

GASTON

**High Rate(HR)Series
VALVER REGULATED SEAL LEAD ACID
BATTERY**

OPERATION MANUAL

Version:V3.2

GASTON NARADA INTERNATIONAL LTD.

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Security Instructions !

Please read this manual! It provides very important information for security, installation and operation. The information will allow your equipment give a better performance and longer service life.

- Do not try to take apart batteries. The spare parts are not inside the battery. Maintenance works should be done by professionals.
- The replacement should be made or supervised by professionals with suitable protection. The batteries for replacement should be same as the old ones in model and type.
- Warning——Do not smoke or use fire near batteries.
- Warning——Do not use any organic cleanser to clean batteries.
- Warning——Do not put the batteries on fire, or they will explode
- Warning——Do not cut open the batteries. They contain electrolyte which is toxic to skin and eyes.
- Warning——Batteries may cause shock and short. Please remove the watch and jewelry such as rings when replace the battery. Also please operate with insulating tools.

Chapter One Product Introduction

1.Features

1.1 Long life

1.1.1 4BS paste technology

1.1.1 Patented grid alloy

1.2 Reliable Seal Technology

1.2.1 High precise ABS heat heal technology;

1.2.2 The seal recombination efficiency reaches up to 99.0%;

1.2.3 Reliable post seal structure ;

1.2.4 Integrated valve design to ensure precise and reliability.

1.3 Excellent high rate discharge performance

1.3.1 Radiate grid design

1.3.2 Unique Through-the-partition welding design

1.3.3 Special positive & negative paste ratio design

1.4 New Appearance Design

1.4.1 Patented knaggy appearance design

1.4.2 Flexible terminal outlet design

1.4.3 Knocked-down nylon handle design

1.4.4 Concentrated gas outlet device

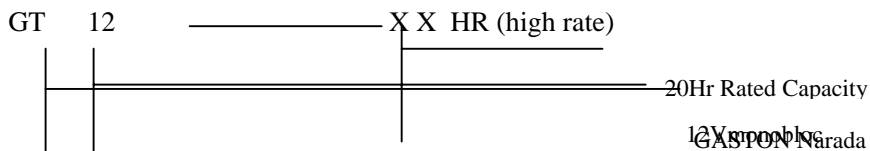
2 Main Applications

2.1 UPS

2.2 Motive Power

3 Indication of Type

Indication of Type



4 Types and Dimensions

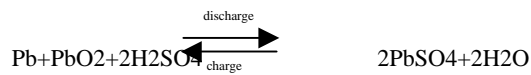
Tab.1-1 Types and Dimensions

Type	Normal	Rated	Rated	Dimnesions(mm)	WT
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				L	W	H	
GT12-33HR	12	33	140	197	132	187	12.5
GT12-50HR	12	50	170	228	139	225	17.5
GT12-55HR	12	54	200	228	139	225	17.5
GT12-75HR	12	75	270	261	173	224	26
GT12-90HR	12	90	310	305	168	212	30
GT12-100HR	12	100	370	341	173	241	36
GT12-134HR	12	134	475	345	172	278	45
GT12-150HR	12	150	515	345	172	278	50.8

7. Working Principal

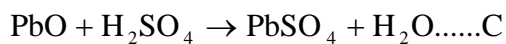
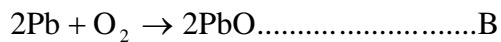
The chemical reaction takes place in lead acid battery is as follows:



Following by-reaction A takes place in ordinary lead acid battery:

This by-reaction makes water loss gradually and pure water need to be added regularly to keep the battery operate normally.

HR battery adopts design of barren-liquor and utilizes AGM (microporous glass fiber) separator. Thus there is a path existing between the positive and the negative. Also special alloy grid is chosen to increase vent hydrogen over-potential gassing on the negative plate, which prevent generation of Hydrogen. Otherwise, the oxygen generated from positive diffuses through separator to the negative and the oxygen gas reacts quickly and is recombined into water. The reactions are as follows B and C:



So it is possible to build HR battery in sealed structure.

