POWERLINE

PV-1

Solar Battery User's Manual

SolarUM.2/05.Rev.0

Table of Contents

PRECAUTIONS

NEVER smoke or produce a spark in the battery area.

When performing battery maintenance wear safety glasses, rubber gloves and protective clothing.

When using a hydrometer avoid letting the rubber tube shake as this can cause drops of electrolyte to splash onto your clothing or into your eyes. Store your hydrometer in a clean dry place.

DO NOT OVERFILL Excessive water may spill out while battery is charging.

USE <u>ONLY DISTILLED WATER!</u> Using tap or well water will void your warranty.

DO NOT let foreign objects enter the cells.

INSTALLATION

STEP 1 Acquire the following safety items:

- Safety glasses or face shield
- Acid resistant apron
- Insulated 7/16 wrench
- Insulated ratchet with 7/16 socket
- 1 gal. neutralizing agent (1# baking soda to gal. water, mix this solution thoroughly)
- Rubber gloves

NOTE: Wrapping your tools with several layers of electrical tape will reduce the hazard of shorting from cell to cell. You should also remove any jewelry that may be at risk of shorting.

INSTALLATION – Continued

STEP 2 Inspect the battery and tray 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 into 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 as well as the cell tops then rinse with clear water and wipe dry.

CAUTION: If you should get battery acid in your eyes, flush with clear water for 15 minutes and seek medical attention. **DO NOT** use the neutralizing agent in your eyes.

STEP 3 Remove the tray lid by tapping one hinge back into the lid hinge; or remove the internal hex-head bolts.

STEP 4 Remove the buss bars.

STEP 5 Connect the cell lifting strap into the holes of the terminals and lift the cells out of the tray. If the clevis on the cell lifting strap will not slide over the terminal slightly spread the clevis.

NOTE: If you move the battery fully assembled skip the remaining steps.

WARNING: Do not let the lid fall onto the cells as this could cause shorting from terminal to terminal.

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.

INSTALLATION – Continued

WARNING: The weight inside the plastic cells will cause the sides to bulge when removed from the tray. 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.

NOTE: As you remove the cells from the tray you may notice the electrolyte level is very low. **DO NOT** add water to the cells, this condition is normal. As soon as the battery is reassembled, charge the battery at 2% of its rated capacity. After approximately 2 hours, the electrolyte level will return to normal. If the electrolyte level does not rise as expected, contact your dealer.

STEP 6 Neutralize the sides of the cells and the steel tray. Rinse and dry thoroughly.

STEP 7 Move the steel tray to the desired location.

STEP 8 Install the cells back into the tray using the diagram on page 12 to ensure the cells are correctly installed. The cells must be completely seated in the tray to properly install the cell interconnects. All plastic spacers **MUST** be reinstalled when the battery is assembled.

STEP 9 Referring to the diagrams on page 12 or 13, install the nuts and bolts in the exact pattern as shown. If your installation requires the inverter connections to be on the opposite side of what is shown, turn the book over and proceed. Torque all bolts to 115-135 inch lbs.

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

INSTALLATION – Continued

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 an internal hex head bolt, use an Allen wrench to remove and replace the lid.

ADDING WATER

Fill to ¼" from the bottom of the cap (throat). A flashlight will make adding water much easier. 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 intercell connectors. Add water after the battery is done 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 approximately ¾ 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 over fill. Do NOT use tap or well water.** They can contain small amounts or nickel, iron, manganese, copper, chlorine, nitrates, etc. These and other minerals can seriously affect battery life.

HYDROMETER

Insert the rubber tip into the cell but not into the electrolyte. Squeeze the bulb and lower the rubber tip into the electrolyte and 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, this 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.

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 see a physician. **Do not use neutralizing agent in your eyes.**

VOLTAGE

OPEN CIRCUIT 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). 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.

DOD (Depth of Discharge)	Total Battery Volts 12 v / 24 v / 48 v	Specific Gravity
0% (Full Charged)	12.78 / 25.56 / 51.12	1.275 – 1.285
50% (Half Discharged)	12 / 24 / 48	1.205
80% (Considered Dead)	10.5 / 21 / 42	1.175
100% (Over Discharged)	9.3 / 18.6 / 37.2	1.140

NOTE: You must take the electrolyte temperature into consideration when using voltage readings (see Pg. 13).

