



PRODUCT GUIDE



EnerSys™
Power/Full Solutions™

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Introduction

This product guide covers the **PowerSafe V** Front Terminal range and is designed to help you select the most appropriate battery for your particular application. Technical information includes detailed discharge performance data for each unit and advice on calculating the correct battery size.

Enersys has earned an international reputation for quality and reliability based on more than 100 years' experience in the manufacture of batteries, and is at the forefront of new product design to meet customer's increasing technical requirements.

The new **PowerSafe V** Front Terminal range of valve regulated lead acid batteries has been designed specifically for use in applications which demand the highest levels of security and reliability. With proven compliance to the most rigorous international standards, **PowerSafe V** is recognised worldwide as the premium battery for Telecom/IT applications. PowerSafe's reputation for long service life, combined with excellent high rate performance, also makes it the number one choice for high integrity, high specification UPS systems.

The use of gas recombination technology for lead acid batteries has totally changed the concept of standby power. This technology provides the user with the freedom to use lead acid batteries in a wide range of applications.

The minimal level of gas evolution allows battery installation in cabinets or on stands, in offices or near main equipment, thus maximising space utilisation and reducing storage and maintenance costs.

PowerSafe V delivers superior performance whilst occupying less space than conventional standby power batteries. The use of V0 rated, flame retardant ABS for the thick wall containers and lids offers high mechanical strength with excellent safety features.

The **PowerSafe V** Front Terminal monobloc's compact design and standard footprint, suitable for 19", 23" and ETSI racking, give users the benefit of increased energy density. With all electrical connections at the front, installation and inspection are simpler and quicker.



Range Summary



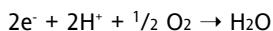
Unit Type	Nominal Capacity (Ah) @ 20°C		Dimensions (mm)			Typical Weight (kg)	Pillar Diameter	Short circuit Current (A)	Internal Resistance (mΩ)
	Nominal Voltage (V)	C ₁₀ to 1.80Vpc	Length	Width	Overall Height				
12V50F	12	50	41	280	105	280	25.0	M6	1575
12V52F	12	52	42	390	105	228	26.0	M6	2000
12V65F	12	65	53	390	125	228	31.0	M6	2500
12V80F	12	80	64	558	105	228	40.0	M6	2906
12V82F	12	80	66	390	125	256	37.0	M6	3000
8V100F	8	100	80	384	125	228	32.0	M6	3636
12V100F	12	100	80	558	125	228	47.5	M6	3636
12V105F	12	105	87	561	125	235	46.0	M6	3500
12V125F	12	125	100	561	105	316	56.0	M6	3818
12V155F	12	155	129	561	125	316	67.0	M6	4605

How gas recombination works

When a charge current flows through a fully charged conventional lead acid cell, electrolysis of water occurs to produce hydrogen from the negative electrode and oxygen from the positive electrode. This means that water is lost from the cell and regular topping up is needed.

However, evolution of oxygen and hydrogen gases does not occur simultaneously, because the recharge of the positive electrode is not as efficient as the negative. This means that oxygen is evolved from the positive plate before hydrogen is evolved from the negative plate.

At the same time that oxygen is evolved from the positive electrode, a substantial amount of highly active spongy lead exists on the negative electrode before it commences hydrogen evolution. Therefore, providing oxygen can be transported to the negative electrode, conditions are ideal for a rapid reaction between lead and oxygen:
ie. oxygen is electrochemically reduced on the negative electrode according to the following formula,

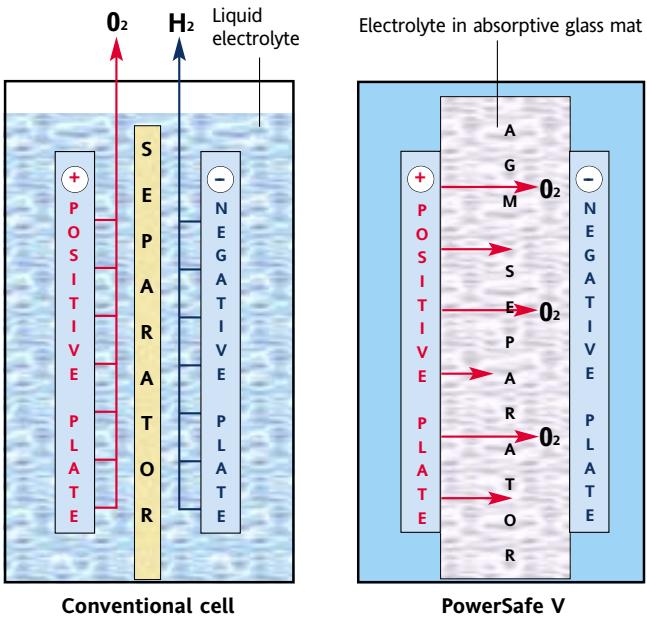


and the final product is water.

The current flowing through the negative electrode drives this reaction instead of hydrogen generation which would occur in a flooded cell.

This process is called gas recombination. If this process was 100% efficient no water would be lost from the cell. By careful design and selection of cell components, gas recombination between 95% to 99% is achieved.

Principle of the oxygen reduction cycle



Oxygen and hydrogen escape to the atmosphere.

Oxygen from the positive plate transfers to the negative and recombines to form water.

Recombination efficiency

Recombination efficiency is determined under specific conditions by measuring the volume of hydrogen emitted from the battery and converting this into its ampere hour equivalent. This equivalent value is then subtracted from the total ampere hours taken by the battery during the test period, and the remainder is the battery's recombination efficiency and is usually expressed as a percentage.

As recombination is never 100%, some hydrogen gas is emitted from PowerSafe cells and batteries through the self-regulating valve. The volume of gas emitted is very small and typical average values on constant potential float at 20°C are as follows:

PowerSafe V hydrogen emissions	
Float Voltage (V)	Volume of gas emitted (ml per cell per C ₃ Ah per month)
2.28	3.7
2.40	24.0

1 High conductivity connectors and terminal

The pillar has a brass insert, to which is screwed an angled copper connector fitted with a bolt and stainless steel nut and washers. This front mounted terminal minimises installation work.

2 High integrity pillar seal

Compression grommet designed for long life.

3 Self-regulating relief valve

Low pressure non-return valve prevents ingress of atmospheric oxygen.

4 Rugged super-thick positive plates

Thick grids designed to resist corrosion and prolong life.

5 Balanced negative plates

Ensure optimum recombination efficiency.

6 Tough flame retardant cell box

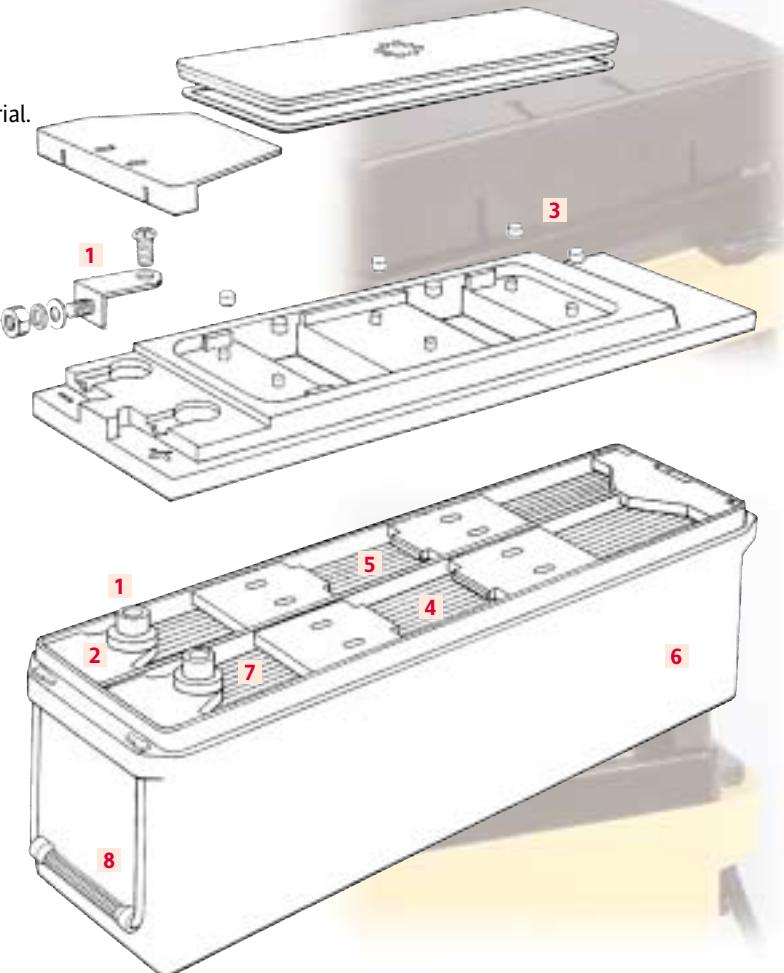
Thick-wall V0 rated ABS, highly resistant to shock and vibration.

7 Separators

Low resistance microporous glass fibre. The electrolyte is absorbed within this material.

