Component Maintenance Manual (CMM)

For Hawker® Valve Regulated Sealed Lead Acid Aircraft Batteries

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Contents

1 Scope

1.1 This manual covers the storage, servicing, maintenance, replacement, repair and disposal of Hawker® VRLA AGM aircraft batteries manufactured by EnerSys Energy Products Inc. under Parts Manufacturer Approval No. PQ3810CE.

1.2 A complete list of batteries manufactured under Type Certificates can be found at: http://www.enersys.com/defense/pdfs/MSB_Certs_list.pdf

2 Safety Notes

2.1 Short circuit current for a Hawker® aircraft battery can exceed 2000 amps. The following steps must be taken for safety.

2.2 Use only insulated tools when working on and around the battery.

2.3 Remove all metal jewelry including necklaces, rings, watches and belts with large buckles.

2.4 Do not smoke, cause a spark or use an open flame near a battery.

2.5 Always ensure that the battery lid is securely fitted prior to charging.

3 General Maintenance Notes

3.1 Use a Fluke Digital Voltmeter Series 70, or equivalent, to perform all voltage measurements.

3.2 This manual covers both 24Volt and 12Volt batteries. Voltage values listed in this manual are given for 24Volt batteries with the applicable 12Volt battery value shown in parentheses after the 24Volt value.

3.3 Discharges for capacity testing should be stopped at 60 minutes or when the terminal voltage reaches the value published for the rated capacity. This prevents excessive working of the battery and prolongs its life.

3.4 Only charge the battery in a well-ventilated air space. See section 11 for details concerning charging.

4 Introduction

4.1 Hawker® VRLA AGM batteries are designed as valve regulated, recombinant systems and classified as non-spillable and unrestricted for transportation per US D.O.T. Regulation 49 C.F.R. Section 173.159 para d. when correctly packaged. As a result, the battery can be oriented and operated in any attitude or position without spillage of electrolyte under full aerobatic conditions.

4.2 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.

5 Battery Description

5.1 The 24Volt Hawker® VRLA AGM aircraft batteries covered by this maintenance manual consist of two 12Volt sealed monoblocs connected in series, enclosed in a polyester bonded fiber glass or metal case, which incorporates the battery main terminal connector.

5.2 Each 12Volt monobloc consists of six 2Volt cells internally connected in series to make a 12Volt block. The individual 2Volt cells are not replaceable. The cells within the monoblocs are interconnected with through-the-partition-wall weld connections.

5.3 The cells are manufactured with proprietary VRLA AGM technology that can deliver high performance engine start capability in excess of $50C_1$ Amps at normal temperature and superb durability under emergency load conditions.

5.4 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.

5.5 Batteries can be configured with or without external vents depending upon the installation requirements. The fiberglass container does not always have vents installed.

6 Specifications

6.1 Capacity

6.1.1 The capacity of Hawker® VRLA AGM aircraft batteries is stated in Amp hours (Ah) at the one hour rate. For example an 18Ah battery will provide 18Amps for one hour to the end voltage shown on the name plate for the Amp-Hour rating.

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

6.2 Temperature Effects

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

6.2.2 Battery temperatures below 25°C reduce performance, which causes a reduction in capacity. However, this is not a permanent condition; the capacity will be restored as the temperature rises. Long term exposure to low temperature will not damage the battery.

6.3 State of Charge (see Figure 1, page 7)

6.3.1 The open circuit voltage (OCV) of the battery can be used as a guide to the state of charge (SOC) of the battery. The graph in Figure 1 shows the relationship between open-circuit voltage and the state of charge. The Red Line shows the SOC for the OCV after 24 hours or more after charge. The Blue Line shows the SOC for the OCV 4 hours after a charge.

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

7 Receipt of Battery & Acceptance Checks

7.1 All batteries ship from the manufacturer in the fully charged condition; the date of the latest charge is marked on the outer packaging and on the battery instruction label.

7.2 If the battery is received within three months of the latest charge, the only acceptance check required immediately upon receipt is inspection of the box for damage during shipping. The battery **does not** have to be unpacked.

