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Technical Bulletin

Field and Sustainment Maintenance and Recovery Procedures For Automotive HAWKER ARMASAFE Plus Battery NSN 6140-01-485-1472

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HEADQUARTERS, DEPARTMENT OF THE ARMY

April 2007

Warning Summary

This battery weighs 88 pounds and a two-man lift is required. Battery should be carried by the handles supplied and should not be lifted by a battery strap attached to the posts. Failure to carry battery in this manner may lead to personnel injury.

This battery contains sulfuric acid electrolyte so proper care and considerations should be taken to protect equipment and personal clothing when handling batteries with damaged or broken cases. Use approved, acid resistant protective clothing and wash and neutralize battery box after removal of damaged battery pieces. Failure to do so may result in personnel injury or death.

Perform all charging functions in a well ventilated area. The potential for hydrogen gas build up and explosion exists with any lead-acid battery. Failure to comply may result in personnel injury or death.

Immediately stop charging any battery that develops signs of melting or swelling or if the surface temperature of the case is too hot to comfortably touch with a bare hand. Do not handle or attempt to move battery until it has cooled for a couple hours to avoid the risk of an explosion. Failure to comply may result in personnel injury or death.

LIST OF EFFECTIVE PAGES/WORK PACKAGES

NOTE: The portion of text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Date of issue for the original manual is:

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Total number of pages for front and rear matter is 12 and the total number of work packages is 32, consisting of the following:

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Field and Sustainment
Maintenance and Recovery Procedures
for Automotive HAWKER ARMASAFE Plus Battery
NSN 6140-01-485-1472

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *1 April 2007*

TABLE OF CONTENTS

Section		Para.
1.0	General	
	Purpose…….....	1.1
	Background info……..	1.2
	Recharge and Disposal Directive……	1.3
	Battery State of Health/Charge characteristics……..	1.4
	Description…..……	1.5
2.0	Equipment Required	
	Test Equipment……..	2.1
	Charger Equipment……	2.2
	Other Equipment…….	2.3
3.0	Pre-Charge	
	Inspection……...	3.1
	Testing……	3.2
4.0	Charging Procedures	
	Buss Bar…….	4.1
	Single Battery……...	4.2
	NATO Slave Receptacle…….	4.3
5.0	Post Charge Testing	
	Resting……..	5.1
	Testing……..	5.2
6.0	New Battery	
	Top Off……..	6.1
7.0	Disposal	
8.0	Acronyms/Definition of terms	
9.0	Charger Characteristics	

1.0 General

1.1 Purpose:
This Technical Bulletin is provided as an aid to correctly recover subject battery NSN 6140-01-485-1472, FSCM 0WY95 Part Number 9750N7025 and reduce the incidences of premature disposal. This Technical Bulletin will remain in force until superseded by TM 9-6140-200-14 dated after above date. Questions or concerns should be addressed to Team Power by sending an e-mail message to batteries@tacom.army.mil or calling commercial (586)753-2629 or (586)574-8000 or DSN (312)786-2629/8000.

1.2 Background:
The HAWKER ARMASAFE Plus battery is the trade name for the battery manufactured by Hawker Energy Products Inc. a division of Enersys Inc. **The HAWKER ARMASAFE Plus battery has proven to be very recoverable, rechargeable multiple times from voltages as low as 0.24 VDC.** Therefore the battery must be charged and tested before disposal is approved. The HAWKER ARMASAFE Plus battery is a 12 VDC battery with a 1225 Cold Cranking Amps rating. It is of the 6T NATO size family of batteries. This battery is a Valve Regulated Lead Acid (VRLA) battery. It is a sealed system with Absorbed Glass Mat (AGM) technology that contains only a small amount of electrolyte in the cell chamber; therefore NO liquid will be introduced into the cell chamber at any time after manufacturing. Other than removal of dust, dirt or corrosion buildup on the exterior of the battery no maintenance beyond recharging is required.

