

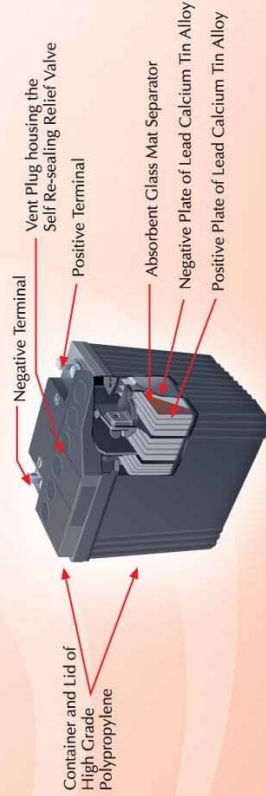
SEALED MAINTENANCE FREE/ VALVE REGULATED LEAD ACID BATTERIES

Exide Industries Ltd., the largest manufacturer of lead acid batteries in India, launched in the year 1997 the Power Pack of the future - The VRLA battery - a result of in-house R&D efforts and technical collaboration with M/s Shin-Kobe Electric Machinery Co., Japan, the manufacturers of HITACHI batteries. The VRLA battery manufactured by Exide Industries Ltd. uses AGM or "Absorbent Glass Mat" technology. The electrolyte is in absorbed condition, held within the pores of the glass mat separator. The separator in turn, is tightly packed in between the positive and the negative plates.

To eliminate the harmful effects of early gassing, "lead antimony alloy" is replaced by "lead calcium tin alloy" in the plate grid structure. Very little electrolysis/gassing takes place and whatever water is converted to oxygen and hydrogen is reconverted back.

The released hydrogen is in its ionic state and, not being in gaseous form, cannot escape. The oxygen, though in gaseous form, cannot bubble upwards in the absence of any free electrolyte. It has to pass through the separator pores, through electrolyte and air pockets alternately and is forced to the surface of the negative plate. The oxygen reacts with the spongy lead of the negative plate and is recombined as shown :

Therefore this battery is also known as Oxygen Recombination Battery. The recombination is 100% efficient and no water is lost from the system.



At times, the rate of oxygen generation exceeds the rate of recombination due to imposition of higher than recommended charging voltages or due to operation in higher than recommended ambient temperature. This causes increase of pressure inside the battery and excess pressure is released through specially designed Self Re-sealing Relief Valve, and hence the name VRLA or Valve Regulated Lead Acid battery. The only limitation of this versatile battery arises from the fact that these are temperature and charging voltage sensitive. Although maintenance by way of water topping up is not required, regular checking and assurance of proper charging voltage, depth of discharge and operating temperature is needed. This is true for all the VRLA or SMF batteries.

WHY EXIDE POWERSAFE PLUS

The Features

- (1) **Sealed Maintenance Free** : No need for checking electrolyte level and topping throughout its life. Sealed construction ensures no leakage or seepage of electrolyte from terminal or casing.
- (2) **Free from Orientation Constraints** : The sealed construction with immobilised electrolyte allows the battery to be installed in any position, horizontal, vertical, sideways – without any effect on its performance.
- (3) **Eco Friendly** : The unique gas recombination technology effectively nullifies generation of gas during normal use. It is totally eco friendly, ensuring clean and safe environment.
- (4) **Minimal Voltage Drop** : Since battery emits no gases or fumes, it can be placed adjacent to the UPS system or other electronic equipment, ensuring minimal voltage drop between battery and equipment.
- (5) **Easy Handling – Easy Installation** : Lightweight and compact. Modular construction, easy to install and easy to connect and commission.
- (6) **Ready To Use** : Available in fully (factory) charged condition.
- (7) **Good Service Life** : Between 3 to 5 years life for small and medium monobloc range (EP range) depending on cyclic/float applications.
- (8) **Low Self Discharge** : Self discharge very low as compared to conventional flooded batteries.
- (9) **Charge Retention & Recovery** : Excellent charge retention and recovery ability due to special design of plates and separators with an absolutely balanced electrolyte.
- (10) **Superior High Rate Discharge** : Very low internal resistance and very high electrolyte – active material reactive interface – allows very high currents for short and medium duration.
- (11) **High Reliability** : Tough construction and heavy duty design with superior corrosion resistant lead calcium tin alloy.

