PowerSafe™ Planté

Installation, Operation & Maintenance Manual

EnerSys®
Power/Full Solutions

Publication No. EN-PL-IOM-002 - August 2007

Contents

Batteries are often the last lines of defence in providing electrical energy after failure of the mains supply. EnerSys® supplies three types of vented lead acid PowerSafe™ Planté cells described in this publication. All EnerSys Planté cells meet the requirements of BS EN 60896-11 and BS6290 Part 2.

This manual provides the user with information for optimising performance and service life.

The information contained in this manual should be read in conjunction with EN 50272 and BS 6133.

Reference should also be made to the appropriate Health & Safety Data Sheet, a copy of which is available upon request.

Warranties are only valid if the product has been installed, operated and maintained in accordance with these instructions.

1. Scope and Safety Warnings

Planté batteries are hazardous. Take note of the meanings of the following symbols and information.

(1) No Smoking

No smoking! No naked flames!

No sparks! Risk of explosion.

(2) Contains explosive gases

Risk of explosion and fire!

Avoid short circuits. Never place metal tools or other objects on batteries as they are always live.

(3) Shield eyes

Always wear safety glasses and protective clothing.

Comply with accident prevention regulations and your national Health and Safety standards.

(4) Note operating instructions

Observe instructions for use of the battery and ensure they are visibly prominent near the battery.

(5) Keep away from children

(6) Danger

Heavy weights! Take care when transporting, lifting and installing batteries.

(7) Electrical Hazard

Electrical Hazard!
Batteries are always live.

(8) Sulphuric Acid

Electrolyte is highly corrosive sulphuric acid!

Flush any acid splashes from eyes and off skin with plenty of clean water. Seek medical aid immediately.

Contaminated clothing should be washed in water with minimum delay.

(9) Recycle/Pb

Old batteries bearing this sign are recyclable.

Batteries not returned for recycling must be disposed of as special waste in accordance with national regulations.

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1.1 Risk analysis

The immediate risks are electrical energy, ignition of gases, sparks from short circuits, chemical burns from the electrolyte and handling.

Electrical Energy

- Electrical energy can be supplied from both batteries and charging equipment.
- Use acid resistant insulated tools and remove or insulate all metallic items worn about the person.
- Protect the eyes by wearing safety spectacles.
- Minimise the number of conductors exposed at any one time. Use temporary insulation if connectors are not insulated.
- On high voltage batteries break the battery down into sections of 60 cells or less, and never work alone.

Ignition of gases

- Prevent ignition of gases from the battery.
- Never permit smoking, sparks or any kind of flames near the battery.
- Isolate circuits before connection or disconnection of test loads or chargers.
- Ensure that ventilation maintains the concentration of hydrogen gas below the explosive threshold.

Chemical Burns

- Before starting work ensure that a supply of water, eye wash stations, and a first aid kit is available.
- The eyes and face should be protected.
- For general inspection and maintenance, boiler suit, eye protection, and rubber gloves should be worn.
- When filling a cell with electrolyte, a plastic apron and rubber boots should also be worn.
- In case of electrolyte burns, wash affected areas with lots of cold water. If electrolyte gets into eyes, rinse with eyewash.
- In all cases, seek immediate medical advice.

Handling

- Cells can be very heavy and awkward to handle.
- The terminal pillars should not be used to lift cells.
- Lifting devices should be designed such that they do not cause short circuits across the terminal pillars.

Electrolyte Spillage

- Electrolyte spills should be contained and neutralised. Sulphuric acid should not be allowed to enter the drains.

1.2 For the batteries' health and safety

A battery is normally the last line of defence against system failure and maintenance routines should reflect this.

- Ensure that the battery charging system is operating correctly.
- When topping up add only de-ionised water, never add any kind of sulphuric acid.
- Keep the battery clean, coat connectors with grease and ensure correct fastener tightness.
- Apply equalising charges as appropriate to maintain the correct state of charge.

