

# Maintenance Manual

For

## Hawker Valve Regulated Sealed Lead Acid Aircraft Batteries



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# Record of Revisions

<b>Revision Number</b>	<b>Description of Changes</b>	<b>Date</b>	<b>Approval</b>
0	New Document – Original Issue	10/20/00	Don Nissanka
1	Document update – amended CC Charge currents	07/12/01	Robert Griffiths
2	Amended ratings for 37Ah battery to 40Ah	01/10/02	Robert Griffiths
3	Addition of Maintenance Interval Guidelines	10/20/04	Robert Griffiths

NOTE: The most recent revision of this manual can be obtained by going to <http://www.enersys.com> or by calling Enersys Energy Products Inc (Hawker) direct.

## **SCOPE**

### **PARTS MANUFACTURER APPROVAL N°. PQ3810CE**

Maintenance of Hawker Sealed Lead Acid, Valve Regulated, Recombinant, Batteries in Aircraft Manufactured under Type Certificates:

**See PMA List (available on website)**

**Note: Please contact EnerSys (Hawker) Customer Service for the most recent PMA listing.**

# Maintenance Procedure

## 1. Scope

This manual covers the maintenance of aircraft batteries manufactured by EnerSys Energy Products Inc, formerly Hawker Energy Products Inc.

## 2. Introduction

- 2.1 Hawker lead acid batteries are sealed and are designed as valve regulated recombinant systems. As a result, the battery can be oriented and operated in any attitude or position without spillage of electrolyte under fully aerobatic conditions.
- 2.2 The battery is maintenance free with respect to electrolyte replenishment. Under no circumstances should any attempt be made to introduce any substances, e.g. acid, distilled water or alkali, to the battery.

## 3. Battery Description

- 3.1 Hawker 24V aircraft batteries covered by this maintenance manual consist of two 12V sealed monoblocs wired in series, enclosed in a polyester bonded fiber glass or metal case, which incorporates the battery main terminal connector.
- 3.2 All 12V batteries are completely sealed and are manufactured using a thin plate configuration making up six 2V cells internally. The 2V cells are not replaceable.
- 3.3 Thin fiberglass separators inter-space the positive and negative plates. The tightly packed plates and separator form a compressed and rugged construction, which enhances the battery's resilience to vibration.
- 3.4 The thin plates are adopted to give high performance engine start capability, which provides in excess of 50C<sub>1</sub> amps at normal temperature, without compromising the endurance of the battery under emergency load conditions.
- 3.5 The cells within the monoblocs are inter-connected by through the wall weld connections.

## 4. Specifications

### 4.1 Capacity

The capacity of Hawker sealed lead acid aircraft batteries are stated in ampere-hours at the 1-hour rate e.g. an 18Ah battery will provide an 18-ampere discharge for 1 hour.

**NOTE: Unless otherwise directed by the aircraft manufacturer, 80% of rated capacity is normally the minimum requirement for flight.**