The Benefits

- Saving of hundreds of litres of distilled/ demineralised water throughout its lifetime as compared to conventional batteries.
- Saving of manpower for regular topping up and cleaning corroded terminals as in conventional batteries.
- No damage of flooring by spillage of battery acid or water during maintenance.
- No need of separate battery room.
- Can be installed by stacking together in any convenient orientation or position, thereby saving huge floor space as compared to conventional batteries.
- Saving of hundreds of square feet of costly floor space in metropolitan areas.
- Battery can be installed inside offices and working areas – no need for separate battery rooms, costly acid proof flooring etc. Battery can be installed in a cabinet also.
- No need for elaborate air exhaust systems as in conventional battery installations.
- Saving from transmission loss – Higher efficiency – Lower electricity consumption – Lower cost on cabling.
- Does not require specially trained technical manpower for elaborate installation and commissioning procedures.
- No delay between receipt and use. Instant power source.
- Comparable with the best international makes.
- Better than the international makes in the same capacity range.
- Can be stored for 3 to 6 months, depending on ambient temperature before recharge and without any loss of efficiency or performance.
- Lower consumption of electricity during use.
- Very long shelf life.
- Leads to greatly improved ability to recover from deep discharge.
- Requires smaller capacity (as compared to flooded batteries) for high rate discharges upto 15 mins/30 mins/ 60 mins duration.
- Lower size, lower cost, lower space requirement.
- Can deliver the rated performance throughout its service life.

ADVANTAGE EXIDE

- **Technology** : Manufactured in technical collaboration with Shin-Kobe Electric Machinery Co., Japan, maker of world-renowned Hitachi batteries. Exide Industries Ltd. is an ISO 9001 organisation.
- **Experience** : Over 60 years accumulated experience of Research & Development, field operations & feedback.
- **Manufacturing Base** : The only company having multilocal manufacturing units spread across the country with ultra large manufacturing capacities.
- **Result** : Factory fresh batteries, whenever and wherever you need them. VRLA batteries come in factory charged condition and thus, the fresher they are, the better.
- **Network** : Easy availability - with 26 Company branches, 30 Exide Powercentres and near 1000 Industrial dealers spread out all over the country.
- **Solution Provider** : Experienced engineers are available to offer total solutions regarding equipment selection, installation, operation and maintenance.
- **Eco-friendly Company** : ISO 14001, TS 16949, OHSAS 18001 certifications. Ensuring eco-friendly production process. The only company having own smelting house and large network to collect and recycle used batteries to avoid environmental damage.
- **Recycle Symbol** : The batteries manufactured both for domestic and exports are labelled with the recycle symbol.
- **Safety Conscious** : Underwriters Laboratories Inc.® USA certification for the products are available as an option.



APPLICATIONS

FOR STANDBY POWER

- ▶ UPS Systems
- ▶ Telecommunication Systems
- ▶ Office Automation Equipment
- ▶ Fire Alarm & Security Systems
- ▶ Electronic PABX Systems
- ▶ Cable Television Equipment
- ▶ Electronic Attendance & Cash Registers
- ▶ Process Instrumentation & Control
- ▶ Railway Signalling
- ▶ Power Plants & Substations
- ▶ Cellular Phones & Pagers (Base Stations & Transmitters)
- ▶ Geophysical Equipment
- ▶ PCO Monitors (Electronic)

FOR PORTABLE POWER

- ▶ Search Lights
- ▶ Portable Communication Sets
- ▶ Portable Testing & Measuring Instruments
- ▶ Medical Electronics
- ▶ Marine & Offshore Equipment
- ▶ Vending Machines & Weighing Scales
- ▶ Solar Lanterns



EXIDE POWERSAFE PLUS

**SMALL AND MEDIUM SIZED
SEALED LEAD ACID BATTERIES**

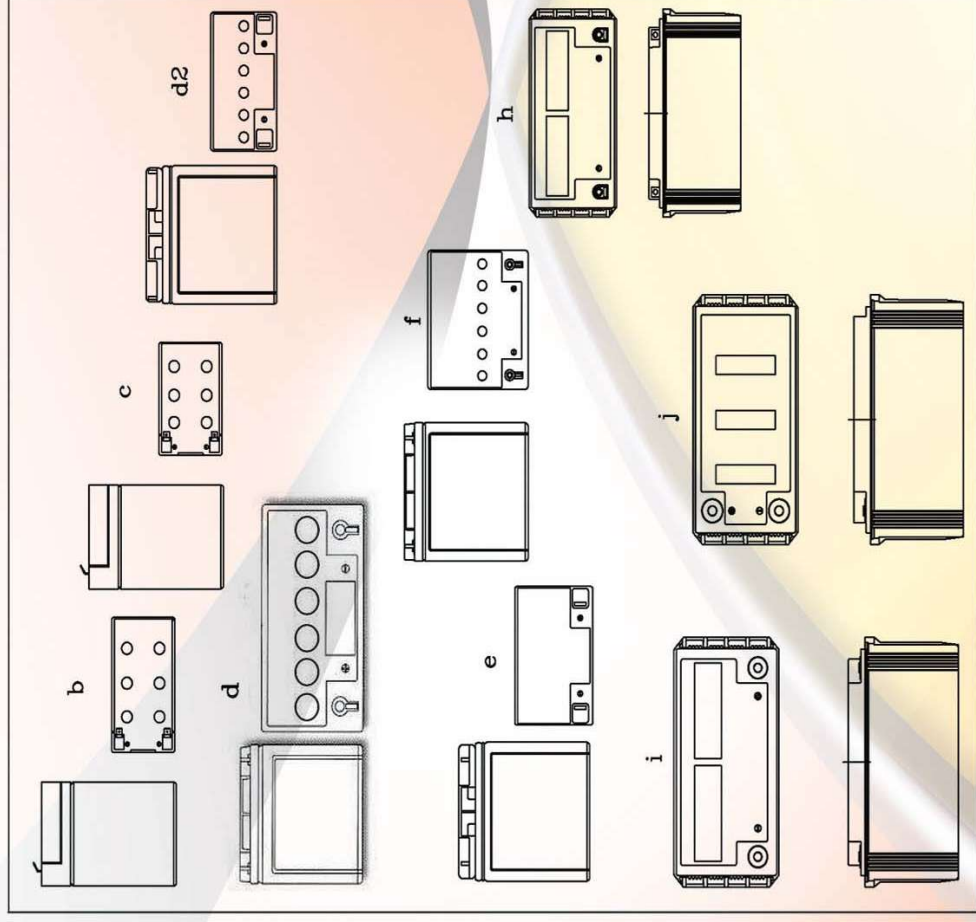
**Performance Characteristics
conforming to JIS C8702**

