

Battery Information and Sizing

All standalone and battery-backup PV systems require battery storage. Photovoltaic modules charge the batteries during daylight hours and the batteries supply the power when it is needed, often at night and during cloudy weather. Utility grid-tie systems supply power directly to the utility grid; no battery storage is needed.

The two most common types of rechargeable batteries in use

today are lead acid and alkaline. Lead-acid batteries have plates made of lead, mixed with other materials, submerged in a sulfuric acid solution. We do not list nickel-cadmium batteries in this catalog because of their high cost and environmental problems related to disposal. Nickel metal hydride and lithium ion batteries look promising for the future, but at this time their price is much too high for the size needed for all but the smallest of remote lighting systems.

Battery Size

The size of the battery bank required depends on the storage capacity required, the maximum discharge rate, the maximum charge rate, and the minimum temperature at which the batteries will be used. When designing a power system, all these factors are compared and the one requiring the largest capacity will dictate battery size. Temperature has a significant effect on lead-acid batteries. At 40°F they will have 75% of rated capacity, and at 0°F their capacity drops to 50%. The storage capacity of a battery – the amount of electrical energy it can hold – is usually expressed in amp-hours. Using one amp for 100 hours means 100 amp-hours have been used. A battery in a PV power system should have sufficient amp-hour capacity to supply needed power during the longest expected period of cloudy weather. A lead-acid battery should be sized at least 20% larger than this amount. If there is a source of backup power, such as a standby generator with a battery charger, the battery bank does not have to be sized for worst-case weather conditions.

Lead-Acid Batteries

Lead-acid batteries are the most common in PV systems because their initial cost is lower and because they are readily available nearly everywhere in the world. There are many different sizes and designs of lead-acid batteries, but the most important designation is whether they are deep cycle batteries or shallow cycle batteries. Shallow cycle batteries, like the starting batteries in automobiles, are designed to supply a large amount of current for a short time and to stand mild overcharge without losing electrolyte. However, they cannot tolerate being deeply discharged. If they are repeatedly discharged to less than 20% of capacity their life will be very short. These batteries are not a good choice for a PV system. Deep cycle batteries are designed to be repeatedly discharged by as much as 80% of their capacity so they are a good choice for PV systems. Even though they are designed to withstand deep cycling, these batteries will have a longer life if the cycles are shallower. All lead-acid batteries fail prematurely when they are not recharged completely after each cycle. Letting a lead-acid battery stay in a discharged condition for days at a time will cause a permanent loss of capacity. Sealed deep cycle lead-acid batteries (gel cells and absorbed glass mat) are maintenance-free. They never need watering or an equalization charge. Sealed batteries require very accurate regulation to prevent overcharge and over-discharge. Either of these conditions will drastically shorten their lives. We recommend sealed batteries for remote, unattended power systems.

Caring for Lead-Acid Batteries

Always use extreme caution when handling batteries and electrolyte. Wear gloves, goggles and old clothes. "Battery acid" will burn skin and eyes and destroy cotton and wool clothing.

The quickest way to ruin lead-acid batteries is to discharge them deeply and let them stand "dead" for an extended time. The positive plates change from lead oxide when charged, to lead sulfate when discharged. If they remain in the lead sulfate state for a few days, part of the plate does not return to lead oxide when the battery is recharged. The parts of the plates that become "sulfated" no longer store energy.

Batteries that are deeply discharged and then charged partially on a regular basis can fail in less than one year. Check your batteries on a regular basis to be sure they are being charged. Use a hydrometer to check the specific gravity of your lead-acid batteries. If batteries are cycled very deeply and then recharged slowly, the specific gravity reading will be lower because of incomplete mixing of electrolyte. Check the electrolyte level in wet-cell batteries at least four times a year and top-off each cell with distilled water. Do not add water to discharged batteries. Electrolyte is absorbed when batteries are discharged. If you add water at this time and then recharge the battery, electrolyte will overflow and make a mess. Keep the tops of your batteries clean and check that cables are tight. Do not tighten or remove cables while charging or discharging. Any spark around batteries can cause a hydrogen explosion inside the case and ruin one of the cells – and you. It is a good idea to do an equalizing charge when some cells show a variation of 0.05 specific gravity from each other. This is a long steady overcharge, bringing the battery to a gassing or bubbling state. Do not equalize sealed or gel-type batteries.