Chapter Two Technical Characteristics

1.Discharge Data with Constant Current & Constant Power

Tab.2-1 Discharge Data with Constant Current (A,25C)

End voltage	Type	5 Min	10 Min	15 Min	20 Min	30 Min	40 Min	45 Min	50 Min	1h	1.5h	2h	3h	5h	10h
1.50V	GT12-33HR	106	73.2	59.4	50	38	31	28.5	27	23.4	16.8	14	9.4	6	3.40
	GT12-50HR	137	94.3	90.0	75.8	57.6	47.0	43.2	40.9	35.5	25.5	21.2	14.2	9.09	4.95
	GT12-55HR	177	122	99.0	83.3	63.3	51.7	47.5	45.0	39.0	28.0	23.3	15.7	10.0	5.44
	GT12-75HR	196	137	105	99.0	78.0	62.0	57.5	54.0	49.5	37.8	34.0	23.3	14.8	7.60
	GT12-90HR	291	200	155	129	95.0	76.0	73.0	57.0	54.5	38.2	34.5	24.0	15.0	8.00
	GT12-100HR	342	220	180	149	115	97.0	89.0	85.0	76.0	54.5	43.7	30.1	19.2	10.1
	GT12-134HR	420	295	237	177	147	121	112	103	79.5	60.3	47.8	33.9	23.0	12.8
1.60V	GT12-33HR	106	73.2	58	49	37.5	30.8	28.5	27	23.3	16.8	14	9.30	6.00	3.40
	GT12-50HR	137	94.3	87.9	74.2	56.8	46.7	43.2	40.9	35.3	25.5	21.2	14.1	9.09	4.95
	GT12-55HR	177	122	96.7	81.7	62.5	51.3	47.5	45.0	38.8	28.0	23.3	15.5	10.0	5.44
	GT12-75HR	196	136	105	99.0	77.0	62.0	57.5	54.0	49.5	37.5	34.0	23.3	14.8	7.50
	GT12-90HR	288	197	152	126	93	75.9	72.5	56.5	54.3	38	34.5	24	15	8
	GT12-100HR	320	218	180	148	114	96.0	89.0	84.5	75.0	54.5	43.6	30.0	19.1	10.0
	GT12-134HR	420	278	235	174	146	118	109	101	79.1	59.9	47.3	33.5	22.8	12.7
1.63V	GT12-33HR	105	73	57	48	37	30.6	28.4	27	23.2	16.7	13.9	9.30	5.90	3.30
	GT12-50HR	135	94.0	86.4	72.7	56.1	46.4	43.0	40.9	35.2	25.3	21.1	14.1	8.94	4.80
	GT12-55HR	175	122	95.0	80.0	61.7	51.0	47.3	45.0	38.7	27.8	23.2	15.5	9.83	5.28
	GT12-75HR	195	136	105	99.0	77.0	61.0	57.5	53.5	49.5	37.5	33.9	23.3	14.8	7.50
	GT12-90HR	280	195	150	124	93	75.4	72.3	56.5	54.3	38	34	24	15	8
	GT12-100HR	312	217	177	148	114	96.0	88.7	84.0	75.0	54.5	43.4	29.9	19.0	10.0
	GT12-134HR	420	273	232	174	145	118	109	101	79.1	59.8	47.3	33.5	22.8	12.7
1.65V	GT12-33HR	105	73	55	48	36.5	30.4	28.2	26.4	23.2	16.7	13.9	9.29	5.90	3.30
	GT12-50HR	135	94.0	83.3	72.7	55.3	46.1	42.7	40.0	35.2	25.3	21.1	14.1	8.94	4.80
	GT12-55HR	175	122	91.7	80.0	60.8	50.7	47.0	44.0	38.7	27.8	23.2	15.5	9.8	5.28
	GT12-75HR	194	136	105	99.0	77.0	61.0	57.0	53.5	49.2	37.5	33.8	23.2	14.7	7.50
	GT12-90HR	280	194	150	124	93	75.4	72.3	56.5	54.3	38	34	23.5	15	8
	GT12-100HR	295	217	175	147	113	95.0	88.5	83.5	74.0	54.0	43.3	29.8	18.9	9.9
	GT12-134HR	402	271	232	174	146	118	109	100	79	59	47.3	33.5	22	12.5
1.67V	GT12-33HR	104	72.8	55	47	36	30.4	28	26.4	23.1	16.5	13.8	9.26	5.9	3.2
	GT12-50HR	134	93.8	83.3	71.2	54.5	46.1	42.4	40.0	35.0	25.0	20.9	14.0	8.94	4.65
	GT12-55HR	173	121	91.7	78.3	60.0	50.7	46.7	44.0	38.5	27.5	23.0	15.4	9.8	5.12
	GT12-75HR	192	135	103	98.0	76.0	61.0	57.0	53.5	49.2	37.5	33.7	23.1	14.7	7.40
	GT12-90HR	276	192	150	124	93	75	72.3	56.5	54.3	38	34	23.5	15	8
	GT12-100HR	290	215	173	147	113	94.0	88.3	83.5	74.0	54.0	43.1	29.7	18.9	9.9
	GT12-134HR	350	265	230	174	145	117	108	100	79	59	47	33.5	22	12.5
1.70V	GT12-33HR	104	72.8	54	47	36	30.4	28	26.3	23.1	16.5	13.7	9.24	5.8	3.2
	GT12-50HR	134	93.8	81.8	71.2	54.5	46.1	42.4	39.8	35.0	25.0	20.8	14.0	8.79	4.65
	GT12-55HR	173	121	90.0	78.3	60.0	50.7	46.7	43.8	38.5	27.5	22.8	15.4	9.7	5.12
	GT12-75HR	192	135	103	98.0	76.0	61.0	57.0	53.5	49.2	37.4	33.4	23.0	14.6	7.40
	GT12-90HR	268	170	144	115	90	73	72.1	56.5	54.3	38	34	23.5	15	8
	GT12-100HR	280	213	172	145	113	94.0	88.0	83.0	73.0	53.5	42.8	29.5	18.7	9.8
	GT12-134HR	335	260	233	171	145	117	108	99	79	59	46	33.5	22	12.5
1.75V	GT12-33HR	103	72.6	53.3	47	36	29.7	28	26.2	23.1	16.4	13.6	9.2	5.8	3.2

