Polymer Gel Standby Battery

AcmeG Range

(Front Access Design)

OPERATION MANUAL

Version 3.1

NARADA POWER SOURCE CO., LTD

Website: www.naradabattery.com

Contents

Important Safety Instructions

Please read this operation manual carefully. It offers very important safety instructions, installation and operation guide, and ensure your equipment with best performance and prolong the service life of your equipment.

- For the sake of your safety, please do not attempt to remove the components of the battery. The maintenance of the battery can only be carried out by service engineers specially trained by the principal.
- Considering the potential harm of the lead component to the health and environment, the battery can be replaced only by the service center authorized by the manufacturer. To replace the battery or maintenance equipment, please call the after-sales service hotline for information of the nearest service center.
- Please check the local regulations on the correct way of dealing with battery disposal or send the battery to the authorized service center for replacement.
- Battery replacement should be operated or supervised by engineers who are experienced and aware of the preventive measures on the potential harm of the battery.
- Warning - Do not smoke and refrain having fire near the battery.
- Warning - Do not use any organic solvent to clean the battery.
- Warning - Do not have fire near the battery or it may explode.
- Warning - Do not remove the components of the battery as it contains electrolyte that may cause injury to the human body.
- Warning - Battery may cause short circuit. Please remove any watches and jewelry during replacement of the battery, and operate with tools with insulated materials.

				
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 Product Introduction

1. Features

1.1 Long life

- using the polymer gel electrolyte
- 4BS paste technology
- Special paste technology
- Special patent grid alloy

1.2 Wide operational temperature range

- Excellent charging and discharging ability at low temperature
- Decline the water-loss at high temperature

1.3 Unique rack line dimension and design created by Narada in China

- Long and narrow construction design with excellent heat dispersing capability
- Both positive and negative posts are along one side of the battery giving ease of monitoring and maintenance
- Flexible connectors that can fit according to each client's requirement
- Suitable for 19", 23" rack or cabinet
- Patented gas collecting system

2. Main Application Fields

- Telecom standby and cyclical applications
- UPS system
- Power system
- Solar energy system
- Emergency lighting system

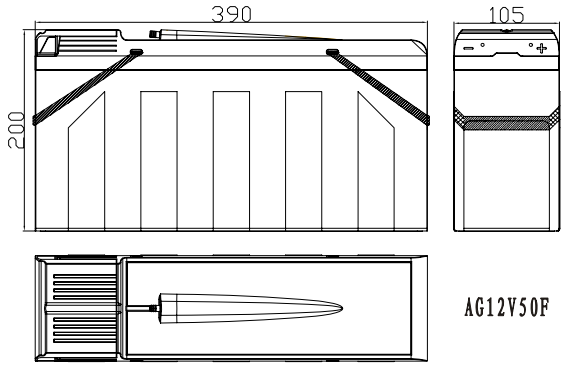
3. Types & Dimensions

Table 1-1 Narada AcmeG Series Battery Specification

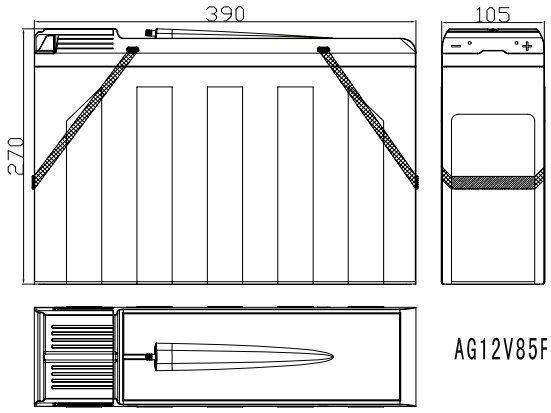
Type	Normal Voltage (V)	Rated Capacity C10(Ah)	Dimensions(mm)			WT (kg)
			L	W	H	
AG12V50F	12	50	390	105	200	21.3
AG12V85F	12	85	390	105	270	31.5
AG12V100F	12	100	390	105	287	33.0

AG12V100A	12	100	390	105	287	33.0
AG12V125F	12	125	558	125	270	46.0
AG12V155F	12	155	558	125	270	52.5
AG12V180	12	180	558	125	316	60.5

4. Dimension and Sketch Map



AG12V50F



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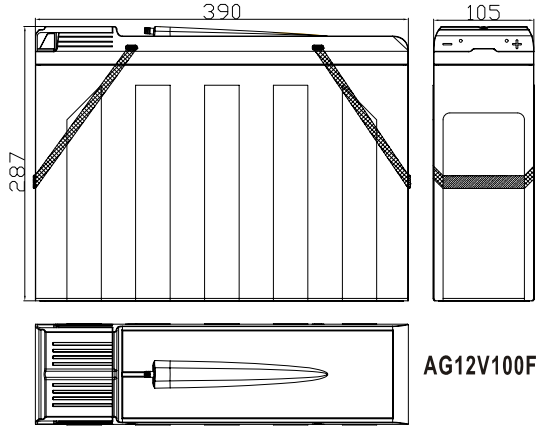