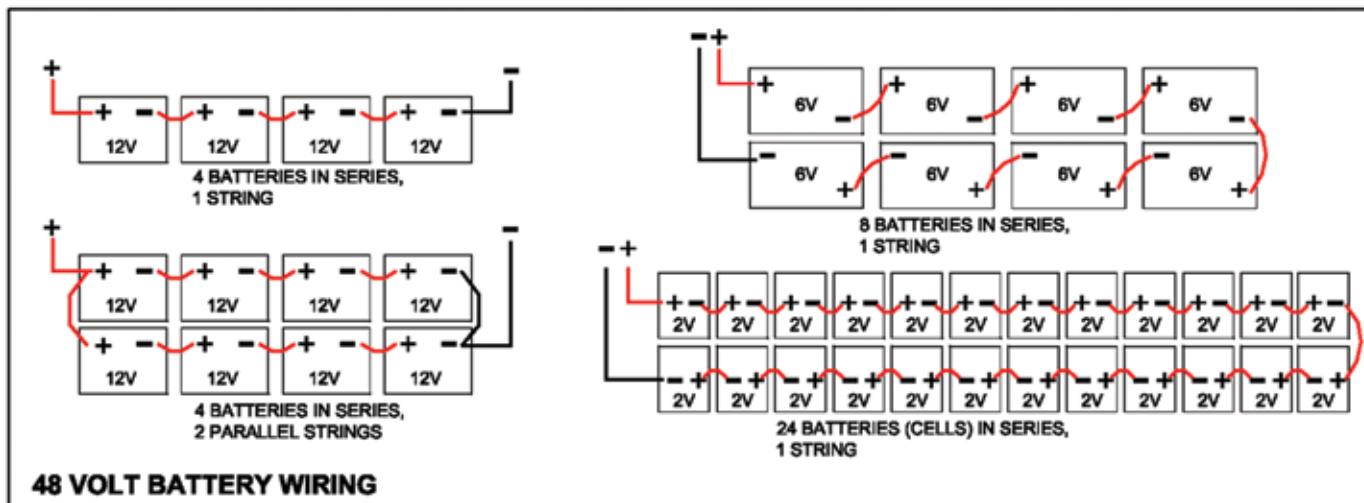
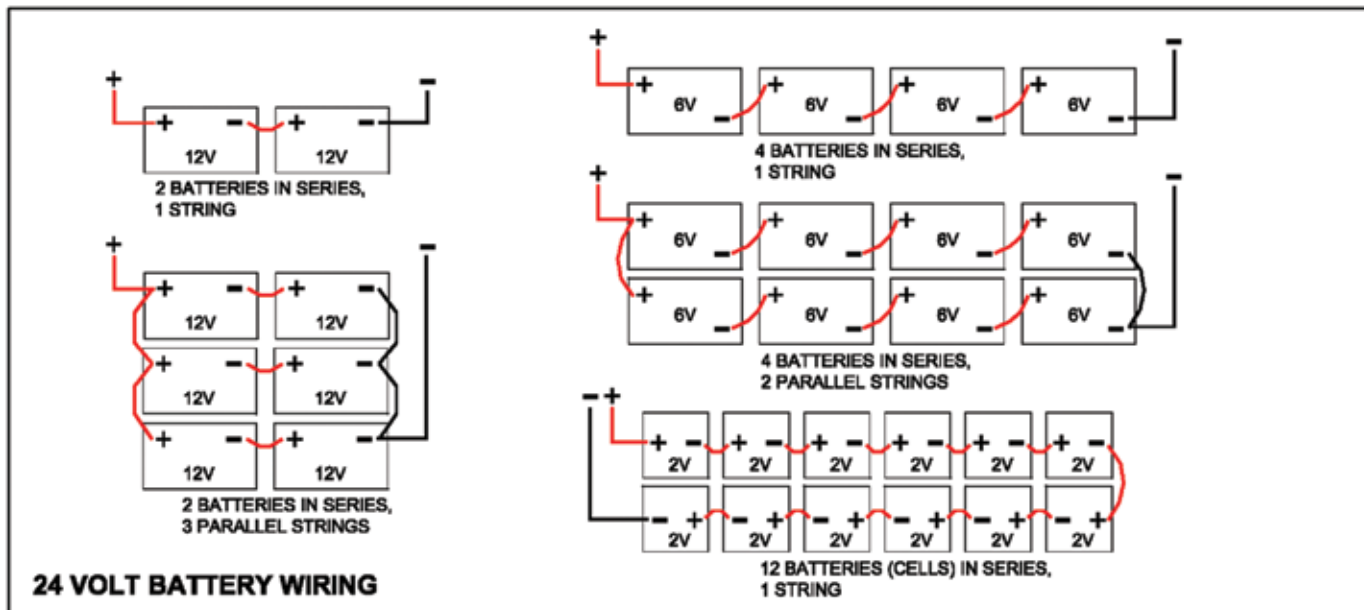
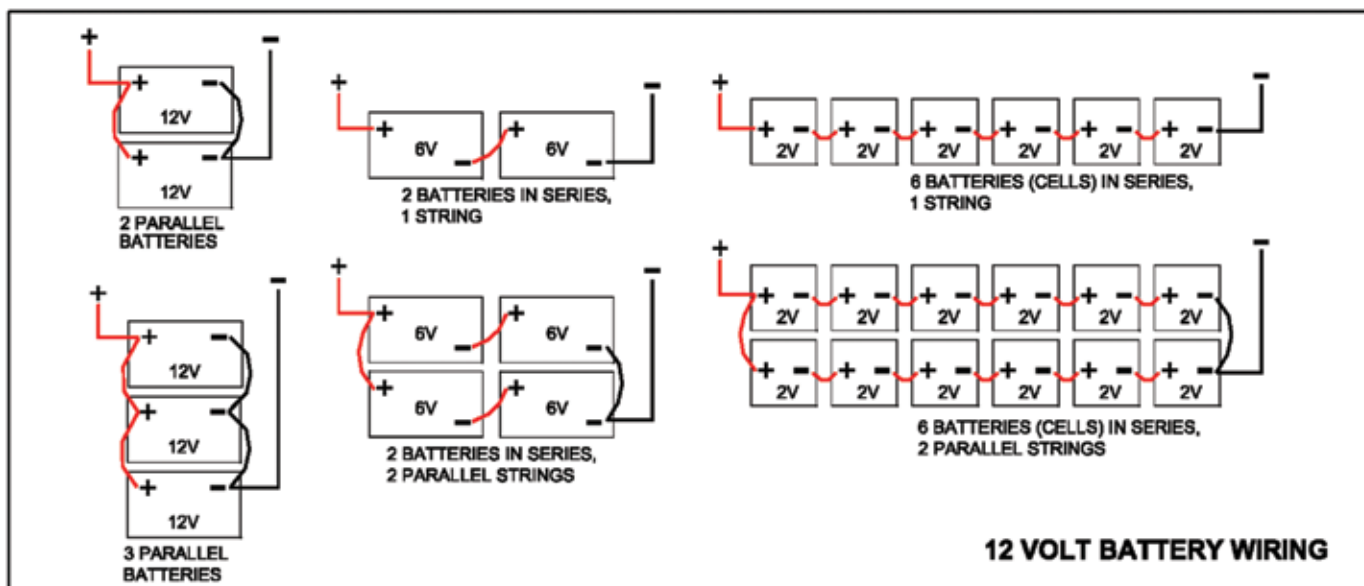
With proper care, lead-acid batteries will have a long service life and work very well in almost any power system. With poor treatment lead-acid battery life will be very short.

We strongly recommend the use of an amp-hour meter with all battery systems. See pages 138-139.

Battery warranties do not cover damage due to poor maintenance or loss of capacity from sulfation.

Battery Wiring Diagrams

The diagrams below show typical 12-, 24- and 48-volt battery wiring configurations. Batteries can deliver extremely high current. Always install fuse protection on any positive wiring connected to batteries.



Battery State-of-Charge

Battery state-of-charge (SOC) can be measured by an amp-hour meter, voltage or by specific gravity. Some care and knowledge is required to interpret state-of-charge from voltage or specific gravity readings. We recommend amp-hour meters for all systems with batteries.

Amp-Hour Meters

An amp-hour meter is like having a gas gauge for batteries. It gives users all the information they need to keep their batteries charged. At a glance the user can see system voltage, current, and battery condition. (See the meter section for more information on amp-hour meters.)

Measuring Battery State-of-Charge

Battery voltage will vary for the same state-of-charge depending on whether the battery is being charged or discharged, and what the current flow is in relation to the size of the battery. The table below will give you an idea of state-of-charge for various battery conditions in flooded cell lead-acid batteries. Voltage varies with temperature. While charging, a lower temperature will increase battery voltage. Full-charge voltage on a 12-volt battery is 0.9 volts higher at 32°F than at 70°F. While discharging, a higher temperature will increase battery voltage. There is little temperature effect while a battery is standing.

(Thanks to Ralph Heisey, Bogart Engineering, for this information.)

