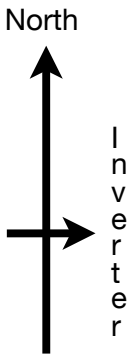
~~ battery specific gravity (3 cells) and temp (°F) ~~~~~~~~~~~~~~~~~~~~~~~~		
1	2	3
4	5	6
7	8	9
10	11	12
	13	14



measured average S.G			1.263								
1-12-2011 (measured at 7 to 8 p.m. after 60 minute equalization at 15.5V at 10% Ah of battery bank)											
1.260	1.265	1.265	40	1.265	1.265	1.265	36	1.262	1.265	1.265	38
1.265	1.265	1.266	37	1.255	1.260	1.260	36	1.265	1.262	1.265	38
1.264	1.263	1.258	38	1.261	1.260	1.264	36	1.265	1.260	1.265	37
1.262	1.265	1.265	39	1.265	1.265	1.265	38	1.263	1.265	1.260	40
				1.265	1.265	1.265	40	1.261	1.261	1.260	42
temperature corrected S.G.			1.246								
temperature corrected specific gravity from normal (post equalize) or 1.277 g/mL											
-0.001	0.004	0.004	-40	*0.006*	*0.006*	*0.006*	-44	0.002	0.005	0.005	-42
0.005	*0.005*	*0.006*	-43	-0.004	0.001	0.001	-44	0.005	0.002	0.005	-42
0.004	0.003	-0.002	-42	0.002	0.001	0.005	-44	*0.005*	0.000	*0.005*	-43
0.001	0.004	0.004	-41	0.005	0.005	0.005	-42	0.002	0.004	-0.001	-40
				0.004	0.004	0.004	-40	-0.001	-0.001	-0.002	-38

Equalize every 40 days of use (at least 2x/ year)

measured average S.G			1.268	batter monitor			96.3%				
7-30-2011 temperature corrected specific gravity from normal value											
1.266	1.267	1.268	82	1.270	1.269	1.270	82	1.270	1.270	1.270	82
1.270	1.269	1.269	82	1.266	1.268	1.266	82	1.270	1.270	1.270	82
1.267	1.269	1.267	82	1.269	1.268	1.270	83	1.270	1.270	1.270	83
1.267	1.269	1.268	81	1.270	1.267	1.269	83	1.267	1.267	1.265	82
				1.268	1.270	1.267	82	1.267	1.270	1.265	82
temperature corrected S.G.			1.269								
cells are auto-formatted to flag cells out of factory specifications											
-0.004	-0.003	-0.002	2	-0.000	-0.001	-0.000	2	-0.000	-0.000	-0.000	2
-0.000	-0.001	-0.001	2	-0.004	-0.002	-0.004	2	-0.000	-0.000	-0.000	2
-0.003	-0.001	-0.003	2	-0.001	-0.002	-0.000	3	-0.000	-0.000	-0.000	3
-0.003	-0.001	-0.002	1	-0.000	-0.003	-0.001	3	-0.003	-0.003	*-0.005*	2
				-0.002	-0.000	-0.003	2	-0.003	-0.000	*-0.005*	2

non-equalized specific gravity random sample data

date	SG	temp	V	W load	battery	cell
1-12-11	1.257	41	12.1	300	4	1
1-12-11	1.256	40	12.1	300	7	2
1-12-11	1.254	43	12.1	300	14	1
average	1.256	41.3				
standard	1.240	80				

precent charge		85%				
date	SG	temp	V	W load	battery	cell
1-12-11	1.220	35	11.9	300	4	1
1-12-11	1.220	36	11.9	300	7	2
1-12-11	1.215	36	11.9	300	14	1
average	1.218	35.7				
standard	1.201	80				

date	SG	temp	V	W load	battery	cell					SOC
11-17-11	1.180	42.0	11.8	-	4	2					
11-17-11	1.180	42.0	11.8	-	7	2					
11-17-11	1.180	42.0	11.8	-	8	3					
average	1.180	42.0									59%
standard	1.165	-0.004/-10°F									33%
battery monitor :		84%									

date	SG	temp	V (Victron)	V (Xantrex)	W load (Xantrex)	battery	cell		Amps (Victron)	Amps (Xantrex)	Ah used	SOC
12-20-11	1.210	39.0	-	-	-	2	2		-	-	-	
12-20-11	1.210	39.0	-	-	-	5	2		-	-	-	
12-20-11	1.210	39.0	-	-	-	8	2		-	-	-	
12-20-11	1.210	39.0	-	-	-	11	2		-	-	-	
12-20-11	1.210	39.0	-	-	-	13	2		-	-	-	
average	1.210	39.0	11.91	11.9	380-400				20.2	22	198	67%
standard	1.194	-0.004/-10°F										60%
battery monitor :		91.2%										

Analysis of previous two data collections and battery monitor accuracy:

16% / 67% = .24 ratio
8.8% / 40% = .22 ratio

Faceplate battery capacity is 1540 Ah @ 12V
Ratio indicates that capacity @ 40°F and under current conditions is 198 / .40 = 495 Ah
In other words, in winter we have 250Ah = 50% instead of 780Ah = 50% faceplate capacity

date 2:00 pm	SG	temp	V (Victron)	V (Xantrex)	W load (Xantrex)	battery	cell		Amps (Victron)	Amps (Xantrex)	Ah used	SOC
12-31-11	1.250	33.0	-	-	-	2	2		-	-	-	
12-31-11	1.250	33.0	-	-	-	5	2		-	-	-	
12-31-11	1.250	33.0	-	-	-	8	2		-	-	-	
12-31-11	1.250	33.0	-	-	-	11	2		-	-	-	
12-31-11	1.248	33.0	-	-	-	10	2		-	-	-	
average	1.250	33.0	12.12	-					12	-	28.3	92.0%
standard	1.231	-0.004/-10°F										77%

Equalization
MS 3000 Inverter/Charger presets as follows
72-74 amps
15.7-15.8 volts
60 minutes (6:22-7:22 pm)
4hr, 40min pre-charge at 14.7-14.8 volts / 30-35 amps initiated at 34 amp deficit according to BMV 600s battery monitor

date 7:30 pm	SG	temp	V (Victron)	V (Xantrex)	W load (Xantrex)	battery	cell		Amps (Victron)	Amps (Xantrex)	Ah used	SOC
12-31-11	1.262	44.0	-	-	-	2	2		-	-	-	
12-31-11	1.262	43.0	-	-	-	5	2		-	-	-	
12-31-11	1.261	43.0	-	-	-	8	2		-	-	-	
12-31-11	1.261	44.0	-	-	-	11	2		-	-	-	
12-31-11	1.260	43.0	-	-	-	10	2		-	-	-	
average	1.261	43.4		-								98.5%
standard	1.247	-0.004/-10°F										83%

Equalization

MS 3000 Inverter/Charger presets as follows

72-74 amps

15.7-15.8 volts

18 minutes (8:10 - 8:28 pm) - auto cut-off, well pump (soft start) may kicked on - should not have been enough to interrupt the equalize - wondering in Inverter auto-shut off due to over-voltage? No faults logged on System Panel

45min pre-charge at 14.7-14.8 volts / 30-35 amps initiated immediately after recording specific gravity above

date 8:45 pm	SG	temp	V (Victron)	V (Xantrex)	W load (Xantrex)	battery	cell		Amps (Victron)	Amps (Xantrex)	Ah used	SOC
12-31-11	1.265	45.0	-	-	-	2	2		-	-	-	
12-31-11	1.265	45.0	-	-	-	5	2		-	-	-	
12-31-11	1.263	46.0	-	-	-	8	2		-	-	-	
12-31-11	1.266	45.0	-	-	-	11	2		-	-	-	
12-31-11	1.262	45.0	-	-	-	10	2		-	-	-	
average	1.264	45.2		-								100%
standard	1.250	-0.004/-10°F										85%

Equalization

MS 3000 Inverter/Charger presets as follows

72-74 amps

15.7-15.8 volts

Pre-charge originally initiated, equalize would not initiate - failed two times over 30 minutes, no faults logged

Time Table for charging from MS3000

					Totals	
0 hours	4.370	1	0.67	0.3	6.34	total hours
0 amps	155	75	23	23	276	Ah charge current
1.229		1.247		1.250		specific gravity
77%		83%		85%		% based on standard s.g.

After reviewing charge pattern, it appears that the batteries ability to accept current diminished with time (time: 9:10 p.m.)

- batteries should be considered to be at “full charge”

Temperature correction states that +0.004 for each -10F from 80°F (standard)

Is this because the subsequent “corrected value” represents the current capacity of the batteries in the cold?

- uncorrected spec. gravity = 1.264 / 93%, corrected = 1.248 / 85%
- 85% is about correct for total system capacity at 0°C / 32°F
- cold solvent has a lowered capacity to hold solute
- cold liquid is more dense due to closer molecular packing

Battery Monitor Adjustments

1.17 amp draw for sidewalk and workbench LEDs on and motion sensor

2.36 amp draw when sidewalk, workbench, kitchen LEDs on and motion sensor

Ith set to 2.00 amps - current under/over threshold will not count against SOC

Battery Monitor Set Points:		
CEF	90%	charge efficiency factor
Ith	2 amps	current threshold
PC	1.25	Peukert exponent
Vc	15V	charged voltage
Cb	1500Ah	battery capacity
DF	50%	discharge floor

date 2:00 pm	SG	temp	V (Victron)	V (Xantrex)	W load (Xantrex)	battery	cell		Amps (Victron)	Amps (Xantrex)	Ah used	SOC
1-1-12	1.250	39.0	-	-	-	2	2		-	-	-	
1-1-12	1.250	41.0	-	-	-	5	2		-	-	-	
1-1-12	1.250	43.0	-	-	-	8	2		-	-	-	
1-1-12	1.250	42.0	-	-	-	11	2		-	-	-	
1-1-12	1.249	41.0	-	-	-	10	2		-	-	-	
average	1.250	41.2	12.20	12.2	293				15		112-118	93.5%
standard	1.234	-0.004/-10°F										78%

Why does +0.004/-10°F make sense for having temperature correction? and not the opposite as literature suggests
Why does +0.004/-10°F make sense for diminished battery capacity in the cold?