WARNING

This battery contains sulfuric acid electrolyte so proper care and considerations should be taken to protect equipment and personal clothing when handling batteries with damaged or broken cases. Use approved, acid resistant protective clothing and wash and neutralize battery box after removal of damaged battery pieces. Failure to do so may result in personnel injury or death.

1.3 Recharge and Disposal Directive:
When the users organization does not have the capability to recharge the HAWKER ARMASAFE Plus battery it should be directed to the supporting Sustainment Unit to have the battery recharged and returned to service. Field level maintenance is authorized to turn in this battery for disposal but, due to the cost and recoverability of this battery, it should be disposed of only after testing and attempting to recharge it without success.

1.4 Battery State of Charge Characteristics:
The HAWKER ARMASAFE Plus battery's approximate State of Charge (SOC) can be determined by measuring its Open Circuit Voltage. (OCV) For a **"**rested**"** battery (a battery that hasn't been charged or discharged for at least 8 hours) OCV and SOC are related as follows:

> 12.9 Volts OCV: 95% - 100% state of charge (SOC)
12.7 Volts OCV: about 80% SOC
12.5 Volts OCV: about 60% SOC
12.3 Volts OCV: about 50% SOC
12.1 Volts OCV: about 35% SOC
11.9 Volts OCV: about 20% SOC
11.7 Volts OCV: about 10% SOC
11.5 Volts OCV: about 5% SOC
< 11.4 Volts OCV: 0% SOC

If the battery hasn't "rested" sufficiently after charging, the voltage reading will be a bit higher than normal. If the battery hasn't "rested" sufficiently after discharging, the voltage reading may be a bit lower than normal.

1.5 Description:
- Dimensions are (LxWxH) 10 inch x 10 inch x 8* inch (*9 inch including post)
- Color is gray case; gray lid.
- Handles: acid resistant nylon; Battery should be carried by the handles supplied and should not be lifted by a battery strap attached to the posts.
- Weight: 88 pounds; two-man lift is required.
- Voltage & Amp hours: 12 VDC, 120 Ahr (20 hrs@ 6 amp rate)
- CCA rating 1225 amps @ -18°C (0°F)
- BCI group 6T

2.0 Equipment Required

2.1 Test Equipment needed:
- Multi-meter or Voltmeter: any type that reads in $1/10^{th}$ VDC increments.
- Battery Analyzer (e.g. Midtronics or Pulsetech) or Load Tester (any brand available).

2.2 Charger Equipment needed:
Any Charger that has a constant voltage output (rated at 12VDC or 12/24 VDC) that can apply a charge to one or more batteries at a time using either alligator clamps or NATO Slave Connector.

a. To verify the voltage rating of a charger, attach charger to a fully charged battery (6TMF or HAWKER), apply power, wait a couple minutes until the amp meter registers 1 amp or less, then measure the voltage on the leads at the battery terminals. If the voltage exceeds 15 VDC (>30 VDC if you are hooked into the NATO Slave Receptacle across multiple batteries) do not use it to charge HAWKER batteries.

b. Constant current chargers are not recommended for charging HAWKER ARMASAFE Plus Batteries, especially to “top off” new batteries.

c. Some free issue charging equipment is available from the AMC Battery Management Office located at CECOM, Ft Monmouth, NJ. POC is Mr Rafael Casanova DSN (312)992-8941 Comm (732)532-8941 or e-mail Rafael.casanova@us.army.mil

2.3 Other equipment needed:
- Battery Post Cleaner (NSN 5120-00-926-5175) or wire brush (NSN 7920-00-291-5815), any brand.
- Pliers, slip joint preferred - any size.
- Permanent marker. Any color.
- Chalk or pencil

3.0 Pre-Charge

3.1 Pre-Charge Battery Inspection:

Before starting to test or recover any battery, a visual inspection must be performed. Any batteries with physical damage described below should be disposed of immediately. With a permanent marker label battery as "DAMAGED". Things to look for consist of the following:

a. Check top, sides, and bottom for cracks, dents, leaking or swelling in the battery case and lid.

b. Check that battery lid and case is sealed.

c. Make sure terminals are not melted, bent, or otherwise damaged.