Battery condition @ 77°F	Nominal battery voltage		
	12V	24V	48V
Battery during equalization charge	Over 15	Over 30	Over 60
Battery near full charge while charging	14.4 to 15.0	28.8 to 30.0	57.6 to 60.0
Battery near full discharge while charging	12.3 to 13.2	24.6 to 26.4	49.2 to 52.8
Battery fully charged with light load	12.4 to 12.7	24.8 to 25.4	49.6 to 50.8
Battery fully charged with heavy load	11.5 to 12.5	23.0 to 25.0	46.0 to 50
No charge or discharge for 6 hours - 100% charged	12.7	25.4	50.8
No charge or discharge for 6 hours - 80% charged	12.5	25	50
No charge or discharge for 6 hours - 60% charged	12.2	24.4	48.8
No charge or discharge for 6 hours - 40% charged	11.9	23.8	47.6
No charge or discharge for 6 hours - 20% charged	11.6	23.2	46.4
No charge or discharge for 6 hours - fully discharged	11.4	22.8	45.6
Battery near full discharge while discharging	10.2 to 11.2	20.4 to 22.4	40.8 to 44.8

Hydrometers

A hydrometer is very accurate at measuring battery state-of-charge if you measure the electrolyte near the plates. Unfortunately, you can only measure the electrolyte at the top of the battery. When a battery is being charged or discharged, a chemical reaction takes place at the border between the lead plates and the electrolyte. During charging, the electrolyte changes from water to sulfuric acid. The acid becomes stronger and the specific gravity rises as the battery charges. Near the end of the charging cycle gas bubbles rising through the acid stirs the fluid to mix it. It takes several hours for the electrolyte to mix so that you get an accurate reading at the top of the battery. Always try to take readings after a period of no charge or discharge.

Hydrometer Readings

The table shows battery state-of-charge at various specific gravities. These readings are correct at 75 degrees F.

State of charge	Specific gravity
100% charged	1.265
75% charged	1.239
50% charged	1.2
25% charged	1.17
Fully discharged	1.11

Battery Sizing Worksheet

Use this worksheet to determine what size battery is required for your system. Battery size, or capacity, is measured in amp-hours. Battery voltage is determined by the number of "cells" in series. All lead-acid battery cells have a nominal output of 2 volts. Actual cell voltage varies from about 1.7 volts at full discharge to 2.4 volts at full charge. 12-volt lead-acid batteries are made of 6 separate cells in one case. 6-volt batteries are made of 3 cells in one case. Putting battery cells in parallel increases amp-hour capacity, but does not change voltage.

Battery temperature	Multiplier
80°F/26.7°C	1
70°F/21.2°C	1.04
60°F/15.6°C	1.11
50°F/10.0°C	1.19
40°F/4.4°C	1.3
30°F/-1.1°C	1.4
20°F/-6.7°C	1.59

Step 1 Total average amp-hours per day required (line 10 from the Off-Grid Load Worksheet on page 12): _____

Step 2 Maximum number of continuous cloudy days expected in your area : _____

Step 3 Multiply line 1 by line 2: _____

Step 4 Divide line 3 by 0.8 to maintain a 20% reserve after deep discharge period.
(Dividing line 3 by a more conservative 0.5 will maintain a 50% reserve and increase battery life): _____

If no special conditions below apply, skip to line 9:

Special Condition #1: Heavy Electrical Load

Step 5 Maximum amperage that will be drawn by the loads for 10 minutes or more : _____

Step 6 Multiply line 5 by line 10: _____

Special Condition #2: High-Charge Current

Step 7 Maximum output amperage of PV array or other battery charger : _____

Step 8 Multiply line 7 by 10: _____

Step 9 Amp-hours from line 4, 6 or 8, whichever is largest : _____

Step 10 If you are using a lead acid battery, select the multiplier from the battery temperature table above which corresponds to the battery's wintertime average ambient temperature: _____

Step 11 Multiply line 9 by line 10. This is your optimum battery size in amp-hours: _____

Step 12 Amp-hours of battery chosen. (Industrial Cell, T105=220, L16=350, etc.): _____

Step 13 Divide line 11 by line 12. This is the total number of batteries in parallel required: _____

Step 14 Round off to the next highest whole number. This is the number of parallel strings required: _____

Step 15 To determine the number of batteries required in series, divide the system voltage (12, 24, or 48) by the voltage of the chosen battery (2V, 6V or 12V): _____

Step 16 Multiply line 14 by line 15.
This is the total number of system batteries needed for the chosen battery: _____

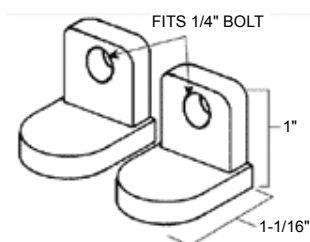
East Penn/MK Battery

MK Sealed PV/Solar Batteries

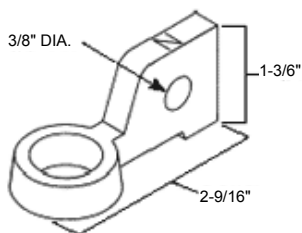
MK sealed batteries are designed for maintenance-free operation for the life of the battery. Sealed construction eliminates periodic watering, corrosive acid fumes and spills. Tank formed plates ensure voltage matching between cells. Most models are rated non-spillable by ICAO, IATA and DOT, meaning easy transportation by air requiring no special containers. Exceptions are the three AGM models marked by asterisks in the table, which cannot be shipped by air freight or UPS and must be shipped by truck freight on pallets. 1-year warranty.

MK Sealed Gel Batteries

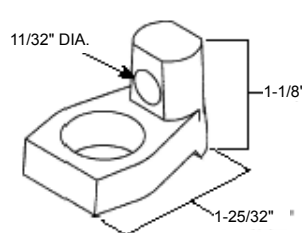
The gelled electrolyte won't stratify, so no equalization charging is required. Less than 2% per month standby loss means low discharge during transport and storage. Gel batteries are best for cycling operations and where very cold temperatures are expected. They can operate at temperatures from -76 to 140 F.



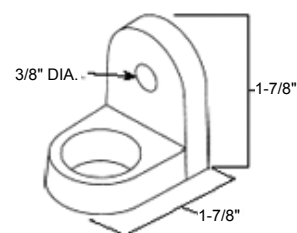
T874



T876



T881



T975

Battery type	Model number	Volts	Terminals	Capacity (Ah)		Dimensions (in) L" x W" x H"	Weight lbs	Item code	Price
				20-hr rate	100-hr rate				
Sealed gel solar batteries	8GU1	12	T874	31.2	36.1	7.8 x 5.2 x 7.3	24	040-03015	\$119
	8G22NF	12	T881	50	57	9.38 x 5.5 x 9.25	38	040-03018	\$202
	8G24UT	12	T881	73.6	84	10.9 x 6.8 x 9.9	53.6	040-03022	\$270
	8G27	12	T876	86.4	99	12.75 x 6.75 x 9.75	63.2	040-03024	\$294
	8G31	12	T876	97.6	108	12.94 x 6.75 x 9.75	71.7	040-03027	\$329
	8G4DLTP	12	T975	183	210	20.8 x 8.5 x 10	130	040-03030	\$640
	8G8DLTP	12	T975	225	265	20.8 x 11 x 10	161	040-03033	\$779
	8GGC2	6	T881	180	198	10.3 x 7.2 x 10.9	69	040-03036	\$356
Sealed AGM solar batteries	8AU1H	12	T874	32.5	37	7.8 x 5.2 x 7.3	24	040-03117	\$100
	8A22NF	12	T881	55	63	9.38 x 5.5 x 9.25	38	040-03120	\$184
	8A24DT	12	T881	79	91	10.9 x 6.8 x 9.9	53.6	040-03123	\$231
	8A27	12	T876	92	106	12.75 x 6.75 x 9.75	63.2	040-03126	\$275
	8A31DT*	12	DUAL	105	116.2	12.94 x 6.75 x 9.75	71.7	040-03129	\$315
	8A4DLTP*	12	T975	200	216	20.8 x 8.5 x 10	130	040-03132	\$588
	8A8DLTP*	12	T975	245	257	20.8 x 11 x 10	161	040-03135	\$693
	8AGC2	6	T881	200	220	10.3 x 7.2 x 10.9	69	040-03137	\$315

