USERS MANUAL

Solar-One® Battery System

Precautions and Warnings

Batteries contain sulfuric acid (which causes sever burns) and while being charged, emit hydrogen gas which is explosive. You must always assume the battery is emitting hydrogen gas. Batteries are always electrically live and will deliver very large amounts of current if shorted. To reduce the risk of personal injury and/or harm to property and the environment follow the precautions below.

DO NOT SMOKE, USE OPEN FLAMES, OR CREATE AN ELECTRICAL ARC OR SPARK IN THE VICINTY OF THE BATTERY.

USE INSULATED TOOLS, REMOVE ALL JEWERLY, WEAR PROTECTIVE CLOTHING AND EYE PROTECTION WHEN WORKING ON BATTERIES.

IF YOU GET BATTERY ACID IN YOUR EYES IMMEDITALY FLUSH WITH CLEAR WATER FOR 15 MINUETS AND SEEK MEDICAL ATTENTION. DO NOT USE NETURALIZING AGENT IN YOUR EYES.

ALWAYS KEEP A SOLUTION OF NETURALIZING AGENT ON HAND. (1 gal. of water thoroughly mixed with 1 lb. of baking soda) USE THIS AGENT TO NETURALIZE ANY ACID THAT MAY GET ON YOUR SKIN OR CLOTHING AND FOR GENERAL BATTERY CLEANING. RINSE WITH CLEAR WATER WHEN BUBBLING STOPS.

ENSURE THE BATTERY COMPARTMENT IS WELL VENTALIATED. IF POWERVENTING DEVICES ARE USED, ENSURE THAT THEY ARE FUNCTIONING PROPERLY.

ONLY USE THE CELL LIFTING STRAP PROVIDED TO REMOVE CELLS FROM THE CAN. IF THE BATTERY IS TO BE INSTALLED WITH ALL CELLS IN THE CAN, COVER THE CELL TREMINALS WITH A NON CONDUCTIVE MATERIAL SUCH AS PLYWOOD OR A THICK RUBBER MATERIAL.

ONLY PERSONS WHO ARE TRAINED TO MAINTAIN, INSTALL AND CARE FOR BATTERIES SHOULD BE ALLOWED TO WORK WITH THE BATTERY.

ONLY USE DISTILLED OR DEIONIZED WATER AND DO NOT OVER FILL.

Receiving the Battery

Immediately inspect the exterior of the packaging, including the pallet. Look for wet spots or stains that would indicate the battery was damaged or tipped over during transit. If there is visible evidence of damage you should make a note on the shipping papers “SHIPMENT RECEIVED DAMAGED”. Refuse the shipment and notify your Solar-One dealer. Shipping damage is not covered under the battery warranty. Photographs of the damage may be very helpful.

When the shipment is received and there is no visible damage, but damage is found during unpacking, immediately file a “CONCILED DAMAGE REPORT” with the shipper and notify your Solar-One dealer. Shipping damage is not covered under the battery warranty. Photographs of the damage may be very helpful.

Tech support 941-474-0110 M-F 9am-5pm eastern time. Before calling for tech support please have your battery’s model #, serial #, recent cell voltages, and specific gravity of all cells. Thank You.

Installation

Step 1 Acquire the following safety items: Safety glasses or face shield, Acid resistant apron, Insulated 1/2" wrench, Insulated ratchet with 1/2" socket, 1 gal neutralizing agent, (1# baking soda to gal. water, mix this solution thoroughly) Rubber Gloves

Step 2 Inspect the battery and can for evidence of damage, if damage has occurred file a claim with the carrier immediately. If you see liquid on the top of the cells pour some neutralizing agent in to a small container and apply with a clean paint brush. **Be extra careful not to get any of this agent into the cell.** Apply this agent to the terminals and the cell tops until bubbling stops, Rinse with clear water and wipe dry.

Note: If the battery can be installed without removing the cells, connect a chain to the holes on the end of the can. To prevent a short, be sure the lid is closed and that a non conductive material such as plywood or thick rubber covers the terminals. Use a 2x4 wood spreader that is approx. 1/2" shorter than the can. The spreader will prevent end pressure on the can.

Step 3 Remove the can lid by tapping one hinge back into the lid hinge, or remove the internal hex-head bolts.

Warning: Do not allow the lid fall onto the terminals as this could cause shorting from terminalto terminal. COVER THE CELL TREMINALS WITH A NON CONDUCTIVE MATERIAL SUCH AS PLYWOOD OR A THICK RUBBER MATERIAL ETC.

Step 4 Remove the buss bars.

Step 5 Connect the cell lifting strap into the holes of the terminals that are inline with the round post that protrude from the case. Lift the cells out of the can. The first cell out of the can will be harder than the remaining the cells. If you find the first cell very hard to remove try another cell or lubricate with soapy water. If the clevis on the cell lifting strap will not slide over the terminal, slightly spread the clevis.

Caution: These cells can be extremely heavy, a come-along or block and tackle may be needed to do the lifting. Do not try lifting these cells by yourself serious injury could occur.

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Installation cont.

Warning: The weight inside the plastic cells will cause the sides to bulge when removed from the "can", this is normal, however use caution when handling the cells. Any pressure on the sides will cause the cells to "breathe" and can release small droplets of electrolyte in the area of the cap. Placing a rag over the vent cap will reduce this hazard. To prevent serious and permanent damage to the battery, do not leave the cells out of the "can" for more than 24 hours.

Note: As you remove the cells from the can you may notice the electrolyte level is low. **DO NOT** add water to the cells, this condition is normal. See "Initial Charge" below

Warning: **Never allow tools or other conductive objects to make contact with two or more battery terminals.**

Step 6 Neutralize the sides of the cells and the steel can. Rinse and dry thoroughly.

Step 7 Move the steel can to the desired location.

Step 8 Install the cells back into the can using the diagram on page 12 or 13 to ensure the cells are correctly installed. The cells must be completely seated in the can to properly install the cell interconnects. All plastic spacers **must** be reinstalled when the battery is reassembled.

Step 9 Referring to the diagrams on page 12 or 13 install the nuts and bolts in the exact pattern as shown. Torque all bolts to 40 in. lbs. and re-torque annually.