NOTE

Do not attempt to replace missing vents

d. Cell Vents missing.

(1) Check that all vent caps are in place (flush) and do not appear to be elevated. Elevated vent caps are a sign of a defective vent or that the battery has gassed excessively. Gently tap vent back in place, then with a permanent marker, mark the vent with an "R". If it elevates again during charging or operational use, dispose of battery.

(2) If a battery is turned in for recharge and a vent cap with an "R" marked on it is elevated again, disposal is authorized without further testing. Label battery as "Damaged".

3.2 Pre Charge Battery testing:

After performing the visual inspection, test the battery for potential internal electrical damage.

a. Using a battery post cleaner or wire brush, clean any corrosion build-up from the terminals.

b. Using Voltage Meter test Open Circuit Voltage (OCV) of the battery. Set meter to lowest DCV reading that is greater than 15V DC. Place the positive lead (red) on the battery post marked with a (+) sign and the negative lead (black) on the other battery post with the (-) sign. Note the volt meter reading and, with chalk or pencil, record test OCV on top of battery. This OCV becomes a reference point for future tests and should be removed at the conclusion of charging and testing.

c. If Battery Tester-Analyzer is available:

(1) Determine if internal damage exists. Many testers will not give a reading if OCV is less than seven (<7) VDC. If no reading is given or no internal damage is indicated proceed with charging procedures. See instruction paragraph 4.0. If no reading is given, charge the battery for 24 hours and retest with Multi-meter and Analyzer. If no change is detected after 24 hours of charging, the battery is considered bad. Mark battery as "CHARGED, TESTED BAD."

(2) If at any time an 'Unstable Battery" reading is received, use pliers and apply gentle force to make sure terminals are snug with a clockwise turn effort. If any movement is experienced greater than an $1/8^{th}$ of a turn in either post, the battery is defective, Label battery as "DAMAGED" and dispose. **DO NOT** force posts to turn by applying strong force.

(3) If a battery analyzer is not available proceed with charging the battery per instructions in paragraph 4.0.

4.0 Charging Battery:

WARNING

- Perform all charging functions in a well ventilated area. The potential for hydrogen gas build up and explosion exists with any lead-acid battery. Do not smoke or have open flames in the charging area. Failure to comply may result in personnel injury or death.

- Immediately stop charging any battery that develops signs of melting or swelling or if the surface temperature of the case is too hot to comfortably touch with a bare hand. Do not handle or attempt to move battery until it has cooled for a couple hours to avoid the risk of an explosion. Failure to comply may result in personnel injury or death.

- This battery weighs 88 pounds and a two-man lift is required. Battery should be carried by the handles supplied and should not be lifted by a battery strap attached to the posts. Failure to carry battery in this manner may lead to personnel injury.

CAUTION

If you are unsure of the output voltage of your charger test it first, see section 2.2a. If charger is an older version and has no adjustments it most likely is not compatible with AGM Batteries. Closely monitor its usage to ensure it does not damage the batteries being charged.

a. After performing the pre-charge inspection and testing, the HAWKER ARMASAFE Plus battery can be charged either in or out the vehicle by attaching charger leads directly on the battery (12 VDC) red lead to positive post (+), black lead to negative post (-) or through the vehicles NATO Slave connection, (24VDC). Batteries can be charged individually or as a group using the following procedures. If using the NATO Slave receptacle use a charger with 24 volt capacity and a NATO Slave connector plug.

