TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LISTS) FOR NICKEL-CADMIUM BATTERY BB-693A/U (NSN 6140-01-072-3123)

HEADQUARTERS, DEPARTMENT OF THE ARMY

6 JANUARY 1983

5 SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK

1 DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL

2 IF POSSIBLE, TURN OFF THE ELECTRICAL POWER

3 IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH OR LIFT THE PERSON TO SAFETY USING A DRY WOODEN POLE OR A DRY ROPE OR SOME OTHER INSULATING MATERIAL

4 SEND FOR HELP AS SOON AS POSSIBLE

5 AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESUSCITATION

WARNINGS

DANGEROUS CHEMICALS ARE USED IN
NICKEL-CADMIUM BATTERIES

Never add electrolyte to a nickel-cadmium battery unless there has been spillage. Add only distilled water. The electrolyte in the nickel-cadmium battery is a solution of potassium- hydroxide (KOH), also commonly called lye, which is a very strong caustic chemical. Be sure to wear rubber gloves and apron and a pair of protective goggles when handling these batteries and electrolyte. You can get very serious burns if any part of your body comes in contact with electrolyte. Be sure to *flush immediately under* running water or in a large vessel filled with cool, clean water. Seek medical help without delay for eyes.

EXPLOSIVE GASES

Charging the battery can be dangerous. Be sure the doors or windows are open so that there is plenty of fresh air. *First* connect the battery to the charger and *then* turn the *switch on.* Afterward turn the charger *switch off* before disconnecting the battery. It is possible that the gases generated during charging can explode if these precautions are not taken. Also, *be sure* there is no smoking or lighting a match or cigarette lighter in the charging area. The battery box cover must be removed when charging. REMEMBER, THE EXPLOSION CAN BE HEAVY AND YOU CAN GET HURT IF THE ABOVE PRECAUTIONS ARE NOT TAKEN.

DO NOT MIX SULPHURIC ACID AND KOH

Sulphuric acid used in lead-acid batteries should *never* be used at or near a nickel-cadmium battery. Mark all tools and hydrometers red for lead-acid batteries and blue for nickel-cadmium and keep them *separate* and *apart.* Not only will a violent reaction occur when the acid and alkali come in contact but even the fumes from a lead-acid battery on charge will permanently damage the nickel-cadmium battery.

BATTERY SHOP SAFETY PRACTICES

Maintenance personnel should be thoroughly trained in the use of charging, discharging and test procedures of nickel-cadmium batteries. The charging and maintenance of various alkali electrolyte batteries can be conducted in the same area but *must* be kept in a separate and different room from lead-acid batteries. Be sure to have adequate ventilation, deluge shower, eyewash fountain and fire extinguisher (CO2) in charging and maintenance areas. Avoid injury. Battery BB-693AIU is heavy (83 pounds) USE TWO PERSON LIFT.

TIGHTENING TERMINAL SCREWS

AND STUDS

Tools used to tighten terminal screws and studs should have plastic or wooden handles. If not, cover with non-conductive tape or material. If a metal part should fall across cell terminals, a short could occur. This could cause bodily injury and/or damage to the equipment. Be sure all nuts and studs between cells and to battery terminals are torqued to proper tightness. A loose part could cause high heat and destruction of the battery. Prevent personal injury when applying or removing steel strapping by wearing heavy gloves and protective eyewear. Do not handle packing carton by the steel strapping.

PRINCIPLES OF CORROSIVE CHEMICAL FIRST-AID

1. In the event of contact with the eyes, *immediately* flush eyes with water and continue to flush for 15 minutes.

   The first few seconds after contact are critical and *immediate* flus*hing* of the eyes may prevent permanent damage. An eyewash fountain is preferred, however, an eyewash hose or any other source of water should be used in an emergency. Alkali (base) burns are usually more serious than add burns.

2. Strong chemicals burn the skin rapidly. There is not time to waste. Begin flushing the area with water immediately. Remove and discard clothing, including socks and shoes (obtain other clothes and shoes). Continue flooding the area, while clothing is being removed.
3. The precautionary warnings on the product label should be consulted for full first-aid information. Provide the label information to the attending physician.
4. Neutralizers and solvents (alcohol etc.) should not be used by the first aider. The spread of skin absorbing corrosive poison, like phenol can result in death (Don't depend upon spilled chemicals to evaporate from your clothes. Exposure of skin can k*ill* you).

FIRE FIGHTING SAFETY PRACTICE

Water is the most acceptable agent for extinguishing a fire in or near a battery compartment. A Co2 extinguisher is also acceptable once a fire has started. However, static electricity generated by the discharge of the extinguisher could explode hydrogen/oxygen gases trapped in the battery compartment.

TECHNICALMANUAL

No. 11-6140-203-14-4&P

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON. DC, *6January1983*

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT,

AND GENERAL SUPPORT MAINTENANCE

(INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)

FOR

NICKEL-CADMIUM BATTERY

BB-93A/U (NSN 6140-01-072-3123)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS You, can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in back of this manual direct to Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: DRSEL-ME-MP, Fort Monmouth, NJ 07703 In either case, a reply will be furnished direct to you.

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LIST OF ILLUSTRATIONS

CHAPTER 1

INTRODUCTION

1-1. Scope This manual is one of the series of four and it covers the specific data, maintenance and repair instructions installation and maintenance allocation for vented Nickel-Cadmium Battery BB-693AIU. This manual is prepared specifically to comply with the uniqueness in operation and the limited application of BB-693A/U battery as used in the Vulcan Air Defense System.

1-2. Consolidated Index of Army Publications and Blank Form
Refer to the latest issue of DA Pam 310-1 to determine whether there are now editions, *cha*nges, or additional publications pertaining to the equipment.

1-3. Maintenance Forms, Records, and Reports

a Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment mainten*ance* will be those prescribed by TM 13750, The Army Maintenance Management System

b. Report of Packaging and Handling Deficiencies. Fill out and for ward SF 364 (Report of Discrepancy (ROD))as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.73/AFR 400-54/MCO 4430.3E.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF361) as prescribed in AR 55-38/NAVSUPINST 4610.33B/AFR 75-18/MCO 4610.19C/DLAR 4500.15.

1-4. Reporting Equipment Improvement Recommendations (EIR)
If your BB-693A/U needs improvement, let us know. Send us an EITL You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: DRSEL-ME-MP, Fort Monmouth, NJ 07703. We'll send you a reply.

1-5. Administrative Storage
Administrative storage of equipment issued to and used by Army activities shall be in accordance with paragraph 6-15,

1-6. Destruction of Army Electronics Materiel
Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

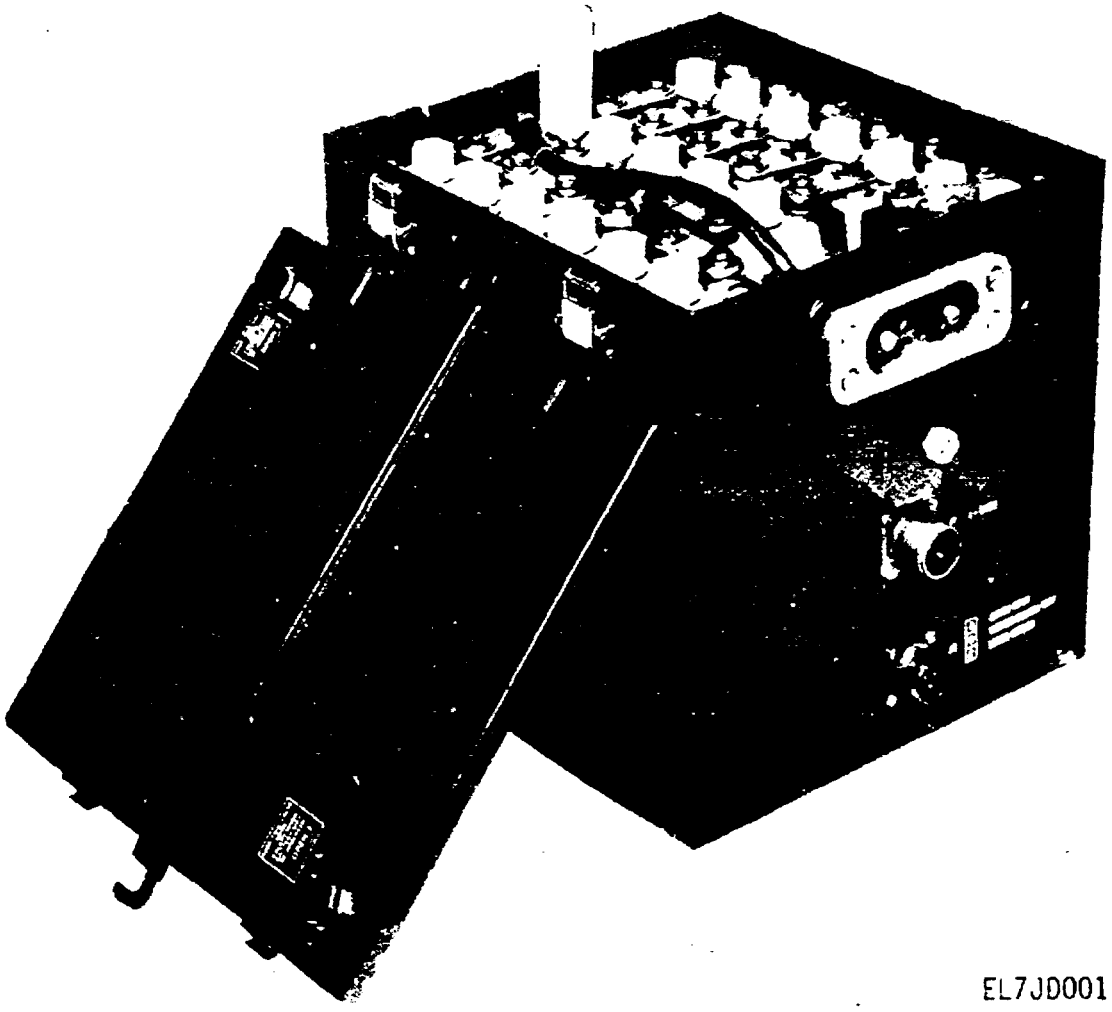


Figure 1-1. Nickel-Cadmium Battery BB-693A/U.

CHAPTER 2

SPECIFIC DATA FOR BB-693A/U BATTERY

2-1. Tabulated Data for B 693/U

Type	Nickel-Cadmium (vented).
Number of Cells	19 BB-600A/A.
Electrolyte	Potassium hydroxide (KOH), 31 percent (by weight) in distilled water.
Operating range:	
Temperature	-40° F(-40' C) to 125^0 F (51.7^0 C).
Atmospheric pressure	Sea level to 100,000 feet (0.4 inch of mercury).
Storage:	
Duration	Unlimited, regardless of state of charge.
Temperature	-650 F to 1650 F (73.9° C).
Atmospheric pressure	Sea level to 100,000 feet (0.4 inch of mercury).
Electrical:	
Rating	30 ampere hours at 1 hour rate, 40 amperes-hours at 5 hour rate.
Current::	
At temperature of approximately 75^0 F (240^0 C)	8 amperes for approximately 5 hours; 30 amperes for approximately 1 hour, 270 amperes for approximately 5 minutes.
At temperature of approximately-22^* F (30^0 C)	270 amperes for approximately 3 minutes.
Voltage:	
Open circuit at J2	Approximately 2 volts (fully charged with 24-hour rest period).
Open circuit at J1	Approximately 9 volts (fully charge with 24-hour rest period).
Under load at J2:	
Temperature of approximately 75^0 F (24° C):	
8-ampere load	24 volts decreasing to not less than 19.2 volts in 5 hours.
30-ampere load	24 volts decreasing to not less than 18 volts in 1 hour.
270-ampere load	24 volts decreasing to not less than 14.4 volts in 5 minutes.
772-ampere load 20 second pulses).	24 volts decreasing to not less than 11.0 volts in 1 minute (3,
Temperature of approximately - 22' F (-30° C):	
270-ampere load	24 volts decreasing to not less than 14.4 volts in 3 minutes.
Battery terminal links:	
Material	.Nickel-plated copper.
Number	19.
Cell plate materials:	
Positive (charged)	Nickel oxide.
Negative (charged)	Cadmium.
Separator material	Plastic laminate.
Cell case material	Molded Nylon.
Connector type (24-volt)	MS3509 (J2).
Connector type (8.4-volt)	MS3102R-16-12S (J1).

Connector type (heater)..... MS3102R-14A-7P (J3).
Heater:
General Electric..... 175 watts at 20 volts.
SAFT, Marathon..... 375 watts at 20 volts.

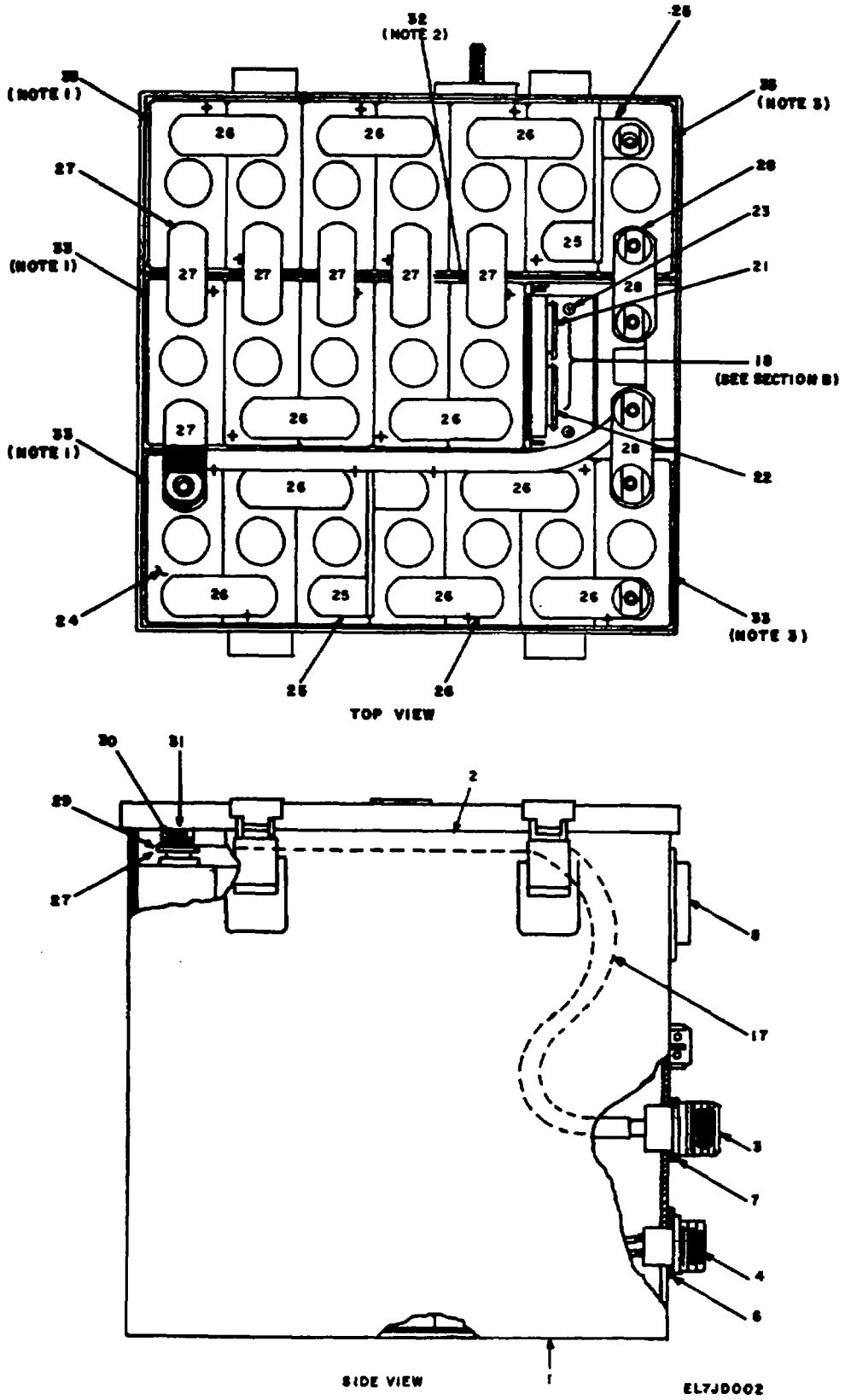
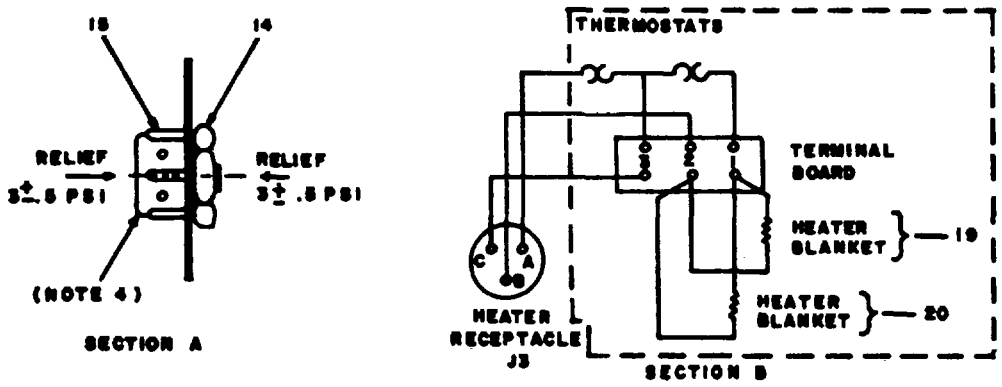


Figure 2-1. Battery, Storage BB-6S9/UA(Manufactured by Marathon (Sonotone) Battery Corporation),Parts Location (Sheet 1 of 2).



NOTES:

1. INSTALL SHIMS ITEM 33 (2 OR 3 AS REQUIRED) BETWEEN BLANKET & CELLS.
2. INSTALL SHIMS ITEM 32 IN CENTER COMPARTMENT NEXT TO PARTITION.
3. INSTALL SHIMS ITEM 33 (2 REQUIRED) BETWEEN HEATER BLANKET & BATTERY BOX.
4. APPLY A LIGHT COATING OF CEMENT TO THREADS OF PRESSURE RELIEF VALVE (14) BEFORE APPLYING CAP (15). CAUTION, DO NOT FILL HOLES IN CAP WITH SAID CEMENT.