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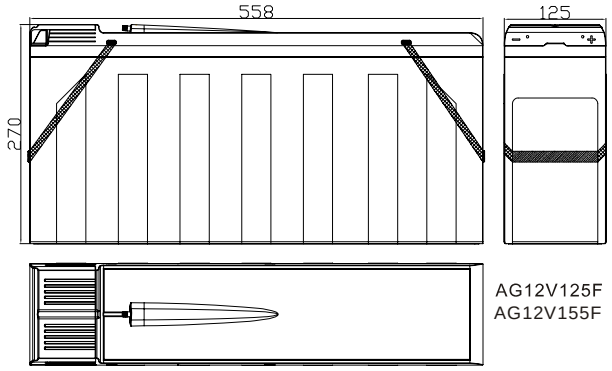
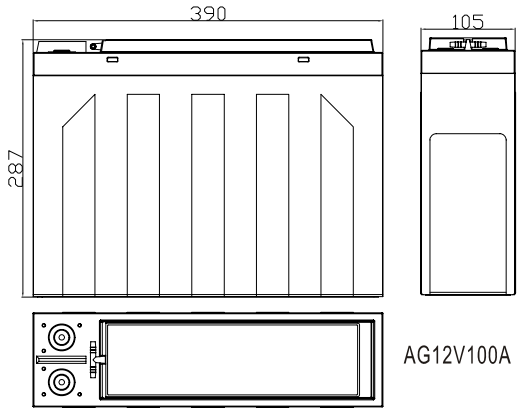


AG12V125F
AG12V155F



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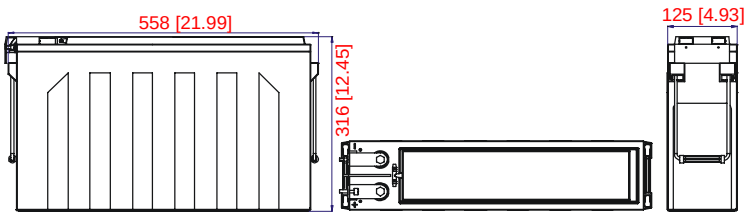
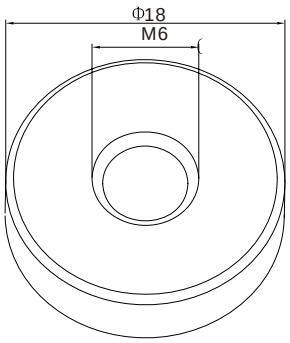


AG12V180

5. Terminals Sketch Map



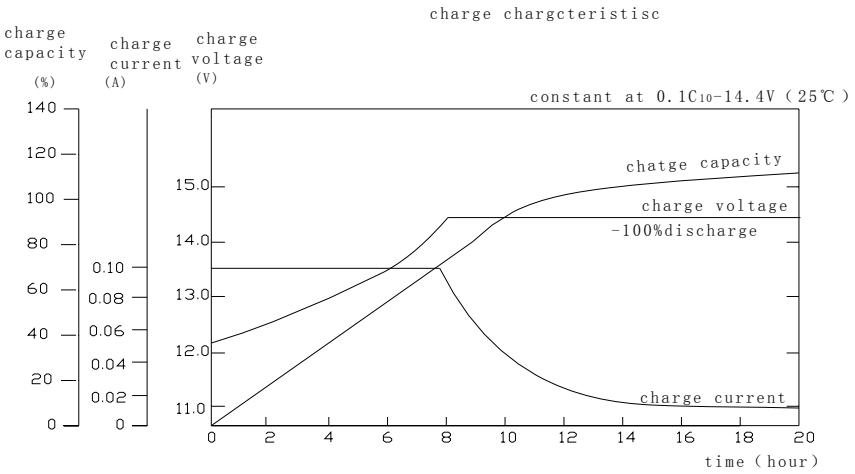
AG12V50F, AG12V58F, AG12V100F
AG12V125F, AG12V155F, AG12V100A

Chapter Two Technical Characteristics

1. Charge Performance Curve

Fig 2-1 shows the recharge characteristics of 100% DOD discharge AG12V100F battery with current of 0.1C_{10}A current and limit voltage 14.4V/block (25ºC).

2. Internal Resistance and Short Circuit Current



The internal resistance of the battery is a dynamic nonlinear parameter that varies continuously with the temperature and discharge state. The internal resistance is at its lowest when the battery is fully charged. Table 2-1 shows the internal resistance and short circuit current of Narada battery in fully charged state according to the IEC60896 standard.