POWERSAFE PLUS RANGE

General Applications

Type of Battery	Rated Capacity (Wh) at 27 °C										Dimensions (mm)			Terminal Layout					
	Nominal Voltage (V)					Overall Height (mm)					Width (mm)	Height (mm)							
	1.75 V/cell	1.75 V/cell	10 hrs V/cell	3 hrs V/cell	1.5 hrs V/cell	30 mins V/cell	1.5 V/cell	1.5 hrs V/cell	1.5 hrs V/cell										
EP 7.5-12	12	7.5	6.5	5.5	5.3	4.5	3.7	100.0	94.0	151.0	65.0	2.40	92.00	37.50	22.00	105.0	ABS	b	F ₂
EP 9-12/EP 1234 W	12	9	8.1	6.8	6.4	5.4	4.5	100.0	94.0	151.0	65.0	2.60	110.00	42.00	18.00	135.00	ABS	b	F ₂
EP 12-12	12	12	11.2	9.0	8.6	7.2	6.0	100.0	94.0	151.0	98.0	3.8	98.0	38.0	16.0	180.0	ABS	c	F ₂
EP 17-12	12	17	16.0	12.9	12.2	10.2	8.5	167.0	167.0	181.0	76.0	5.0	88.0	41.0	15.0	255.0	ABS	d ₂	F ₃
EP 26-12 W(TP)	12	26	24.0	19.5	18.7	15.6	13.0	175.0	175.0	166.0	125.0	8.8	86.0	35.0	10.0	390.0	TP10	d	F ₄
EP 26-12 (ABS)	12	26	24.0	19.5	18.7	15.6	13.0	179.0	179.0	178.0	124.0	9.2	79.0	34.0	10.0	390.0	ABS	e	F ₅
EP 32-12	12	32	29.1	24.0	23.0	19.2	16.0	179.0	179.0	178.0	124.0	9.9	97.0	39.0	10.0	480.0	ABS	e	F ₅
EP 42-12	12	42	38.5	31.5	30.2	25.2	21.0	170.0	170.0	200.0	165.0	14.0	91.0	36.0	8.0	420.0	TP10	f	F ₆
EP 42-12 (COS)	12	42	38.5	31.5	30.2	25.2	21.0	181.0	181.0	199.0	165.0	13.9	85.0	36.3	8.0	420.0	TP10	f	F ₆
EP 65-12	12	65	60.0	48.6	46.8	39.0	32.5	174.0	174.0	350.0	166.0	20.3	77.0	38.4	6.0	500.0	TP10	h	F ₇
EP 65-12 (COS)	12	65	60.0	48.6	46.8	39.0	32.5	181.0	181.0	350.0	166.0	20.2	75.0	38.6	6.0	500.0	TP10	h	F ₇
EP 75-12	12	75	69.0	56.2	54.0	45.0	37.5	174.0	174.0	391.0	166.0	23.0	80.0	39.0	6.0	500.0	TP10	h	F ₇
EP 100-12	12	100	91.0	75.0	72.0	60.0	50.0	235.0	235.0	407.0	173.0	32.5	73.0	37.0	6.0	600.0	TP10	h	F ₈
EP 120-12	12	120	109.0	90.0	86.4	72.0	60.0	239.0	239.0	452.0	172.0	38.0	77.0	38.0	6.0	600.0	TP10	!	F ₉
EP 150-12	12	150	136.5	112.5	108.0	90.0	75.0	240.0	240.0	557.0	172.0	48.30	78.00	38.00	5.00	900.0	TP10	!	F ₉
EP 200-12	12	200	182.0	150.0	144.0	120.0	100.0	240.0	240.0	533.0	250.0	67.20	75.00	36.00	5.00	1200.0	TP10	!	F ₉