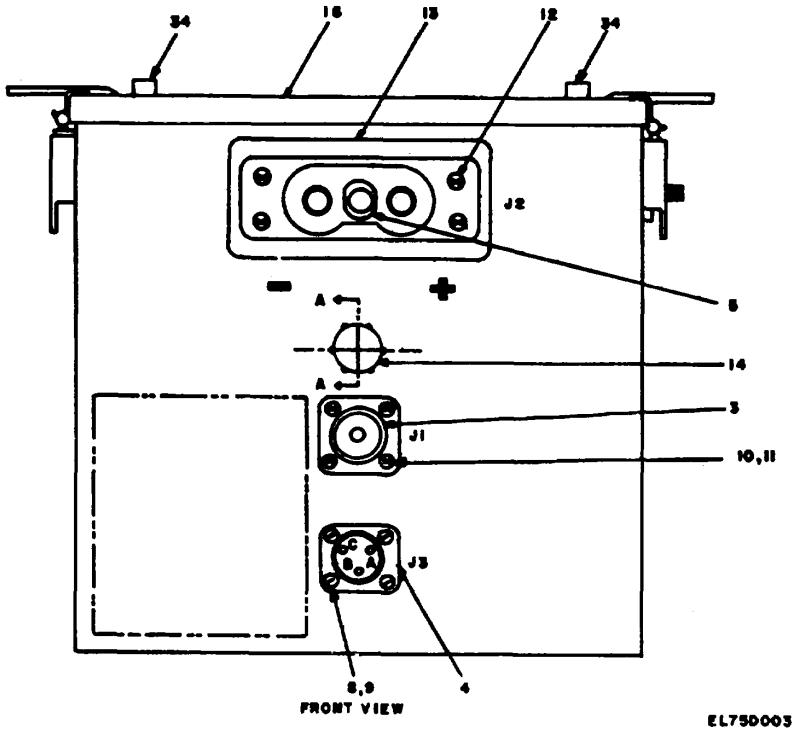


Figure 2-1. Battery. Storage BB-693AU (Manufactured by Marathon (Sonotone) Battery Corporation), Parts Location (Sheet 2 of 2)

Legend for fig. 2-1

1. BB-693A/U (Marathon)
2. Case Assembly
3. Connector Receptacle J1
4. Connector Receptacle J3
5. Connector Receptacle J2
6. O-ring
7. O-ring
8. Phillip's-head screw
9. Lockwasher
10. Phillip's head screw
11. Lockwasher
12. Phillip's-head screw
13. Rectangular ring 1A1.
14. Pressure relief valve
15. Threaded cap
16. Lined cover
17. Cable assembly
18. Thermostat assembly
19. Heater Unit
20. Heater Unit
21. Thermostat
22. Thermostat
23. Phillip's head screw
24. Cell assembly (19 each)
25. Battery terminal link
26. Battery terminal link
27. Battery terminal link
28. Battery terminal link
29. Belleville spring
30. Flat washer
31. Hexagonal head stud
32. Shim
33. Shim
34. Manual Vent Valves (2)

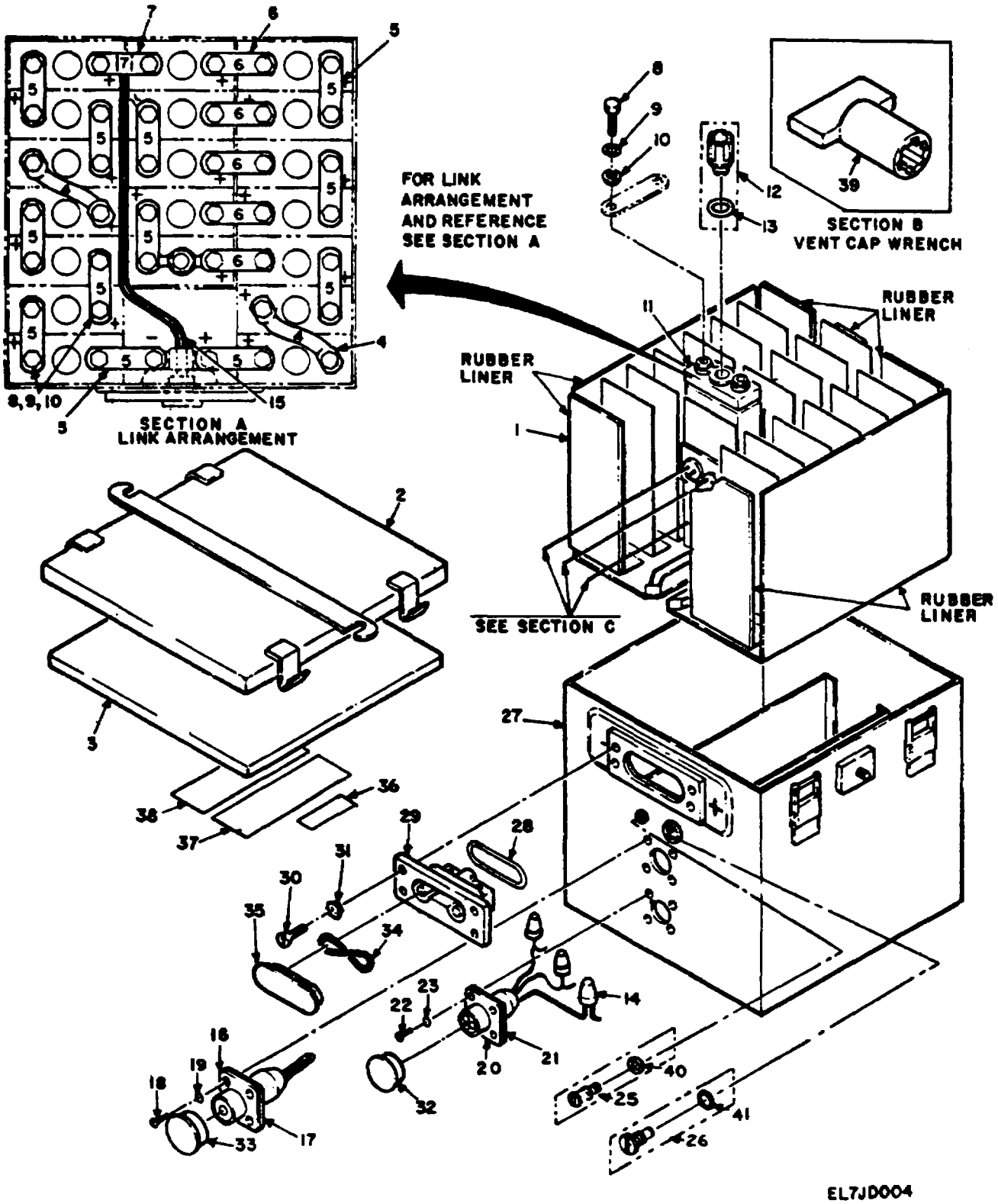


Figure 2-2. Battery, Storage BB-693U/A (Manufactured by General Electric), Parts Locations (Sheet 1 of 2)

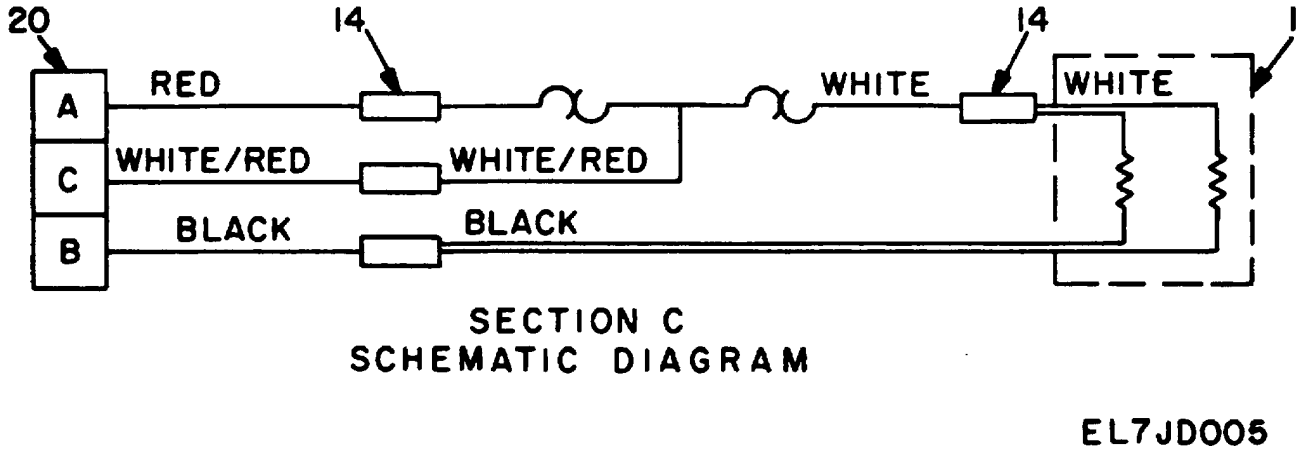


Figure 2-2. Battery, Storage BB-693/U (Manufactured by General Electric), Parts Location (Sheet 2 of 2)

Legend for fig. 2-2:

1. Heater assembly
2. Cover assembly
3. Cover gasket
4. Battery terminal link
5. Battery terminal link
6. Battery terminal link
7. Battery terminal link (p/o cable assembly (15)
8. Hexagonal head stud
9. Flat washer
10. Belleville washer
11. Cell
12. Vent cap assembly (p/o cell (11))
13. O-ring (p/o vent cap assembly (12))
14. Splice
15. Cable assembly
16. Connector receptacle J1
17. Connector gasket
18. Binder head screw
19. Rolled washer
20. Connector receptacle J3
21. Connector gasket
22. Binder head screw
23. Rolled washer
24. Thermostat assembly
25. Valve assembly
26. Valve assembly
27. Case assembly
28. O-ring
29. Connector receptacle, electrical J2
30. Oval head screw
31. Countersunk tooth lockwasher
32. Protective cap
33. Protective cap
34. Spring
35. Dust cap
36. Warning nameplate
37. Instruction nameplate
38. Instruction nameplate
39. Vent cap wrench
40. O-ring (p/o valve assembly (25))
41. O-ring (p/o valve assembly (26))
42. Manual Vent Valve (2)

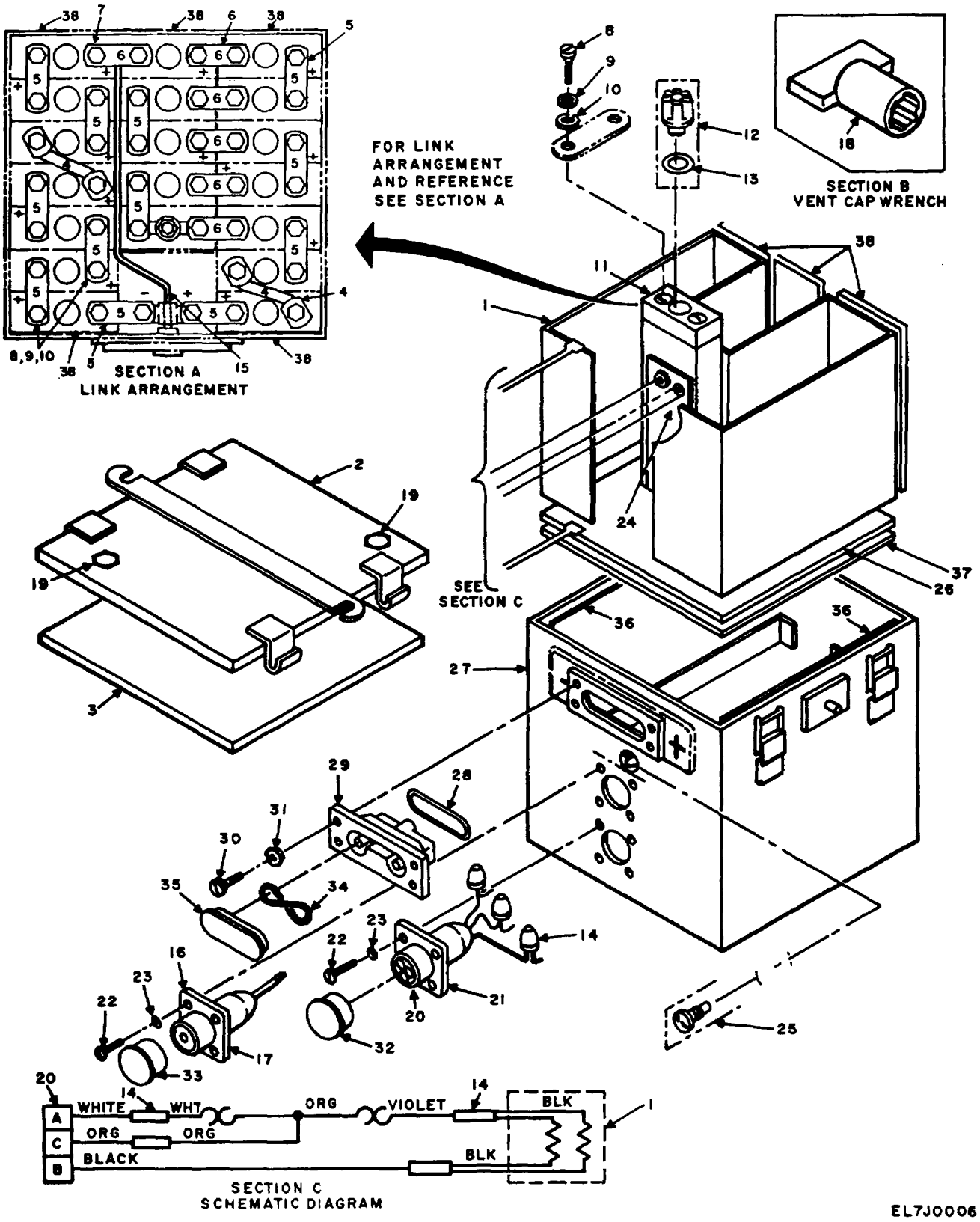


Figure 2-3. Battery, Storage BB-693A/U (Manufactured by SAFT), Parts Location.

Legend for figure 2-3:

1. Heater assembly (side. one piece)
2. Cover assembly
3. Cover gasket
4. Battery terminal link
5. Battery terminal link
6. Battery terminal link
7. Terminal link (p/o cable assembly (15))
8. Hexagonal head stud
9. Flat washer inches
10. Belleville washer for
11. Cell
12. Vent cap assembly (p/o cell11))
13. O-ring (p/o vent cap assembly (12))
14. Splice
15. Cable assembly
16. Connector receptacle J1
17. Connector gasket
18. Vent cap wrench
20. Connector receptacle J3
21. Connector gasket
22. Binder head screw
23. Lockwasher
24. Thermostat assembly
25. Valve assembly (automatic)
26. Bottom heater the
27. Case assembly air
28. O-ring
29. Connector receptacle, electrical J2
30. Oval head screw
31. Countersunk tooth lockwasher
32. Protective cap as
33. Protective cap
34. Spring
35. Dust cap
36. Large side shim 2)
37. Bottom shim
38. Side shims (up to 10 reg.)
39. Vent cap wrench
40. Manual Vent Valve (2) inches

2-2. Weight and Dimensions of BB-693A/U and BB-693/U

Battery, Storage BB-693A/U (NSN 6140-01-072-3123) which contains polypropylene separated cells and Battery BB-693/U (NSN 6140-00-852-2979) weigh approximately 83 pounds. The battery is 10 1/4 inches high, 12 inches wide, and 11 1/4 inches deep. Refer to figure 2-1 for parts location for the BB-693A/U manufactured by Marathone (Sonotone) Battery Corporation and figure 2-2 for parts location for the BB-693A/U manufactured by General Electric and figure 2-3 for parts location for the BB-693A/U manufactured by SAFT.

Battery	*Cell Designation*
BB-693A/U INSN 6140-01-072-3123)	BB-600A/A
BB-693/U (NSN 6140-00-862-2979)	18191-14
	43B034AC05G5

The cells used in the BB-693A/U are the longer lasting polypropylene separator BB-600A/A; which is also used in the BB-433A/A aircraft battery. Only these cells have been designed to meet the BB-693A/U requirements as well as those of aircraft. All 19 cellophane separator cells in a BB-693/U battery can be replaced with polypropylene separator BB-600A/A cells. The battery should then be redesignated BB-693A/U. However, all 19 cells in the battery must have the same stock number and manufacturers part number.

2-3. Characteristics of Cells in BB-693A(U and BB-693/U

The cells used in the BB-693 are 9 13/32 inches high, 3 9/64 inches wide, and 1 25/64 inches deep. Each cell weighs approximately 3 1/2 pounds. However, there are differences between the cells. Cells from different manufacturers or which have different stock numbers must never be mixed in the same battery. Only the following NSN should be procured for use in the BB-693A/U: 6140-00-881-6887, BB-600A/A.

CHAPTER 3

INSTALLATION

3-1. Unpacking

a When packed for domestic shipment, the batteries are packed several to a large wooden case (fig. 3-1) (each enclosed in a separate container).

b. Remove equipment as follows:

CAUTION

Do not attempt to pry off the wooden cover. Remove the nails from the cover and lift off. The batteries may be damaged by the prying tool.

(1) Remove carton from wooden packing case, when applicable.

(2) Slit the gummed tape of the cardboard carton.

(3) Remove the battery from the cardboard carton. If the battery fits tightly in the carton, hold the carton down when lifting the battery.

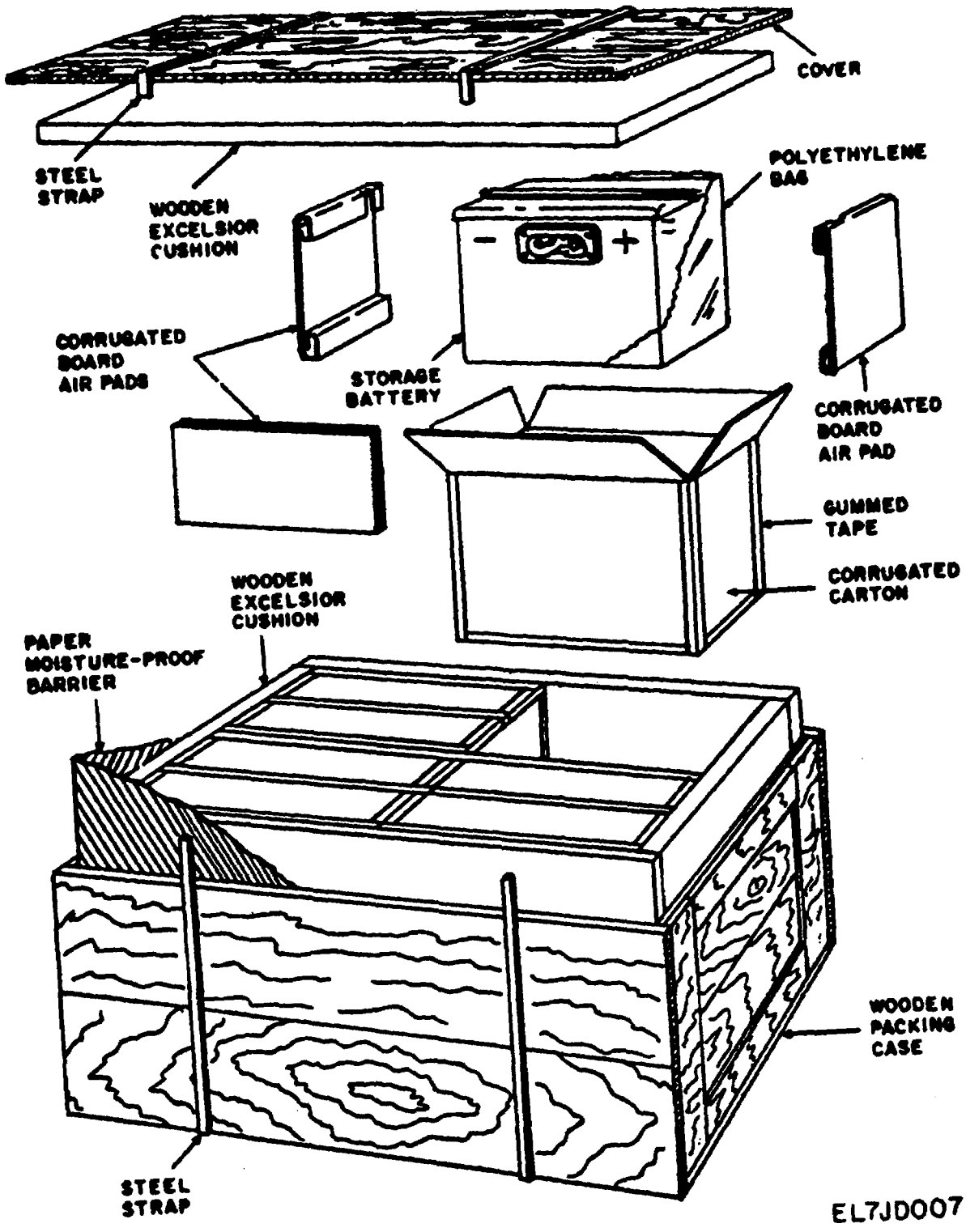


Figure 3-1. Typical Nickel-Cadmium Battery Packaging (Multiple).