Step 10 Install the lid by taping the hinge pin back into the can hole. When you install the lid you have a choice of where the hinges are located. Some lid hinges use a internal hex head bolt, use an allen wrench to remove and replace the lid.

Initial Charge:

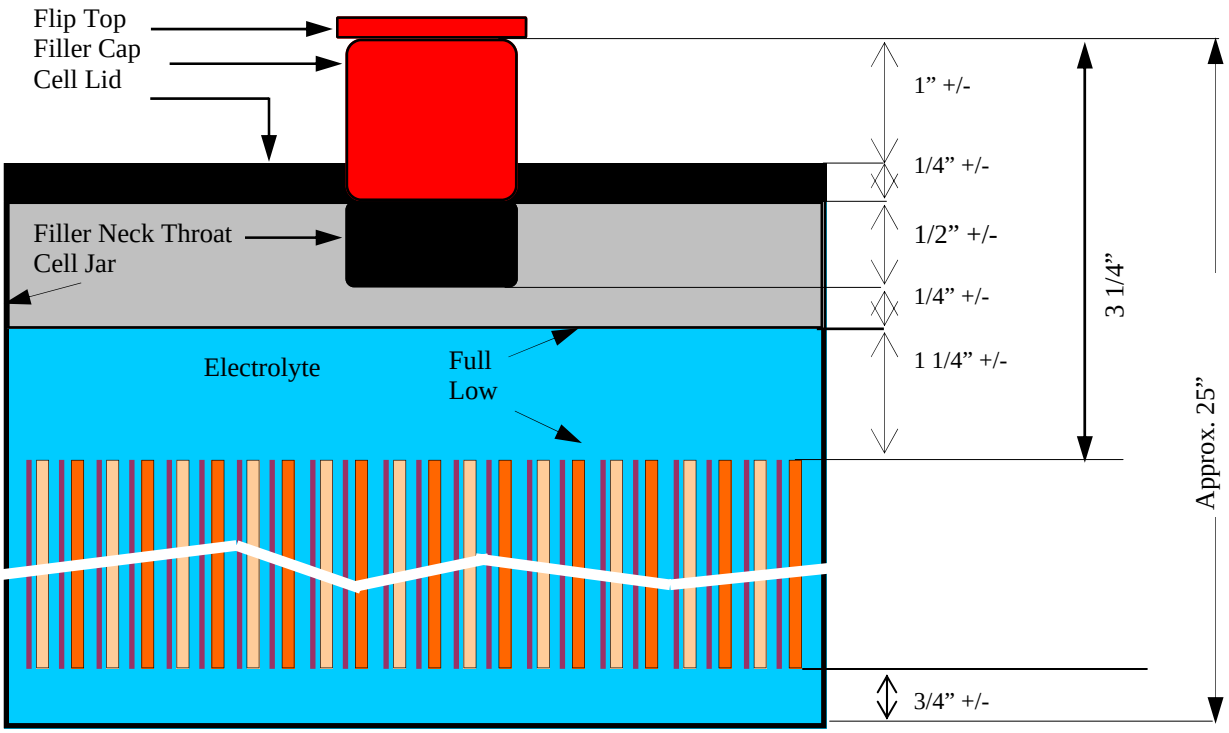
The battery ships from the factory with a minimum specific gravity of 1.265. However when received, the electrolyte level may be low and have a lower than 1.265 reading. This has to do with shipping, handling and hot temperatures in trucks. Prior to adding water, charge the battery at 15 volts for a 12 volt system, 30 volts for a 24 volt system, and 60 volts for a 48 volt system. The charge should be applied until the electrolyte level rises to the normal level or slightly lower, and a full gravity of 1.280 is achieved. Label each cell, check the specific gravity and voltage of all cells, and enter the in formation in the area provided on page 16.

Adding Water

Fill to: 1/4" (+/-) from the bottom of the filler neck throat. (**See cell drawing below)** A flashlight will make adding water much easier. Putting a full level mark on the hydrometers rubber tube will be helpful too.

A certain amount of water loss is normal in all batteries, and must be replaced at regular intervals with distilled or deionized water. Over-filling is one of the most common errors made during battery maintenance and will cause gradual lowering of the specific gravity and a subsequent loss of capacity, corrosion to the can and the intercell connectors. Add water **after** the battery has finished charging and **after** taking hydrometer readings. If the battery is subjected to freezing temperatures it is a good idea to add water when the battery is reaching appx. 3/4 charged or 1 hour before ending an equalize charge. It can take up to several days for the fresh water to mix with the rest of the acid, this fresh water could freeze before mixing with the electrolyte.

Warning: **Do Not Overfill. Do Not Use Tap Or Well Water** they may contain small amounts of nickel, iron, manganese, copper, chlorine, nitrates, etc. These and other minerals can seriously affect battery life.



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Using A Hydrometer

Insert the rubber tube into the cell, but not into the electrolyte. Squeeze the bulb and lower the rubber tip into the electrolyte, now release the pressure from the bulb. The barrel will fill up and the float will rise. It is very important for the float to be freely suspended in the electrolyte. Gently move the hydrometer back and forth until the float is not in contact with the barrel. Where the numbers on the float intersect with the top of the electrolyte is the specific gravity. See the following section for interpreting your hydrometer readings. With the rubber tip in the cell, but not submersed into the electrolyte squeeze the bulb and drain the electrolyte back into the cell. Wipe dry any spilled electrolyte. We recommend the NAPA 700-1145 hydrometer.

Warning: Always wear protective clothing and eye/face protection when working around batteries. If you should get acid in your eyes or on your skin, flush with clear water for 15 minutes and seek medical help.
Do Not use neutralizing agent to flush your eyes!

Specific Gravity

The standard fully charged specific gravity for the **Solar-One** is 1.275-1.285 @ 77° F the 100% discharged gravity is 1.140 @ 77° F. Since the acid content of the electrolyte decreases linearly as the cell is discharged, the decrease in gravity is directly proportionate to the amount in ampere-hrs taken out. The specific gravity at any point in the discharge indicates the depth of discharge, and can be translated into ampere-hrs taken out. Knowing that the fully charged specific gravity is 1.280 and the discharged specific gravity is 1.140 we can find our state of discharge.

