圣阳电源
SACRED SUN

VALVE-REGULATED SEALED LEAD ACID BATTERY

SP Series

SACRED SUN

Technical Manual

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Chapter I: Product Introduction

Product Characteristics

Advantages

- Design life: >20Ah,10 years; ≤20Ah, 5 years (25℃);
- EUROBAT Classification: Long life (>20Ah) and Standard Commercial (≤20Ah);
- Maximum charge efficiency;
- High gas recombination efficiency;
- Low self-discharge rate;
- Easy handling;
- Easy installation: vertical or horizontal.

Design features

- Positive plates — Flat pasted plate with lead-calcium-tin grid alloy;
- Negative plates — Flat pasted plate with lead-calcium grid alloy;
- Separators — Microporous AGM separator;
- Container and Lid — High-strength ABS (option: available in Flame Retardant UL94 V0 version)
- Electrolyte — Absorbed sulfuric acid;
- Terminal posts — High-conductivity terminals with threaded inserts;
- Post sealing — Double sealing structure;
- Vents — High-efficiency low pressure venting system.

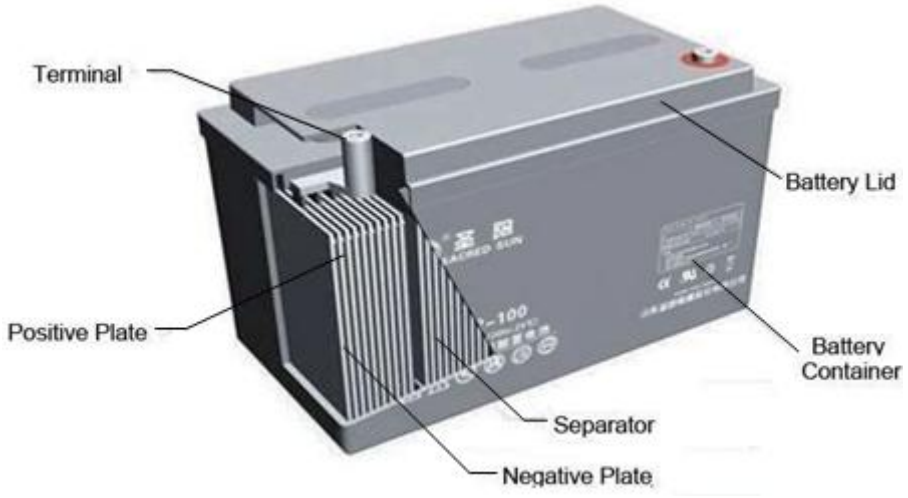
Main Applications

- UPS units
- Emergency power
- Alarms , Fire & Security Systems
- Medical
- General Electronics & Control Equipment
- Communications Equipment

Standards

- IEC61056-1/2:2002
- IEC60896-21/22
- GB/T 19639.1-2005
- JIS C8702-1/2:2009
- JIS C8704-1/2: 2009
- Eurobat Guide

Battery Construction



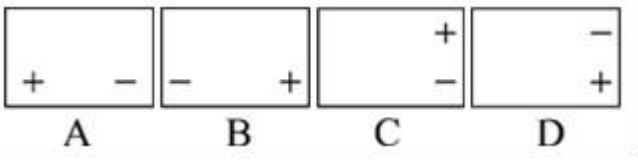
General Specification

SP series

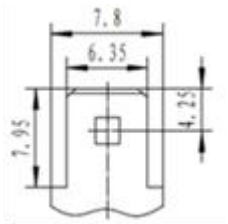
Table 1-1 SP series general specification

Battery Type	Rated Voltage (V)	Rated Capacity (Ah,25℃)		Dimensions (mm)				Weight (kg)	Short Circuit Current (A)	Internal Resistance (mΩ,25℃)	Terminal Type	Terminal Layout
		C_{10} 1.80V/cell	C_{20} 1.75V/cell	L	W	H	TH					
SSP12-6.5	12	5.95	6.5	151	65.5	94	99	2.05	170	27	SP-03	D
SSP12-7	12	6.44	7	151	65.5	94	99	2.15	190	23	SP-03	D
SSP12-8	12	7.43	8	151	65.5	94	99	2.35	210	19	SP-03	D
SSP12-9HR	12	8.10	9	151	65.5	94	99	2.62	230	14	SP-03	D
SSP12-12	12	10.90	12	151	98.5	95.5	101.5	3.6	310	14	SP-03	D
SSP12-18	12	16.55	18	181	76.5	167	167	5.30	460	15	SP-11	B
SP12-26(R)	12	24.05	26	164.5	175	127	127	8.0	670	8.5	M6×Φ14	B
SP12-26(F)	12	24.05	26	164.5	175	127	127	8.0	670	8.5	SP-11	B
SP12-33	12	30.29	33	195	130	158	163	10.5	850	10.2	M6×Φ12	A
SP12-38	12	38	39.5	196	165	165	170	12.2	1300	9.0	M6×Φ16	B
SP12-42	12	42	43.6	196	165	165	170	12.8	1400	8.5	M6×Φ16	B
SP12-50	12	50	52	257	132	193	198	16.0	1600	7.2	M6×Φ16	A
SP12-65	12	65	67.6	314	166	169	174	20.0	1900	6.3	M6×Φ16	B
SP12-80	12	80	83.2	350	167	179.5	179.5	23.2	2400	5.0	M6×Φ16	A
SP12-100	12	100	106	330	174	217	226	29.0	2500	4.9	M8×Φ18	A
SP12-120	12	120	126	375	174	219	227	33.8	2900	4.1	M8×Φ18	A
SP12-150	12	150	156	483	171	219	227	41.5	3400	3.5	M8×Φ18	A
SP12-200	12	200	212	522	234	218	223	57.8	4000	3.0	M8×Φ18	C
SP12-250	12	250	260	534	271	225	233	71.0	4800	2.5	M8×Φ18	C

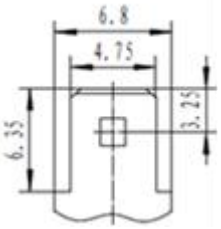
Terminal Layout



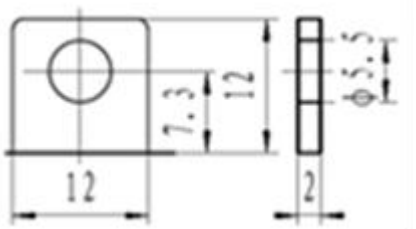
Terminal Type



SP-03



SP-02(Optional)



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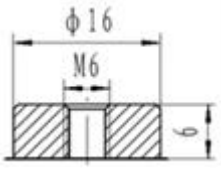
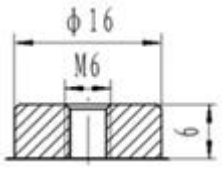
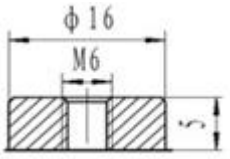
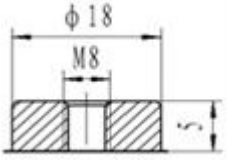








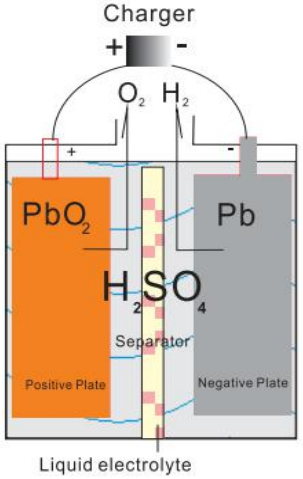
VRLA Technology

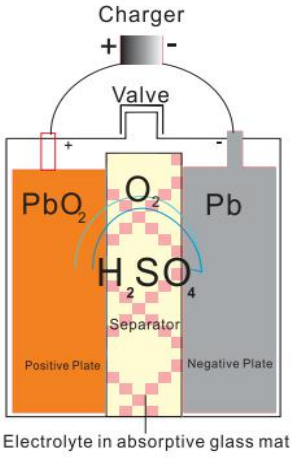
The electrochemical reaction of batteries in charge and discharge process is as follows:

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

In the final stage of charge process, active substance in positive plate is fully transformed to lead dioxide, but negative plate has not reached fully charged stage, the process of active substance in negative plate transforming to spongy lead is not finished, oxygen gas generated in positive plate reaches the negative plate through separator pores and then reacts with active substance in negative plate, resulting depolarized state in negative plate, and restraining the generation of hydrogen.