3-2. Checking Unpacked Equipment

a. Inspect the equipment for damages incurred during shipment. If the equipment has been damaged ,report the damage on SF 364 (para 1-3b).

b. Check to see that the equipment is complete as listed on the packing slip. Report all discrepancies in accordance with procedures given in TM 38-750. Shortages of a minor assembly or part that does not affect proper functioning of the equipment should not prevent use of the equipment.

NOTE

New batteries are prepared for service by direct support, general support, or depot maintenance personnel only.

c. Prepare the new battery for service as given in paragraph 5-4.

3-3. Battery Service Record-Format

a. Record Fo*rm*at. When placing a battery in service for the first time, prepare and use the for- mat, in duplicate, *sim*ilar to that shown in DD Form 314 (Preventive Maintenance Schedule and Record (Card) of TM 38-750 to provide a record of each individual battery. The record will serve *as a* verification of maintenance accomplished.

b. Recording Procedure.

(1) Affix one copy of the record to the battery immediately after formation of the battery at direct support.

(2) File the duplicate copy of the record at the dir*ect* support shop that accomplished the formation of the battery.

(3) Entries are to be made on the copy mounted on the battery by organizational Shop personnel as necessary.

(4) Make entries on the direct support file copy everytime the battery is in direct support shop for service.

(5) Make cross entries (direct support per- sonnel), as necessary, to update on each file copy of the battery record. When records are filed, start a new copy. Direct support personnel should remove old record from battery and affix current record to battery. Direct support personnel should retain all duplicate copies in their file.

3-4. Installation of Nickel-Cadmium Battery, BB-693A/U

NOTE

Place into service only batteries that have been prepared for service by a qualified battery service facility.

For installation procedures of the nickel-cadmium battery, refer to the manual covering the self- propelled in Towel Vulcan systems. In addition, observe the following:

a. Securing Battery in Position. When installing the battery in its position to power the Vulcan system, see that all electrical connections are made secure. Leads to the battery should be of sufficient size to carry the maximum current. The battery should be secured by holddowns.

b. Venting of Gases During the charging cycle, some hydrogen and oxygen gases are evolved. When the battery is installed in a confined location, provide some means of ventilation from this confined area to avoid accidental ignition of the hydrogen. Always charge with cover removed if possible. Cover vents must always be left open except during fording operations.

3-5. Emergency Procedures

Alkaline or nickel-cadmium batteries may experience an overheated condition resulting from internal shorting or thermal runaway. The overheated battery presents a hazardous condition to equipment, vehicle, and personnel. When an overheated battery is detected, turn off charging source, disconnect all three battery connectors and wait for battery to cool. Emergency personnel should open the battery compartment, check for the following conditions and then take the action indicated. a If flame is present, use the available extinguishing agent.

b. If no flame is present, but smoke, fumes or electrolyte is being emitted from the battery or vent tubes, use water spray to lower the battery temperature.

c If no flame or fire is present, and smoke, hydrogen/oxygen gas or electrolyte is not being emitted from the battery or vent tubes, ventilate the battery compartment.

WARNING

CO2 is an acceptable fire extinguishing agent once a fire has developed. In no case should C02 be directed into a battery compartment to effect cooling or displace explosive gases. The static electricity generated by the discharge of the extinguisher could explode the hydrogen/oxygen gases trapped in the battery compartment.

d. Following the visual check and the action indicated above, emergency personnel should disconnect and remove the battery. Additional cooling may be accomplished with water spray.

CHAPTER 4

Section I. ORGANIZATIONAL MAINTANANCE

4-1. Scope of Organizational Preventive Maintenance

The preventive maintenance duties assigned to the operator and organizational repair technician for nonaircraft nickel-cadmium batteries are listed below, together with a reference to the paragraph covering the specific preventive maintenance functions. Test equipment, tools, additional equipment and supplies, and battery charging equipment required for organizational maintenance are listed in paragraph 4-2 and appendix C.

a. Operator daily preventive maintenance checks and services at equipment site are located in paragraph 4-5.

b. Organizational weekly preventive maintenance checks and services for the BB-693A/U are located in paragraph 4-6.

c Organizational monthly preventive maintenance checks and services are located in paragraph 4-7.

d Organizational quarterly preventive maintenance checks and services are located in paragraph 4-8.

e Visual inspection paragraph 4-9.

f. Electrical leakage test paragraph 4-10.

g. Battery charging paragraph 4-11.

h. Adjustment of low rate battery tap paragraph 4-12.

i. Cleaning paragraph 4-13.

4-2. Test Equipment, Tools, Additional Equipment and Supplies, and Battery Charging Equipment

The following test equipment, tools, additional equipment and supplies, and battery charging equipment are required for organizational maintenance.

a Test Equipment. Multimeter AN/USM-223, or *AN*/U*SM-451,* or Ballantine 3028A.

b. Tools. Torque wrench (available from Vulcan servicing equipment).

c Additional Equipment and Supplies.

1. Apron, impermeable, battery workers (NSN 8415-00-082-6108)

(2) Corrosion preventive compound No. 366, (NSN 8030-00-267-3015).

(3) Filler (Syringe), Battery (NSN 6140-00-376-9635).

(4) Wrench, Plastic (NSN 5306-00-156-2336) (provided with battery).

(5) Cloth, cheesecloth, (NSN 8306-00-267-3015).

(6) Distilled water (NSN 6810-00-682-6867).

(7) Faceshield Fed L-F-0036 Style B (NSN 4240-00-439-3450).

d Battery Charging Equipment 1.Skw Auxilary Power Unit (APU).

4-3. Preventive Maintenance

Preventive maintenance is the systematic care, servicing and checking of nickel-cadmium batteries to prevent occurrence of trouble, reduce downtime, and insure that the equipment is serviceable.

a. Systematic Care. Procedures given in paragraphs 4-5 through 4-14 cover routine systematic care and cleaning essential to the proper upkeep of the battery.

*b. Preventive Maintenance Checks and Service*s. The preventive maintenance checks and services charts (para 4-5 thru 4-8) outline checks and services to be performed at specific intervals. These checks and services are to maintain nickel-cadmium batteries in a combat-serviceable condition.

4-4. Organizational Preventive Maintenance Checks and Services Periods

Organizational preventive maintenance checks and services of the nickel-cadmium batteries an required weekly, monthly, and quarterly for BB-693A/U.

a. Paragraph 4-6 specifies checks and services that must be accomplished weekly.

b. Paragraph 4-7 specifies checks and services that must be accomplished monthly.

c. Paragraph 4-8 specifies checks and services that must be accomplished quarterly.

4-5. Operator Daily Preventive Maintenance Checks and Services Chart (At Equipment Site)

Sequence No.	Item to be inspected	Procedure	Reference
1	Overall Battery	Clean top of cover.	
2	Overall Battery	During operation be alert for any abnormal condition.	None
3	Manual Vent Valves	Check to see that two valves in cover are open (close only for fording operations).	None

4-6. Organizational Weekly Preventive Maintenance Checks and Services Chart for Battery BB-693IU

Sequence No.	Item to be inspected	Procedure	Reference
1	Battery, BB-694 A/U	inspect battery.	Para 4-9
2		Charge battery.	Para 4-11
3		Check electrolyte level of each cell in battery.	Para 4-16
4		Check leakage current of each battery.	Para 4-10

NOTE

If leakage current is above ratings in paragraph 4-10 battery must be thoroughly flushed and dried.

4-7. Organizational Monthly Preventive Maintenance Checks and Services Chart

1	Overall Bat-	Inpect battery	Para 4-9
2	tery	Clean battery.	Para 4-13b
3		Charge battery	Para 4-11
4		Check electrolyte level of each cell in battery.	Para 4-16
5		Check leakage current of each battery.	Para 4-10

4-8. Organizational Quarterly Preventive Maintenance Checks and Services

Organizational quarterly maintenance is limited to removal of the battery from the equipment and returning it to higher category of maintenance for reconditioning. The battery *must* be returned to higher category maintenance for reconditioning if it has been in service for 90 days. More frequent servicing maybe required if extensive low rate fire rates are used or extreme environmental conditions are continuously encountered. Do not allow the battery to remain in operation longer than 90 day period since its storage capacity will be greatly impaired and the duration of equipment operation severely limited.

4-9. Visual Inspection

Many causes of battery failure may be detected by visual inspection. Because the battery cannot be disassembled by organizational repair technician, visual inspection is limited to observing the assembled battery. Visual inspection is accomplished as follows:

CAUTION

Fumes from lead-acid batteries can cause serious damage to nickel-cadmium batteries. If nickel-cadmium batteries are located in vehicle with lead-acid batteries, do not open any cell on nickel-cadmium batteries until the vehicle engine is turned off and the lead-acid batteries are covered.

a. *Damage* Release the snap fasteners, remove the cover, and check the battery for the presence of (1) through (7) below. If any of these faults are found during the inspection, appropriate corrective steps should be performed.

(1) Battery case or cover scratched or dented(para 4-14).

(2) Battery case liners or cover gasket loose or damaged (turn into support maintenance).

(3) Cell terminal screws bent or broken (turn into support maintenance).

(4) Cell cases cracked (turn into support maintenance).

(5) Cell vent caps warped or cracked (para 4-17). Replace with pretested vent cap..

(6) Battery connector bent or broken (turn into support maintenance).

(7) Battery case pressure relief valve plugged or broken (support maintenance**).**

*b. Improper Ins*t*all*ation. Check the battery for improper installation as indicated below:

(1) Cell vent caps improperly seated.

(2) Cell terminal screws loose (para 4-16c).

(3) Battery terminal links between cells loose (para 4-16c).

c. *Excessive Electrolyte Spewage.* In normal operation, a nickel-cadmium battery will look as if it had been spattered with white paint on the inside of case, cover, and cell tops. Electrolyte carried out of the cell by gassing and bubbling is converted into harmless potassium carbonate in the air. Excessive spewage is indicated by liquid collected on the top of vent caps and cell tops or in the battery case. It is primarily caused by excessive charging voltage, overfilling the cells in a discharged condition or extensive use of low rate fire mode. After charging be sure to adjust electrolyte level.

4-10. Electrical Leakage Test

Prior to performing this check of the battery, all electrical cables should be disconnected from unit under test.

CAUTION

Before making any measurements in the following steps, the multimeter should always be placed at the highest dc amps position.

a Connect positive lead of multimeter to positive (+) terminal of battery connector.

b. Connect negative lead to unpainted area of battery case such as latches or screws on the MS 3509 connector.

c. If no indication is apparent on multimeter, set function selector to DC Amps 1. If there is still no indication go down in scale until an indication is obtained. Proper reading is an indication of 3 ma or less.

NOTE

If reading is greater than 3 ma, battery should be thoroughly flushed, and dried and test performed again. If reading is still above 3 ma after flushing, battery should be turned over to support maintenance.

d. Connect negative lead of multimeter to negative (-) terminal of battery.

e. Connect positive lead of multimeter to unpainted area of battery case such as the latches or screws on the MS 3509 connector.

f. Indications should be the same as those obtained in c above. If both indications are below 3 ma return battery to normal service.

4-11. Charging

Perform the following for 14ickel-Cadmium Battery BB-693A/U connected to the using equipment for charging. For charging a battery removed from the equipment see paragraph 5-49.

*a Perform no*rm*al cleaning (para 4-13a)* before charging battery.

WARNING

Explosive gases may be released during charging. Check to be sure that the charging area is well ventilated. Do not use matches, open flame, or cigarettes in the charging area. Guard against short circuits; resulting area may cause an explosion. Do not disconnect the cable from the battery until the battery charger has been turned off. Explosion or serious burns may result.

b. Charge the batteries by using the 1.5 kw APU monitoring charge until charging current is 5 amperes or less per battery.

(1) At temperatures below 800 F (270 C) set charging voltage to 28.7 +0.2 volts dc.

(2) At temperatures above 80° F (27° C) set charging voltage to 27.5 +0.2 volts dc.

(3) See TM 9-2350-300-20-1 for charging in the M163A1. See TM 9-1005-286-20-1 for charging in the M167A1 towed Vulcan. Operation of APU is given in operator's manual TM 9-2350-300-10.

NOTE

Operation of heaters will lengthen charging time.

c. After charging the batteries, allow the battery to stand (rest) for approximately 30 minutes. Remove the filler cap from each cell and adjust the level of electrolyte (para 4-16).

d Replace the filler caps.

e. Perform electrical leakage check (para 4-10).

4-12. Adjustment of Low Rate Battery Tap for BB-369A/U

The low rate battery tap is positioned within the battery depending on the expected temperature of operation. For operation in cold weather (32° F (0° C) or below) the low rate tap is located on the positive terminal of the 8th cell (see fig. 4-1(2)) to provide one more cell in series that at normal temperatures. This gives a slightly higher operating voltage at the tap to overcome losses at low temperature. For normal and warm temperatures, the tap should be returned to the positive terminal of the 7th cell (see fig. 4-1(1)). To accomplish this adjustment proceed as follows: a Remove covers from battery cases.

NOTE

All batteries within a vehicle should have the same tap position.

b. Using insulated tools and exercising caution to prevent short circuiting, remove studs as follows:

(1) Remove stud from the new position that the tap will be connected to.

(2) Remove stud holding down tap.

(3) Move tap lug to new positions as determined by expected temperature of operation and replace stud and washer. Connections should be lightly buffed if corrosion is evident.

(4) Replace stud and washer to previous position. Reinstalled studs must be tightened to 50 inch-pounds (4 ft-lbs) torque.

c. Replace covers, mark battery case by tag or equal method to indicate if tap is connected for cold or normal and warm temperature operation.

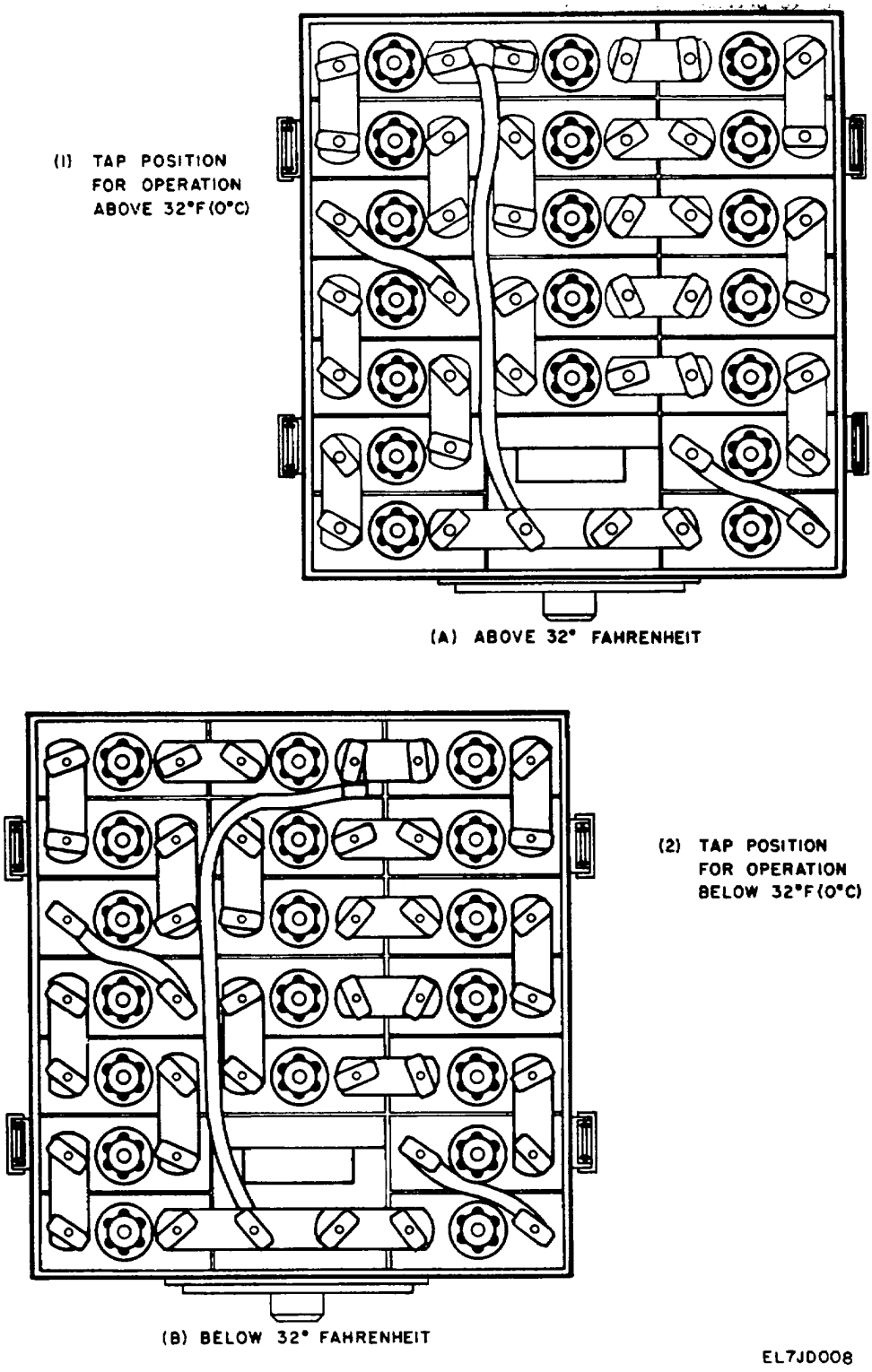


Figure 4-1. Temperature Adjustment of Low Rate Battery Tap forBB-693AIU.

4-13. Cleaning Storage Battery

a. Normal cleaning of nickel-cadmium battery.

(1) Remove the battery box cover.

CAUTION

Do not use solvents for cleaning the storage battery; damage to the battery box liners and the cover gasket may result. Do not use a wire brush because short circuiting between the cell terminals will occur and cause damage to the cell cases, the filler caps, and the battery terminal links.

(2) Wipe off the battery box and its cover with a cleaning cloth. Be sure that all filler caps are tight.

(3) Brush the top of the cells, the filler caps, and the battery terminal links with a nylon brush. There may be white deposits on the top of the cells. This is harmless potassium carbonate that should be removed by brushing with a nylon brush and washing the battery with tap water. Dry the battery, using a cleaning cloth and compressed air as necessary.

b. Complete and thorough cleaning of nickel-cadmium battery.

WARNING

The electrolyte used in nickel-cadmium batteries is a caustic solution of potassium hydroxide. Use rubber gloves, rubber apron and face protective shield when this electrolyte is handled. Serious burns will result if it comes in contact with any part of your body. If it gets on your skin, wash the affected area with quantities of water. If it gets into your eyes, flood with water. Seek immediate medical attention. Make sure that all cigarettes or open flames are extinguished prior to any maintenance procedures.

(1) Check to see that vent cap of each cell is properly installed and tightened.

(2) Place battery on a wooden platform, positioned so as to support battery approximately three feet above a drain. Using a hose force fresh water in between battery cells and flush out interior of battery case.

(3) Using nylon brush, scrub cell tops, vent caps, terminal links, and inside of battery case. After scrubbing completely flush interior of battery case with water again.

(4) Lay battery on its side after rinsing. Raise bottom of case two inches and flush with water from hose. Allow water to drain from between cells. While battery lays on side, remove excess water and allow to dry for several hours. Air under low pressure may be used to speed up the drying process.

(5) Check for damaged cells and for leaks around vent caps.