8 Lifting handles

All the cells in the range are provided with moulded lifting handles or rope handles.



Selection of Battery Size

The following examples are designed to illustrate the method of determining which PowerSafe V Front Terminal unit will support your required duty load.

Constant current discharge

EXAMPLE A. To demonstrate constant current calculation and also the effect of temperature.

A nominal 50V telecommunications system using a 24 cell battery and requiring 9 amps constant current will operate satisfactorily at a minimum battery terminal volts level of 42 volts.

Calculate the battery type required for 5 hours standby duration on the basis of:

- (a) 20°C operating temperature
- (b) 0°C operating temperature

METHOD

- (1) Minimum allowable volts per cell

$$\frac{42 \text{ volts}}{24 \text{ cells}} = 1.75 \text{ Vpc}$$

- (2) Hence, cell performance requirement is 9 amps constant current to 1.75Vpc

- (3) By reference to constant current performance table relating to 1.75 volts per cell level (see page 9):

(a) at 20°C

12V52F unit size is smallest available size to use (9.4 amps available).

Conclusion: Use 4 - 12V52F.

(b) at 0°C by reference to the table on page 15 of this product guide, available current output at 20°C is reduced by factor 0.86.

Therefore at 0°C - 5 hours output is reduced to, on 12V52F size, 9.4 amps x 0.86 = 8.08 amps.

Hence 12V52F unit size too small!

Try the next largest unit size - 12V65F. At 0°C available current output is 11.7 amps x 0.86 = 10.06 amps.

Conclusion: Use 4 - 12V65F.

Constant power discharge

EXAMPLE B. To demonstrate constant power calculation.

An inverter system requires a D.C. constant power input of 43.8 kW in the voltage range 479 volts maximum, 354 volts minimum.

Calculate the optimum battery size required for 20°C operation for a 1 hour standby period.

METHOD

- (1) Number of cells

$$= 479 / 2.28 \text{ Vpc} = 210 \text{ cells.}$$

- (2) Minimum volt per cell

$$354 / 210 = 1.686 \rightarrow 1.69 \text{ Vpc.}$$

- (3) Watts per cell

$$= 43800 \text{ watts} / 210 \text{ cells} = 208.57 \text{ watts per cell.}$$

- (4) Hence cell performance requirement is 208.57 watts to 1.69Vpc at 20°C.

- (5) By reference to the constant power performance table (see page 12) relating to 1.69 volts per cell level, 12V155F monobloc is the correct available size to use.



Performance Data

Constant current discharge performance data



Unit Type	Discharge Currents (Amperes) at 20°C to 1.60 volts per cell												Standby Time (Hours)												
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	180.0	124.4	93.9	75.6	64.0	55.5	49.5	44.6	40.8	37.6	35.0	32.6	23.7	18.8	15.7	13.6	10.7	9.0	7.7	6.8	6.1	5.6	5.1	4.3	2.2
12V52F	191.0	132.0	99.6	80.2	67.9	58.9	52.5	47.3	43.3	39.9	37.1	34.6	25.1	19.9	16.7	14.4	11.4	9.5	8.2	7.2	6.5	5.9	5.4	4.6	2.5
12V65F	239.0	164.0	125.0	100.0	84.9	73.7	65.6	59.1	54.1	49.9	46.3	43.3	31.3	24.9	20.8	18.0	14.3	11.9	10.2	9.0	8.1	7.3	6.7	5.7	3.1
12V80F	280.0	183.0	145.0	118.0	101.0	88.1	78.7	71.1	65.1	60.0	55.8	52.2	38.1	30.4	25.4	22.0	17.4	14.5	12.5	11.0	9.9	9.0	8.2	7.0	3.7
12V82F	250.0	182.0	144.0	120.0	105.0	90.0	82.0	74.0	66.0	61.0	56.0	51.0	38.0	31.0	26.0	22.0	18.0	14.9	12.8	11.2	9.9	9.0	8.2	7.0	3.7
8V100F	350.0	236.0	181.0	148.0	126.0	110.0	98.4	88.9	81.4	75.0	69.8	65.3	47.6	37.9	31.8	27.5	21.8	18.2	15.6	13.8	12.4	11.2	10.3	8.7	4.6
12V100F	350.0	236.0	181.0	148.0	126.0	110.0	98.4	88.9	81.4	75.0	69.8	65.3	47.6	37.9	31.8	27.5	21.8	18.2	15.6	13.8	12.4	11.2	10.3	8.7	4.6
12V105F	350.0	274.0	212.0	171.0	148.0	126.0	115.0	104.0	92.0	86.0	80.0	74.0	54.5	43.0	36.2	31.0	24.4	20.2	17.2	14.9	13.1	11.5	10.5	9.0	4.8
12V125F	360.8	283.2	229.7	193.2	166.8	147.4	134.2	118.7	106.3	99.3	92.3	85.4	66.7	48.9	41.9	34.9	28.7	23.1	21.6	18.4	15.8	14.4	12.4	10.6	5.3
12V155F	465.0	379.0	304.0	254.0	223.0	193.0	176.0	159.0	142.0	133.0	124.0	114.0	86.0	63.0	54.0	45.0	37.0	29.8	27.0	23.0	19.8	18.0	15.5	13.3	6.6

Unit Type	Discharge Currents (Amperes) at 20°C to 1.63 volts per cell												Standby Time (Hours)												
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	167.6	113.1	89.6	72.4	61.3	53.2	47.4	42.8	39.1	36.1	33.5	31.3	22.7	18.0	15.0	13.6	10.3	8.6	7.4	6.5	5.8	5.3	4.8	4.1	2.2
12V52F	185.0	129.0	98.9	79.9	67.7	58.7	52.3	47.2	43.2	39.8	37.0	34.5	25.0	19.9	16.6	14.4	11.4	9.5	8.2	7.2	6.4	5.8	5.4	4.6	2.4
12V65F	232.0	162.0	124.0	99.9	84.6	73.4	65.4	59.0	54.0	49.7	46.2	43.2	31.2	24.8	20.8	18.0	14.2	11.8	10.2	9.0	8.0	7.3	6.7	5.7	3.0
12V80F	266.0	184.0	143.0	118.0	99.7	86.6	78.3	71.5	65.8	60.9	56.1	52.1	38.2	30.2	25.3	21.7	17.4	14.5	12.5	11.0	9.8	8.9	8.2	7.0	3.7
12V82F	250.0	182.0	144.0	120.0	105.0	90.0	82.0	74.0	66.0	61.0	56.0	51.0	38.0	31.0	26.0	22.0	18.0	14.9	12.8	11.2	9.9	9.0	8.2	7.0	3.7
8V100F	333.0	231.0	178.0	147.0	125.0	108.0	97.9	89.3	82.2	76.1	70.2	65.1	47.8	37.7	31.6	27.2	21.7	18.1	15.6	13.7	12.3	11.2	10.2	8.7	4.6
12V100F	333.0	231.0	178.0	147.0	125.0	108.0	97.9	89.3	82.2	76.1	70.2	65.1	47.8	37.7	31.6	27.2	21.7	18.1	15.6	13.7	12.3	11.2	10.2	8.7	4.6
12V105F	350.0	274.0	212.0	171.0	148.0	126.0	115.0	104.0	92.0	86.0	80.0	74.0	54.5	43.0	36.2	31.0	24.4	20.2	17.2	14.9	13.1	11.5	10.5	9.0	4.8
12V125F	360.8	283.2	229.7	193.2	166.8	147.4	134.2	118.7	106.3	99.3	92.3	85.4	66.7	48.9	41.9	34.9	28.7	23.1	21.6	18.4	15.8	14.4	12.4	10.6	5.3
12V155F	465.0	379.0	304.0	254.0	223.0	193.0	176.0	159.0	142.0	133.0	124.0	114.0	86.0	63.0	54.0	45.0	37.0	29.8	27.0	23.0	19.8	18.0	15.5	13.3	6.6