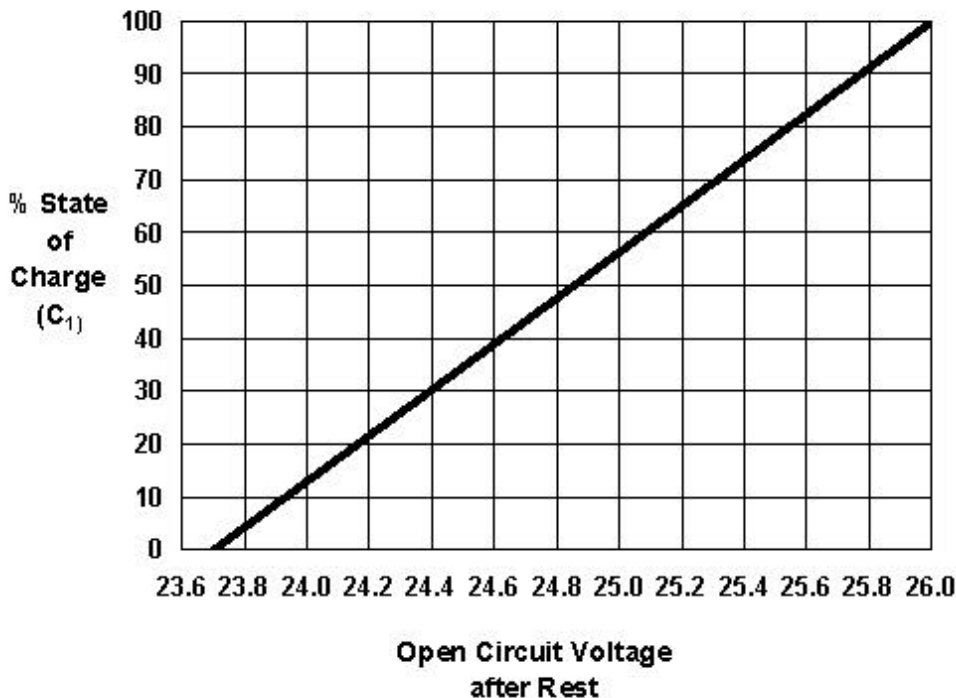
### 4.2 Temperature Effects

The ideal ambient temperature for battery operation is 23 to 25°C. Long term exposure to temperature above 30°C will shorten the life of the battery.

As the temperature falls the availability of capacity of the battery is reduced, which obviously causes a reduction in performance. However, this is not a permanent condition and the capacity will be restored as the temperature rises. Long term exposure to low temperature will not damage the battery.

### 4.3 State of Charge

The open circuit voltage of the battery can be used as a guide to the state of charge of the battery. The graph below shows the relationship between open-circuit voltage after four hours stand and the state of charge.



Note that state of charge is not the same as available capacity. A battery at end-of-life and fully charged will show an OCV of 26.0V approximately but have an available capacity of 80% of rated capacity.

## 5. Storage

It is recommended that the fully charged battery should be stored in a cool dry place, ideally below 25°C. The battery charge retention will be reduced and possible performance degradation will occur if subjected to long term exposure well in excess of this temperature.

The battery has a maximum inspection free storage life of 2 years, if stored at or below 20°C, after which a boost charge should be administered in accordance with para 7.2.

However, it is advisable to conduct an inspection and open circuit voltage check after 12 months and boost charge in accordance with para 7.2 if necessary.

The battery may be stored up to 5 years without degradation of performance provided that an inspection and open circuit voltage check is conducted every 12 months. If stored in temperatures in excess of 25°C the battery should be inspected every 6 months, and boost charged in accordance with para 7.2 should the open circuit voltage fall below 25.2 volts.

Should the batteries be returned to storage following in-service use, they must be fully recharged and if possible packed in original packaging.

## 6. Condition of Batteries on Receipt /Acceptance Checks

All batteries are dispatched from the manufacturing plant in a fully charged condition, the date of the latest charge being marked on the outer packaging and on the battery instruction label. The only acceptance check required immediately upon receipt is to look for signs of damage in transit. Unpacking and detailed examination is unnecessary and should be left until the battery is removed from storage.

The battery labels show:

- a. Type of battery (i.e. lead acid – aerobic)
- b. Manufacturer's name
- c. Product number
- d. Serial number
- e. Manufacturing date code
- f. Terminal polarity
- g. Normal battery voltage
- h. Rated capacity
- i. Safety instructions
- j. Disposal instruction

## 7. Commissioning Procedure & Initial Testing after Storage

(Refer to Battery Commissioning Flowchart Appendix C)

### SAFETY NOTES:

- a. Short circuit current will exceed 2000 amps; all tools must be insulated. Care must be taken with all items of metal in clothing and jewelry, e.g. buckles, zips, rings, watches, chains, etc.
- b. Always ensure that the battery lid is securely fitted prior to charging.
- c. A dedicated lead acid charging room is not required for servicing. A normal electrical workshop may be used and under certain conditions the battery can be serviced in a nickel cadmium battery room.
- d. Use a Fluke Digital Voltmeter Series 70, or equivalent, to carry out Open Circuit Voltage (OCV) checks.
- e. All discharges must be performed at the rates detailed at Table 2. Discharges should be discontinued as soon as a duration of 48 minutes or end point of 20 (10v) volts is achieved. This prevents excessive working of the battery and prolongs its life.
- f. Nuts are **NOT** to be re-tightened except when monoblocs are replaced, and then only calibrated torque spanners are to be used set to 35 inch pounds (3.9 Nm).

### 7.1 Visual Inspection

Visually inspect the exterior of the battery casing for signs of damage and cracks. Examine the battery terminal and heater connector, if fitted, for signs of damage, corrosion, and water/dirt ingress; clean if necessary.