(1) If charging on the vehicle make sure all current draws (i.e. lights, electronic equipment etc.) are turned **OFF**. Do not attempt to jump start the vehicle with the charger unless it is specifically designed to do so; i.e. includes power assist mode.

b. All charging functions should be performed in a ventilated area. The volume of hydrogen gas emitted from the HAWKER ARMASAFE Plus battery is far less than can be expected from the 6TMF flooded lead acid battery. The technology used in the HAWKER ARMASAFE Plus battery greatly reduces the risk of explosion, however, the potential for hydrogen gas exploding exists with any lead-acid battery.

c. Monitor the battery for excessive heat during charging. During the charging procedure, some heat is generated as a natural result of charging. However, if a battery becomes too hot to comfortably touch with the bare hand or the case or lid begins to melt or shows signs of swelling, it should be removed from the charger immediately. Allow battery to cool before attempting to move. If this condition exists repeatedly with a specific charger, the charger may not be compatible with the HAWKER battery technology and its use should be discontinued.

d. Charging Checklist:

- When charging multiple batteries in one set they must be identical types. Do not charge a flooded battery and a VRLA battery on same charger at the same time.
- Do not mix flooded and VRLA batteries in the vehicle.
- Be sure to charge batteries in well ventilated areas only.
- During charge cycle, the batteries should be examined daily.
- Voltage levels stated in this Technical Bulletin should not be used to set the vehicle voltage regulator, refer to the appropriate vehicular Technical Manual for this value.
- HAWKER Armasafe Plus batteries are lead-acid batteries and must be disposed of following local procedures for the recycling of hazardous waste materiel. Do not dispose by putting out with the trash.

4.1 Buss Bar Multiple Battery Procedures:
For standard military battery shops or units with chargers that will handle more than one battery at a time.

CAUTION

When hooking up batteries, large amounts of current are available even in discharged batteries. Make sure all leads are clear; avoid making contact with any material but the intended battery post. Attach all the positive (+) terminals first then the negative (-) terminals. Disconnect in the reverse order, negatives (-) first. Do not mix battery types (such as flooded 6TMF and AGM) on the buss during charging. Failure to comply may result in equipment damage.

NOTE

Group batteries for charging by OCV. Group ranges are 0 to 5.9 VDC; 6.0 to 9.9 VDC; 10.0 and above. Ideal voltage spread of the group is no more than 3.0 VDC and can cross groups (i.e. OCV= 4.4 to 7.4 VDC).

a. Connect batteries to a standard constant applied voltage buss bar charger set and adjust voltage to between 14.7V and 15.2V*. Clamp wiring and contacts must be tight and clean with minimal corrosion to assure good connections.

(1) These settings should result in approximately 14.7V to 15.2V * applied potential when measured at the battery's terminals at the end of the charge period.

(2) Allow for at least 10A charging current available per battery on the buss. Higher buss charge current will help accelerate the battery charge time. For example, if you are using a charger that has a max output of 100 amps source do not attempt to connect more than 10 batteries to it.

* Do not use these values for the vehicles voltage regulator setting. Consult the appropriate Technical Manual.

b. Charge batteries for 24 to 48 hours (see step iii below). Weekend charging of 64 hours (Friday 1600 to Monday 0800) can be performed, but best to have someone check the system at least once per day to assure proper operation (no excessive heat, gassing, leaking, proper voltage applied) and to determine whether charge has been completed. Severely depleted batteries can take two to three days or longer to recharge. (See section 9 for charger operational lab observations.)

(1) Immediately remove any battery from buss that shows signs of excessive heat, gassing, leaking, or swelling during charge stage. Battery should then be disposed of. Battery should be marked with a permanent marker with date and statement "CHARGED, TESTED BAD."

(2) After removing a bad battery from the string and more batteries are to be charged, before putting in a replacement measure the OCV of the batteries in the setup and select one with similar OCV ± 1 VDC.

(3) Batteries are finished when charge current (amp meter on charger) drops to less than 1 amp per battery and holds there for 3 hours. For example, if 12 batteries are on buss, then overall current should be <12A.

(4) Test batteries individually; see para. 5.0.

4.2 Single Battery Procedures:

For standard military battery shops or units with chargers that will handle only one battery at a time.

a. Connect charger to the battery posts. Clamp wiring and contacts must be tight and clean with minimal corrosion to assure good connections.

