TECHNICAL MANUAL

BATTLEFIELD DAMAGE ASSESSMENT AND REPAIR FOR ENVIRONMENTAL CONTROL UNIT (ECU)

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Distribution is unlimited.

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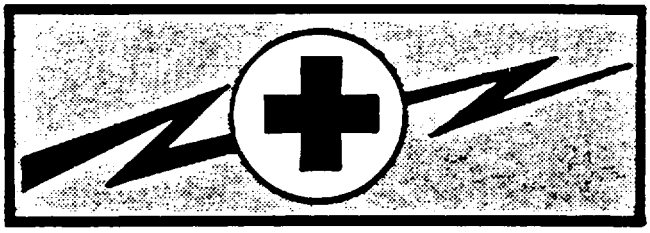
HEADQUARTERS, DEPARTMENT OF THE ARMY
16 JUNE 1989

WARNING



WARNING

HIGH VOLTAGE

is used in the operation of this equipment.

DEATH ON CONTACT

may result if personnel fail to observe safety precautions.

Never work on electronical equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent in administering first aid. When the technician is aided by operators, he must warn them about dangerous areas.

Whenever possible the power supply to the equipment must be shut off before beginning work on the equipment. Take particular care to ground every capacitor likely to hold a dangerous potential. When working inside the equipment, after the power has been turned off, always ground every part before touching it.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through vital organs of the body.

WARNING: Do not be misled by the term "low voltage'" Potentials as low as 50 volts may cause death under adverse conditions.

This technical manual contains non-standard maintenance procedures. All normal safety procedures should be observed when the tactical situation permits.

Engine and associated systems may be very hot. Use caution when performing all BDAR action to avoid being burned.

Solvents, POL and other liquid chemicals may be hazardous to your health. Use only in well ventilated areas. Keep all sources of fire away.

Use personal protective equipment such as eye goggles, gloves and hearing protection when performing BDAR actions. Serious injury can result when such safety equipment is not used.

For Artificial Respiration, refer to FM 21-11.

TECHNICAL MANUAL

No. 5-4120-394-BD

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C 16 June 1989

Technical Manual

for

BATTLEFIELD DAMAGE ASSESSMENT AND REPAIR

ENVIRONMENTAL CONTROL UNITS

Approved for public release. Distribution is unlimited.

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 the back of this manual direct to: Commander, U.S. Army Troop Support Command. ATTN: AMSTR-MCTS, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. A reply will be furnished directly to you.

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HOW TO USE THIS MANUAL

This manual is designed to help you accomplish your mission when your equipment has sustained battlefield damage or is malfunctioning for any other reason during a combat situation. Instructions are given in this manual for assessing damage to the Environmental Control Unit (ECU) so that a decision can be made to continue operation without repair, to repair by replacement of parts from other or similar ECUs, or to affect other expedient repair.

If a decision to repair the ECU is made, this manual, in Chapter 3, covers repairs for such physical damage to the ECU structure as refrigerant line, ducting, etc. A procedure index in the beginning of the chapter provides a quick locator for the paragraphs that cover repair for specific types of structural damage. For each repair procedure, the manual gives the effect on performance of the repair, the estimated time required to make the repair, materials and tools required, and other options available to accomplish the repair, or accomplish the mission without repair. Alternate procedures are provided, if applicable, to accomplish repair depending on materials available and the local situation.

Chapter 4 covers detailed assessment and repair for the Environmental Control Units electrical system. A decision logic diagram to locate damage, and a procedure index is provided for each of these subjects to facilitate returning to operational status. To support operation under battlefield conditions, a list of commonly used parts is provided to allow repair by substitution of a part from other equipment that is compatible.

CHAPTER 1

INTRODUCTION

BDAR FIXES SHALL BE USED ONLY IN COMBAT OR FOR TRAINING AT THE DISCRETION OF THE COMMANDER (AUTHORIZED TRAINING FIXES ARE LISTED IN APPENDIX E) IN EITHER CASE DAMAGES SHALL BE REPAIRED BY STANDARD PROCEDURES AS SOON AS PRACTICABLE.