### 7.2 Voltage Checks/Boost charge

**(Note that all 12V battery testing requirements are in Parenthesis)**

If OCV is in excess of or equal to 25.5 (12.75) volts, the capacity is at least 80% and the battery can be fitted to the aircraft.

7.2.1 If the OCV is above or equal to 25.3 (12.65) volts but below 25.5 (12.75) volts,

- a. Charge for 4 hours at the current rate shown in Table 1. The battery can then be fitted to the aircraft.
- OR**
- b. Charge at constant voltage as per para 7.2.2.b.

7.2.2 If the OCV is less than 25.3 (12.65) volts:

**EITHER**

- a) (i) Charge the battery for 6 hours at the current rate shown in Table 1. Stand the battery for a minimum of 16-24 hours then
- (ii) Carry out a capacity test at the discharge rate shown in Table 2 to an end point of 20.0 (10.0) volts or 48 minutes duration, which ever is achieved first.

Measure and record OCV prior to commencing discharge (refer to para 16)

**TABLE 1**

<b>Charge Current</b>	<b>Battery Rating</b>
1.0 Amps	13 Ampere-hour
1.4 Amps	18 Ampere-hour
1.8 Amps	22 Ampere-hour
2.0 Amps	25 Ampere-hour
3.0 Amps	40 Ampere-hour

**TABLE 2**

<b>Discharge Current</b>	<b>Battery Rating</b>
13 Amps	13 Ampere-hour
18 Amps	18 Ampere-hour
22 Amps	22 Ampere-hour
25 Amps	25 Ampere-hour
40 Amps	40 Ampere-hour

**OR**

- b) (i) Charge at a constant voltage 29(14.5) volts, with a charger with a minimum current capability of 10 amps for:

- 4 hours for 13 Ampere-hour battery
- 4 hours for 18 Ampere-hour battery
- 5 hours for 22 Ampere-hour battery
- 6 hours for 25 Ampere-hour battery
- 8 hours for 40 Ampere-hour battery

Stand the battery for a minimum for 4 hours then

- (ii) Carry out a capacity test at the discharge rate shown in Table 2 to an end point of 20.0 (10.0) volts or 48 minutes duration, which ever is achieved first.

7.2.3 If the discharge duration is at least 48 minutes, continue with para 7.2.4 otherwise carry out procedure detailed in para 7.2.5.

7.2.4 For discharge duration equal to 48 minutes, record the capacity and date of test on the battery label. Recharge in accordance with para 9, ensure the battery is clean and issue for service.

7.2.5 If discharge duration is less than 48 minutes, recharge the battery as detailed in para 9.

- 7.2.6 It is recommended to stand the battery on open circuit for 16 to 24 hours, however a 4-hour minimum stand is sufficient to conduct the test.
- 7.2.7 Conduct a further discharge test, as described in para 7.2.2. Table 2.
- 7.2.8 If the discharge duration is now in excess of 48 minutes; prepare for issue as para 7.2.4.
- 7.2.9 If the discharge duration is still below 48 minutes battery should be charged and rejected in accordance with para 8.0 of this maintenance manual.

**NOTE:**

**A total of 2 discharge tests may be carried out to achieve a duration in excess of 48 minutes.**

## **8. Rejection Procedure**

If the battery fails to attain 48 minutes duration after 2 discharge tests, it should be rejected and notification of failure sent to the manufacturer if the battery is still under warranty or has failed under suspicious circumstances.

The battery should be held until called for inspection by the manufacturer.

## 9. Charging Procedure

(Note that all 12V battery testing requirements are in Parenthesis)

**NOTE: Charging should be conducted in an environment between 20°C and 30°C. The battery capacity may vary if charged outside of this recommended temperature range.**

Charging the batteries can be either constant current or constant voltage depending on the charging equipment available.

**NOTE: The manufacturers preferred method of charging is constant voltage.**

### 9.1 Constant Current Charging

CONSTANT CURRENT CHARGERS MUST BE CAPABLE OF APPLYING A VOLTAGE IN EXCESS OF 40 VOLTS.

#### **NOTE: Monitoring of Battery Voltage During Constant Current Charging**

Record OCV prior to commencement of battery charge (refer to para 16). After 30 minutes of charge measure and record battery on charge voltage. If the on charge voltage is greater than 29 (14.5) volts and the OCV at the start was less than or equal to 25 (12.5) volts, STOP the charge and reject the battery.