Principle of the oxygen reduction cycle is as follows:

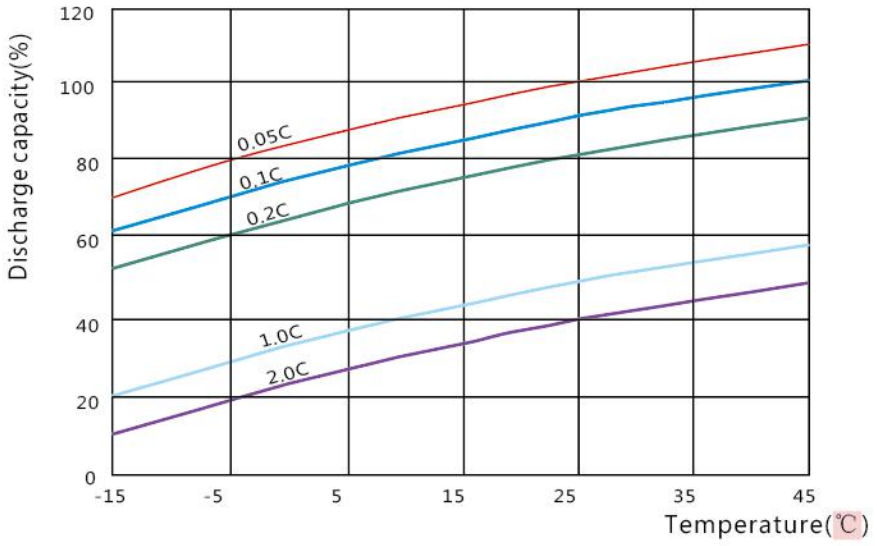




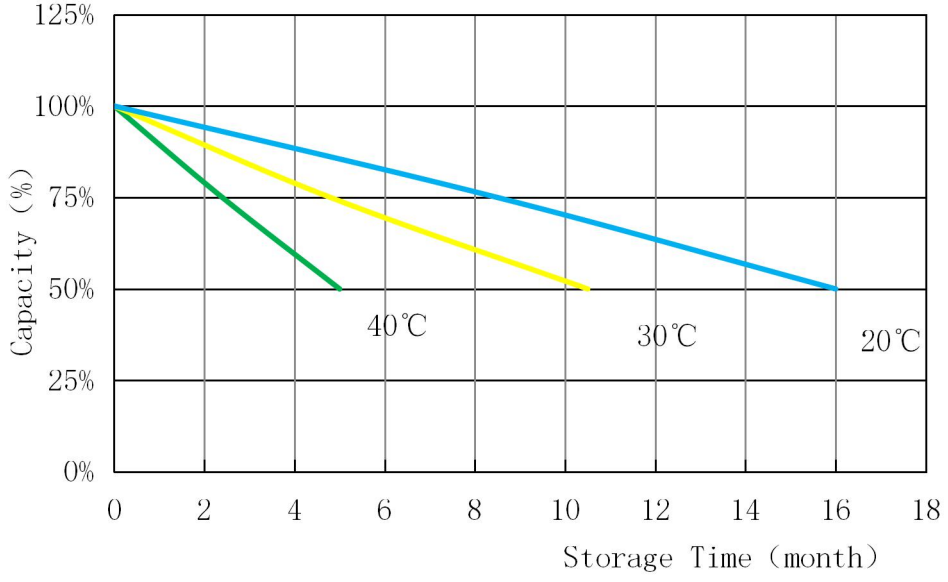
Chapter II: Electrical Characteristics

Discharge/Charge Curve

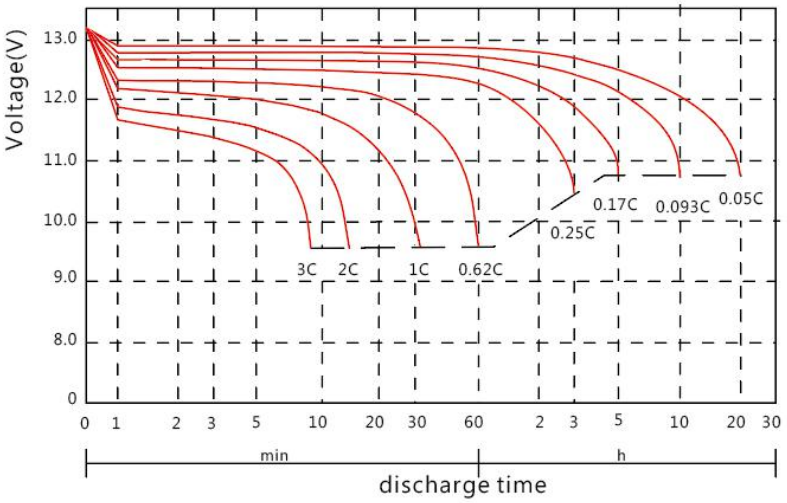
- Figure 2-1 Discharge capacity and temperature curve



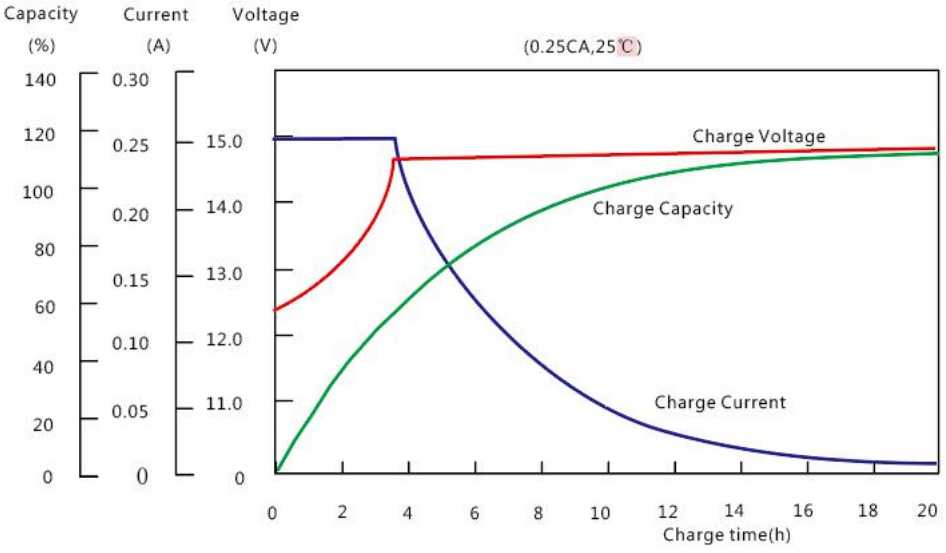
- Figure 2-2 Discharge capacity and storage time curve



- Figure 2-3 Discharge characteristic curve under different discharge rates (25 ℃)



- Figure 2-4 Charge characteristic curve



Performance Data

Constant current discharge data

- Table 2-1 SP Battery Constant Current Discharge Data Sheet (Amperes, 25 ℃)