VOLTAGE – Continued

FULLY CHARGED VOLTAGE READINGS On-charge voltage readings are most informative and are good indicators of battery condition. These readings should be taken when the battery is approaching full charge with 2% of the battery capacity flowing into the battery. New batteries, when fully charged and 2% of the battery capacity flowing into the battery, will have cell voltages between 2.55 – 2.65 vpc. Older batteries with the same circumstances will have voltages about 2.45 – 2.55 vpc. Multiplying the battery capacity times .02 will give you 2% of capacity.

Example: 6-85F-17S 845 x .02 = 16.9 amps.

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 cause of abnormally wide spread or charge voltages are:

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

General Settings for Trace Inverter/Charger

	12 Volt	24 Volt	48 Volt
Bulk	14.8	29.6	59.2
Equalize	15 – 15.5	30 – 31	60 – 62
Float	13.5	27	54

These voltage settings are ball park settings that will work for most systems. If you find your specific gravity is not reaching 1.275-1.285 raise these settings by .1 volt increments until the specific gravity readings indicate a fully charged battery. If the battery uses an excessive amount of water or is overheating, lower the settings by .1 volt increments until the overcharge is removed.

SPECIFIC GRAVITY

The standard fully charged specific gravity for the **HAWKER PV-1 Solar Battery** is 1.275 – 1.285 at 77˚ F (see Fig. 4 and Fig. 5 on page 14) and the 100% discharged gravity is 1.140. 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 gravity is 1.280 and the final specific gravity is 1.140 we can find our state of discharge.

EXAMPLE: Assume the specific gravity is 1.180 that 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. (See Fig 1 on Page 14)

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.

RECORD KEEPING

This simple task is required for your warranty and will be of great assistance in determining the health of your battery. Record keeping is the single most important tool in good battery maintenance. As the battery ages you can see trends, spot possible problems before they become permanent and make any adjustments to your charging systems. Without records it is almost impossible to know how your system is functioning. While instrumentation in Renewable Energy has made leaps and bounds, they are only another tool in the proper operation of your battery. By using the records and instrumentation together, your battery system can provide you with years of trouble-free service.

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 3 hours after the battery has become full. The equalize charge rate should be approximately 2% 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 cause of sulfation are:

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

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

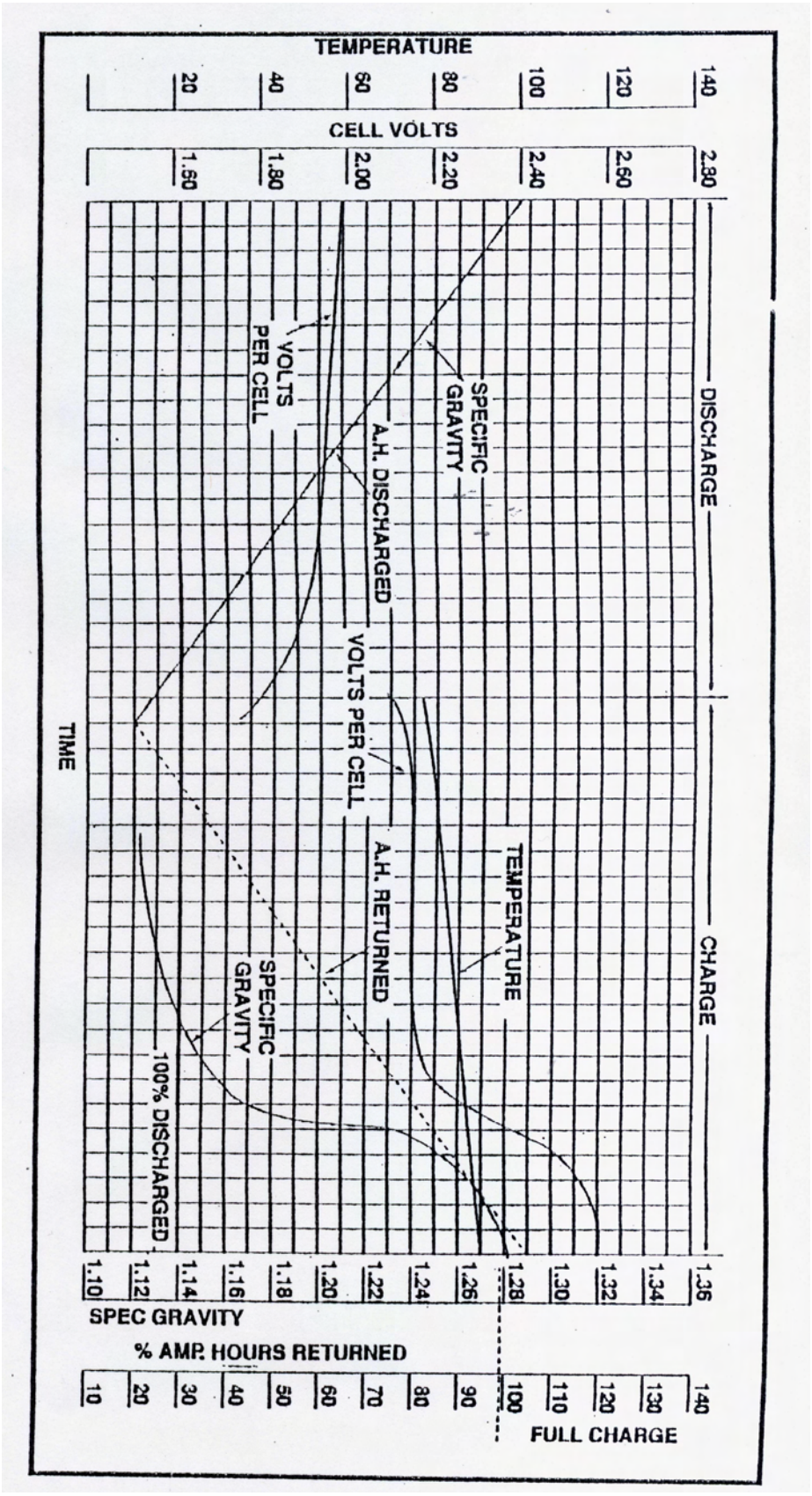
SULFATED BATTERIES – Continued

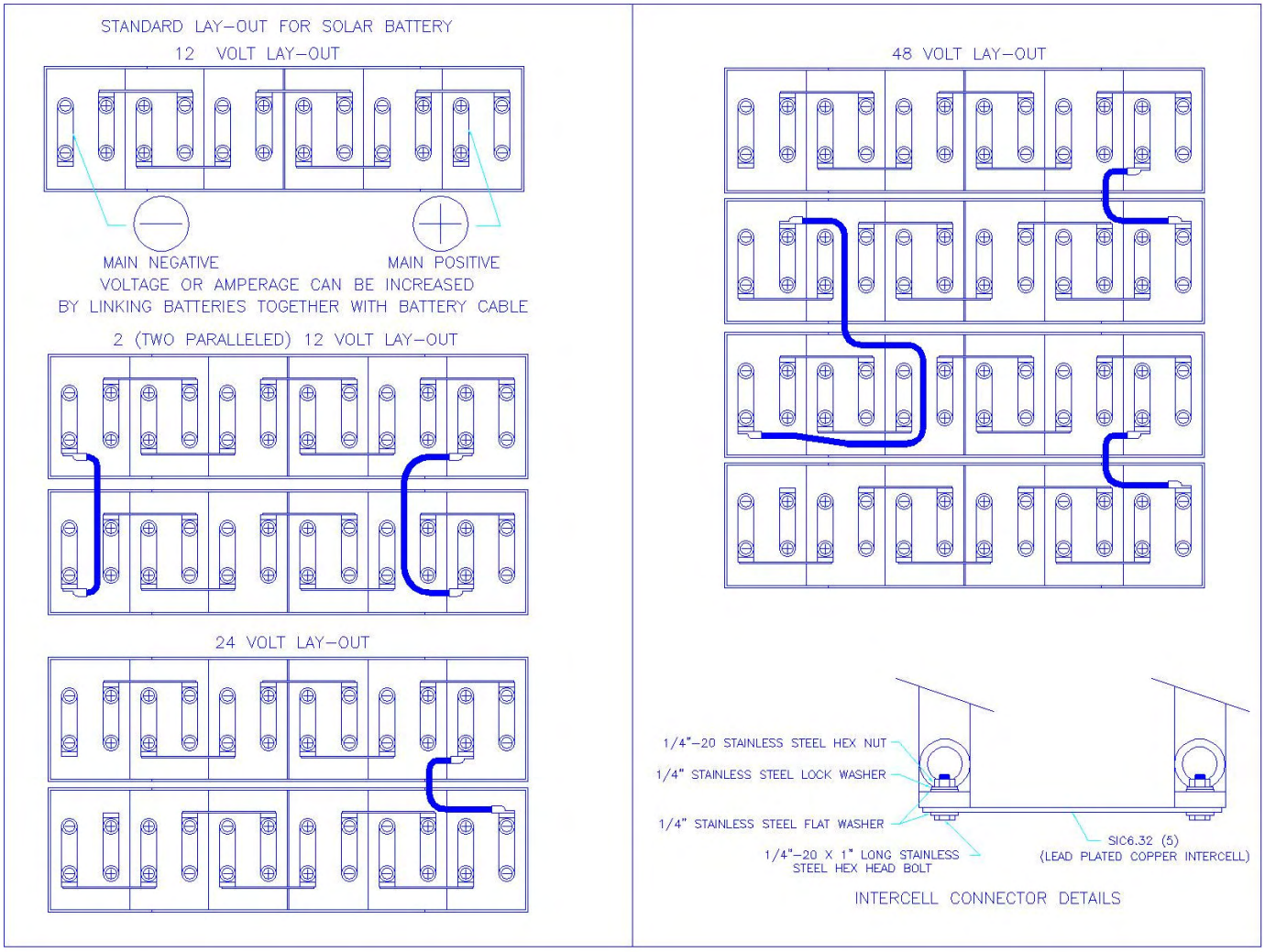
Cells of a sulfated battery give a low specific gravity and voltage reading and the battery will not become fully charged after a regular equalize charge. Before assuming that the battery is sulfated, rule out the possibility that low specific gravity may be