VRLA BATTERY

2V GEL Series handbook

CCB Industrial Battery Co., Ltd.
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www.ccbbattery.com

Content

Safety and warning

Please read this manual! It provides very important direction for fix and operation, which can make best capability for the equipment, and elongate the using life.

- For your safety, please do not try to open it, equipment does not contain spare part. The maintain work can only be done by our trained woke servitors
- As a result of the battery's latent endanger to heath and environment, they should be only changed in our authorization service center. If you need to change the battery or maintain the equipment, please call the nearest service center.
- Batteries can be reclaimed, if it could not be carefully handled, it would bring a lot of endangers to environment and heath. Please check laws to get the validity ways or send the equipment to service center.
- The changer of battery can only be done by person who knows well about the danger and the prevention. When changing the battery, please use the same model and type sealed lead acid battery.

⚠ Warning—do not smoke or use fire near batteries。

⚠ Warning—do not use organic solvent to wash batteries

⚠ Warning—dot not put batteries into the fire, or it may bombed。

⚠ Warning—do not open batteries, it contains electrolyte, which can hurt the skin and eyes。

Please take care of the following marks in using

				
Warning	Electricity danger	Protecting your eye	Watch Short-circuits	With adults custody
				
Read the manual	Fire forbidden	Circle use	Do not put batteries into dustbin	The product has past the UL Safe authentication

Chapter One Introduction to the Product

The CCB GEL-2V range of gel technology batteries offers outstanding performance including a 15+ years design life .The CCB GEL-2V series batteries is designed based on the Eos series. Using the polymer gel electrolyte . Built to the highest standards and compliant with the latest IEC60896-21/22 standard .This range also offers 100% capacity out-of-the-box and is capable of handling deep discharges for complete peace of mind. The use of flexible connectors and the ability to be installed both horizontally and vertically allows for multiple installation possibilities.

1. Product Characters:

- Design life is above 20 years in float application and cycle life is above 1500 times in 80% DOD (Depth of Discharge) term

  Grid alloy with special patented formula
  Special patented negative paste formula

  4BS paste technology

  Extra-thick plate design

- Reliable seal performance, no acid spillage, recombination efficiency reach 99.9%
  Patented post sealing structure

  “Labyrinth” patented security valve

  High precise ABS sealing technology

- Initial capacity above 100%, the remaining capacity above 94% when storage for 3 months (25ºC)

- Remarkable high rate discharge performance. Low internal resistance

Patented grid design. Large section copper structure

- Supply the Unique flexible connectors made of rubber wrapped with copper wires with Patented silver-coated ends and another option is copper bar connector.

Assure the good connections of post and connectors and low connection resistance

Combination of suppleness and rigidity for more flexible connections

Monitor hole designed

- Flexible and convenient installation, slinky outside looking

Shockproof blocking assembling

Satisfy customer’s individual requirements and provide up to 8-class shockproof

Streamline and dime-light battery outside-looking design.

2. Main application domain

- Correspondence exchange and transmission system
- Mobile communication system
- Power plant and power transformer system
- Navigation aid signaling system
- Solar energy system
- Radio and broadcasting station
- Emergency lighting system
- Other spare, circulatory system

3. Construction

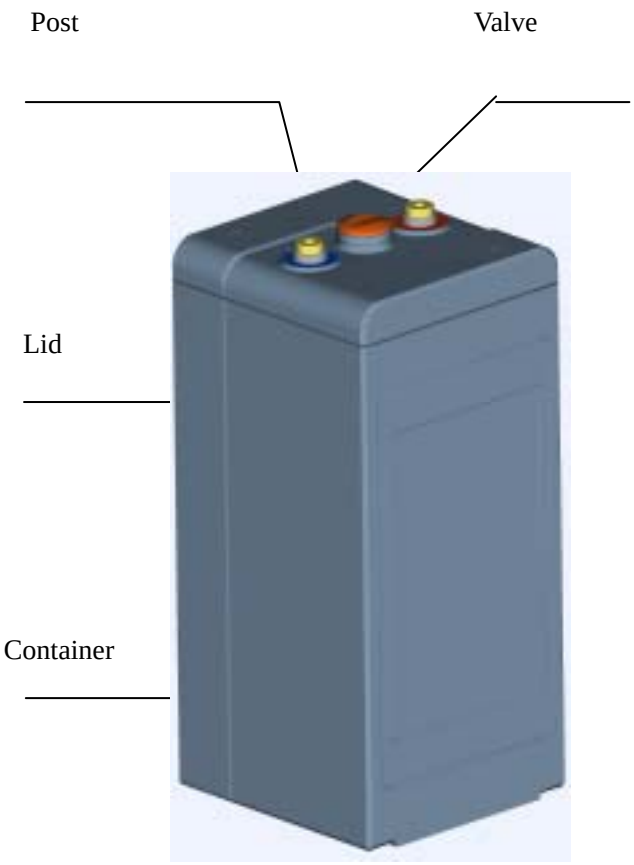


Fig. 1-1 Construction

4. Types and Dimensions

Table 1-1 type specifications

Cell Type	Rated Voltage (V)	Rated Capacity (Ah)			Dimensions (mm)				Weight (Kg)
		C_{10}	C_3	C_1	Length	Width	Height	Overall Height	
GEL-2V 200	2	200	150	110	94.5	184.5	360.5	372	14.5
GEL-2V 300	2	300	225	165	123	184.5	360.5	372	19.4
GEL-2V 400	2	400	300	220	166	184.5	360.5	372	26.5
GEL-2V 500	2	500	375	275	194.5	184.5	360.5	372	31.3
GEL-2V 600	2	600	450	330	223	184.5	360.5	372	37.5
GEL-2V 800	2	800	600	440	154	229	555	566	52.7
GEL-2V 1000	2	1000	750	550	186	229	555	566	62.8
GEL-2V 1500	2	1500	1125	825	265.5	229	555	566	93
GEL-2V 2000	2	2000	1500	1100	349	233	555	566	122