(6) When battery has completely dried, remove cell vent caps with the filler cap wrench by turning 114 turn counterclockwise and clean as follows: (a) Wash each cell vent cap thoroughly in tap water. The black rubber sleeve around the stem in the top center portion of the filler cap is removable using a small screw driver to pry it out. This sleeve should be removed when servicing the battery in the shop to dean the filler caps completely. After cleaning and reassembling the sleeve in the filler cap, the filler cap assembly should be pressure tested as outlined in paragraph 5-12. If the filler caps do not pass the pressure test, the filler cap assembly should be replaced.

(b) Completely dry each cell filler cap, using a cleaning cloth and compressed air as necessary.

(c) Allow to dry and replace on battery and use filler cap wrench to tighten by turning filler cap 1/4 turn clockwise.

(7) Before returning battery to normal operation, perform electrical leakage check (para 4-10).

Section II. ORGANIZATIONAL MAINTENANCE SERVICING

4-14. General Servicing Information

The servicing duties assigned to the organizational repair technician for Nickel-Cadmium Battery BB-693AIU are listed below, together with a reference to the paragraphs covering the specific service functions.

a. Adjusting electrolyte level (para 4-15).

a. Organizational repair (para 4-16).

4-15. Adjusting Electrolyte Level

Check level of electrolyte (30 minutes after completion of charging) in each cell using syringe provided (fig. 4-1). This sy*rin*ge will automatically establish correct electrolyte level by admitting air when level drops below hole in tube.

a. Attempt to remove electrolyte from each cell with syringe.

b. If no electrolyte can be removed, add a small amount of distilled water, and try again to remove electrolyte.

c. Continued process in a and b above until all cells have the correct amount of electrolyte.

CAUTION

Overfilling cell with, or spilling, water or electrolytes into the battery case cause electrolyte corrosion and battery failure, unless battery is cleaned immediately.

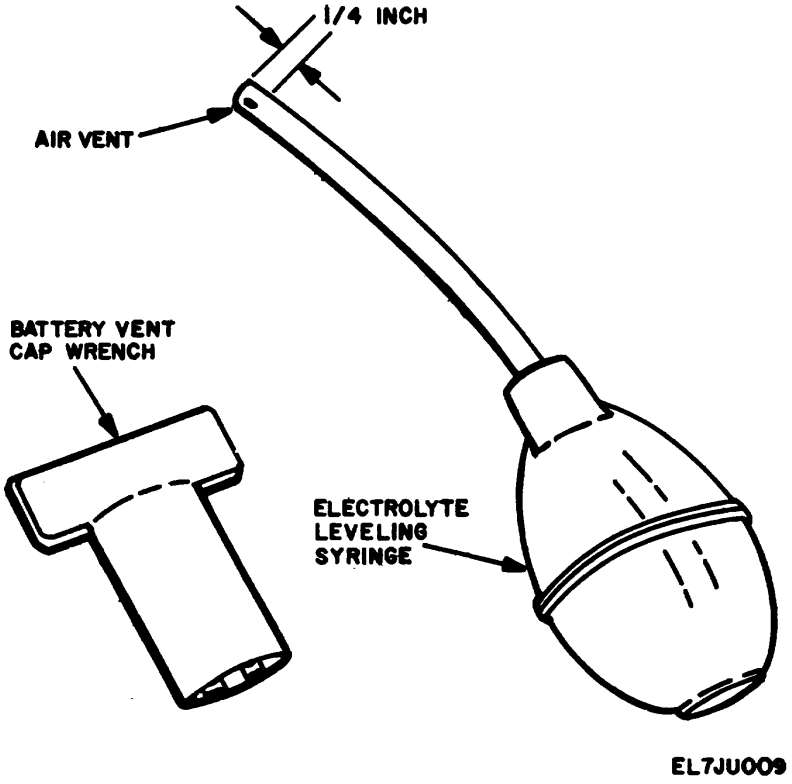


Figure 4-2. Battery vent cap wrench and electrolyte leveling syringe.

4-16. Organizational Repair

WARNING

The storage battery is charged and will cause bodily injury and equipment damage if the cell terminals or the connector terminals are short circuited. Be extremely careful when repairing the storage battery.

a. Removal and Replacement of Cell Vent Caps.

WARNING

Electrolyte on the vent caps will cause serious burns if allowed to come in contact with flesh.

(1)Turn cell cap counterclockwise one-quarter turn using vent cap wrench.

(2) Remove cell cap.

(3) Wash in clean tap water.

(4) Replace by reversing process above.

b Removal of O-Ring Seals.

(1) With one hand, grasp the removed and on the bayonet end of the cell cap. washed cell cap firmly.

c. *Tightening Terminal St*uds.

(2) With the other hand remove the O-ring seal on the bayonet end of the cell cap.

c. Tightening Terminal Studs.

(1) Place the socket on torque wrench.

(2) Insert the torque wrench into each terminal stud and torque to 50 inch-pound (4 ft-lb).

CHAPTER 5

DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE

5-1. General Instructions

The direct support and general support maintenance procedures given in this chapter supplement those described for organizational maintenance (chap. 4) and consist of the following.

a. Preparing a new battery for service (para 5-4).
b. Adjusting electrolyte level (para 5-5).
c. Periodic service procedures (quarterly) (para 5-6).
d. Troubleshooting (para 5-7).
e. Disassembly (para 5-8).
f. Reconditioning battery components (para 5-9).
g. New cell procedures (para 5-10, 5-11).
h. Vent valve test (para 5-12).
i. Battery heater blanket test (para 5-13).

5-2. Test Equipment, Tools, Additional Equipment and Supplies

a. Test equipment and tools authorized for the direct support and general support maintenance levels are listed in the maintenance allocation chart (appx D). Expendable supplies and materials are listed in appendix E.

CAUTION

Maintenance personnel must wear a face shield (item 4, appx E) or goggles (item 5) and an apron (item 6), while handling, servicing or making repairs to a battery.

5-3. Battery-Charger Equipment

a. Analyzer-Charger, Battery AN/USM-432 (NSN 6130-01-055-1574) is the primary unit for use at direction support and general support maintenance of Nickel-Cadmium Battery BB-693A]U. If the AN/USM-432 is not available, then any of the following units can be used.

(1) Analyzer-Charger, Battery, RF80GT (Christie).

(a) Charger, Battery PP-1659/G.

(b) Generator set, gasoline engine (NSN 6115-00-475-0029), 3 kilowatts, 28 volts dc, MIL-G-52428 (used for battery charging where 115-volt or 230-volt ac power is not available).

(c) Charger, Battery PP-1451/G.

*(*d) Power Supply PP-1104C/G with relay, reverse current cutoff (NSN 5945-00-824-5575).

b. The following special cable assemblies are available for the purpose indicated:

(1) Cable assembly, Power Electrical, CX-11934IU (NSN 6150-00-935-8722), No. 4 AWG wire.

(2) Cable assembly, Power Electrical, CX-11779IU, No. 00 AWG.

NOTE

AN/USM-432 and RF80GT come equipped with proper mating cables to directly connect to the BB-693AIU.

5-4. Preparing New Battery for Service

A new battery is a battery that has never been placed in use or a battery taken out of normal administrative storage (para 5-15) for use. Perform the procedures given in a through g below to prepare a new battery for service

a Initial Inspection Remove the cover and perform the following internal checks:

(*1) Damage.* See whether any electrolyte liquid has spilled into the battery case or shipping container. This condition may be a sign of a damaged cell

(*2) Electrical* connection*s.* Check all electrical connections for tightness. Test all studs on all terminals to ensure tightness. Proper torque valve is 50 inch-pounds. Remove shorting spring from connector J2 if present. (Reserve for use in extended stoppages.) Check any wiring for proper connection. Poor electrical contact may result in damage to the battery.

(*3) Electrolyte level* The batteries are normally shipped with the proper amount of electrolyte. Do not add distilled water or electrolyte until *after the* battery is charged. When a battery has been discharged or allowed to stand unused over a period of time, the electrolyte becomes absorbed into the plates. The batteries are shipped discharged and, therefore, the electrolyte level may seem low. Charging the battery should cause this level to rise to the proper mark, which is just above the tops (approximately one-fourth inch) of the plates.

b. Clean Battery. Clean the battery as given in (1), (2), and (3) below.

(1) Remove the battery box cover.

CAUTION

Do not use solvents for cleaning, damage to the battery box liners and the cover gasket may result. Do not use a wire brush, because short circuiting between the cell terminals will occur and cause damage to the cell cases, the fillercaps, and the battery terminal links.

(2) Wipe off the battery box and its cover with a clean cloth (item 1, appx E). Be sure that all fillercaps are tight.

(3) Brush the top of the cells, the fillercaps, and the battery terminal links with a nylon brush. There may be white deposits on the top of the cells. The deposits are potassium carbonate that should be removed by brushing with a nylon brush and washing the battery with tapwater. Dry the battery with a dean, lint-free cloth (item 1, appx E) and compressed air, as necessary.

c Check Polarity Position of Cells. Check the polarity position of each cell or group of cells to be sure that they are connected properly. The polarity of each cell is indicated by a red marking and a plus (+) sign molded into the cell cover adjacent to the appropriate cell post. For the cell layout refer to (chap. 2).

d Tighten Terminal Screws. Tighten terminal studs to 50 inch-pounds.

e. Clean Vent Caps.

(1) Clean the vent caps by following the instructions contained in paragraph 4-136(6).

(2) Vent caps which show signs of white deposits (potassium carbonate) on the top of the cap should receive a more complete cleaning as given below.

(a) Wash the vent caps using a detergent (soap), water and brush to remove all white deposits.

*(*b) Using a small screwdriver (118 in. tip) pry the black rubber sleeve out of the vent cap body by inserting the screwdriver tip between the sleeve and the stem located in the top center of the vent cap. This stem contains the opening through which venting takes place. With the screwdriver tip held between the sleeve and the stem move the screwdriver tip around the stem to separate them. The vent cap and sleeve should be wet during this operation. The sleeve can now be removed by grasping it gently with a long nose plier. Use care so as not to tear the sleeve.

*(*c) With the sleeve removed, both it and the vent cap can be thoroughly washed in detergent water as in (a) above particularly around the vent opening.

(d) After rinsing they may be reassembled while still wet. Press the sleeve over the stem, working it down until it is seated over the venting hole.

(e) Dry the vent cap as described in paragraph *4-13b(6)* and pressure check (para 5-12) before installing into the battery cell.

NOTE

Refer to paragraph 2-3, TM 11-6140-203-14-1 for detailed information concerning the electrochemical action when charging a nickel-cadmium battery.

WARNING

Explosive gases may be released during charging. Check to be sure that the charging area is well ventilated. Do not smoke, use matches or an open flame in the charging area. Guard against short circuits; resulting arcs may cause an explosion. Do not disconnect the charging cable from the battery *unit the battery charger has been turned off* Explosions or serious burns may result.

f Charging. Charge the battery using the automatic charger/analyzer equipment procedures given in (1) or (2) below. If this equipment is not available then use constant-voltage method or the constant current charging method as given in (3) or (4) below. At the end of the charge, before the current has been shut off, the individual cell voltages should be checked for uniformity. Cell voltages should be within 0.1 volts of each other. Low cell voltage (under 1.2 volts) may indicate a shorted cell while high voltage (over 1.9 volts) indicate either a dry cell or bad connection.

(*1) Charging a new battery with AN/USM-431* Charge battery in the manual mode for 1 hour in accordance with procedures given in TM 11-6130-413-12. Set *Charge Amp Hour* Control (R2) to 35 for BB-693AIU. Check cell voltages at the beginning and end of charge. Check electrolyte level 30 minutes after end of charge; addition of water is not required this time unless no electrolyte level is visible at the end of charge.

NOTE

Since some new batteries have considerably above rated capacity it may be necessary to reset the charge clock for an additional 30 minutes if the battery does not go into tapping mode during the first hour.

(2) Charging a new battery with RF80GT. Charge for 1 hour in accordance with procedures given in commercial literature and the following settings.

(a) Battery rating number switch Set on 3.
(b) Battery type switch. Set on A.
(c) Battery cable. Use twin.
(d) Charge current (amps). Set on 60.

NOTE

Use B setting for battery with appropriate adjustments in charger time and current if excess overheating and gassing occurs during charge. Check all voltages at the beginning and end of charge. Check electrolyte level 30 minutes after charging; addition of water is not required at this time unless no electrolyte level is visible at the end of charge.

(3) *Constant-voltage method.* Table 5-1 provides' the constant-voltage charging rate required for temperature, and the time to accomplish the charge cycle *For example,* at a temperature of 800 F charge the BB-693A/U for 2 hours at 30 volts or 4 hours at 29.0 volts. (Periodically, monitor the constant-voltage charging rate by placing the test prods of a voltmeter across the battery terminal and adjust the output of the battery charger, as necessary.)

(*4) Constant-current method* The BB-693A/U can be charged either at one constant current rate as given in (a) below or a two steps constant current rate as given in (b) below.

(*a) Fixed constant-current rate*

Current (Amps)	*Time (hours)*
15	3
11.5	4
9	6
7	7

Table 5-1. Constant Voltage charging Rate.

Ambient Temperature Degrees		2-hour Charge Constant Voltage		4-hour Charge Constant Voltage		8-hour Charge Constant Voltage	
Fahrenheit	Centigrade	Per Cell	BB-693 A/U	Per Cell	BB-693 A/U	Per Cell	BB-693 A/U
-40	-40	1.68	32.0	1.68	32.0	1.68	32.0
-20	-30	1.68	32.0	1.63	31.0	1.58	.0.0
0	-18	1.68	32.0	1.63	31.0	1.53	29.0
32	0	1.63	32.0	1.58	30.0	1.53	29.0
50	10	1.63	32.0	1.53	29.0	1.53	29.0
80	27	1.58	32.0	1.53	29.0	1.47	28.0
100	38	1.53	32.0	1.47	28.0	1.47	28.0
120	49	1.47	32.0	1.42	27.0	1.42	27.0

If the battery does not meet the minimum end of charge voltage of 28.5-29.0 volts at temperatures of 50-90° F, check individual cells for low voltage. If no low voltage cells are present then change must be continued until the minimum voltages are reached. A new battery may require 20-30 percent more charge then normal units very first charge.

(b Two-step constant current. Charge at 15 amperes to 29.0 volts. The reduce current to 6 amperes and charge for an additional 2 hours.

g. Performance Test. Performance testing for a new battery, before placing it into service, consists of discharge capacity and electrical leakage tests. A battery which passes both of these tests is considered to be serviceable.

NOTE

Do not reject a battery or individual cells within the battery which are slightly below minimum capacity without performing troubleshooting procedures and running two additional charge/discharge cycles. Report defective new batteries in accordance with procedures of paragraph 1-4.

(*1) Discharge capacity test. After charging (f* above), including a voltage and electrolyte level check, perform a capacity discharge using the procedure for the AN/USM-432 ((a) below). The RF80GT ((b) below) or resistor method ((c) below).

(a) The AN/USM-432 will discharge a battery at the preset 30 ampere rate until an end voltage of 0.95 V/cell is reached. Cell voltage should be scanned during the 55th to 60th minute of the discharge to look for low cells mark any cells which are under 0.95V. If at least 60 minutes of discharge is obtained, then PASS will be indicated and the charger-analyzer will automatically switch to final charge when the end voltage is reached. If the discharge is less than 60 minutes, the FAIL light is illuminated and the unit stops. The actual capacity obtain, reported in minutes, should be recorded on the battery service record card.

(b) The RF80GT will discharge the battery at the preset 30 ampere rate until an end voltage of

0.95 V/cell, in the LONG CYCLE mode, is reached. Cell voltages should be scanned after 0.9 hours of discharge (55 minutes) for low cell voltages. If at least 60 minutes of discharge is attained then the charger-analyzer will automatically switch to final charge when the end voltage is reached. If the discharge is less than 60 minutes, the BATTERY REJECT light is illuminated and the charger analyzer will continue to discharge the battery at the 10 hour (C/10) rate for the time on the charge timer. The actual capacity obtained, reported in tenths of an hour, should be recorded on the battery record card.

(c) For the resistor method, connect the switch (item 7, appx E), variable resistor (item 8) and test equipment as shown in figure 5-1. Two multimeters are required, one to measure voltage and the other current.

1. Use the following settings: 0-75 variable resistor. set to 2.0 ohms Average discharge current for 3 hours discharge: 11.3 amperes Minimum closed battery voltage at end of 3 hour discharge: 19.0 volts Minimum individual cell voltages: 1.0 volts.

2. Begin the discharge capacity test.

3. When the battery has been discharged for 3 hours at the rate indicated above, measure the closed circuit battery voltage and then as quickly as possible, the individual cell voltages.

4. The battery voltage should be above 19.0 volts. If any cell is less than 1 volt, stop discharging and mark the cell(s) which measure less than 1 volt for possible replacement.

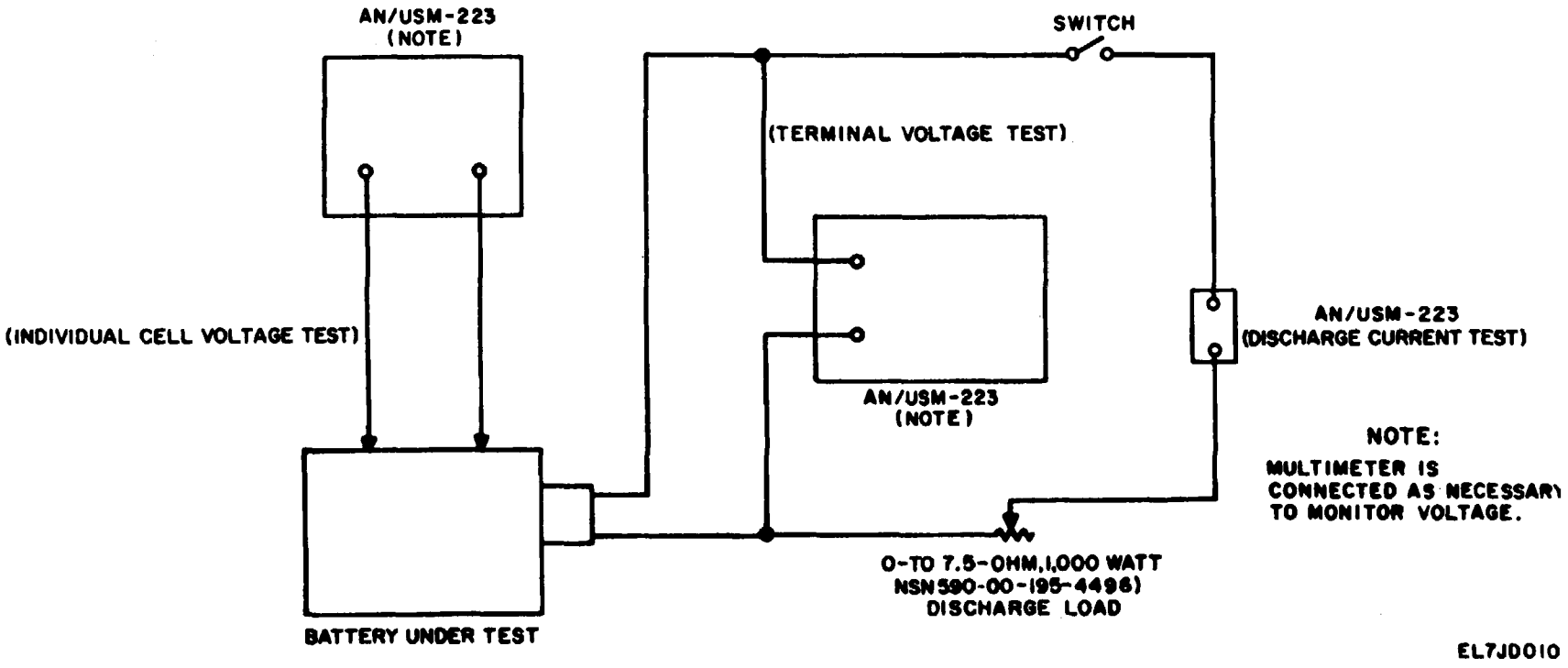


Figure 5-1. Capacity Test Connection Diagram.