due to acid loss. If the sulfation has not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

1. Neutralize, wash and dry the battery.
2. Add water to the proper level
3. Charge the battery at 2% of its capacity using the 6 hr. rate until 100% of the battery's capacity has been restored.

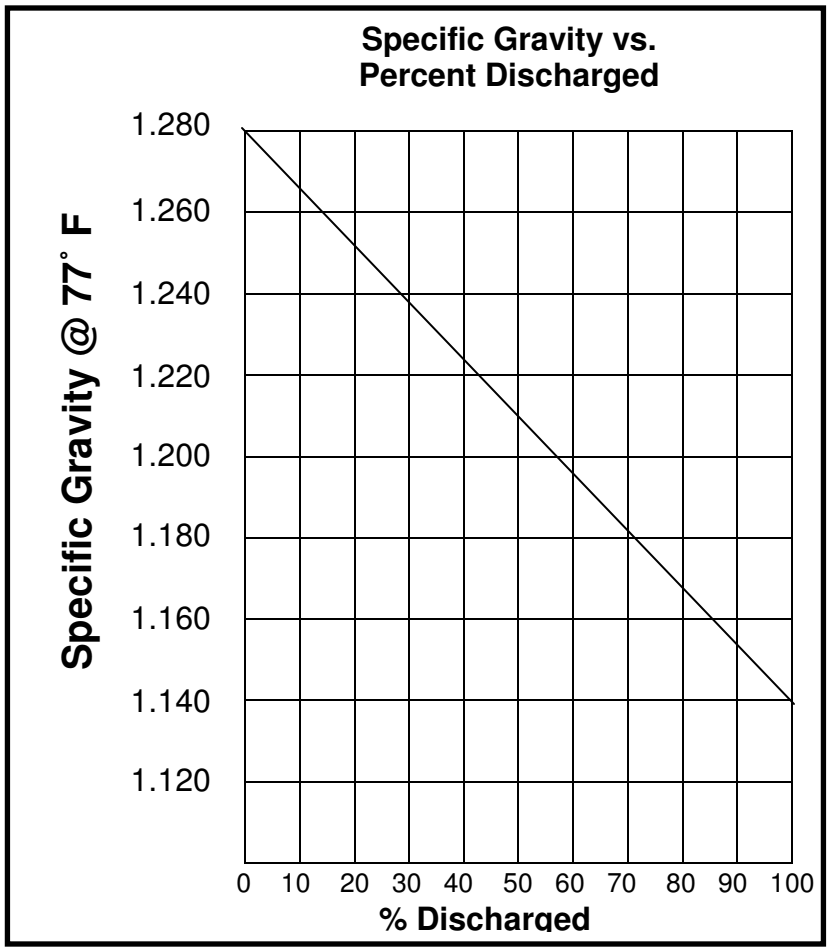
   Example: 6-85F-23S
   1160 A/H x .77 = 893 A/H at the 6 hr. rate
   893 A/H x .02% = 17.86 amps
   17.86 amps x 50 hrs = 100% of the 6 hr. capacity