Section I. GENERAL

1-1. Scope. This technical manual (TM) is for use by operators, organizational, and direct support/general support maintenance personnel. It provides procedures and guidelines for battlefield repairs for environmental control units during combat.

a. *Purpose.* The purpose of Battlefield Damage Assessment and Repair (BDAR) is to rapidly return disabled equipment to the operational commander by expediently repairing, by-passing, or jury-rigging components to restore the minimum essential systems required for the support of the specific combat mission. These repairs may be temporary and may not restore full performance capability.

b. *Manual Content.* This TM describes BDAR procedures of a general nature applicable to all environmental control units.

Repair guidelines. All possible types of combat damage and failure modes cannot be predicted nor are all effective field expedient repairs known. This TM provides guidelines for assessing and repairing battlefield failures of Environmental Control Units (ECU) and is not intended to be a complete catalog of all possible emergency repairs. The repairs described here will serve as guidelines and will stimulate the experienced operator or mechanic to devise expedients as needed to rapidly repair equipment in a combat crisis.

1-2. Application. The procedures in this manual are designed for battlefield environments and should be used in situations where standard maintenance procedures are impractical. These procedures are not meant to replace standard maintenance practices, but rather to supplement them strictly in a battlefield environment. Standard maintenance procedures will provide the most effective means of returning damaged equipment to ready status provided that adequate time, replacement parts, and necessary tools are available. BDAR procedures are only authorized for use in an emergency situation in a battlefield environment, and only at the direction of the commander.

a. *Extent of Repair.* BDAR techniques are not limited to simple restoration of minimum functional combat capability. If full functional capability can be restored expediently with a limited expenditure of time and assets, this should be done.

b. *Repair Drawbacks.* Some of the special techniques in this manual if applied, may result in shortened life or damage to components of the ECU. The commander must decide whether the risk of having one less ECU available outweighs the risk of applying the potentially destructive expedient repair technique. Each technique gives appropriate warnings and cautions, and lists systems limitations caused by this action.

1-3. Definitions. The following terms specific to BDAR are used in this TM.

a. *Battlefield Damage*. The term "battlefield damage" includes all incidents which occur on the battlefield and which prevent the equipment from accomplishing its mission, such as combat damage, random failures, operator errors, accidents, and wear-out failures.

b. *Repair Procedures*. The term "repair" or "fix" in this manual includes any expedient action that returns a damaged part or assembly to a full or an acceptably degraded operating condition including:

(1) Short cuts in parts removal or installation.

(2) Installation of components from other similar equipment that can be modified to fit or interchange with components on the Environmental Control Unit.

(3) Repair using parts that serve a non-critical function elsewhere on the same Environmental Control Unit (ECU) for the purpose of restoring a critical function.

(4) By-passing of non-critical components in order to restore basic functional capability.

(5) Expeditious cannibalization procedures.

(6) Fabrication of parts from kits or readily available materials.

(7) Jury rigging.

c. *Damage Assessment* “Damage Assessment" is a procedure to rapidly determine what is damaged, whether it is repairable, what assets are required to make the repair, who can do the repair (e.g. Organizational/Crew, Intermediate Direct Support (IDS), or Intermediate General Support (IGS)), and where the repair should be made. The assessment procedure should include the following steps:

(1) Determine if the repair can be deferred, or if it must be done.

(2) Isolate the damaged areas and components.

(3) Determine which components must be fixed.

(4) Prescribe fixes.

(5) Determine if parts or components, materials, and tools are available.

(6) Estimate the manpower and skill required.

(7) Estimate the total time (clock-hours) required to make the repair.

(8) Establish the priority of the fixes.

(9) Decide where the fix shall be performed.

(10) Decide if recovery is necessary and to what location.

d. *Fully Mission Capable*. The term fully mission capable (FMC) means that the equipment meets the minimum functional combat capability requirements.

e. *Combat Capable*. The term combat capable means that the equipment meets the minimum functional combat capability requirements.

f. *Combat Emergency Capable*. The term combat emergency capable means that the equipment meets the needs for the specific mission, however, all systems are not functional. Also additional damage due to the nature of an expedient repair may occur to the equipment if it is used. The commander must decide if these limitations are acceptable for that specific emergency situation.

g. *Cannibalization*. The term cannibalization as used in this TM means any use of repair parts or components obtained from other equipment either damaged or of lower priority to the immediate mission. In this TM, the term is used to include controlled exchange.