Table (1)

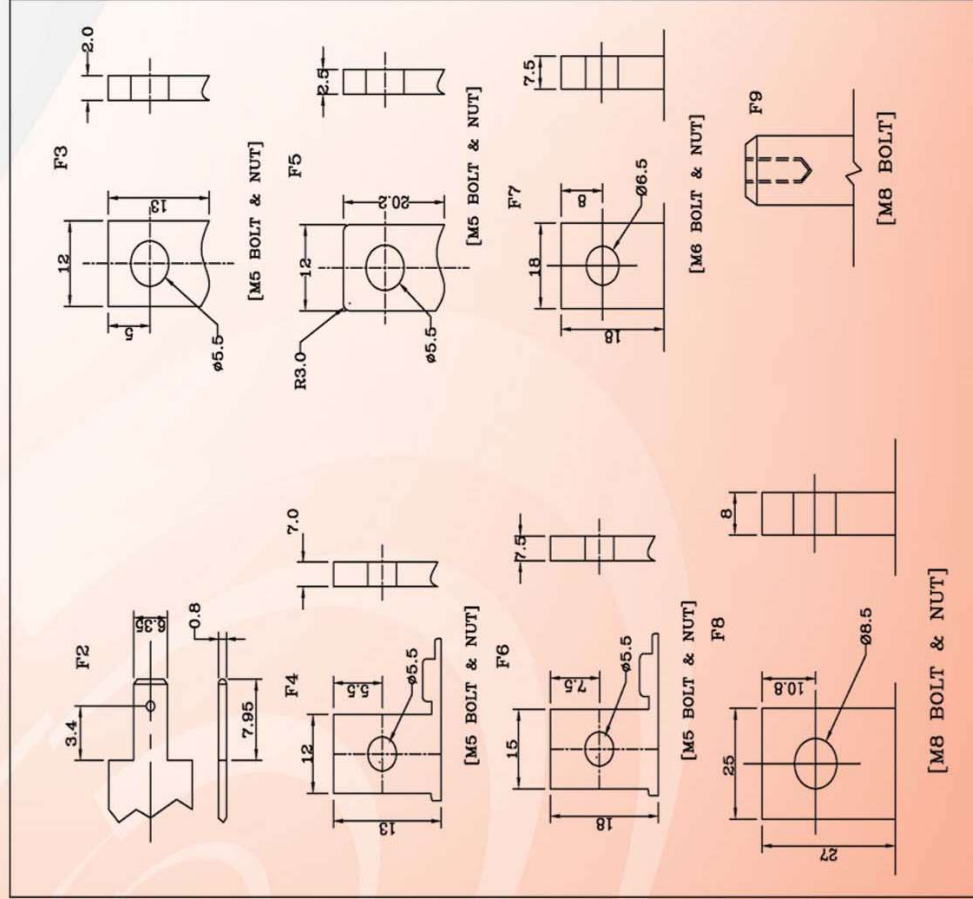


LAYOUT FOR BATTERY OUTLINE

Advantages : International size - matches dimension of any International equipment. High Rate performance
- matches or better High Rate performance of equivalent International types.

Powersafe Plus Series

BATTERY CHARGING FOR POWERSAFE PLUS



CHARGER

CHARGER
'Constant Potential' chargers, with current limit facility only, are recommended for normal continuous operation.

CHARGE LIMITS

Table 2 shows the charge voltage and limit current. The charge voltage of the battery has to be reduced with increasing temperature and increased with decreasing temperature. Accordingly, charging with a given voltage requires increased charge current when the temperature is high and reduced charge current at a lower temperature.

- a) Even under high temperature, a charging voltage of 2.2V/cell is required.

- b) Even under low temperature, the charging voltage must be set at less than 2.45V/cell so as to prevent gas generation from the battery.

- c) The battery life will be shortened as service temperature rises.



CHARGE PARAMETERS

Recharge Voltages: Batteries to be recharged in CC-CV mode only.

Mode of Operation	Voltage settings per 12V unit for ambient temperature 20–30 deg C	Current Setting
Float	13.7V +/- 0.1V	Maximum: 0.3CA Minimum: 0.1CA
Cyclic	14.7V +/- 0.1V	

Temperature Compensation : (Reference 25 deg C) FLOAT : -18 mV / deg C / 12V unit
CYCLIC : -30 mV / deg C / 12V unit

Table (2)

Powersafe Plus Series

CHARGE CHARACTERISTICS

Charge under constant potential charging mode at 27 °C

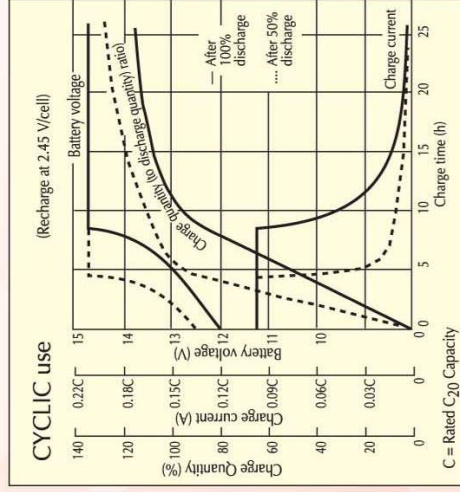


Figure (3)