5. Working Principal

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

$$Pb+PbO_2+2H_2SO_4 \underset{\text{Charge}}{\overset{\text{Discharge}}{\rightleftharpoons}} 2PbSO_4+2H_2O$$

Following by-reaction ① takes place in ordinary lead acid battery:

$$2H_2O \longrightarrow 2H_2\uparrow+O_2\uparrow \qquad ①$$

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

CCB GEL-2V battery adopts design of barren-liquor and utilizes AGM (micro porous 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 prevents 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：

$$2Pb+O_2 \longrightarrow 2PbO \qquad ②$$

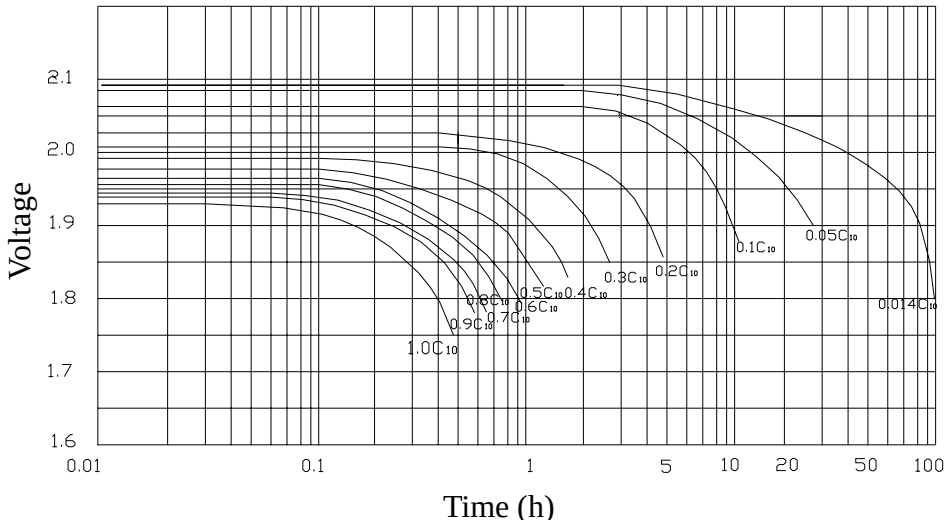
$$PbO+H_2SO_4 \longrightarrow PbSO_4+H_2O \qquad ③$$

So it is possible to build CCB GEL-2V battery in sealed structure.

Chapter Two Technical characteristic

1.Discharge Curve

Fig. 2-1 Discharge Performance Curves at Different Discharge Rates（25℃）



2.Charge Curve

Fig.2-2 recharge characteristics of 100% DOD CCB GEL-2V500 battery with current of $0.1C_{10}A$ and limit voltage of 2.35V/Cell (25°C)

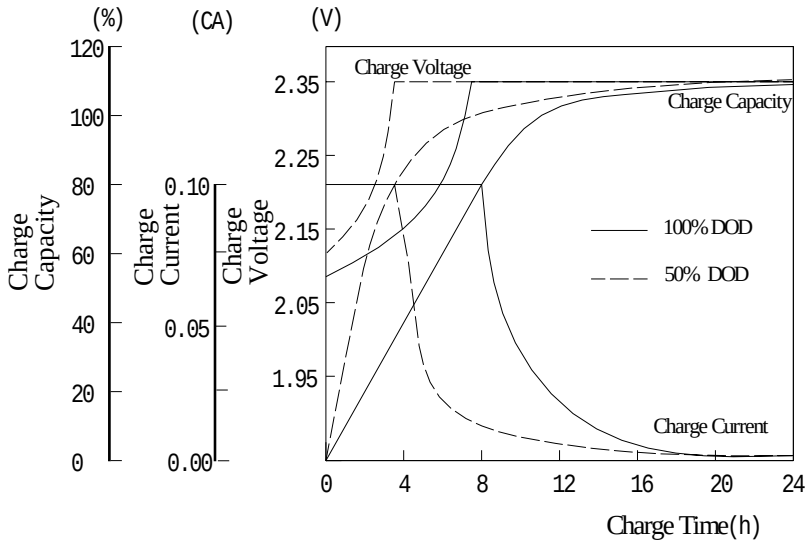


Table2-1 Constant current discharge characteristic (25℃)