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MK Sealed AGM Batteries

These are completely sealed, absorbed glass mat, valve-regulated batteries with efficient recombination. UL Recognized components to UL MH17218. AGM batteries are recommended for battery backup standby power systems where batteries are in float service with occasional deep discharges. They can operate at temperatures from -40 to 140 F. Delivered from one of 20 MK warehouses

across the U.S. NOTE: The 3 asterisked models in the table can NOT be shipped by air or UPS, only by truck freight.

MK 8L-16 6-Volt Deep Cycle Battery

This version of East Penn's MK L-16 battery is the best commercial deep cycle battery value we offer. They have flag terminals and a heavy duty plastic case. MK L-16 batteries are made in USA.

They seem to be able to maintain the best price on this type of battery because they own their own lead smelter which allows them to have better control of lead prices. Capacity is 370 amp-hours at a 20-hour rate and 420 amp-hours at a 100-hour rate.



Model	Volts	Dimensions (inches)	Weight (lbs)	Item code	Price
8L-16	6	11.75 x 7 x 17.3	113	040-01957	\$410

Trojan

Commercial Deep Cycle Lead Acid Batteries

These batteries have been used in off-grid power systems in remote cabins for the past 25 years with great success. Because of their low initial cost, they are the most affordable true, deep cycle batteries. The T105 golf cart battery is designed to be used in small electric vehicles where they are cycled heavily and last about 2 years. In a remote home system where they are cycled down 20% every day they can last 3 to 6 years. The L-16 battery is a heavy-duty cousin of the golf cart battery with much thicker lead plates and nearly twice the capacity. Trojan's Renewable Energy (RE) Series (L16RE-2V, L16RE-A, L16RE-B and T105-RE) is a line of technologically advanced lead-acid deep cycle batteries, optimized for renewable energy applications such as solar PV, small wind, and micro hydro. They have heavier duty separators and plates designed for longer life and their warranty has been extended to two years free replacement and 60 months additional pro-rated on the L16s and 36 months pro-rated on the T-105.



Model	Volts	Capacity (Ah)		Dimensions (in) L" x W" x H"	Weight lbs	Item code	Price
		20-hour rate	100-hour rate				
T-105-RE	6	225	250	10.375 x 7.125 x 11.25	67	040-01937	\$220
L16RE-A	6	325	360	11.625 x 7 x 17.7	115	040-01965	\$445
L16RE-B	6	370	410	11.625 x 7 x 17.7	118	040-01967	\$505
L16RE-2	2	1110	1235	11.625 x 7 x 17.7	119	040-01920	\$505

Rolls/Surrette

S-series Batteries

These commercial batteries are the same size the L16 batteries from Trojan and Deka. They are rated at 1000 cycles at 50% depth of discharge. Batteries shipped to commercial addresses qualify for free shipping to some regions of the country. East of the Mississippi, freight is free on orders of 18 batteries or more to the same commercial address. West of the Mississippi and east of the Rockies, freight is free on orders of 36 batteries or more. West of the Rockies, freight is free on orders of 54 batteries or more.



Surrette model	Battery voltage	Capacity (Ah)		Rated cycles (50% DOD)	Warranty (years)	Dimensions (in)			Weight wet / dry	Item code	Price
		20-hr rate	100-hr rate			L"	W"	H"			
S-460	6	350	460	1000	7	12.28	7.12	17	117 / 90	040-02106	\$450
S-530	6	400	530	1000	7	12.28	7.12	17	125 / 105	040-02109	\$497
S-600	6	450	600	1000	7	12.28	7.12	17	125 / 105	040-02110	\$578
S-1380	2	1050	1380	1000	7	12.28	7.12	17	125 / 105	040-02113	\$486
S-1580	2	1200	1596	1000	7	12.28	7.12	17	125 / 105	040-02114	\$533
S-1750	2	1300	1728	1000	7	12.28	7.12	17	125 / 105	040-02115	\$615

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Rolls/Surrette

Deep Cycle Industrial Flooded Batteries

These are the new generation, dual container, deep cycle Rolls batteries from Surrette (S-460 and S-530 are not dual container). They are high-capacity batteries with a heavy-duty plate grid to resist positive plate breakdown. The plates are double insulated with glass mat and a polyethylene envelope, eliminating the possibility of separator misalignment, cracked separators, treeing or shorting at the bottoms or sides. Rolls batteries are rated at 3200 cycles at 50% depth of discharge. Each 2-volt cell is built into its own lightweight container made of durable polypropylene with the cover heat bonded to the container, thus acid leakage is eliminated. The cells are then assembled into a tough, lightweight polyethylene outer container with a removable lid. Even if the outer case is broken the battery remains operable and spill-free. The individual cells of the CS and KS series are bolted together allowing the battery to be disassembled. The cells can be independently removed.



This facilitates easy on-site installation, disassembly, assembly, or replacements of individual cells without special skills or tools. All Surrette CS & KS deep cycle solar batteries come with a 10-year warranty, 3-year full warranty, and 7-year prorated warranty.

Surrette model	Battery voltage	Capacity (Ah)		Rated cycles (50% DOD)	Warranty (years)	Dimensions (inches)			Weight wet / dry	Item code	Price
		20-hr rate	100-hr rate			L"	W"	H"			
2-KS-33PS	2	1766	2491	3300	10	15.44	8.31	24.81	208/145	040-02220	\$1,190
2-YS-31PS	2	2430	3435	3300	10	15.50	9	31.63	285/200	040-02221	\$1,790
4-CS-17PS	4	546	770	3200	10	14.38	8.25	18.25	128 / 98	040-02223	\$830
4-KS-21PS	4	1104	1557	3200	10	15.75	9.38	24.75	267 / 186	040-02226	\$1,548
4-KS-25PS	4	1350	1900	3200	10	15.75	10.63	24.75	315 / 220	040-02229	\$1,895
6-CS-17PS	6	546	770	3200	10	22	8.25	18.25	221 / 178	040-02232	\$1,242
6-CS-21PS	6	683	963	3200	10	22	9.75	18.25	271 / 217	040-02235	\$1,491
6-CS-25PS	6	820	1156	3200	10	22	11.25	18.25	318 / 254	040-02238	\$2,293
8-CS-17PS	8	546	770	3200	10	28.25	8.25	18.25	294 / 238	040-02247	\$1,148
8-CS-25PS	8	820	1156	3200	10	28.25	11.25	18.25	424 / 342	040-02250	\$1,605
12-CS-11PS	12	357	503	3200	10	22	11.25	18.25	272 / 220	040-02259	\$1,550

HuP Solar-One

2100 Cycle Industrial Batteries

The Solar-One battery with HuP Technology is optimized for renewable energy systems. It has a slightly enlarged epoxy-coated steel case that allows cell removal and easier installation without a forklift or crane. Solar-One batteries are designed with 0.310" thick positive plates and a patented technology that allows them to be warranted for 2100 cycles to 80% depth of discharge. The 10-year warranty, 7-year free replacement and 3 years prorated is the best in the RE industry. Each Solar-One is made up of six 2-volt cells and comes with stainless steel hardware, lead-plated copper busbars, a cell-lifting strap and an operator/installation manual. Order two for 24-volt systems or four for 48-volt systems. Many sizes are in stock and available for immediate shipment. Other sizes are made to order; please allow up to 8 weeks for delivery. Free shipping to a commercial location in the continental 48 states.