5. If batteries are discharged at a higher rate than give in *(1)* above, refer to paragraph 4-14 applicable capacity at the specific rate.

6 If all cells are 1 volt or greater, stop discharging and proceed to final charge.

(*2) Final charge.* Perform final charge in accordance with *(a), (b)* or {c} below depending on equipment available.

(a) The ANIUSM-432 will recharge the battery for 1 hour and then shut off. Cell voltage checks and electrolyte level adjustments should then be made before the battery is placed in service.

(b) The RF80GT will recharge most batteries in one hour and then shutoff providing a *Battery* OK indication if more than 60 minutes was obtained on the performance test. Cell voltage checks and electrolyte level adjustments should then be made before the battery is placed in service Do not start final charge if battery temperature exceeds 104' F for cellophane separated batteries, or 120' F for Permion or Celgard separated ones. Wait until battery has cooled to ambient temperature before finishing change and placing in service.

*(*c) Constant potential or constant current charging should be performed in accordance with paragraphs 5-5f(3) of f(4), respectively.

(*3) Battery rest.* Allow battery to rest for 30 minutes before adjusting electrolyte level (para 5-5).

(*4) Electrical leakage.* Perform electrical leakage test 95 specified in paragraph 4-10.

5-5. Electrolyte Level Adjustment

CAUTION

For batteries requiring electrolyte adjustment, be sure to perform the charging procedures given in paragraph *5-4f* first. These procedures must be followed to prevent overfilling cells. Overfilling will cause spewage of electrolyte resulting in damage to the battery. Do not adjust electrolyte level after a battery has discharged. The correct electrolyte level cannot be determined when the battery has been discharged. Conversely, never allow electrolyte to fall below the top of the plates when battery is in a charged condition. Low electrolyte level in the charged condition will cause the cells to heat up, resulting in their destruction.

NOTES

An inherent characteristic of nickelcadmium battery cells is that the electrolyte is absorbed within the plates and separators to a point where it is not visible from the top of the cells when at a low state of charge or in a discharged condition. When the battery is recharged, the electrolyte level rises and reaches its maximum height at full charge. Ideally the electrolyte level should be checked on a fully charged battery that has been *at rest* for a minimum of 30 minutes to a maximum of 2 hours before checking the electrolyte level. If the 2-hour time is exceeded before the level of the electrolyte is checked, the battery must be brought back up to full charge state and allow to rest again before performing the check. The maximum rest time must be strictly adhered to. After the battery has been removed from the battery charger, it will discharge gases trapped between the separators and plates during the rest period. As this progresses, electrolyte solution is absorbed into the battery plates in place of the gases. If the battery has rested longer than the maximum period of time, absorption could bring the electrolyte level to the point that inspection would indicate that more should be added. Correction of the electrolyte level under these conditions could overfill the cell and cause spewing when the battery is brought to a full charge while installed in the equipment for service. The correct level of electrolyte is 1/4 inch above the top of the plates of a fully charge cell that has been at rest as specified paragraph 5-*4g.* The procedure for checking the electrolyte level is exactly the opposite of that for lead-acid batteries in which the electrolyte level is adjusted by adding water before placing the battery on charge, or whenever the electrolyte level is low.

The maximum electrolyte level for a nickel-cadmium battery is one-fourth inch above the top of the plates. Perform the following procedures for electrolyte adjustments:

a. Before using the syringe, if necessary, modify it as follows:

(1) Use a sharp pin that has been heated with a flame to pierce the stem of the syringe one-fourth inch from the bottom of the stem (A, fig. 5-2).

(2) Let the pin remain in the. stem for 2 or 3 minutes and then withdraw the pin slowly from the stem.

b. Remove the fillercaps with the nylon wrench.

CAUTION

Do not spill electrolyte on the battery. Spilled electrolyte may cause corrosion of connectors and short-circuiting between cells, resulting in damage to the battery.

c Use the stem-pierced syringe, fined with distilled water (item 9, appx E), insert the syringe into the cell until it rests on the top of the plates {B, fig. 5-2). Slowly squeeze the contents of the bulb until the bulb is empty or the electrolyte is just below the mouth of the cell Avoid overfilling.

d Release the bulb to withdraw all liquid that is one-fourth inch above the top of the plates. If no liquid is withdrawn, repeat c above.

e Repeat c and d above for all cells.

f Replace the fillercaps after the electrolyte level of all cells has been adjusted.

g. Thoroughly wash out the syringe

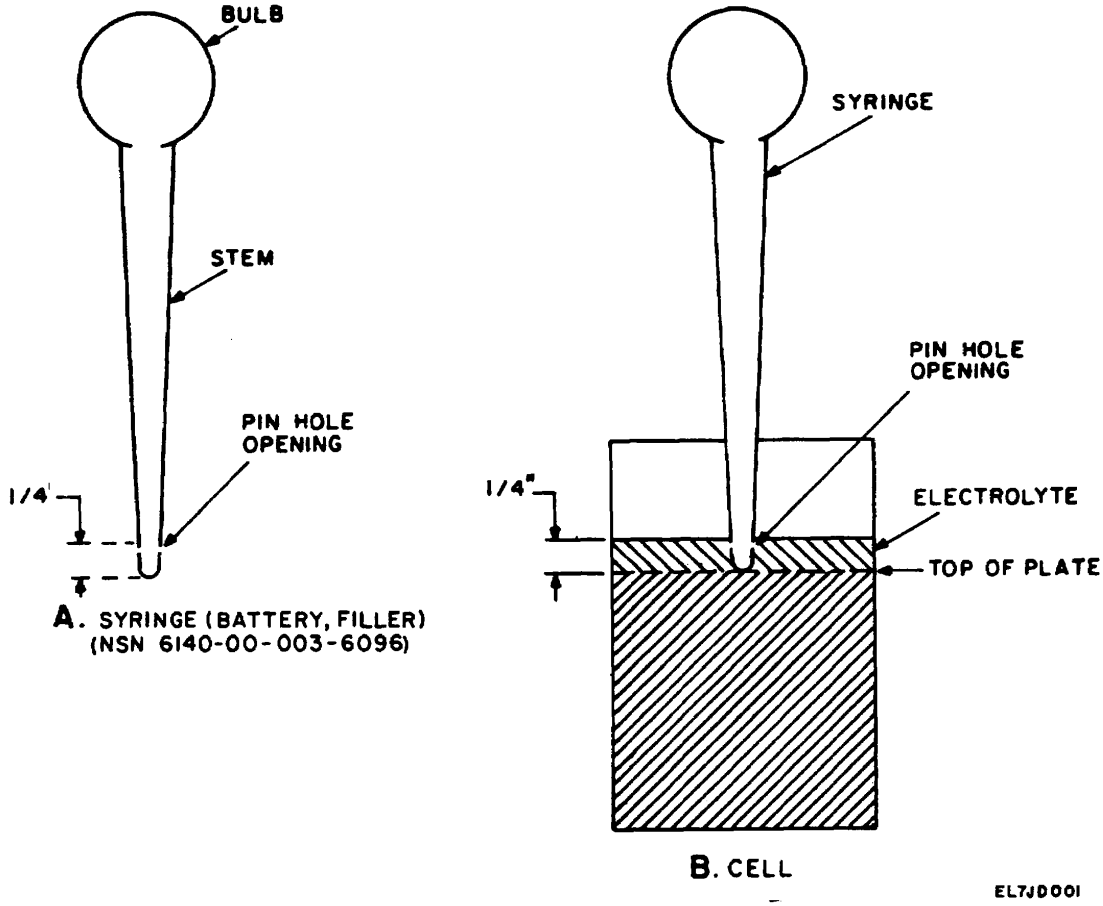


Figure 5-2. Electrolyte Level Adjustment.

5-6. Periodic Service Procedures

For batteries returned to direct support or general support for quarterly maintenance service, proceed in accordance with maintenance flowchart (fig. 5-3) and as follows:

a Perform the procedures given below:

(1) Inspect in accordance with procedures of paragraph 5-4a

(2) Clean in accordance with procedures of paragraph 5-4b.

(3) Check polarity position of cells in accordance with procedures of paragraph 5-4c.

(4) Inspect for tightness of terminal studs.

(5) Check heater resistance by following procedures in paragraph 5-13a.

b. Perform electrical leakage test as specified in paragraph 4-10. If battery has a leakage current of over 3 milliamperes it must be deep discharged before disassembly.

NOTE

Refer to TM 11-6140-203-14-1 for information concerning the temporary lows of capacity of a nickel-cadmium battery and the discharge method recommended to restore the rated capacity to the nickel cadmium battery.

c. Deep discharge and balance using one of the procedures given below. Use of the discharge fixture is the preferred method.

(*1) Discharge fixture method.*

(a) Position the discharge fixture NSN 6110-00-014-6225 over an uncovered battery. Push down firmly on the discharge fixture until it uniformly covers the battery case (fig. 5-4).

*(*b) Clamp the battery case catches on the strikes of the discharge fixture bottom plate.

(c) Leave the discharge fixture on the battery for 16 to 18 hours, or for 8 hours after the light on the fixture is extinguished. Remove discharge fixture only after battery is fully discharged.

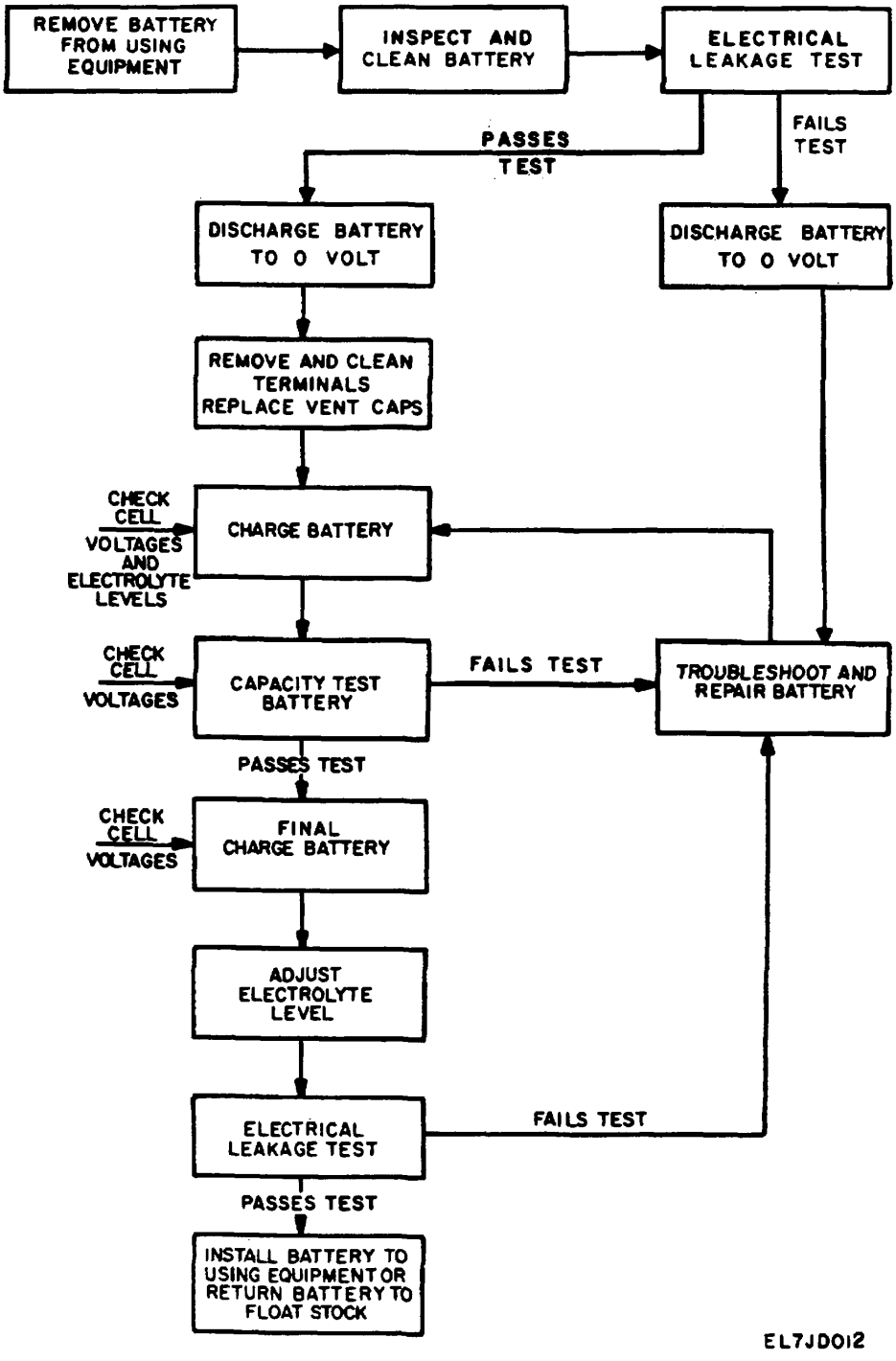


Figure 5-3. Maintenance Flow Chart Quarterly for Nickel-Cadmium Battery BB-693A/U.

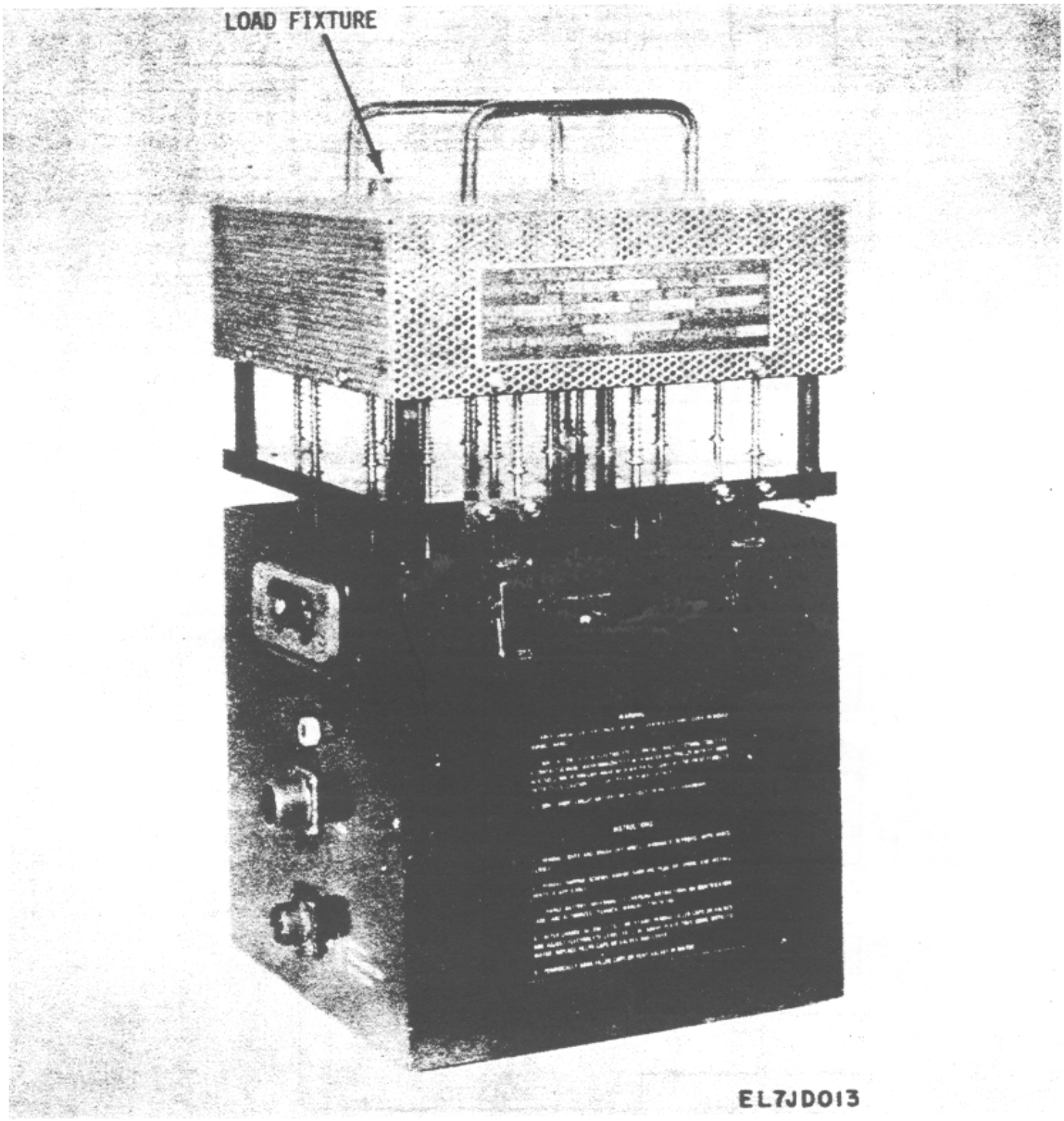


Figure 5-4. Discharging Battery.

(2) discharge with AN/USM-432. If discharge rack is not available, use AN/USM-432 in is required *the Manual Discharge* position to discharge the battery to zero volts. Monitor cell voltages with voltmeter and when the terminal voltage of any cell discharge switch set to DEEP to discharge the reaches 0.5 volts or lower, place a shorting device battery to 10 volts or less. Monitor cell voltages (metal spring strip) across the positive and negative with voltmeter and when the terminal voltage of terminals of that cell Continue until all cells are shorted out. Best results are obtained if cells are left shorted overnight; however, a minimum of 3 hours is required.

(3) *Deep discharge with* RF80GT. If a discharge rack is not available, use the RF80GT with the discharge switch set to DEEP to discharge the battery to 10 volts or less. Monitor cell voltages with voltmeter and when the terminal voltage of

any cell reaches 0.5 volts or lower, place a shorting device (metal spring strip) across the positive and negative terminals of that cell. Continue this process until the overall battery voltage drops below 10 volts. Shutoff the RF80GT and disconnect the battery. Then connect individual shorting strips across the remaining battery cells. Allow cells to remain shorted out for at least 3 hours; however, best results will be obtained with an overnight stand.

(4) Deep discharge using load resistor. If a discharge rack or charger/analyzer is not available proceed as described in (a) and (*b)* below.

(a) the 0to 7.5-ohm, 1, 000-watt variable resistor (item 8, appx E), two multimeters, knife switch (item 7), and nickel-cadmium battery to be discharged as shown in figure 5-5. (Be sure that the knife switch is in the open position.)

*(*b) Close and open the knife switch as necessary while adjusting the 0 to 7.5-ohm variable resistor for a resistance value high enough to permit the discharge current to flow at approximately the 3-hour rate of the battery. Monitor the terminal voltage of each cell during discharge using the multimeter. When the terminal voltage of a cell reaches 0 volts, place a shorting device (spring metal strip) across the positive and negative terminals of that cell DO NOT USE ANY OTHER METHOD TO DETERMINE WHEN A SHORTING DEVICE SHOULD BE PLACED ACROSS THE CELL TERMINALS.