	GT12-50HR	133	93.5	80.8	71.2	54.5	45.0	42.4	39.7	35.0	24.8	20.6	13.9	8.79	4.65
	GT12-55HR	172	121	88.8	78.3	60.0	49.5	46.7	43.7	38.5	27.3	22.7	15.3	9.7	5.12
	GT12-75HR	190	135	103	97.0	76.0	61.0	57.0	53.5	49.0	37.4	32.8	23.0	14.4	7.30
	GT12-90HR	252	168	144	115	90	73	72.1	56.5	54.3	38	33	23.5	15	8
	GT12-100HR	275	212	170	143	112	91.0	87.0	82.0	72.0	53.0	42.1	29.0	18.5	9.8
	GT12-134HR	321	242	216	168	142	116	107	93.8	78.9	58.1	45.1	32.4	20.9	12.5
	GT12-150HR	360	271	242	188	160	130	120	105	88.3	65	50.5	36.3	23.4	13.4
1.80V	GT12-33HR	98	70	52.8	46.2	35.2	29.4	27.6	25.8	22.5	16.2	13.3	9.2	5.8	3.1
	GT12-50HR	126	90.2	80.0	70.0	53.3	44.5	41.8	39.1	34.1	24.5	20.2	13.9	8.79	4.51
	GT12-55HR	163	117	88.0	77.0	58.7	49.0	46.0	43.0	37.5	27.0	22.2	15.3	9.7	4.96
	GT12-75HR	188	135	103	94.0	75.0	60.0	56.0	52.5	47.0	37.0	31.8	22.5	14.0	7.20
	GT12-90HR	222	162	132	106.5	85	72	68	56.1	51	38	32	23	15	8
	GT12-100HR	250	208	168	140	110	90.0	86.0	80.0	70.0	52.0	41.1	28.5	18.3	9.7
	GT12-134HR	289	227	209	174	138	114	104	83.6	75.9	56.8	44	31.5	20.5	12.5
GT12-150HR	324	255	234	194.7	155	127.5	117	93.6	85	63	49.3	35.3	23	13.4	
1.85V	GT12-33HR	92	66	51	44	34	28.2	27.3	25.5	21.5	15.9	12.9	8.8	5.7	3.1
	GT12-50HR	118	85.0	77.3	66.7	51.5	42.7	41.4	38.6	32.6	24.1	19.5	13.3	8.64	4.32
	GT12-55HR	153	110	85.0	73.3	56.7	47.0	45.5	42.5	35.8	26.5	21.5	14.7	9.5	4.75
	GT12-75HR	175	123	99	90.0	67.5	57.0	55.0	51.5	45.8	36.5	31.0	20.7	14.0	7.10
	GT12-90HR	184	146	120	102.6	77	65.1	62.3	53.6	47.7	38	32	22	15	8
	GT12-100HR	228	200	164	131	103	88.0	82.8	78.0	68.0	50.0	40.0	27.9	18.0	9.7
	GT12-134HR	272	217	202	157	123	105	86.6	81.3	71.5	59.49	41.8	30.3	19.7	12
	GT12-150HR	305	243	226	176	138	118	97	91	80	66.6	46.8	33.9	22.1	12.6

Tab. 2-2 Discharge Data with Constant Power (Watts/Cell,25C)