Unit Type	Discharge Currents (Amperes) at 20°C to 1.65 volts per cell												Standby Time (Hours)												
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	170.6	120.6	92.4	75.0	63.6	55.2	49.2	44.4	40.6	37.4	34.8	32.5	23.5	18.7	15.6	13.6	10.7	9.0	7.6	6.8	6.0	5.5	5.0	4.3	2.2
12V52F	181.0	128.0	98.1	79.6	67.5	58.6	52.2	47.1	43.1	39.7	36.9	34.5	24.9	19.8	16.6	14.3	11.4	9.5	8.1	7.2	6.4	5.8	5.3	4.6	2.4
12V65F	226.0	160.0	123.0	99.5	84.4	73.3	65.3	58.9	53.9	49.6	46.1	43.1	31.2	24.8	20.7	17.9	14.2	11.8	10.2	9.0	8.0	7.3	6.7	5.7	3.0
12V80F	258.0	181.0	141.0	117.0	99.5	86.6	78.3	71.5	65.8	60.9	56.1	52.1	38.2	30.2	25.3	21.7	17.3	14.5	12.5	11.0	9.8	8.9	8.2	7.0	3.7
12V82F	250.0	178.0	141.0	118.0	104.0	90.0	80.0	78.0	72.0	65.0	60.0	51.0	38.0	31.0	26.0	22.0	18.0	14.9	12.8	11.2	9.9	9.0	8.2	7.0	3.7
8V100F	322.0	227.0	177.0	146.0	124.0	108.0	97.9	89.3	82.2	76.1	70.2	65.1	47.8	37.7	31.6	27.2	21.7	18.1	15.6	13.7	12.3	11.2	10.2	8.7	4.6
12V100F	322.0	227.0	177.0	146.0	124.0	108.0	97.9	89.3	82.2	76.1	70.2	65.1	47.8	37.7	31.6	27.2	21.7	18.1	15.6	13.7	12.3	11.2	10.2	8.7	4.6
12V105F	350.0	274.0	212.0	171.0	145.0	126.0	114.0	100.0	92.0	85.0	80.0	74.0	54.5	43.0	36.2	31.0	24.4	20.2	17.2	14.9	13.1	11.5	10.5	9.0	4.8
12V125F	360.8	283.2	229.7	193.2	166.8	147.4	134.2	118.7	106.3	99.3	92.3	85.4	66.7	48.9	41.9	34.9	28.7	23.1	21.6	18.4	15.8	14.4	12.4	10.6	5.3
12V155F	465.0	365.0	296.0	249.0	215.0	190.0	173.0	153.0	137.0	128.0	119.0	110.0	86.0	63.0	54.0	45.0	37.0	29.8	27.0	23.0	19.8	18.0	15.5	13.3	6.6

Discharge Currents (Amperes) at 20°C to 1.67 volts per cell														Standby Time (Hours)													
Standby Time (Minutes)														Discharge Currents (Amperes) at 20°C to 1.69 volts per cell													
Unit Type	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24		
12V50F	165.8	117.8	91.3	74.5	63.4	55.1	49.1	44.3	40.5	37.3	34.7	32.4	23.5	18.7	15.6	13.6	10.6	8.9	7.6	6.8	6.0	5.5	5.0	4.3	2.2		
12V52F	176.0	125.0	96.9	79.1	67.3	58.5	52.1	47.0	43.0	39.6	36.8	34.4	24.9	19.8	16.6	14.3	11.3	9.4	8.1	7.2	6.4	5.8	5.3	4.6	2.4		
12V55F	220.0	157.0	121.0	98.9	84.1	73.1	65.1	58.7	53.7	49.5	46.0	43.0	31.1	24.7	20.7	17.9	14.2	11.8	10.2	9.0	8.0	7.3	6.7	5.7	3.0		
12V80F	251.0	178.0	140.0	116.0	99.1	86.4	78.2	71.5	65.7	60.9	56.1	52.1	38.2	30.2	25.3	21.7	17.3	14.4	12.4	11.0	9.8	8.9	8.2	7.0	3.7		
12V82F	238.0	174.0	139.0	116.0	102.4	88.4	78.4	72.0	65.0	60.0	56.0	51.0	38.0	31.0	26.0	22.0	18.0	14.9	12.8	11.2	9.9	9.0	8.2	7.0	3.7		
8V100F	313.0	222.0	175.0	145.0	124.0	108.0	97.8	89.3	82.2	76.1	70.2	65.1	47.8	37.7	31.6	27.2	21.6	18.0	15.5	13.7	12.3	11.1	10.2	8.7	4.6		
12V100F	313.0	222.0	175.0	145.0	124.0	108.0	97.8	89.3	82.2	76.1	70.2	65.1	47.8	37.7	31.6	27.2	21.6	18.0	15.5	13.7	12.3	11.1	10.2	8.7	4.6		
12V105F	346.8	265.2	205.6	166.6	142.6	124.4	112.0	100.0	92.0	85.0	80.0	74.0	54.5	43.0	36.2	31.0	24.4	20.2	17.2	14.9	13.1	11.5	10.5	9.0	4.8		
12V125F	355.5	276.1	225.0	189.8	165.6	145.6	132.7	118.7	106.3	99.3	92.3	85.4	66.7	48.9	41.9	34.9	28.7	23.1	21.6	18.4	15.8	14.4	12.4	10.6	5.3		
12V155F	453.0	355.8	290.0	244.6	213.4	187.6	171.0	153.0	137.0	128.0	119.0	110.0	86.0	63.0	54.0	45.0	37.0	29.8	27.0	23.0	19.8	18.0	15.5	13.3	6.6		
Standby Time (Minutes)														Discharge Currents (Amperes) at 20°C to 1.69 volts per cell													
Unit Type	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24		
12V50F	161.1	115.9	90.1	73.9	62.9	54.8	48.9	44.2	40.4	37.2	34.6	32.3	23.4	18.6	15.5	13.6	10.6	8.9	7.6	6.8	6.0	5.5	5.0	4.3	2.2		
12V52F	171.0	123.0	95.6	78.4	66.8	58.2	51.9	46.9	42.9	39.5	36.7	34.3	24.8	19.7	16.5	14.3	11.3	9.4	8.1	7.2	6.4	5.8	5.3	4.6	2.4		
12V65F	213.0	154.0	120.0	98.0	83.5	72.8	64.9	58.6	53.6	49.4	45.9	42.9	31.1	24.7	20.7	17.9	14.1	11.8	10.1	8.9	8.0	7.3	6.7	5.7	3.0		
12V80F	242.0	174.0	138.0	115.0	98.5	86.1	78.0	71.4	65.6	60.7	56.0	52.1	38.2	30.2	25.3	21.7	17.3	14.4	12.4	10.9	9.8	8.9	8.2	6.9	3.7		
12V82F	226.0	170.0	137.0	114.0	100.8	86.8	78.8	72.0	65.0	60.0	56.0	51.0	38.0	31.0	26.0	22.0	18.0	14.9	12.8	11.2	9.9	9.0	8.2	7.0	3.7		
8V100F	302.0	218.0	173.0	144.0	123.0	108.0	97.6	89.2	82.0	75.8	70.1	65.1	47.8	37.7	31.6	27.2	21.6	18.0	15.5	13.7	12.2	11.1	10.2	8.6	4.6		
12V100F	302.0	218.0	173.0	144.0	123.0	108.0	97.6	89.2	82.0	75.8	70.1	65.1	47.8	37.7	31.6	27.2	21.6	18.0	15.5	13.7	12.2	11.1	10.2	8.6	4.6		
12V105F	342.6	256.4	199.2	162.2	140.2	122.8	110.0	100.0	92.0	85.0	80.0	74.0	54.5	43.0	36.2	31.0	24.4	20.2	17.2	14.9	13.1	11.5	10.5	9.0	4.8		
12V125F	350.2	269.0	220.4	186.4	164.4	143.7	131.1	118.7	106.3	99.3	92.3	85.4	66.7	48.9	41.9	34.9	28.7	23.1	21.6	18.4	15.8	14.4	12.4	10.6	5.3		
12V155F	441.0	346.6	284.0	240.2	211.8	185.2	169.0	153.0	137.0	128.0	119.0	110.0	86.0	63.0	54.0	45.0	37.0	29.8	27.0	23.0	19.8	18.0	15.5	13.3	6.6		
Standby Time (Minutes)														Discharge Currents (Amperes) at 20°C to 1.71 volts per cell													
Unit Type	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24		
12V50F	155.5	113.1	89.0	72.9	62.4	54.6	48.7	44.0	40.2	37.1	34.6	32.2	23.4	18.6	15.5	13.6	10.6	8.9	7.6	6.7	6.0	5.5	5.0	4.3	2.2		
12V52F	165.0	120.0	94.4	77.4	66.2	57.9	51.7	46.7	42.7	39.4	36.7	34.2	24.8	19.7	16.5	14.3	11.3	9.4	8.1	7.1	6.4	5.8	5.3	4.6	2.4		
12V65F	207.0	150.0	118.0	96.7	82.8	72.4	64.6	58.3	53.4	49.3	45.8	42.8	31.0	24.6	20.6	17.8	14.1	11.8	10.1	8.9	8.0	7.3	6.6	5.7	3.0		
12V80F	233.0	171.0	136.0	114.0	97.8	85.7	77.8	71.2	65.3	60.3	55.9	52.0	38.2	30.2	25.3	21.7	17.2	14.4	12.4	10.9	9.8	8.9	8.1	6.9	3.7		
12V82F	219.4	166.0	135.0	112.4	99.2	85.4	78.4	71.4	64.4	59.6	55.6	50.8	37.8	30.8	26.0	22.0	18.0	14.9	12.8	11.2	9.9	9.0	8.2	7.0	3.7		
8V100F	291.0	214.0	171.0	143.0	122.0	107.0	97.2	89.0	81.6	75.4	69.8	65.0	47.7	37.7	31.6	27.2	21.5	18.0	15.5	13.6	12.2	11.1	10.2	8.6	4.6		
12V100F	291.0	214.0	171.0	143.0	122.0	107.0	97.2	89.0	81.6	75.4	69.8	65.0	47.7	37.7	31.6	27.2	21.5	18.0	15.5	13.6	12.2	11.1	10.2	8.6	4.6		
12V105F	335.6	247.6	192.8	158.0	137.4	120.8	108.0	99.2	91.2	84.4	79.4	73.6	54.2	42.8	36.0	30.8	24.3	20.1	17.1	14.9	13.1	11.5	10.5	9.0	4.8		
12V125F	341.9	262.0	215.6	182.8	162.3	141.7	129.4	118.0	105.7	98.7	91.7	84.9	66.4	48.6	41.6	34.8	28.6	23.0	21.4	18.4	15.8	14.4	12.4	10.6	5.3		
12V155F	428.0	337.6	277.8	235.6	209.2	182.6	166.8	152.0	136.2	127.2	118.2	109.4	85.6	62.6	53.6	44.8	36.9	29.7	26.8	23.0	19.7	18.0	15.5	13.3	6.6		

