Saft stationary batteries, solutions you can count on!

1xSYS_00001 95xUP1L1500

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Stationary Ni-Cd battery sizing

project name	New Project 1
project reference	P_30Mar21_Brooks_a
System name	SYS_00001 - IEEE/UPS
System reference	SYS_00001
Customer	
Customer reference	

Battery proposal

Proposed battery	**1 x 95 x UP1L 1500**	
Electrical data	Rated capacity	1500 Ah
	Fast charge voltage	137.75 V (1.45 V/cell)
	Floating charge voltage	134.9 V (1.42 V/cell)
	Final voltage/cell	1.105 V
	Short-circuit current	8,403 A
	Topping-up interval	20.0 years
Physical data	Battery weight	13,152.8 lb

Technical specifications

Sizing method	IEEE	I	
Voltage window	Minimum system voltage	105.00 V	
	Maximum system voltage	137.75 V	
Charge method	Dual rate		
Load profile	Number	Current	Time (hh:mm:ss)
	1	204 A	04:15:00
Options	Nominal temperature	77 °F	
	Minimum temperature	77 °F	
	Maximum temperature	77 °F	
	State of charge	100%	
	Design margin	1.1	
	Aging factor	1.25	

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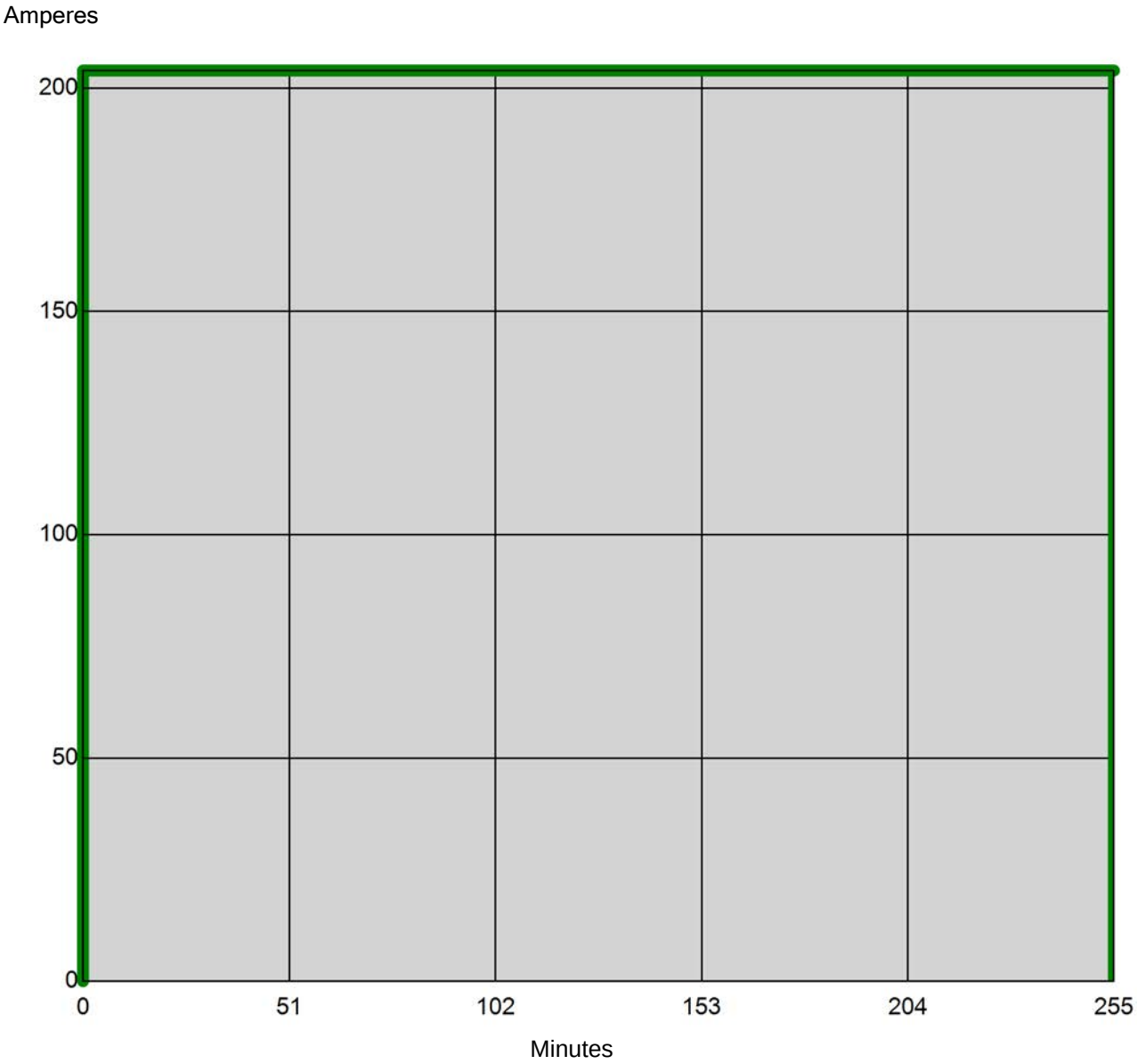
Stationary Ni-Cd battery sizing