Example: Assume the specific gravity is 1.180. 1.180 is 100 points below the fully charged specific gravity of 1.280. With a difference of 140 points from 100% charged to 100% discharged we can divide 100/140 = 71% discharged. Use this formula to help keep your Amp/Hr meter synchronized with your battery.

Warning: All Lead-Acid batteries are considered discharged when 80% of the capacity has been removed. **Never** remove more than 80% of the battery capacity.

Temperature

Lead acid batteries are a chemical reaction, and when subjected to different temperatures will produce different results. The normal operation temperature 77-80°F. Lower than normal temperatures will reduce capacity, slightly extend life, require a higher recharge voltage, and cause specific gravity readings to be adjusted down, from the actual reading. Higher temperatures have the opposite effect. Correction tables can be found on page 9 of this manual.

Warning: **Never** allow the electrolyte temperature to exceed 105°F.

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Voltage Readings

OPEN CIRCUIT VOLTAGE READINGS There is a definite relationship between the cell voltage and the specific gravity of a cell that is on open circuit (no charging or discharging for at least 24 hours). These open circuit voltage readings are useful in determining uniformity. A fully charged battery on open circuit, with a specific gravity of 1.260 - 1.280 will read 2.10 volts per cell to 2.12 volts per cell at 77°F. This spread of .02 vpc is considered normal for a new battery As the battery ages the spread will increase to about .03 vpc.

VARIATIONS IN ON-CHARGE VOLTAGE If all cells of a battery show similar full-charge voltages, they are equally healthy. The uniformity and value of the individual cell voltage readings vary with the overall condition of the battery. A battery with an on-charge voltage of 2.45 to 2.50 volts per cell has more uniformly healthy cells than a battery having an on-charge voltage spread of 2.40 to 2.50 volts per cell. The battery's age and service duty must be considered in the interpretation of the on-charge voltage readings. An example would be an older battery which has on-charge cell voltage readings of 2.45 volts to 2.65 volts. The reason may very well be that the inside cells operate at higher than average temperatures causing higher local action, which would result in lower voltage. Regular equalize charging will compensate for the higher self-loss of the inside cell. Any wide spread in on-charge voltage that could not be attributed to the battery's service life or age, is a sign that something is wrong and attention is necessary. Some causes of abnormally wide spread or charge voltages are:

1. Abnormal temperature differential.
2. Internal shorts.
3. Acid loss causing overdischarge.
4. Insufficient charging.
5. Insufficient equalize charging.

Note: If your inverter or charge controller uses a battery temperature probe, secure the probe to the lead interconnect where the terminals penetrate the cell. Use the most central cell of your battery.

Equalize Charge

The term "equalize" simply means a controlled overcharge. This procedure is used to adjust the difference between cells that develop due to temperature variations within the battery, manufacturing, and cycling of the battery. The equalize charge will also help scrub off sulfate particles that tend to build up on the battery's positive plate. When to equalize: If a cell has a .020 difference in specific gravity or at least once a month. How to equalize: Generally you continue the bulk charge for an additional 2-3 hours after the battery has become full. The equalize charge rate should be appx. 2% - 5% of the battery capacity. This will tend to raise the battery voltage 1-1.5 volts above the bulk setting. Ensure that any sensitive loads can accept this higher voltage.

Sulfated Batteries

All lead acid batteries sulfate when discharged. The active material must convert to lead sulfate in order for the cells to produce energy. The term sulfated battery means that the battery has developed abnormal sulfate and has its capacity reduced as a result. The most common causes of sulfation are:

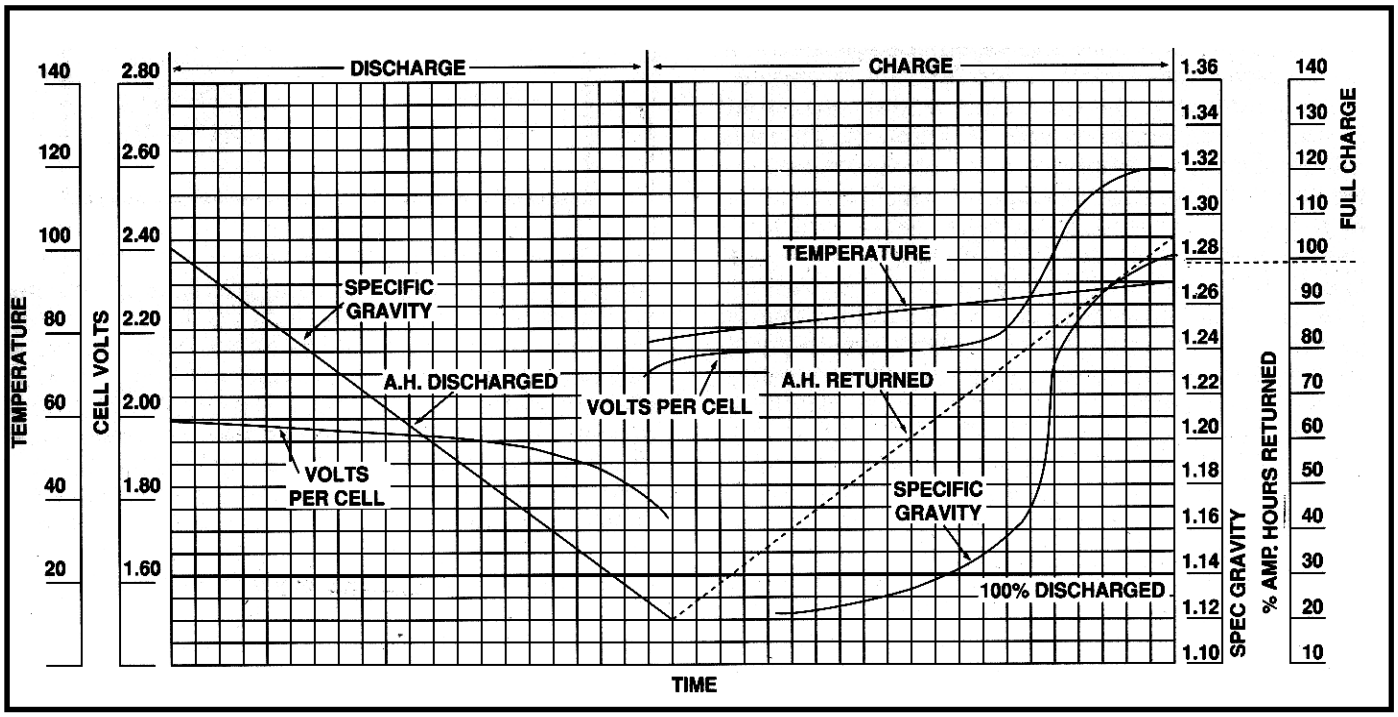
1. Under charging or neglect of equalize charge.
2. Standing in a partially or completely discharged condition.
3. Low electrolyte level.
4. Adding battery acid.
5. High specific gravity.
6. High temperature.