Discharge Currents (Amperes) at 20°C to 1.73 volts per cell																									
Unit Type	Standby Time (Minutes)																								
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	150.8	110.3	87.0	72.0	61.7	54.1	48.3	43.7	40.0	37.0	34.4	32.1	23.3	18.6	15.5	13.6	10.6	8.9	7.6	6.7	6.0	5.5	5.0	4.2	2.2
12V52F	160.0	117.0	92.3	76.4	65.5	57.4	51.3	46.4	42.5	39.3	36.5	34.1	24.7	19.7	16.5	14.2	11.3	9.4	8.1	7.1	6.4	5.8	5.3	4.5	2.4
12V55F	200.0	146.0	115.0	95.5	81.9	71.7	64.1	58.0	53.2	49.1	45.6	42.6	30.9	24.6	20.6	17.8	14.1	11.7	10.1	8.9	8.0	7.2	6.6	5.7	3.0
12V58F	224.0	167.0	134.0	113.0	97.0	85.1	77.4	70.9	65.0	59.9	55.6	51.8	38.1	30.1	25.2	21.7	17.2	14.3	12.4	10.9	9.8	8.9	8.1	6.9	3.7
12V62F	218.2	162.0	133.0	111.2	97.6	84.2	77.2	70.2	63.2	58.8	54.8	50.4	37.4	30.4	26.0	22.0	18.0	14.8	12.7	11.1	9.8	8.9	8.1	6.9	3.7
8V100F	280.0	209.0	168.0	141.0	121.0	106.0	96.7	88.6	81.2	74.9	69.5	64.8	47.6	37.7	31.5	27.1	21.5	17.9	15.4	13.6	12.2	11.1	10.1	8.6	4.6
12V100F	280.0	209.0	168.0	141.0	121.0	106.0	96.7	88.6	81.2	74.9	69.5	64.8	47.6	37.7	31.5	27.1	21.5	17.9	15.4	13.6	12.2	11.1	10.1	8.6	4.6
12V105F	322.8	238.8	186.4	154.0	134.2	118.4	106.0	97.6	89.6	83.2	78.2	72.8	53.5	42.4	35.7	30.4	24.2	20.0	17.0	14.8	13.0	11.5	10.5	9.0	4.8
12V125F	330.7	255.1	210.6	179.1	159.5	139.5	127.6	116.4	104.4	97.5	90.5	84.0	65.8	48.0	41.0	34.5	28.5	22.8	21.1	18.4	15.7	14.4	12.4	10.6	5.3
12V155F	414.0	328.8	271.4	230.8	205.6	179.8	164.4	150.0	134.6	125.6	116.6	108.2	84.8	61.8	52.8	44.4	36.7	29.4	26.4	23.0	19.6	18.0	15.5	13.3	6.6

Discharge Currents (Amperes) at 20°C to 1.75 volts per cell																									
Unit Type	Standby Time (Minutes)																								
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	145.1	106.5	85.0	70.9	60.9	53.3	47.8	43.3	39.8	36.8	34.2	31.9	23.2	18.5	15.5	13.6	10.6	8.9	7.6	6.7	6.0	5.5	5.1	4.2	2.2
12V52F	154.0	113.0	90.2	75.2	64.6	56.6	50.7	46.0	42.2	39.0	36.3	33.9	24.6	19.6	16.4	14.2	11.2	9.4	8.1	7.1	6.4	5.8	5.3	4.5	2.4
12V55F	192.0	142.0	113.0	94.0	80.7	70.7	63.4	57.5	52.8	48.8	45.4	42.4	30.8	24.5	20.5	17.7	14.1	11.7	10.1	8.9	8.0	7.2	6.6	5.7	3.0
12V80F	215.0	163.0	132.0	111.0	96.0	84.4	76.8	70.5	64.5	59.4	55.2	51.6	38.0	30.0	25.2	21.7	17.1	14.3	12.3	10.9	9.7	8.8	8.1	6.9	3.7
12V82F	217.0	158.0	131.0	110.0	96.0	83.0	76.0	69.0	62.0	58.0	54.0	50.0	37.0	30.0	26.0	22.0	18.0	14.7	12.7	11.1	9.8	8.9	8.1	6.9	3.7
8V100F	269.0	204.0	165.0	139.0	120.0	106.0	96.1	88.1	80.6	74.3	69.0	64.5	47.4	37.5	31.5	27.1	21.4	17.9	15.4	13.6	12.2	11.0	10.1	8.6	4.6
12V100F	269.0	204.0	165.0	139.0	120.0	106.0	96.1	88.1	80.6	74.3	69.0	64.5	47.4	37.5	31.5	27.1	21.4	17.9	15.4	13.6	12.2	11.0	10.1	8.6	4.6
12V105F	310.0	230.0	180.0	150.0	131.0	116.0	104.0	96.0	88.0	82.0	77.0	72.0	52.8	42.0	35.4	30.0	24.0	19.8	16.9	14.8	13.0	11.5	10.5	9.0	4.8
12V125F	319.4	248.3	205.6	175.4	156.8	137.4	125.7	114.8	103.2	96.2	89.2	83.0	65.2	47.3	40.4	34.1	28.3	22.7	20.8	18.4	15.6	14.4	12.4	10.6	5.3
12V155F	400.0	320.0	265.0	226.0	202.0	177.0	162.0	148.0	133.0	124.0	115.0	107.0	84.0	61.0	52.0	44.0	36.5	29.2	26.0	23.0	19.5	18.0	15.5	13.3	6.6

Discharge Currents (Amperes) at 20°C to 1.80 volts per cell																									
Unit Type	Standby Time (Minutes)																								
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	130.0	97.1	78.6	66.2	57.7	51.0	46.0	41.8	38.4	35.6	33.2	31.0	22.7	18.2	15.3	13.5	10.5	8.8	7.5	6.6	5.9	5.4	5.0	4.2	2.2
12V52F	138.0	103.0	83.4	70.3	61.2	54.1	48.8	44.4	40.8	37.8	35.2	32.9	24.1	19.3	16.2	14.0	11.1	9.3	8.0	7.0	6.3	5.7	5.2	4.5	2.4
12V65F	172.0	129.0	104.0	87.8	76.4	67.7	61.0	55.6	51.1	47.2	44.0	41.1	30.1	24.1	20.2	17.5	13.9	11.6	10.0	8.8	7.9	7.2	6.5	5.6	3.0
12V80F	193.0	152.0	125.0	106.0	92.3	81.6	74.5	68.6	63.0	58.2	53.9	50.3	37.2	29.5	24.8	21.3	16.9	14.1	12.2	10.7	9.6	8.7	8.0	6.8	3.7
12V82F	195.0	144.0	118.0	103.0	91.0	80.0	73.0	67.0	60.0	56.3	52.5	49.0	36.0	30.0	25.0	22.0	17.0	14.2	12.3	10.7	9.6	8.7	8.0	6.8	3.6
8V100F	241.0	189.0	156.0	133.0	115.0	102.0	93.2	85.8	78.7	72.7	67.4	62.8	46.5	36.9	31.0	26.7	21.2	17.7	15.2	13.4	12.0	10.9	10.0	8.5	4.6
12V100F	241.0	189.0	156.0	133.0	115.0	102.0	93.2	85.8	78.7	72.7	67.4	62.8	46.5	36.9	31.0	26.7	21.2	17.7	15.2	13.4	12.0	10.9	10.0	8.5	4.6
12V105F	260.0	209.0	167.0	140.0	123.0	109.0	100.0	92.0	84.0	79.0	74.0	69.0	51.0	41.0	34.0	29.0	23.0	19.0	16.3	14.3	12.7	11.4	10.5	9.0	4.7
12V125F	290.0	220.4	185.5	160.6	143.6	127.3	117.2	107.1	97.0	90.8	84.6	78.4	62.1	45.8	39.6	33.4	27.2	21.8	20.0	17.6	15.0	14.0	12.4	10.6	5.3
12V155F	345.0	284.0	239.0	207.0	185.0	164.0	151.0	138.0	125.0	117.0	109.0	101.0	80.0	59.0	51.0	43.0	35.0	28.1	25.0	22.0	18.8	17.5	15.5	13.3	6.6