Constant Current Discharge Data Sheet (25℃)------Amperes(A)														
Battery Type	End Voltage (V/cell)	Discharge Time												
		5 min	10 min	15 min	20 min	30 min	45 min	1 h	1.5 h	2 h	3 h	5 h	10 h	20 h
SSP12-6.5	1.60	30.23	17.909	13.383	10.497	7.622	5.405	4.321	3.132	2.492	1.844	1.216	0.611	0.330
	1.65	29.02	17.525	13.102	10.302	7.493	5.318	4.264	3.093	2.463	1.820	1.207	0.607	0.328
	1.70	27.20	16.917	12.686	10.019	7.307	5.216	4.198	3.051	2.429	1.802	1.197	0.603	0.326
	1.75	24.18	15.990	12.233	9.746	7.150	5.113	4.128	3.0117	2.405	1.786	1.187	0.600	0.325
	1.80	19.83	14.631	11.413	9.230	6.864	4.945	4.033	2.960	2.371	1.765	1.174	0.595	0.323
SSP12-7	1.60	31.50	18.942	13.608	11.126	7.887	5.788	4.636	3.349	2.700	2.000	1.298	0.659	0.354
	1.65	30.24	18.425	13.356	11.021	7.812	5.727	4.592	3.307	2.668	1.975	1.291	0.657	0.353
	1.70	28.58	17.926	13.028	10.800	7.692	5.633	4.534	3.265	2.640	1.957	1.281	0.655	0.352
	1.75	25.2	17.220	12.600	10.496	7.490	5.507	4.445	3.22	2.606	1.938	1.270	0.650	0.350
	1.80	20.16	15.498	11.718	9.940	7.190	5.325	4.343	3.165	2.569	1.915	1.256	0.644	0.348
SSP12-8	1.60	37.16	22.539	16.454	12.919	9.296	6.652	5.319	3.827	3.087	2.265	1.493	0.761	0.405
	1.65	36.02	21.974	16.108	12.679	9.139	6.545	5.248	3.779	3.052	2.236	1.486	0.758	0.404
	1.70	35.26	21.652	15.882	12.499	9.016	6.463	5.192	3.743	3.022	2.217	1.474	0.756	0.402
	1.75	31.68	20.160	15.040	11.995	8.720	6.293	5.080	3.680	2.980	2.195	1.461	0.750	0.400
	1.80	28.20	18.446	14.032	11.359	8.371	6.086	4.963	3.617	2.938	2.168	1.445	0.743	0.398
SSP12-9HR	1.60	43.92	25.222	17.329	13.441	9.722	6.765	5.444	3.883	3.108	2.303	1.471	0.840	0.458
	1.65	42.57	24.590	16.965	13.191	9.558	6.656	5.372	3.834	3.072	2.274	1.464	0.835	0.456
	1.70	41.67	24.229	16.727	13.004	9.430	6.573	5.314	3.797	3.042	2.254	1.453	0.825	0.452
	1.75	37.44	22.560	15.840	12.480	9.120	6.400	5.200	3.733	3.000	2.232	1.440	0.820	0.450
	1.80	33.32	20.642	14.779	11.819	8.755	6.189	5.080	3.670	2.958	2.205	1.424	0.810	0.445
SSP12-12	1.60	45.71	29.034	22.055	17.415	13.005	9.724	7.673	5.491	4.248	2.993	1.970	1.122	0.611
	1.65	44.34	28.361	21.591	17.092	12.786	9.568	7.571	5.423	4.198	2.955	1.953	1.115	0.607
	1.70	43.02	27.817	21.289	16.849	12.615	9.448	7.490	5.370	4.157	2.929	1.937	1.107	0.604
	1.75	39.00	25.900	20.160	16.170	12.200	9.200	7.329	5.280	4.100	2.900	1.920	1.100	0.600
	1.80	34.79	23.699	18.809	15.313	11.712	8.896	7.160	5.190	4.043	2.865	1.899	1.090	0.596
SSP12-18	1.60	79.24	46.407	34.180	27.334	19.879	14.769	11.728	8.581	6.900	5.096	3.287	1.709	0.918
	1.65	77.67	44.753	33.282	26.827	19.543	14.630	11.571	8.473	6.820	5.032	3.258	1.694	0.911
	1.70	75.17	42.831	32.694	26.446	19.282	14.407	11.448	8.391	6.753	4.987	3.233	1.684	0.905
	1.75	62.64	38.448	30.960	25.380	18.648	13.920	11.201	8.251	6.660	4.938	3.204	1.6704	0.900
	1.80	54.50	35.180	28.886	24.035	17.902	13.461	10.944	8.110	6.567	4.879	3.169	1.655	0.895

■ Table 2-1 SP Battery Constant Current Discharge Data Sheet (Amperes, 25 ℃)

Constant Current Discharge Data Sheet (25℃)-------Amperes(A)														
Battery Type	End Voltage (V/cell)	Discharge Time												
		5 min	10 min	15 min	20 min	30 min	45 min	1 h	1.5 h	2 h	3 h	5 h	10 h	20 h
SP12-26	1.60	98.90	63.260	50.310	41.067	29.203	20.615	16.723	11.900	9.620	7.140	4.779	2.456	1.317
	1.65	94.94	61.324	49.070	40.478	28.959	20.446	16.611	11.831	9.553	7.102	4.757	2.447	1.312
	1.70	88.03	58.364	47.610	39.471	28.351	20.095	16.374	11.677	9.451	7.032	4.717	2.427	1.303
	1.75	84.24	56.940	46.800	39.000	28.080	19.933	16.255	11.610	9.404	7.003	4.701	2.420	1.300
	1.80	75.98	53.296	44.647	37.713	27.350	19.495	15.963	11.424	9.307	6.947	4.670	2.405	1.294
SP12-33	1.60	104.00	74.900	60.630	49.625	35.585	25.793	20.336	14.561	12.019	8.685	5.812	3.167	1.700
	1.65	97.00	72.000	59.191	49.141	35.307	25.579	20.194	14.463	11.947	8.624	5.772	3.154	1.691
	1.70	92.94	69.300	58.413	48.582	34.947	25.379	20.033	14.360	11.862	8.571	5.730	3.127	1.678
	1.75	86	66.600	56.340	47.025	33.890	24.640	19.470	13.970	11.550	8.360	5.600	3.070	1.650
	1.80	77.22	63.084	54.103	45.276	32.717	23.893	18.917	13.591	11.251	8.170	5.494	3.029	1.635
SP12-38	1.60	130.1	85.50	66.20	51.470	40.00	30.65	22.90	19.10	14.50	10.64	6.700	4.016	2.075
	1.65	125.2	82.60	63.82	49.64	38.83	29.57	22.16	18.59	14.20	10.33	6.604	3.964	2.055
	1.70	121.2	80.60	61.36	48.04	37.57	28.42	21.57	18.01	13.80	10.07	6.526	3.910	2.015
	1.75	116.6	77.30	59.02	46.44	36.50	27.62	20.90	17.39	13.38	9.791	6.460	3.860	1.975
	1.80	110.6	74.00	56.90	44.93	35.34	26.94	20.10	16.81	13.00	9.500	6.356	3.800	1.935
SP12-42	1.60	143.8	94.50	73.20	57.35	44.76	35.00	26.44	21.37	16.50	11.98	7.360	4.530	2.340
	1.65	138.6	91.30	70.09	54.71	42.74	33.60	25.43	20.50	15.90	11.61	7.290	4.450	2.290
	1.70	135.2	89.10	67.29	52.61	41.26	32.40	24.44	19.82	15.30	11.25	7.200	4.380	2.230
	1.75	130.1	85.40	64.58	50.35	39.55	30.85	23.10	18.80	14.70	10.89	7.140	4.310	2.180
	1.80	122.2	81.67	61.86	48.57	38.23	29.30	21.78	18.00	14.00	10.50	6.960	4.200	2.120
SP12-50	1.60	172.0	115.0	92.50	75.00	56.00	41.12	29.78	23.67	18.99	13.50	8.927	5.325	2.715
	1.65	154.4	111.0	88.91	73.13	54.56	40.00	29.09	22.88	18.56	13.25	8.792	5.250	2.675
	1.70	141.2	106.0	86.45	70.87	53.27	39.01	28.42	22.24	18.13	13.03	8.632	5.170	2.640
	1.75	130.2	101.3	83.45	68.31	51.74	37.82	27.50	21.57	17.67	12.80	8.500	5.100	2.600
	1.80	120.8	96.00	79.93	66.24	50.00	36.50	26.38	20.94	17.21	12.50	8.294	5.000	2.520
SP12-65	1.60	214.8	148.0	120.0	96.50	72.20	52.81	38.25	30.38	23.44	18.02	11.68	6.920	3.630
	1.65	196.4	142.0	115.4	92.80	70.00	51.20	37.43	29.62	22.85	17.51	11.44	6.850	3.560
	1.70	181.6	136.0	110.8	89.60	68.20	50.00	36.62	29.11	22.26	17.09	11.28	6.750	3.480
	1.75	167.8	131.0	106.8	86.80	66.70	48.74	35.75	28.52	21.92	16.67	11.05	6.650	3.380
	1.80	152.9	125.0	102.2	83.60	64.70	47.50	34.56	27.93	21.50	16.25	10.70	6.500	3.270