1.3 Electromagnetic compatibility

- Rechargeable cells or batteries are not sensitive to normal electromagnetic disturbances and therefore no immunity tests are required.

2. Cell Identification

The cells are provided with the following identification: -

- The cell type (e.g. YAP13) together with MAX and MIN electrolyte level indication is included on the product label.
- Colour coded Positive (red) and Negative (blue) pillar rings identify month and year of manufacture.
- Cells supplied filled and charged have a barcode label giving individual cell serial number together with date of initial filling and charging.

3. Unpacking

All items should be carefully checked against the accompanying advice notes to determine if any are missing. They should be inspected for damage and, for cells supplied filled and charged, the terminal voltage measured to ensure that none are below 2.02 Volts per cell. If any are below this value, or if any items are missing, damaged or broken the Company should be notified at once.

It is normal for the electrolyte level of products supplied in a filled and charged condition to be a little below the maximum level. This occurs because gas bubbles created during initial charging are not always dispersed before dispatch but during transit. However, if on opening the package there is obvious indication of acid spillage, the affected cells should be topped up with dilute acid to the recommended electrolyte level, the cells should be inspected for transit damage and the fault reported to EnerSys®.

Product supplied filled and charged will have an electrolyte specific gravity below that for fully charged cells because of self-discharge occurring after initial factory charging.

4. Storage

If the battery is not to be used immediately, certain criteria must be observed for it to remain in good condition. Cells should be stored in a clean and dry environment with temperature as moderate as the climate will allow. Cells must not be stored in direct sunlight.

The maximum period for which the product can be stored depends on the condition in which it is supplied.

4.1 Storage times for cells supplied dry charged

Typical storage times are:-

- 12 months up to 20°C
- 6 months up to 30°C
- 3 months up to 40°C

These storage times are applicable to a relative humidity of 50%. Storage times are progressively reduced to half that stated at a relative humidity of 100%.

If the storage times and/or temperature limits are exceeded, the product may lose its dry charged characteristics and becomes described as time expired dry charged. Time expired dry charged cells have an indefinite storage time but require an extended commissioning charge that may be up to twice as long as that required for cells stored for those times stated.

4.2 Storage time for cells supplied filled and charged

Typical storage time is:-

- 3 months up to 20°C

The storage time is dependent on temperature and cells should be given a 'freshening' charge when the open circuit voltage falls below 2.02Vpc. Failure to undertake the appropriate freshening charges may result in permanent damage to the cells.

5. Installation Instructions

5.1 Installation of battery stands

- Assemble the battery stand in accordance with the instructions provided with the stand.
- Ensure that the stand is level and stable. Steel stands are provided with adjustable insulating feet.
- Where two or more stands are supplied, ensure that the runners of adjacent stands are adjusted to the same height.
- Ensure rubber-insulating strips are fitted to each runner.
- Fit stand-to-wall or floor fixing brackets as required.
- Ensure that all nuts and bolts are tight and capnuts fitted.

5.2 Installation of cells

- The cells must be carefully handled and must not be lifted by the terminals. Lifting or manoeuvring cells by the terminals will damage the pillar seal and/or lid to container seal and will lead to premature failure. Suitable lifting equipment should be used.
- If the battery has been supplied dry charged, it may be better to fill the cells with acid before putting them onto the stand. However, it must be remembered that filled cells present a greater hazard, and there is a maximum stand time of 24 hours between filling cells and charging.
- Before filling or installation, clean any deposits of oxide formed during storage from cell terminals and coat all exposed metal parts with the grease supplied. Extra care must be taken when cleaning the terminals of filled and charged cells to avoid accidental shorting.
- Clean each cell with a cotton cloth dampened with water. If necessary, a small amount of mild detergent may be added to remove any greasy film. Do not use solvents, paraffin or other similar cleaning agents and abrasives.
- Coat all exposed metal parts of terminal pillars and connectors with the grease provided.
- Carefully position each cell on the stand or in the cabinet avoiding unnecessary shock loading. Ensure that the cells sit firm and square on the stand runner or shelf.
- Determine the positive and negative battery take-off positions and commence assembly from either of these positions. For normal series connection, commencing from the positive end (cell number 1) ensure that the negative terminal is connected to the positive terminal of the next cell and so on through the battery.
- It is good practice to omit initially the occasional inter-cell connector and thus limit the battery voltage to safe levels whilst it is being worked on. Section 13 details the recommended positions and Section 5.5 gives further instructions for these batteries. These connections should only be fitted with the load isolated and when the rest of the installation is complete.
- Using an insulated torque spanner, tighten all fasteners to the value stated in Section 12. Exceeding the stated torque values may damage or break the screw threads, leading to an unsafe installation.
- Re-check all cells to ensure that they sit firm and square on the runner or shelf.
- The resistance between each connector or battery take-off and cell pillar, when measured using a micro-ohm meter, should be less than 25 micro-ohms.