		Discharge Currents (Amperes) at 20°C to 1.85 volts per cell												Standby Time (Hours)											
Unit Type	5	Standby Time (Minutes)											Standby Time (Hours)												
		10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7					
12V50F	112.1	85.6	71.1	60.1	52.8	47.0	42.6	39.0	36.1	33.5	31.3	29.4	21.7	17.4	14.7	12.7	10.1	8.4	7.3	6.4	5.7	5.2	4.8	4.1	2.1
12V52F	119.0	90.8	75.4	63.8	56.0	49.9	45.2	41.4	38.3	35.6	33.2	31.2	23.0	18.5	15.6	13.5	10.7	8.9	7.7	6.8	6.1	5.5	5.1	4.3	2.4
12V65F	149.0	113.0	93.1	79.7	70.0	62.4	56.6	51.7	47.8	44.5	41.5	39.0	28.8	23.2	19.5	16.9	13.4	11.2	9.6	8.5	7.6	6.9	6.3	5.4	3.0
12V80F	169.0	137.0	114.0	98.2	85.7	76.0	69.9	64.7	59.5	55.1	51.3	47.9	35.8	28.6	23.9	20.5	16.3	13.6	11.8	10.4	9.3	8.5	7.8	6.6	3.6
12V82F	180.0	125.0	106.0	91.0	81.0	72.0	66.0	60.0	54.0	51.3	48.7	46.0	34.0	28.0	23.0	20.0	16.0	13.4	11.5	10.1	8.9	8.0	7.4	6.2	3.3
8V100F	211.0	171.0	142.0	123.0	107.0	95.0	87.3	80.8	74.4	68.9	64.1	59.9	44.8	35.8	29.8	25.6	20.3	17.0	14.7	13.0	11.6	10.6	9.7	8.3	4.5
12V100F	211.0	171.0	142.0	123.0	107.0	95.0	87.3	80.8	74.4	68.9	64.1	59.9	44.8	35.8	29.8	25.6	20.3	17.0	14.7	13.0	11.6	10.6	9.7	8.3	4.5
12V105F	244.0	187.0	153.0	129.0	114.0	102.0	92.7	85.0	78.0	73.0	68.5	64.0	47.2	36.0	31.8	27.0	21.7	18.0	15.4	13.6	12.0	10.9	10.0	8.5	4.4
12V125F	248.3	187.8	159.9	138.9	124.9	111.0	103.2	94.7	86.1	80.7	76.0	70.6	56.3	41.9	36.1	30.3	25.2	20.2	18.4	16.0	13.9	12.4	11.5	9.8	5.3
12V155F	320.0	242.0	206.0	179.0	161.0	143.0	133.0	122.0	111.0	104.0	98.0	91.0	72.5	54.0	46.5	39.0	32.5	26.0	23.0	20.0	17.4	15.5	14.4	12.3	6.6

Performance Data

Constant power discharge performance data



Constant Power Discharge (Watts per cell) at 20°C to 1.60 volts per cell																									
Unit Type	Standby Time (Minutes)																								
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	307.7	218.3	169.2	137.5	117.3	102.9	91.6	82.9	76.2	70.4	65.6	61.3	44.7	35.8	30.1	26.1	20.8	17.4	15.0	13.3	11.9	10.8	9.9	8.5	4.6
12V52F	320.0	227.0	176.0	143.0	122.0	107.0	95.3	86.2	79.2	73.2	68.2	63.8	46.5	37.2	31.3	27.1	21.6	18.1	15.6	13.8	12.4	11.2	10.3	8.8	4.8
12V55F	399.0	284.0	220.0	179.0	153.0	133.0	119.0	108.0	99.0	91.5	85.2	79.7	58.2	46.5	39.1	33.9	27.0	22.6	19.5	17.2	15.4	14.0	12.9	11.0	6.0
12V80F	456.0	324.0	255.0	212.0	181.0	158.0	144.0	131.0	121.0	113.0	104.0	97.0	71.6	56.8	47.7	41.1	33.0	27.6	23.9	21.1	18.9	17.2	15.8	13.5	7.3
12V82F	450.0	326.0	258.0	215.0	188.0	161.0	149.0	137.0	125.0	116.0	107.0	97.0	69.0	57.0	48.0	42.0	34.0	28.7	24.8	21.7	19.2	17.4	15.9	13.6	7.2
8V100F	569.0	406.0	318.0	265.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V100F	569.0	406.0	318.0	265.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V105F	585.0	479.0	379.0	311.0	271.0	232.0	214.0	196.0	176.0	166.0	154.0	141.0	103.0	82.9	69.6	59.8	47.0	39.0	33.2	28.8	25.4	22.3	20.4	17.4	9.2
12V125F	645.6	499.0	412.1	351.5	312.0	272.4	249.9	227.4	204.9	191.7	178.5	165.3	129.6	93.9	80.7	68.3	56.6	45.0	41.6	36.8	31.2	28.0	24.5	21.0	10.6
12V155F	832.0	662.0	540.0	460.0	408.0	356.0	326.0	296.0	267.0	250.0	233.0	215.0	167.0	121.0	104.0	88.0	73.0	58.0	52.0	46.0	39.0	35.0	30.6	26.2	13.2

Constant Power Discharge (Watts per cell) at 20°C to 1.65 volts per cell																									
Unit Type	Standby Time (Minutes)																								
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	307.7	218.3	169.2	137.5	117.3	102.9	91.6	82.9	76.2	70.4	65.6	61.3	44.7	35.8	30.1	26.1	20.8	17.4	15.0	13.3	11.9	10.8	9.9	8.5	4.6
12V52F	320.0	227.0	176.0	143.0	122.0	107.0	95.3	86.2	79.2	73.2	68.2	63.8	46.5	37.2	31.3	27.1	21.6	18.1	15.6	13.8	12.4	11.2	10.3	8.8	4.8
12V55F	399.0	284.0	220.0	179.0	153.0	133.0	119.0	108.0	99.0	91.5	85.2	79.7	58.2	46.5	39.1	33.9	27.0	22.6	19.5	17.2	15.4	14.0	12.9	11.0	6.0
12V80F	456.0	324.0	255.0	212.0	181.0	158.0	144.0	131.0	121.0	113.0	104.0	97.0	71.6	56.8	47.7	41.1	33.0	27.6	23.9	21.1	18.9	17.2	15.8	13.5	7.3
12V82F	450.0	326.0	258.0	215.0	188.0	161.0	149.0	137.0	125.0	116.0	107.0	97.0	69.0	57.0	48.0	42.0	34.0	28.7	24.8	21.7	19.2	17.4	15.9	13.6	7.2
8V100F	569.0	406.0	318.0	265.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V100F	569.0	406.0	318.0	265.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V105F	585.0	479.0	379.0	311.0	271.0	232.0	214.0	196.0	176.0	166.0	154.0	141.0	103.0	82.9	69.6	59.8	47.0	39.0	33.2	28.8	25.4	22.3	20.4	17.4	9.2
12V125F	645.6	499.0	412.1	351.5	312.0	272.4	249.9	227.4	204.9	191.7	178.5	165.3	129.6	93.9	80.7	68.3	56.6	45.0	41.6	36.8	31.2	28.0	24.5	21.0	10.6
12V155F	832.0	662.0	540.0	460.0	408.0	356.0	326.0	296.0	267.0	250.0	233.0	215.0	167.0	121.0	104.0	88.0	73.0	58.0	52.0	46.0	39.0	35.0	30.6	26.2	13.2

Constant Power Discharge (Watts per cell) at 20°C to 1.65 volts per cell																									
Unit Type	Standby Time (Minutes)																								
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	301.9	217.3	168.3	137.5	117.3	102.9	91.6	82.9	76.2	70.4	65.6	61.3	44.7	35.8	30.1	26.1	20.8	17.4	15.0	13.3	11.9	10.8	9.9	8.5	4.6
12V52F	314.0	226.0	175.0	143.0	122.0	107.0	95.3	86.2	79.2	73.2	68.2	63.8	46.5	37.2	31.3	27.1	21.6	18.1	15.6	13.8	12.4	11.2	10.3	8.8	4.8
12V55F	393.0	282.0	219.0	179.0	153.0	133.0	119.0	108.0	99.0	91.5	85.2	79.7	58.2	46.5	39.1	33.9	27.0	22.6	19.5	17.2	15.4	14.0	12.9	11.0	6.0
12V80F	446.0	321.0	254.0	212.0	181.0	158.0	144.0	131.0	121.0	113.0	104.0	97.0	71.6	56.8	47.7	41.1	33.0	27.6	23.9	21.1	18.9	17.2	15.8	13.5	7.3
12V82F	450.0	319.0	253.0	211.0	186.0	162.0	150.0	137.0	125.0	116.0	108.0	97.0	69.0	57.0	48.0	42.0	34.0	28.7	24.8	21.7	19.2	17.4	15.9	13.6	7.2
8V100F	557.0	401.0	318.0	265.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V100F	557.0	401.0	318.0	265.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V105F	585.0	479.0	379.0	311.0	271.0	232.0	214.0	196.0	176.0	162.0	151.0	141.0	103.0	82.9	69.6	59.8	47.0	39.0	33.2	28.8	25.4	22.3	20.4	17.4	9.2
12V125F	645.6	499.0	412.1	351.5	312.0	272.4	249.9	227.4	204.9	191.7	178.5	165.3	129.6	93.9	80.7	68.3	56.6	45.0	41.6	36.8	31.2	28.0	24.5	21.0	10.6
12V155F	832.0	662.0	540.0	460.0	408.0	356.0	326.0	296.0	267.0	250.0	233.0	215.0	167.0	121.0	104.0	88.0	73.0	58.0	52.0	46.0	39.0	35.0	30.6	26.2	13.2