End voltage	Type	5 Min	10 Min	15 Min	20 Min	30 Min	40 Min	45 Min	50 Min	1h	1.5h	2h	3h	5h	10h
1.50V	GT12-33HR	292	189	145	104	76.2	63	58.8	55.7	46.2	34.2	28.0	20.0	12.9	7.17
	GT12-50HR	301	219	177	143	109	88	83.0	76.8	67.9	49.2	40.3	28.8	18.6	10.3
	GT12-55HR	389	261	205	165	126	102	92.2	85.4	74.6	54.1	44.3	31.7	20.4	11.3
	GT12-75HR	544	370	287	233	182	133	126	116	108	80.8	61.7	50.0	33.7	16.2
	GT12-90HR	641	436	338	279	206	168	153	141	122	94	71	53.5	39	20
	GT12-100HR	751	525	417	357	256	203	186	175	156	114	78.3	58.3	43.5	23.7
	GT12-134HR	756	549	489	364	304	249	231	212	181	135	90.4	68.3	44.3	24.4
	GT12-150HR	790	595	530	395	330	270	250	230	196	146	98	74	48	26.5
1.60V	GT12-33HR	289	186	143	104	75.8	63.0	58.7	55.5	45.8	34	27.9	19.8	12.9	7.10
	GT12-50HR	298	215	175	142	108	88.0	82.7	76.6	67.4	48.9	40.2	28.5	18.5	10.2
	GT12-55HR	385	257	203	165	125	102	91.9	85.1	74.1	53.8	44.2	31.4	20.3	11.2
	GT12-75HR	537	368	284	233	181	132	125	115	108	80.3	61.3	49.7	33.3	16.2
	GT12-90HR	633	434	336	277	205	167	152	140	121	93	70.5	53	38.6	19.5
	GT12-100HR	740	518	405	346	254	201	184	173	154	113	78.2	58.0	43.3	23.7
	GT12-134HR	746	544	484	359.7	299.8	244.4	226	207.5	180	134	89.5	67.8	43.8	24
	GT12-150HR	780	590	525	390	325	265	245	225	195	145	97	73.5	47.5	26
1.63V	GT12-33HR	287	185	142	104	75.7	62.9	58.7	55.4	45.7	33.7	27.9	19.8	12.8	7.07
	GT12-50HR	296	214	174	142	108	87.8	82.8	76.5	67.1	48.5	40.2	28.5	18.5	10.2
	GT12-55HR	383	256	201	165	125	102	92.0	84.9	73.8	53.3	44.2	31.4	20.3	11.2
	GT12-75HR	530	364	282	232	179	131	123	113	106	79.5	60.3	49.2	32.8	16.1
	GT12-90HR	619	430	334	275	205	166	151	139	120	93	70	52.5	38.4	19.2
	GT12-100HR	735	544	403	346	254	201	184	173	153	113	78.0	58.0	43.3	23.5
	GT12-134HR	741	535	479	359.7	299.8	244.4	226	207.5	180	134	89.5	67.8	43.8	24
	GT12-150HR	765	580	520	390	325	265	245	225	195	145	97	73.5	47.5	26