Table 2-1. Internal resistance and short circuit current (25ºC)

Type	Internal resistance (mΩ)	Short circuit current (A)
AG12V50F	8.94	1500
AG12V85F	6.52	1897
AG12V100F	6.36	1989
AG12V100A	6.59	1909
AG12V125F	5.76	2226
AG12V155F	4.30	2814
AG12V180	3.85	3280

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

3. Discharge data with constant current & constant power

Tab.2-1 Discharge data with constant current (A, 25℃)

AG12V50F	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V/cell	187.0	100.5	61.1	44.2	35.7	20.5	14.9	11.7	9.86	8.46	6.49	5.30	4.53	2.84	2.37
1.67V/cell	175.6	96.9	60.1	43.8	35.5	20.4	14.6	11.6	9.81	8.41	6.44	5.25	4.52	2.81	2.35
1.70V/cell	174.0	95.3	59.0	43.5	35.3	20.2	14.5	11.6	9.65	8.30	6.44	5.25	4.47	2.81	2.35
1.75V/ cell	160.0	92.2	58.5	43.2	34.7	19.7	14.4	11.4	9.60	8.25	6.38	5.20	4.47	2.80	2.35
1.80V/ cell	143.5	86.0	55.9	41.4	33.9	19.5	14.3	11.4	9.39	8.10	6.33	5.14	4.44	2.77	2.34
1.83V/ cell	136.7	78.7	54.9	40.0	32.4	19.3	13.8	10.8	9.08	7.84	6.18	4.95	4.22	2.76	2.31
1.85V/ cell	127.9	76.7	51.1	38.5	31.4	18.6	13.4	10.7	8.87	7.63	5.97	4.91	4.17	2.71	2.28
AG12V85F	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V/ cell	305.6	164.2	99.9	72.2	58.4	33.5	24.3	19.1	16.1	13.8	10.6	8.75	7.40	4.64	3.87
1.67V/ cell	287.0	158.3	98.2	71.6	58.1	33.3	23.9	19.0	16.0	13.7	10.5	8.66	7.39	4.60	3.84
1.70V/ cell	284.5	155.8	96.5	71.1	57.6	33.1	23.7	18.9	15.8	13.6	10.5	8.66	7.31	4.59	3.84
1.75V/ cell	261.6	150.7	95.7	70.6	56.8	32.2	23.5	18.6	15.7	13.5	10.4	8.58	7.31	4.58	3.84
1.80V/ cell	234.5	140.5	91.4	67.7	55.3	31.9	23.3	18.6	15.4	13.2	10.3	8.49	7.26	4.53	3.83
1.83V/ cell	223.5	128.7	89.7	65.4	52.9	31.5	22.5	17.7	14.8	12.8	10.1	8.18	6.90	4.52	3.77
1.85V/ cell	209.1	125.3	83.5	62.9	51.3	30.3	21.9	17.5	14.5	12.5	9.8	8.11	6.82	4.43	3.73
AG12V100F	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V/ cell	359.6	193.2	117.5	85.0	68.7	39.4	28.6	22.4	19.0	16.3	12.5	10.29	8.71	5.46	4.55
1.67V/ cell	337.6	186.3	115.5	84.3	68.3	39.2	28.1	22.3	18.9	16.2	12.4	10.19	8.70	5.41	4.51

1.70V/ cell	334.7	183.3	113.5	83.7	67.8	38.9	27.9	22.2	18.6	16.0	12.4	10.19	8.61	5.40	4.51
1.75V/ cell	307.8	177.3	112.5	83.1	66.8	37.9	27.6	21.9	18.5	15.9	12.3	10.09	8.61	5.39	4.51
1.80V/ cell	275.9	165.3	107.6	79.7	65.1	37.6	27.4	21.8	18.1	15.6	12.2	10.0	8.54	5.33	4.50
1.83V/ cell	262.9	151.4	105.6	77.0	62.2	37.1	26.5	20.8	17.5	15.1	11.9	9.62	8.11	5.32	4.43
1.85V/ cell	246.0	147.4	98.2	74.0	60.3	35.7	25.8	20.6	17.1	14.7	11.5	9.54	8.02	5.22	4.39
AG12V125F	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V/ cell	409.4	220.0	133.8	96.7	78.2	44.8	32.6	26.4	23.2	19.9	15.4	12.7	10.88	6.82	5.69
1.67V/ cell	384.5	212.1	131.6	96.0	77.8	44.6	32.0	26.2	23.1	19.8	15.3	12.6	10.87	6.76	5.64
1.70V/ cell	381.1	208.7	129.3	95.3	77.2	44.3	31.8	26.1	22.7	19.6	15.3	12.6	10.76	6.75	5.64
1.75V/ cell	350.5	201.9	128.2	94.6	76.1	43.1	31.4	25.8	22.6	19.4	15.2	12.5	10.76	6.73	5.64
1.80V/ cell	314.2	188.3	122.5	90.7	74.1	42.8	31.2	25.7	22.1	19.1	15.1	12.5	10.67	6.66	5.63
1.83V/ cell	299.4	172.4	120.2	87.7	70.8	42.2	30.2	24.5	21.4	18.5	14.7	11.9	10.14	6.64	5.54
1.85V/ cell	280.1	167.9	111.8	84.3	68.7	40.6	29.4	24.2	20.9	18.0	14.2	11.8	10.03	6.52	5.49
AG12V155F	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V/ cell	506.6	272.2	165.6	119.7	96.8	55.5	40.3	33.0	28.8	25.0	19.1	15.9	13.49	8.46	7.06
1.67V/ cell	475.7	262.4	162.8	118.7	96.2	55.2	39.6	32.9	28.7	24.8	19.0	15.7	13.48	8.38	7.00
1.70V/ cell	471.5	258.2	160.0	117.9	95.5	54.8	39.3	32.7	28.2	24.5	19.0	15.7	13.34	8.36	7.00
1.75V/ cell	433.6	249.8	158.6	117.0	94.1	53.4	38.9	32.3	28.0	24.3	18.8	15.6	13.34	8.35	7.00
1.80V/ cell	388.7	233.0	151.6	112.3	91.7	53.0	38.6	32.2	27.4	23.9	18.7	15.5	13.23	8.26	6.98
1.83V/ cell	370.5	213.3	148.8	108.5	87.7	52.3	37.4	30.7	26.5	23.1	18.2	14.8	12.58	8.24	6.87
1.85V/ cell	346.6	207.7	138.4	104.3	85.0	50.3	36.4	30.4	25.9	22.5	17.6	14.7	12.44	8.08	6.81