Charge for 13 hours at:

- 1.0 amps for 13 Ampere-hour battery
- 1.4 amps for 18 Ampere-hour battery
- 1.8 amps for 22 Ampere-hour battery
- 2.0 amps for 25 Ampere-hour battery
- 3.0 amps for 40 Ampere-hour battery

**NOTE: Before the voltage stabilizes at around 31 (15.5) volts it may rise as high as 35 (17.5) volts as the gas recombination process starts. This occurrence is normal and will not degrade the battery.**

### 9.2 Constant Voltage Charging 29 (14.5) Volts

CONSTANT VOLTAGE CHARGERS MUST BE CAPABLE OF SUPPLYING A MINIMUM OF 10 AMPS.

The higher the available current the faster the battery will recharge; typical durations are shown below:

Battery Capacity	Charge Duration		
	@10A	@20A	@30A and above
13 Ampere-hour	4 hours	2 hours	1 hour
18 Ampere-hour	4 hours	3 hours	2 hours
22 Ampere-hour	6 hours	5 hours	2 hours
25 Ampere-hour	6 hours	5 hours	4 hours
40 Ampere-hour	8 hours	7 hours	6 hours

## 10. Routine Maintenance

(Refer to Battery Maintenance Flowchart Appendix D)

### 10.1 Service Period

The table below shows the recommended battery maintenance intervals, and their tolerances, for Hawker Sealed Lead Acid Batteries. Depending on the type of aircraft the battery is installed on, this first check will be performed at either 12 months or 18 months. Refer to the table for schedule. The applicability column indicates which aircraft must have its battery capacity checked at 12 months, and which aircraft at 18 months.

If the Off-Aircraft Battery Capacity Check shows remaining capacity is greater than 90%, the next check should be at 180 days or 1500 operating hours, whichever occurs first.

If the Off-Aircraft Battery Capacity Check shows between 81% and 90% capacity remaining, then the next check should be after 90 days or 750 operating hours (whichever occurs first).

If the Off-Aircraft Battery Capacity Check shows 80% or less, remove the battery from service.

**Table. Maintenance Intervals**

Off-Aircraft Capacity Checks	Applicability	Compliance Schedule
<b>12 Month</b> Initial Check	Saab 340, Jetstream 41 Aircraft, Bell 206 Helicopters	At 365 days $\pm$ 30 days, or 3000 hours $\pm$ 300 hours (whichever comes first), after the installation of a new battery.
<b>18 Month</b> Initial Check	All aircraft/helicopters not identified under the 12 Month Initial Check	At 548 days $\pm$ 45 days, or 4500 hours $\pm$ 450 hours (whichever comes first), after the installation of a new battery.
<b>6 Month</b> Check Interval (extension, after the initial check)	All Aircraft	When measured capacity is greater than 90% of new capacity, the next capacity check shall be at 180 days $\pm$ 15 days, or 1500 hrs $\pm$ 100 hour intervals following the initial battery check.
<b>3 Month</b> Check Interval (extension, after the initial check)	All Aircraft	When measured capacity is between 81% and 90% of new capacity, the next capacity check shall be at 90 days $\pm$ 10 days, or 750 hrs $\pm$ 50 hour intervals following the initial battery check.

**N.B.** The above intervals are a guideline only to recommended servicing intervals. You can derive a user / application specific servicing interval using the above method once you have obtained accurate information via the capacity checks.

## 10.2 Residual Capacity Test

**NOTE: Always ensure that the battery lid is securely fitted prior to charging. (where applicable)**

10.2.1 Visually inspect the exterior of the battery casing for signs of damage and cracks. Measure and record OCV (refer to para 16).

10.2.2 Discharge the battery at the following rate:

Discharge Current	Battery Rating
13 Amps	13 Ampere-hour battery
18 Amps	18 Ampere-hour battery
22 Amps	22 Ampere-hour battery
25 Amps	25 Ampere-hour battery
40 Amps	40 Ampere-hour battery

Discharge to an end voltage of 20 (10) volts or 48 minutes whichever is achieved first. Record the terminal voltage at the end of the discharge.

**NOTE: Discharge duration should not be allowed to exceed 48 minutes.**

10.2.3 If a discharge duration of 48 minutes is achieved, recharge the battery as detailed in para 9.0 of this manual. Record the test result on the battery label and return to service.

10.2.4 If the discharge duration is less than 48 minutes perform an additional capacity test as detailed in para 7.2.2.

10.2.5 If this second discharge duration is still below 48 minutes the battery should be rejected in accordance with para 8.0 of this manual.