1-4. Quality Deficiency Report/Equipment Improvement Recommendations (QDR/EIR). If your Environmental Control Unit (ECU) needs improvement, let us know. Send an EIR. 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 us at: Commander, U.S. Army Troop Support Command, ATTN: AMSTR-QX, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. We will send you a reply.

Section II. BDAR STANDARDS AND PRACTICES

1-5. BDAR Characteristics. BDAR capability requires simplicity, speed, and effectiveness. Some BDAR procedures include repair techniques that violate standard peacetime maintenance practices. In a combat situation, greater risks are necessary and acceptable.

1-6. Training. The commander should insure that an adequate number of members of his organization, including supervisors, are trained in BDAR procedures applicable to his equipment. Operators should be trained to perform initial battlefield damage assessment as listed in Appendix E, for his crew position.

1-7. Environment. BDAR may be required in a chemically toxic environment or under other adverse conditions with severe limitations in personnel, facilities, equipment, and materials. Performance of repair tasks may be necessary while wearing protective gear. Expedient decontamination procedures are described in FM 3-220.

1-8. Permanent Repair. Upon completion of the mission, or at the next practicable opportunity, the Environmental Control Unit will be recovered or evacuated to the appropriated maintenance facility for permanent standard repair as required.

Section III. BDAR RESPONSIBILITIES AND TASKS

1-9. General.

BDAR Applicability. Battlefield damage assessment and repair procedures are applicable at all levels from crew through intermediate general support maintenance depending on the extent of the damage, the time available, the skills required, and the parts, components, tools, and materials available. Within these limits, each maintenance level will rapidly take whatever action is necessary and possible to restore the Environmental Control Unit (ECU) to the combat ready condition required for continuation of the mission.

1-10. Commander and Crew. Operator/crew are responsible for first BDAR assessment and limited repair.

a. *First Assessment*. The crew will make the first assessment immediately after damage has occurred. Crew members will provide the commander with an initial damage assessment which will include notice of system failure and all major systems visibly damaged, inoperative or impaired. If possible all systems will be checked at the same time by different crew members. If the failure is due to hostile fire, the report will include the location of impact and the available crew. Immediacy of the report is more important than how long it will take to achieve operability. The initial report, therefore, may omit repair time estimates. An initial out-of-action report to the commander should include these essentials:

(1) Equipment damaged (out-of-action or impaired).

(2) Location of equipment.

(3) Mobility status (where applicable).

(4) Current and anticipated enemy action. (If under hostile fire.)

b. *Assessment Checks*. BDAR Forms discussed in Chapter 2 permit a systematic assessment by the crew. Assessment checks include looking at the damaged parts, determining what system they belong to, and deciding how they can be expediently repaired to permit immediate operation (full or partial).

c. *Safety Check*. A safety check should be made for any obvious hazards.

(1) Have any combustibles such as fuel, hydraulic fluid, or oil accumulated?

(2) Does wiring appear to be safe? Could arcing occur to stored ammo or leaking combustibles?

d. *Functional/Operational Test*. A functional operational test should be performed next on those systems which appear undamaged. For systems with a built-in self-test feature, this will be done. Only those systems found to be damaged or inoperative, shall be identified.

e. *Commander's BDAR Report*. The crew shall report to the Commander the results of the crew's damage assessment, naming the major known causes of the failure. If repair by crew is possible, he shall report a total estimated repair time and what functions may be restored.

f. *Crew Assistance.* The Commander will respond with directives and, if required, will call IDS to the location of the damaged equipment for assistance. If possible, sufficient information will be provided to enable IDS to bring any needed repair parts or special tools.

g. *Crew Repairs.* The crew shall proceed to make any possible field expedient repairs to restore operability to the limit of their skills, materials, and tools available.

1-11. Organizational Maintenance and Maintenance Teams (MT). The organizational maintenance team (MT) and assessor operate out of the company or battalion trains. The MT assessor performs his assessment and the maintenance team completes repairs if possible at the damage site. If the site is within direct fire or under enemy observation, movement to a more secure site in defilade may be necessary. This is still considered "on-site".

a. *Personnel Safety Precautions.* If the ECU has been left unattended in the forward battle area, the immediate area should be checked for mines and the equipment checked for booby traps before starting the battle damage assessment. The MT should also make the safety checks necessary.

b. *MT Assessment Scope*. The MT assessment is more thorough than the crew's, using organizational maintenance support tools and equipment as needed. MT assessment includes:

(1) Reviewing the crew's out-of-action report, if available.