Constant Power Discharge (Watts per cell) at 20°C to 1.67 volts per cell

Unit Type	Standby Time (Minutes)												Standby Time (Hours)												
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	296.2	2144	167.3	137.5	117.3	102.9	91.6	82.9	76.2	70.4	65.6	61.3	44.7	35.8	30.1	26.1	20.8	17.4	15.0	13.3	11.9	10.8	9.9	8.5	4.6
12V52F	308.0	223.0	174.0	143.0	122.0	107.0	95.3	86.2	79.2	73.2	68.2	63.8	46.5	37.2	31.3	27.1	21.6	18.1	15.6	13.8	12.4	11.2	10.3	8.8	4.8
12V55F	385.0	279.0	218.0	179.0	153.0	133.0	119.0	108.0	99.0	91.5	85.2	79.7	58.2	46.5	39.1	33.9	27.0	22.6	19.5	17.2	15.4	14.0	12.9	11.0	6.0
12V80F	437.0	317.0	253.0	212.0	181.0	158.0	144.0	131.0	121.0	113.0	104.0	97.0	71.6	56.8	47.7	41.1	33.0	27.6	23.9	21.1	18.9	17.2	15.8	13.5	7.3
12V82F	428.4	312.2	249.8	207.8	183.2	159.6	148.0	135.8	123.8	114.8	106.4	96.2	69.0	57.0	48.0	42.0	34.0	28.7	24.8	21.7	19.2	17.4	15.9	13.6	7.2
8V100F	546.0	396.0	316.0	265.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V100F	546.0	396.0	316.0	265.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V105F	585.0	466.2	369.4	304.6	262.0	229.6	208.2	189.2	174.0	161.2	150.2	140.2	103.0	82.9	69.6	59.8	47.0	39.0	33.1	28.8	25.4	22.3	20.4	17.4	9.2
12V125F	629.5	488.7	405.5	346.9	308.2	269.9	247.7	225.5	203.3	190.1	177.2	164.4	129.0	93.9	80.7	68.3	56.6	45.0	41.6	36.5	31.2	28.0	24.5	21.0	10.6
12V155F	811.2	629.8	522.6	447.0	397.2	347.8	319.2	290.6	262.0	245.0	228.4	211.8	166.2	121.0	104.0	88.0	73.0	58.0	52.0	45.6	39.0	35.0	30.6	26.2	13.2

Constant Power Discharge (Watts per cell) at 20°C to 1.69 volts per cell

Unit Type	Standby Time (Minutes)												Standby Time (Hours)												
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	289.4	211.5	166.3	137.5	117.3	102.9	91.6	82.9	76.2	70.4	65.6	61.3	44.7	35.8	30.1	26.1	20.8	17.4	15.0	13.3	11.9	10.8	9.9	8.5	4.6
12V52F	301.0	220.0	173.0	143.0	122.0	107.0	95.3	86.2	79.2	73.2	68.2	63.8	46.5	37.2	31.3	27.1	21.6	18.1	15.6	13.8	12.4	11.2	10.3	8.8	4.8
12V55F	376.0	275.0	216.0	178.0	153.0	133.0	119.0	108.0	99.0	91.5	85.2	79.7	58.2	46.5	39.1	33.9	27.0	22.6	19.5	17.2	15.4	14.0	12.9	11.0	6.0
12V80F	425.0	313.0	251.0	211.0	181.0	158.0	144.0	131.0	121.0	113.0	104.0	97.0	71.6	56.8	47.7	41.1	33.0	27.6	23.9	21.1	18.9	17.2	15.8	13.5	7.3
12V82F	405.8	305.4	246.6	204.6	180.4	157.2	146.0	134.6	122.6	113.6	104.8	95.4	69.0	57.0	48.0	42.0	34.0	28.7	24.8	21.7	19.2	17.4	15.9	13.6	7.2
8V100F	531.0	391.0	314.0	264.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V100F	531.0	391.0	314.0	264.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V105F	585.0	453.4	359.8	298.2	258.0	227.2	205.4	188.4	172.0	160.4	149.4	139.4	103.0	82.9	69.6	59.8	47.0	39.0	33.0	28.8	25.4	22.3	20.4	17.4	9.2
12V125F	613.4	478.5	399.0	342.2	304.5	267.4	245.5	223.6	201.8	188.6	176.0	163.4	128.4	93.9	80.7	68.3	56.6	45.0	41.6	36.2	31.2	28.0	24.5	21.0	10.6
12V155F	790.4	616.6	514.2	441.0	392.4	344.6	316.4	288.2	260.0	243.0	226.8	210.6	165.4	121.0	104.0	88.0	73.0	58.0	52.0	45.2	39.0	35.0	30.6	26.2	13.2

Constant Power Discharge (Watts per cell) at 20°C to 1.71 volts per cell

Unit Type	Standby Time (Minutes)												Standby Time (Hours)												
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	281.7	207.7	165.4	136.5	117.3	102.9	91.6	82.9	76.2	70.4	65.6	61.3	44.7	35.8	30.1	26.1	20.8	17.4	15.0	13.3	11.9	10.8	9.9	8.5	4.6
12V52F	293.0	216.0	172.0	142.0	122.0	107.0	95.3	86.2	79.2	73.2	68.2	63.8	46.5	37.2	31.3	27.1	21.6	18.1	15.6	13.8	12.4	11.2	10.3	8.8	4.8
12V55F	367.0	270.0	214.0	177.0	152.0	133.0	119.0	108.0	99.0	91.5	85.2	79.7	58.2	46.5	39.1	33.9	27.0	22.6	19.5	17.2	15.4	14.0	12.9	11.0	6.0
12V80F	412.0	309.0	249.0	210.0	181.0	158.0	144.0	131.0	121.0	113.0	104.0	97.0	71.6	56.8	47.7	41.1	33.0	27.6	23.9	21.1	18.9	17.2	15.8	13.5	7.3
12V82F	394.8	299.0	243.4	202.4	178.4	155.2	144.2	133.2	121.4	112.6	103.6	94.8	69.0	57.0	48.0	42.0	34.0	28.6	24.7	21.7	19.2	17.4	15.9	13.6	7.2
8V100F	515.0	386.0	311.0	262.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V100F	515.0	386.0	311.0	262.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V105F	576.6	441.4	350.4	291.8	233.6	224.2	202.0	186.4	170.0	158.8	148.0	102.5	82.4	69.3	59.6	46.8	38.8	32.9	28.8	25.4	22.3	20.4	17.4	9.2	
12V125F	596.0	468.5	392.2	336.9	300.3	264.5	242.9	221.6	199.9	185.6	173.8	162.2	127.6	93.6	80.4	68.0	56.3	44.9	41.4	36.0	31.0	27.8	24.5	21.0	10.6
12V155F	768.0	603.8	505.4	434.2	387.0	340.8	313.0	285.6	257.6	239.2	224.0	209.0	164.4	120.6	103.6	87.6	72.6	57.8	51.8	45.0	38.8	34.8	30.6	26.2	13.2

Constant Power Discharge (Watts per cell) at 20°C to 1.73 volts per cell

Unit Type	Standby Time (Minutes)												Standby Time (Hours)												
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	274.0	202.9	162.5	135.6	116.3	102.9	91.6	82.9	76.2	70.4	65.6	61.3	44.7	35.8	30.1	26.1	20.8	17.4	15.0	13.3	11.9	10.8	9.9	8.5	4.6
12V52F	285.0	211.0	169.0	141.0	121.0	107.0	95.3	86.2	79.2	73.2	68.2	63.8	46.5	37.2	31.3	27.1	21.6	18.1	15.6	13.8	12.4	11.2	10.3	8.8	4.8
12V55F	357.0	264.0	211.0	176.0	152.0	133.0	119.0	108.0	99.0	91.5	85.2	79.7	58.2	46.5	39.1	33.9	27.0	22.6	19.5	17.2	15.4	14.0	12.9	11.0	6.0
12V58F	399.0	304.0	247.0	209.0	181.0	158.0	144.0	131.0	121.0	113.0	104.0	97.0	71.6	56.8	47.7	41.1	33.0	27.6	23.9	21.1	18.9	17.2	15.8	13.5	7.3
12V62F	392.4	293.0	240.2	201.2	177.2	153.6	142.6	131.6	120.2	111.8	102.8	94.4	69.0	57.0	48.0	42.0	34.0	28.5	24.6	21.6	19.1	17.3	15.8	13.5	7.2
8V100F	499.0	380.0	309.0	261.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V100F	499.0	380.0	309.0	261.0	226.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V105F	559.8	430.2	341.2	285.4	248.8	220.6	198.0	183.2	168.0	156.4	146.0	136.7	101.4	81.5	68.6	59.1	46.5	38.4	32.8	28.7	25.3	22.3	20.4	17.4	9.2
12V125F	577.3	458.9	385.1	331.0	295.7	261.0	239.8	219.5	197.7	181.3	170.7	160.6	126.6	93.0	79.8	67.4	55.7	44.5	41.1	36.0	30.7	27.5	24.5	21.0	10.6
12V155F	744.0	591.4	462.2	426.6	381.0	336.4	309.0	282.8	254.8	233.6	220.0	207.0	163.2	119.8	102.8	86.8	71.8	57.4	51.4	45.0	38.4	34.4	30.6	26.2	13.2