CCB GEL-2V200																
End voltage per cell	5min	10min	15min	30min	1hr	1.5hr	2hr	3hr	4hr	5hr	6hr	8hr	10hr	12hr	24h	48hr	100hr
1.60V	418	309	282	209	132	97	77.9	57.2	45.9	38.8	33.5	26.7	22.2	18.7	10	5.05	2.7
1.65V	405	286	263	200	125	93	76.1	55.8	44.7	37.8	33	26.3	21.9	18.5	9.9	5.01	2.66
1.70V	385	266	246	184	120	90	73.3	54.2	44.1	37.5	32.6	25.8	21.6	18.3	9.9	4.97	2.62
1.75V	358	253	233	171	114	86	70.8	52.5	42.9	36.5	32.1	25.5	21.3	18	9.8	4.91	2.55
1.80V	322	240	220	160	107	81	67.7	50.9	41.4	35.6	31.3	25	20.8	17.6	9.6	4.83	2.47
1.85V	274	213	195	143	96	73	61.1	48.3	40.1	34.4	30.3	24.3	20.2	17.2	9.3	4.71	2.39
1.90V	213	182	165	122	86	69	57.3	45.3	38.3	33.1	29.1	23.4	19.6	16.7	9.1	4.58	2.28
CCB GEL-2V300																	
End voltage per cell	5min	10min	15min	30min	1hr	1.5hr	2hr	3hr	4hr	5hr	6hr	8hr	10hr	12hr	24h	48hr	100hr
1.60V	505	463	423	313	198	145	116.9	85.8	68.8	58.2	50.2	40	33.2	28.1	15	7.57	4.05
1.65V	467	429	394	300	188	140	114.2	83.7	67	56.7	49.5	39.5	32.9	27.8	14.9	7.51	3.99
1.70V	436	399	370	276	179	134	110	81.3	66.1	56.3	48.9	38.8	32.4	27.5	14.8	7.45	3.93
1.75V	416	379	350	256	171	130	106.2	78.7	64.3	54.7	48.1	38.3	31.9	27.1	14.7	7.36	3.83
1.80V	400	360	330	240	160	122	101.6	76.3	62.2	53.4	46.9	37.6	31.2	26.4	14.4	7.24	3.7
1.85V	354	319	293	214	145	110	91.7	72.4	60.2	51.6	45.4	36.5	30.4	25.8	13.9	7.07	3.58
1.90V	304	273	247	184	128	103	86	67.9	57.4	49.7	43.7	35.1	29.3	25.1	13.6	6.87	3.41
CCB GEL-2V400																	
End voltage per cell	5min	10min	15min	30min	1hr	1.5hr	2hr	3hr	4hr	5hr	6hr	8hr	10hr	12hr	24h	48hr	100hr
1.60V	673	617	564	418	264	194	155.9	114.4	91.8	77.6	66.9	53.4	44.3	37.4	20	10.1	5.41
1.65V	622	571	526	400	250	186	152.3	111.6	89.4	75.7	66	52.7	43.8	37	19.9	10.02	5.32
1.70V	581	533	493	368	239	179	146.7	108.4	88.2	75	65.2	51.7	43.2	36.6	19.8	9.94	5.24
1.75V	554	506	467	342	228	173	141.5	105	85.8	72.9	64.1	51.1	42.6	36.1	19.6	9.81	5.1
1.80V	533	480	440	320	214	163	135.5	101.8	82.9	71.3	62.5	50.1	41.6	35.2	19.2	9.65	4.94
1.85V	472	426	390	285	193	147	122.2	96.6	80.2	68.8	60.5	48.7	40.5	34.4	18.6	9.43	4.78
1.90V	406	364	330	245	171	137	114.6	90.6	76.5	66.3	58.3	46.8	39.1	33.4	18.2	9.16	4.55

CCB GEL-2V500

End voltage per cell	5min	10min	15min	30min	1hr	1.5hr	2hr	3hr	4hr	5hr	6hr	8hr	10hr	12hr	24h	48hr	100hr
1.60V	842	771	705	522	330	242	194.9	143	114.7	97	83.7	66.7	55.4	46.8	24.9	12.62	6.76
1.65V	778	714	657	500	313	233	190.4	139.5	111.7	94.6	82.6	65.8	54.8	46.3	24.8	12.52	6.65
1.70V	727	666	616	460	299	224	183.3	135.5	110.2	93.8	81.5	64.6	54	45.8	24.7	12.42	6.55
1.75V	693	632	583	427	285	216	176.9	131.2	107.2	91.2	80.2	63.8	53.2	45.1	24.4	12.27	6.38
1.80V	666	600	550	400	267	203	169.3	127.2	103.6	89.1	78.1	62.6	52	44	24	12.07	6.17
1.85V	590	532	488	357	241	183	152.8	120.7	100.3	86.1	75.6	60.8	50.6	43	23.2	11.79	5.97
1.90V	507	455	412	306	214	171	143.3	113.2	95.7	82.9	72.8	58.5	48.9	41.8	22.7	11.46	5.69

CCB GEL-2V600

End voltage per cell	5min	10min	15min	30min	1hr	1.5hr	2hr	3hr	4hr	5hr	6hr	8hr	10hr	12hr	24h	48hr	100hr
1.60V	1010	926	846	626	396	290	233.8	171.6	137.7	116.4	100.4	80.1	66.5	56.1	29.9	15.15	8.11
1.65V	933	857	788	600	376	280	228.4	167.4	134.1	113.5	99.1	79	65.8	55.5	29.8	15.03	7.99
1.70V	872	799	739	552	359	269	220	162.5	132.2	112.5	97.7	77.5	64.8	54.9	29.7	14.9	7.86
1.75V	831	758	700	513	342	259	212.3	157.5	128.6	109.4	96.2	76.6	63.8	54.1	29.3	14.72	7.65
1.80V	799	720	660	480	320	244	203.2	152.7	124.3	106.9	93.8	75.1	62.4	52.8	28.9	14.48	7.41
1.85V	708	638	585	428	289	220	183.3	144.9	120.3	103.3	90.8	73	60.7	51.6	27.9	14.14	7.16
1.90V	609	546	495	367	257	206	171.9	135.9	114.8	99.4	87.4	70.2	58.7	50.1	27.3	13.75	6.83