AG12V180	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V/ cell	506.5	317.6	209.0	153.8	125.6	72.8	51.6	40.7	34.6	29.2	23.1	18.6	16.0	9.90	8.30
1.67V/ cell	474.4	312.6	206.0	153.8	124.6	72.1	51.4	40.7	34.4	28.9	22.9	18.5	15.9	9.80	8.23
1.70V/ cell	457.3	306.5	203.0	152.8	123.6	71.8	51.2	40.6	34.3	28.8	22.8	18.4	15.8	9.71	8.19
1.75V/ cell	434.2	293.5	195.0	149.7	122.6	71.2	50.9	40.4	34.1	28.5	22.6	18.2	15.7	9.61	8.12
1.80V/ cell	389.9	269.3	183.9	142.7	118.6	69.6	50.0	40.0	33.5	28.0	22.5	18.1	15.6	9.61	8.08
1.83V/ cell	355.8	252.3	174.9	136.7	116.6	67.8	49.1	39.5	32.8	27.3	22.2	18.0	15.5	9.52	8.04
1.85V/ cell	337.7	240.2	170.9	131.7	113.6	66.0	48.2	39.0	32.3	27.0	21.9	17.9	15.4	9.52	7.99
AG12V100A	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V/ cell	359.2	193.0	117.4	84.9	68.6	39.3	28.6	22.4	18.9	16.2	12.5	10.28	8.70	5.45	4.55
1.67V/ cell	337.3	186.1	115.4	84.2	68.2	39.1	28.1	22.3	18.8	16.1	12.4	10.18	8.69	5.40	4.51
1.70V/ cell	334.3	183.1	113.4	83.6	67.7	38.8	27.9	22.2	18.5	15.9	12.4	10.18	8.60	5.39	4.51
1.75V/ cell	307.5	177.1	112.4	83.0	66.7	37.8	27.6	21.9	18.4	15.8	12.3	10.08	8.60	5.38	4.51
1.80V/ cell	275.6	165.2	107.5	79.6	65.0	37.5	27.4	21.8	18.0	15.5	12.2	10.0	8.53	5.32	4.50
1.83V/ cell	262.7	151.2	105.5	76.9	62.1	37.0	26.5	20.8	17.4	15.0	11.9	9.61	8.11	5.31	4.43
1.85V/ cell	245.8	147.3	98.1	73.9	60.2	35.6	25.8	20.6	17.0	14.6	11.5	9.53	8.02	5.21	4.39

Tab 2-3 Discharge data with constant power (Watts/cell, 25℃)

AG12V50F	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V/cell	313.5	177.0	110.5	83.0	67.5	38.6	28.2	22.3	18.8	16.2	12.6	10.3	8.69	5.58	4.66
1.67V/cell	301.5	173.9	109.5	82.5	67.0	38.5	27.8	22.3	18.8	16.1	12.5	10.2	8.69	5.53	4.66
1.70V/cell	300.0	171.8	109.5	82.5	67.0	38.3	27.8	22.2	18.6	16.0	12.4	10.1	8.63	5.53	4.65
1.75V/ cell	279.7	170.7	109.0	82.0	66.0	38.1	27.5	22.2	18.6	16.0	12.3	10.1	8.58	5.53	4.65
1.80V/ cell	256.9	161.4	106.4	80.4	65.5	38.0	27.5	22.1	18.2	15.8	12.3	10.1	8.58	5.53	4.64
1.83V/ cell	245.5	147.9	105.3	77.8	62.9	37.5	26.8	21.3	17.8	15.4	12.1	9.9	8.32	5.53	4.61
1.85V/ cell	229.4	144.3	97.6	74.7	60.8	36.3	26.1	21.0	17.4	15.0	11.8	9.8	8.22	5.43	4.58
AG12V85F	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V/ cell	511.9	286.4	178.9	134.4	109.3	63.2	46.2	36.6	30.8	26.6	20.6	16.9	14.24	9.15	7.64
1.67V/ cell	492.4	281.3	177.2	133.5	108.4	63.1	45.6	36.5	30.8	26.4	20.5	16.8	14.24	9.07	7.64
1.70V/ cell	489.8	278.0	177.2	133.5	108.4	62.8	45.6	36.4	30.4	26.3	20.3	16.6	14.15	9.07	7.63
1.75V/ cell	459.8	276.3	176.4	132.7	106.8	62.5	45.1	36.4	30.4	26.2	20.2	16.6	14.07	9.07	7.63
1.80V/ cell	420.5	261.2	172.2	130.2	105.9	62.3	45.0	36.3	29.9	25.9	20.1	16.6	14.07	9.07	7.61
1.83V/ cell	409.6	239.3	170.5	126.0	101.7	61.5	43.9	34.9	29.2	25.2	19.9	16.2	13.64	9.07	7.56
1.85V/ cell	384.3	233.5	157.9	120.9	98.4	59.5	42.7	34.5	28.6	24.7	19.3	16.0	13.47	8.90	7.50
AG12V100F	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V/ cell	602.8	340.3	212.6	159.7	129.9	74.5	54.4	43.2	36.4	31.4	24.3	19.98	16.78	10.79	9.01
1.67V/ cell	579.8	334.3	210.6	158.7	128.9	74.3	53.7	43.1	36.4	31.2	24.2	19.78	16.78	10.69	9.01
1.70V/ cell	576.8	330.3	210.6	158.7	128.9	74.0	53.7	42.9	35.9	31.0	24.0	19.58	16.68	10.69	8.99
1.75V/ cell	537.9	328.3	209.6	157.7	126.9	73.6	53.1	42.9	35.9	30.9	23.8	19.58	16.58	10.69	8.99