Cell type	Capacity @ 20-hr rate	Weight lbs	Dimensions (in) L" x W" x H"	Item code	Price
SO-6-85-17	845 A-H	742	40 x 7.75 x 25	040-05269-A	\$4,206
SO-6-85-19	950 A-H	808	40 x 8.25 x 25	040-05272-A	\$4,452
SO-6-85-21	1055 A-H	880	40 x 8.75 x 25	040-05275-A	\$4,792
SO-6-85-23	1160 A-H	959	40 x 9 x 25	040-05278-A	\$5,228
SO-6-85-25	1270 A-H	1036	40 x 10.25 x 25	040-05281-A	\$5,472
SO-6-85-27	1375 A-H	1102	40 x 11.25 x 25	040-05284-A	\$5,822
SO-6-85-31	1585 A-H	1252	40 x 12.75 x 25	040-05290-A	\$6,800
SO-6-85-33	1690 A-H	1336	40 x 13.50 x 25	040-05293-A	\$7,080
SO-6-100-33	1990 A-H	1550	40 x 13.5 x 28	040-05295	\$8,144

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GNB

Absolyte GP Industrial Sealed Batteries

The Absolyte battery was developed by GNB, in conjunction with Sandia National Laboratories, as the first VRLA, large capacity, deep cycle battery for photovoltaic applications. This design provides for extended partial state-of-charge operation and allows for deep discharge recovery. Their wide band of temperature operation, from -40°C (-40°F) to +50°C (122°F), retains more capacity in cold temperatures than traditional flooded batteries. Life expectancy in float conditions is 20 years @ 25°C (77°F) with proper charging. Life expectancy in cycling conditions is 1200 cycles to 80% DOD with proper charging. Sealed cells with absorbed glass mat (AGM) separators eliminate the need for periodic water additions as found in flooded cells. Periodic visual inspections, voltage readings, and connection retorquing are required.

Protective steel tray housings offer maximum installation flexibility and the Absolute GP is qualified to stack horizontally up to eight high for use in 1997 UBC/2001 CBC Seismic Zone IV (at or below grade). This provides for high capacity in a small footprint and frees up floor space for other equipment; and because they are sealed, they do not require a separate battery room.

They are IEC 896, BS 6290, UL Recognized, ISO 9001:2000, designed to meet Telcordia SR4228 and GR-63-CORE (NEBS).



Applications

Absolyte GP batteries are ideal for photovoltaic and alternative energy applications including:

- Village electrification
- Telecommunications
- Residential power
- Railroad signal
- Navigational aids



GNB part #	Volts	Capacity (Ah)		Dimensions (inches)			Weight lbs	Item code	Price
		20-hr rate	100-hr rate	L"	W"	H"			
6-cell 12-volt batteries									
6-50G05	12	120	140	17.19	8.53	16.22	157	040-04409	\$1,464
6-50G07	12	182	210	21.69	8.53	16.22	209	040-04412	\$1,739
6-50G09	12	240	290	26.19	8.53	16.22	252	040-04415	\$2,055
6-50G13	12	360	430	35.19	8.53	16.22	356	040-04421	\$2,625
6-90G07	12	300	360	21.69	8.53	23.56	316	040-04430	\$2,185
6-90G09	12	400	480	26.19	8.53	23.56	396	040-04433	\$2,563
6-90G11	12	500	600	30.69	8.53	23.56	477	040-04436	\$2,982
6-90G13	12	600	720	35.19	8.53	23.56	557	040-04439	\$3,518
6-90G15	12	700	840	39.69	8.59	23.56	637	040-04442	\$3,861
3-cell 6-volt batteries									
3-100G13	6	680	790	19.93	8.53	26.38	328	040-04313	\$1,837
3-100G15	6	800	920	22.18	8.59	26.38	374	040-04316	\$2,082
3-100G17	6	900	1,000	24.50	8.59	26.38	424	040-04319	\$2,305
3-100G19	6	1,020	1,100	26.75	8.59	26.38	470	040-04322	\$2,508
3-100G21	6	1,140	1,300	29	8.59	26.38	515	040-04325	\$2,721
3-100G27	6	1,460	1,700	35.75	8.59	26.38	653	040-04334	\$3,377
3-100G29	6	1,580	1,800	38	8.59	26.38	704	040-04337	\$3,628
3-100G31	6	1,700	1,900	40.25	8.59	26.38	750	040-04340	\$3,882
3-100G33	6	1,820	2,100	42.50	8.59	26.38	795	040-04343	\$4,129
2-volt cells									
1-100G39	2	2,040	2,370	19.93	8.53	26.38	328	040-04225	\$1,805
1-100G45	2	2,340	2,760	22.18	8.59	26.38	374	040-04228	\$3,612
1-100G51	2	2,700	3,000	24.50	8.59	26.38	424	040-04231	\$2,305
1-100G57	2	3,060	3,300	26.75	8.59	26.38	470	040-04234	\$2,510
1-100G63	2	3,420	3,900	29	8.59	26.38	515	040-04237	\$2,724
1-100G69	2	3,780	4,200	31.25	8.59	26.38	561	040-04240	\$2,904
1-100G75	2	4,080	4,500	33.50	8.59	26.38	608	040-04243	\$3,133
1-100G81	2	4,440	5,100	35.75	8.59	26.38	653	040-04246	\$3,377
1-100G87	2	4,800	5,400	38	8.59	26.38	704	040-04249	\$3,628
1-100G93	2	5,100	5,700	40.25	8.59	26.38	750	040-04252	\$3,884
1-100G99	2	5,460	6,300	42.50	8.59	26.38	795	040-04255	\$4,132

East Penn

Deka Unigy II Sealed Industrial Batteries



The Deka Unigy II line features two module designs with a wide range of capacities to fit the requirements of renewable energy applications. These batteries are ideal for float applications with an occasional deep discharge, such as battery-backup for grid-connected systems. The front safety shield design easily clips on and off without tools for quicker assembly. The modules are coated with acid resistant epoxy powder paint and each module has mounting holes for grounding option.