4. Discharge the battery to 1.75 volts per cell (10.5 for 12 volt systems or 21 volts for 24 volt systems) making sure not to allow any cells to go into reversal. **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.
5. Recharge until the specific gravity is the same for 3 hours.
6. Repeat the process until the specific gravity remains constant. If the battery gives 80% or more you have succeeded; if not, replace the battery.


TEMPERATURE
20
40
60
80
100
120
140
CELL VOLTS
1.50
1.80
2.00
2.20
2.40
2.60
2.80
DISCHARGE
CHARGE
VOLTS PER CELL
SPECIFIC GRAVITY
A.H. DISCHARGED
VOLTS PER CELL
A.H. RETURNED
TEMPERATURE
SPECIFIC GRAVITY
100% DISCHARGED
TIME
1.10
1.12
1.14
1.16
1.18
1.20
1.22
1.24
1.26
1.28
1.30
1.32
1.34
1.36
SPEC GRAVITY
% AMP. HOURS RETURNED
10
20
30
40
50
60
70
80
90
100
110
120
130
140
FULL CHARGE


STANDARD LAY-OUT FOR SOLAR BATTERY
12 VOLT LAY-OUT
MAIN NEGATIVE
MAIN POSITIVE
VOLTAGE OR AMPERAGE CAN BE INCREASED
BY LINKING BATTERIES TOGETHER WITH BATTERY CABLE
2 (TWO PARALLELED) 12 VOLT LAY-OUT
24 VOLT LAY-OUT
48 VOLT LAY-OUT
1/4"-20 STAINLESS STEEL HEX NUT
1/4" STAINLESS STEEL LOCK WASHER
1/4" STAINLESS STEEL FLAT WASHER
1/4"-20 X 1" LONG STAINLESS STEEL HEX HEAD BOLT
SIC6.32 (5)
(LEAD PLATED COPPER INTERCELL)
INTERCELL CONNECTOR DETAILS

FIGURES



Freezing Points of Battery Electrolyte

Specific Gravity	Centigrade	Fahrenheit
1.000	0	+32
1.050	-3.3	+25
1.100	-7.7	+18
1.125	-10	+14
1.150	-15	+5
1.175	-20	-4
1.200	-26	-15
1.210	-31	-23
1.220	-36	-33
1.230	-41	-42
1.260	-57	-71
1.270	-62	-80
1.280	-66	-87
1.290	-69	-92

Cell Specific Gravity Temperature Correction

Temp. Fahrenheit	Correction Factor
39-41	-.012
42-44	-.011
45-47	-.010
48-50	-.009
51-53	-.008
54-56	-.007
57-60	-.006
61-63	-.005
64-66	-.004
67-69	-.003
70-72	-.002
73-75	-.001
76-78	0
79-81	+.001
82-84	+.002
85-87	+.003
88-91	+.004
92-94	+.005