1.80V/ cell	494.0	310.4	204.6	154.7	125.9	73.4	53.0	42.8	35.3	30.6	23.7	19.58	16.58	10.69	8.97
1.83V/ cell	472.1	284.4	202.6	149.7	120.9	72.5	51.7	41.2	34.5	29.7	23.5	19.08	16.08	10.69	8.91
1.85V/ cell	441.1	277.4	187.6	143.7	116.9	70.1	50.3	40.7	33.7	29.1	22.8	18.88	15.88	10.49	8.84
AG12V125F	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V/ cell	682.7	385.4	240.7	180.8	147.7	84.8	61.9	51.8	45.0	39.0	30.3	25.3	21.36	13.73	11.47
1.67V/ cell	656.7	378.6	238.5	179.7	146.6	84.5	61.1	51.7	45.0	38.8	30.2	25.0	21.36	13.60	11.47
1.70V/ cell	653.3	374.1	238.5	179.7	146.6	84.2	61.1	51.4	44.4	38.5	29.9	24.8	21.23	13.60	11.44
1.75V/ cell	609.2	371.8	237.3	178.6	144.3	83.7	60.5	51.4	44.4	38.4	29.7	24.8	21.10	13.60	11.44
1.80V/ cell	559.5	351.5	231.7	175.2	143.2	83.5	60.3	51.3	43.6	38.0	29.5	24.8	21.10	13.60	11.42
1.83V/ cell	534.6	322.1	229.4	169.5	137.5	82.5	58.9	49.4	42.7	36.9	29.3	24.2	20.47	13.60	11.34
1.85V/ cell	499.6	314.2	212.5	162.8	133.0	79.8	57.3	48.8	41.7	36.2	28.4	23.9	20.21	13.35	11.25
AG12V155F	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V/ cell	846.5	477.9	298.5	224.2	183.2	105.1	76.8	64.2	55.8	48.4	37.6	31.22	26.22	16.86	14.08
1.67V/ cell	814.3	469.5	295.7	222.8	181.8	104.8	75.8	64.1	55.8	48.1	37.4	30.90	26.22	16.70	14.08
1.70V/ cell	810.1	463.9	295.7	222.8	181.8	104.4	75.8	63.8	55.0	47.8	37.1	30.59	26.07	16.70	14.05
1.75V/ cell	755.4	461.1	294.3	221.4	179.0	103.8	75.0	63.8	55.0	47.6	36.8	30.59	25.91	16.70	14.05
1.80V/ cell	693.7	435.9	287.3	217.2	177.5	103.6	74.8	63.6	54.1	47.1	36.6	30.59	25.91	16.70	14.02
1.83V/ cell	662.9	399.4	284.5	210.2	170.5	102.3	73.0	61.2	52.9	45.8	36.3	29.81	25.13	16.70	13.92
1.85V/ cell	619.5	389.6	263.5	201.8	164.9	98.9	71.0	60.5	51.7	44.8	35.2	29.50	24.82	16.39	13.81
AG12V180	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V	883.4	586.9	375.9	301.5	256.3	151.8	107.5	83.9	70.7	60.1	46.1	39.6	34.3	20.9	17.5

1.67V	835.2	570.8	372.9	299.5	255.3	151.8	107.5	83.6	70.4	59.9	46.0	39.5	34.2	20.8	17.4
1.70V	805.0	559.8	370.8	298.5	254.3	150.8	106.5	83.4	70.0	59.8	45.9	39.5	34.1	20.7	17.4
1.75V	743.7	538.7	363.8	294.5	250.2	149.7	106.5	82.9	69.6	59.5	45.6	39.4	34.0	20.5	17.3
1.80V	683.4	509.5	352.8	285.4	244.2	146.7	104.5	81.9	68.6	59.0	45.3	39.2	33.8	20.2	17.3
1.83V	663.3	482.4	341.7	277.4	237.2	142.7	102.5	80.9	67.6	58.4	45.1	38.9	33.6	20.0	17.2
1.85V	650.2	460.3	334.7	271.4	232.2	139.7	100.0	79.9	66.4	57.7	44.8	38.8	33.4	19.7	17.2