5.3 Battery take-off connections

To prevent damage to the cell pillar seal, large unsupported cables must not be terminated directly onto the pillars.

Terminal take-off plates and transition boxes to suit all applications are available.

5.4 Insulation shrouds

When the terminal assembly is secure and liberally coated with the grease supplied, fit the insulating terminal shrouds.

5.5 Installation of high voltage batteries

A battery consisting of 60 or more cells connected in series presents additional hazards and the following notes on installation should be employed.

- Limit the battery voltage by omitting inter-cell connectors to give a maximum section voltage of 120V or 60 cells.
- The omitted inter-cell connectors should be chosen such that they are in an easily accessible position. These connectors should only be fitted with the load and charger isolated and when the rest of the installation is complete.
- Never work alone on high voltage batteries.
- Always use insulated tools and wear approved high voltage insulating gloves.
- When supplied, fit the "high voltage battery" warning labels in a prominent position.

6. Filling with Acid

- Where cells have been supplied dry charged, first clean and grease the pillars. This will protect the pillar if acid is spilled during the filling process.
- Pure, cool, sulphuric acid of 1.205 specific gravity (corrected to 15°C) complying with BS3031 or equivalent must be used for initial filling. If concentrated acid has been obtained it is essential for it to be diluted with de-ionised water, complying with BS4974 Grade A or equivalent, before being put in the cells. (Contact EnerSys® for further advice on acid mixing.)
- Fill to the MAX level and allow to stand for approximately 3 hours to allow the acid to soak into the separators and the plates. After this 3 hour stand period top up the cells with the same acid to the MAX level line.
- Commence the commissioning charge not more than 24 hours after filling the first cell. Failure to observe this procedure can result in a permanent loss of capacity or reduced battery life. Therefore, do not fill any cells without first ensuring that the charging equipment is functioning correctly and is capable of charging the complete battery. If the battery has to be split into sections for commission charging, only fill cells that can be fully commissioned at one time.

7. Commissioning Charge

The commissioning charge must be carried out at CONSTANT CURRENT, without voltage limit, at the recommended charge rate specified in Table 1.

The electrolyte temperature should not be allowed to exceed 52°C during the charge. If this temperature is reached the charge must be terminated. The charge should not be continued until the electrolyte temperature has reduced to 35°C.

Pilot cells should be chosen to be representative of a group of not more than 20 cells. During the commissioning charge, the specific gravity, voltage and temperature of the pilot cells should be recorded every hour. The specific gravity and voltage of all cells should be recorded every 3 hours and at the end of the charge.

During charging, the voltage will rise slowly up to about 2.30Vpc, followed by a more rapid increase up to about 2.70Vpc. This higher voltage indicates that the cells are approaching a fully charged condition.

Throughout the commission charge, the electrolyte level must be maintained between the MAX and MIN lines by adding de-ionised water. However, when cells are gassing freely at top of charge, electrolyte levels up to 5mm above the MAX line are permitted.

The commissioning charge is not complete until the specific gravity and voltage readings of each cell remain constant over three successive hourly readings and all cells are gassing freely.