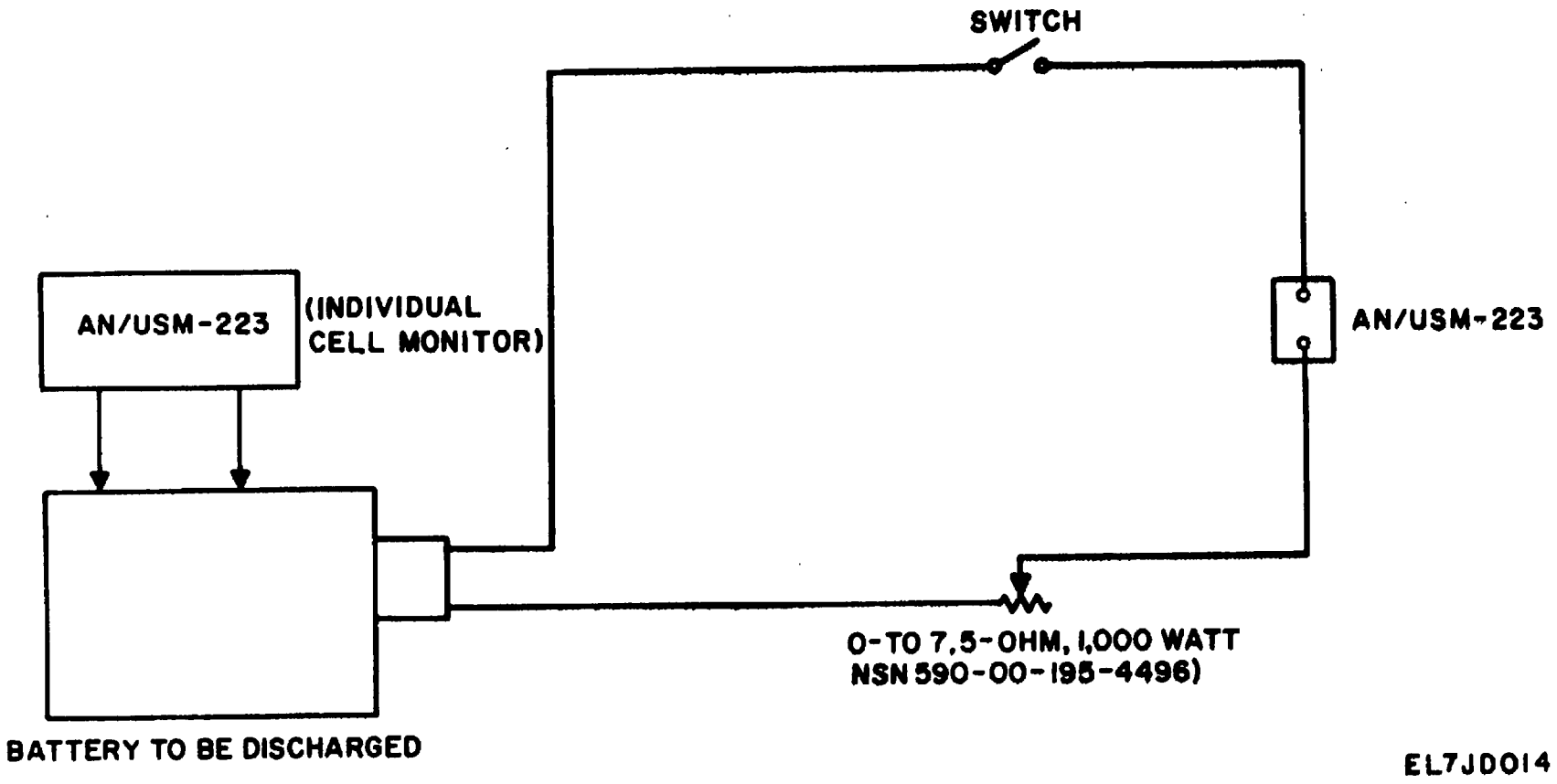


Figure 5-5. Discharging Connection Diagram.

d. Remove vent caps and replace with ones that have been previously cleaned and tested (para 5-12).

e. Remove terminal links, clean off all corrosion preventive compound, then lightly polish contact surfaces on both links and cells with fine emery cloth or sandpaper. Replace terminal links following the layout paragraph 4-14. Torque all studs to 50 inch-pounds.

f. When battery has been reassembled, charge the battery in accordance with one of the procedures given in paragraph 5-4f. Check cell voltages for uniformity. During last 10-20 percent of charge, remove fillercaps and check for a visible electrolyte level Add small amounts of distilled water *only* to those cells that are excessively low. Replace the vent caps.

g. Test the capacity of the battery as given in paragraphs 5-4g(1).

h. Recharge battery in accordance with final charge procedure of paragraph 5-4g(2).

i. Allow battery to rest for 30 minutes before adding distilled water to adjust the electrolyte level Follow procedures in paragraph 5-5.

j. Perform electrical leakage test of paragraph 4-10.

k. Reapply corrosion preventive compounds where required. Check to see that low voltage tap is on proper position (para 4-12) for expected ambient temperature.

l Return battery to service or stock. Maintain battery sets for each vehicle together.

NOTE

BB-693/U batteries containing cellophane separated cells should not be used in a set with BB-693A/U batteries containing the polyolefin separated BB-600A/A cells.

5-7. Troubleshooting

The following procedures will aid in troubleshooting a defective battery (table 5-12). Visually inspect the battery to determine whether the trouble is caused by loose connections (a below), corroded connections *(*b below), electrical leakage (c below), or an incorrectly installed cell *(d* below).

a. Loose Connections. If connections are loose, proceed as follows:

(1) Clean the battery (para 4-13b) and tighten terminal studs, using the proper torque valves (para 4-16c).

(2) Discharge the storage battery (para 5-6c).

(3) Remove and clean terminal links (para 5-6e).

(5) After charge, allow the battery to rest for 30 minutes. Remove the vent caps. Using distilled water, adjust the electrolyte level to 1/4 inch above the top of the plates (para 5-5). Replace vent caps.

(6) Test the performance of the battery as given in paragraph 5-4g.

b. Corroded Terminals. If connections are corroded or dirty proceed as follows:

(1) Clean the battery (para *4*-13b).

(2) Discharge the battery (para 5-6c).

(3) Remove, clean and replace terminal links and cell terminals (para 5-7e).

(4) Charge (para 5-4f).

(5) After charge allow the battery to rest for 30 minutes Remove the vent caps using distilled water, adjust the electrolyte level to 1/4 inch above the top of the plates (para 5-5). Replace vent caps.

(6) Test the performance of the battery is given in paragraph 5-4g.

c Electrical Leakage Test. Using the multimeter perform the electrical leakage test as described in paragraph 4-10.

d. *Reverse Polarity Position* If a cell has been installed in reverse polarity as determined when performing an individual cell voltage test, proceed as follows:

(1) Discharge the battery (para 5-6c).

(2) Remove and reinstall the cell in the battery.

(3) Charge the battery (para 5-4f).

(4) Capacity test the battery (para 5-4g).

e. Troubleshooting Table. Table 5-2 is provided to aid in isolating troubles that occur in the battery. Before following the procedures outlined in the troubleshooting table, perform the procedures given in a through d above

Table 5-2. Troubleshooting

Condition	Probable trouble	Corrective action
Electrolyte spewage during charge.	a. High charge current or high ambient temperature during charge	a. Reduce charging current, check heater thermostats.
	b. Excessive electrolyte.	b. Withdraw excessive electrolyte
	c. Defective cell or cells.	c. Replace defective cells as necessary.
	d. Cell installed in reverse polarity	d. Reinstall cell correctly.
	e. Extend operations with low rate of fire.	e. Minimize use of low rate firing, or perform quarterly service more frequently.

Table 5-2. Troubleshooting-Continued

Condition	Probable trouble	Corrective action
Overheating or burn marks on terminal links.	Loose Terminals links	Clean links and terminals, then tighten links to correct torque (para 4-17c) as necessary.
Electrolyte leakage	a. Defective cell or cells. b. Defective o-ring. c. Defective vent valve. d. Defective vent cap.	a. Replace defective cells as necessary. b. Replace defective O-ring (para 4-17b). c. Replace defective vent valve. d. Replace defective vent cap (para 4-17a)
Battery does not provide rated capacity.	a. Battery not fully charged. b. Defective cell or cells. c. Cell installed in reverse polarity. d. loose terminal links	a. Charge battery (para 5-4f). b. Replace defective cells as necessary. c. Reinstalled cell correctly. d. Clean links and terminals, then tighten link to correct torque (para 4-17c)
Open circuit terminal voltage reading is zero.	Loose or missing terminal links	Clean links and terminals, then tighten link to correct torque (para 4-17c) as necessary.
Electrical leakage.	a. Defective cell or cells. b. Electrolyte leakage.	Replace defective cells as necessary. b. Replace defective O-ring, vent valve, fillercap (para 4-17).

5-8. Disassembly

A complete disassembly of the battery is required for any of the following defects Defective cells, electrical leakage, defective heater assembly, or defective battery case. Disassemble the battery, as given in a through e below.

a Discharge the battery as given in paragraph 5-6c.

b. After completely discharging the battery, remove all terminal links by removing their crews and associated washers

c Remove all cells from the battery cam follows:

(1) Loosen all fillercaps to *re*lieve any internal pressure.

(2) Fabricate a cell puller by using two terminal links bent at right ages and appropriate no *conductive h*eavy cord or fat web material as shown in figure 5-6.

NOTES

Do not use wire or other conductive material Use the cell terminal screws and washers to secure the cell puller to the cell terminals and carefully work each cell out of the battery case starting with the cell that is approximately in the center position.

If a cell puller cannot be fabricated as shown in figure 5-6, screw a stud of the appropriate size into each cell terminal. Grasp these studs with pliers and lift the cell straight up.

d. Remove liners from the battery case and inspect the interior of the case for peeling or chipping of paint or corrosion.

e. Remove the battery terminal connector or receptacle as follows: (1) Remove screws and washers that hold the connector receptacle to the battery case.

(2) Remove the battery terminal connector or receptacle.

CAUTION

Be careful when removing the gaskets from the battery case. Do not allow the scrapper to gouge the battery case.

(3) For connectors or receptacles having damaged gaskets, remove the gaskets by scraping or peeling the gasket from the battery case. For batteries having liners or cover gaskets, remove liners and cover gaskets by scraping or peeling.

CAUTION

Do not charge cells outside of batter case or unsupported since they will swell and prevent reassembly.

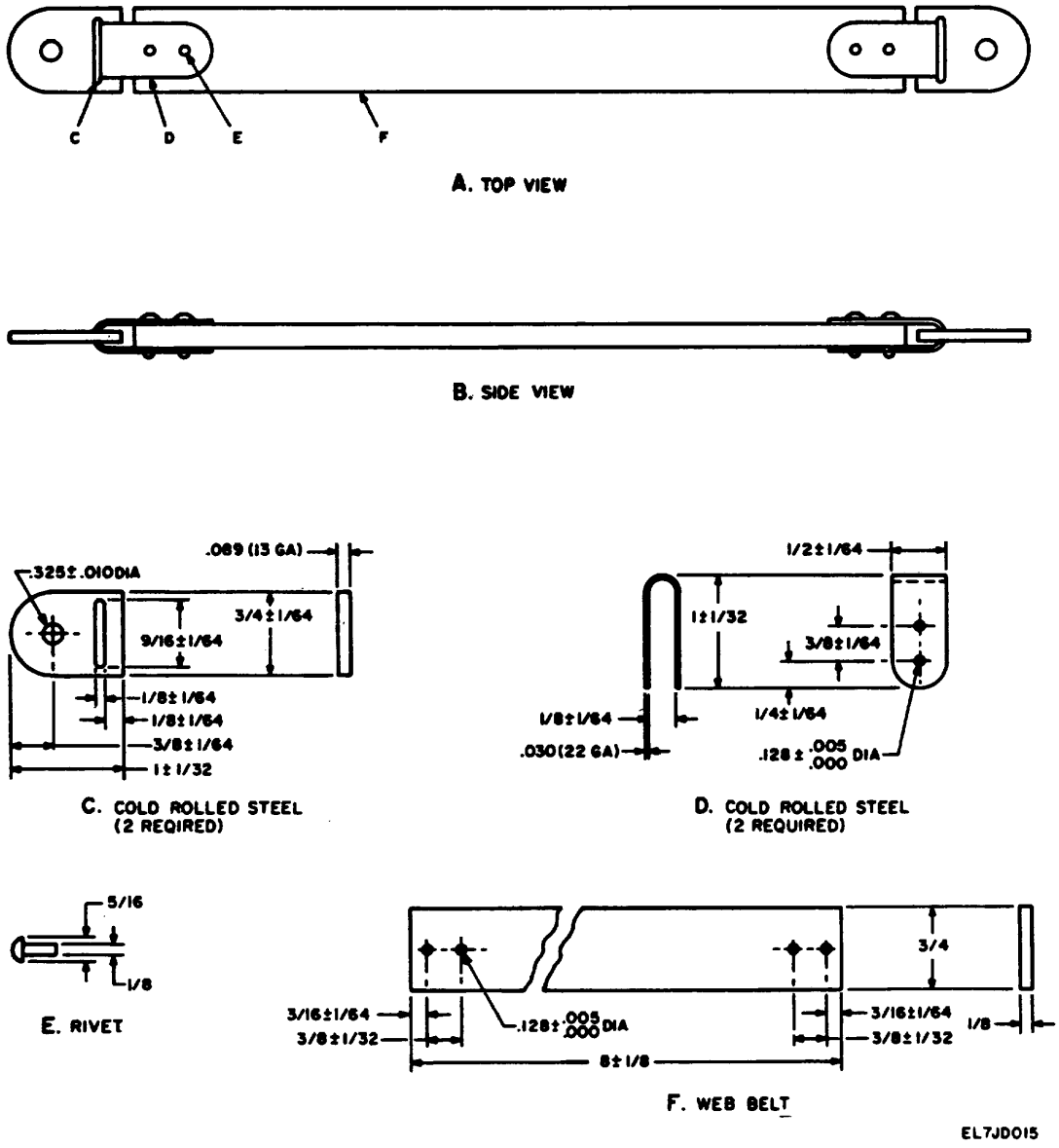


Figure 5-6. Cell Puller.

5-9. Reconditioning Battery Components.
After the battery is disassembled (para 5-8), proceed as follows

a Individual Cell Inspection.

(1) Remove, clean (para 4-13), and replace fillercaps on all cells. Be sure fillercaps are on tight.

CAUTION

Do not allow tapwater to enter cell; the electrolyte will be diluted or contaminated and will require replacement.

(2) Wash each cell with tapwater. Remove potassium carbonate deposits by brushing with the nylon brush Rewash the cell with tapwater.

WARNING

When using an air hose for cleaning, the compressed air source must limit the nozzle pressure to no more than 29 pounds per square inch gauge (PSIG). Goggles must be worn at all times while cleaning with compressed air.

(3) Air hose until dry.

(4) Lightly buff each cell terminal with fine sandpaper or emery cloth.

(5) Examine each cell for cracks, distorted case, discoloration, and electrolyte contamination If a cell has a crack or distorted case, the cell is beyond repair and should not be used. If the exterior of a cell is discolored with burn spots or contains gross electrolyte contamination (contamination is evidence if the electrolyte is badly discolored), the cell is unserviceable and should be discarded. For cells that visually appear to be free of cracks, discoloration, distortion, and electrolyte contamination, proceed as follows to test the cell for electrolyte leakage: (a) Invert cell for 2 minutes.

(b) After the cell has been inverted for 2 minutes, lay cell on each of its sides either on a blotter or a paper towel for 30 seconds per side Any wetting of the blotter or the paper towel is cause to consider the cell defective unless it comes from only the cell vent.

b. Installing Cover Gasket (1) Check to be sure that the cover is clean and dry.

(2) Lay the cover on a clean, flat surface and thoroughly clean the side of the cover to be cemented.

(3) Apply a layer of cement (item 10, appx E) to the cleaned area of the cover.

(4) Apply a layer of cement to the cleaned side of the cover gasket.

(5) Position the cover gasket on the cover, with the cemented area of both cover and cover gasket mating.

(6) Firmly press (by hand) the cover gasket in place on the cover.

(7) Allow at least 2 hours for the cement to dry before installing the cover on the battery.

c. *Installing Battery Terminal Connector or Receptacle*

(1) Check to be sure that the terminal connector or receptacle is clean and dry.

(2) Install the terminal connector or receptacle, using screws, washers, and gaskets as required *d. Installing Battery Case Liner.*

NOTE

If necessary to replace any liner, use polyamide plastic sheet (item 11, appx E).

(1) Check to see that the battery case is clean and dry.

(2) Cut the battery case liner or insulator (polyamideplasticsheet,(NSN 9330-00-877-2872)), to the same size as the one removed and install the replacement battery case liner in the battery case.

e. Installing Heater Blanket Assembly.

(1) Check to be sure that there are no rips, tears, or broken wires in the heater assembly.

(2) Test heater assembly for correct thermostat operation and heater resistance valves {para 5-13).

(3) Reinstall heater in correct position is given in paragraph 4-14 for each manufacturer.

f. Installing Cells in Battery Case

NOTE

Each battery must be constructed of cells made by the same manufacturer and carry the same part number. DO NOT mix cells made by different manufacturers of different part or stock numbers from the same manufacturer, to retrofit a battery. Use cells with or as close to the same date code or length of service as possible. If replacement cells with the same manufacturer's part number as those in the battery are not available; obtain 19 new cells to reassemble the battery (para 5-11). Keep any extra used good cells for future replacement use.

(1) Using appropriate cell layout diagram shown in chapter 2, replace all cells in the battery case. If a cell is difficult to insert, apply a light coat of petroleum jelly or teflon spray to the sides of the cell case and press firmly into place with the polarity symbols in the correct direction. Cells are connected in series (positive to negative). Using

polyamide plastic sheets (item 11, appx E), shim cells as necessary for a tight fit.

(2) Replace all terminal hardware in the following sequence: (a) Intercell connectors.

(b) Belleville washer.

(c) Flatwasher.

(d) Stud (fingertight).

NOTE

Torque hardware before applying corrosion preventive compound. Be sure all cell terminals and intercell connectors are clean and smooth before assembling.

(3) Torque all connections as specified in paragraph 5-11c.

g. Charging and Testing.

(1) Charge the battery (para 5-4f).

(2) After charging allow the battery to rest for 30 minutes. Remove the vent caps. Using distilled water, adjust the electrolyte level to 1/4 inch above the top of the plates (para 5-5). Replace vent caps.

(3) Test the performance of the battery as given in paragraph 5-4g.

(4) Perform electrical leakage test (para 4-10).

h Corrosion Prevention. After all performance and leakage requirements have been met, coat all hardware with corrosion preventive compound (item 12, appx E).

5-10. Individual New Cells.

When individual new cells are being prepared for use, be careful when charging. Do not charge individual cells unless the plastic cell case is externally supported because gas pressure, while charging the unprotected cell, may cause the cell case to crack. When assembling cells to make up a battery, be sure that all cells were constructed by the same manufacturer and have the same NSN and manufacturers part number. To avoid an unbalance in the battery, do *not* mix cells made by different manufacturers or having different NSN's to retrofit a battery. Clean and check vent caps prior to charging.

5-11. Preparing a Battery for Service Containing All New Cells

Perform the procedures given in a through f below to assembly a battery containing all new cells and prepare it for service.

a. Initial Inspection Remove cell packaging material and perform the following:

(*1) Damage.* See whether any electrolyte liquid has spilled into the shipping materials. This may be the sign of a damaged cell.

(*2) Vent caps.* Clean and test cell vent caps in accordance with paragraph 5-12.

(*3) Electrical connections.* Remove shorting strap from cells. Polish terminal surface with fine emery cloth or sandpaper to remove any oxide coating.

b. Electrolyte Level The cells are normally shipped with the proper amount of electrolyte. Do not add additional 31 percent KOH electrolyte until after the battery has been charged. However, if the cells contain an excess amount of electrolyte while in the discharged state, this should be removed before charge is begun. Follow procedures of paragraph 5-4a(3). Electrolyte is only used for undefiled new cells on the first charge. Use distilled water at all other times.

c Assemble Battery.