- Table 2-1 SP Battery Constant Current Discharge Data Sheet (Amperes, 25 ℃)

Constant Current Discharge Data Sheet (25℃)-------Amperes(A)														
Battery Type	End Voltage (V/cell)	Discharge Time												
		5 min	10 min	15 min	20 min	30 min	45 min	1 h	1.5 h	2 h	3 h	5 h	10 h	20 h
SP12-80	1.60	261.0	181.0	137.0	110.0	82.60	61.80	46.51	36.42	29.18	20.75	13.74	8.270	4.240
	1.65	249.0	176.0	133.0	108.0	81.10	60.70	45.70	36.12	28.95	20.56	13.66	8.210	4.220
	1.70	234.0	166.7	129.2	105.3	80.00	59.80	45.10	35.82	28.75	20.38	13.57	8.160	4.200
	1.75	212.0	157.0	124.7	102.4	78.10	58.40	44.00	35.45	28.50	20.23	13.50	8.080	4.160
	1.80	188.6	146.0	120.0	98.50	75.30	56.50	42.80	34.82	28.14	20.00	13.41	8.000	4.110
SP12-100	1.60	335.0	236.0	181.0	148.0	110.0	80.00	59.80	47.30	37.30	26.60	17.63	10.50	5.430
	1.65	315.0	227.0	175.0	144.0	107.0	78.00	58.20	46.50	36.90	26.30	17.40	10.40	5.400
	1.70	292.0	216.0	169.0	140.0	104.0	76.00	56.30	45.60	36.20	26.00	17.20	10.30	5.350
	1.75	262.0	201.0	162.0	135.0	101.0	74.00	55.00	45.00	35.30	25.50	17.00	10.20	5.300
	1.80	237.0	184.0	153.9	129.0	97.00	72.50	53.40	43.50	34.50	25.00	16.60	10.00	5.200
SP12-120	1.60	372.0	280.0	217.0	174.5	132.0	97.50	71.60	56.52	44.50	32.70	21.73	12.40	6.550
	1.65	366.0	275.0	213.0	170.0	128.9	95.90	69.80	55.75	43.64	32.29	21.25	12.32	6.450
	1.70	351.0	264.0	205.0	163.9	126.0	93.50	68.00	54.72	42.74	31.74	20.75	12.25	6.370
	1.75	317.0	243.0	193.0	157.4	122.0	90.00	66.00	53.45	42.00	31.10	20.40	12.18	6.300
	1.80	268.0	219.6	179.0	146.8	114.0	85.00	63.00	51.00	40.50	30.00	19.70	12.00	6.200
SP12-150	1.60	465.0	330.0	253.1	190.3	160.5	117.8	89.40	70.80	56.00	40.80	26.34	15.42	7.940
	1.65	450.0	322.1	245.9	184.6	155.4	114.2	87.40	69.10	54.70	40.30	26.07	15.35	7.900
	1.70	435.0	310.8	238.3	178.9	150.7	110.7	84.90	67.30	53.30	39.50	25.90	15.28	7.850
	1.75	390.0	293.8	229.1	172.7	146.4	107.1	82.50	65.70	52.20	38.60	25.50	15.20	7.800
	1.80	350.0	271.9	214.8	163.7	141.1	102.9	79.70	64.00	50.90	37.50	24.94	15.00	7.700
SP12-200	1.60	553.6	440.0	335.0	262.0	203.0	151.0	117.0	95.00	74.50	53.20	35.30	20.45	10.77
	1.65	535.7	415.0	325.0	253.0	198.0	147.0	115.0	93.50	73.40	52.50	34.80	20.37	10.70
	1.70	508.9	400.0	310.0	244.0	190.0	143.0	113.0	91.50	72.40	51.70	34.40	20.28	10.65
	1.75	464.3	364.0	290.0	234.0	182.0	138.0	110.0	89.00	71.50	51.00	34.00	20.20	10.60
	1.80	401.8	335.0	273.0	220.0	175.0	133.0	105.0	86.50	69.00	50.00	33.20	20.00	10.50
SP12-250	1.60	663.7	500.0	390.0	314.0	246.0	190.0	153.0	116.0	89.00	62.50	42.90	23.60	12.50
	1.65	637.2	487.0	379.0	307.0	240.0	186.0	148.5	116.0	89.00	65.10	42.90	25.70	13.25
	1.70	601.8	470.0	367.0	298.0	232.0	180.0	145.5	114.0	88.00	64.60	42.50	25.55	13.18
	1.75	561.9	450.0	353.0	287.0	223.0	174.0	142.5	111.0	86.00	64.00	42.05	25.40	13.09
	1.80	513.3	425.0	332.0	270.0	210.0	167.0	137.5	107.0	83.00	63.30	41.65	25.26	13.00

Constant power discharge data

- Table 2-2 SP Battery Constant Power Discharge Data Sheet (W/cell, 25℃)