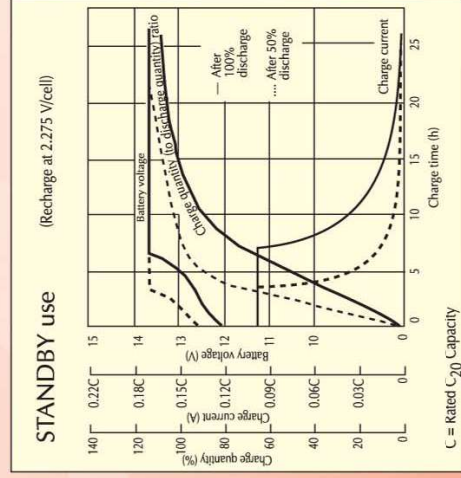


Figure (4)

SERVICE LIFE

The trend of service life of EP Plus batteries under different operating conditions

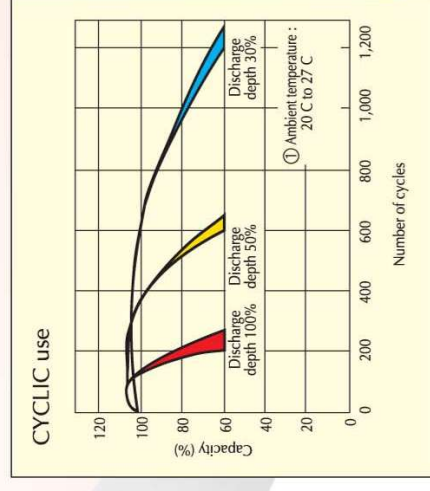


Figure (5)

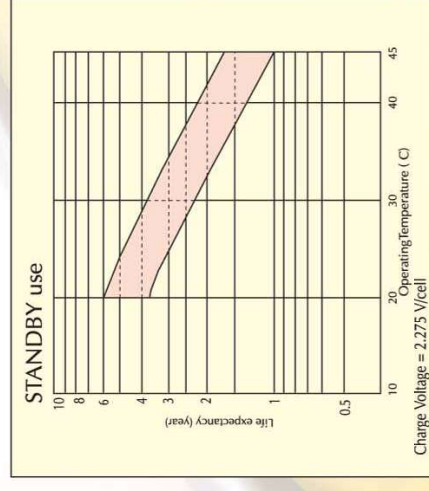
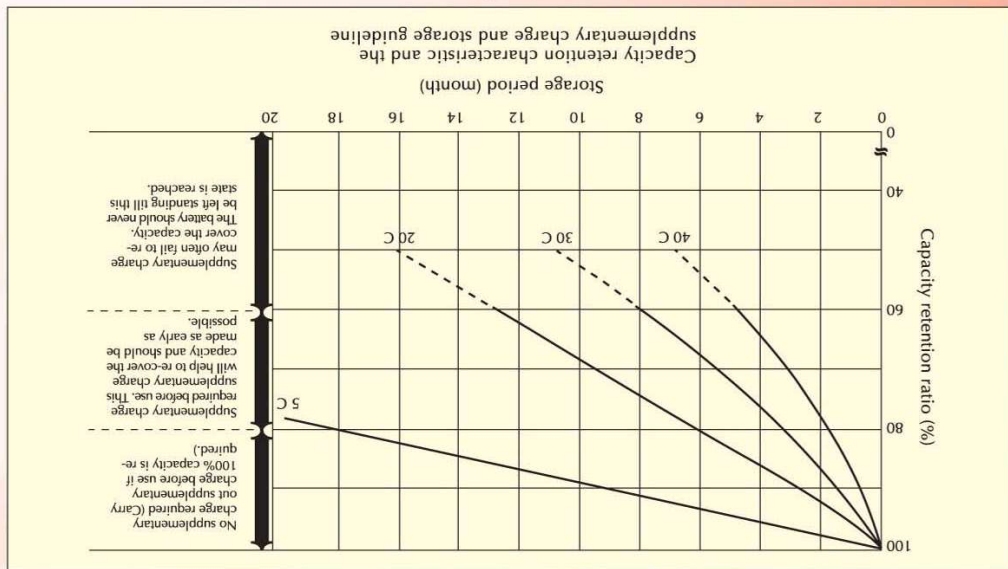


Figure (6)