CCB GEL-2V800

End voltage per cell	5min	10min	15min	30min	1hr	1.5hr	2hr	3hr	4hr	5hr	6hr	8hr	10hr	12hr	24h	48hr	100hr
1.60V	1170	1070	984	800	527	404	324.6	238.3	187.6	155.8	134.3	105.1	87	74	40.3	20.2	10.81
1.65V	1097	1000	927	730	498	382	315.4	231.9	184.7	153.9	132.6	104.2	86.6	73.5	39.8	20.04	10.65
1.70V	1031	948	877	667	473	364	304.6	221.5	178.3	150	129.4	102.7	85.2	72.9	39.6	19.87	10.49
1.75V	973	898	825	615	446	350	293.4	216.4	174.5	147.5	127.5	101.3	84.5	72.5	39.2	19.63	10.2
1.80V	919	841	770	576	424	336	284.5	211.6	171.5	144.1	125	99.4	83.4	71.7	38.4	19.3	9.88
1.85V	789	715	655	506	374	301	256.5	194.1	158.6	135.1	118.2	95.4	80	68.5	37.3	18.86	9.55
1.90V	646	577	517	421	310	251	214.4	173.4	144	122.3	107.3	86.5	72.9	63.3	34.8	18.33	9.1

CCB GEL-2V1000

End voltage per cell	5min	10min	15min	30min	1hr	1.5hr	2hr	3hr	4hr	5hr	6hr	8hr	10hr	12hr	24h	48hr	100hr
1.60V	1462	1338	1230	1000	659	505	405.8	297.9	234.4	194.8	167.8	131.4	108.8	92.5	50.4	25.25	16.22
1.65V	1371	1250	1158	912	622	477	394.2	289.9	230.9	192.4	165.8	130.2	108.2	91.8	49.7	30.05	15.97
1.70V	1289	1185	1096	834	591	455	380.7	276.9	222.9	187.6	161.8	128.4	106.5	91.1	49.5	29.81	15.73
1.75V	1216	1122	1032	769	558	437	366.7	270.5	218.2	184.3	159.4	126.6	105.6	90.7	49.1	29.44	15.3
1.80V	1149	1051	962	720	530	420	355.7	264.5	214.4	180.1	156.3	124.2	104.2	89.7	48	28.96	14.81
1.85V	986	893	818	633	468	376	320.6	242.6	198.2	168.8	147.8	119.2	99.9	85.7	46.6	28.29	14.33
1.90V	808	722	646	526	387	314	268	216.7	180	152.9	134.1	108.1	91.1	79.1	43.5	27.49	13.66

CCB GEL-2V1500

End voltage per cell	5min	10min	15min	30min	1hr	1.5hr	2hr	3hr	4hr	5hr	6hr	8hr	10hr	12hr	24h	48hr	100hr
1.60V	2194	2007	1846	1500	988	757	608.6	446.8	351.7	292.1	251.7	197.1	163.2	138.8	75.6	37.87	20.27
1.65V	2057	1875	1737	1368	933	715	591.4	434.8	346.4	288.5	248.7	195.4	162.3	137.8	74.5	37.57	19.96
1.70V	1933	1778	1644	1251	886	682	571.1	415.3	334.4	281.3	242.7	192.5	159.7	136.6	74.2	37.26	19.66
1.75V	1824	1683	1547	1153	837	656	550	405.8	327.2	276.5	239.1	189.9	158.4	136	73.6	36.8	19.13
1.80V	1723	1577	1443	1080	795	630	533.5	396.7	321.6	270.2	234.4	186.3	156.3	134.5	72	36.2	18.52
1.85V	1479	1340	1228	949	702	564	480.9	363.9	297.4	253.2	221.7	178.8	149.9	128.5	69.9	35.36	17.91
1.90V	1211	1083	969	789	580	471	402	325.1	270	229.3	201.1	162.1	136.6	118.6	65.3	34.37	17.07

CCB GEL-2V2000

End voltage per cell	5min	10min	15min	30min	1hr	1.5hr	2hr	3hr	4hr	5hr	6hr	8hr	10hr	12hr	24h	48hr	100hr
1.60V	2925	2676	2461	2000	1318	1010	811.5	595.8	468.9	389.5	335.6	262.7	217.6	185	100.9	50.5	27.03
1.65V	2743	2500	2316	1824	1244	954	788.5	579.8	461.9	384.7	331.6	260.5	216.4	183.7	99.4	50.09	26.62
1.70V	2578	2371	2192	1668	1182	910	761.4	553.7	445.8	375.1	323.6	256.7	213	182.2	99	49.68	26.21
1.75V	2431	2245	2063	1538	1116	875	733.4	541	436.3	368.7	318.8	253.2	211.2	181.3	98.1	49.07	25.5
1.80V	2297	2102	1924	1440	1060	840	711.3	529	428.8	360.3	312.6	248.5	208.4	179.3	96	48.26	24.69
1.85V	1972	1787	1637	1266	936	752	641.2	485.2	396.5	337.6	295.6	238.4	199.9	171.3	93.3	47.14	23.88
1.90V	1615	1443	1292	1052	774	627	536	433.5	360.1	305.8	268.2	216.2	182.1	158.1	87.1	45.82	22.76

Table2-2 discharge data with constant power (25℃)