Constant Power Discharge Data Sheet (25℃)-------Watt (W)														
Battery Type	End Voltage (V/cell)	Discharge Time												
		5 min	10 min	15 min	20 min	30 min	45 min	1 h	1.5 h	2 h	3 h	5 h	10 h	20 h
SSP12-6.5	1.60	55.06	33.65	25.46	20.17	14.76	10.54	8.47	6.17	4.92	3.65	2.42	1.22	0.66
	1.65	53.08	33.01	24.99	19.83	14.54	10.39	8.38	6.10	4.88	3.62	2.40	1.21	0.66
	1.70	50.19	32.06	24.31	19.36	14.23	10.23	8.27	6.04	4.82	3.59	2.39	1.21	0.65
	1.75	44.86	30.41	23.52	18.90	13.96	10.06	8.15	5.97	4.78	3.56	2.38	1.20	0.65
	1.80	37.08	27.97	22.05	17.95	13.44	9.74	7.99	5.89	4.73	3.53	2.35	1.19	0.65
SSP12-7	1.60	57.40	36.11	26.26	21.57	15.34	11.30	9.09	6.59	5.34	3.96	2.58	1.31	0.71
	1.65	55.39	35.20	25.83	21.42	15.23	11.21	9.02	6.52	5.28	3.92	2.57	1.31	0.71
	1.70	52.87	34.36	25.28	21.05	15.04	11.06	8.94	6.46	5.24	3.90	2.56	1.31	0.71
	1.75	46.75	33.11	24.49	20.50	14.67	10.83	8.78	6.39	5.18	3.87	2.54	1.30	0.70
	1.80	37.75	29.92	22.84	19.46	14.13	10.51	8.60	6.29	5.12	3.83	2.52	1.29	0.70
SSP12-8	1.60	67.69	42.49	31.30	24.83	18.00	12.97	10.43	7.53	6.10	4.49	2.97	1.52	0.81
	1.65	65.92	41.52	30.74	24.43	17.74	12.80	10.31	7.46	6.05	4.44	2.96	1.51	0.81
	1.70	65.05	41.13	30.44	24.16	17.56	12.68	10.23	7.41	6.00	4.41	2.94	1.51	0.81
	1.75	58.66	38.40	28.91	23.26	17.03	12.38	10.03	7.30	5.93	4.38	2.92	1.50	0.80
	1.80	52.63	35.30	27.11	22.10	16.39	11.99	9.83	7.19	5.86	4.33	2.90	1.49	0.80
SSP12-9HR	1.60	80.00	47.45	32.97	25.83	18.83	13.19	10.68	7.64	6.14	4.57	2.93	1.674	0.916
	1.65	77.90	46.43	32.38	25.42	18.55	13.01	10.56	7.57	6.09	4.52	2.92	1.668	0.913
	1.70	76.76	46.02	32.05	25.13	18.37	12.90	10.48	7.51	6.04	4.49	2.90	1.651	0.906
	1.75	69.33	43.01	30.45	24.20	17.81	12.59	10.27	7.41	5.97	4.45	2.88	1.644	0.904
	1.80	62.20	39.53	28.55	22.99	17.15	12.20	10.07	7.30	5.90	4.41	2.85	1.627	0.895
SSP12-12	1.60	83.57	54.50	41.90	33.39	25.16	18.96	15.05	10.81	8.39	5.93	3.92	2.24	1.22
	1.65	81.30	53.42	41.13	32.86	24.80	18.71	14.89	10.71	8.31	5.87	3.89	2.23	1.22
	1.70	79.15	52.58	40.70	32.49	24.54	18.52	14.76	10.63	8.25	5.83	3.87	2.22	1.21
	1.75	72.22	49.10	38.66	31.30	23.82	18.10	14.47	10.47	8.15	5.79	3.84	2.21	1.21
	1.80	64.76	45.07	36.25	29.79	22.94	17.53	14.19	10.32	8.06	5.73	3.81	2.19	1.20
SSP12-18	1.60	138.7	84.61	64.37	52.36	38.43	28.79	23.00	16.89	13.63	10.10	6.54	3.41	1.83
	1.65	138.5	82.45	63.05	51.55	37.87	28.59	22.73	16.73	13.50	10.00	6.49	3.38	1.82
	1.70	136.6	79.60	62.39	51.04	37.51	28.23	22.55	16.61	13.41	9.93	6.46	3.37	1.82
	1.75	115.4	72.03	59.37	49.13	36.41	27.38	22.12	16.37	13.25	9.85	6.41	3.35	1.81
	1.80	101.2	66.55	55.68	46.75	35.06	26.53	21.68	16.12	13.09	9.75	6.35	3.33	1.80

■ Table 2-2 SP Battery Constant Power Discharge Data Sheet (W/cell, 25℃)

Constant Power Discharge Data Sheet (25℃)-------Watt (W)														
Battery Type	End Voltage (V/cell)	Discharge Time												
		5 min	10 min	15 min	20 min	30 min	45 min	1 h	1.5 h	2 h	3 h	5 h	10 h	20 h
SP12-26	1.60	180.65	118.61	96.04	79.25	56.75	40.32	32.86	23.48	19.05	14.18	9.52	4.91	2.64
	1.65	174.07	115.42	93.92	78.37	56.43	40.11	32.74	23.41	18.96	14.15	9.50	4.90	2.63
	1.70	162.65	110.70	91.68	76.81	55.54	39.58	32.40	23.20	18.84	14.06	9.46	4.88	2.63
	1.75	156.25	108.39	90.38	76.08	55.12	39.35	32.23	23.12	18.78	14.03	9.45	4.88	2.63
	1.80	142.00	101.87	86.52	73.76	53.84	38.60	31.73	22.80	18.64	13.96	9.40	4.86	2.62
SP12-33	1.60	183.82	138.39	114.45	94.71	68.38	49.90	39.61	28.49	23.63	17.19	11.56	6.34	3.41
	1.65	175.09	134.32	112.48	94.31	68.22	49.78	39.44	28.39	23.58	17.11	11.51	6.33	3.40
	1.70	171.06	130.92	111.81	93.84	67.97	49.66	39.42	28.36	23.55	17.10	11.49	6.31	3.39
	1.75	159.28	126.24	108.13	91.07	66.09	48.35	38.41	27.67	22.99	16.72	11.25	6.21	3.34
	1.80	144.31	120.36	104.32	87.99	64.06	47.09	37.44	27.02	22.49	16.40	11.07	6.14	3.32
SP12-38	1.60	239.4	165.7	130.0	100.6	82.65	61.99	45.55	36.91	28.60	20.68	13.20	8.014	4.214
	1.65	231.5	160.9	126.4	97.83	80.74	60.40	44.49	36.10	28.20	20.38	13.03	7.923	4.172
	1.70	224.6	156.1	123.4	95.28	79.31	58.73	43.40	35.80	27.80	20.07	12.90	7.841	4.123
	1.75	218.4	151.2	120.2	92.74	77.32	57.38	42.22	35.06	27.00	19.84	12.70	7.747	4.064
	1.80	209.2	144.6	117.5	90.23	75.18	55.95	40.90	34.28	26.50	19.62	12.50	7.649	3.976
SP12-42	1.60	264.0	185.0	144.0	117.6	93.10	73.30	52.60	43.00	34.22	23.30	16.80	9.040	4.750
	1.65	258.0	178.0	139.0	113.3	90.80	70.80	51.05	42.50	33.60	22.90	16.40	8.890	4.650
	1.70	251.0	172.0	135.0	109.1	87.20	67.30	49.18	41.00	32.83	22.40	16.00	8.780	4.560
	1.75	243.0	168.0	130.6	104.9	83.80	65.00	46.65	40.50	32.15	22.10	15.70	8.650	4.485
	1.80	234.3	160.0	126.0	100.7	80.00	62.30	44.30	39.00	31.59	21.70	15.40	8.450	4.375
SP12-50	1.60	290.0	206.8	159.5	139.0	111.90	81.50	61.74	48.72	37.75	26.52	18.50	10.92	5.655
	1.65	275.2	198.9	156.3	135.9	109.20	78.95	59.70	47.63	36.96	25.90	18.20	10.69	5.540
	1.70	266.5	192.5	153.4	132.3	105.90	77.08	58.03	46.44	35.97	25.31	17.59	10.42	5.435
	1.75	256.1	186.1	149.6	129.2	102.80	74.60	56.27	45.00	34.58	24.45	16.90	10.25	5.280
	1.80	245.0	177.4	145.7	125.5	97.83	71.94	54.17	43.50	33.40	23.56	16.50	9.890	5.100
SP12-65	1.60	395.2	267.3	208.9	166.5	130.00	103.00	76.28	62.80	46.50	33.67	21.41	13.58	7.115
	1.65	368.7	257.0	202.4	160.6	127.00	100.00	73.92	60.30	45.74	33.29	21.20	13.40	7.015
	1.70	342.0	246.6	196.0	154.8	121.40	97.70	71.83	58.60	45.02	33.01	21.00	13.24	6.890
	1.75	313.0	233.4	187.0	148.8	117.00	94.00	69.46	56.60	44.17	32.62	20.90	13.07	6.800
	1.80	283.0	220.0	177.0	140.6	111.00	89.80	66.78	54.50	43.50	32.24	20.70	12.86	6.675

■ Table 2-2 SP Battery Constant Power Discharge Data Sheet (W/cell, 25℃)