(1) If possible, use a constant voltage charger of newer technology, which may have multiple charge settings and steps (such as AGM setting, if charger has this switch setting select this switch position). If voltage is adjustable the voltage should be set between 14.4V and 15.0V* and there should be at least 10A current available for charging.

(2) Before applying power to Charger, select the charger setting to AGM. If the charger has adjustable voltage settings, adjust the voltage to 14.4V to 15.0VDC.*

* Do not use these values for the vehicles voltage regulator setting. Consult appropriate Technical Manual.

(3) If battery charger has no adjustments or switches (and is not a SMART Charger and output voltage is > 15.0 VDC) the battery should be closely monitored (every 15 minutes) during the first two hours of charge process. If it shows signs of excessive heat when touching the exterior, gassing, leaking or swelling during charge stage, charging should be stopped immediately. If charger is an older model and user is unsure as to the output voltage of the charger, see para 2.2a for testing procedure.

Caution

If using a "Constant Current Charger," use formula of: 120 divided by output Amperage = allowable hours of charge Time' (120/A=T). Do not charge a battery longer than formula value (example: 20 hours if charger has a 6 Amp constant amperage output). This type charger is NOT recommended for use on HAWKER ARMASAFE Plus batteries, especially for "TOP OFF" charging. Use of this charger may result in equipment damage.

b. Charge batteries for 12 hours or longer (see step ii below). Weekend charging of 64 hours (Friday 1600 to Monday 0800) can be performed, but be sure to check the system at least once per day to assure proper operation (no excessive gassing or leaking, proper voltage applied) and to determine whether charge has been completed. Severely depleted batteries (OCV <10 VDC) can take up to four days to recharge. If OCV voltage is not significantly improved (>10 VDC) after four days it may never make a full recovery.

(1) Immediately remove any battery from charger that shows signs of excessive heating, gassing, leaking, or swelling during charge stage. Battery should be disposed of. Battery should be marked with a permanent marker with date and statement "CHARGED, TESTED BAD."

(2) Battery is finished when charge current (amp meter on charger) drops to ≤ 1 amp and holds there for 3 hours. Automatic chargers will stop charging and give a screen reading of "Charge Complete". Some automatic chargers may not fully recharge with one charge cycle; may or may not indicate a good battery. Additional charge cycles may be required to ensure full recharge of the battery. If the OCV is unchanged in two consecutive cycles the battery has reached its capacity. Proceed with testing.

(3) Test battery; see para 5.0.

4.3 Charging through NATO Slave Receptacle (24 VDC):

a. Connect charger to the NATO Slave receptacle. Ensure cable clamps and contacts are tight and clean with minimal corrosion to assure good connections. Ensure all current drawing devices are OFF i.e. lights, electronic equipment etc.

(1) If possible, use a constant voltage charger of newer technology, which may have multiple charge settings and steps (such as an AGM setting, if charger has this switch setting select this switch position). If voltage is adjustable the voltage should be set between 28.8V and 30.0V* or 24V switch setting selected and there should be at least 5A current per battery available for charging. Such settings may give the operator the option of setting the charge voltage and current, to expedite charge time, and will assure decreasing amperage out put as the battery charges in step (b.) below.

(2) Before applying power to Charger, select the charger setting for AGM. If the charger has adjustable voltage output capabilities, adjust the voltage to 28.8V to 30.0VDC.*

* Do not use these values for the vehicles voltage regulator setting. Consult appropriate Technical Manual.

(3) If battery charger has no adjustments or switches (and is not a SMART Charger and output voltage is > 30.0 VDC) the battery should be closely monitored every 15 minutes, during the first two hours of charge process. If it shows signs of excessive heat when touching the exterior, gassing, leaking or swelling during charge stage, charging should be stopped immediately. If charger is an older model and user is unsure as to the output voltage of the charger, see paragraph 2.2a for testing procedure.

b. Charge batteries for 12 hours or longer (see step iii). Weekend charging of 64 hours (Friday 1600 to Monday 0800) can be performed, but it is best to have someone check the system at least once per day to assure proper operation (no excessive gassing, leaking, proper voltage applied) and to determine whether charge has been completed. Severely depleted batteries (OCV <10 VDC) can take up to four days to recharge. If OCV voltage is not significantly improved (>10 VDC) after four days it may never make a full recovery.