These batteries are available with interlocked frames for locations with tough seismic requirement and non-interlocked frames where this is not required. They are also available with flame retardant polyethylene cases. The interlocking module frames require only front access bolts for mounting, providing quick and safe installation. Their standard one-piece base enables it to be used as an anchoring template. Anchors can be drilled and installed with the base in place. They are certified to UBC 97 Zone 4 Top of Building up to 8 modules high. The non-interlock modules require front and rear access bolts for mounting, providing easy and safe installation. The standard two-piece base enables anchors to be drilled and installed with base in place. The non-interlock version is certified to UBC 97 Zone 2B Top of Building up to 8 modules high.

					Non-Interlock SpaceSaver	Interlock SpaceSaver
					Flame retardant poly case	Flame retardant poly case
Item code prefix	Deka model	Amp hours		Suffix >	-NL	-IL
		20 hour rate	100 hour rate	Module volts	Price per module	
040-06011	6AVR75-5	180	210	12	\$2,134	\$2,343
040-06012	6AVR75-7	280	310	12	\$2,382	\$2,618
040-06013	6AVR75-9	380	420	12	\$2,631	\$2,888
040-06014	6AVR75-11	460	520	12	\$2,851	\$3,133
040-06015	6AVR75-13	540	630	12	\$3,109	\$3,418
040-06016	6AVR75-15	640	730	12	\$3,431	\$3,771
040-06017	3AVR75-17	720	840	6	\$2,337	\$2,565
040-06018	3AVR75-19	820	940	6	\$2,501	\$2,749
040-06019	3AVR75-21	920	1050	6	\$2,662	\$2,923
040-06022	3AVR75-23	1000	1150	6	\$2,780	\$3,055
040-06023	3AVR75-25	1100	1250	6	\$2,906	\$3,194
040-06024	3AVR75-27	1200	1360	6	\$3,063	\$3,366
040-06025	3AVR75-29	1280	1460	6	\$3,388	\$3,723
040-06026	3AVR75-31	1380	1570	6	\$3,523	\$3,868
040-06027	3AVR75-33	1460	1670	6	\$3,633	\$3,988
040-06028	6AVR95-15	790.6	941.2	12	\$3,840	\$4,221
040-06029	3AVR95-17	903.5	1075.7	6	\$2,581	\$2,836
040-06030	3AVR95-19	1016.4	1210.1	6	\$2,767	\$3,040
040-06031	3AVR95-21	1129.4	1344.6	6	\$2,942	\$3,231
040-06032	3AVR95-23	1242.3	1479	6	\$3,083	\$3,388
040-06033	3AVR95-25	1355.3	1613.5	6	\$3,232	\$3,551
040-06034	3AVR95-27	1468.2	1747.9	6	\$3,391	\$3,726
040-06035	3AVR95-29	1581.1	1882.4	6	\$3,726	\$4,094
040-06036	3AVR95-31	1694.1	2016.9	6	\$3,879	\$4,263
040-06037	3AVR95-33	1807	2151.3	6	\$4,012	\$4,409
040-06038	2AVR125-33	2367	2930	4	N/A	\$3,764

DPW Solar

POWER-FAB Pole-Mount Aluminum Battery Boxes

Side-of-pole mount aluminum NEMA 3R hinged door boxes from DPW Solar are available for several battery sizes and battery/equipment configurations. They are made to order from 0.125" 5052-H32 aluminum with white powder coating, and can be built to meet specific application requirements. The doors have padlock hasps and stainless steel continuous hinges. Each box has a removable control-mounting plate, screened vents and two 7/8" wire entrance holes.

Battery size	Batteries spaces	Dimensions (inches) D" x W" x H"	Item code	Price
Group 27, 30	1	9 X 16 x 20	048-04179	\$545
Group 27, 30	2	16 X 16 x 20	048-04188	\$660
Group 27, 30	4	16 X 16 x 20	048-04200	\$840
Group 27, 30	6	16 X 25 x 34	048-04201	\$1,020
Golf cart	2	14 X 18 x 22	048-04197	\$545
Golf cart	4	14 X 18 x 36	048-04203	\$680
4D	1	12 X 24 x 22	048-04282	\$630
4D	2	12 X 24 x 36	048-04291	\$790
8D	1	15 X 24 x 22	048-04285	\$760
8D	2	15 X 24 x 36	048-04294	\$865



MNBE-B



MNBE-C

MidNite Solar

Battery Enclosures

These grey powder-coated steel battery enclosures with locking doors are ETL Listed for indoor use in the US and Canada. They are designed for use with sealed batteries. The MNBE-A ships by UPS, but all other sizes ship by truck freight. All are shipped unassembled. Choose the proper sized enclosure for the size and number of batteries that you need. Use multiple enclosures, side-by-side, for larger battery banks. The MNBE-A and MNBE-B enclosures can be stacked two high. The MNBE-D3R is an aluminum outdoor enclosure which is identical to the MNBE-D.



MNBE-A



MNBE-D

MidNite model	Battery size	Battery capacity	Shelves included	Dimensions (inches) D" x W" x H"	Shipping dimensions	Weight (lbs)	Item code	Price
MNBE-A	27 or 31 8D	6 2	2	14.5 X 29 x 27.25	30" X 32" x 7.5"	71	048-05501	\$425
MNBE-B	27 or 31	8	2	15.25 X 33.6 X 34.5	18" X 8" x 36" & 18" X 9" x 37"	102	048-05503	\$605
MNBE-C	27 or 31 8D	12 3	3	16 X 36.5 X 55	Ships by truck on a 42" x 42" x 60" pallet	190	048-05505	\$849
MNBE-D	27, 31, GC2	8	2	15.25 X 33.6 X 34.5	34" x 15.25" x 41"	116	048-05506	\$649
MNBE-D3R	27, 31, GC2	8	2	15.25 X 33.6 X 34.5	34" x 15.25" x 41"	116	048-05506	\$949
MNBE-E	27, 31, GC2, L16	8	2	15.25 X 33.6 X 34.5	2 Boxes 49" x 19" x 8"	128	048-05507	\$749
Extra shelf	Extra Shelf for MNBE-C, MNBE-D or MNBE-D3R						048-05520	\$89

POWER-FAB Chest-Style Battery Enclosures

Pad mount, chest style enclosures are manufactured with 0.125" 5052-H32 aluminum. All die marks and welds are sanded smooth and the boxes are finished with a reflective bright white polyester powder coat to minimize internal heat gain. All enclosures are provided with integrated louvers located to promote convective air flow through the enclosure to reduce internal temperatures and remove gasses. Filters are located over the louvers to keep out dust and insects. The filters are removable for cleaning or replacement. All standard enclosures are built to meet NEMA 3R specifications.

Other sizes are available. For sizes not listed here, contact us for price.