Cell Voltage Correction Factors

Electrolyte Temperature ˚F	Cell Voltage Correction To Be Subtracted From Measured Volts	Electrolyte Temperature ˚F	Cell Voltage Correction To Be Added To Measured Volts
49-51	-0.09	76-78	None Needed
52-54	-0.08	79-81	+0.01
55-57	-0.07	82-84	+0.02
58-60	-0.06	85-87	+0.03
61-63	-0.05	88-90	+0.04
64-66	-0.04	91-93	+0.05
67-69	-0.03	94-96	+0.06
70-72	-0.02	97-99	+0.07
73-75	-0.01	100-102	+0.08

Temperature Effect On Batteries

Electrolyte Temperature ˚F	Percent Capacity
77˚	100%
60˚	95%
50˚	91%
40˚	87%
30˚	81%

TROUBLESHOOTING

PROBLEM	PROBABLE CAUSE	REMEDY
Battery not performing as expected.	1. Battery is undersized 2. Battery not fully charged 3. Weak or defective cells 4. Grounds or shorts 5. Phantom loads in system 6. Battery is spent	1. Replace with a larger battery 2. Check charger and controller 3. Perform a load test 4. Clean battery and all connections in the system 5. Find and eliminate loads 6. Replace battery
Battery overheats on charge.	1. Improper equipment settings 2. Malfunction of charging equipment 3. Battery too deeply discharged 4. High resistance connection 5. Low electrolyte level 6. Battery room too warm 7. Weak or defective cells 8. Battery is spent	1. Adjust charging equipment 2. Verify charging equipment output 3. Limit discharge to 80% DOD 4. Check for hot connections 5. Water battery to correct level and allow to cool and recharge 6. Provide cooler battery room 7. Repair or replace battery 8. Replace battery
Battery overheats on discharge	1. Excessive load 2. Battery not full recharged 3. Battery over discharged 4. Battery room too warm	1. Reduce loads. Need larger battery 2. Let battery cool. Do a load test 3. Limit discharge to 80% DOD 4. Provide cooler battery room
Low electrolyte level	1. Lack of watering 2. Frequent overcharging 3. Spilled electrolyte 4. Cracked or broken jars	1. More care required 2. Adjust/check charging system 3. Add water, equalize and adjust specific gravity (contact dealer) 4. Replace jars
Unequal cell voltages	1. Overdischarging 2. Acid loss due to over-watering or spillage 3. Corroded or dirty tops 4. Grounds in battery 5. Impurities in electrolyte 6. Battery used infrequently 7. Weak or defective cells 8. Lack of equalize charges	1. Give equalize charge 2. Give equalize charge and adjust specific gravity 3. Neutralize and clean tops 4. Clean battery 5. Use only distilled water 6. Deep discharge and equalize 7. Repair or replace battery 8. Equalize more often
Unequal Specific Gravity	1. All of the above 2. Recently added water 3. Improper gravity adjustment after cell replacement	1. All of the above 2. Gassing will mix new water 3. Adjust specific gravity(see your dealer)

TROUBLESHOOTING

Model # (12 Volt)	Rated Amp Hrs @ 20 hr. Rate	Dimensions LxWxH in Inches @ 12 V	Weight in Lbs.*	Short Circuit Ratings Amps @ 104˚ F
6-85F-17S	845	38.25 x 6.94 x 25	666	9,600
6-85F-19S	950	38.25 x 7.69 x 25	738	10,800
6-85F-21S	1055	38.25 x 8.44 x 25	816	12,000
6-85F-23S	1160	38.25 x 9.19 x 25	888	13,300
6-85F-25S	1270	38.25 x 9.94 x 25	966	14,400
6-85F-27S	1375	38.25 x 10.69 x 25	1044	15,600
6-85F-29S	1482	38.25 x 11.44 x 25	1116	16,800
6-85F-31S	1585	38.25 x 12.19 x 25	1194	18,000
6-85F-33S	1690	38.25 X 12.94 x 25	1272	19,200

*Weights +/-5%

Warranty	10 years
Cycles to 80% DOD	2100 over 10 years
Battery Type	Flooded Lead-Acid
Positive Plate	Tetrafluoroethylene (Teflon®)/Lead Antimony)
Post-to-Cover Seal	Burned Post to Cover
Cell “Jar” Material	Injection Molded Polypropylene
Cell Cover Material	Polypropylene
Tray Material	Epoxy Coated Steel
Intercell Connectors	Lead Plated Copper Rated @ 700 Amps
Specific Gravity @ 77˚ F	1.285-1.275 Fully Charged 1.160 80% Discharged

Model # Breakdown

Example: 6-85F-17S

6 cells per Tray
85 amps per positive plate
F represents Powerline
17 plates total (8 pos. & 9 neg)
PV-1 Solar Battery

Photo is a 12-85F-13 battery.