(1) Immediately remove any battery from charger that shows signs of excessive heating, gassing, leaking, or swelling during charge stage. Battery should be disposed of. Battery should be marked with a permanent marker with date and statement "CHARGED, TESTED BAD."

(2) If a battery is removed from a vehicle and the others are still charging, measure the OCV of the other batteries and replace with a battery of similar OCV ± 1 VDC is acceptable or charge the remaining batteries and install a new battery when they have completed the charging cycle. See paragraph 6.0.

(3) Batteries are finished when charge current (amp meter on charger) drops to less than 1/2 amp per battery and holds there for 3 hours. For example, if 4 batteries are in the battery box, then overall current should be <2A. Automatic chargers will stop charging and give a screen reading of "Charge Complete". Some automatic chargers may not fully recharge with one charge cycle; may or may not indicate a good battery. Additional charge cycles may be required to ensure full recharge of the battery. If the OCV is unchanged in two consecutive cycles the battery has reached its capacity. Proceed with testing.

(4) Test batteries individually; see paragraph 5.0.

5.0 Post Charge Testing:

5.1 Resting Batteries:

Remove batteries from charger and allow them to settle (rest; cool preferably overnight). See rest times below for type of testing to be performed.

NOTE

Batteries that are still heated from charging process may give erroneous readings.

5.2 Testing:

If battery OCV and load voltage are above 12.85 VDC and 10.80VDC respectively, the battery is good for reissue to fleet as is without need for recharging. If the battery OCV and load voltage are below 12.85 VDC and/or 10.80V respectively, it needs additional charging. If at the end of two charge cycles the OCV is identical ±0.1 VDC to the previous cycle, the battery has probably reached its potential. Proceed and use this value for all tests. This value may increase as the battery rests (cools to ambient temperature).

a. **OCV Test only:** After a rest period of 18 hours minimum, using a voltmeter measure the batteries OCV which should be ≥ 12.85 VDC. Voltmeter should read in 1/10th volts or smaller units.

b. **LOAD TEST:** After a rest period of two hours minimum, measure the battery OCV & load test at a discharge rate between 550A and 615A for 15 seconds [with ambient temperature between +20°C (68°F) to +30°C (87°F) if possible]. Load testing provides actual engine start simulation load to the battery simulating actual use in the field. This testing (steps (i) and (ii) below) allows for fast, easy, and economical determination of battery state of charge and health.

(1) Using a voltmeter measure the batteries OCV which should be ≥ 12.85 VDC. Voltmeter should read in 1/10th volts or smaller units.

(2) Use a battery load tester to load test battery. The load voltage should be ≥10.80V after applying 15 seconds of discharge. Wait two minutes before measuring OCV at which time Battery should have returned back to OCV observed in step (a.).

c. **Calculated Cold Crank Amps (CalcCCA) test:** After a rest period of two hours minimum if load tester is not available, a secondary alternative test (CalcCCA) may be performed using battery testers such as the Midtronics Micro-400 or 490. However, the CCA results indicated on the testers are NOT true CCA test readings and are subject to greater variation in determining battery state of health. When using this type of test, the CalcCCA reading should be ≥1400A (typically varies between 1400A and 2000A). If CalcCCA test or the Capacity test is used and if CalcCCA is below 1400A, and/or the Capacity test runs less than 48 minutes, the battery needs additional charging.

(1) Charge battery again by repeating paragraph 4.0 (using 24 hours as the charge time) and repeat paragraph 5.0 if battery has not yet passed load testing requirement.

d. **Capacity Test:** After a rest period of two hours minimum the best test for battery state of health is a true capacity test of 80A constant current loaded until the battery voltage reaches 10.0V. The run time for this type test should be ≥ 48 minutes. If this test is used, the battery must be recharged by repeating paragraph 4.1 (or 4.2 or 4.3) steps (a.), (b.), and paragraph 5.0 if battery has not yet passed load testing requirement.