When the battery is fully charged, the specific gravity of the electrolyte should be between 1.205 and 1.215 (corrected to 15°C) with the electrolyte at the MAX level. The cell voltages should typically be between 2.60 and 2.80 volts whilst still on charge.

It is recommended that specific gravity, temperature, current and voltage readings are entered on the Commissioning Charge record sheet provided.

Table 1

Cell Type	Capacity* (Ah)	Electrolyte Volume (litres)	Charge Rate (Amperes)
YAP 5	15	1.0	1
YAP 9	30	1.6	2
YAP13	45	2.8	3
YAP17	60	2.7	4
YAP21	75	3.2	5
YCP 9	100	4.5	7
YCP11	125	6.2	8.5
YCP13	150	5.9	10
YCP17	200	7.2	14
YCP21	250	8.6	17
YCP25	300	10.0	21
YCP27	325	13.7	23
YCP29	350	13.4	24
YCP33	400	12.8	28
YCP35	425	12.5	30
YHP11	500	27.1	35
YHP13	600	25.7	42
YHP15	700	38.1	49
YHP17	800	36.7	56
YHP19	900	35.4	63
YHP21	1000	44.8	70
YHP23	1100	43.5	77
YHP25	1200	56.1	84
YHP27	1300	54.8	91
YHP29	1400	53.5	98
YHP31	1500	66.6	105
YHP33	1600	65.2	112
YHP35	1700	63.9	119
YHP37	1800	76.8	126
YHP39	1900	75.5	133
YHP41	2000	74.1	140

**10 hour rate to 1.85Vpc at 15°C*

7.1 For cells supplied dry charged

- The charge should commence a minimum of 4 hours and maximum of 24 hours after filling the first cell.
- Actual commissioning charge time depends on the storage time, temperature, humidity and the charge current. Typically, new dry charged cells require a minimum of 20 hours charge. Time expired dry charged cells require an extended charge period that may be up to 2 times longer.

7.2 For cells supplied filled and charged

- Typically, new filled and charged cells will require a minimum of 8 hours charge.
- Under CONSTANT VOLTAGE commissioning charge conditions, 2.70Vpc is recommended. Should constraints limit the maximum voltage available, commissioning times will increase. 2.40Vpc is considered the minimum acceptable commissioning voltage for filled and charged cells.

8. General Charging Requirements

8.1 Trickle charge

Trickle charging is a method of keeping the cells in a fully charged condition by passing a small current through them. The correct trickle charge current is that which neither allows the cell to gas nor the gravity to fall over a period of time. It is in the region of 1mA per Ah of the 10 hour capacity for YAP cells, and 0.3 x capacity at the 10 hour rate + 70 (with the answer being in mA) for YCP and YHP cells. With this small current flowing, the cell voltage will be approximately 2.25V.

8.2 Float charge

Constant voltage float charging at 2.25 volts per cell will maintain full capacity with minimal water loss. Lower float voltage levels (minimum 2.15Vpc) may be used but must be complemented with regular equalising charges. Failure to undertake the appropriate equalising charges will effect both the performance and service life of the battery.

The charging system must be capable of providing a steady voltage within ±1%V and the current available must not be less than the value given in Table A. The maximum current need not be limited providing the cell voltage does not exceed 2.25V. However, it is recommended that the maximum charging current is limited to 10% of the 10-hour capacity when equalising or boost charging.

Charger output or load induced current ripple can cause permanent damage and a reduction in battery life. The RMS limit is 7% in Amperes of the 10-hour capacity over the frequency range 100 to 360Hz.

8.3 Recharge

An applied voltage of 2.25Vpc is sufficient to maintain a Planté battery in a fully charged condition but is only considered suitable for recharging when extended recharge times are acceptable. Furthermore, because the applied voltage is always less than the gassing voltage of the cells (2.30Vpc), recharging at 2.25Vpc will produce stratification of the electrolyte.

Stratification is the separation of the electrolyte into distinct layers of differing densities. This produces a higher specific gravity at the bottom of the cells than at the top resulting in gravity readings taken being misleading.