(2) Interviewing commander and crew is available.

(3) Visually inspecting damaged parts and systems.

(4) Performing a self-test.

(5) Making tests with organizational test equipment, if required.

(6) Performing additional operational tests, as necessary.

c. *MT Assessment Procedure.* Using this information and following the steps of paragraph 1-3c, the MT will:

(1) Determine what must be repaired or replaced.

(2) Determine sequence and priority of repair actions.

(3) Estimate repair times for each repair task.

(4) Total the repair task times and determine if the repairs can be performed in the time available.

(5) Determine repair location and, if other than on-site, arrange for recovery of the equipment to the repair site.

d. *MT Repairs.* If all critical repairs can be made within the available time with the skills, materials, tools, and equipment at hand, the MT assisted by the crew, will proceed with the on-site repair.

e. *MT Assistance.* If the damage exceeds the repair capability of the MT, and time is available for an MST on-site fix, the MST shall be called.

f. *ECU Recovery*. If time for an MST on-site repair is not available, but the ECU is repairable, the MT shall provide for recovery of the ECU to a designated collection point.

g. *Non-repairable ECU*. If the ECU is not repairable, the MT shall provide for one of the following:

(1) Recovery to a maintenance collection point for evacuation to the rear.

(2) On-site stripping (if approved by commander, coordinated with support maintenance).

(3) Abandonment/destruction (if directed by commander).

h. *Contaminated ECU.* If the ECU is contaminated, the MT shall mark the ECU with contamination markers and arrange for recovery to a decontamination site.

1-12. Direct Support/General Support Maintenance Team (MST). The MST shall assist the MT as needed, using direct support maintenance tools and equipment. MST assessment and repair procedures are the same as those of the MT except at a higher maintenance level. If possible, the MT will tell the MST what tools and spare parts are needed to perform the repairs. While waiting for the MST to arrive, the crew, under the supervision of the MT, will open up the ECU and make it ready for the MST to perform the BDAR when it arrives.

a. *Repair Priority*. Damaged ECU removed to designated repair sites shall be selected for repair by the MST in order of:

(1) Most essential to the completion of the mission.

(2) Can be repaired in the least amount of time.

1-13. Time Limits for Repairing Damage. In combat the time available for BDAR is limited. One of the factors to be considered in the selection of a repair site is the amount of time available at the site based on the tactical situation.

a. *Estimate of Time to Effect Repair.* Every assessment must include an estimate of total elapsed time for all tasks required to restore the Environmental Control Unit. The time available at the selected repair site must equal or exceed the estimated time required to accomplish all tasks associated with the BDAR.

b. *Time Guidelines*. Determining where BDAR will take place should be based on the guidelines in Table 1-1. These are general rules which must be adjusted by the commander based on his best estimate of how the most responsive maintenance support can be provided. He must consider the tactical situation, maintenance backlog, personnel, tools, TMDE, and repair parts available. The guidelines are based on a defensive scenario and can be extended when applied to the offense.

Table 1-1. Summary of BDAR Time Guidelines.

Location	Elements performing BDAR	Time guidelines
Breakdown Site	1. Operator/Crew 2. Battalion Maintenance Team (MT) 3. Maintenance Support Team (MST) from Forward Support Maintenance Company	2 Hours
Battalion Trains (OMCP)	1. Battalion Maintenance Platoon 2. Maintenance Support Team (MST) from Forward Support Maintenance Company 3. Maintenance Support Team (MST) from Maintenance Battalion	6 hours
Brigade Support Area	1. Forward Support Maintenance Company 2. Maintenance Support Team (MST) from Maintenance Battalion 3. Maintenance Support Team (MST) from COSCOM CE	24 Hours
Division Support Area	1. Maintenance Battalion 2. Maintenance Support Team (MST) from COSCOM	36 Hours
Corps Support	1. COSCOM Maintenance Companies	96 Hours