1.65V	GT12-33HR	285	184	141	104	75.4	62.9	58.6	55.3	45.7	33.6	27.8	19.8	12.8	7.07
	GT12-50HR	294	213	173	142	107	87.8	82.6	76.3	67.1	48.4	40.1	28.5	18.4	10.2
	GT12-55HR	380	255	200	164	124	102	91.8	84.8	73.8	53.2	44.1	31.3	20.3	11.2
	GT12-75HR	524	361	279	231	179	130	123	113	106	78.8	60.0	48.8	32.5	16.1
	GT12-90HR	616	427	332	274	205	166	151	139	120	93	70	52.5	38.4	19.2
	GT12-100HR	723	510	400	345	254	201	184	173	153	113	78.0	57.8	43.2	23.5
	GT12-134HR	729	530	479	359.7	299.8	244.4	226	207.5	180	134	89.5	67.8	43.8	24
	GT12-150HR	750	575	520	390	325	265	245	225	195	145	97	73.5	47.5	26
1.67V	GT12-33HR	280	183	140	103	75.0	62.7	58.5	55.2	45.6	33.5	27.7	19.8	12.73	7.00
	GT12-50HR	288	212	171	141	107	87.5	82.5	76.1	67.0	48.2	39.9	28.4	18.3	10.1
	GT12-55HR	373	253	198	163	124	101	91.7	84.6	73.7	53.0	43.9	31.3	20.2	11.1
	GT12-75HR	512	359	270	230	178	129	123	113	106	78.3	59.5	46.3	32.0	16.0
	GT12-90HR	608	423	330	273	205	165	151	139	120	93	70	52.5	38.4	19.2
	GT12-100HR	714	505	397	345	253	201	183	172	153	112	77.8	57.7	43.2	23.3
	GT12-134HR	719	521	475	359.7	299.8	244.4	226	207.5	180	134	89.5	67.8	43.8	24
	GT12-150HR	745	565	515	390	325	265	245	225	195	145	97	73.5	47.5	26
1.70V	GT12-33HR	270	182	139	101	75.0	62.5	58.3	55.0	45.5	33.4	27.7	19.7	12.7	6.92
	GT12-50HR	278	211	170	139	107	87.3	82.3	75.9	66.9	48.1	39.8	28.4	18.2	9.96
	GT12-55HR	360	252	197	160	124	101	91.4	84.3	73.6	52.9	43.8	31.2	20.1	11.0
	GT12-75HR	500	350	268	228	177	128	122	112	105	77.5	58.8	45.7	31.3	15.8
	GT12-90HR	591	415	325	270	203	164	150	138	120	93	70	52.5	38.4	19.2
	GT12-100HR	700	496	390	345	253	200	183	172	152	112	77.7	57.7	43.2	23.2
	GT12-134HR	705	511	438	355.1	299.8	244.4	226	207.5	180	134	89.5	67.8	43.8	24
	GT12-150HR	725	555	475	385	325	265	245	225	195	145	97	73.5	47.5	26
1.75V	GT12-33HR	265	177	137	101	74.7	62.2	57.8	54.5	45.3	33.2	27.5	19.7	12.5	6.87
	GT12-50HR	273	205	168	138	106	86.8	81.5	75.2	66.6	47.7	39.6	28.3	18.0	9.89
	GT12-55HR	353	245	194	160	123	101	90.6	83.6	73.3	52.5	43.5	31.1	19.8	10.9
	GT12-75HR	484	342	265	223	172	127	120	110	103	76.2	58.0	45.0	30.8	15.8
	GT12-90HR	555	397	314	262	199	161	147	136	118	92	69.6	52	38	19
	GT12-100HR	622	475	378	338	245	197	183	172	152	111	77.5	57.5	43.0	23.2
	GT12-134HR	666	479	424	345.9	295.1	239.8	221.4	202.9	175	134	89	67.3	43.3	24
	GT12-150HR	685	515	460	375	320	260	240	220	190	145	96.5	73	47	26
1.80V	GT12-33HR	259	173	135	99	73.7	61.2	57.0	54.0	44.9	33	27.3	19.5	12.3	6.83
	GT12-50HR	267	200	165	136	105	85.4	80.4	74.5	66.0	47.5	39.3	28.1	17.8	9.84
	GT12-55HR	345	239	191	157	122	98.9	89.3	82.8	72.6	52.3	43.3	30.9	19.5	10.8
	GT12-75HR	470	330	263	222	162	125	118	108	103	75.0	56.0	43.3	30.0	15.7
	GT12-90HR	535	375	299	252	184	142	134	123	116	90	67.2	51.5	36	18.8
	GT12-100HR	594	462	369	329	240	196	180	170	150	109	77.2	57.2	42.7	23.0
	GT12-134HR	600	466	410	341.3	285.9	235.2	216.7	198.3	172	131	88.5	66.4	42.9	23.1
	GT12-150HR	615	485	445	370	310	255	235	215	187	142	96	72	46.5	25
1.85V	GT12-33HR	252	168	120	92	72.5	59.3	56.0	52.7	44.3	32.5	26.3	19.2	12.0	6.67
	GT12-50HR	260	194	147	126	103	82.8	79.0	72.7	65.2	46.8	37.9	27.6	17.3	9.60
	GT12-55HR	327	224	152	141	114	91.1	82.5	73.6	68.2	49.3	40.1	28.5	17.7	10.4
	GT12-75HR	420	300	258	210	158	123	117	107	102	73.3	55.0	42.5	28.7	15.0
	GT12-90HR	504	355	283	244	168	130	125	117	113	88	66	50.5	34	18
	GT12-100HR	560	441	358	303	230	187	175	166	146	108	75.3	56.3	41.5	22.7
	GT12-134HR	565	446	397	336	277	226	212	194	168	129	86.7	64.6	41.5	22.1
	GT12-150HR	580	462	430	364	300	245	230	210	182	140	94	70	45	24

2. Charge Characteristics Curve

Fig. 2-1 Recharge characteristics curve of GT12-100HR with initial 0.1C₂₀A current and limit voltage 14.4V/Cell.