## 11. Deep Discharge Recovery

**(Note that all 12V battery testing requirements are in Parenthesis)**

If the battery is heavily discharged, recognized by an OCV of less than 20 (10) volts and usually due to a low current drain, it is said to be in a deeply discharged state. The Hawker battery should recover from deep discharge using the recommended charging regimes at para 9.

Stand battery on open circuit for 16 to 24 hours after Constant Current charge or 4 hours following Constant Potential charge.

It is strongly recommended that deep discharging of batteries is prevented or kept to a minimum.

## **12. Unscheduled Removal From Aircraft** (Note that all 12V battery testing requirements are in Parenthesis)

In normal service the battery should not need to be removed from aircraft between service intervals.

If however, a battery is inadvertently discharged it should be removed to the battery room for residual capacity test and recharged as detailed at para 9.0.

Once re-installed in the aircraft, before start up the battery open circuit voltage should be checked to ensure it is greater than 25.5 (12.75) volts.

## **13. Transportation**

Hawker aircraft batteries are classified as Non-spillable and exempt from hazardous goods regulations in accordance with :-

- 1) US Dept of Transportation - 49 CFR Section 173.159 para d.
- 2) ICAO / IATA Packing Instruction 806, Special Provision A67.
- 3) IMDG Class 8, UN ID 2800 exemption for Non-Spillable batteries.

when securely packed and protected against short circuits.

## **14. Spare Parts for 24 Volt Batteries**

The battery consists of a plastic outer case with a removable lid and two 12V monoblocs.

The 12V monoblocs must be replaced in pairs supplied by the manufacturer. Lock nuts and internal battery connectors are supplied as part of the re-blocking kit and must be replaced simultaneously.

Re-blocking kits can be purchased from Hawker, and can be installed by the purchaser (refer to para 15) or their appointed distributor.

See Appendix A for re-blocking kit details.

## **15. Re-blocking Procedure for 24 Volt Batteries** (Refer to Re-blocking Schematic for 24V Battery Appendix A)

When re-blocking a battery ensure that the correct re-blocking kit is used i.e. denoted by Ampere-hour rating and correct part number.

Follow the instructions below carefully:

- a. Ensure that all parts of the re-blocking kit are present.
- b. Remove the battery case lid by removal of the 4 lid hold down screws.

- c. Remove the nuts, washers and metal strip laminations from the monoblocs rear terminal posts. Discard the nuts, washer and laminations.
- d. Remove the nuts and washers from the front terminal post and lift off the laminations. Discard the removed nuts and washers.

**NOTE: Do not remove the front laminations from the main battery connectors.**

- e. Remove the expended monoblocs and replace with the new monoblocs.
- f. Reconnect the front laminations using nuts and washers provided in the re-blocking kit and torque tighten the terminal nuts to 35 inch pounds (3.9 Nm).

**NOTE: Over tightening the terminal nuts may result in fracturing of terminal posts.**

- g. Connect the rear laminations across the back two terminal posts of the monoblocs using the nuts and washers provided in the re-blocking kit. Torque tight the terminal nuts to 35 inch pounds (3.9 Nm).
- h. Replace battery case lid. Finger tighten all four lid screws prior to torque tightening to 10 inch pounds (1.1 Nm).

**NOTE: Over tightening of the lid screws will cause cracking of the battery case around the screw location holes.**

- i. Record the serial number and installation date of the re-blocking kit in the Capacity field of the battery label Servicing Record block.

**NOTE: Any future warranty claim against this re-blocking kit may be invalidated if this action is not carried out.**

- j. Amend any Master Record Index incorporated the new information of para 16.
- k. Commission battery in accordance with para 7.

## 16. Master Record Index

A master record index must be kept for each individual battery.

This index should show:

- i) Battery part number and serial number
- ii) Date of receipt from manufacturer
- iii) Date of commission
- iv) Date of installation on aircraft
- v) Date and results of periodic routine maintenance or unscheduled maintenance
- vi) Date of battery returned to storage
- vii) Date of any failure
- viii) Date of any returns to manufacturer
- ix) OCV prior to any discharge
- x) Serial number of Re-blocking Kit
- xi) Date of re-blocking

The record index will provide an indication as to the status of the battery, its life in service and is essential for warranty claim investigation.