7.2.1 If the box is damaged from shipping, unpack the battery to inspect for any damage. If damage to the battery is found, contact the shipper immediately.

7.3 If the battery is received 4 months or longer after the latest charge, unpack the battery to perform a voltage check in accordance with Section 9.

7.4 The battery label shows:

7.4.1 Type of battery (i.e. lead acid – aerobatic)
7.4.2 Manufacturer's name
7.4.3 Product number
7.4.4 Serial number
7.4.5 Manufacturing date code
7.4.6 Terminal polarity
7.4.7 Nominal battery voltage
7.4.8 Rated capacity
7.4.9 Safety instructions
7.4.10 Disposal instructions

8 Storage

8.1 The battery should be stored, fully charged, in a dry environment at or below 25ºC. Storing a battery at a temperature above 25°C accelerates the aging process reducing service life.

8.2 Every year, inspect a stored battery and check the OCV. If the OCV falls below 25.5V administer a boost charge per Section 11.

8.3 The battery can be stored for up to two (2) years at 25°C or below with no inspection or boost charge. After two (2) years a boost charge must be administered per Section 11 regardless of OCV.

8.4 A battery may be stored up to five (5) years without degradation of performance provided that an inspection and open circuit voltage check is conducted every year and boost charges are administered as dictated above.

8.5 If a battery stored in temperatures in excess of 25ºC, it should be inspected every six months and given a boost charge per Section 11 when the OCV falls below 25.5V.

8.6 Batteries returned to storage following in-service use, must be fully recharged and, ideally, packed in original packaging.