Constant Power Discharge Data Sheet (25℃)-------Watt (W)														
Battery Type	End Voltage (V/cell)	Discharge Time												
		5 min	10 min	15 min	20 min	30 min	45 min	1 h	1.5 h	2 h	3 h	5 h	10 h	20 h
SP12-80	1.60	440.0	320.0	248.0	203.3	150.60	114.20	86.30	69.36	55.50	39.57	26.48	16.18	8.250
	1.65	428.0	315.0	246.0	199.9	148.80	112.20	85.34	68.69	55.07	39.36	26.34	16.04	8.200
	1.70	408.0	307.0	242.0	196.3	147.30	110.80	84.18	68.30	54.65	39.21	26.25	15.92	8.170
	1.75	376.0	289.0	234.0	193.1	145.10	109.10	82.95	67.69	53.99	38.98	26.13	15.77	8.140
	1.80	336.7	269.0	224.0	187.3	141.20	106.90	81.16	66.90	53.23	38.66	25.98	15.60	8.070
SP12-100	1.60	565.0	422.0	329.0	272.4	204.0	151.0	112.0	88.00	69.70	50.10	33.30	20.50	10.98
	1.65	540.0	410.0	323.0	266.9	201.0	147.6	110.7	87.06	69.13	49.75	33.07	20.30	10.92
	1.70	509.0	394.0	315.0	261.5	197.0	144.5	108.8	86.13	68.44	49.30	32.87	20.11	10.88
	1.75	467.0	372.0	304.0	253.6	192.0	141.5	106.5	85.12	67.68	48.90	32.62	19.90	10.81
	1.80	429.0	346.9	290.0	244.0	186.0	139.0	103.8	83.50	66.50	48.12	32.30	19.62	10.61
SP12-120	1.60	615.0	470.0	370.0	301.8	237.0	177.0	134.5	105.0	82.79	61.40	40.31	24.84	13.14
	1.65	610.0	465.0	365.0	296.7	232.4	174.9	131.7	104.0	81.86	60.75	39.79	24.60	12.94
	1.70	590.4	455.0	357.0	290.5	227.3	171.5	128.9	103.0	80.93	60.15	39.48	24.41	12.83
	1.75	540.0	425.0	342.0	282.6	221.7	168.1	126.5	101.4	80.15	59.60	39.02	24.20	12.65
	1.80	460.0	387.0	320.0	269.1	215.0	163.0	123.2	99.00	78.70	58.45	38.50	23.90	12.46
SP12-150	1.60	760.0	560.0	450.5	333.9	275.40	202.00	157.4	132.9	104.5	76.84	49.45	30.85	15.90
	1.65	742.0	546.6	439.1	325.3	267.90	197.10	154.7	130.5	103.0	76.08	49.00	30.73	15.87
	1.70	705.0	528.6	424.1	315.3	261.40	192.60	151.9	129.0	101.7	75.39	48.56	30.59	15.82
	1.75	655.0	504.0	407.9	303.7	252.30	188.70	148.1	126.6	100.0	74.68	48.12	30.45	15.76
	1.80	589.0	472.3	387.9	290.7	244.10	183.30	143.3	123.3	98.50	73.58	47.50	30.23	15.63
SP12-200	1.60	928.6	740.0	580.0	458.0	355.0	273.0	210.0	171.0	136.0	100.8	66.20	40.00	21.10
	1.65	892.9	710.0	565.0	451.0	349.0	267.0	207.0	169.0	135.0	100.1	65.80	39.70	21.05
	1.70	854.5	677.0	548.0	437.0	341.0	262.0	203.0	168.0	134.0	99.50	65.30	39.50	20.99
	1.75	791.1	640.0	521.0	420.0	329.0	256.0	199.0	167.0	133.0	98.70	64.70	39.30	20.94
	1.80	714.3	595.0	491.0	399.0	312.0	248.0	193.0	164.0	131.0	96.60	64.00	39.00	20.80
SP12-250	1.60	1106	853.0	690.0	560.0	450.00	350.00	265.0	207.0	162.0	126.0	80.40	49.47	25.76
	1.65	1079	833.0	671.0	548.0	440.00	343.00	260.0	205.0	161.0	125.0	79.50	49.38	25.70
	1.70	1035	805.0	653.0	534.0	427.00	334.00	255.0	202.0	159.0	124.1	78.70	49.26	25.63
	1.75	984.1	775.0	631.0	516.0	412.00	321.00	247.0	199.0	157.0	123.1	77.60	49.13	25.56
	1.80	882.3	730.0	605.0	495.0	397.00	309.00	237.0	195.0	155.0	121.8	76.30	48.90	25.43

Chapter III: Operation and Maintenance

Safety Instructions

Please read these instructions carefully in order to ensure correct, safe and effective operation. This manual provides you very important guidance for installation and operation, which will guarantee your equipment with optimal performance and longer service life.

- For your safety, please do not open the batteries;
- As batteries contain lead which can potentially be harmful to the environment and health, and as batteries are connected to electricity, they must be installed, maintained and replaced by skilled personnel only.
- Used batteries must be recycled and disposed properly as improper disposal of batteries is harmful to the environment and health. Used batteries shall be properly disposed following relative regulations and laws.
- It is strictly forbidden to mix batteries with different specifications, manufacturers and capacities.
- All installations must comply with the safety regulations and norms. Read through our Operation Guide / Safety Instructions before starting any installation work.

Notices

				
Warning	Electrical shock	Protective eyewear and clothing required	Keep children away from the batteries	No short circuit
				
No flames and sparks	Recycle	Proper disposal	Read instructions	Electrolyte is highly corrosive

Factors Influencing Capacity

Battery capacity consists both of nominal capacity and actual capacity, for nominal capacities of the FT series battery please refer to Table 1-1. Actual capacity is the real quantity of electricity battery discharge under certain condition, it equals to discharge current multiplied by discharge time, the unit is Ah.

Battery capacity is directly related to discharge current, end voltage and discharge temperature.

Temperature Effect on Battery Capacity

Figure 3-1 describes temperature effect on battery capacity (C10). For example, if temperature falls from 25℃ to 0℃, battery capacity will be 85% of the nominal capacity, low temperature will cause long term charge shortage, negative plates will be irreversibly sulfated and as a result the battery cannot be used normally.

As temperature rises, battery capacity will increase to a certain point. For example, if temperature rises from 25℃ to 35℃, battery capacity will be approximately 105% of the nominal capacity. From 35℃ to 50℃, the capacity increase is very low and if temperature rises beyond 50℃, there is no increase in battery capacity.

- Figure 3-1 temperature effect on battery capacity curve

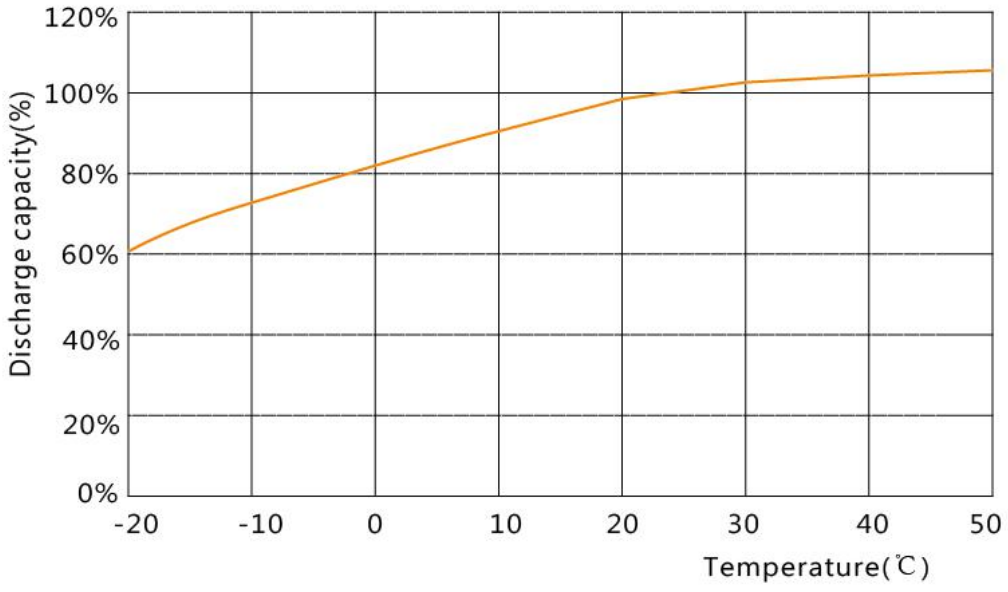
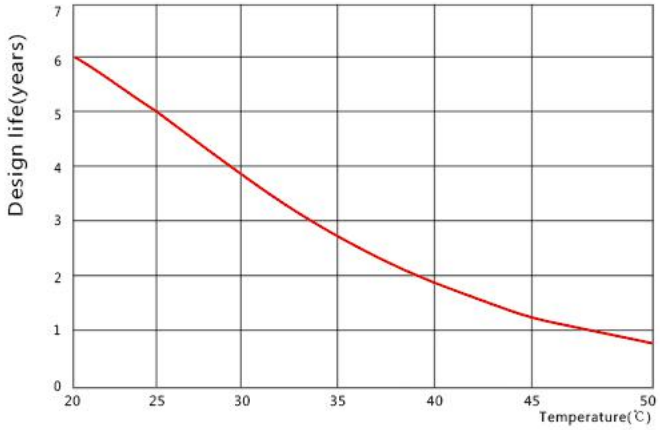
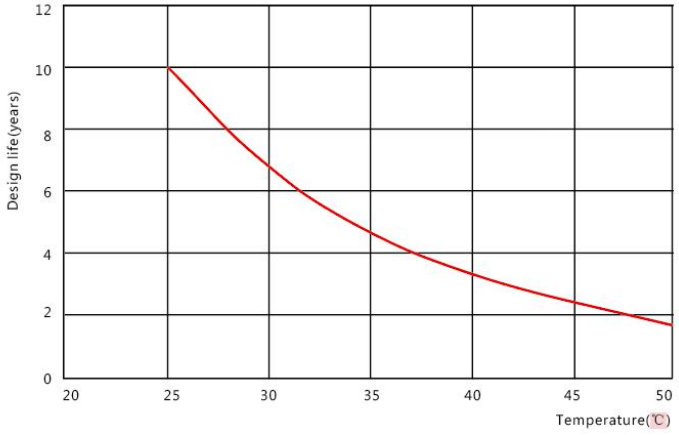