## 17. Disposal

Dispose of in accordance with local regulations for lead acid batteries. If in doubt contact

Energys Energy Products Inc.  
617 N. Ridgeview Drive  
Warrensburg, MO 64093  
USA

Energys Ltd.  
Stephenson Street  
Newport, Gwent  
UK

Tel. (800) 964-2837  
Fax (800) 283-2948

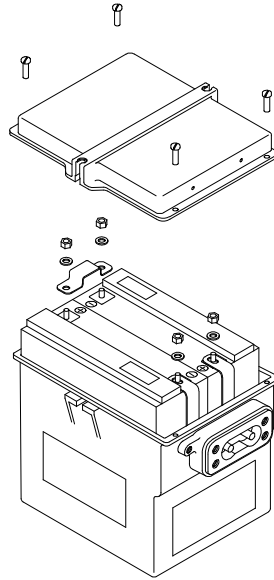
Tel. +44 1633 277673  
Fax +44 1633 281787

A control of Substances Hazardous to Health statement and Material Safety Data Sheet are available from Energys (Hawker) on request.

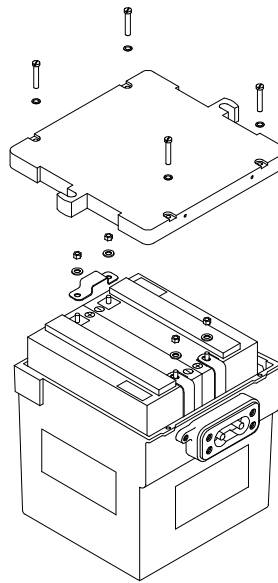
# APPENDIX A

## Re-Blocking Schematic for 24-Volts Battery

24Volt 25 Ah Battery – Use Hawker Re-block Kit 9250-0083



24Volt 40Ah Battery – Use Hawker Re-block Kit 9250-0137



## APPENDIX B Installation Schematic for 12-Volt Battery

### Terminal Kit - Installation Instructions

#### Parts List (2 each of items below)

- 90° Battery Terminal
- M6 Lock Washer
- M6 Machine Screw
- Insulation Cap
- Spacer

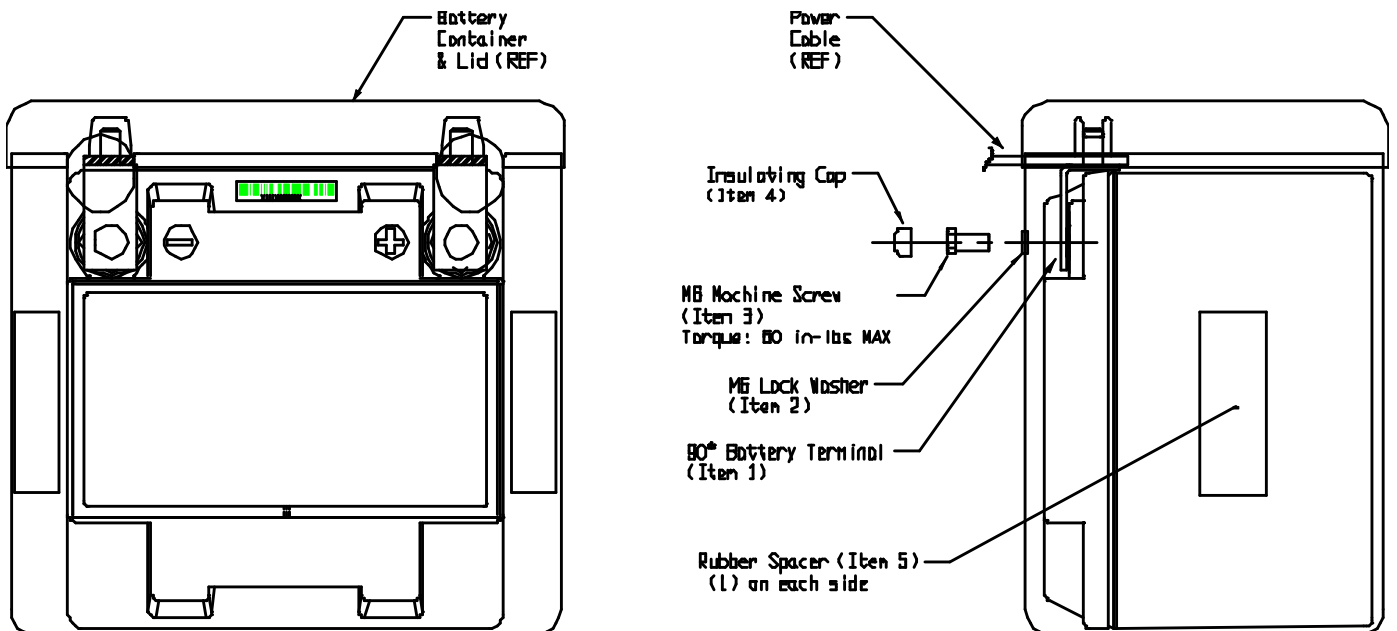
**Step 1** - Install items 1 through 3 as shown in figure 1.