Stratification will eventually disappear (i.e. the electrolyte will be fully mixed) after a prolonged period of float charge at 2.25Vpc providing that further discharges have not taken place. Alternatively, by vigorously pumping the cell electrolyte in and out of a hydrometer, the electrolyte will mix more quickly enabling stabilised gravity readings to be obtained earlier. However, on a battery with a large number of cells this may prove to be impractical.

Repeated operations of emergency discharge (greater than 1 discharge per month to more than 30% of the battery capacity) with a limited voltage recharge at 2.25Vpc, may also lead to out of step conditions due to the lack of gassing charge. It is probable that the available capacity from the battery would tend to decrease after a number of such cycles.

Consequently, optimum recharging necessitates an increase in charging rate and is typically referred to as boost charging.

8.4 Boost charge

A boost charge is normally undertaken after an emergency discharge and restores the battery to full capacity in the optimum time.

Boost charging at CONSTANT CURRENT, without voltage limit, may be carried out at the rate specified in Table A. Under CONSTANT VOLTAGE conditions, the recommended boost charge voltage is 2.70Vpc with the charger output current limited to 10% of the 10 hour capacity. The minimum recommended value is 2.40Vpc; this will result in an extended recharge period as the battery will automatically limit the charge current irrespective of the charger output.

The boost charge is not complete until the specific gravity and voltage readings of each cell remain constant over three successive hourly readings and all cells are gassing freely.

8.5 Equalising charge

Batteries that have electrolyte specific gravity readings, corrected for temperature and electrolyte level, more than 10 points (0.010) below the fully charged value require an equalising charge.

Typically where the applied float voltage and/or recharge voltage is too low and stratification has occurred, an equalising charge should follow that procedure detailed in Section 8.4.

9. Adjustment of Specific Gravity

At the end of the commissioning charge, and with the electrolyte at the MAX level, the electrolyte specific gravity of all cells must be adjusted to 1.210±0.005 (corrected to 15°C).

The electrolyte specific gravity varies with temperature and readings from a hydrometer should be corrected to the reference temperature of 15°C as follows:-

- For each 1½°C above 15°C, add 1 point (0.001) to the specific gravity as read on the hydrometer
- For each 1½°C below 15°C, subtract 1 point (0.001) from the specific gravity as read on the hydrometer.

Eg. Hydrometer reading 1.199 at 27°C is corrected as follows: - [(27-15) ÷ 1.5] x 0.001 + 1.199 = 0.008 + 1.199 = 1.207

Generally, if any adjustment is needed it will be because the gravity is high. As a guide, first remove some electrolyte from the cell and refill to the MAX level with de-ionised water. For every 5ml of water added per litre of electrolyte in the cell, the gravity will be 1 point (0.001) lower. Further adjustment may be required after a short mixing charge at the standard charge rate given in Table A for 15 to 45 minutes.

It is unlikely that the specific gravity will be low. However, if it is determined that the cell is fully charged, strong acid must be added. Using the same principle as above, for every 6ml of 1.400sg acid added per litre of electrolyte in the cell, the final gravity will be 1 point (0.001) higher. If no strong acid is available, add filling-in acid instead of water during subsequent topping up until the gravity is within specification.

10. Battery Discharge Testing Procedure

Before any discharge test, it must be established that the battery is fully charged. A capacity test must be started no longer than 24 hours after completion of charge. Before the test, measure and record cell specific gravities and electrolyte temperature, cell float voltages, overall battery voltage and charging current. Check all connections are clean and check all torque values. The test should be carried out in general accordance with BS EN 60896-11. It should be noted that the battery temperature would affect its discharge performance.

11. Service Instructions

A standby battery is often the last line of defence in situations when the normal power supply is lost. Accordingly, service of the equipment must reflect the importance of having a backup battery. If, at any time, an abnormal condition is observed, make a note along with readings of voltage, specific gravity and temperature, then establish the cause of the abnormality and rectify it, without delay.