1-14. Recording BDAR Repairs. All BDAR repairs must be recorded and the record properly processed.

a. All components which are repaired using BDAR or other expedient techniques, shall be marked with DD Form 1577, or similar conspicuous tag. It is not necessary to fill out the form. The purpose of marking an item which has been repaired using BDAR techniques is to quickly enable maintenance personnel to recognize these parts when the equipment is subsequently returned for authorized permanent repair.

b. When a component is cannibalized, a tag should be attached in the space created by the missing part to alert higher echelon repair personnel quickly that the part has been removed.

c. When the equipment is recovered/evacuated for permanent standard repair, and DA Forms 2404 and 2407 are used, the notation "BDAR" shall be added in the space provided for description of deficiencies.

d. DA Pam 738-750 provides for disposition of DA Form 2404 and copy number 3 of DA Form 2407. When "BDAR" is noted on these forms, they shall be mailed to: Commander, U.S. Army Troop Support Command, ATTN: AMSTRMES, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. The information on these forms will provide data for designing ECU to be less susceptible to combat damage and easier to repair when damaged.

CHAPTER 2

ASSESSING BATTLEFIELD DAMAGE

BDAR FIXES SHALL BE USED ONLY IN COMBAT OR FOR TRAINING AT THE DISCRETION OF THE COMMANDER (AUTHORIZED TRAINING FIXES ARE LISTED IN APPENDIX E) IN EITHER CASE DAMAGES SHALL BE REPAIRED BY STANDARD PROCEDURES AS SOON AS PRACTICABLE.

Section I. INTRODUCTION

2-1. Scope. This chapter provides guidelines to use to assess battlefield damage. It directs you to an expedient repair procedure, or to the standard system TM if an expedient repair procedure for your problem doesn't exist.

2-2. General. Use this BDAR technical manual (TM) in conjunction with the operator's technical manual (TM). This chapter explains how to use this manual to assess and fix battlefield damage that prevents equipment operation. This chapter contains the general fault assessment tables, general troubleshooting instructions, and maintenance instructions. General fault assessment tables, specific fault assessment tables, and detailed assessment procedures are used to locate the damage; an expedient repair procedure tells how to fix the damage. An index of the expedient repair procedures is located in each chapter. If you don't know or aren't sure of exactly what your problem is, use the assessment tables and procedures to find the fault.

2-3. Application. Perform the following steps to find and fix battlefield damages:

a. Do the Preventive Maintenance Checks and Services (PMCS) in the TM. At the same time, look for obvious damage to the Environmental Control Unit (ECU).

b. If applicable, do the troubleshooting/repair recommended by the TM.

c. If you find the problem, determine its effect on the operation of the ECU.

d. If the problem does not affect equipment operation, the commander shall decide whether to attempt to fix the problem or continue with the mission.

e. If the damage does affect the ECU operation, do one of the following:

(1) Replace the bad part/assembly with a good one (from supply or other source).

(2) Replace the bad part/assembly with a substitute, if one exists.

(3) Use the expedient repair procedures in this manual to repair the damage.

Section II. GENERAL FAULT ASSESSMENT TABLES

2-4. General. This section provides an overall damage assessment procedure to evaluate the operability of individual equipment.

a. *Assessment References*. The assessment procedures are designed to assure that all necessary aspects of an ECU's capability are evaluated during the assessment process. The procedures refer you to:

(1) Procedures in this manual if a "quick-fix" is possible.

(2) The standard TM if the best repair is covered in the system TM.

(3) A higher maintenance level if access to devices or materials to do the quick-fix are available only at those levels.

b. *Procedure Content.* Each procedure:

(1) Contains general information about the problem.

(2) Lists materials and/or tools required other than those commonly available to the crew, MT, and MST (If the listed items are not available, improvise. Anything that will do the job is acceptable.)

(3) Lists the estimated number of persons needed and the estimated time required to complete the repair.

(4) States the operational limitations caused by the repair action before experiencing further damage/degradation to the ECU.

(5) The third is assessment of where and how to repair the damage.