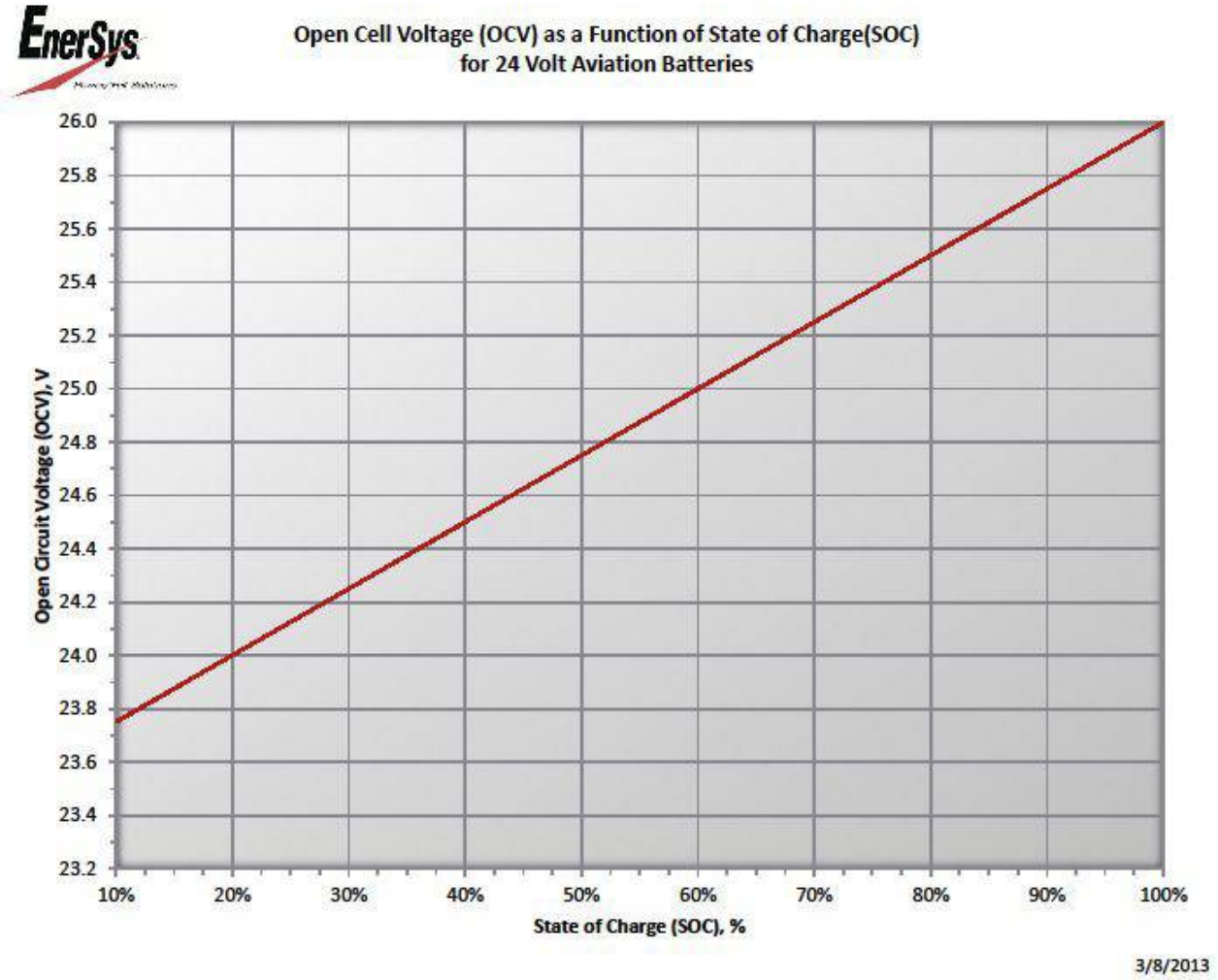

Figure 1: State of Charge (SOC) as a function of Open Circuit Voltage (OCV)

9 Commissioning Procedures and Initial Testing after Storage

(Refer to Battery Commissioning Flowchart Appendix A)

9.1 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 as necessary.

9.2 Measure the open cell voltage (OCV)

9.3 If OCV equals 25.50 (12.75) Volts or greater, the capacity is at least 80% and the battery can be issued for service.

9.4 If OCV is less than 25.50 (12.75) Volts and greater than 25.30 (12.65) Volts the battery needs to be charged before placing it into service.

9.4.1 Follow Section 11 for charging procedures.

9.4.2 If the OCV equals 25.50 (12.75) Volts or greater after charging, the battery can be issued for service.

9.5 If OCV equals 25.30Volts (12.65) Volts or less the battery needs to be charged **and** given a capacity test before placing it into service.

9.5.1 Follow Section 11 for charging procedures.

9.5.2 Follow Section 13 for capacity testing procedures.

9.5.3 If the battery fails to make 80% capacity after charging and a capacity test, it can be recharged and tested a second time.

9.5.4 If the battery achieves at least 80% capacity:

9.5.4.1 Record the capacity and date of test.

9.5.4.2 Issue the battery for service.

9.5.5 If the battery fails to achieve 80% capacity after two (2) charge and capacity tests, reject the battery per Section 14.

9.6 Batteries with and OCV of 25.50 (12.75) Volts or less should never be installed in an aircraft.

10 Routine Maintenance

(Refer to Battery Maintenance Flowchart Appendix B)

10.1 The maintenance schedule is shown in tabular form in Table 10.1.

10.2 The maintenance schedule is shown in text form below.

10.2.1 For Saab 340 & Jetstream 41 aircraft and Bell 206 helicopters the first routine maintenance check occurs at 12 months (365) ±30 days or 3000 ±300 hours, whichever comes first.

10.2.2 For all other aircraft and helicopters not covered in 10.2.1 the first routine maintenance check occurs at 18 months (548) ±45 days or 4500 ±450 hours, whichever comes first.

10.2.3 Subsequent maintenance checks occur at the following intervals depending on the results of the capacity test. These intervals apply to **all** aircraft and helicopters.

10.2.3.1 When the measured capacity equals 90% or greater, the next check occurs in 6 months (180) ±15 days or 1500 ±100 hours whichever comes first.

10.2.3.2 When the measured capacity is between 81% and 90%, the next check occurs in 3 months (90) ±10 days or 750 ±50 hours whichever comes first.