When topping up cells it is imperative that only de-ionised water complying with BS 4974 grade A is used. Also, it is recommended that cells be topped up before the level of electrolyte is allowed to fall to the minimum line, otherwise stratification may occur. If stratification is suspected, the battery should be given an equalising charge as detailed in Section 8.5 until the electrolyte is thoroughly mixed. Unless the cell is actually being topped up, the service vent must be fitted at all times.

11.1 Initial records

At the commissioning stage it is important to measure and record individual cell specific gravities, temperature and cell voltages. After completing the commissioning charge and immediately after reverting to normal operation, ensure that the battery charging voltage is within the recommended limits for the system and the float voltage is correct. Measure and record all cell voltages, pilot cell specific gravities and temperature, and charge current. A pilot cell is considered representative of the battery as a whole and several pilot cells should be chosen.

11.2 Monthly inspection

- Ensure that the battery charging voltage is within the recommended limits for the system and the float charge voltage is correct.

11.3 Three monthly service

- Ensure that the battery charging voltage is within the recommended limits for the system and the float charge voltage is correct.
- With the battery in its normal mode of operation measure and record all cell voltages, specific gravities and temperatures, and charging current.
- Check electrolyte levels and top up cells as required with de-ionised water.

11.4 Six Monthly Service

- With the charging system connected and the battery in its normal mode of operation, measure and record all cell specific gravities and temperatures, cell voltages and charging current.
- Check battery and cell connections for correct torque tightness as detailed in Section 12.
- Check and top up all cells as required with de-ionised water.
- Keep connectors and terminals clean and well coated with grease to prevent corrosion.
- Carry out a thorough visual inspection of the battery and record any abnormalities. Establish the cause of the abnormality and correct.

11.5 Extended period servicing

When the monthly checks have shown that the battery and charging system are operating correctly, the interval between these checks can be extended to three months. However, this should not be done for the first six months.

Similarly, the normal three monthly services may be extended to six months and the six monthly services to annual, providing the battery has been operating satisfactorily.

11.6 Cell cleanliness

Ensure that the cells are at all times clean and dry. Any water or acid spillage should be cleaned up immediately. Clean each cell with a cotton cloth dampened with water. If necessary, a small amount of mild detergent may be added to remove any greasy film. Do not use solvents, paraffin or other similar cleaning agents and abrasives.

12. Torque Settings

Ensure that at installation and at each six monthly service the cell connector torque is as detailed in Table 2.

Table 2

Type	Torque Nm
YAP	5.0 ± 0.5
YCP	11.0 ± 1.0
YHP	11.0 ± 1.0

13. Isolation Connectors for High Voltage Batteries

Section 5.5, Installation of high voltage batteries explains the additional hazard and appropriate precautions that must be employed when working on batteries greater than 120V or 60 cells. During installation, isolating connectors are omitted and should only be fitted after all other work on the battery has been completed.

Similarly, before any other work is performed, it is essential that the isolating connectors be removed to ensure the battery is broken into sections of less than 120V or 60 cells. The exact position of each isolating connector is not critical but the maximum number of units in each section should not exceed 60 cells; suggested positions are detailed in Table 3.

When supplied, fit the isolation link labels and the "high voltage battery" warning labels in a prominent position.

Table 3

No. of Cells	No. of Sections	Section 1	Section 2	Section 3	Section 4
1-24	1				
25-99	2	49-50			
100-119	3	35-40	75-80		
120-129	3	40-45	80-85		
130-139	3	45-50	85-90		
140-149	4	30-35	70-75	105-115	
150-159	4	35-40	75-80	115-120	
160-169	4	40-45	80-85	120-125	
170-179	4	40-45	85-95	130-135	
180-189	4	45-50	90-95	135-145	
190-199	5	35-40	75-80	115-120	155-160
200-209	5	40-45	80-85	120-125	160-165
210-219	5	40-45	85-90	130-135	170-175
220-229	5	45-50	90-95	135-140	180-185
230-240	5	45-50	90-95	140-145	190-195

14. Diagnosis of Battery Condition

The following notes enable an easy assessment of the state of charge and general condition of the cells to be made.

