltage(V) (25C)	243	54
Equalization Charge Voltage(V)	253.8	56.4
Equalization Charge Period	3 month or voltage of one of battery in the group is lower than 13.1V	
Current for equalization charge transfer to float charge(A)	$0.005C_{10}$	
*Limited Current(A)	$=<0.2C_{10}$(can raise to $0.3C_{10}$ in some special occasions)	

* The float voltage is at 25C. Please refer to table 4-2 for parameter at other temperatures

* Limited current means output current of switch minus current which the communication equipment needs.

2.Floating Operation

2.1 Gaston battery can be either floating used or cycle used.

2.2 Floating voltage shall be adjusted according to ambient temperature, see Table 4-2:

Table 4-2 Floating Voltage VS. Ambient Temperature

Ambient Temperature (C)	Floating Voltage (V/unit)	48V system/4 units	220V system/18 units
0~10	13.98	55.9	251.6
11~15	13.80	55.2	248.4
16~20	13.62	54.5	245.2
21~25	13.50	54.0	243.0
26~30	13.38	53.5	240.8
31~35	13.26	53.0	238.7
36~40	13.14	52.6	236.5

2.3 The best ambient temperature of floating operation is 21~25C. At this temperature, the batteries are under full charged condition and the life can be 10 years. However, if the floating voltage is lower than the reference value, the batteries are not under full charged condition, thus the capacity will be decrease even under normal temperature (21~25C). Sometimes the decrease cannot be recovered. Otherwise, if the floating voltage is higher than the reference value, it will also decrease the life. Please see following table:

Table 4-3 Floating Voltage VS Life

Floating Voltage used for a long period	The percentage to shorten the life of battery
13.32~13.68V/unit	0%
13.74~14.10V/unit	50%
14.16~14.40V/unit	75%

3. Equalization Charge

Equalization charge is somewhat different with floating charge. The charge voltage is different. The voltage of equalization charge is higher than that of floating charge. The battery need an equalization charge in the following conditions:

--After installation of the battery system, the batteries need to be supplemental charged.

--Floating operation over three months, and the voltage of more than one battery is lower than 13.1V.

--Storage over three months.

--Floating operation for three months.

The method of equalization charge is suggested as follows:

--Charge with 13.80V–14.41V/unit for 24 hours.

Note: Above-mentioned charge time is in the condition that temperature is from 20Cto 25C.If the ambient temperature decreases, it’s better to increase the charge time; otherwise, decrease the charge time. The signal of battery which is full charged is the current keep same for three hours when the voltage is constant.

Chapter Five Maintenance

1.Regulated Maintenance

1.1 Instruments and tools needed:

1.1.1 Digital Voltage Meter

1.1.2 Insulated wrench

1.1.3 Internal resistance, conductive, instant loading experiment instruments

1.2 Monthly Maintenance

- Keep the battery-room clean.
- Measure and record the ambient temperature of the battery-room.
- Check each battery's cleanness, check damage and overheating trace of the terminal, container and lid.
- Measure and record the total voltage and floating current of the battery system.

1.3 Quarterly Maintenance

- Repeat monthly inspection.
- Measure and record floating voltage of every on-line battery. If more than one battery's voltage is lower than 13.1V after temperature adjustment, the batteries need to be equalization charged. If the problem is still existing after adopting above-mentioned measures, the batteries need yearly maintenance or even three years' maintenance. If all methods are ineffective, please contact us.

1.4 Yearly Maintenance

- Repeat quarterly maintenance and inspection.
- Check whether connectors are loose or not every year.
- Make a discharge test to check with exact load every year, discharge 30-40% of rated capacity.

1.5 Three-year Maintenance

- Make a capacity test every three years and every year after six years' operation. If the capacity of the battery decreases to lower than 80% of rated capacity, the battery should be replaced.

2. Precautions

2.1 Insufficient Charge

If the floating voltage is not set correctly (too low or not amend according to temperature), the battery system will in an insufficient charge state for a long period of time. When the electricity is cut, the battery may not be able to work because the active material is saltilized and the capacity is decreased.

2.2 Over Charge

Please do not neglect the performance of rectify to transfer floating charge to equalization

charge. If the rectify cannot transfer charge modes because of its wrong performance or no adjustment, the battery system is always in an equalization charge state. Thus may cause serious problems for battery, such as water loss, life decrease, heat out of control, deformation, etc.

2.3 Too low or too high temperature

We have mentioned that too low temperature will affect the capacity of battery. While too high temperature will also cause problems, such as water loss, life decrease, heat out of control, deformation, etc.

2.4 Too low end voltage

The end voltage is also an important parameter for battery. The battery shall stop discharge when reach a certain voltage (The normal end voltage is 10.5V, in some special causes, is 9.6V). If the end voltage is too low, it will be difficult to recharge the battery and decrease the charge efficiency, thus reduce the life of battery.

2.5 Do not charge the battery immediately after discharge.

If the battery is put aside without charge for a long time (2 hours above) after discharge, it will affect the capacity and life of the battery. Because some large size PbSO4 will create in the negative which are difficult to transfer to active Pb.