NOTE

If battery still falls below 12.85V open circuit and 10.80V loaded voltage, (or falls below 1400A CalcCCA, or <48minutes capacity test run time,) after one additional 24 hour charging cycle, then battery disposal is recommended.

Battery should be marked with a permanent marker with date and statement "CHARGED, TESTED BAD."

6.0 PLACING NEW BATTERIES INTO SERVICE:

- **TOP OFF Charge**: When replacing a battery or set of batteries with a fresh new battery(s); before they are installed or the vehicle is operated the batteries should be charged (Topped off) until the OCV reaches 12.85 VDC and the amperage meter on charger reads <1 amp for one hour. For best results allow batteries to charge over night. Follow procedure 4.1, 4.2 or 4.3 Step (a.) as applicable.

- If replacing one battery in a string of batteries, it is best to replace with a used battery that has been recovered, or to replace all batteries in the string with new ones and redistribute the used serviceable batteries. Battery should be tested and charged (topped off) to insure the OCV is >12.85 VDC upon installation.

7.0 Disposal Procedures:

- The HAWKER ARMASAFE Plus battery shall be inspected and tested before permission to dispose is granted. Disposal authority is given to the Field Level.

- Marking the battery. Use a permanent ink marker to mark the battery when indicated during the inspection paragraph 3.0 or testing phase paragraph 5.0.

- The HAWKER ARMASAFE Plus battery is a lead-acid battery. Follow local procedures for the handling of Hazardous Waste Materials**.** Do not dispose of by placing with trash. Most States or Countries require disposal through a local Defense Re-utilization & and Marketing Service site (DRMO).

8.0 Acronyms and Definition of terms:
OCV- Open Circuit Voltage; The electrical value measured between the positive and negative posts on the battery.

CalcCCA- calculated Cold Cranking Amperage; an indication of Amperage available to perform start function.

AGM- (Absorbed Glass Mat) A lead-acid battery format where the electrolyte is held in fiberglass mats suspended between the battery plates.

VRLA- Valve Regulated Lead Acid; sealed and maintenance free battery.

Vent- there are six vents per 12 volt battery. They are located in the lid in a 3X2 pattern, circular in shape, one inch or 2.5 CM in diameter.

Buss Bar- a means of attaching one charger to two or more batteries to be charged at the same time.

Passivation- when batteries are left in a discharged state, a layer of lead oxide begins to coat the plates hampering the cells' ability to accept or release energy. Passivation may result in a battery taking 24 hours or more to begin to draw current during charging, and may result in false "bad battery" readings by battery analyzers and chargers.

Pulsing- Some chargers apply "pulses" of voltage to the battery, purported to remove the sulfating layers accumulated on the battery cell plates.

Field Level Maintenance- Under the new two level maintenance, this term has not been fully defined (subject to change) but should encompass the old Operator/Crew (C), Organizational (O) and most of the Direct Support (F) functions, tools and equipment available.

Sustainment Level Maintenance- All old Direct Support (F) function not Field Level capable, General Support (G) and above.

9.0 Charger Characteristics experienced in lab testing:
A large number of used and discarded HAWKER ARMASAFE Plus batteries were secured from a DRMO yard, brought to TARDEC's Battery Lab for recoverability testing and to prove out the above instructions. The chargers listed here were used to test and recover batteries. Team Power's observations are listed below only to assist the user in what can be expected from equipment readily available to the unit maintenance personnel-

Many batteries required several diagnostic pulsing cycles before they would take a charge. In the lab we ran five cycles on a charger to begin to break down the passivation accumulated on the cell plates. After five cycles we connected the battery to another charger. Often times a rest period of several hours between chargers would have some positive results.