The following indicate a cell in a healthy charged condition:

- Specific gravities all within 1.205 to 1.215 corrected for temperature.
- Float voltage correct.
- Positive plates - dark brown colour.
- Negative plates - metallic slate grey colour.
- Gassing from cells when switched to boost charge.

14.1 Fault diagnosis

Characteristics of an undercharged battery	Characteristics of an over charged battery
Specific gravities low and irregular	Specific gravities high
Cell float voltages low or irregular	Float voltages high or low
Positive plates light brown colour	Excess gassing on float charge
Negative plates non-metallic dark grey colour	Low electrolyte levels
Boost charge voltage is low	Excessive deposits of sediment in the base of cell container.
No gassing when the system is switched to boost charge	Shedding of positive plate active material
Both positive and negative plates speckled	Spongy deposit on negative plates
	Expansion and distortion of positive plates
	Excessive water consumption

An undercharged battery is caused by:	An overcharged battery results from:
Charge voltages and/or currents too low	Excessive periods of boost charge
Insufficient equalising charges (current or duration)	Too high charging rate
	Float voltage settings too high

If there is evidence of undercharging or overcharging, adjust the charge rates and if necessary consult EnerSys® for further advice.

Appendix 1

Commissioning and boost charge record sheet

This record sheet must be completed during commission and boost charging.

Battery Title :	
Battery Type :	
Installed At :	Date Installed :
Charge current (see Table 1) :	A

	Time =			Time =			Time =			Time =		
	Amps =			Amps =			Amps =			Amps =		
Cell No.	Volts V	Specific Gravity	Electrolyte Temp °C	Volts V	Specific Gravity	Electrolyte Temp °C	Volts V	Specific Gravity	Electrolyte Temp °C	Volts V	Specific Gravity	Electrolyte Temp °C

Comments :	

Engineer's Name :	Date :

Appendix 2

Service record sheet

This record sheet must be completed during service and maintenance operations.

Battery Title :	
Battery Type :	
Installed At :	Date Installed :

Battery Float Voltage (V) :	Battery Boost Voltage (V) :
Battery Charging Current (A) :	Electrolyte Temperature (°C) :

Cell No.	Volts V	Specific Gravity	Cell No.	Volts V	Specific Gravity	Cell No.	Volts V	Specific Gravity	Cell No.	Volts V	Specific Gravity	Cell No.	Volts V	Specific Gravity	Cell No.	Volts V	Specific Gravity
1			41			81			121			161			201		
2			42			82			122			162			202		
3			43			83			123			163			203		
4			44			84			124			164			204		
5			45			85			125			165			205		
6			46			86			126			166			206		
7			47			87			127			167			207		
8			48			88			128			168			208		
9			49			89			129			169			209		
10			50			90			130			170			210		
11			51			91			131			171			211		
12			52			92			132			172			212		
13			53			93			133			173			213		
14			54			94			134			174			214		
15			55			95			135			175			215		
16			56			96			136			176			216		
17			57			97			137			177			217		
18			58			98			138			178			218		
19			59			99			139			179			219		
20			60			100			140			180			220		
21			61			101			141			181			221		
22			62			102			142			182			222		
23			63			103			143			183			223		
24			64			104			144			184			224		
25			65			105			145			185			225		
26			66			106			146			186			226		
27			67			107			147			187			227		
28			68			108			148			188			228		
29			69			109			149			189			229		
30			70			110			150			190			230		
31			71			111			151			191			231		
32			72			112			152			192			232		
33			73			113			153			193			233		
34			74			114			154			194			234		
35			75			115			155			195			235		
36			76			116			156			196			236		
37			77			117			157			197			237		
38			78			118			158			198			238		
39			79			119			159			199			239		
40			80			120			160			200			240		

Comments (Report any weak cells and detail attention given) :

Engineer's Name :	Date of Service :

Notes :

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