CCB GEL-2V200														
End voltage per cell	5MIN	10MIN	15MIN	30MIN	1HR	1.5HR	2HR	3HR	4HR	5HR	6HR	8HR	10HR	12HR	24HR
1.60V	580	531	485	387	273	213	176	130.6	104.2	86.3	73.7	57.6	47	39.6	21.2
1.65V	551	506	466	366	253	197	162	122.6	98.8	83.3	71.3	55.5	45.9	38.8	20.8
1.70V	530	485	449	356	240	189	157	118.2	95.5	81.4	69.9	54.3	44.5	37.7	20.4
1.75V	513	469	432	344	231	183	152	113.9	93.5	79.4	68.3	52.3	43.9	37.1	20.2
1.80V	499	450	412	332	226	179	149	109.9	90.4	77.2	66.3	50.9	43.2	36.6	19.9
1.85V	454	409	375	295	205	166	137	104	87	73.6	62.8	49.2	41.5	35.3	19.1
1.90V	401	359	326	249	177	142	119	96.5	81	68.7	58.7	46.1	38.5	32.8	17.9
CCB GEL-2V300															
End voltage per cell	5MIN	10MIN	15MIN	30MIN	1HR	1.5HR	2HR	3HR	4HR	5HR	6HR	8HR	10HR	12HR	24HR
1.60V	869	797	728	580	410	320	265	195.9	156.3	129.4	110.5	86.4	70.5	59.4	31.8
1.65V	827	760	699	548	379	296	243	183.9	148.2	124.9	107	83.2	68.9	58.2	31.2
1.70V	795	728	674	535	361	283	236	177.4	143.2	122.1	104.9	81.4	66.8	56.6	30.6
1.75V	770	703	649	517	347	275	227	170.8	140.2	119.1	102.5	78.4	65.8	55.6	30.3
1.80V	749	675	618	498	339	268	223	164.8	135.7	115.8	99.5	76.4	64.8	54.8	29.8
1.85V	681	614	563	443	308	249	205	156.1	130.4	110.3	94.2	73.9	62.3	53.0	28.6
1.90V	601	539	489	374	265	213	178	144.7	121.4	103.1	88	69.1	57.8	49.2	26.8
CCB GEL-2V400															
End voltage per cell	5MIN	10MIN	15MIN	30MIN	1HR	1.5HR	2HR	3HR	4HR	5HR	6HR	8HR	10HR	12HR	24HR
1.60V	1159	1063	971	773	547	427	353	261.3	208.3	172.6	147.4	115.2	94.1	79.4	42.4
1.65V	1103	1013	932	731	505	395	324	245.2	197.6	166.5	142.7	110.9	91.8	77.5	41.6
1.70V	1060	971	899	713	481	378	314	236.5	190.9	162.8	139.9	108.5	89.1	75.5	40.8
1.75V	1027	937	865	689	462	366	303	227.8	186.9	158.8	136.7	104.5	87.8	74.4	40.4
1.80V	999	900	824	664	452	358	297	219.7	180.9	154.3	132.6	101.8	86.4	73.1	39.8
1.85V	908	819	751	591	411	332	273	208.1	173.9	147.1	125.6	98.5	83.1	70.6	38.2
1.90V	801	718	652	498	354	285	237	192.9	161.9	137.5	117.4	92.1	77	65.8	35.8

CCB GEL-2V500															
End voltage per cell	5MIN	10MIN	15MIN	30MIN	1HR	1.5HR	2HR	3HR	4HR	5HR	6HR	8HR	10HR	12HR	24HR
1.60V	1449	1328	1214	966	683	533	441	326.6	260.4	215.7	184.2	144	117.6	99.3	53
1.65V	1378	1266	1165	914	631	493	404	306.5	247	208.2	178.4	138.7	114.8	97.0	52
1.70V	1325	1214	1123	891	601	472	393	295.6	238.7	203.5	174.8	135.7	111.4	94.5	51
1.75V	1284	1171	1081	861	578	458	379	284.7	233.6	198.5	170.8	130.6	109.7	93.0	50.5
1.80V	1248	1125	1030	830	564	447	372	274.7	226.1	192.9	165.8	127.3	108	91.4	49.7
1.85V	1135	1024	939	738	513	415	342	260.1	217.4	183.9	157	123.1	103.8	88.2	47.7
1.90V	1002	898	814	623	442	356	296	241.2	202.4	171.8	146.7	115.2	96.3	82.3	44.7
CCB GEL-2V600															
End voltage per cell	5MIN	10MIN	15MIN	30MIN	1HR	1.5HR	2HR	3HR	4HR	5HR	6HR	8HR	10HR	12HR	24HR
1.60V	1739	1594	1456	1160	820	640	529	391.9	312.5	258.8	221.1	172.8	141.1	119.0	63.6
1.65V	1654	1519	1398	1097	758	592	485	367.8	296.4	249.8	214	166.4	137.7	116.1	62.4
1.70V	1590	1456	1348	1069	721	567	471	354.7	286.4	244.2	209.8	162.8	133.6	113.2	61.2
1.75V	1540	1406	1297	1033	693	550	455	341.6	280.4	238.1	205	156.8	131.6	111.6	60.6
1.80V	1498	1350	1237	997	677	537	446	329.6	271.3	231.5	199	152.7	129.6	109.7	59.7
1.85V	1362	1228	1126	886	616	498	410	312.1	260.9	220.7	188.4	147.7	124.6	105.9	57.3
1.90V	1202	1078	977	747	531	427	356	289.4	242.9	206.2	176	138.2	115.6	98.7	53.7
CCB GEL-2V800															
End voltage per cell	5MIN	10MIN	15MIN	30MIN	1HR	1.5HR	2HR	3HR	4HR	5HR	6HR	8HR	10HR	12HR	24HR
1.60V	2014	1843	1695	1401	1014	791	645	478.3	385.9	325.6	286.2	233.1	192.9	164.1	84.8
1.65V	1945	1773	1642	1347	982	756	618	466.3	377.8	317.5	279.8	227.9	188.1	159.6	83.2
1.70V	1880	1729	1599	1302	945	720	593	456.6	368.2	311.1	273.3	224.3	186.5	159.6	81.6
1.75V	1803	1664	1530	1224	891	678	568	447.8	361.7	305.5	265.3	219.5	184.9	158.6	80.8
1.80V	1722	1576	1442	1144	820	637	547	434.1	356.1	297.4	259.7	214.6	181.7	156.2	79.6
1.85V	1518	1375	1260	988	703	571	506	410	336.8	281.4	245.2	202.4	172	147.3	76.4
1.90V	1276	1140	1021	808	596	514	457	373.8	311.9	262.9	231.5	189.7	161.9	140.6	71.5