MAINTENANCE

WEEKLY

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.
4. Inspect connections for corrosion (clean as needed).

MONTHLY

1. Record hydrometer readings of all cells (after the battery is fully charged).
2. Check water level (add as needed).
    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 more or *less* than the average, circle those readings and check for improvement at next monthly reading. If the low cells do not improve, the cells are in need of an equalize charge, specific gravity adjustment or internal inspection.
3. Record Amp/Hrs consumed.
4. Record battery temperature.
5. Clean battery with a damp cloth. (If battery tops are wet with acid use neutralizing agent with a clean paint brush, dry thoroughly.)
6. Equalize the battery (see Page 5).
7. Inspect connections for corrosion (clean as needed).

YEARLY

1. Torque all terminal bolts.

ENTERING DATA IN THE WEEKLY FORMS

It is essential that you label each cell for these records to aid in the operation of your battery. This form is designed to enter general battery information on a weekly basis and will, at a glance, show any abnormalities in the battery's health.

Select a pilot cell, this should be the cell with the lowest specific gravity after you do your initial charge after installation. It is suggested that the pilot be rotated annually to a different cell in the battery.

Step 1. Enter the date.
Step 2. Enter the pilot cells voltage.
Step 3. Enter the specific gravity of the pilot cell.
Step 4. Check your A/H meter and enter the amp/hrs reading.
Step 5. Enter the cell temperature.
Step 6. Enter a "W" if water has been added in the previous week. Enter an "E" if the battery has been equalized in the previous week. Enter a "C" if the battery was cleaned in the previous week.

ENTERING DATA IN THE MONTHLY FORMS

Once a month enter the specific gravity and cell volt ages of all cells in the appropriate columns. If your battery has more than 12 cells you can identify these cells as "AA, BB, CC" , etc.

WEEKLY

DATE	CELL VOLTAGE	SP. GR.	A/H USED	CELL TEMP.	W.E.C.

WEEKLY

DATE	CELL VOLTAGE	SP. GR.	A/H USED	CELL TEMP.	W.E.C.

WEEKLY

DATE	CELL VOLTAGE	SP. GR.	A/H USED	CELL TEMP.	W.E.C.

WEEKLY

DATE	CELL VOLTAGE	SP. GR.	A/H USED	CELL TEMP.	W.E.C.

WEEKLY

DATE	CELL VOLTAGE	SP. GR.	A/H USED	CELL TEMP.	W.E.C.

WEEKLY

DATE	CELL VOLTAGE	SP. GR.	A/H USED	CELL TEMP.	W.E.C.

WEEKLY

DATE	CELL VOLTAGE	SP. GR.	A/H USED	CELL TEMP.	W.E.C.

WEEKLY

DATE	CELL VOLTAGE	SP. GR.	A/H USED	CELL TEMP.	W.E.C.

WEEKLY

DATE	CELL VOLTAGE	SP. GR.	A/H USED	CELL TEMP.	W.E.C.

WEEKLY

DATE	CELL VOLTAGE	SP. GR.	A/H USED	CELL TEMP.	W.E.C.

WEEKLY

DATE	CELL VOLTAGE	SP. GR.	A/H USED	CELL TEMP.	W.E.C.

MONTHLY

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

MONTHLY

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

MONTHLY

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

MONTHLY

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

MONTHLY

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

MONTHLY

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

MONTHLY

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

MONTHLY

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

MONTHLY

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

MONTHLY

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

MONTHLY

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

MONTHLY

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		

CELL	SP. GR.	Cell Voltage
A		
B		
C		
D		
E		
F		
G		
H		
I		
K		
K		
L		