CAPACITY RETENTION



Retention of Charge of Powersafe Plus Series under ideal storage conditions

Maximum discharge current for various durations and cut-off voltages

Discharge current in ampere to Powersafe Plus type sealed lead acid battery

END TEMP	CELL VOLTAGE (V)	DISCHARGE TIME									
		0.5min	1min	2min	3min	4min	5min	7min	10min	15min	20min
1.80	25	4.0C (3.20)	3.9C (3.15)	3.8C (3.10)	3.7C (3.00)	3.5C (2.80)	3.2C (2.60)	2.8C (2.30)	2.3C (2.00)	1.8C (1.65)	1.5C (1.40)
	5	3.2C (2.55)	3.0C (2.40)	2.7C (2.35)	2.5C (2.30)	2.3C (2.15)	2.2C (2.00)	1.9C (1.80)	1.7C (1.65)	1.4C (1.30)	1.2C (1.10)
	-5	2.5C (2.10)	2.4C (2.05)	2.2C (2.00)	2.1C (1.95)	1.9C (1.80)	1.8C (1.65)	1.6C (1.50)	1.4C (1.30)	1.1C (1.00)	0.9C (0.80)
	25	5.6C (4.30)	5.1C (4.00)	4.9C (3.90)	4.7C (3.80)	4.0C (3.20)	3.6C (2.80)	3.0C (2.40)	2.4C (2.00)	1.6C (1.30)	1.3C (1.10)
1.70	25	5.6C (4.30)	5.1C (4.00)	4.9C (3.90)	4.7C (3.80)	4.0C (3.20)	3.6C (2.80)	3.0C (2.40)	2.4C (2.00)	1.6C (1.30)	1.3C (1.10)
	5	5.1C (4.20)	4.6C (3.60)	4.3C (3.40)	4.0C (3.15)	3.4C (2.80)	2.8C (2.30)	2.4C (2.00)	2.0C (1.80)	1.3C (1.10)	1.0C (0.90)
	-5	3.6C (2.90)	3.4C (2.70)	3.0C (2.65)	2.8C (2.60)	2.5C (2.30)	2.3C (2.00)	2.0C (1.85)	1.7C (1.60)	1.1C (1.00)	0.86C (0.80)
	25	6.6C (4.85)	5.9C (4.70)	5.2C (4.45)	4.6C (4.05)	4.2C (3.60)	3.8C (3.30)	3.2C (2.85)	2.7C (2.35)	2.0C (1.85)	1.5C (1.35)
1.65	25	6.6C (4.85)	5.9C (4.70)	5.2C (4.45)	4.6C (4.05)	4.2C (3.60)	3.8C (3.30)	3.2C (2.85)	2.7C (2.35)	2.0C (1.85)	1.5C (1.35)
	5	5.6C (4.90)	4.9C (4.10)	4.1C (3.60)	3.6C (3.30)	3.15C (2.90)	2.95C (2.60)	2.5C (2.10)	2.1C (1.90)	1.7C (1.60)	1.4C (1.30)
	-5	4.4C (3.90)	3.9C (3.80)	3.3C (3.20)	2.9C (2.90)	2.6C (2.60)	2.4C (2.40)	2.1C (2.10)	1.7C (1.70)	1.35C (1.35)	1.15C (1.10)
	25	7.6C (5.40)	6.7C (5.20)	5.6C (4.90)	4.9C (4.40)	4.4C (3.90)	3.9C (3.50)	3.3C (3.00)	2.8C (2.40)	2.1C (1.90)	1.7C (1.60)
1.60	25	7.6C (5.40)	6.7C (5.20)	5.6C (4.90)	4.9C (4.40)	4.4C (3.90)	3.9C (3.50)	3.3C (3.00)	2.8C (2.40)	2.1C (1.90)	1.7C (1.60)
	5	6.1C (5.40)	5.2C (4.30)	4.3C (3.75)	3.8C (3.50)	3.3C (3.10)	3.1C (2.75)	2.6C (2.30)	2.2C (2.00)	1.8C (1.70)	1.5C (1.40)
	-5	5.1C (4.40)	4.4C (3.90)	3.5C (3.30)	3.0C (2.75)	2.7C (2.40)	2.5C (2.20)	2.2C (2.00)	1.9C (1.65)	1.4C (1.30)	1.2C (1.10)
	25	8.1C (6.00)	7.2C (5.30)	6.1C (4.00)	5.2C (4.90)	4.4C (3.50)	3.8C (3.20)	3.2C (2.80)	2.6C (2.30)	1.9C (1.70)	1.5C (1.40)

The number in bracket shows the discharge current of rated capacity above 17Ah. C is rated capacity at 20 hrs.