AG12V100A	5min	15min	30min	45min	1h	2h	3h	4h	5h	6h	8h	10h	12h	20h	24h
1.60V/ cell	601.0	339.3	211.9	159.2	129.5	74.3	54.3	43.0	36.3	31.3	24.2	19.92	16.73	10.76	8.98
1.67V/ cell	578.1	333.3	209.9	158.2	128.5	74.1	53.6	42.9	36.3	31.1	24.1	19.72	16.73	10.66	8.98
1.70V/ cell	575.1	329.3	209.9	158.2	128.5	73.8	53.6	42.7	35.8	30.9	23.9	19.52	16.63	10.66	8.96
1.75V/ cell	536.3	327.4	209.0	157.2	126.5	73.4	53.0	42.7	35.8	30.8	23.7	19.52	16.53	10.66	8.96
1.80V/ cell	492.5	309.4	204.0	154.2	125.5	73.2	52.9	42.6	35.2	30.5	23.6	19.52	16.53	10.66	8.94
1.83V/ cell	470.6	283.6	202.0	149.3	120.5	72.3	51.6	41.0	34.4	29.6	23.4	19.02	16.04	10.66	8.88
1.85V/ cell	439.8	276.6	187.1	143.3	116.5	69.9	50.2	40.5	33.6	29.0	22.7	18.82	15.84	10.46	8.81

Chapter Three Operation and Maintenance

1. Operation Conditions

Ambient temperature: AcmeG series optimum temperature is 15℃～25℃, the higher and lower temperatures will impact battery performance

Operation temperature range

Operate status	Temperature range	Optimum temperature
Discharge	-40℃～50℃	15℃～25℃
Charge	-20℃～50℃	15℃～25℃
Storage	-20℃～40℃	15℃～25℃

Ambient humidity：≤95％

Cabinet ventilation conditions: meet the standard EN 50272-2:2001

2. Capacity and Influencing Factors

2.1 The capacity of the battery is the capacity that battery can be discharged under certain conditions, represented by the symbol 'C'. The standard unit of measurement for capacity is ampere-hour (Ah).

Capacity can be expressed in Rated Capacity or Actual Capacity. Please refer to Table 1-1 for the Rated Capacity of Narada battery. The Actual Capacity is the product of the discharge current and the discharge time i.e. Ah.

2.2 Factors that influence the Actual Capacity

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

2.3 Discharge Rate

If the discharge rate (hour rate) is lower, the discharge current is larger, and the discharge time is shorter, then the capacity that can be discharged will be lesser. 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.

2.4 End Voltage

The end voltage is the lowest working voltage below which the battery will not be able to discharge further. The end voltage of AcmeG series battery is typically 10.8V per block. Due to the characteristics of gel battery, the battery will not be able to discharge even if the end voltage drops. 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 the life of the battery.

Table 3-1 Discharge End Voltage at Different Current

Discharge current (A)	Discharge end voltage (V/block)
I＜0.2C	10.8
0.2C≤I＜0.5C	10.2
0.5C≤I＜1.0C	9.30
I≥1.0C	7.80

3. Ambient Temperature, Capacity and Life

3.1 Relationship between Ambient Temperature and Capacity

VRLA batteries can be used in very low or high temperature (below -15° C or above 45° C). However the battery data such as capacity life and floating voltage are measured with temperature between 20ºC-25ºC as a standard. The capacity of the battery will decrease with lower temperature as shown in Fig. 3-1 below.