Batteries that were above 10 volts charged up without much difficulty, Batteries between 4 volts and 10 volts often took patience and multiple tries to recover. Once the battery began to take amperage it usually did so quickly. Batteries below 4 volts often times took a couple days before the chargers could diagnose battery condition and begin to recover.

Pulse Tech Pro-HD (Roll around) NSN 6130-01-500-3401:

Minimum Battery Voltage (OCV) start: approx. 4.0 VDC
Diagnostic time: Instantaneous, will not pulse test a passivated battery
12/24 Capability: 12 and 24 volt auto select
Charge time: 24 hours or more.
Number of charge cycles to recover a battery: Multiple cycles may be needed
End of Charge Charger status: light comes on and charging stops.

This charger will instantly go to ‘charge complete’ status (all lights off except complete) for highly passivated batteries. It will not pulse a battery until it begins to take a charge.

This charger comes with a NATO slave connector, interchangeable with the alligator clamp leads.

Associated model PP-1660-F/U (Roll around) NSN 6130-01-518-7866:

Minimum Battery Voltage (OCV) start: approx. 2.4 VDC
Diagnostic time: 45-50 minutes
12/24 Capability: 12 and 24 VDC manual select
Number of charge cycles to recover a battery: Multiple cycles may be needed
End of Charge Charger status: Display gives a status reading, then beeps every minute till power is terminated

Charger has a 45-50 minute diagnostic cycle and will give a defective battery reading, allow the battery to rest up to five minutes and restart. It was found that many batteries required five or more of these diagnostic cycles before they begin to take a charge. Once battery started to accept a charge it often would recharge in less than two hours.

This charger comes with a NATO slave connector, interchangeable with the alligator clamp leads.

Midtronics GR-1(Roll around) NSN TBD:

Minimum Battery Voltage (OCV) start: default 0.5 VDC
Diagnostic time: 1-3 minutes
12/24 Capability: 12 volts (Final version will be 12 and 24 manual select)
Charge time: first cycle by default is 5 hours, subsequent charge efforts will change based on battery condition.
Number of charge cycles to recover a battery: Multiple cycles may be needed
End of Charge Charger status: Digital reading with battery status plus a beep every minute till power is terminated.

Operator must manually select battery conditions to set up the charger by selecting the onscreen values. It will then run in automatic or manual mode.

During diagnostics it will select an estimated time to recover a battery. Preset is approximately five hours. Once timer has reached zero it will again diagnose the battery and give a reading. If the battery is not yet fully charged it will indicate a defective battery. Allow the battery to rest several hours or overnight (to cool off), restart the charger and it should finish the charging recovery cycle. Screen will tell the operator the OCV and available CCA in the battery. Once battery reaches 95-96% state of health it will go into a top-off trickle charge and will run for several hours until it reaches 100+%.

This charger has a Manual mode for charging multiple batteries in parallel(Buss); Caution: in manual mode it will not auto stop charging, however it will trickle charge till it is turned off. When charging multiple batteries, if one is defective and will not take a charge and the others will, the bad battery will control the charger and the other batteries will be cooked/over charged.

Pulse Tech model 745-600 (Desk Top) NSN 6130-01-398-6951:

Minimum Battery Voltage (OCV) start: approx. 0.2 VDC
Diagnostic time: none
12/24 Capability: No 24 volt setting; **12 Volts only**
Charge time: 18-30 hours
Number of charge cycles to recover a battery: Multiple cycles may be needed.
End of Charge Charger status: light comes on and charger stops.

This charger is a 12 volt charger, designed to charge one battery at a time.

The type of battery switch (AGM-Flooded) is located on the rear of the charger.

By Order of the Secretary of the Army:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army
0706001

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 344873, requirements for TB 9-6140-252-13.

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PART I – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
TB 9-6140-252-13	1 APRIL 2007	Automotive HAWKER ARMASAFE Plus Battery (NSN 6140-01-485-1472)

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON *(Provide exact wording of recommended changes, if possible).*

**Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

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