Table (3)

Powersafe Plus Series

DISCHARGE PERFORMANCE

Powersafe Plus Series

DISCHARGE CURRENT AND RECOMMENDED FINAL DISCHARGE VOLTAGE

Discharge Current (A)	Final Discharge Voltage (V/cell)
0.2 C > (A) or intermittent discharge	1.75
0.2 C < or = (A) < 0.5 C	1.70
0.5 C < or = (A) < 1.0 C	1.55
1.0 C < or = (A)	1.30

Table (4)

EFFECT OF TEMPERATURE ON CAPACITY

This figure represents the relation between the temperature and discharge capacity

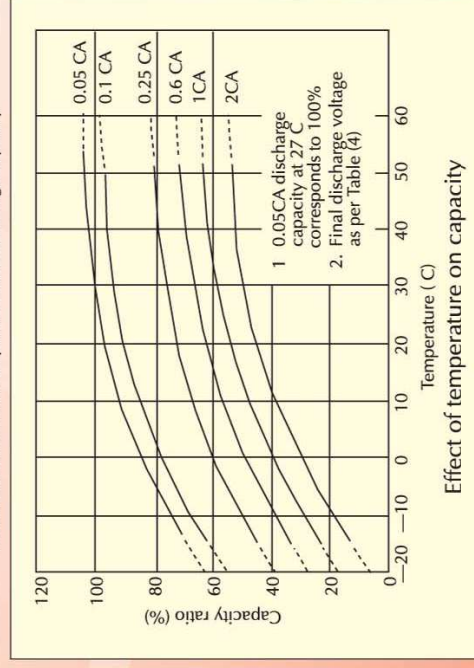


Figure (8)

Powersafe Plus Series

DISCHARGE CHARACTERISTICS

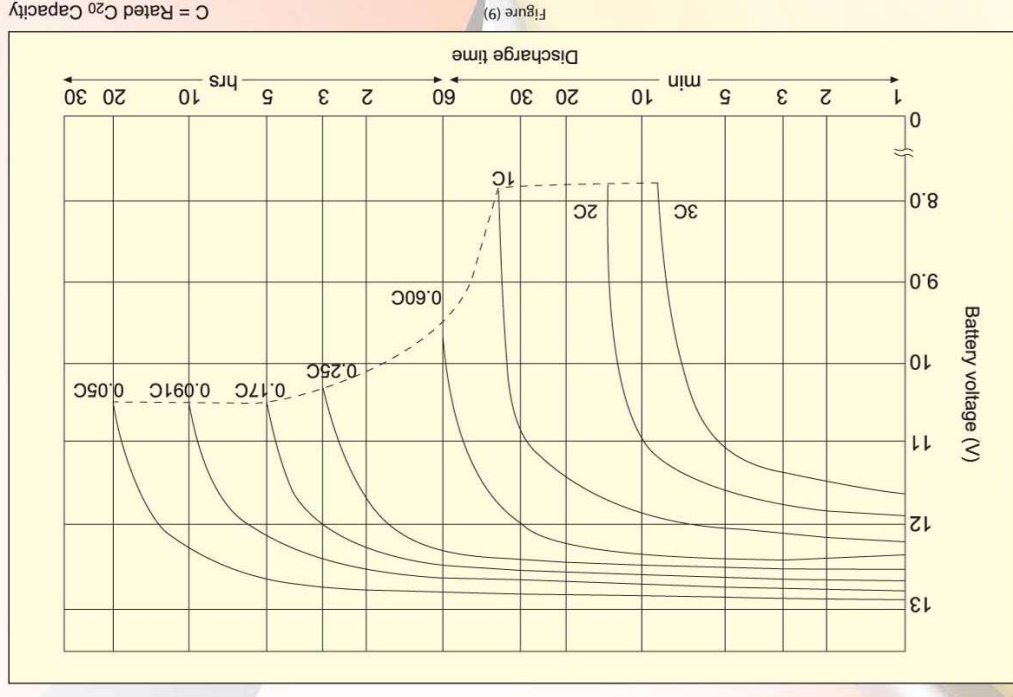


Figure (9)