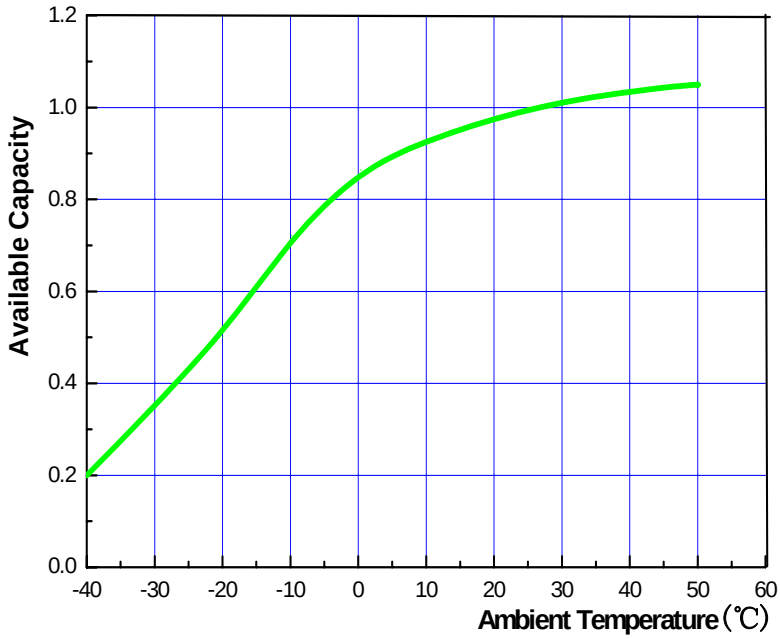


Fig.3-1: Ambient Temperature vs. Available Capacity

As represented by the graph above, the capacity of the battery will decrease when the temperature is too low. For example, if the temperature decreases from 25ºC to 0ºC, the capacity will be decrease to85% of the nominal capacity. The battery will be in a less-charged state with lower temperature and this will lead to battery failure in discharging and the active material in the negative plate to saltilize.

The capacity of the battery will increase when the temperature rises. For example, the capacity will increase by 6% when the temperature increases by 10ºC. However the high temperature will accelerate the corrosion of the grid and cause water loss in the battery, thus shortening the battery life.

As such it is always important to control the ambient temperature at the customer premises. Please ensure room ventilation and usage of air-condition is recommended in high temperature working environment.

3.2 Floating Operation

Floating voltage is chosen with the assumption of battery operating under the optimal working condition. If the floating voltage is too high, the battery floating current will get larger and increase the grid eroding speed, thus reducing the service life of the battery. When the floating voltage is too low, the battery will not be able to maintain its fully-charged condition. This will create sulphate and reduces the battery capacity, hence affecting the service life of the battery. The floating voltage of Narada AcmeG series battery is 13.5V/block under 25ºC. The temperature compensation is at -18mV/ºC/block.

Floating voltage under different temperature is calculated by the following formula:

$V_T=13.5-(T-25)\times 0.003\times 6$

V_T—Floating voltage under T temperature

Table 3-2 Floating Voltage under Different Temperature

Ambient temperature(ºC)	Floating voltage (V/cell)	Floating voltage (V/block)
≤5	2.31	13.86
10	2.295	13.77
15	2.28	13.68
20	2.265	13.59
25	2.25	13.50
30	2.235	13.41
35	2.22	13.32
≥40	2.205	13.23

Note: If ambient temperature below 5℃ or above 40℃, temperature compensate is no longer go on.

3.3 Equalization Charge

VRLA battery needs Equalization Charge regularly to ensure the battery operating under 25ºC working condition. The equalization voltage of Narada AcmeG series battery is 14.4V/block. The temperature compensation is at -30mV/ºC/block.

Equalization voltage under different temperature is calculated by the following formula:

$V_T=14.4-(T-25)\times 0.005\times 6$

V_T—equalization voltage under T temperature

Table 3-3 Equalization Voltage under Different Temperature

Ambient temperature(℃)	Equalization voltage (V/cell)	Equalization voltage (V/block)
≤5	2.50	15.00
10	2.475	14.85
15	2.45	14.70
20	2.425	14.55
25	2.40	14.40
30	2.375	14.25
35	2.35	14.10
≥40	2.325	13.95

Note: If ambient temperature below 5℃ or above 40℃, temperature compensate is no longer go on.

3.4 Ambient Temperature and Life

High temperature is harmful to the battery and affects its service life. When the ambient temperature exceeds 25ºC， the service life reduces by half for every 10ºC increment in temperature. For example, the battery service life is 10 years under 25ºC but if the operating temperature is 35ºC, the service life will become 5 years. The formula to calculate the service life is as follows:

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

whereby T : actual ambient temperature

t_T : design life under T

t_{25}: design life under 25ºC

As such the ambient temperature should always be controlled.

4. Charging Request

4.1 Equalization Charging

Equalization charging should be carried out in the following situation:

a. There are more than two batteries which voltage is under 13.0V in one group.

b. More than three months after floating operation.

Equalization charging is recommended as follows:

Charge the battery group with constant current not exceeding $0.1C_{10}A$ till the average voltage increases to 14.4V/block(25ºC)， then change into constant voltage of 14.4V/block charging. The equalization charging time should be 24 hours.

4.2 Battery Charging

Battery Charging should be carried out in the following situation:

a. The batteries should be recharged in time after discharge.
b. After battery system is installed.
c. Battery storage period exceeding three months or open circuit voltage lower than 12.6V/block.

Battery charging is recommended as follows:

The batteries should first be charged on the constant current of $0.10C_{10}A$ till the average voltage of the batteries increases to 14.4V, then the batteries should be charged with constant voltage of 14.4V till the charging has completed.

On some occasions, the batteries have to be fully charged immediately, then fast charging could be adopted. The value of limit current should not be larger than $0.2C_{10}A$, and the charge voltage should be 14.4V/block(25ºC).

We can determine if the batteries are fully charged by one of following two conditions:

a. After charging 18～24hours. The charging time will be lesser if it is not deep discharged. For example at 20% DOD (refer to Table 2-1 for the Depth of Discharge vs Charging Time), the charging time can be shorten to 10 hours.

b. Under the condition of constant voltage, the value of charge current has no variation for continuously three hours.