10.2.4 The above intervals are the **minimum** recommended servicing intervals. User or application specific service intervals can be developed, but they must be shorter in time than the intervals shown above.

Table 10.1: Maintenance Intervals		
Off-Aircraft Capacity Checks	**Applicability**	**Compliance Schedule**
12 Month Initial Check	Saab 340, Jetstream 41 Aircraft, Bell 206 Helicopters	At 365 ±30 days, or 3000 ±300 hours (whichever comes first), after the installation of a new battery
18 Month Initial Check	All aircraft/helicopters not identified under the 12 Month initial check	At 548 ±45 days, or 4500 ±450 hours (whichever comes first), after the installation of a new battery.
6 Month 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 ±15 days, or 1500 ±100 hour intervals following the initial battery check.
3 Month 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 ±10 days, or 750 ±50 hour intervals following the initial battery check.

10.3 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 as necessary. Always ensure that the battery lid is securely fitted prior to charging, (when applicable).

10.4 Measure and record the OCV using a digital multi-meter. Measure and record the weight of the battery.

10.4.1 If the OCV measures 25.50 (12.75) Volts or less, charge the battery per Section 11. Otherwise, test the battery in the “as found” condition.

10.5 Perform a capacity test per Section 13.

10.6 If the result of the capacity test is 80% or less:

10.6.1 If the battery has been tested once, it can be charged and tested a second time.

10.6.1.1 Recharge per section 11.

10.6.1.2 Retest per section 13.

10.6.2 If the battery fails to make 80% capacity after two (2) capacity tests reject the battery per Section 14.

10.7 If the result of the capacity test is greater than 80% but less than 90%:

10.7.1 Record the capacity and date of test on the battery label.

10.7.2 Ensure the battery is clean and return the battery to service.

10.7.3 Schedule the next routine maintenance check per 10.2.3.2.

10.7.4 Issue the battery.

10.8 If the result of the capacity test is greater than or equal to 90%:

10.8.1 Record the capacity and date of test on the battery label.

10.8.2 Ensure the battery is clean and return the battery to service.

10.8.3 Schedule the next routine maintenance check per 10.2.3.1.

10.8.4 Issue the battery.

11 Charging Procedure

11.1 This manual only covers Constant Voltage (CV) charging because CV charging is the preferred method. Every effort should be made to charge Hawker® VRLA AGM batteries with constant voltage. If constant current charging is the only available option, please contact EnerSys Technical Support for guidance.

11.2 Charging should be performed in the battery work shop where the ambient temperature is maintained between 20ºC and 30ºC. The battery can be charged outside this temperature window if a temperature compensated charger is used.

11.3 Charge the battery at a constant voltage of 29.0Volts (14.50Volts) with a charger capable of delivering a **minimum** of 10Amps. Charge time depends on the rated capacity of the battery and the maximum current available from the charger. Use Table 11.3 for guidance.

11.3.1 The higher current limit available on the charger, the faster the battery will charge.

11.3.2 After charge completion allow the battery to rest open circuit for 4 hours before performing a capacity test or measuring the OCV.

Table 11.3: Constant Voltage Charge Parameters

Battery Rating	Min Current Available from the Charger = 10Amps	Min Current Available from the Charger = 20Amps	Min Current Available from the Charger = 30Amps or more
	Charge Time	Charge Time	Charge Time
10 Amp-hour	3 hours	2 hours	1 hour
18 Amp-hour	4 hours	3 hours	2 hours
22 Amp-hour	6 hours	5 hours	2 hours
25 Amp-hour	6 hours	5 hours	4 hours
40 Amp-hour	8 hours	7 hours	6 hours
43 Amp-hour	9 hours	8 hours	7 hours

12 Deep Discharge recovery / Unscheduled Removal from Aircraft

12.1 Discharging a Hawker® battery below 18.0Volts (9.0Volts) under load is considered abuse and voids the warranty.

12.2 A battery is considered deeply discharged when the OCV equals less than 20.0Volts (10.0Volts).

12.3 The VRLA AGM technology used in Hawker® batteries allows recovery from deep discharge where a normal VRLA battery may not be recoverable. The most common cause for a deeply discharged battery is a low current drain for an extended period of time.