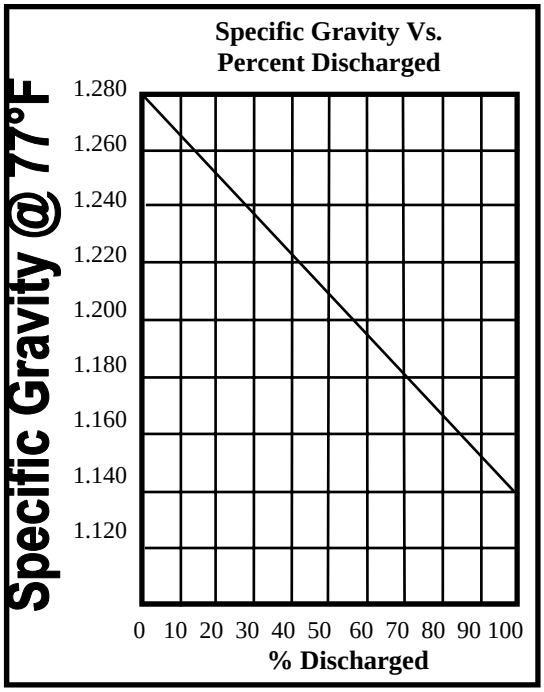
Cells of a sulfated battery give a low specific gravity and voltage readings and the battery will not become fully charged after a regular equalize charge. Before assuming that the battery is sulfated, rule out the possibility that low specific gravity may be due to acid loss, If the sulfation has not progressed too far, it may be possible to return the battery to a serviceable condition by paying careful attention to the following:

(A) Neutralize, wash and dry the battery.
(B) Add water to the proper level.
(C) Charge the battery at 2% of its 6 hr capacity until 100% of the battery's capacity has been restored. The 6 Hr. capacity is on the label on one end of your battery.
(D) Discharge the battery to 1.75 volts per cell (10.5 for 12 volt systems, 21 for 24 volt systems or 42 for 48 volt systems) making sure not to allow any cells to go into drop below 1.75 volts or cell reversal may occur. **Cell reversal** can be identified by very high cell voltage (3-4 volts) while on charge, or very low cell voltage (1 volt or less) while being discharged.
(E) Recharge until the specific gravity is the same for 3 hours.
(F) Repeat the process until the specific gravity remains constant. If the battery gives 80% or more you have succeeded, if not, replace the battery.

Warning: Do not let your battery stand in a discharged state for more than 24 hours or when temperatures are below freezing.

Solar-One Specifications





Specific Gravity Temperature Correction	
Electrolyte Temperature	**Hydrometer Correction**
49-51 °F	-.009
52-54 °F	-.008
55-57 °F	-.007
58-60 °F	-.006
61-63 °F	-.005
64-66 °F	-.004
67-69 °F	-.003
70-72 °F	-.002
73-75 °F	-.001
76-78 °F	No Correction
79-81 °F	+.001
82-84 °F	+.002
85-87 °F	+.003
88-90 °F	+.004
91-93 °F	+.005
94-96 °F	+.006
97-99 °F	+.007
100-102 °F	+.008

Cell Voltage Temperature Correction	
Electrolyte Temperature	**Cell Voltage Correction**
49-51 °F	-.09
52-54 °F	-.08
55-57 °F	-.07
58-60 °F	-.06
61-63 °F	-.05
64-66 °F	-.04
67-69 °F	-.03
70-72 °F	-.02
73-75 °F	-.01
76-78 °F	No Correction
79-81 °F	+.01
82-84 °F	+.02
85-87 °F	+.03
88-90 °F	+.04
91-93 °F	+.05
94-96 °F	+.06
97-99 °F	+.07
100-102 °F	+.08

Freezing points of battery Electrolyte	
Electrolyte Temperature	**Specific Gravity**
32 °F	1.000
25 °F	1.050
18 °F	1.100
14 °F	1.125
5 °F	1.150
-4 °F	1.175
-15 °F	1.200
-23 °F	1.210
-33 °F	1.220
-42 °F	1.230

Temperature Effects on Battery Capacity	
Temperature	**Capacity**
77 °F	100%
60 °F	95%
50 °F	91%
40 °F	87%
30 °F	81%
20 °F	74%

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Solar-One Specifications

Model # 12 Volts	Rated A/H (20 hr)	Rated A/H (6 hr)	*Usable A/H (20 hr)*	Rated Watt/hrs (20 hr)	*Usable Watt/hrs (20 hr)*	*Min. Charging System	*Max. Charging System	L x W x H in Inches	Weight in Lbs.	Short Circuit Ratings in Amps @ 104°F
SO-6-85-17/12	845	680	*676*	10,140	*8,112*	68 amps	136 amps	40 x 7.75 x 25	742	9,600
SO-6-85-19/12	950	765	*760*	11,400	*9,120*	76.5 amps	153 amps	40 x 8.55 x 25	808	10,800
SO-6-85-21/12	1055	850	*844*	12,660	*10,128*	85 amps	170 amps	40 x 8.75 x 25	880	12,000
SO-6-85-23/12	1160	935	*928*	13,920	*11,136*	93.5 amps	187 amps	40 x 9.00 x 25	959	13,300
SO-6-85-25/12	1270	1020	*1016*	15,240	*12,192*	102 amps	204 amps	40 x 10.25 x 25	1036	14,400
SO-6-85-27/12	1375	1105	*1100*	16,500	*13,200*	110.5 amps	221 amps	40 x 11.25 x 25	1102	15,600
SO-6-85-31/12	1585	1275	*1268*	19,020	*15,216*	127.5 amps	255 amps	40 x 12.75 x 25	1252	18,000
SO-6-85-33/12	1690	1360	*1352*	20,280	*16,224*	136 amps	272 amps	40 x 13.5 x 25	1336	19,200
SO-6-100-33/12	1990	1600	*1592*	*23,880*	*19,104*	160 amps	320 amps	40 x 13.5 x 28	1550	22,600