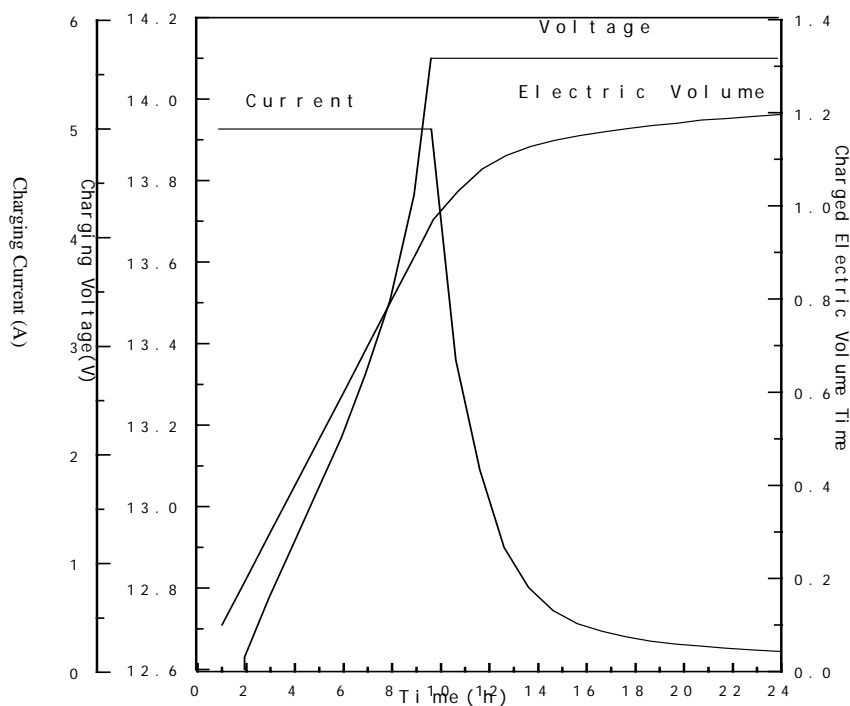


Fig. 2-1 Constant Voltage Limit Current Charge Curve

3 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 2-3 shows the internal resistance and short circuit current in fully charged state

Table 2-3 Internal resistance and short circuit (25C)

Type	Internal Resistance(mOmh)	Short Circuit Current (A)
GT12-33HR	10	1239
GT12-50HR	8.5	1498
GT12-55HR	8.5	1498
GT12-75HR	6.50	1959
GT12-90HR	5.20	2442
GT12-100HR	5.22	2247

GT12-134HR	4.63	2744
GT12-150HR	4.14	3072

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

Chapter Three Operation and Maintenance

1. Operation Condition

Ambient Temperature: -40C~ + 55C (Best temperature 20C~25C)

Ambient Humidity: ≤95%

2.Capacity

2.1 Capacity of battery

The capacity of battery is the capacity that battery can be discharged on the established 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 of HR battery please see Table 1-1. The Actual Capacity is the product of the discharge current and the discharge time, the unit is AH.

2.2 The Influence Factor of the Actual Capacity

The actual capacity is mainly related with the positive and negative active materials and their utilization ratio. The utilization ratio of the materials is mainly influenced by the DOD, the structure of the battery and manufacture technology. In using process the factors that influence the actual capacity are discharge rate, depth of discharge, end voltage and temperature.

2.3 Discharge Rate

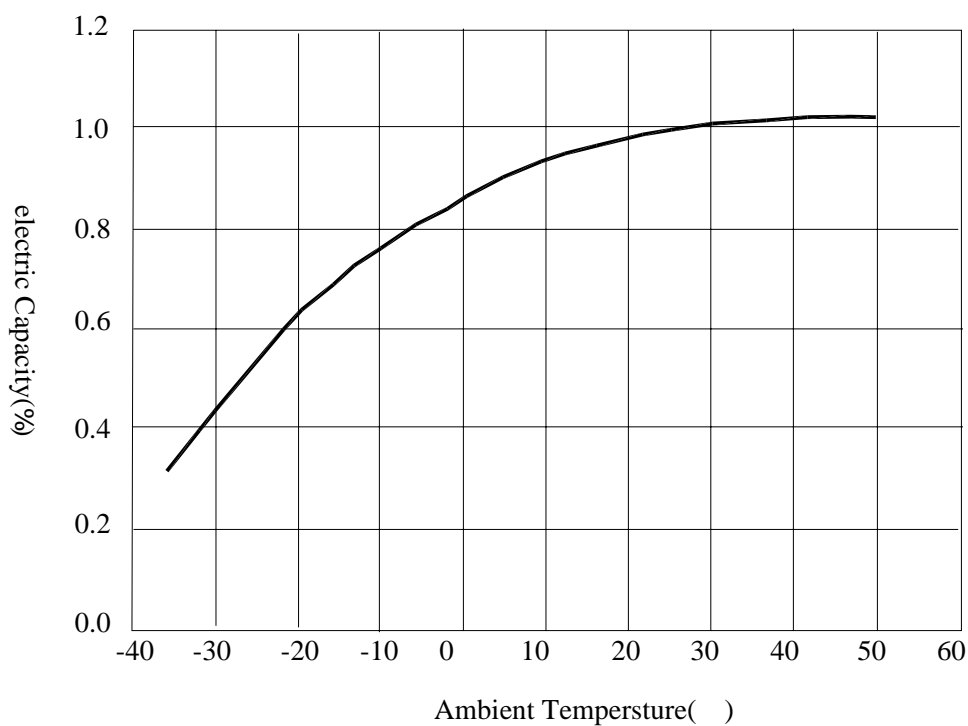
The discharge rate is often described as hour-rate and multiple rates.