(1) Place cells in battery case observing proper polarity. Positive terminals are marked with a plus (+) sign molded into the cell case. Some cells may also have the cell cover near the positive terminal dyed red. For the cell layout refer to chapter 2.

(2) Attach intercell connectors, that have been previously cleaned of all corrosion preventive compound and lightly polished with fine emery cloth or sandpaper following the specific cell layout of chapter 2.

(3) Tighten terminal studs with torque wrench to 50 inch-pounds.

(4) Before charging, reinspect battery for proper polarity of cells and read cell voltages. Check to see that all cells are from the same manufacturer.

d. Charging. Charging a battery that contains new cells that have not been previously formed (particularly those from the Marathon Battery Co.) may require a slightly different procedure than normal for the very first charge. Specifically, a brand new cell may require an input of up to 3 times its rated capacity before it is fully formed. With any of the charging methods given below, individual cell voltages should be read during the first two (2) minutes of charge.

(*1) Constant current method* Reject the battery if any cell is shorted, measures less than 1.0 volt, or has reversed polarity. Very high cell voltage readings, above 1.6 volts, may indicate either dirty or loose connections, or a dry cell. If a cell is dry, adding a small quantity of 31 percent KOH electrolyte will immediately lower the voltage. Bad connections can be checked by comparing the voltage readings taken on the terminal screws with those taken at the intercell links. The difference should not exceed 0.02 volts with 30 amperes flowing or 0.04 volts with 60 amperes flowing. Cell voltage should also be read during the last 10

minutes of the initial charge to determine if all cells are uniform within 0.1 volts of the average of the entire battery. Electrolyte level should also be checked to determine if electrolyte is visible in all cells. Charge at the C/2 rate for 3 hours (for 30Ah, BB600A/A cells charge at 15A). Then lower the charging current to the C/5 rate (for 30 Ah, BB600A/A cells charge at 6.0A), continue charge until battery voltage remains constant for 2 consecutive hourly readings and/or all cells are above .1.5 volts. Do not exceed 8 hours of charging time at the C5 rate.

(*2) Pulse charging method with the AN/USM-432 Set charger in* Manual Charge *Mode* at a CHARGE-AMPERE-HOUR setting two-thirds (2/3) of normal. For example, with a BB693A/U battery which would normally be set at 30-35 use a setting of 22. After one hour of charge, turn timer clockwise to provide a second hour. Determine when charger goes into topping mode. With charge in topping mode, increase CHARGE-AMPERE HOUR setting to the normal value and continuing in the topping mode for a minimum of 4 hours, turning the charge dock back to the start position as required. Cell voltages and electrolyte levels should be checked for uniformity periodically, as previously described. For indications of dry cells and/or high resistance connections, the voltage change (from cell to cell) must be compared between the pulse ON and OFF periods

(*3) Reflex charging method with the RF80GT.* Set the charger to a current equal to the rated capacity of the battery (for a BB-693AIU set current to 30 amperes), switch to Reflex mode and charge for 2 hours. To complete initial formation charge, reduce the current to the C/2 rate (15 am *peres* for the 30 Ah BB-693A/U) and charge for an additional 4 hours in the Reflex mode. Notice the Ammeter-Zeroing which is used to indicate full charge on the RF80GT may not occur because of the lower than normal current setting. Full charge may be checked by switching to the constant current mode for 5 minutes and checking to see that all cell voltages are above 1.5 volts. Cell voltages and electrolyte levels should be checked for uniformity periodically as previously described. For indications of dry cells and/or high resistance connections, the voltage change (from cell to cell) must be compared between the positive and negative pulse periods.

e. Performance Test. Performance testing shall be in accordance with paragraph 5-5g. The electrical leakage test shall be performed following the discharge test in paragraph 4-10 with the criteria for acceptance a leakage current less than 0.1 milliamperes per Ah of battery rated capacity. (For example, the sum of the positive and negative leakage current for a 30 Ah BB-693AIU must be less than 3mA.) In general, however, the normal measured leakage current value should be zero.

f. Final Charge If the battery has passed both the capacity and leakage tests, then it can be given its final charge in accordance with the normal procedure for the specific charger-analyzer used. However, if the battery temperature exceeds 120° F (for Permion or Celgard Separated Batteries) or 104° F (for cellophane separated ones) on the AN/USM-432 or the RF80GT, allow sufficient time for the battery to cool before starting the final charge. After completing the final charge, check all cell voltages, adjust the electrolyte level (para 5-5).

5-12. Vent Cap Valve Test

a. Fabricate the vent cap valve tester as shown in figure 5-7. (Use on old BB600/A cell or equivalent, that has been flushed clean and is empty of electrolyte.) Details of the connection to the side of the cell have not been provided because of the wide variety of equipment presently available in the field.

b. Before testing, wash the flllercap thoroughly in detergent and water.

CAUTION

When using an air hose for cleaning, the compressed air source must limit the nozzle pressure to no more than 29 pounds per square inch gauge (PSIG). Goggles must be worn at all times while cleaning with compressed air.

c After washing, rinse the fillercap with clean water and dry with an air blower.

d. Place the fillercap to be tested on the test cell.

e. Connect the air regulator to a compressed air outlet and adjust the air pressure until it builds up in the test cell. The fillercap vent valve should open between 2 psi and 10 psi.

f. If the fillercap vent valve does not open between 2 psi and 10 psi, discard the fillercap. If the fillercap vent valve does open between 2 psi and 10 psi, remove the O-ring from the fillercap, replace with a new O-ring, and return the fillercap to stock for reissue.

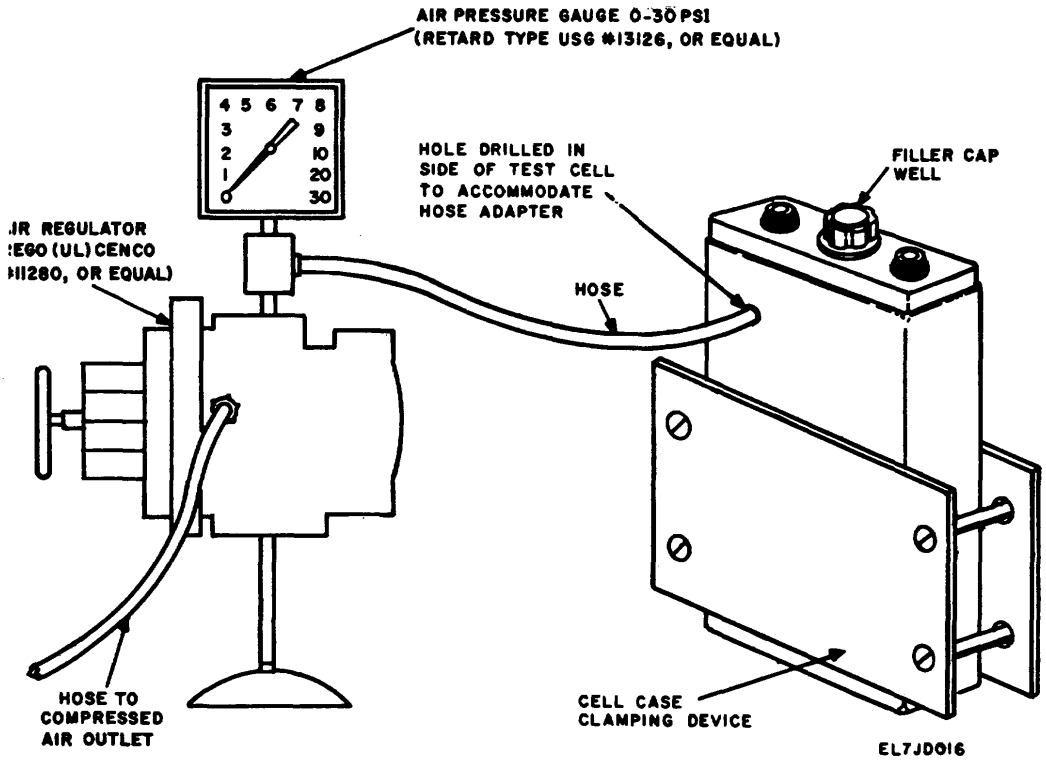


Figure 5-7. Fabrication Diagram for Fillercap Vent Valve Tester.

5-13. Battery Heater Blanket Assembly Electrical Test

The battery heater electrical test consists of 2 parts. One part is conducted at temperatures above 50 :5° F and the other is conducted at low temperature.

a Thermostats. The BB-693A/U battery is equipped with two series connected normally closed thermostats that open at temperatures above 50 ±5° F (13 :3° C). At normal ambients resistance measurements taken with a multimeter across pins A and B and C and B of the connector J3 *should* read very high valves indicating that both thermostats are open.

b. Heating Elements. "The resistance of the various heating elements can only be measured through connector J3 if the battery temperature is under 450 F (9° C). This temperature can be obtained by filling the empty case (no cells) with ice water. Otherwise measurements can only be made at the battery blanket terminal board by removing the insulating materials. The following heater resistance valves for the various manufacturers is provided.

(*1*) *General Electric heater blanket.*

(a) Resistance 4.4 to 4.8 ohms.

(b) Power consumption: 175 t9 watts at W volts dc.

(*2*) *Marathon heater blankets.*

(a) Resistance:

1. Center element: 3.5-3.6 ohms.

2. Outer element: 8.0-8.1 ohms.

3. Combined: 2.4-2.5 ohms.

(b) Power consumption: 350 watts at 29 volts dc.

(3) SAFT heater blankets.

(a) Resistance: 1. Bottom element: 8.4-9.3 ohms.

2. Outer element: 2.8-3.0 ohms.

3. Combined 2.2-2.4 ohms.

(b) Power consumption: 365 watts at 29 volts dc.

(c) High resistances. If very high resistances are measured directly across the heating elements then it is an indication that a heater element is defective and must be replaced.

5-14. Battery Case Vent

For BB-693A/U batteries equipped with a cover that contains manual vents, only one automatic valve that releases pressure from within the case is required. The specified valve is 3.0 t0.6 psig.

5-15. Administrative Storage of Nickel Cadmium Batteries

Nickel-cadmium batteries can be placed in administrative storage because of no immediate operational need and the necessity to reduce the maintenance workload; or to hold it ready while the associated end item of equipment is in the repair or overhaul process or for temporary excess quantities of direct exchange batteries. The nickel-cadmium battery is handled differently under each set of circumstances.

a Normal Administrative Storage Procedures The following procedure applies when a nickel cadmium battery is being placed in normal administrative storage.

(1) Remove the nickel-cadmium battery from the end item of equipment.

(2) Perform the cleaning procedures in paragraph 4-13.

(3) Place the nickel-cadmium battery in the administrative storage area making sure that the connector terminals are not accidentally short circuited. It is not necessary to discharge the nickel cadmium battery since the charge will be lost through normal leakage and it will be deep-cycle discharged and recharged prior to returning to service. Protect from freezing and excessive heat.

(4) When the nickel-cadmium battery is to be returned to service, perform the full quarterly procedure contained in paragraph 5-6.

(b) Hold-Ready Administrative Storage Procedures. The following procedure applies when a nickel-cadmium battery is placed in a hold-ready administrative storage while the end item of equipment is in the repair or overhaul process.

(1) Remove the nickel-cadmium battery from the equipment.

(2) Perform those quarterly maintenance procedures covered by paragraphs 5-6a through f.

(3) Perform capacity discharge test of paragraph 5-6g if battery provides required service time. Deep discharge in accordance with paragraph 5-6c except the minimum shorting time shall be only 8 hours. Connect shorting spring across battery terminal J2 and remove individual cell shorting device.

(4) Place the nickel-cadmium battery in the ready-hold administrative storage area. Protect from freezing and excess heat.

(5) When the nickel-cadmium battery is required for installation in the repaired or overhauled end item of equipment, remove it from administrative storage. Remove the shorting device from across the terminals of the battery.

(6) Charge the nickel-cadmium battery in accordance with the instructions contained in paragraph 5-4f The countdown to the next quarterly service interval will start at this point in time.

(7) Install the nickel-cadmium battery in the end item equipment.

APPENDIX A

REFERENCES

The following publications are available to maintenance personnel of Nickel-Cadmium Batteries BB-693A/U.

DA Pam 310-1	Consolidated Index of Army Publications and Blank Forms.
SB 11-573	Painting and Preservation of Supplies Available for Field Use for Electronics Command Equipment.
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TM 9-1005-286-10	Operator's Manual (Crew) for Gun, Air Defense Artillery, Towed, 20-MM, M167A1 (NSN 1005-01-014-0837).
TM 9-2350-300-10	Operation and Maintenance Manual (Crew) for Gun, Air Defense Artillery, Self-Propelled: 20-MM, M163A1 (NSN 2350-01-017-2113).
TM 9-2350-300-20-1	Organizational Maintenance Manual for Gun, Air Defense Artillery, Self-Propelled: 20-MM, M163A1; Cannon M168; Mount M157A1; Sight M61 and Radar Set ANIVPS-2 (NSN 2350-01-017-2113).
TM 11-6130-236-12	Operator and Organizational Maintenance Manual; Charger, Battery PP-1451/G (NSN 6130-00-985-8157).
TM 11-6130-238-14	Operator's Organizational, Direct Support, and General Support Maintenance Manual for Charger, Battery PP-1659/G, and PP-1659A/G (NSN 6130-00-985-8185).
TM 11-6130-246-12	Operator's and Organizational Maintenance Manual: Power Supply PP-1104C/G (NSN 6130-00-542-6385) (With Instructions for Use as Battery Charger).
TM 11-6140-203-14-1	Operator, Organizational, Direct Support, General Support, Maintenance Manual: Aircraft and Nonaircraft Nickel-Cadmium Batteries (General).
TM 11-6140-203-14-2	Operator's, Organizational, Direct Support, and General Support Maintenance Manual for Aircraft Nickel-Cadmium Batteries.
TM 11-6625-654-14	Operator's, Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Repair Parts and Special Tools) for Multimeter AN/USM-23.
TM 38-750	The Army Maintenance Management System (TAMMS).
TM 750-244-2	Procedures for Destruction of Electronics Material to Prevent Enemy Use (Electronics Command).
TM 11-6130-413-12	Operator's and Organizational Maintenance Manual: Battery Charger-Analyzer AN/USM-432 (NSN 6130-01-055-1574).

APPENDIX D

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

D-1. General

This appendix provides a summary of the maintenance operations for BB-693A/U. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

D-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. *Service.* Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d Adjust. To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. *Align* To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment or system.

k Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart i. *Repair*. T*he* application of maintenance services (insect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance per formed by the Army. Overhaul does not normally return an item to like new condition.

i. Rebuild Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/components.

D-3. Column Entries

a Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, *Maintenance Functions.* Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d Column 4, *Maintenance Category.* Column 4

specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "work time" figures will be shown for each category. The number of task-hours specified by the "work item" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C-Operator/Crew
O-Organizational
F-Direct Support
H-General Support
D-Depot

e. *Column* 5, *Tools and Equipment.* Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function

f Column 6, Remarks. Column 6 contains an alphabetic code which leads to the remark in section IV, Remarks, which is pertinent to the item opposite the particular code.

D-4. Tool and Test Equipment Requirements (Sect. III)

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

D-5. Remarks (Sect. IV)

a. Reference Code. This code refers to the appropriate item in section II, column 6.

b. *Remark*s. This column provides the required explanatory information necessary to clarify items appearing in section II.

SECTION II. MAINTENANCE ALLOCATION CHART FOR NICKEL-CADMIUM BATTERY BB-693A/U

(1) Group number	(2) Component/assembly	(3) Maint. function	(4) Maint. category C	O	F	H	D	(5) Tool/ equipment	(6) Remarks
00	BATTERY STORAGE BB-693A/U	Inspect		0.1					A
		Service		0.2					A
		Test		0.6				5	A
		Inspect		0.1					B
		Service		0.2				5	B
		Adjust		0.4					B
		Inspect			0.1				C
		Service			0.2				C
		Test			3.5				C
		Inspect			0.5			5	D
		Service			0.1			1-12	D
		Repair			2.5			3	D
		Test			3.5			1-12	D
		Rebuild			2.0			1-12	D
		See Note							
01	BATTERY, STORAGE 9CELL0 BB-600A/A	Inspect			0.2		3	E	
		Service			1.2			1-12	E
		Replace			1.0			3	E
		Repair			0.2				E
02	CASE ASSEMBLY, BATTERY	Inspect			0.15			5	D
		Service			0.2				D
		Replace			0.5			3, 5	D
	NOTE TIMES BASED ON SINGLE UNIT. REDUCE TIME/UNIT ACCORDINGLY WHEN MULTIPLE UNITS PROGRAMMED.								

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR NICKEL-CADMIUM BATTERY BB-693A/U

(1) TOOL OR TEST EQUIPMENT REF CODE	(2) MAINTENANCE LEVEL	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NUMBER
1	F, H, D	FIXTURE, BATTERY DISCHARGE AND CELL - VOLTAGE BALANCING MX-8927A/U FOR BB-693A/U BATTERY	6110-00-014-6225	
2	O, F, H, D	MULTIMETER TS-352B/U (NOTE 6)	6625-00-553-0142	
3	F, H, D	TOOL KIT, BATTERY SERVICE TK-90/G	5180-00-542-5812	
4	F, H, D	ANALYZER-CHARGER AN/USM-432 (NOTE 2)	6130-01-055-1574	
5	O, F, H, D	MULTIMETER AN/USM-451 (NOTE 7)	6625-01-060-6804	
6	F, H, D	CABLE ASSEMBLY, POWER ELECTRICAL CX-11934/U, NO. 4 AWG(NOTE 3)	6150-00-935-8722	
7	F, H, D	CABLE ASSEMBLY, POWER ELECTRICAL CX-11779/U, NO. 2/0 AWG (NOTE 3)	6150-00-410-9880	
8	F, H, D	CHARGER, BATTERY PP-1451/G	6130-00-985-8157	
9	F, H, D	CHARGER, BATTERY PP-1659/G	6130-00-985-8185	
10	F	GENERATOR SET, GASOLINE ENGINE 3KW, 28V DC, MIL-G52428(NOTE 4)	6115-00-475-0029	
11	F, H, D	POWER SUPPLY PP-1104C/G (NOTE 5)	6130-00-542-6385	
12	F, H, D	RELAY, REVERSE CURRENT CUTOFF (NOTE 5)	5945-00-824-5575	

NOTES

1. DEEP-CYCLE THE BATTERY EVERY 90 DAYS (3 MONTHS). THE QUARTLERY DEEP CYCLE TEST IS PERFORMED AT DIRECT SUPPORT MAINTENANCE.

2. ANALYZER-CHARGER AN/USM-432 IS USED TO CHARGE AND ANALYZE BB-693A/U STORAGE BATTERIES. CHRISTIE RF80GT, AN/GSM-261 OR EQUIVALENT MAY BE USED IF AVAILABLE.

3. CABLE ASSEMBLIES, POWER, ELECTRICAL CX-11779/U AND CX-11934/U ARE REQUIRED FOR CHARGING BB-693A/U STORAGE BATTERIES EQUIPPED WITH RECEPTACLE MIL-C-18148A(ASG). CX-11934/U CAN BE USED UP TO 100 AMPERES DC.

4. GENERATOR SET, GASOLINE ENGINE IS USED FOR CHARGING WHERE 115- 230-VOLT AC POWER IS NOT AVAILABLE.

5. REVERSE RELAY MUST BE CONNECTED TO THE OUTPUT OF POWER SUPPLY PP-1104C/G TO PREVENT BATTERY FROM DISCHARGING THROUGH THE POWER SUPPLY IN THE EVENT OF POWER FAILURE.