12.4 If a battery is inadvertently deeply discharged below 18.0Volts (9.0Volts), it should be removed from the aircraft immediately for recharge.

12.5 Charge the battery following the procedures in Section 11.

12.6 Perform a capacity test following the procedures in Section 13.

12.7 Even though a deeply discharged battery can be recovered; it is strongly recommended that deep discharging of batteries be prevented.

12.8 Deep discharges usually result from an unknown parasitic load on the battery that slowly drains the battery over a long period of time. If the battery suffers a deep discharge, inspect the electrical system for a parasitic load.

13 Capacity Testing

13.1 Capacity testing is performed by discharging the battery with a constant current load at the one- hour rate and measuring the time required (in minutes) to reach the cut off voltage.

13.2 Discharge the battery at the appropriate constant current value found in table 13.1 below.

Table 13.1: Capacity Test Current Values

Battery Rating	Discharge Current
10 Amp-hour	10 Amps
18 Amp-hour	18 Amps
22 Amp-hour	22 Amps
25 Amp-hour	25 Amps
40 Amp-hour	40 Amps
43 Amp-hour	43 Amps

13.3 End the test when the terminal voltage reaches the voltage value on the name plate used for the Amp-Hour rating **or** when the run time reaches 60 minutes duration, **whichever occurs first**.

13.4 Calculate the capacity of the battery using this equation:

Capacity% = (Run Time / 60) X 100

13.5 The minimum allowable capacity for flight is 80% or 48 minutes.

13.6 Recharge the battery per Section 11.

14 Rejection Procedure

14.1 If the battery fails to attain a 48 minute run time (80% capacity) after two discharge tests and has been in service for **more than two (2) years**, it should be considered non-serviceable. Recycle or otherwise properly disposed of battery. Refer to section 19 for disposal options.

14.2 If the battery fails to attain a 48 minute run time (80% capacity) after two discharge tests and has been in service for **less than two (2) years**, contact your distributor for further instructions.

14.3 If the battery is eligible for re-blocking contact your distributor for specific re-blocking instructions.

15 Transportation

15.1 Hawker® aircraft batteries are classified as non-spillable and exempt from hazardous goods regulations in accordance with the following governing bodies when securely packed and protected against short circuits.

15.1.1 US Department of Transportation – 49 CFR Section 173.159 Section d.

15.1.2 ICAO / IATA Packing Instruction 806, Special Provision A67.

15.1.3 IMDG Class 8, UN ID 2800 exemption for non-spillable batteries.

16 Master Record Index

16.1 A Master Record Index must be kept for each individual battery including the following data points:

16.1.1 Battery part number and serial number
16.1.2 Date of receipt from manufacturer
16.1.3 Date of commission
16.1.4 Date of installation on aircraft
16.1.5 Date and results of periodic routine maintenance or unscheduled maintenance
16.1.6 Date of battery returned to storage
16.1.7 Date of any failure
16.1.8 Date of any returns to manufacturer

16.1.9 OCV prior to any capacity test
16.1.10 Serial number of re-blocking kit
16.1.11 Date of re-blocking

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

17 Disposal

Dispose of the battery in accordance with local regulations for lead acid batteries. Never put a battery in a landfill. If in doubt local distributor or EnerSys at:

EnerSys Energy Products Inc.
617 N. Ridgeview Drive
Warrensburg, MO 64093
USA
Tel. (800) 964-2837
Fax (800) 283-2948