Battery size	Batteries spaces	Layout	Dimensions (inches)	Weight (lbs)	Non-insulated		Insulated	
					Item code	Price	Item code	Price
27/30	2	2x1	16x16x16	26	048-04030	\$768	048-04033	\$1,030
	4	2x2	18x30x16	39	048-04031	\$973	048-04034	\$1,283
	4	1x4	16x34x16	37	048-04032	\$995	048-04035	\$1,314
	6	2x3	25x30x16	50	048-04140	\$1,158	048-04143	\$1,518
	8	2x4	30x33x16	60	048-04036	\$1,320	048-04043	\$1,711
	10	2x5	41x30x16	70	048-04037	\$1,469	048-04044	\$1,903
8d	2	2x1	24x26x16	44	048-04057	\$1,047	048-04065	\$1,368
	4	2x2	26x46x16	68	048-04116	\$1,433	048-04119	\$1,835
	4	1x4	24x50x16	65	048-04066	\$1,459	048-04067	\$1,871
	6	2x3	38x46x16	90	048-04128	\$1,781	048-04131	\$2,255
	8	2x4	46x50x16	111	048-04068	\$2,102	048-04069	\$2,629
	10	2x5	62x46x16	131	048-04164	\$2,400	048-04167	\$2,993
	12	2x6	46x74x16	150	048-04070	\$2,701	048-04077	\$3,431
	12	4x3	50x68x16	150	048-04071	\$2,691	048-04078	\$3,415
Golf cart	2	2x1	13x18x17	25	048-04074	\$750	048-04079	\$1,009
	4	2x2	18x25x17	37	048-04075	\$935	048-04080	\$1,236
	4	1x4	14x35x17	36	048-04076	\$980	048-04081	\$1,298
	6	2x3	25x27x17	47	048-04134	\$1,112	048-04137	\$1,462
	8	2x4	25x32x17	56	048-04152	\$1,256	048-04155	\$1,637
	10	2x5	43x25x17	65	048-04082	\$1,400	048-04089	\$1,825
	12	2x6	25x51x17	74	048-04083	\$1,547	048-04090	\$2,088
	12	4x3	34x35x17	74	048-04084	\$1,529	048-04091	\$2,056
L-16, S460, S530	2	2x1	19x22x28	43	048-04088	\$868	048-04095	\$1,157
	4	2x2	22x32x28	61	048-04122	\$1,113	048-04125	\$1,452
	4	1x4	19x39x28	63	048-04096	\$1,155	048-04097	\$1,508
	6	2x3	31x32x28	76	048-04146	\$1,333	048-04149	\$1,726
	8	2x4	32x39x28	89	048-04158	\$1,518	048-04161	\$1,945
	10	2x5	32x48x28	102	048-04098	\$1,698	048-04099	\$2,173
	12	2x6	32x56x28	115	048-04170	\$1,882	048-04173	\$2,476
	12	4x3	39x46x28	114	048-04171	\$1,860	048-04172	\$2,446
	14	2x7	32x65x28	128	048-04174	\$2,077	048-04175	\$2,694
	16	2x8	32x73x28	141	048-04176	\$2,257	048-04177	\$2,929
	16	4x4	39x59x28	137	048-04187	\$2,194	048-04181	\$2,845

RPPS

Pole-Mount Battery/Control Boxes



Powder-coated aluminum NEMA 3R hinged door boxes hold 2 or 4 Type 31 batteries. An optional aluminum panel that mounts in the top section can be used for charge controllers and other electronics. Box for 4 batteries is pictured above. Box for 2 batteries has 1 shelf. To mount on a pole, order pole mount brackets below.

Description	Item code	Price
Battery control enclosure - 4 battery	048-04314	\$800
Battery control enclosure - 2 battery	048-04312	\$650
Battery enclosure pole mount brackets - 1 pair	048-04319	\$56
Aluminum back panel w/ hardware	048-04315	\$20

Water Miser Battery Caps

Water Misers are molded plastic "flip-top" vent caps designed to reduce and ease maintenance on flooded lead-acid batteries. There is no need to remove the caps when charging, filling or equalizing the batteries.

When charging, the plastic pellets capture up to 90% of the moisture and acid droplets. This reduces acid fumes, corrosion, and keeps the battery tops much cleaner and dryer. Excess water is dropped back into the battery cell. Water loss is reduced, which extends time between watering. These caps fit all batteries with standard bayonet caps.



Description	Item code	Price
Water Miser battery cap	040-09913	\$8.50

Heavy Duty Plastic Battery Box

These battery enclosures are made from HDPE plastic, the same material used to manufacture the outside cases of batteries. A removable lid with handles allows easy access to the batteries for service. Enclosures for L-16s are made with a removable middle section that minimizes lifting when installing the batteries. The plastic is acid resistant and very strong, but easy to drill with a hole saw for adding conduit fittings or battery filling tubes. The hydrogen vent fitting on the lid should be extended to the exterior of the building.

Each of the boxes can be ordered with, or without a drain fitting. The drain allows the batteries to be washed and hosed off. The drain option includes a 3" rigid foam base with HDPE trim ring and 3/4" pipe that extends horizontally out of the trim ring. Dimensions listed are inside of the battery compartment. Shipping size is slightly larger.



Battery type	Battery quantity	With drain	Dimensions W" x L" x H"	Item code	Price
L16	4	No	33 x 14 x 22.5	048-04014	\$399
L16	4	Yes	33 x 14 x 22.5	048-04015	\$479
L16	8	No	33 x 27 x 22.5	048-04016	\$459
L16	8	Yes	33 x 27 x 22.5	048-04017	\$549
T105	4	No	32.5 x 12.5 x 17	048-04018	\$319
T105	4	Yes	32.5 x 12.5 x 17	048-04019	\$399
T105	8	No	32.5 x 23.5 x 17	048-04020	\$389
T105	8	Yes	32.5 x 23.5 x 17	048-04021	\$479

QuickCote

Anti-Corrosion Protectant

QuickCote offers a complete acid neutralizing coating, formulated especially for battery terminals and exposed electrical connections. The 8-ounce can has a brush-on applicator that will give years of use and cannot clog like aerosol coatings.



Description	Item code	Price
QuickCote	046-00195	\$20

Schneider Electric

Xantrex Truecharge2 12V Battery Charger

Truecharge2 is available as a 20- or 40-amp electronic battery charger for deep cycle batteries. Switch settings give correct charge for wet, gel cell, or absorbed glass mat (AGM) batteries. Selectable 2- or 3-stage charging; 3-stage includes float charge. Manual equalize charge button. Manual or automatic temperature compensation. The optional temperature sensing probe corrects charge voltage for actual battery temperature. These chargers have full output even with low-cost generators, which is important when using the charger with a 1000- to 3000-watt generator. Dimensions: 2.75" x 6.7" x 9.8". 1-year warranty.