**Step 2** - Attach insulation caps onto head of machine screws.

**Step 3** - Install spacers as shown on figure 1.

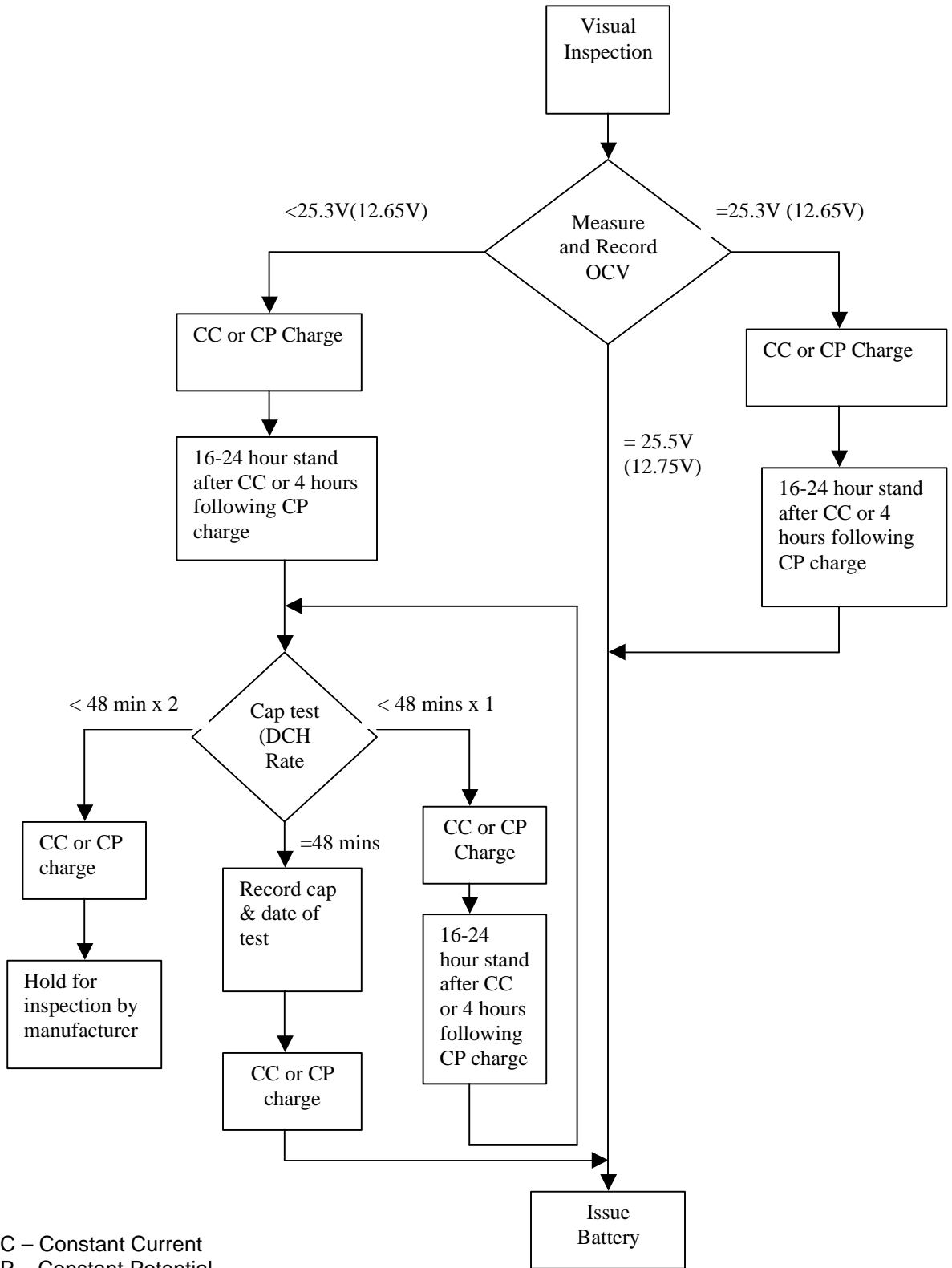
**Step 4** - Carefully insert battery into container and re-attach power cables to terminal studs.