Model # 24 Volts	Rated A/H (20 hr)	Rated A/H (6 hr)	Usable A/H (20 hr)	Rated Watt/hrs (20 hr)	Usable Watt/hrs (20 hr)	*Min. Charging System	*Max. Charging System	L x W x H in Inches Depending on how configured	Weight in Lbs.	Short Circuit Ratings in Amps @ 104°F
SO-6-85-17/24	845	680	676	20,280	16,224	68 amps	136 amps	80 x 7.75 x 25 or 40 x 15.5 x25	1484	9,600
SO-6-85-19/24	950	765	760	22,800	18,240	76.5 amps	153 amps	80 x 8.25 x 25 or 40 x 16.5 x 25	1616	10,800
SO-6-85-21/24	1055	850	844	25,320	20,256	85 amps	170 amps	80 x 8.75 x 25 or 40 x 17.5 x 25	1760	12,000
SO-6-85-23/24	1160	935	928	27,840	22,272	93.5 amps	187 amps	80 x 9.00 x 25 or 40 x 18.00 x 25	1918	13,300
SO-6-85-25/24	1270	1020	1016	30,480	24,384	102 amps	204 amps	80 x 10.25 x 25 or 40 x 20.5 x 25	2072	14,400
SO-6-85-27/24	1375	1105	1100	33,000	26,400	110.5 amps	221 amps	80 x 11.25 x 25 or 40 x 22.5 x 25	2204	15,600
SO-6-85-31/24	1585	1275	1268	38,040	30,432	127.5 amps	255 amps	80 x 12.75 x 25 or 40 x 25.5 x 25	2504	18,000
SO-6-85-33/24	1690	1360	1352	40,560	32,448	136 amps	272 amps	80 x 13.5 x 25 or 40 x 27.0 x 25	2672	19,200
SO-6-100-33/24	1990	1600	1592	47,760	38,208	160 amps	320 amps	80 x 13.5 x 28 or 40 x 27.0 x 28	3100	22,600

Model # 48 Volts	Rated A/H (20 hr)	Rated A/H (6 hr)	*Usable A/H (20 hr)*	Rated Watt/hrs (20 hr)	*Usable Watt/hrs (20 hr)*	*Min. Charging System	*Max. Charging System	L x W x H in Inches Depending on how configured	Weight in Lbs.	Short Circuit Ratings in Amps @ 104°F
SO-6-85-17/48	845	680	*676*	40,560	*32,448*	68 amps	136 amps	160 x 7.75 x 25 or 80 x 15.5 x 25 Or 40 x 31 x 25	2968	9,600
SO-6-85-19/48	950	765	*760*	45,600	*36,480*	76 amps	153 amps	160 x 8.25 x 25 or 80 x 8.25 x 25 or 40 x 33 x 25	3232	10,800
SO-6-85-21/48	1055	850	*844*	50,640	*40,512*	85 amps	170 amps	160 x 8.75 x 25 or 80 x 18.00 x 25 or 40 x 36.00 x 25	3520	12,000
SO-6-85-23/48	1160	935	*928*	55,680	*44,544*	93 amps	187 amps	160 x 9.00 x 25 or 80 x 18.00 x 25 or 40 x 35.00 x 25	3836	13,300
SO-6-85-25/48	1270	1020	*1016*	60,960	*48,768*	102 amps	204 amps	160 x 10.25 x 25 or 80 x 20.5 x 25 or 40 x 41.0 x 25	4144	14,400
SO-6-85-27/48	1375	1105	*1100*	66,000	*52,800*	110 amps	221 amps	160 x 11.25 x 25 or 80 x 22.5 x 25 or 40 x 45.0 x 25	4408	15,600
SO-6-85-31/48	1585	1275	*1268*	76,080	*60,864*	127 amps	255 amps	160 x 12.75 x 25 or 80 x 25.5 x 25 or 40 x 51.0 x 25	5008	18,000
SO-6-85-33/48	1690	1360	*1352*	81,120	*64,896*	136 amps	272 amps	160 x 13.5 x 25 or 80 x 27.0 x 25 or 40 x 54.0 x 25	5344	19,200
SO-6-100-33/48	1990	1600	*1592*	*95,520*	*76,416*	160 amps	320 amps	160 x 13.5 x 28 or 80 x 27.0 x 28 0r 40 x 54.0 x 28	6200	22,600

* The Charging System is the sum of all charging sources including, but not limited to: Solar, Wind, Hydro generator, Inverter/ Charger, DC generator, or stand alone battery charger.

Solar-One Specifications

24 hr. Open Circuit Volts vs. Depth of Discharge (DOD)				
DOD	**12 volts**	**24 volts**	**48 volts**	**Specific Gravity**
0% (Full Charged)	12.75	25.50	51.00	1.275-1.285
30%	12.36	24.72	49.44	1.236
50% (Half Discharged)	12.12	24.24	48.48	1.205
70%	11.88	23.76	47.52	1.181
80% (Considered Dead)	11.76	23.52	47.04	1.168

The above values must be taken with no charge or discharge (Open Circuit) on the battery for a minimum of 24 hours. The temperature must be at 77°F and you must use a very accurate Digital Multi Meter.

Recharge Settings			
	12 volt	**24 volt**	**48 volt**
Bulk	14.4—14.8	28.8—29.6	57.6—59.2
Equalize	15.0—15.5	30.0—31.00	60—62
Float	13.50	27.0	54.0
Absorption time	2 hrs.	2 hrs.	2 hrs.
Equalize times	2 hrs.	2 hrs.	2 hrs.

These voltage settings are ball park settings that will work for most systems. Use the lower values if cycling is shallow, use the higher values if the cycling is moderate to deep. If you find your specific gravity is not reaching 1.275-1.285 raise the voltage settings by .1 volt increments until the specific gravity readings indicate a fully charged battery. You can also increase the absorption time to correct low specific gravity. If the battery uses an excessive amount of water or is overheating lower the settings by .1 volt increments until the overcharge is removed.