Load profile



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Stationary Ni-Cd battery sizing

Battery calculation worksheet IEEE 1115-2014

Range	UP1L
No. of cells	95
Final voltage/cell	1.105 V
Nominal temperature	77 °F
Minimum temperature	77 °F
Maximum temperature	77 °F

(1) Period	(2) Load (Amperes)	(3) Changes in Load (Amperes)	(4) Duration of Period (minutes)	(5) End of Section (minutes)	(6) Kt Factor * **	(7) Temp Derating Factor **	(8) Required Section Size (3)x(6)x(7) =Rated Ah
Section 1 - First 1 Periods Only - If A2>A1, go to Section 2-No							
1	A1=204.00	A1-0= 204.00	M1=255.00	t=M1=255.00	5.0222	1.0000	1,024.53
Total							1,024.53

(*) In this calculation, constant potential charging effects are included in our Kt factors
(**) The factors is interpolated when needed and rounded down to 4 decimals in the calculation

Maximum Section size 1,024.53 + Random size 0.00 = Uncorrected Size 1,024.53.
Uncorrected Size 1,024.53 x Design margin 1.1 x Aging factor 1.25 / State of charge 100% = 1,408.73.
When the cell size is greater than a standard cell size, the next larger cell is required.
The Required cell size is 1,408.73 Amperes-hours. Therefore cell UP1L 1500 is required.

The Kt factor is a way to present the performance of a cell.
Kt=Nominal capacity (Ah)/Performance (A)
It is valid for a specific cell type, discharge time and final voltage.

Temperature compensated charge voltage
Recommended. The value to apply for ambient temperatures >+20°C is -2 mV/°C (-1.1 mV/°F) starting from +20°C (+68°F). For other conditions see Technical Manual.

Storage
The battery must be stored in a dry indoor location, on open, well ventilated shelves away from direct sunlight between 0°C and +30°C (+32°F and 86°F).
The batteries are supplied filled with electrolyte and charged. They can be stored in this condition for maximum 24 months from date of shipment in accordance with the recommendations set forth in this I&O.

Storage of a filled battery at temperatures above +30°C (+86°F) can result in permanent change and loss of product performance, depending on the duration of the storage above the maximum recommended temperature.
Never drain the electrolyte from the cells.
To ensure maximum protection of the cells always store the product in its original packaging.

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IEC 62485-2 / EN 50272-2 ventilation requirement / heat dissipation

Battery **95 x UP1L 1500**

During the last stage of high-rate charging (end of charge and during overcharge), the battery is emitting gases (oxygen-hydrogen mixture). The purpose of ventilating a battery location or enclosure is to maintain the hydrogen gas concentration below the 4% hydrogen threshold. Battery accommodation rooms are to be considered as safe from explosions, when by the natural or forced ventilation the concentration of hydrogen gas is kept below this safety limit. Note that specific local regulations for battery installation and ventilation may be valid in your area.

Hydrogen gas (H2) Concentration	4%	**standard**	IEC 62485-2 / EN 50272-2
LEL Value	100%		

Ventilation air flow Q

$$Q = v \times q \times s \times n \times I_{gas} \times C_{rt} \times 10^{-3}\ (m^3/h)$$

Variable	Description	Value
v x q x s	v = dilution factor to avoid a 4% hydrogen concentration ((100 % - 4%) / 4%)	24
	q = maximum generated hydrogen for 1 Ah of overcharge per cell assuming no gas recombination	0.42 x 10^{-3} m³/Ah
	s = general safety factor	5
n	Number of cells	95
$I_{gas} = I_{float/Boost} \times f_g \times f_s$	Current producing gas during overcharge when charged with constant voltage	
	I_{float} = current for the float charge under fully charged condition at 1.42 V to 1.43 V at + 20 °C	2 mA/Ah
	I_{Boost} = current for the boost charge under fully charged condition at 1.43 V to 1.45 V at + 20 °C	5 mA/Ah
	f_g = gas emission factor, proportion of current at fully charged state producing hydrogen	0.2
	f_s = safety factor taking into account faulty cells and an ageing	5
$I_{gas} = I_{commissioning}$	Current for commissioning at constant current charge at 0,2 C_5 A	200 mA/Ah
C_{rt}	Rated capacity	1500 C_5 Ah

	At float	At boost	Commissioning
Air flow Q (m³/h)	14.36	35.91	1436.40

Note: The charger must be protected against malfunction. If not, the ventilation should be calculated to suit the greatest current available from the charger.