CCB GEL-2V1000															
End voltage per cell	5MIN	10MIN	15MIN	30MIN	1HR	1.5HR	2HR	3HR	4HR	5HR	6HR	8HR	10HR	12HR	24HR
1.60V	2518	2304	2119	1751	1267	989	806	597.9	482.3	407	357.7	291.4	241.2	205.1	106
1.65V	2431	2216	2053	1683	1227	945	772	582.8	472.3	396.9	349.7	284.9	235.1	199.5	104
1.70V	2350	2161	1998	1628	1181	900	742	570.8	460.2	388.9	341.6	280.4	233.1	199.4	102
1.75V	2253	2080	1912	1531	1113	848	709	559.7	452.2	381.8	331.6	274.3	231.1	198.5	101
1.80V	2152	1970	1803	1431	1025	797	683	542.6	445.1	371.8	324.6	268.3	227.1	195.5	99.5
1.85V	1898	1719	1575	1236	878	713	633	512.5	421	351.7	306.5	253	215	184.4	95.5
1.90V	1595	1425	1276	1010	745	643	571	467.3	389.9	328.6	289.4	237.1	202.4	175.7	89.4
CCB GEL-2V1500															
End voltage per cell	5MIN	10MIN	15MIN	30MIN	1HR	1.5HR	2HR	3HR	4HR	5HR	6HR	8HR	10HR	12HR	24HR
1.60V	3777	3456	3178	2627	1901	1483	1209	896.8	723.5	610.4	536.6	437.1	361.7	307.6	159
1.65V	3646	3324	3079	2525	1841	1417	1159	874.2	708.4	595.4	524.5	427.3	352.7	299.5	156
1.70V	3524	3242	2997	2442	1771	1351	1113	856.1	690.3	583.3	512.5	420.5	349.7	299.1	153
1.75V	3380	3120	2868	2296	1670	1272	1064	839.6	678.3	572.8	497.4	411.5	346.7	297.7	151.5
1.80V	3228	2955	2704	2146	1537	1195	1025	813.9	667.7	557.7	486.8	402.4	340.6	293.1	149.2
1.85V	2847	2579	2362	1853	1317	1070	950	768.7	631.5	527.5	459.7	379.5	322.6	276.5	143.2
1.90V	2393	2138	1914	1515	1117	965	856	700.9	584.8	492.9	434.1	355.7	303.6	263.6	134.1
CCB GEL-2V2000															
End voltage per cell	5MIN	10MIN	15MIN	30MIN	1HR	1.5HR	2HR	3HR	4HR	5HR	6HR	8HR	10HR	12HR	24HR
1.60V	5036.0	4608.0	4237.0	3502.0	2534.0	1978.0	1612.0	1195.8	964.7	813.9	715.5	582.8	482.3	410.0	212.0
1.65V	4861.0	4432.0	4106.0	3366.0	2454.0	1889.0	1545.0	1165.6	944.6	793.8	699.4	569.7	470.3	399.2	208.0
1.70V	4699.0	4323.0	3996.0	3256.0	2361.0	1801.0	1484.0	1141.5	920.4	777.8	683.3	560.7	466.3	398.9	204.0
1.75V	4507.0	4160.0	3824.0	3061.0	2227.0	1696.0	1419.0	1119.4	904.4	763.7	663.2	548.6	462.2	396.8	202.0
1.80V	4304.0	3940.0	3605.0	2861.0	2050.0	1594.0	1367.0	1085.2	890.3	743.6	649.1	536.6	454.2	390.8	199.0
1.85V	3795.0	3438.0	3150.0	2471.0	1756.0	1427.0	1266.0	1024.9	842.1	703.4	613.0	506.0	430.1	368.6	190.9
1.90V	3190.0	2851.0	2552.0	2020.0	1489.0	1286.0	1142.0	934.5	779.8	657.2	578.8	474.3	404.8	351.4	178.9

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 2-2 shows the internal resistance and short circuit current of Narada battery in fully charged state according to the IEC60896 standard. Pay attention to the battery to short-circuit causes the battery voltage to reduce to 0V, and will cause the battery internal component damage.

Table2-3 Internal resistance and short circuit current (25°C)

type	Internal Resistance (mΩ)	Short Circuit Current (A)
CCB GEL-2V200	0.66	3084
CCB GEL-2V300	0.47	3960
CCB GEL-2V400	0.35	5089
CCB GEL-2V500	0.33	6009
CCB GEL-2V600	0.28	7178
CCB GEL-2V800	0.21	9061
CCB GEL-2V1000	0.18	10696
CCB GEL-2V1500	0.14	14068
CCB GEL-2V2000	0.11	17217

Chapter Three Operation and Maintenance

1. Parameters

The CCB GEL-2V series battery in -15 ℃ ~ 45 ℃ environment, the recommendation is suitable the temperature is 15 ℃ ~ 25 ℃. Using under the high or low temperature, can reduce the battery life. The next table is taking the 48V system as an example. The switching power supply parameter reference establishment value, different uses electricity the environment battery electric discharge. Because of the frequently power cut in the environment in four kind and above four kinds, the battery discharges frequently punishes at the same time in the sufficient insufficient condition. Therefore needs to enhance the floating voltage and the charging current by causes the battery in the short time the sufficient electricity. The user acts according to the locus the power supply category comparative table 3-1.