Description	Item code	Price
Truecharge 2 40 amp charger	045-02896	\$400
Truecharge 2 20 amp charger	045-02895	\$300
Temperature sensor	045-02898	\$42
Remote control panel	045-02897	\$95

IOTA

DLS Converter/Chargers

The DLS series converter/power supply output is so clean and ripple-free, it can be used with or without a battery. The DLS series converter/charger quickly and efficiently charges batteries from the full rated output of the DLS. The DLS then maintains the batteries, only putting into the battery what is required by load or self discharge, cutting back to milliamps as the battery requires. Low and transient AC line voltage can be a major cause of converter/power supply failure. The DLS series converter/power supply is protected against low line voltage, spikes from the AC power source, or from improperly adjusted generators. When used as a power supply, the DLS model will only supply what is required by the load. When not in use it is essentially off, reducing electricity usage. External fuses can be quickly and easily replaced.

Chargers have 120 VAC input. 75-amp and larger chargers have 120V 20-amp plugs. 2-year warranty

IOTA IQ-4 Smart Controller

The IQ-4 makes the DLS charger into a 3-stage charger with bulk, absorption and float charging. If the battery remains in float stage for 7 days, it delivers a bulk charge. The IQ-4 is not recommended for generator-powered battery charging if generator is only run for short periods of time.



IOTA model	Battery volts	Charge amps	Dimensions (inches)	Weight (lbs)	Item code	Price
DLS-15	12	15	7 x 6.5 x 3.5	4	045-02112	\$132
DLS-30	12	30	7 x 6.5 x 3.5	5.5	045-02115	\$171
DLS-45	12	45	7 x 6.5 x 3.5	5.5	045-02118	\$183
DLS-55	12	55	7 x 6.5 x 3.5	5.5	045-02121	\$215
DLS-75	12	75	10 x 6.5 x 3.5	7.8	045-02124	\$440
DLS-90	12	90	10 x 6.5 x 3.5	7.8	045-02127	\$497
DLS-27/15	24	15	7 x 6.5 x 3.5	5.5	045-02130	\$281
DLS-27/25	24	25	7 x 6.5 x 3.5	5.5	045-02133	\$335
DLS-27/40	24	40	10 x 6.5 x 3.5	7.8	045-02136	\$545
DLS-54/15	48	15	10 x 6.5 x 3.5	7.8	045-02148	\$545
IQ-4	12	Smart Controller for 12V Chargers			045-02103	\$30

Samlex

Battery Chargers

These compact, lightweight, multi-stage battery chargers are designed to charge and maintain lead-acid and gel-cell batteries without supervision. Safely charge and condition multiple banks of marine, RV, industrial and automotive batteries. Charges have 120VAC input. 1-year warranty.



Samlex model	Battery volts	Bulk voltage	Float voltage	Max DC current	Amp meter	Isolated banks	Dimensions (inches)	Weight lbs	Item code	Price
SEC-1215A	12	14.4	13.8	15	Yes	3	8.4 x 8.4 x 3.25	5.0	045-03073	\$162
SEC-1230A	12	14.4	13.8	30	Yes	3	10.7 x 8.4 x 3.25	5.3	045-03076	\$266
SEC-1245A	12	14.4	13.8	45	No	2	12 x 9 x 4	11.1	045-03079	\$410
SEC-1280A	12	14.4	13.8	80	No	2	15 x 9 x 4.25	12.1	045-03080	\$580
SEC-2415A	24	28.8	27.6	15	Yes	3	10.7 x 8.4 x 3.3	5.3	045-03082	\$266
SEC-2425A	24	28.8	27.6	25	No	2	12 x 9 x 4	11.1	045-03085	\$410
SEC-2440A	24	28.8	27.6	40	No	2	15 x 9 x 4.25	12.1	045-03087	\$580

Solar Converters

Battery Desulfator

The battery desulfator from Solar Converters rejuvenates weak and dead batteries. It uses sharp spikes of current forced into the battery to "jar" sulfate crystals and cause mechanical and electrical resonance to grind them down, removing sulfation from battery plates. It can be used for 12-, 24- and 48-volt batteries. Voltage and pulse strength are adjustable. Two wires connect to positive and negative battery terminals. 1-year warranty.



Description	Item code	Price
BD-2 battery desulfator	045-07105	\$140

Battery Power Solutions

Battery Life Saver Desulfators

These electronic devices dissolve the lead sulfate crystals covering the battery's plates, converting them back into the original elements. They use high frequency pulses to loosen and dissolve the sulfate. Battery Life Savers rejuvenate the sulfuric acid solution as well as the lead plates, and run constantly to keep the battery in optimum condition.



The BLS-12-A from Battery Power Solutions is for use with smaller 12V battery systems and vehicles. It comes with eye rings for attachment to the battery clamp bolts.

BLS-12/24-B is our most popular model. Ideal for 12- and 24-volt renewable energy battery banks. It's equipped with plier type battery clips.

BLS-12/24-C is the same as the BLS-12/24-B, but has 5/16" lugs for attachment to battery.

BLS-36-A is a 36-volt version for use with 36V battery systems and battery powered vehicles. Includes 3/8" lugs for attachment to the battery terminals.

BLS-48-A is for use with battery banks that operate at 48 volts. Includes 3/8" lugs for attachment to the battery terminals.

Description	Item code	Price
BLS-12-A	045-07161	\$120
BLS-12/24-B	045-07163	\$140
BLS-12/24-C	045-07165	\$140
BLS-36-A	045-07167	\$150
BLS-48-A	045-07169	\$140

Zephyr

Power Vent Battery Box Vent

Lead-acid batteries produce hydrogen gas when charging. But if the battery box is left open to vent gas in cold climates, the batteries get too cold and battery capacity is significantly reduced. A vent that solves this problem is especially important when battery boxes are placed in basements, garages and sheds. When heat rises in the structure, a low pressure area forms around the box, cool air flows into the box and gases vent into the structure. The Power Vent controls battery box venting, removing hydrogen gas while reducing cold air infiltration into the box. The



Power Vent contains a gravity-operated damper that normally stays closed. When connected to a voltage-controlled relay, the fan operates only when the batteries are being charged and blows gas vapors out. Designed for battery banks under 2200 Ah and charge rates under 125 amps. Fan can be operated from the auxiliary relay on a Xantrex XW inverter, from the auxiliary relay of an OutBack FX inverter (use 12 volt-fan for all OutBack inverter voltages) or by a voltage controlled switch (sold separately). The 12/24-volt unit uses 3 watts and pushes air at 6 CFM with a 360° maximum change of direction. Dimensions: 4" diameter x 7.25" with a 2" PVC pipe socket on the inlet and outlet. The 48-volt unit uses 6 watts and pushes 8 CFM with a 360° maximum change of direction. Dimensions: 4" diameter x 10" long, with a 3" PVC pipe socket on the inlet and outlet.

Description	Item code	Price
Power vent 12V	085-08205	\$79
Power vent 24V	085-08207	\$79
Power vent 48V	085-08209	\$104

Hydrometers

Reads actual specific gravity for an accurate measurement of battery state of charge. Float type has built-in thermometer for temperature correction. Variation of 0.20 or greater specific gravity between battery cells indicates a need for battery equalization charging or a weak cell.



Description	Item code	Price
Hydrometer float type	046-00154	\$8
Hydrometer dial type	046-00156	\$8