Battery Capacity at 45°F

112Ah/0.075	~ 1500 Ah = 15Ah/1%
-0.004/-10°F	if full = 85%, then 1/2 capacity will be 42.5% x 15Ah = 637.5Ah
+0.004/-10°F	if full = 100%, then 1/2 capacity will be 750Ah

Trend was repeated for two winters - lower spec. gravity in cold temperature that is

24h rest, voltage recorded = 12.5V, 117Ah from full

date 2:00 pm	SG	temp	V (Victron)	V (Xantrex)	W load (Xantrex)	battery	cell		Amps (Victron)	Amps (Xantrex)	Ah used	SOC
1-2-12	1.226	33.0	-	-	-	2	2		-	-	-	
1-2-12	1.226	35.0	-	-	-	5	2		-	-	-	
1-2-12	1.224	36.0	-	-	-	8	2		-	-	-	
1-2-12	1.225	37.0	-	-	-	11	2		-	-	-	
1-2-12	1.225	35.0	-	-	-	10	2		-	-	-	
average	1.225	35.2	11.94	12	294				18.4	18	214-217	82.0%
standard	1.207	-0.004/-10°F										65.5%

Battery Capacity at 35°F

215Ah/0.195	~ 1102 Ah = 11Ah/1%

1.153 = 42.5%
1.172 = 50%

date 9:55 am	SG	temp	V (Victron)	V (Xantrex)	W load (Xantrex)	battery	cell		Amps (Victron)	Amps (Xantrex)	Ah used	SOC
1-3-12	1.200	27.0	-	-	-	2	2		-	-	-	
1-3-12	1.198	30.0	-	-	-	5	2		-	-	-	
1-3-12	1.199	32.0	-	-	-	8	2		-	-	-	
1-3-12	1.201	33.0	-	-	-	11	2		-	-	-	
1-3-12	1.200	30.0	-	-	-	10	2		-	-	-	
average	1.200	30.4									308	70.5%
standard	1.180	-0.004/-10°F										53.0%

Victron BMV 600s / 33°F battery / 308Ah from full charge

11.80V	20.3A load	10:45pm
12.05V	1.25A load from LEDs	7:15am
12.12V	System @ Rest (no loads, LEDs off)	9:35am
12.10V	Load Sense on	9:55am

Battery Capacity at 35°F

308Ah/0.295 ~ 1044 Ah = 10.4Ah/1%

1.153 = 42.5%
1.172 = 50%

Summary of Winter Performance

+0.02V	adjustment for Load Sense
+0.07V	adjustment for LEDs on (not including kitchen LED)
+0.30V	adjustment for 20A load from AC appliances
522Ah	~ half battery capacity @ 0°C / 32°F for C50 rate
22A	end of Absorb charge current (Xantrex MS3000)
67.80%	faceplate battery capacity @ 0°C / 32°F
1044Ah	derate battery monitor 22.2% (from 1540Ah faceplate)

MS3000 charging at 102A (Vic), 13.92V (Vic), 32°F (Xantrex)

date 11:30am	SG	temp	V (Victron)	V (Xantrex)	W load (Xantrex)	battery	cell		Amps (Victron)	Amps (Xantrex)	Ah used	SOC
1-3-12	1.205	35.0	-	-	-	2	2		-	-	-	
1-3-12	1.205	35.0	-	-	-	5	2		-	-	-	
1-3-12	1.200	35.0	-	-	-	8	2		-	-	-	
1-3-12	1.205	35.0	-	-	-	11	2		-	-	-	
1-3-12	1.200	35.0	-	-	-	10	2		-	-	-	
average	1.203	35.0									197	71.0%
standard	1.185	-0.004/-10°F										55.5%

*battery monitor set to 90% charge efficiency; (308-197)/.90 = 123.3Ah
~ 123.3/1.5 = 82.2Ah/percent

date 12:30am	SG	temp	V (Victron)	V (Xantrex)	W load (Xantrex)	battery	cell	Amps (Victron)	Amps (Xantrex)	Ah used	SOC
1-3-12	1.212	38.0	-	-	-	2	2	-	-	-	
1-3-12	1.210	37.0	-	-	-	5	2	-	-	-	
1-3-12	1.205	38.0	-	-	-	8	2	-	-	-	
1-3-12	1.213	39.0	-	-	-	11	2	-	-	-	
1-3-12	1.210	37.0	-	-	-	12	1	-	-	-	
average	1.210	37.8								124	74.0%
standard	1.193	-0.004/-10°F									59.0%

*battery monitor set to 90% charge efficiency; (197-124)/.90 = 81.1Ah
~ 81.1/3.5 = 23.3Ah/percent