Warranty	10 Years 7 years free replacement 3 years prorated
Cycles To 80% DOD	2100 Over 10 Years
Battery Type	Flooded Lead-Acid
Positive Plate	Tetrafluoroethylene (Teflon®) /Lead Antimony
Positive Plate Thickness	.031”
Post-to-Cover Seal	Burned Post to Cover
Cell “Jar” Material	Injection Molded Polypropylene
Cell Cover Material	Polypropylene
Can Material	Epoxy Coated Steel
Intercell Connectors	Lead-Plated Copper Rated @ 230 Amps
Specific Gravity @ 77°F	1.285-1.275 Fully Charged 1.160 80% Discharged
Maximum Temperature	105°F
Gallons of Electrolyte Per Cell	6-85-17=1.7 6-85-19=1.9 6-85-21=2.1 6-85-23=2.2
	6-85-25=2.5 6-85-27=2.7 6-85-31=3.1 6-85-33=3.3 6-100-33=3.7

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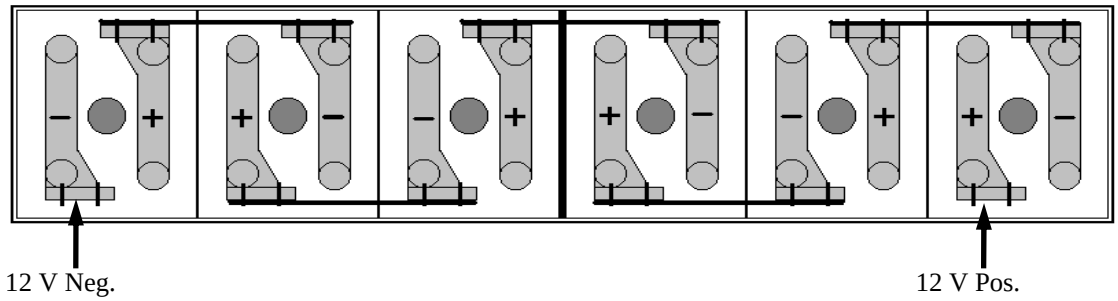
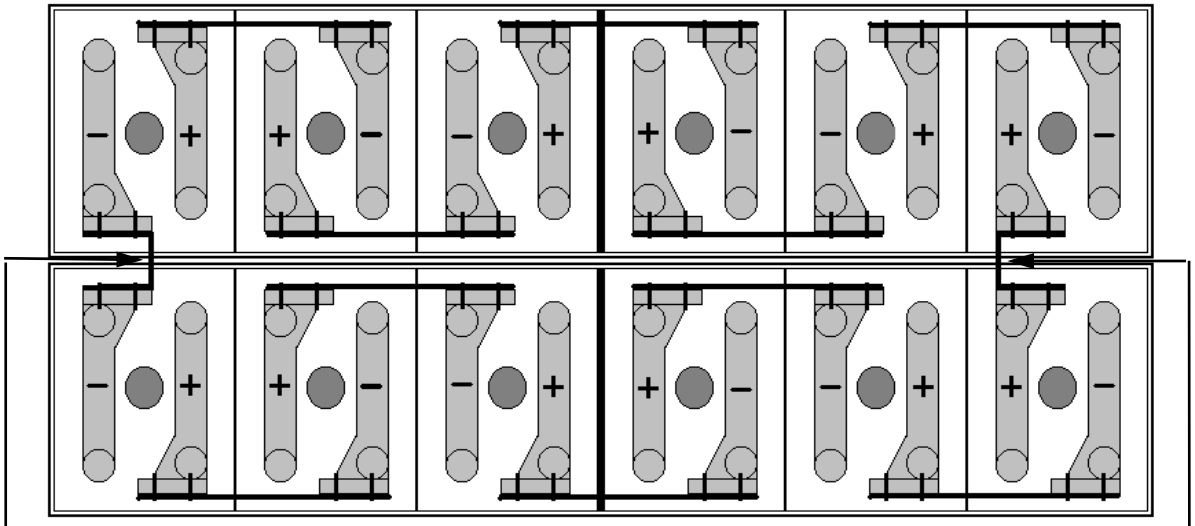
Diagrams

12 Volt All Models



12 V Neg. 12 V Pos.

2 (Two Paralleled) 12 Volt All Models



12 V Neg. 12 V Pos.

Note:

Each container of **Solar-One** batteries comes with an extra lead coated copper buss bar. This bar is to be used for making a parallel connection as shown above, or a series connection as seen on the next page. This bar is bent on site and can be a “horse shoe” (above) or a “Z” (next page) configuration. When bending the bar use a smooth radius instead of sharp bends. Sharp bends tend to stretch the backside of the copper making it less effective in the transfer of energy.