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IEC 62485-2 / EN 50272-2 ventilation requirement / heat dissipation

Battery **95 x UP1L 1500**

Number of air changes per hour

	Length (m)	Width (m)	Height (m)	Volume (m³)
Battery room volume				
Occupied volume				3.6
Free air volume				

	At float	At boost	Commissioning
Number of air changes per hour		N/A	

Natural ventilation

The amount of ventilation air flow shall preferably be ensured by natural ventilation, otherwise by forced ventilation. For natural ventilation, battery rooms or enclosures require an air inlet and an air outlet with a free area of opening calculated by the formula A > 28 x Q (cm²). The air velocity is assumed to be 0.1 m/sec.

	At float	At boost	Commissioning
Free area of openings - inlet & outlet (cm²)	14.36*28=402.2	35.91*28=1005.5	1436.40*28=40219.2

The above calculations are done according to the IEC 62485-2 standard.
Always check local regulations.

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IEC 62485-2 / EN 50272-2 ventilation requirement / heat dissipation

Battery **95 x UP1L 1500**

H2 emissions

The calculated H2 emission value is the amount of H2 that will be released from the cells under normal charging conditions without safety factors.

H2 Emission = 0.42 x 0.001 x Crt x Ihydrogen x n dm^3/h (litre/h)

Actual gassing = 0.63 x 0.001 x Crt x Ihydrogen x n dm^3/h (litre/h)

Variable	Description	Value
$I_{hydrogen} = I_{float/Boost} x (1-R_v)$	Current producing gas during overcharge when charged with constant voltage	
	I_{float} = current for the float charge under fully charged condition at 1.42 V to 1.43 V at + 20 °C	2 mA/Ah
	I_{Boost} = current for the boost charge under fully charged condition at 1.43 V to 1.45 V at + 20 °C	5 mA/Ah
	R_v = recombination degree, proportion of hydrogen that is recombined into water	0.95
$I_{hydrogen} = I_{commissioning}$	Current for commissioning at constant current charge at 0,2 C_5 A	200 mA/Ah
n	Number of cells	95
C_{rt}	Rated capacity	1500 C_5 Ah

	At float	At boost	Commissioning
H2 Emission (dm^3/h)	5.99	15.0	11970
H2+O2 Emission (dm^3/h)	8.98	22.4	17955

Heat dissipation

The heat dissipation during float is normally used for dimensioning the cooling system. The cells will also generate heat during discharge and recharge but the generated heat will be absorbed by the plates and the electrolyte and will slowly dissipate to the surrounding air.

	At float 1.42V Per cell	**At boost** 1.45V Per cell	**At discharge** av.current of 204A av.voltage of 1.15V Per cell
Heat dissipation per system (W)	384.5	988.6	N/A

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IEC 62485-2 / EN 50272-2 ventilation requirement / heat dissipation

Battery **95 x UP1L 1500**

Safety distance according to IEC 62485-2 chaper 7.7

$$d = 28,8 \times \sqrt[3]{I_{gas}} \times \sqrt[3]{C_{rt}}\ \text{mm}$$

Variable	Description	Value
$I_{gas} = I_{float/Boost} \times f_g \times f_s$	Current producing gas during overcharge when charged with constant voltage	
	I_{float} = current for the float charge under fully charged condition at 1.42 V to 1.43 V at + 20 °C	2 mA/Ah
	I_{Boost} = current for the boost charge under fully charged condition at 1.43 V to 1.45 V at + 20 °C	5 mA/Ah
	f_g = gas emission factor, proportion of current at fully charged state producing hydrogen	0.2
	f_s = safety factor taking into account faulty cells and an ageing	5
C_{rt}	Rated capacity	1500 C_5 Ah

	At float	At boost
Safety distance (mm)	415	563

NOTE The required safety distance d can be achieved by the use of a partition wall between battery and sparking device.