Constant Power Discharge (Watts per cell) at 20°C to 1.75 volts per cell

Unit Type	Standby Time (Minutes)												Standby Time (Hours)												
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	266.3	193.0	159.6	133.7	115.4	101.9	91.3	82.9	76.2	70.4	65.6	61.3	44.7	35.8	30.1	26.1	20.8	17.4	15.0	13.3	11.9	10.8	9.9	8.5	4.6
12V52F	277.0	207.0	166.0	139.0	120.0	106.0	95.0	86.2	79.2	73.2	68.2	63.8	46.5	37.2	31.3	27.1	21.6	18.1	15.6	13.8	12.4	11.2	10.3	8.8	4.8
12V55F	346.0	258.0	207.0	174.0	150.0	132.0	119.0	108.0	99.0	91.5	85.2	79.7	58.2	46.5	39.1	33.9	27.0	22.6	19.5	17.2	15.4	14.0	12.9	11.0	6.0
12V58F	387.0	298.0	244.0	207.0	180.0	158.0	144.0	131.0	121.0	113.0	104.0	97.0	71.6	56.8	47.7	41.1	33.0	27.6	23.9	21.1	18.9	17.2	15.8	13.5	7.3
12V62F	390.0	287.0	237.0	200.0	176.0	152.0	141.0	130.0	119.0	111.0	102.0	94.0	69.0	57.0	48.0	42.0	34.0	28.4	24.5	21.5	19.0	17.3	15.7	13.5	7.2
8V100F	484.0	373.0	305.0	259.0	225.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V100F	484.0	373.0	305.0	259.0	225.0	198.0	179.0	164.0	152.0	141.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V105F	543.0	419.0	332.0	279.0	244.0	217.0	194.0	180.0	166.0	154.0	144.0	135.1	100.4	80.6	68.0	58.6	46.2	38.0	32.7	28.7	25.2	22.3	20.4	17.4	9.2
12V125F	558.7	449.3	377.9	325.1	291.0	257.6	236.7	217.3	195.6	176.9	167.6	159.1	125.7	92.3	79.2	66.7	55.1	44.2	40.8	36.0	30.4	27.2	24.5	21.0	10.6
12V155F	720.0	579.0	487.0	419.0	375.0	332.0	305.0	280.0	252.0	228.0	216.0	205.0	162.0	119.0	102.0	86.0	71.0	57.0	51.0	45.0	38.0	34.0	30.6	26.2	13.2

Constant Power Discharge (Watts per cell) at 20°C to 1.80 volts per cell

Unit Type	Standby Time (Minutes)												Standby Time (Hours)												
	5	10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	242.3	183.7	150.0	126.9	110.6	98.1	89.0	81.3	74.9	69.4	64.7	60.7	44.7	35.8	30.1	26.1	20.8	17.4	15.0	13.3	11.9	10.8	9.9	8.5	4.6
12V52F	252.0	191.0	156.0	132.0	115.0	102.0	92.6	84.5	77.9	72.2	67.3	63.1	46.5	37.2	31.3	27.1	21.6	18.1	15.6	13.8	12.4	11.2	10.3	8.8	4.8
12V55F	316.0	239.0	195.0	165.0	144.0	128.0	116.0	106.0	97.3	90.2	84.2	78.9	58.1	46.5	39.1	33.9	27.0	22.6	19.5	17.2	15.4	14.0	12.9	11.0	6.0
12V58F	354.0	282.0	234.0	201.0	175.0	155.0	142.0	131.0	121.0	112.0	104.0	97.0	71.6	56.8	47.7	41.1	33.0	27.6	23.9	21.1	18.9	17.2	15.8	13.5	7.3
12V62F	355.0	262.0	215.0	189.0	168.0	148.0	136.0	124.0	112.0	105.0	99.0	92.0	68.0	56.0	47.0	41.0	33.0	27.5	23.8	20.8	18.6	16.9	15.6	13.2	7.0
8V100F	443.0	353.0	293.0	251.0	219.0	194.0	178.0	164.0	151.0	140.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V100F	443.0	353.0	293.0	251.0	219.0	194.0	178.0	164.0	151.0	140.0	130.0	121.0	89.5	70.9	59.6	51.4	41.3	34.6	29.9	26.4	23.7	21.5	19.7	16.8	9.1
12V105F	504.0	384.0	312.0	262.0	231.0	205.0	187.0	172.0	158.0	148.0	138.0	130.0	97.0	78.0	65.0	45.0	37.0	32.0	28.0	24.7	22.2	20.4	17.4	9.2	
12V125F	530.0	505.1	345.3	301.9	271.6	240.6	221.9	203.3	185.5	173.8	162.2	151.3	119.5	88.5	76.8	65.2	53.5	42.7	39.2	34.4	29.6	27.2	24.5	21.0	10.6
12V155F	532.0	522.0	445.0	389.0	350.0	310.0	286.0	262.0	239.0	224.0	209.0	195.0	154.0	114.0	99.0	84.0	69.0	55.0	49.0	43.0	37.0	34.0	30.6	26.2	13.2

		Constant Power Discharge (Watts per cell) at 20°C to 1.85 volts per cell														Standby Time (Hours)									
Unit Type	5	Standby Time (Minutes)												Standby Time (Hours)											
		10	15	20	25	30	35	40	45	50	55	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12	24
12V50F	214.4	164.4	135.6	116.3	102.9	91.9	83.6	76.6	71.0	66.2	61.8	58.2	43.3	34.9	29.4	25.6	20.4	17.1	14.8	13.1	11.7	10.7	9.8	8.4	4.6
12V52F	223.0	171.0	141.0	121.0	107.0	95.6	86.9	79.7	73.8	68.8	64.3	60.5	45.0	36.3	30.6	26.6	21.2	17.8	15.4	13.6	12.2	11.1	10.2	8.7	4.8
12V65F	278.0	214.0	176.0	152.0	134.0	120.0	109.0	99.6	92.3	86.0	80.4	75.6	56.2	45.4	38.3	33.3	26.5	22.2	19.2	17.0	15.2	13.9	12.7	10.9	6.0
12V80F	316.0	259.0	217.0	188.0	165.0	147.0	135.0	125.0	116.0	107.0	99.9	93.5	70.3	56.3	47.1	40.5	32.2	27.1	23.4	20.7	18.6	16.9	15.5	13.3	7.3
12V82F	335.0	232.0	196.0	170.0	152.0	135.0	125.0	115.0	103.0	97.0	91.0	86.0	65.0	53.0	45.0	39.0	31.0	26.1	22.4	19.6	17.4	15.6	14.4	12.1	6.4
8V100F	395.0	324.0	271.0	235.0	206.0	183.0	169.0	157.0	144.0	134.0	125.0	117.0	87.9	70.4	58.9	50.6	40.3	33.8	29.3	25.9	23.3	21.1	19.4	16.6	9.1
12V100F	395.0	324.0	271.0	235.0	206.0	183.0	169.0	157.0	144.0	134.0	125.0	117.0	87.9	70.4	58.9	50.6	40.3	33.8	29.3	25.9	23.3	21.1	19.4	16.6	9.1
12V105F	451.0	351.0	288.0	244.0	215.0	193.0	175.0	161.0	148.0	138.0	130.0	122.8	91.3	73.7	61.8	53.0	42.3	35.0	30.0	26.5	23.4	21.3	19.5	16.6	8.7
12V125F	460.1	353.1	302.6	264.6	239.8	215.7	200.2	184.7	167.6	157.5	147.4	137.4	109.4	82.3	71.4	60.5	49.7	39.6	36.8	32.8	28.0	25.4	22.9	19.5	10.6
12V155F	580.0	455.0	390.0	341.0	309.0	278.0	258.0	238.0	216.0	203.0	190.0	177.0	141.0	106.0	92.0	78.0	64.0	51.0	46.0	41.0	35.0	31.8	28.6	24.4	13.2

The PowerSafe V Front Terminal units should be charged using constant potential chargers.

Float voltage

At normal room temperature (20°C), the recommended float voltage is equal to 2.28 volts per cell.

To optimise battery performance it is recommended that the float voltage is adjusted for room ambient temperatures in accordance with the following table.