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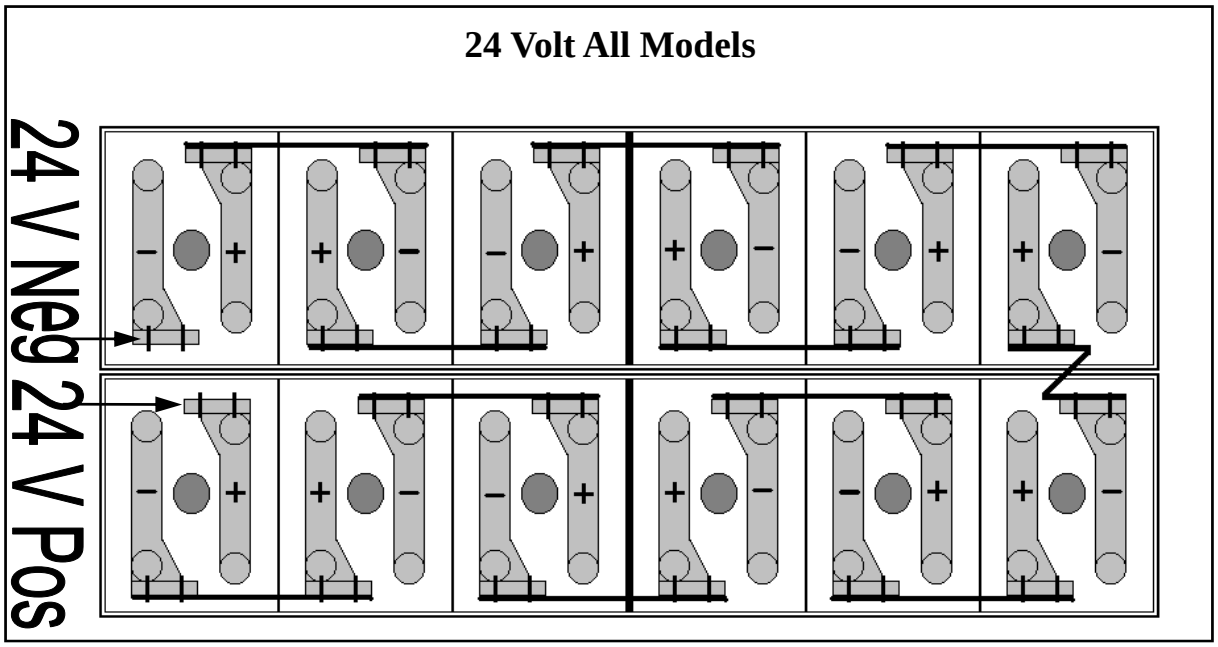
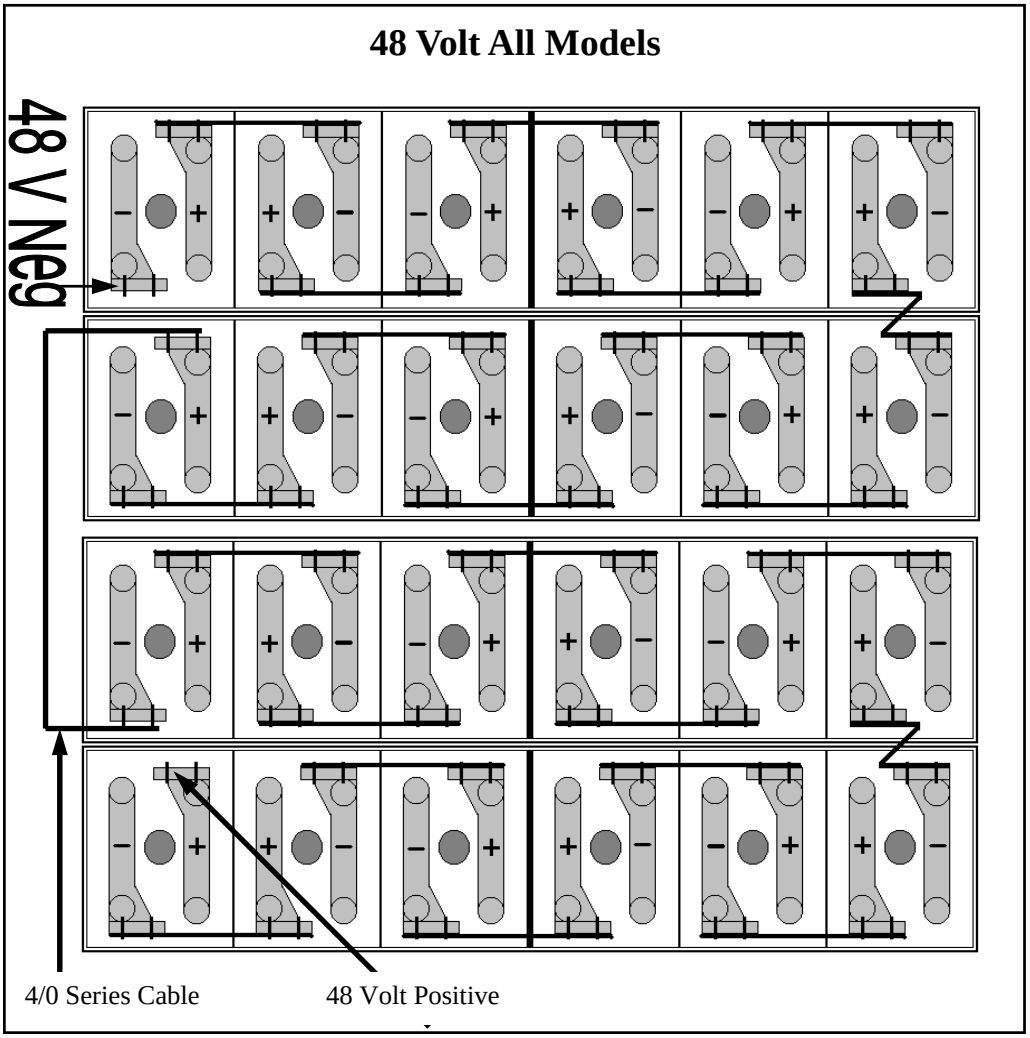
Diagrams





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Troubleshooting

Problem	Probable Cause	Remedy
Battery not performing as expected	Battery is undersized.	Replace with a larger battery.
	Battery not fully charged	Check charger and controller.
	Weak or defective cells.	Perform a load test
	Grounds or shorts.	Clean battery and all connections in the system
	Phantom loads in system	Find and eliminate loads.
	Battery is spent.	Replace battery.
Battery overheats on charge.	Improper equipment settings	Adjust charging equipment.
	Malfunction of charging equipment	Verify charging equipment output.
	Battery too deeply discharged	Limit discharge to 80% DOD.
	High resistance connection.	Check for hot connections.
	Battery room too warm.	Provide cooler battery room.
	Low electrolyte level	Add water to correct level allow to cool and recharge
	Weak or defective cells.	Repair or replace cell
	Battery is spent	Replace battery
Battery overheats on discharge	Excessive load.	Reduce loads. Need larger battery
	Battery not fully recharged	Let battery cool. Do a load test
	Battery over discharged	Limit discharge to 80% DOD
	Battery room too warm.	Provide cooler battery room
Low electrolyte level	Lack of watering.	More care required
	Frequent overcharging	Adjust/check charging system
	Spilled electrolyte	Add water, equalize and adjust specific gravity (contact dealer)
	Cracked or broken jars	Replace jars.
Unequal cell voltages.	Overdischarging	Perform equalize charge
	Acid loss due to over-watering or spillage	Perform equalize charge and adjust specific gravity
	Corroded or dirty tops	Neutralize and clean tops
	Grounds in battery	Clean battery
	Impurities in electrolyte	Use only distilled water
	Battery used infrequently	Deep discharge and equalize
	Weak or defective cells.	Repair or replace battery
	Lack of equalize charges	Equalize more often
Unequal Specific Gravity	All the above	All the above
	Recently added water	Gassing will mix new water
	Improper gravity adjustment after cell replacement	Adjust specific gravity (contact your dealer)

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Maintenance

Bellow are guidelines for maintenance of the **Solar-One** Battery. Your previous knowledge of lead acid batteries may not require this much attention, but remember, the more interaction you have with the battery (The Heart of the system) the better service life you can expect from your investment. If you would like records form please contact us at the phone number below.