Figure 3-2 service life and temperature curve --- SSP series



- Figure 3-3 Service life and temperature curve --- SP series



Charge

Floating charge

Charge method: 2.27V/cell with limited current of 0.3 C_{20} (A).

Charge voltage must be adjusted according to ambient temperature, temperature compensation coefficient is -3mV/cell/℃.

Floating charge voltage at different ambient temperature, as below table

Temperature(℃)	Floating charge voltage (V/cell)
0	2.33~2.36
10	2.30~2.33
20	2.27~2.30
25	2.25~2.28
30	2.24~2.27
35	2.22~2.25

Cycle application

Charge method: 2.45V/cell with limited current of 0.25 C_{20} (A).

Charge voltage must be adjusted according to ambient temperature, temperature compensation coefficient is -4mV/cell/℃.

When charged capacity is about 105-110% of discharged capacity or in constant voltage case, the charge current must be kept unchanged for 3 hours in the final stage of charge., charge is ended.

Fast charge

Increasing the charge voltage to 2.40V per cell can reduce recharge time and it is possible, depending on the depth of discharge, to half the recharge time. Under these conditions, however, the charge must be monitored and must be terminated when the charge current remains reasonably steady for 3 hours after the voltage limit has been reached. At the beginning of charge the current must be limited to 0.3C_{20} (A)

Ripple current

The ripple content of the charging current affects the life of the battery. It is recommended to limit the continuous Ripple current to 0.05C_{20} (in amperes) as recommended value (never exceed 0.1C_{20}). Transient and other ripple type Voltage excursions can be accommodated provided that, with the battery disconnected, the system peak to peak voltage including regulation limits falls within 2.5% of the recommended float voltage of the battery.

Battery Calculations

Floating applications

A battery application is characterized by:

- A voltage which must be held within certain limits;
- A power level which must be delivered;
- A set capacity to maintain the load in terms of time.

By the use of these three parameters, calculations can be affected as follows:

- A situation requires: a maximum voltage of 490 volts a minimum voltage of 378 volts;
- The ambient temperature is 25℃;
- The float voltage is to be 2.27V per cell.

Preliminary calculation:

- The maximum number of cells: 490V/2.27V=216 cells;
- The minimum voltage per cell at the end of discharge: 378/216=1.75V.

Case1: discharge with a surge at the end of discharge

The surge power is to be 50kW for 10 minutes, followed by 10kW for 2 hours.

Discharge current:

During the surge:50000W/378V=132 amps, and then:10000W/378V=26 amps

Determining the cell required for the current required:

Current flow during surge: (132Ax10min)/60min=22Ah

Current flow for 4 hour:26Ax2h-52Ah

Total capacity drawn:22Ah+52Ah=74Ah

Equivalent discharge time at 26 amps to supply 74Ah:74/26=2.8hours

From the table of performance characteristics, expressed in terms of the discharge current in amps for 1.75V end voltage, the cell to give a current of 26 amps for 2.8 hours is the SP12-100

Conclusion:

In this example, it is the total number of Ah required which determine the battery to be used, i.e. 216 cells/36 batteries of type SP12-100.

Case2: discharge with a surge at the end of discharge (here again, it is the surge which dictates the battery to be used).

The continuous power is to be 10kW for one hour, followed by a surge of 50kW for 20 minutes.

Discharge current:

During the surge: 50000W/378V=132 amps

Before the surge: 10000W/378V=26 amps

Capacity drawn in 1 hour: 26Ax1h=26Ah

Capacity drawn during surge (20 min)(132 ampsx20min)/60min=43.5Ah

Total capacity drawn: 69.5Ah

Equivalent discharge time at 360 amps to supply 26Ah (69.5/132)x60min-32min

From the table of performance characteristics, expressed in terms of the discharge current in amps for 1.75V end voltage, the cell to give a current of 132 amps for 32 minutes is the SP12-150. The battery to be used will consist of 216 cells/36 batteries of type SP12-150.

Accidental deep discharge

This may involve discharge of the battery into indicator lamps, a lower load on the battery than that Initially planned, a failure of the charging system, a discharged battery not recharged immediately, etc…

On a fully discharge battery:

All of the sulphuric acid has been consumed, and the electrolyte is now nearly water. Sulphation of the electrolyte is now nearly water. Sulphation of the plates is at a maximum, thus increasing greatly the internal resistance of the battery. The aqueous solution in which the battery now finds itself can give rise to the development of lead dendrites on the separator during recharging, and this may cause the cell to short-circuit internally.

Important note:

This type of deep discharge will still result in the premature deterioration of the battery, and a significant Effect on its life expectancy.

Effect of temperature on capacity

Temperature affects capacity of batteries. The following formula gives the correction factors according to temperature, where the reference temperature is 25 ℃

$$C_{25℃} = \frac{C_T}{1 + k\ (T - 25)}$$

In formula:

T---Discharge temperature

C_T---Capacity at temperature of T

k---Temperature coefficient;

k=0.006/℃ at C_{10} discharge;

k=0.008/℃ at C_3 discharge;

k=0.01/℃ at C_1 discharge.

Operating

Warning

- The batteries are already charged when delivered, and are fitted with a protective cap on each terminal. They should be unpacked with care.
- Avoid short-circuiting terminals of opposite polarity, because these units are capable of discharging at a very high current especially if the lid or the container is damaged.

Unpacking the battery

- Each shipment is accompanied by a packing list
- The packing list should be checked, and the Sales Department should be told immediately of any missing items.

Setting up the battery racks

The structure should be assembled in accordance with instructions supplied with the equipment.

Racks

- Ensure that the stretchers and cross-members are correctly interlinked.
- Take up any irregularity in floor surface using shims.
- Ensure that all frame members are correctly interlinked.
- Use the adjustable feet to take up irregularities in the floor surface.
- Metal racks should always be connected to the building earth in accordance with current regulations.

Mounting in a cabinet

- Is sufficiently strong to cope with the weight of the battery.
- Is covered with a layer of insulation.
- Is naturally ventilated.