5. Storage

All gel batteries experience self-discharge in open circuit. The result is that the voltage of open circuit is decreased, and the capacity also decreases. Please note the

following during storage period:

5.1 The self-discharge rate is related to the ambient temperature. The degree of self-discharge is smaller when the ambient temperature is lower, otherwise it will be larger. The required temperature for Narada batteries' storage is 5ºC to 30ºC. The storage place must be clean, ventilated and dry.

5.2 An important parameter in storage is open circuit voltage, which is related to the density of the electrolyte. In order to avoid permanent damage to the plate caused by self-discharge, the batteries should be recharged as storage period shown in following table . The equalization charge method should be adopted.

Storage temperature	Max. Storage period
Above 30℃	3 months
Below 30℃	6 months

5.3 During storage, if the open circuit voltage is lower than 12.6V/block, the batteries should be recharged before usage. The equalization charge method should be adopted.

5.4 All batteries should be fully charged before storage. It is recommended to record the storage time in the periodic maintenance record and to note down the time when the next necessary recharge should be carried out.

Fig. 3-2 is the curve of AcmeG series batteries storage time vs capacity under different temperature.

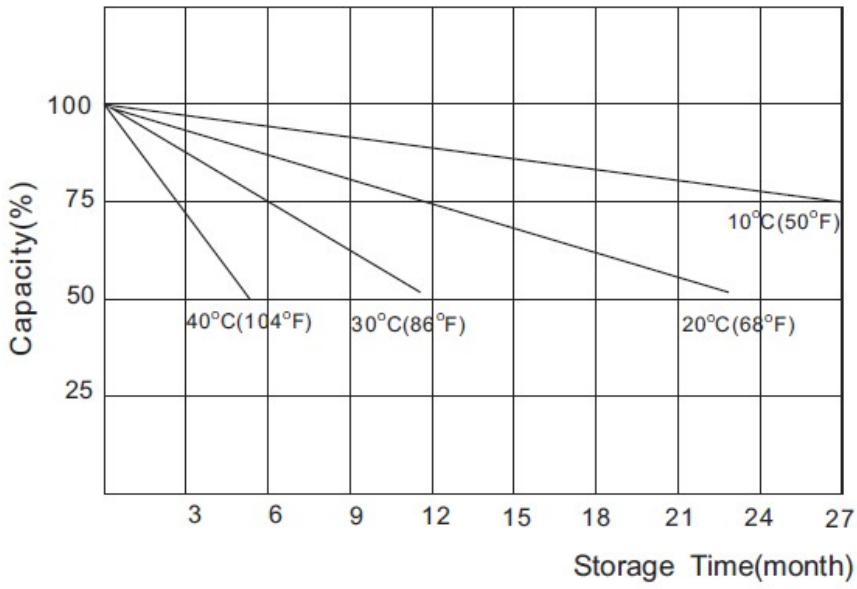


Fig. 3-2 Self-discharge Curve

Chapter Four Maintenance

1. Regulated Maintenance

1.1 Instruments and tools:

1.1.1 Digital Voltage Meter.

1.1.2 Insulated wrench.

1.1.3 Internal resistance, conductive and 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 cleanliness, check damage and trace of overheating on 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 there is more than one battery with voltage of less than 13.1V after temperature adjustment, the batteries have to go through equalization charged. If the problem persists after adopting the above-mentioned measure, the batteries will require yearly maintenance or even three years' maintenance. If all methods are ineffective, please contact the manufacturer.

1.4 Yearly Maintenance

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

1.5 Three-year Maintenance

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

2. Precautions

2.1 Insufficient Charge

If the floating voltage is not set correctly i.e. too low or not amend according to the temperature, the battery system will have 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 ensure the rectifier transfers floating charge to equalization charge. If the rectifier is not able to transfer charge modes, the battery system will always be in an equalization charge state which may cause battery water loss, decrease in service life, overheating and deformation.

2.3 Extreme Temperature

Maintain the correct temperature to ensure the performance of the battery. Extremities in temperature will be detrimental to the battery life and performance.

2.4 Low End Voltage

The end voltage is an important parameter for battery. The normal end voltage is 10.5V and in some cases 9.6V. The battery will stop discharging when it reaches a certain voltage. If the end voltage is too low, it will be difficult to recharge the battery and decrease the charging efficiency, thus affecting the battery life.

2.5 Charging Battery Immediately after Discharge

If the battery is left uncharged for a long period of time i.e. > 2 hours after discharging, it will affect the capacity and battery life. This is due to large size $PbSO_4$ being created in the negative and will be difficult to transfer to active Pb.

3. After-sales Service / Customer Service Hotline

Narada Power Source Co., Ltd.
9F, Building A, No. 50 Zijinghua Road, Hangzhou, China
Tel: +86-571-28827013
Fax: +86-571-28828290
E-mail: intl@narada.biz
Website: www.naradabattery.com

NARADA ASIA PACIFIC PTE.LTD.
65 Ubi Crescent #07-05 Hola centre, Singapore
Tel: +65-6848 1191
Fax: +65-6749 3498
E-mail: sales@narada.com.sg

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:	