The **Solar-One** warranty as it pertains to records, only requires that "reasonable records be kept". Use your best judgment.

Bi-Weekly

(Every other week)

1. Record hydrometer reading of pilot cell (the cell with the lowest specific gravity when you first received the battery. Once a year select a different cell to be the pilot cell)
2. Check the water level (add as needed.)
3. Record Amp/Hrs Consumed from your A/H Meter
4. Inspect for loose or corroded connections (clean and tighten as needed)
5. Ensure the battery has been fully charged at least two (2) times per week

Monthly

1. Check water level (add as needed.)
2. Clean battery with a damp cloth. (If battery tops are wet with acid use neutralizing agent with a clean paint brush, dry thoroughly.)
3. Equalize the battery
4. Inspect for loose or corroded connections (clean and tighten as needed)

Bi-Monthly

(Every Other Month)

1. Record hydrometer readings of all cells (after the battery is fully charged.)
   A. If the average readings are less than 1.275 - 1.285 check all charging sources and adjust as needed.
   B. If one or two cells read 20 points less than the average, circle those readings and check for improvement the next time the battery becomes fully charged. If the low cells do not improve, the cells are in need of an equalize charge.

Yearly

1. Torque all terminal bolts.

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Initial Charge Data

Cell ID.	Volts	Specific Gravity

Cell ID.	Volts	Specific Gravity

Notes

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Hup.® Solar-One®

WARRANTY AND ADJUSTMENT AGREEMENT COVERING HUP® SOLAR ONE®BATTERIES FOR RENEWABLE ENERGY

Sold to _____ Shipped To _____

Charger Type _____ Location _____

Date Shipped _____ Serial Number_____

EnerSys® Delaware Inc. ("EnerSys") warrants all General Battery™ Hup® Solar-One® batteries to be free from defects in workmanship and materials for the period stated in the following table, from the date of installation or no more than three (3) months from date of shipment, whichever comes first.

Total Warranty Period	Full Credit, Parts, Labor[1], Freight[2]	Full Credit, Parts Only	Prorated Credit
120 Months	First 12 Months	13 Through 84 Months	85 Through 120 Months

[1] Service Center labor only. On-site labor is not covered.
[2] Covers freight to and from the Service Center or part replacement shipment to user. It does not include transportation charges for on-site service.

If the battery fails to deliver 80% of its rated capacity at the 20-hour rate within 84 months due to defects in workmanship or materials, the defective parts will be replaced by EnerSys® exclusive of labor and freight.

In addition, if the battery fails to deliver 80% of its rated capacity at the 20-hour rate after 84 months, EnerSys® will credit Northwest Energy an amount equal in dollars to the net purchase price of the original battery, multiplied by the months of unexpired life, divided by the number of months in the period stated above. Credit will be against the purchase of another Hup® Solar-One® battery of equal or greater KWH capacity.

This warranty is subject to the following terms and limitations.

1. The User, Northwest Energy Storage and EnerSys® mutually agree the battery identified above must be sized properly to perform the duty cycle originally intended. The battery must not be required to perform a duty cycle in excess of the originally intended one.
2. The battery must be maintained in accordance with Northwest Energy Storage's current published Operating and Maintenance instructions. The operator of the Renewable Energy (RE) system must keep reasonable records of use and maintenance. Failure to monitor watering intervals, discharges and full recharge may void warranty coverage.
3. Use of each battery must be limited to no more than four (4) 80% depth of discharge cycles per 7-day week and no more than 210 cycles per calendar year. If these amounts are exceeded, the months of warranty will be reduced.
4. The battery must be charged on a properly sized charging system capable of delivering 10% to 20% of the battery AH charge rate. The "charging system" is defined as the sum total of all charging sources. Use of a constant voltage charge controller is prohibited.
5. All RE systems must have an AH metering device installed in accordance with the manufacturer's installation manual.
6. Use only distilled or deionized water. The use of electrolyte additives or compounds voids all warranty coverage.
7. This warranty does not cover physical damage due to acts of nature or man, which stress the battery beyond design limits and exert undesirable influence aside from normal wear and tear. This warranty is void if the battery is subjected to misuse, physical damage or abuse other than normal wear and tear.
8. EnerSys assumes no responsibility for any work accomplished or expenses incurred except with express written consent.
9. This warranty applies to the original purchaser (User) of the battery and is nontransferable. This warranty covers products situated only in North America.
10. EnerSys, at its option, may require proof of purchase consisting of a copy of the original invoice.

EnerSys® shall not be liable for indirect, incidental or consequential damages arising out of sale or relating to the use of this product. The purchaser assumes responsibility for all personal injury and property damage resulting form the handling, possession or use of the product. In no event shall the liability of EnerSys for any and all claims, including claims of breech of warranty or negligence, exceed the purchase price of the product.

THE ABOVE WARRANTY IS IN LIEU OF ALL OTHER REMEDIES, INCLUDING ACTIONS FOR CONTRACT OR NEGLIGENCE. ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY EXCLUDED.

This warranty is understood to be the exclusive agreement between the parties relating to the subject matter hereof. Only an EnerSys Corporate Marketing Representative may make signed, written changes to the warranty made in this agreement.

Signed_____

Date_____

P.O. Box 14145 / Reading, PA 19612-4145
www.enersys.com / 1-800-538-3627

Do Not add water to your new Solar-One® battery until you have completed the initial charge. See page 4.