Temperature	Float voltage range per cell
0°C	2.33-2.36V
10°C	2.30-2.33V
20°C	2.27-2.30V
25°C	2.25-2.28V
30°C	2.24-2.27V
35°C	2.22-2.25V
40°C	2.21-2.24V

Under these conditions a recharge will be completed in approximately 72 hours.

Charging current

A discharged VRLA battery will accept a high recharge current, but for those seeking a more economical charging system a current limit of 0.08 C₁₀ : 0.1 C₃ (A) is adequate.

Note: For a completely discharged battery, 80% of the capacity is replaced in approximately:

- 10 hours at 0.1 C₁₀
- 6 hours at 0.3 C₁₀
- 5 hours no current limit applied

Fast recharge

Increasing the charge voltage to 2.40 volts per cell can reduce recharge time and it is possible, depending on the depth of discharge, to halve 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 consecutive hours after the voltage limit has been reached. At the beginning of charge the current must be limited to 0.1 C₁₀ : 0.125 C₃ (A). This charge regime, in order to achieve a normal service life, must not be used more than once per month.

The effect of temperature on capacity

Correction factors for capacity at different temperatures are shown in the following table, the reference temperature being 20°C.

Duration of discharge	Battery temperature								
	0°C	5°C	10°C	15°C	20°C	25°C	30°C	35°C	40°C
5 minutes to 59 minutes	0.80	0.86	0.91	0.96	1	1.04	1.06	1.09	1.10
1 hour to 24 hours	0.86	0.90	0.94	0.97	1	1.03	1.05	1.06	1.07



Operating Instructions and Guidelines

Accidental deep discharge

- e.g. (i) discharge at a lower current for a longer time than the original system specification.
(ii) failure of the charging system.
(iii) battery not recharged immediately after a discharge.

When a battery is completely discharged:

- (i) the utilisation of the sulphuric acid in the electrolyte is total and the electrolyte now consists only of water. During recharge this condition may produce metallic dendrites which can penetrate the separator and cause a short circuit in a cell.
(ii) the sulphation of the plate is at its maximum and the internal resistance of the cell is also at its maximum.

The battery should be recharged under a constant potential of 2.28 volts per cell with the current limited to a maximum of 0.3 C₁₀ (A) in order to prevent excessive internal heating. For instance, for a 12V155F the maximum charge current is 46.5 amps. If the sulphation of the cell/battery is extensive, then the recharge of the battery may require more than 96 hours.

Note: Deep discharging will produce a premature deterioration of the battery and a noticeable reduction in the life expectancy of the battery.

For optimum operation the minimum voltage of the system should be related to the duty as follows:

Duty	Minimum end voltage
5 min ≤ t ≤ 1h	1.65V
1 h ≤ t ≤ 5h	1.70V
5 h ≤ t ≤ 8h	1.75V
8 h ≤ t ≤ 20h	1.80V

In order to protect the battery it is advisable to have system monitoring and low voltage cut-out.

Float charge ripple

Excessive ripple on the D.C. supply across a battery has the effect of reducing life and performance.

It is recommended therefore, that voltage regulation across the system including the load, but without the battery connected, under steady state conditions, shall be better than ±1% between 5% and 100% load.

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Transient and other ripple type excursions can be accommodated provided that, with the battery disconnected but the load connected, the system peak to peak voltage including the regulation limits, falls within ±2.5% of the recommended float voltage of the battery.

Under no circumstances should the current flowing through the battery when it is operating under float conditions, reverse into the discharge mode.

Electro-Magnetic Compatibility (EMC)

PowerSafe V products are covered by the EMC statement in prEN 50226:1995 which reads as follows:

Rechargeable cells or batteries are not sensitive to normal electromagnetic disturbances, and therefore no immunity tests shall be required. Free-standing rechargeable cells or batteries electrically isolated from any associated electrical system are for all practical purposes electromagnetically inert, and therefore the requirements for electromagnetic compatibility shall be deemed to be satisfied.

Note: It should be noted that rechargeable cells or batteries are part of an electrical system, and the manner in which they are used could invoke the requirements of the electromagnetic compatibility upon that system. In such cases, the requirements of electromagnetic compatibility shall be accommodated by the design of the system.

Maintenance

- Every month, check that the total voltage at the battery terminals is (N x 2.28V) for a temperature of 20°C.
- N = the number of cells in the battery and 2.28 = 20°C float voltage.
- Once a year, take a reading of the individual bloc voltages in the battery. A variation of ±4.5% on individual voltages from the average voltage is acceptable.
- The system must be checked once or twice a year.

Principal factors affecting the life of recombination batteries

- Deep discharge
- Poor control of the float voltage
- Cycling or micro-cycling
- Poor quality of charging current (excessive ripple)
- High ambient temperature

Warning

PowerSafe V Front Terminal units are already charged when delivered.

They should be unpacked with care. Avoid short circuiting terminals of opposite polarity as these units are capable of discharging at a very high current, especially if the lid or the container is damaged.

Unpacking

It is advisable to unpack all the monoblocs and accessories before commencing to erect and not to unpack and erect monobloc by monobloc.

All items should be carefully checked against the accompanying advice notes to ascertain if any are missing. Advise the Sales Department of any discrepancies.

A rigid plastic insulating cover is provided which totally protects the unit terminals. This is factory fitted to all products of the range and there is no need to remove it until access to the terminals is required.

Setting up the battery stands

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

To level the stand use the adjustable insulating feet.

Mounting in a cabinet

Ensure that the cabinet:

- is sufficiently strong to cope with the weight of the battery.
- is suitably insulated
- is naturally ventilated

Connecting the monoblocs

Torque setting

Tighten the nuts or bolts to the recommended levels of torque indicated on the product label.

Always use insulated tools for fitting and torquing up battery connections.

In series

The number of cells in series (N) will not affect the selected float voltage per cell.

Therefore, charging float voltage = N x Cell float Voltage
No special circuit arrangements are required.

In parallel

Using constant voltage chargers, and ensuring that the connections made between the charger and the batteries have the same electrical resistance, no special arrangements have to be made for batteries in parallel. Although no special circuit arrangements are required, where the parallel connection is made at the charger or distribution board, to avoid out of step conditions, the bus bar run length and the area of cross section should be designed so that the circuit resistance value for each string is equal within limits ±5%.

General recommendations

- Do not wear clothing of synthetic material to avoid static generation.
- Use only a clean soft damp cloth for cleaning the monoblocs. Do not use chemicals or detergents.
- Use insulated tools.
- Commence installation at the least accessible point.
- Consult the drawing for the correct position of the monobloc poles.

Commissioning charge

Ensure that the batteries will be operated in a clean environment.

Before use, the batteries should be charged at a constant float voltage adjusted according to the ambient temperature, e.g. 2.28 volts per cell at 20°C for 48 to 96 hours or, alternatively, a voltage of 2.40 volts per cell at 20°C can be used to reduce the commissioning period from 24 to 15 hours.

Where the batteries have been stored under harsh conditions, this increased voltage recharge is particularly effective.

Battery Storage

Storage conditions

Store the battery in a dry, clean and preferably cool location.

Storage time

As the batteries are supplied charged, storage time is limited.

In order to easily charge the batteries after prolonged storage, it is advisable not to store batteries for more than:

- 6 months at 20°C
- 3 months at 30°C
- 6 weeks at 40°C

Battery state of charge

The battery state of charge can be determined by measuring the open-circuit voltage of cells in rest position for 24 hours at 20°C.

State of charge	Voltage
100%	2.14Vpc
80%	2.10Vpc
60%	2.07Vpc
40%	2.04Vpc
20%	2.00Vpc

Open circuit voltage variation with temperature is 2.5mV per 10°C.

Recharge of stored batteries

Following storage and before putting the batteries into service, a refreshing charge shall be performed at 2.28-2.30 volts per cell at 20°C for 48 to 96 hours.

A current limit is not essential, but for optimum charge efficiency the current output of the charger can be limited to 10% of the 3-hour capacity rating.

The necessity of a refreshing charge can also be determined by measuring the open circuit voltage of a stored battery. Refreshing charge is advised if the voltage drops below 2.10 volts per cell.

Failure to observe these conditions may result in greatly reduced capacity and service life.



Battery Accommodation

PowerSafe
V
FRONT TERMINAL

A comprehensive range of steel stands/cabinets has been specifically designed to provide a compact battery arrangement whilst retaining the requirements of electrical and mechanical safety, ease of installation and access during operation for taking meter readings.

Transition boxes can be supplied for convenient connection of outgoing cables.

Please contact Enersys Sales Department for further information.



Global Headquarters
P.O. Box 14145 Reading,
PA 196212-4145
USA
Tel: +1-610-208-1991
+1-800-538-3627
Fax: +1-610-372-8613

EnerSys EMEA
Houtweg 26
1140 Brussels
Belgium
Tel: +32 (0)2 247 94 47
Fax: +32 (0)2 247 94 49

EnerSys Asia
No. 49, Yanshan Road
Shekou, Shenzhen
518066, China
Tel: +86-755-2689 3639
Fax: +86-755-2689 8013

Contact:



www.enersysinc.com