CONSTANT POWER DISCHARGE RATINGS IN WATTS PER BATTERY FOR POWERSAFE PLUS AT 27°C

ECV	BATTERY TYPE	DISCHARGE TIME															
		5	10	15	20	30	60	120	180	240	300	360	480	600			
1.80	7	284	200	155	128	95	55	33	20.5	16.8	14.0	12.1	9.6	8.0			
	9	298	209	163	134	101	61	38	26.5	21.6	18.0	15.7	12.4	10.3			
	12	486	342	265	219	162	94	56	35.0	28.8	24.0	20.9	16.5	13.7			
	17	541	376	299	248	184	220	71	50.0	40.8	34.0	29.6	23.4	19.4			
	26	905	637	497	408	293	185	114	76.4	62.4	52.0	45.2	35.6	29.6			
	42	1393	980	763	629	475	293	180	123.5	100.8	84.0	73.0	58.0	47.9			
	65	2263	1590	1240	1022	772	470	292	191.1	156.0	130.0	113.1	89.7	74.1			
	75	2534	1788	1389	1150	864	526	328	216.0	178.0	150.0	130.5	103.5	83.5			
	100	3307	2323	1810	1491	1125	682	423	294.0	240.0	200.0	174.0	138.0	114.0			
	120	3968	2788	2172	1789	1350	818	508	352.8	288.0	240.0	208.8	165.6	136.8			
	150	4961	3485	2715	2237	1688	1023	635	441.0	360.0	300.0	261.0	207.0	171.0			
	200	6614	4646	3620	2982	2250	1364	846	588.0	480.0	400.0	348.0	276.0	228.0			
	7	315	221	168	137	101	57	34	22.2	18.0	14.7	13.0	10.0	8.4			
	9	329	231	175	143	108	73	44	28.6	23.2	18.9	16.7	13.0	10.8			
	12	539	378	287	234	173	97	58	38.1	31.0	25.2	22.3	17.3	14.4			
	17	600	421	321	262	194	117	73	54.0	43.9	35.7	31.6	24.5	20.4			
1.70	26	1006	705	536	436	313	193	117	82.7	67.1	54.6	48.3	37.4	31.2			
	42	1548	1022	825	671	507	305	185	133.5	108.3	88.2	78.1	60.5	50.4			
	65	2510	1660	1340	1090	823	496	300	206.7	167.7	136.5	120.9	93.6	78.0			
	75	2816	1867	1500	1220	921	555	337	238.5	193.5	157.5	139.5	108.0	90.0			
	100	3660	2416	1948	1583	1200	724	438	318.0	258.0	210.0	186.0	144.0	120.0			
	120	4392	2899	2338	1899	1440	869	526	381.6	309.6	252.0	223.2	172.8	144.0			
	150	5490	3624	2922	2375	1800	1086	657	477.0	387.0	315.0	279.0	216.0	180.0			
	200	7320	4832	3896	3166	2400	1448	876	636.0	516.0	420.0	372.0	288.0	240.0			
	7	332	227	174	141	103	59	35	23.1	18.5	15.4	13.4	10.5	8.8			
	9	345	217	181	146	109	67	41	29.7	23.8	19.8	17.3	13.5	11.3			
	12	569	389	298	241	176	101	59	39.6	31.7	26.4	23.0	18.0	15.1			
	17	632	434	334	270	200	123	77	56.1	44.5	37.4	32.6	25.5	21.4			
	26	1059	716	556	449	320	200	119	85.8	68.6	57.2	50.0	39.0	32.8			
	42	1630	1084	857	690	517	316	190	138.6	110.9	92.4	80.6	63.0	52.9			
	65	2644	1761	1393	1121	840	513	308	214.5	171.6	143.0	124.8	97.5	81.9			
	75	2961	1988	1560	1255	940	577	345	244.5	196.0	165.0	141.0	112.5	96.5			
1.60	100	3834	2569	2015	1618	1207	749	450	330.0	264.0	220.0	192.0	150.0	126.0			
	120	4601	3083	2418	1942	1448	899	540	396.0	316.8	264.0	230.4	180.0	151.2			
	150	5751	3854	3023	2427	1810	1124	675	495.0	396.0	330.0	288.0	225.0	189.0			
	200	7668	5138	4030	3236	2414	1498	900	660.0	528.0	440.0	384.0	300.0	252.0			

Table (5)

ADDITIONAL INFORMATION REGARDING EXIDE POWERSAFE PLUS

Heat Dissipation:

A VRLA battery under normal float condition shall dissipate heat into the atmosphere. For the overall heat load calculation, taking into account a worst case operation, the rate of heat dissipation may be taken as 0.45 Watts/100 Ah C₂₀ capacity/cell.

Hydrogen Evolution:

Hydrogen gas evolved by a lead acid battery may be estimated from the following formula:

$$\text{Hydrogen gas evolved per hour} = 0.45 \times 10^{-3} \times n \times I \text{ at N.T.P.}$$

where, n = number of 2V cells

I = Float current, 0.2 A/100 Ah for a VRLA cell

To design for the ventilation (air flow) requirement so that the hydrogen percentage in the air is always below 4% (lower explosive limit), the air flow rate may be estimated as:

$$Q = d \times s \times 0.45 \times 10^{-3} \times n \times I \text{ m}^3/\text{hr}$$

Where, d = dilution ratio (100 - 4)/4 = 24

S = factor of safety, eg. 5

For a VRLA, the above may be simplified as:

$$Q = 0.0108 \times n$$

Ripple Current:

VRLA batteries should be charged by pure D.C. source only. For optimum life the A.C. ripple content should not exceed 5A per 100Ah C₂₀ capacity.

Overdischarge:

Compared to the alkaline battery, the sealed lead acid battery is very sensitive to overdischarge. And overdischarge results in failure to recover normal capacity, reduced capacity or shortened service life. Overdischarge also occurs by leaving the battery in a discharged state. The Powersafe Plus type sealed lead acid battery overcomes this. If this battery is overdischarged and left standing in a discharged state for several days, it can recover its original capacity when charged.