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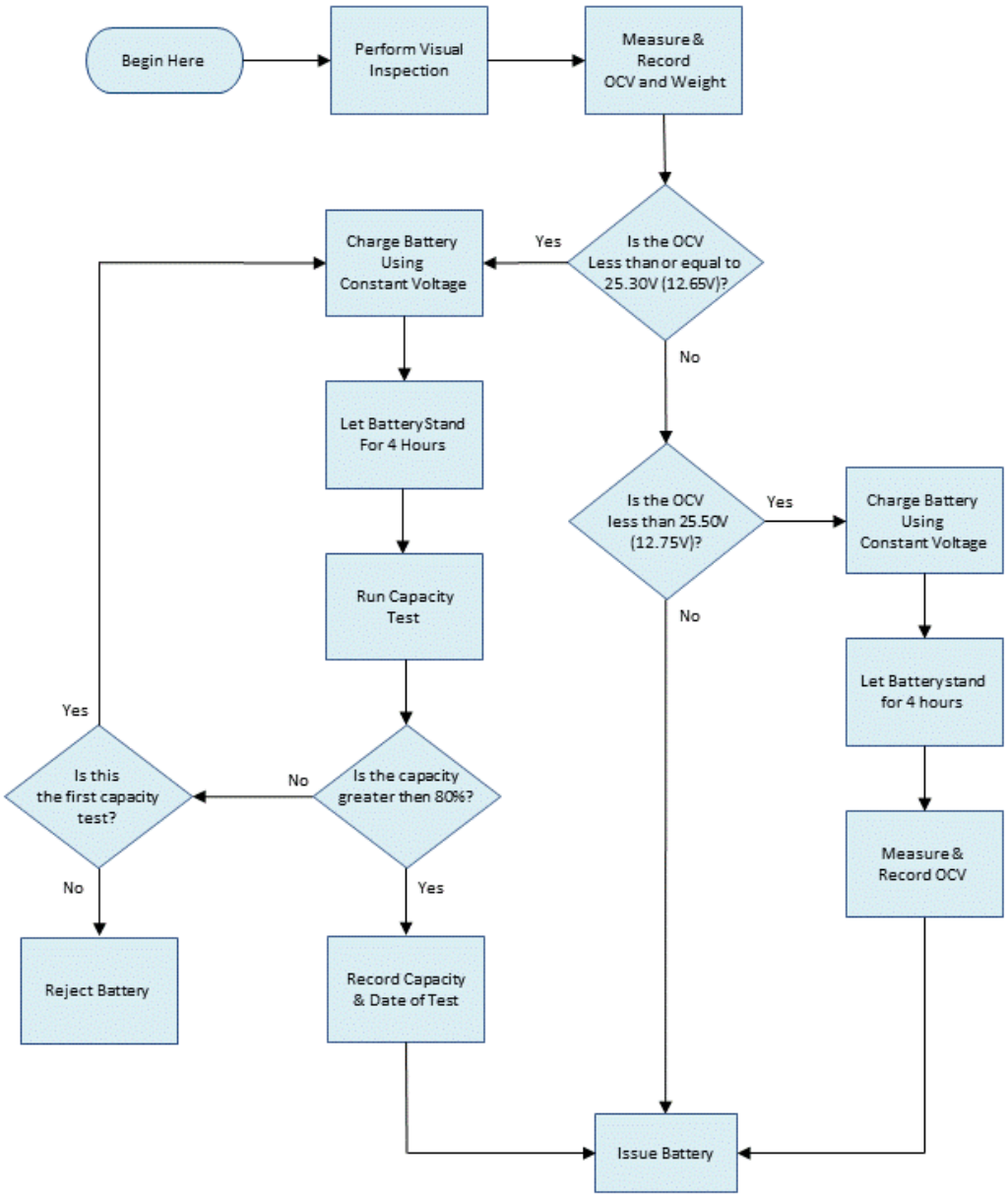
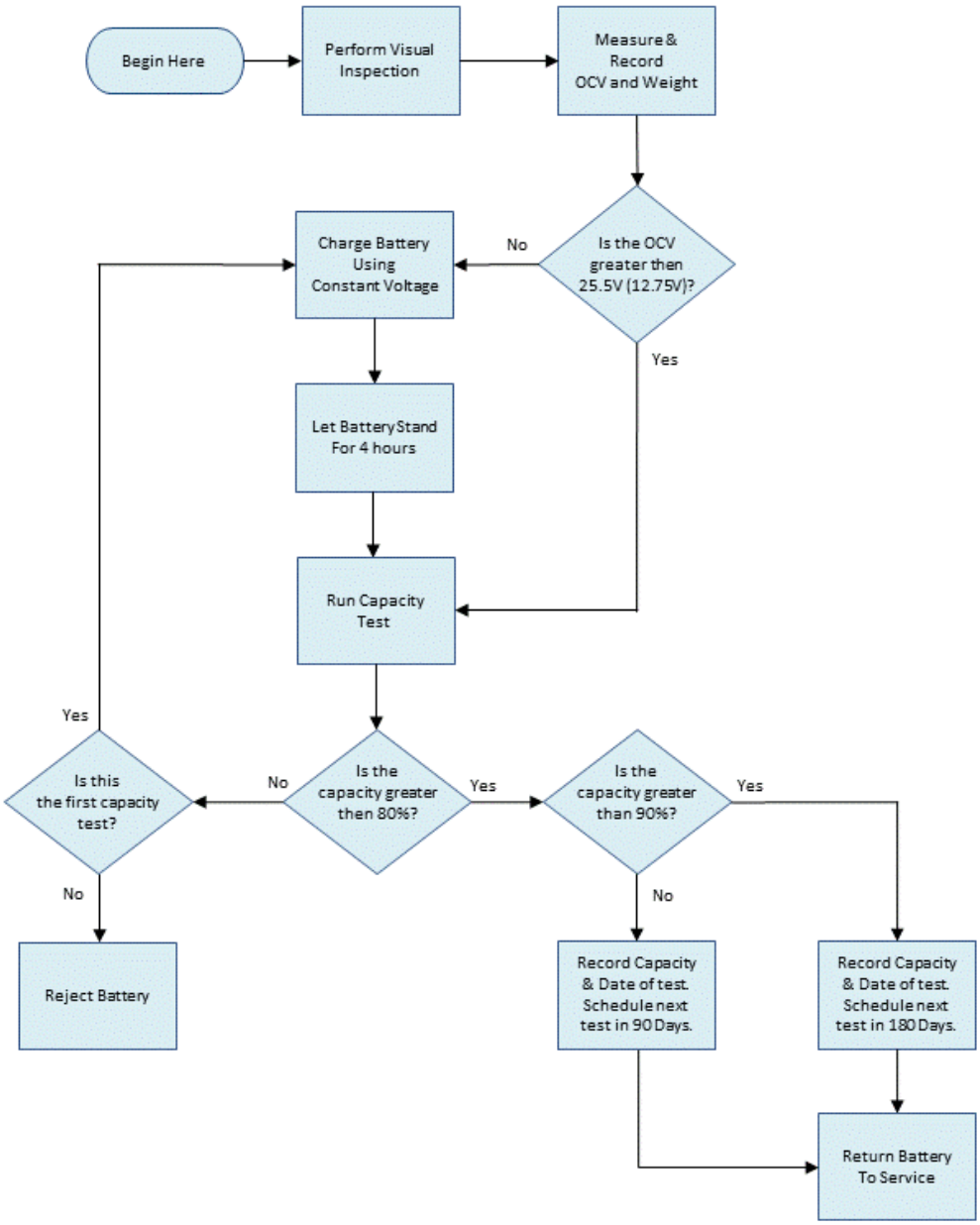
FAX +44 1633 281787

A control of Substances Hazardous to Health statement and Material Safety Data Sheet are available at: http://www.enersys.com/pdfs/msds/english/defense

Appendix A: Battery Commissioning Flowchart



Appendix B: Battery Maintenance Flow Chart



Record of Revisions

Revision Number	Description of Changes	Date	Approval
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
4	Document Update – revised charging and capacity test information, amended reblock kit numbers. Revision Never Issued	6/17/10	Robert Griffiths/ Frank Metzger
5	Complete re-write – removed CC charging and reblocking instructions	03/08/13	Robert Griffiths / Ken Hill

NOTE: The current revision of this manual is at http://www.enersys.com/defense