6. MULTIMETER AN/USM-223 MAY BE SUBSTITUTED FOR TS-352B/U WHERE 5 PERCENT ACCURANCY IS REQUIRED.

7. BALLANTINE DIGITAL VOLTMETER MODEL 3028A MAY BE SUBSTITUTED FOR AN/USM-451 WHERE 1 PERCENT OR BETTER ACCURACY IS REQUIRED.

SECTION IV. REMARKS

FERENCE CODE	REMARKS
A	WEEKLY MAINTENANCE.
B	MONTHLY MAINTEMANCE.
C	PREPARATION OF NEW BATTERY.
D	QUARTERLY MAINTENANCE.
E	LIMITED TO REPLACMENT OF CONNECTOR HARDWARE AND FILLER CAPS.

APPENDIX E

ORGANIZATIONAL AND DIRECT SUPPORT MAINTENANCE

REPAIR PARTS AND SPECIAL TOOLS LIST

Section I. INTRODUCTION

E-1. Scope

This appendix lists spares and repair parts; special tools; special test, measurement, and diagnostic equipment (TMDE), and other special support equipment required for performance of organizational and direct support maintenance of the BB-693A/U. It authorizes the requisitioning and issue of spares and repair parts as indicated by the source and maintenance codes.

E-2. General

This Repair Parts and Special Tools List is divided into the following sections:

a. Section II. Repair Parts List A list of spares and repair parts authorized for use in the performance of maintenance. The list also includes parts which must be removed for replacement of the authorized parts. Parts lists are composed of functional groups in numeric sequence, with the parts in each group listed in figure and item number sequence.

b. Section III. Special Tools List. Not applicable.

c. Section IV. National Stock Number and Part Number Index. A list, in National item identification number (NIIN) sequence, of all National stock numbers (NSN) appearing in the listings, followed by a list, in alphameric sequence, of all part numbers appearing in the listings. National stock numbers and part numbers are cross-referenced to each illustration figure and item number appearance.

3. Explanation of Columns

a. *Illustration.* This column is divided as follows:

(*1) Figure number.* Indicates the figure number of the illustration on which the item is shown.

(*2) Item number.* The number used to identify item called out in the illustration.

b. Source, Maintenance, and Recoverability (SMR) Codes.

(*1) Source code. Sour*ce codes indicate the manner of acquiring support items for maintenance, repair, or overhaul of end items. Source codes are entered in the first and second positions of the Uniform SMR Code format as follows:

Code	*Definition*
PA	Item procured and stocked for anticipated or known usage.
XA	Item is not procured or stocked because the requirements for the item will result in the replacement of the next higher assembly.
XD	A support item that is not stocked. When required, item will be procured through normal supply channels.

NOTE

Cannibalization or salvage may be used as a source of supply for any items source coded above except those coded XA and aircraft support items as restricted by AR 700-42.

(*2) Maintenance code.* Maintenance codes are assigned to indicate the levels of maintenance authorized to USE and REPAIR support items. The maintenance codes are entered in the third and fourth positions of the Uniform SMR Code format as follows:

(a) The maintenance code entered in the third position will indicate the lowest maintenance level authorized to remove, replace, and use the support item. The maintenance code entered in the third position will indicate one of the following levels of maintenance:

Code	*Application/Explanation*
O	Support item is removed, replaced, used at the organizational level.
F	Support item is removed, replaced, used at the direct support level.

(b) The maintenance code entered in the fourth position indicates whether the item is to be repaired and identifies the lowest maintenance level with the capability to perform complete repair (i.e., all authorized maintenance functions). This position will contain one of the following maintenance codes:

Code *Application/Explanation*

F--The lowest maintenance level capable of complete repair of the support item is the direct support level.
Z--Nonreparable. No repair is authorized

(3) Recoverability code. Recoverability codes *are assigned* to support items to *indicate the* disposition action on unserviceab*le items The* recoverability code is entered in the fifth position of the Uniform SMR Code format as follows:

Recoverability codes *Definition*

Z--Nonreparable items When unserviceable, condemn and dispose at the level indicated in pos*i*tion 3.
A--Item requ*ir*es special handling or condemnation procedure*s* because of specific reasons *(i.*, precious metal content, high *dollar* value, critical ma*teri*al or hazar*dous* material). Refer to appropriate *man*uals/di*rectives* for specific instruction.

*c. National Stock N*um*ber. Indicates the* National stock number assigned to t*he item* and will be used f*or re requisitioning* purposes.

d. Federal Supply Code for Manufacturer (FSC& The FSCM is a 5-digit numeric *code listed* in *SB* 70841/*42* which is used to identify the *manufa*cturer, distributor, or Government agency, etc.

e Part Number. Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of it*ems.*

NOTE

When a stock numbered item is requisitioned, the repair part received may have a different part number than the part being replaced f. Description Indicates the Federal item name and, if required, a minimum *descripti*on to identify the item.

g. Unit of Measure (U/M). Indicates the standard of the basic quantity of the listed item as used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr, etc). When the unit of measure differs from the unit of issue, the lowest unit of issue that will satisfy the required units of measure will be requisitioned.

h. Quantity Incorporated in Unit Indicates the quantity of the item used in the breakout shown on the illustration figure, which is prepared for a functional group, subfunctional group, or an assembly.

E-4. Special Inf*ormation* Not applicable.

E-5. How to locate Repair Parts

a. When National stock number or part number is unknown.

(1) *Fi*rst Using the table of contents, determine the functional group within which the item belongs. This is necessary since illustrations are prepared for functional groups and listings are divided into the same groups.

(2) Second Find the illustration covering the functional group to which the item belongs.

(3) Th*ird* Identify the item on the illustration and note the illustration figure and item number of the item.

(*4) Fourth* Using the Repair Parts Listing, find the figure and item number noted on the illustration.

b. When National stock number or part number is known .

(1) *First.* Using the Index of National Stock Numbers and Part Numbers, find the pertinent National stock number or part number. This index is in NIIN sequence followed by a list of part numbers in alphameric sequence, cross-referenced to the illustration figure number and item number.

(2) Second After finding the figure and item number, locate the figure and item number in the repair parts list.

E-6. Abbreviations

Not applicable.

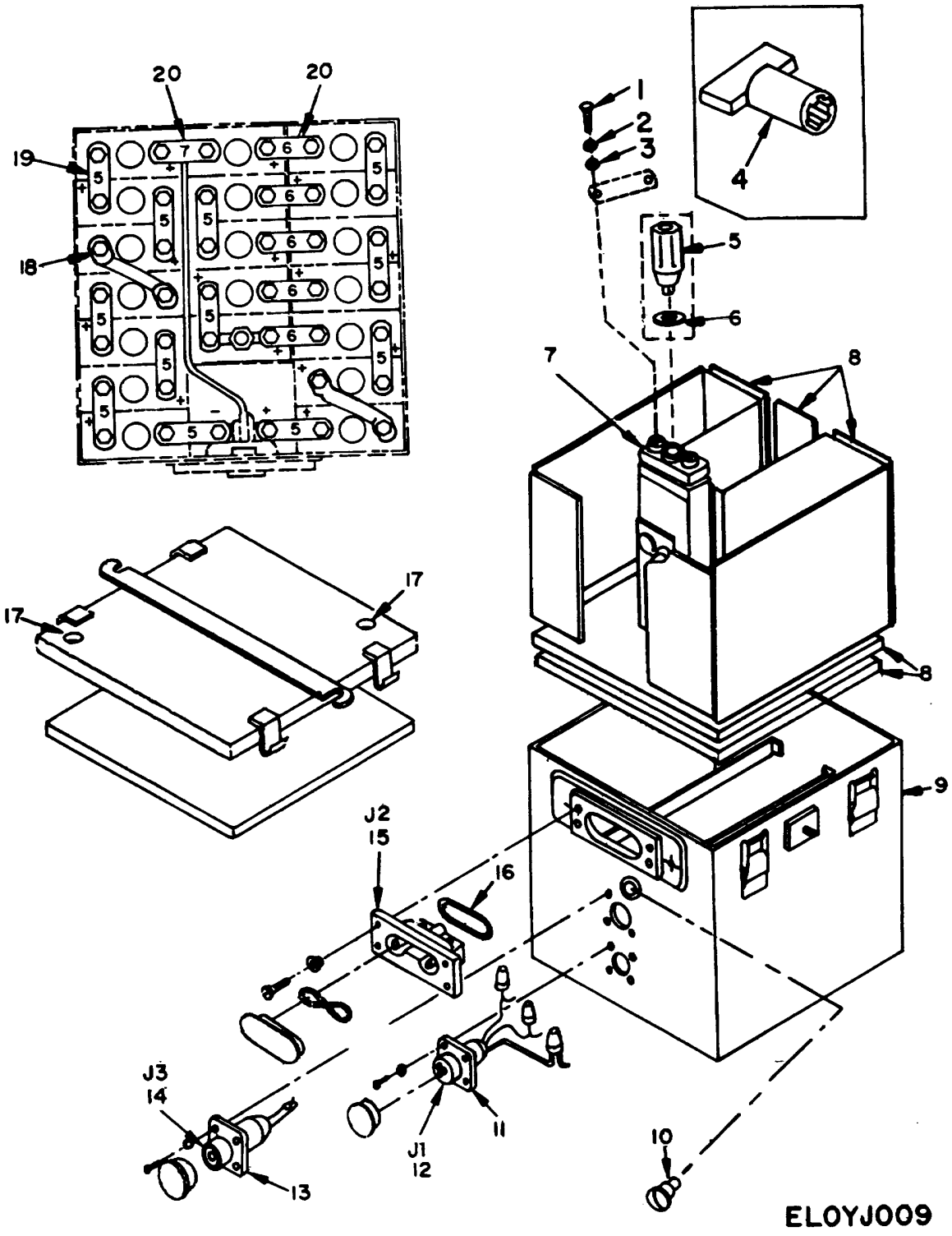


Figure E-1. Battery, Storage BB-693A/U.

(1) ILLUSTRATION (a) FIG NO.	(b) ITEM NO.	(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION USABLE ON CODE U/M IN	7) QTY	(8) INC
UNIT								
						GROUP 00 BATTERY, STORAGE BB693A/U		
E-1	1	PAFZZ	5306-00-156-2336	88044	AN3C3A	BOLT, MACHINE	EA	40
E-1	2	PAFZZ		81349	M81757/1-7B	WASHER, FLAT	EA	40
E-1	3	PAFZZ		96906	M81757/1-8B	BELLEVILLE SPRING	EA	4
E-1	4	PAOZZ	5120-00-618-5305	34122	16979	WRENCH, BATTERY FILL	EA	1
E-1	5	PAOZZ	6140-00-676-3376	74025	Y16934-1	FILLER CAP, BATTERY	EA	19
E-1	6	PAOZZ	5330-00-731-7366	74025	10343-5	PACKING, PREFORMED U	EA	19
E-1	7	PAFFA		80058	BB-600A/A	CELL, BATTERY	EA	19
E-1	8	PAFZZ		81349	MIL-M-20693	PLASTIC SHEET CUT TO FIT CASE AS NECESSARY…	EA	1
E-1	9	PAFFF	6140-01-074-5191	80063	SPEC-LED-U1	CASE, BATTERY ASSEMB	EA	1
E-1	10	XAFZZ		74025	28077	VALVE, PRESSURE EQUA USE ON MARATHON BATTERIES ONLY	EA	1
E-1	10	XAFZZ		19209	162A8032G4	VALVE, PRESSURE USE ON GENERAL ELECTRIC BATTERIES ONLY	EA	1
E-1	10	PAFZZ		09052	18696	VALVE PRESSURE USE ON SAFT BATTERIES ONLY…	EA	1
E-1	11	XDFZZ		19209	17A3200BBP11	GASKET, CONNECTOR	EA	1
E-1	12	PAFZZ	5935-00-801-6616	96906	MS3102R14S7P	CONNECTO	EA	1
E-1	13	XDFZZ	5330-00-008-2161	19209	178A32008BP8	GASKET	EA	1
E-1	14	XAFBZ		09052	18689	CONNECTOR ASSEMBLY	EA	2
E-1	15	PAFZZ	5935-00-673-3621	74025	16163-7	CONNECTO	EA	1
E-1	16	PAFZZ	5330-00-205-0201	19209	162A8089-21	PACKING, PREFORMED	EA	1
E-1	17	PAFZZ	4820-00-908-1571	98021	190ARL	VALVE, PRESSURE RELI	EA	2
E-1	18	PAFZZ		81349	M81757/4-2	LINK, BATTERY	EA	1
E-1	19	PAFZZ		81349	M81757/3-6	LINK, BATTERY	EA	6
E-1	20	PAFZZ		81349	M81757/3-5	LINK, BATTERY	EA	12

NATIONAL STOCK NUMBER AND PART NUMBER INDEX

STOCK NUMBER	FIGURE NO.	ITEM NO.	STOCK NUMBER	FIGURE NO.	ITEM NO.
5330-00-008-2161	E-1	13	6140-00-676-3376	E-1	5
5306-00-156-2336	E-1	1	5330-00-731-7366	E-1	6
5330-00-205-0201	E-1	16	5935-00-801-6616	E-1	12
5120-00-618-5305	E-1	4	4820-00-908-1571	E-1	17
5935-00-673-3621	E-1	15	6140-01-074-5191	E-1	9

FSCM	PART NUNBER	FIGURE NO.	ITEM NO.	FSCM	PART NUMBER	FIGURE NO.	ITEM NO.
88044 6	AN3C3A	E-1	1	74025	10343-5	E-1	
B0058	BB-600A/A	E-1	7	74025	161613-7	E-1	15
81349	MIL-M-20693	E-1	8	19209	162A8032G4	E-1	10
96906	MS3102R14S7B	E-1	12	19209	162A8089-21	E-1	16
81349	M81757/1-7B	E-1	2	34122	16979	E-1	4
96906	M81757/1-8B	E-1	3	19209	17A3200BBP11	E-1	11
81349	M81757/3-5	E-1	20	19209	178A320088P8	E-1	13
81349	M81757/3-6	E-1	19	09052	18689	E-1	14
81349	M81757/4-2	E-1	18	09052	18696	E-1	10
80063	SPEC-LED-U1	E-1	9	98021	190ARL	E-1	17
74025	V16934-1	E-1	5	74025	28077	E-1	10

APPENDIX F

EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

F-1. Scope

This appendix lists expendable supplies and materials you will need to operate and maintain the BB-693A/U. These items are authorized to you by CTA 50-970, Expendable Items (Except Medical Class V, Repair Parts, and Heraldic Items}.

F-2. Explanation of Columns

a. Column 1-Item Number. This number i *assigned* to the *entry* in the listing and is reference in the narrative instructions to identify the material (e.g." Use cleaning compound, item 5, App. D").

b. Column 2-Level. This column identifies the lowest level of maintenance that requires the listed item.

C--*Operat*or/*Crew*
O--Organizational Maintenance
F--Direct Support Maintenance
H--General Support Maintenance

c. *Column 3-National Stock Number.* This is the National stock number assigned to the item; use it to request or requisition the item.

d. Column 4-Descriptionr Indicates *the* Federal item name and, if required, a description to identify the item. The last line for each item indicates the part number followed by the Federal Supply Code for Manufacturer (FSCM) in parentheses, if applicable.

e. Column 5-Unit of Measure (U/A). Indicates *t*he measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit *of* issue, requisition the lowest unit of issue that will satisfy your requirements.

(Next printed page is F-2)

SECTION II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NO.	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION PART NO. AND FSCM	(5) UNIT OF MEAS
1	0	8305-00-267-3015	CLOTH. CHEESECLOTH. LINTLESS, CCCC440 (81348).	YD
2	O, F	8010-00-514-1861	PAINT-TOUCHUP, PRIMER COATING, ZINC CHROMATE YELLOW 30 MINUTES DRYING TIME, USE: METAL RIGID PLASTIC, AND RIGID PLASTIC, AND GLASS, FED SPEC TT-P-00600, 16-OUNCE CAN, 1319 (87187).	CAN
3	O, F	8010-00-598-5936	PAINT-TOUCHUP, ENAMEL, SEMIGLOSS, OLIVE DRAB COLOR NO. X-24087, RUST INHIBITING, USE: AS A ONE OR TWO COAT PAINTING SYSTEM OVER PROPERLY CLEANED AND TREATED METAL, FED SPEC TT-E-485 TYPE II, PACKED IN PRESSURIZED 12 OUNCE CAN, TTE485 (81348).	CAN
4	O, F	4240-00-439-3450	FACESHIELD, INDUSTRIAL, 8 IN. LG, FED-L-F-0036, STYLE B, SIZE 3, LF 36, (81348).	EA
5	F	4240-00-203-0317	GOGGLES, INDUSTRIAL, CHEMICAL TYPE GGG-G 521, TYPE II, (81348).	PR
6	O, F	8415-00-715-0450	APRON, IMPERMEABLE, BATTERY WORKERS MIL-A-41801 (81349).	EA
7	F	5930-00-224-4938	SWITCH, KNIFE, DPST, 60 AMP, 250 V, 1143J (05684).	EA
8	F	5905-00-195-4496	RESISTOR, VARIABLE, 0- TO 7.5-OHM, 1, 000 WATTS (FOR BUILDING BATTERY LOADS), MILR22 (81349).	EA
9	O, F	6810-00-682-6867	DISTILLED OR DEIONIZED WATER, 243 (24774).	GAL
10	F	8040-00-664-4318	ADHESIVE, RUBBER BASE, GENERAL PURPOSE, EC2141 (76381).	PT
11	F	9330-00-877-2872	POLYAMIDE PLASTIC SHEET, L-P-410 (81348).	EA
12	O, F	8030-00-903-0931	CORROSION PREVENTIVE COMPOUND, NOX RUST NO. 366 (02847).	PT
13	F	6810-00-543-4041	ELECTROLYTE (KOH), APPROXIMATELY 31 PERCENT BY WEIGHT PREMIXED SOLUTION IN 500 CC POLYETHYLENE BOTTLE, 1.305 +0.005 SPECIFIC GRAVITY AT 80^0	BTL
14	O, F	5120-00-618-5305	BATTERY VENT CAP WRENCH	EA
15	O, F	6140-00-376-9635	BATTERY FILLER (ELECTROLYTE LEVELING SYRINGE)	EA

INDEX

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THE METRIC SYSTEM AND EQUIVALENTS

'NEAR MEASURE

. Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

'VEIGHTS

Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

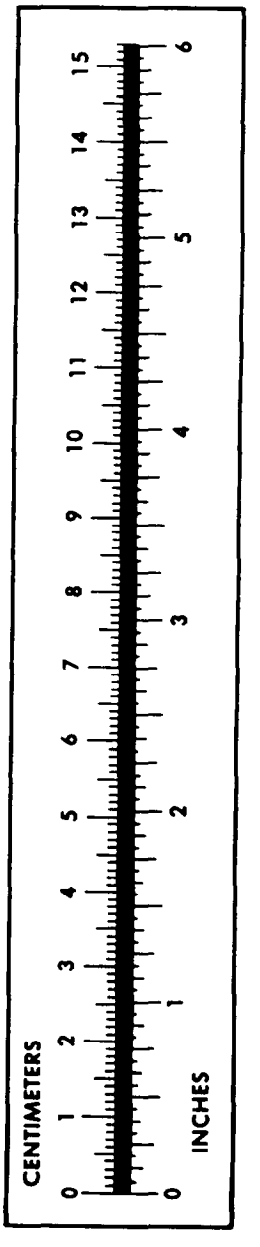
TEMPERATURE

5/9(°F - 32) = °C
212° Fahrenheit is evuivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5C° + 32 =°F

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
ıts	Liters	0.473
arts	Liters	0.946
allons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
'ers	Gallons	0.264
.ms	Ounces	0.035
.ograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pounds-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
lometers per Liter	Miles per Gallon	2.354
›meters per Hour	Miles per Hour	0.621



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