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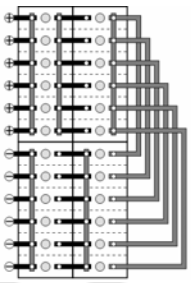
UP1L 1500 - Cell data sheet

Classification

Brand	Saft
Cell type	UP1L 1500
Cell P/N	310560071
Capacity at 5 hours rate	1,500 Ah
IEC Designation	KGL1500P
According to IEC 62259	

Wiring principle Crosswise



Physical data

Overall height	16.18 In		
Cell height			
Width	7.68 In	Weight per cell	138.5 lb
Length	18.62 In	Block length - 2 cells	-
Block length - 3 cells	-	Block length - 4 cells	-
Block length - 5 cells	-	Block length - 6 cells	-
Block length - 7 cells	-	Block length - 8 cells	-
Block length - 9 cells	-	Block length - 10 cells	-

Construction

Container material	Polypropylene	No. of terminals/polarity	6
Separator type	Felt	Terminal material	Steel
Connection torque	265.5 +/- 26.6 Lbf.in	Vent type	Low pressure flame arresting vent (large)
Terminal size	M10 SW 0.630 In		
		Handle	Yes

Plates

Positive		Negative	
Type of plates	Maintenance Free Pocket	Type of plates	Maintenance Free Pocket

Electrolyte

Electrolyte type: Renewal	E13	Max/Min	1.97 In
Electrolyte type: Initial	E22	Vent oil quantity	
Electrolyte per cell: Liquid	15.6 liters		

Connection

Cable area of internal connection cables	6.50 sq.ft.	End-lug (and external cable)	4.65 sq.ft.

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UP1L 1500 - Cell data sheet

Charging

Float voltage	1.42 V/Cell	High rate voltage (min)	1.45 V/Cell
Single-level voltage	1.42 V/Cell		

Resistance/Short circuit

Internal resistance	0.16 mOhm	Short circuit current	8403 A

Performance data

Current discharge

After prolonged float charge of fully charged cells. Available amperes at +20°C +/- 5°C (+68°F +/- 9°F)

V/Cell	10h	8h	5h	3h	2h	1.5h	1h	30m	20m	15m	10m	5m	1m	30s	5s	1s
1	156	193	300	483	629	720	846	1,029	1,120	1,188	1,251	1,379	1,380	1,511	1,783	1,954
1.05	154	190	296	438	548	620	707	842	917	945	998	1,095	1,158	1,257	1,492	1,630
1.1	150	185	275	378	457	503	566	675	728	762	800	862	950	1,037	1,231	1,328
1.14	142	170	234	295	352	390	436	510	554	592	637	721	748	830	985	1,048

Power discharge

Available power (W), after prolonged float charged of fully charged cells at +20°C +/- 5°C (+68°F +/- 9°F)

V/Cell	10h	8h	5h	3h	2h	1.5h	1h	30m	20m	15m	10m	5m	1m	30s	5s	1s
1	181	221	335	517	657	745	865	1,039	1,127	1,193	1,254	1,379	1,380	1,511	1,783	1,954
1.05	180	219	337	482	593	666	754	891	967	995	1,049	1,150	1,216	1,319	1,567	1,711
1.1	175	215	317	428	513	561	629	745	803	839	881	948	1,045	1,141	1,354	1,460
1.14	167	199	273	341	406	448	500	583	632	675	727	822	852	946	1,122	1,195

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UP1L 1500 - Cell data sheet

Kt Factor

Current discharge

After prolonged float charge of fully charged cells. Kt factor at +20°C +/- 5°C (+68°F +/- 9°F)

V/Cell	10h	8h	5h	3h	2h	1.5h	1h	30m	20m	15m	10m	5m	1m	30s	5s	1s
1	9.6	7.76	5.00	3.11	2.39	2.08	1.77	1.46	1.34	1.26	1.20	1.09	1.09	0.99	0.84	0.77
1.05	9.7	7.89	5.06	3.43	2.74	2.42	2.12	1.78	1.64	1.59	1.50	1.37	1.29	1.19	1.01	0.92
1.1	10.0	8.12	5.45	3.97	3.28	2.98	2.65	2.22	2.06	1.97	1.87	1.74	1.58	1.45	1.22	1.13
1.14	10.5	8.84	6.41	5.08	4.26	3.85	3.44	2.94	2.71	2.53	2.35	2.08	2.01	1.81	1.52	1.43

Power discharge

Kt factor power, after prolonged float charged of fully charged cells at +20°C +/- 5°C (+68°F +/- 9°F)

V/Cell	10h	8h	5h	3h	2h	1.5h	1h	30m	20m	15m	10m	5m	1m	30s	5s	1s
1	8.30	6.79	4.47	2.90	2.28	2.01	1.73	1.44	1.33	1.26	1.20	1.09	1.09	0.99	0.84	0.77
1.05	8.35	6.84	4.45	3.11	2.53	2.25	1.99	1.68	1.55	1.51	1.43	1.30	1.23	1.14	0.96	0.88
1.1	8.55	6.98	4.72	3.50	2.93	2.67	2.39	2.01	1.87	1.79	1.70	1.58	1.44	1.32	1.11	1.03
1.14	8.97	7.55	5.49	4.40	3.70	3.35	3.00	2.57	2.37	2.22	2.06	1.83	1.76	1.59	1.34	1.26

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