If the discharge rate is higher and the discharge current is larger, then the discharge time is shorter, and the capacity which can be discharged is less.

2.4 End voltage

The end voltage is the lowest working voltage below which the battery can't be discharged any more or it will harm the battery. Usually the 20hr rate end voltage of HR battery is 10.5V/block. The batteries are not able to discharge more capacity even if the end voltage is lower because of characteristics of lead acid battery, yet the low end voltage makes great harm to the battery. It will greatly shorten batteries' life especially to discharge the battery to 0V while not to recharge in time. Thus the end voltage should not be lower than what is described in table 3-1, or it will cause over-discharge and make recharge fail after several times of over-discharge.

Table 3-1 Discharge End-voltage



Discharge Current (A)	Discharge End Voltage (V/Cell)
$I < 0.2C$	10.5
$0.2C \leq I < 0.5C$	10.2
$0.5C \leq I < 1.0C$	9.30
$I \geq 1.0C$	7.80

3. Temperature

3.1 Available Capacity Vs. Ambient Temperature

Temperature affects capacity of the battery. Fig. 3-1 is the available capacity curve vs. ambient temperature. if the temperature drops, the capacity will decrease, for example, the capacity will decrease to 80% of rated capacity if temperature decreases from 25 to 0 ; and too low temperature will cause battery long term insufficient charged, also will cause no discharge and negative plates sulfate.

Though VRLA battery can be operated at -15C, the standard data is the test result at 25C.

The capacity will increase when temperature raises. For example the capacity will increase to 102% of rated capacity if temperature increase from 25C to 50C. But it will quicken plates' corrosion and water loss if temperature raises, and shorten battery's life.

Fig.3-1 Available Capacity VS. Ambient Temperature

3.2 Temperature and Floating Voltage

The purpose of choosing proper floating voltage is to make the battery operate in a best condition. If the floating voltage is higher, then the floating current is also higher, it will accelerate corruption of the grid and shorten life of the battery. If the floating voltage is lower, the battery can't be kept in fully charged state, this will crystallize PbSO₄, decrease the capacity, and also shorten the life of the battery.

At 25C, the proper floating voltage for HR series is 13.68V/block. And temperature compensate coefficient is -18mV/C/block.

The formula to calculate float voltage at different temperature:

$$V_T = 13.68 - (T - 25) \times 0.018$$

V_T - Floating charge voltage at T temperature

Table 3-2 Floating charge voltage at different temperature

Ambient Temperature(C)	Floating Voltage(V/Cell)
0	13.73
5	13.72
10	13.71
15	13.70
20	13.69
25	13.68
30	13.67
35	13.66
40	13.65

3.3、 Temperature and equalization charge

VRLA battery needs equalization charge periodically to guarantee normal operation. At 25C, the proper equalization voltage for HR series is 14.4V/block. And temperature compensate coefficient is -30mV/C/block.