Connection of cells

All connections should be insulated

In series:

The number of cells in series will determine the total float of voltage:

U = V x N

U --- Total float voltage

V --- Float voltage for one cell

N --- Number of cells

In parallel:

The same battery may be connected in parallel to give higher current capability. This connection in parallel will be preferably carried out through an equipotential wiring for an equal current distribution in each string. There is no technical reason for limiting the number of strings, but for practical installation reasons, it is recommended not to exceed 4 strings in parallel especially if the battery is used in high discharge rates (standby time lower than 1 hour).

General recommendations

- Do not wear clothing of synthetic material, to avoid the generation of static potentials.
- Use insulated tools
- Place the cells beginning with the least accessible rows, spacing the cells as shown on the drawing.
- Consult the drawing for the correct position of the battery poles (positive=red color, negative=black color).
- Before attaching the inter-cell flexible cables, check that all terminals are in the correct position.
- The battery cells are connected in series, which is with a positive pole connected to a negative pole.
- Use only a damp cotton cloth for cleaning purposes.
- Tighten the nuts or bolts to the recommended levels of torque indicated on the operation guide.
- Always use insulated tools for fitting and torque up battery connections.

Storage

Storage Interval:

- Battery should be stored in fully charged state. It is strictly prohibited to storage after discharge.
- Battery storage location must be away from heat, sparks and smoke.
- Battery must be stored in an upright position, avoiding impacts of external force or abrupt loads. Safety valve should be tightened.
- It is strictly prohibited to stack battery without properly protective packaging.
- Battery can be stored in -10～45℃ environment.

Storage temperature	Maximum storage times / refreshening charge intervals	Recommended refreshening charge method
-10～30℃	Every 6 months	Using constant current $0.1C_{10}A$～$0.15C_{10}A$ to charge battery bank till battery average voltage rises to equalizing charge voltage, then switch to constant voltage charging. Charging time is generally 10~20h.
31～45℃	Every 3 months	
Maximum storage time (Shelf life) is 18 months (25℃).		

- Battery must be stored in a dry, ventilated and clean environment.
- Protect the battery from harsh weather, moisture, flooding, direct or indirect sun radiation, organic solvents, corrosive substances and gas.

The state of charge of the battery can be determined by measuring the open circuit voltage after the battery has been allowed to rest for 24 hours.

% of capacity at 25℃	Voltage per cell at different temperature				
	0℃	10℃	20℃	30℃	40℃
100%	2.16	2.15	2.14	2.13	2.13
80%	2.09	2.09	2.09	2.09	2.09
60%	2.06	2.06	2.06	2.06	2.06
40%	2.02	2.02	2.02	2.02	2.02
20%	1.97	1.97	1.97	1.97	1.97

Maintenance

1. Cleaning Notes:

- Battery appearance, terminal area and working environment must be kept clean and dry.
- In battery cleaning process, avoid use of electrostatic cleaning tools.
- Clean the battery with damp cloth. Do not use of gasoline, alcohol or other organic solvents; also do not use cloth containing these substances.

2. Inspection and Maintenance

VRLA batteries are not maintenance-free batteries, battery operation process gradually changes with time. In order to ensure good battery usage, operational management and control are very important. To understand the operation status of batteries and equipment and to prevent accidental damage, regular maintenance is required. Periodically check and record the measurements using the following method for batteries used in UPS system room and base station (including outdoor station) site.

2.1 Monthly Maintenance Inspection Items

Item	Content	Standard	Maintenance
1-Temperature Detection	1-Measure and record battery terminal and container temperature by using infrared thermometer. 2-Use infrared thermometer to measure ambient temperature.	1-Ambient Temp: -20℃~+55℃ 2-Recommended Temperature: 25±5℃	1-Check that the battery temperature compensation functions are turned on and that the battery temperature probe is properly installed. 2-Check that the room temperature conditioning equipment such as air-conditioning is turned on.
2- Battery Float Voltage Measurement	Measure floating voltage on positive and negative terminal of the battery group with multimeter.	Measurement and control module display operating voltage differences within 0.05V	If the monitoring module shows inconsistency even after adjusting, replace or repair it.
3-Battery Appearance	Inspect the battery container for bulging, leakage and damage.	Normal Appearance	Confirm the reason for any abnormal appearance, if it affects normal use, replace the battery.
	Check for dirt stains	Clean Appearance	Clean dust and dirt with damp cloth
	Inspect the connection cables, terminals, etc. for oxidation, rust & other abnormalities	No oxidation, rust	If you find oxidation or rust, replace the connecting wire, and swab terminal with Vaseline etc.

Item	Content	Standard	Maintenance
4- Joints	Use hex or torque wrench to tighten loose bolts.	Securely connected	If found bolt loosened, tighten it
	1-Battery cables, terminals clean / non-corrosive. 2- Follow the installation sequence: 1. Spring washers 2. Flat washers 3, Nuts	No evidence of corrosion	If slight corrosion found after connecting bar removed, clean it with cloth. If severe corrosion, replace the connection bar and clean terminal with sandpaper before tightening.
5-Safety Valve Testing	Inspect for white crystalline or liquid surrounding the safety valve.	No crystalline or liquid surrounding the safety valve	1-For crystalline, use a dry cloth for cleaning. 2-If there is crystalline or liquid, clean it with a dry cloth. Check and tighten the safety valve

2.2 Quarterly Maintenance Inspection Items

In addition to the monthly maintenance items above, inspect the following items:

Item	Content	Standard	Maintenance
1- Measurement of each battery's floating voltage	Measure each battery's floating voltage by using multimeter.	Battery floating voltage differential pressure must meet the following values: 2V series 90 mV 6V series 240 mV 12V series 480 mV	If there are deviations from the reference values, first discharge the battery group and then equalizing charge. After equalizing charge is completed, change to float charge and run for two months. If there are still deviations from the reference values, replace and recycle the battery.
2-Use the equalizing charge to recover the batteries which have either lower capacity or discharge voltage than the other batteries.	Use the equalizing charge to charge the battery 10 hours or more. In case a battery has a severe deviation compared to other batteries, perform charge / discharge cycles three times.	Single battery discharge voltage in the battery group must meet the following values: 2V: 200mV, 6V: 350mV 12V: 600mV	If the battery performance cannot be recovered, it must be replaced.

2.3 Annual Maintenance Inspection Items

In addition to the quarterly maintenance items above, inspect the following items:

Item	Content	Standard	Maintenance
1- Discharge test	Disconnect the AC, take load discharge or discharge online method to check that discharge capacity is minimum 30%-40% of nominal capacity	At the end of discharge, battery voltage should be more than 1.90V/cell, differential pressure must meet the following values: 2V series 200mV 6V series 350mV 12V series 600mV	If the battery voltage is lower than a voltage reference value or the differential pressure is greater than the reference value, discharge the battery, then equalizing charge, then change to float charge and run for 1-2 months. If reference values still exceeded, contact our technical team for assistance.
2- Capacity Test	Use on-line or off-line intelligent discharge device for discharging batteries until the end voltage has reached 1.80V / cell	In back-up use the capacity to be maintained must be more than 80% and in energy storage use more than 60% of the reference capacity	Recovery test: measure and record various parameters specified in the monthly / quarterly maintenance items as well each battery's end voltage during the discharge test. If the battery performance cannot be recovered, replace and re-cycle the battery.
3-Measure and verify the controller parameters	1-Measure the limited charging current values. 2-Check that the equalizing charge starts and ends automatically. 3- Verify the automatic start of battery discharge protection.	Actual operation parameters to meet with the set parameters	In case power equipment and/or controller fails, arrange repair in a due course to ensure correct battery performance and avoidance of reduced battery lifetime.

Maintenance notes

- Operate and store batteries only in an upright position.
- Ensure that the battery installation complies with the design requirements and installation documents.
- Please use only insulated tools during operation and maintenance, any metal objects to be put on top of the battery is strictly prohibited.

SACRED SUN

SHANDONG SACRED SUN POWER SOURCES CO.,LTD

No.1,Shengyang Road, Qufu City,
Shandong Province,273100,P.R.China
Tel:0086-537-4422313
Fax:0086-537-4411980
E-mail:sales@sacredsun.cn