Table3-1 Switching power supply parameter establishment table

Parameter name	Below four kinds supplies power	Four kind and above four kinds supplies power
Floating Voltage（V）	54	54
Equalization Voltage（V）	56.4	56.4
Charging Current（A）	$0.1C_{10}$	$0.1C_{10}$
Limited Current For Charge （A）	$0.2C_{10}$	$0.2C_{10}$
High Voltage Warning（V）	57.6	57.6
Low Voltage Warning（V）	46	47
Temperature Compensate Ratio With Floating Voltage（mV/°Cper cell）	-3	-3
Temperature Compensate Rratio With Equalization Voltage（mV/°Cper cell）	-5	-5
High Temperature Warning（°C）	35	35
LVDS Broke Voltage（V）	44	45
LVDS Recover Voltage（V）	49	50
Equalization Charge Cycle（day）	90	30
Equalization Charge Time（h）	24	24
Condition TO Change Float Charge To Equalization Charge（mA/Ah）	＞50	＞50
Condition To Stop Equalization Charge（mA/Ah）	＜5	＜5

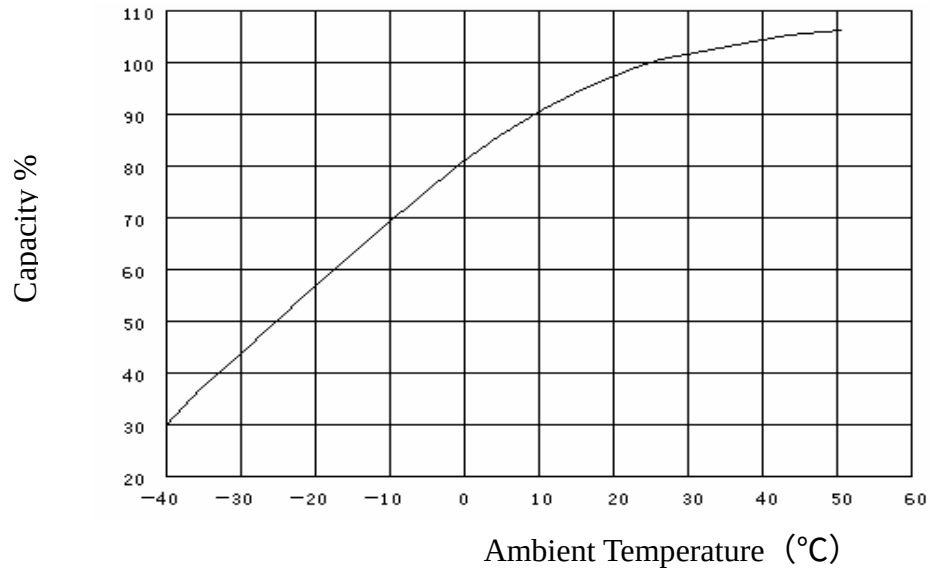
2.Capacity and Influence Factor

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 CCB GEL-2V battery please see Table 1-1. The Actual Capacity is the product of the discharge current and the discharge time, the unit is AH.

3. Ambient temperature Vs. Battery

Temperature affects capacity of the battery. Fig. 3-1 is the available capacity (10h rate) curve vs. ambient temperature. From Fig. 3-1, if the temperature is too low, the capacity will decrease. for example, the capacity will decrease 20% if temperature decreases form 25 ℃ to 0℃; And too low temperature will cause battery long term insufficient charged, also will cause no discharge and negative plates sulfate.
The capacity will increase when temperature rises. For example the capacity will increase 5% if temperature raise 10°C. But it will quicken up plates' corrosion and water loss if temperature rises, shortens battery's life.

Fig.3-1 Available Capacity (10h rate) Curve VS. Ambient Temperature



- **Temperature and Floating Voltage, Equalization voltage**

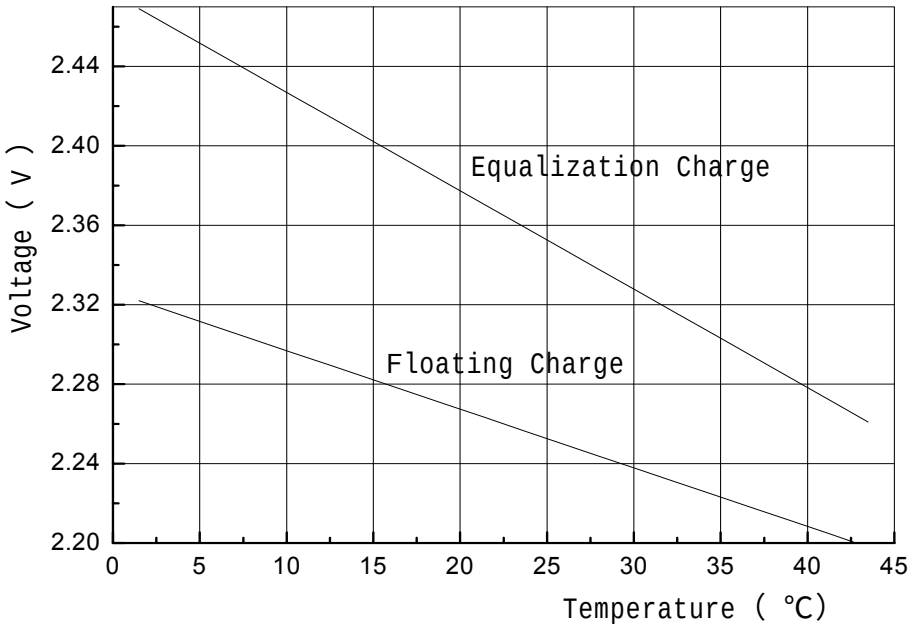
The purpose of choosing certain floating voltage is to reach the designed life and rated capacity of the battery. If the floating voltage is higher, then the floating current is also higher; it will accelerate the corruption the grid and shorten the life of the battery. If the floating voltage is lower, the battery can't be kept in fully charged state, this will crystallize $PbSO_4$, decrease the capacity, and also shorten the life of the battery.