**Step 5** - Replace container lid.

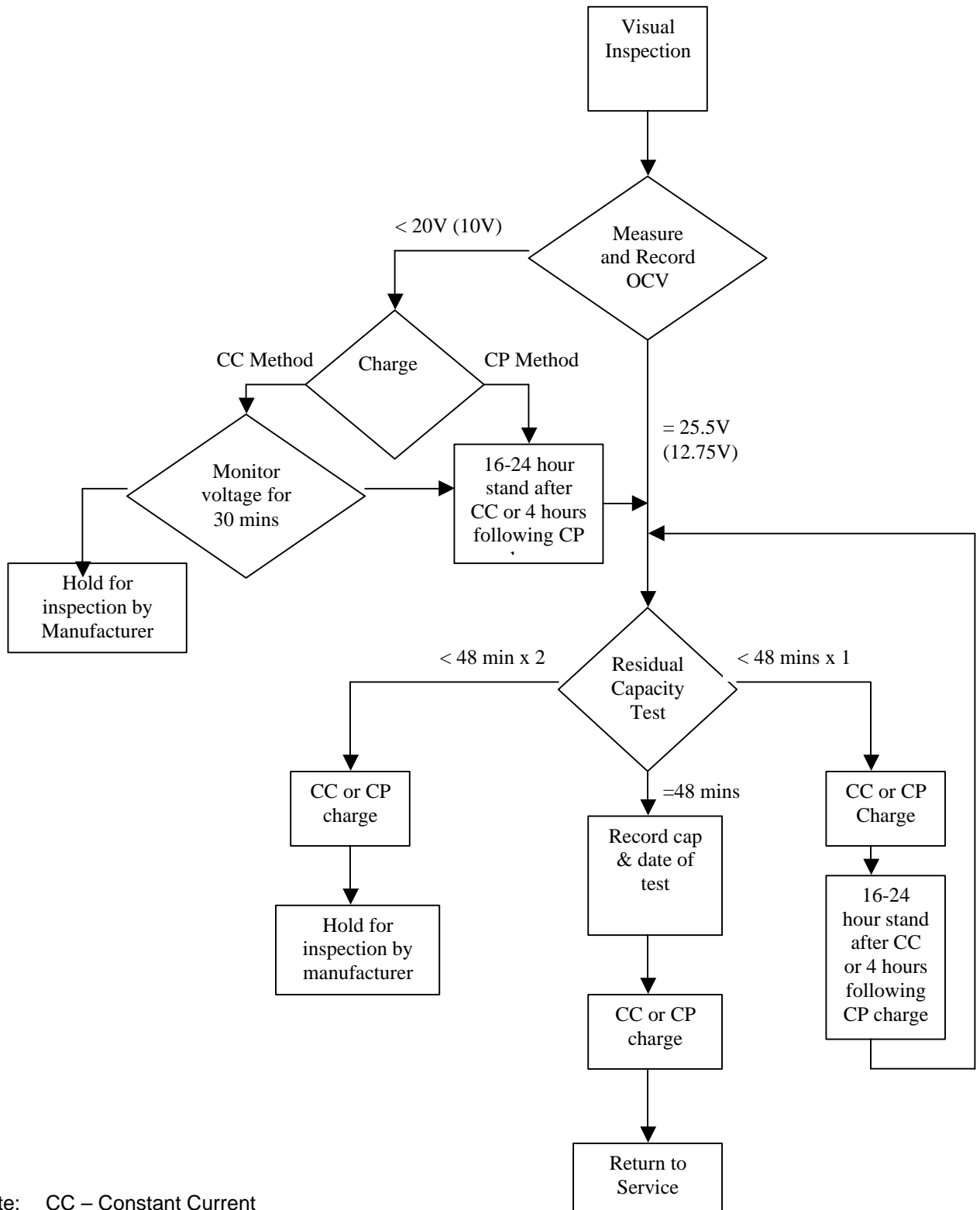


**FIGURE 1**

# Appendix C: Battery Commissioning Flowchart



# Appendix D: Battery Maintenance Flowchart



Note: CC – Constant Current  
 CP – Constant Potential