The formula to calculate equalization voltage at different temperature:

$$V_T = 14.4 - (T - 25) \times 0.030$$

V_T - Equalization charge voltage at T temperature

3-3 Equalization charge voltage at different temperature

Ambient Temperature(C)	Equalization charge Voltage (V/Cell)
0	15.15
5	15.00
10	14.85
15	14.70
20	14.55
25	14.40
30	14.25
35	14.10
40	13.95

3.4 Ambient Temperature Vs. Battery Life

Higher temperature will harm the battery and reduce battery life. When temperature exceeds 25C, the battery life will decrease half per 10C temperature raise. For example, the designed life of battery at 25C is 5 years, when battery operates at 35C, the actual life is only 2.5 years.

$$t_{25} = t_T \times 2^{(T-25)/10}$$

Notes : T the actual ambient temperature;

t_T is designed life at T ambient temperature

t₂₅ is designed life at 25C ambient temperature

The heat disseminate performance of VRLA battery is bad, it's liable to cause thermal run away when heat accumulates. Please improve ventilation and temperature condition when room temperature is high. The distances between batteries should not be smaller than 10mm. Please also adjust the float voltage and equalization voltage according the manual.

4. Charge and discharge requirements

4.1 Equalization charge

Equalization charge is needed in following conditions:

- a The voltage of at least two batteries are lower than 13.1V
- b Floating operation for more than three months

The method of equalization charge is: First charge the batteries on the constant current of not larger than 0.2C₂₀A till the average voltage of the batteries increases to 14.4v/block(25C), then charge the batteries with constant voltage of 14.4V/block, the time of equalization charge is 24 hours.

4.2 Charge

charge the batteries in following conditions. The method is same as that of equalization charge.

- a After discharge
- b Finish installation
- c Storage time is above three months and open circuit voltage is lower than 12.6V/block.

If battery need to be fully charged as soon as possible, then fast charge method can be adopted: limit current less than 0.3C₂₀A, charge voltage 14.4V/block (25C).

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

a The charge time is 18-24 hours (the charge time can be shortened when the batteries were not deep discharged, e.g., the charge time of 20%DOD batteries can be shortened to 10 hours).

b On condition of constant voltage, the value of charge current hasn't varied for continuous three hours.

5.Storage

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

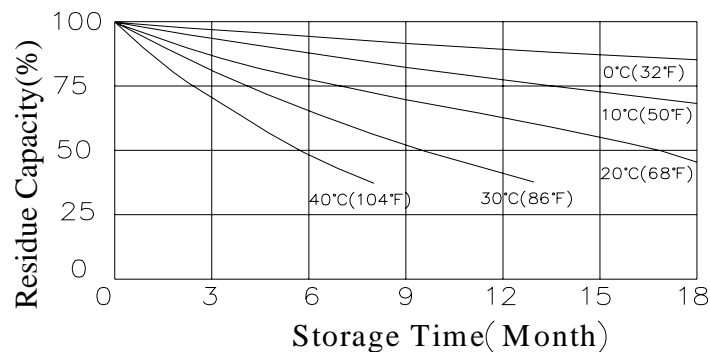
a The self-discharge rate is related with ambient temperature. The self-discharge rate is smaller when the ambient temperature is lower, otherwise is larger. The required temperature of HR batteries' storage environment is from 0C to 35C. The storage place must be clean, ventilated and dry.

b An important parameter in storage is open circuit voltage, which is related with density of the electrolyte. If the open circuit voltage is lower than 12.6V/block, or have been stored for three months, the batteries should be supplementally charged to avoid damage caused by self discharge.

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

d The quality certificates and packages of HR batteries record the latest charge time of the batteries, next charge time can be calculated according to this charge time.

Fig. 3-2 Available Capacity VS. Storage Time at Different Ambient Temperature.



6. Maintenance

In order to assure service life, the batteries should be correctly inspected and maintained. The maintenance methods of HR batteries are recommended as follows

6.1 Monthly Maintenance

Implement following inspection every month:

- 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.

6.2 Quarterly Maintenance

- Repeat monthly inspection.
- Measure and record floating voltage of every on-line battery. If more than two cells' voltage is less than 13.0V after temperature adjustment, the batteries need to be equalization charged. If the problem still exists after adopting above-mentioned measures, the batteries need yearly maintenance or even three years' maintenance. If all methods are ineffective, please contact us.

6.3 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, discharging 30-40% of rated capacity.

6.4 Three-year Maintenance

Make a 80% capacity test every year after three years' operation.

6.5 Operation and Maintenance Precautions

a 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 out, the battery may not be able to work because the acid is saltized and the capacity is decreased.

b 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.

c 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.

d 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 per block at 20h rate). 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.

e Put the battery aside after discharge

If the battery is put aside without charge for a long time 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.

Annex 1

VRLA Battery Regular Maintenance Record

Type		Place	
Test Status		Qty	
Total Voltage(V)	Current (A)	Room Temperature	
No.	Voltage (V)	No.	Voltage(V)
1		13	
2		14	
3		15	
4		16	
5		17	
6		18	
7		19	
8		20	
9		21	
10		22	

11		23	
12		24	
Check by sight			