At 25°C, if the floating voltage is 2.25V, In other degree, please adjust according to Table 3-2. Valve regulated sealed lead sealed lead acid battery need to carry the equalizing charge regularly, in order to guarantees the battery normal operation. At 25°C,NARADA battery' s Equalization voltage is 2.35V～2.40V. It need to be changed by ambient temperature, the temperature compensation coefficient is-5mV/°C/cell.

Table 3-2 Relationship of ambient temperature and voltage

Ambient Temperature (°C)	Float Voltage (V/cell)	Equalization voltage (V/cell)
5	2.31	2.45
10	2.30	2.43
15	2.28	2.40
20	2.27	2.38
25	2.25	2.35
30	2.24	2.33
35	2.22	2.30
40	2.21	2.28

Fig.3－2 The Voltage Setting Curve Vs. Ambient Temperature



- **Ambient temperature Vs. Battery Life**

The heat disseminates performance of VRLA battery is bad, it's liable to cause heat run away when heat accumulates. When temperature exceeds 25℃, the battery life will decrease half per 10℃ temperature raise.

$L_{25}=L_T\times 2^{(T-25)/10}$

Notes：T the actual ambient temperature;

L_T is designed life at T ambient temperature

L_{25} is designed life at 25℃ ambient temperature

Ambient temperature elevating, also will accelerate the battery slab lattice corrosion and the battery moisture content loss, thus will greatly reduce the battery the life. So suppose to control the ambient temperature, after the quantity of heat accumulating to the certain degree can damage the battery, seriously will be able to cause hotly loses control. If indoor temperature reaches too high, improves the ambient temperature. The battery spacing cannot to be lower than 10mm, at the same time according to handbook request regulating cell floating and Equalization voltage value.

4.Requirement for Charge

- **Equalization Charge**

  The battery needs an equalization charge floating operation over three months, and the voltage of at least two batteries are lower than 2.18V. The method of equalization charge is suggested as follows: Charge with 2.35V/Cell for 24 hours, limiting0.1C_{10}A～0.2C_{10}A,when the average voltage raise to Equalization voltage, charge by Equalization voltage for 24hours.

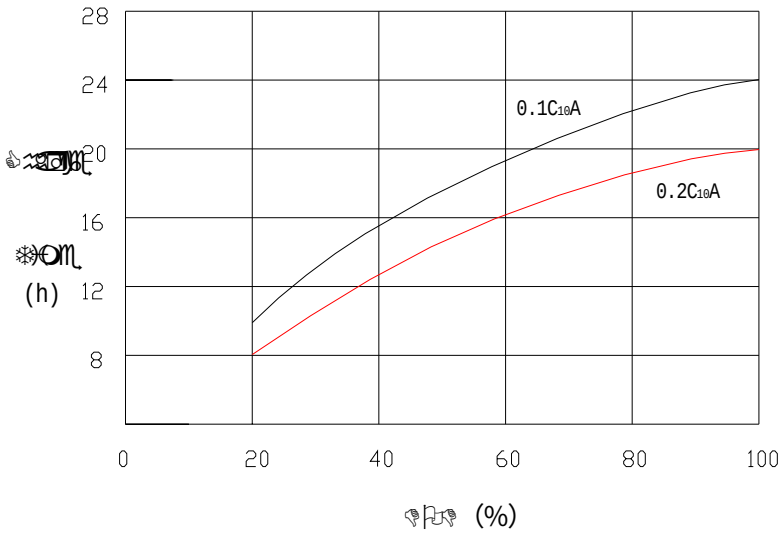
- **Charge**

After discharge, the batteries should be charged in time. The method is recommended as Charge with 2.35V/Cell for 24 hours, limiting0.1C_{10}A～0.2C_{10}A.

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

1. See following table, table3-3 is in different discharge, the time need for 0.1C_{10}A and 0.2C_{10}A battery.
2. On condition of constant voltage, the value of charge current hasn't varied for continuous three hours.

Fig .3-3 The relationship between DOD and charge time



5. 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 please note:

- 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 Narada CCB GEL-2V batteries's storage environment is from 0°C to 35°C. The storage place must be clean, ventilated and dry.
- An important parameter in storage is open circuit voltage, which is related with density of the electrolyte. In order to avoid permanent damage to the plate caused by self-discharge, the batteries should be supplementary charged if they have been stored for three months. The equalization charge method should be adopted.
- During storage, if the open circuit voltage is lower than 2.10V/Cell, the batteries should be

supplementary charged before use. The equalization charge method should be adopted.

— 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 record the time when another necessary supplementary charge should be made.

The quality certificates of CCB GEL-2V batteries record the latest charge time of the batteries, next charge time can be calculated according to this charge time.

6.Maintenance

In order to assure service life, the batteries should be correctly inspected and maintained. The maintenance methods of CCB GEL-2V batteries are recommended as follows:

- **Monthly Maintenance**

Implement the under-mentioned 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.

- **Quarterly Maintenance**

— Repeat monthly inspection.

Measure and record floating voltage of every on-line battery. If more than two cells' voltage is less than 2.18V 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

- **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. 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.

- **Operation and Maintenance Precautions**

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 saltilized and the capacity is decreased.

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.

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.

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 1.8V). 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.

Long time 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 $PbSO_4$ will create in the negative which are difficult to transfer to active Pb.

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Annex 1

VRLA Battery Regular Maintenance Record

Type		Place	
Status		Number of battery	
Total Voltage（V）	Current (A)	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	

Result：

Tester:		Date:	