(6) Provides other expedient options you can use depending on the availability of personnel, materials, tools, and/or time (this does not include standard maintenance procedures or recovery)

c. *Procedure Index.* Following each assessment procedure is an index of the procedures contained in that chapter. If you know exactly what your problem is you can use the index to find the proper expedient repair procedure.

d. *Additional Data.* Additional data is contained in the Appendices.

(1) Appendix A lists references including foreign ownership of U.S. Environmental Control Units (ECU).

(2) Appendix B lists special or fabricated tools used in performing BDAR repairs.

(3) Appendix C lists Expendable & Durable Supplies and Materials that are available for BDAR repairs.

(4) Appendix D lists Substitutes Materials/Parts.

(5) Appendix E lists Training Procedures.

2-5. Assessment Process. The assessment procedures are structured using the logic process. (See Table 2-1.)

a. *Procedure Sequence*. All assessment procedures follow the sequence:

(1) Visually inspect (repair, if necessary).

(2) Functionally test (repair, if necessary).

(3) Assess the performance.

The field fixes will enable the crew to continue operations in some cases, but will usually be most useful to the MT/MST for scheduling and accomplishing fix-forward repairs and assessing combat capabilities for reporting to commanders.

b. *Assessment Types.* There are three types of assessments performed on damaged equipment.

(1) The first assessment is extent and kind of damage and how it affects ECU operation and capabilities.

(2) The second is whether the damage needs to be repaired and,

(3) The third is assessment of where and how to repair the damage.

c. *Assessment Levels*. Assessments of damage may be made in turn by operator/crew, MT, and MST assessors.

(1) Extent and kind of damage is readily assessable.

(2) Whether or not to repair the damage may be readily assessable. However, whether to attempt repair and when and how to repair the damage may be judgment calls. No procedure can take all possible situations into account. Assessment of whether the damage needs to be repaired will be made jointly by the MT and mission commander as they evaluate the equipment for further operation or recovery.

(3) Assessment of where and how to repair the damage will be made by the MT usually with some suggestions by crew/operator. MST's may redirect or change MT's decisions.

NOTE

Items checked in this procedure must work to provide minimum functional operational capability. Even if all systems work, the ECU may be unsafe and may not satisfy normal required operating capabilities or may not receive mission essential maintenance.

ASSESSING BATTLEFIELD DAMAGE

Table 2-1. System Assessment.

ITEM/ACTION	FAULT ISOLATION	BDAR REFERENCE
A. REFRIGERATION SYSTEM.		
1. VISUALLY INSPECT		
a. CONDENSORI EVAPORATOR		
Inspect	Damage visible: -Evaluate extent of damage using procedures in ..... -Determine if.....	CHAPTER 3.
No damage visible	Damage can be repaired -Note repair requirements	Damage cannot be repaired -Note extent of damage
	Continue assessments	
		RECOVER

ASSESSING BATTLEFIELD DAMAGE

Table 2-1. System Assessment (Cont.)

ITEM/ACTION	FAULT ISOLATION	BDAR REFERENCE
b. REFRIGERANT LINES		
Inspect	Damage visible: -Evaluate extent of damage using procedures in	CHAPTER 3.
	-Determine if.....	
No damage visible	Damage can be repaired -Note repair requirements	Damage cannot be repaired -Note extent of damage
	Continue assessments	RECOVER
c HOT-GAS BYPASS SYSTEM		
Inspect	Damage visible: -Evaluate extent of damage using procedures in	CHAPTER 3.
	-Determine if.....	
No damage found	Damage can be repaired -Note repair requirements	Damage cannot be repaired -Note extent of damage
	Continue assessments	RECOVER
2 FUNCTIONALLY TEST		
a REFRIGERATION SYSTEM		
Test reveals	Condenser/Evaporator damage -Evaluate extent of damage using procedures in	CHAPTER 3.
	Refrigerant Line damage: -Evaluate extent of damage using procedures in	CHAPTER 3.
	Hot-Gas Bypass System Damage: -Evaluate extent of damage using procedures in	CHAPTER 3.

ASSESSING BATTLEFIELD DAMAGE

Table 2-1. System Assessment (Cont.)

ITEM/ACTION	FAULT ISOLATION	BDAR REFERENCE
No damage found	-Determine if..... Damage can be repaired -Note repair requirements Continue assessments	Damage cannot be repaired -Note extent of damage RECOVER

This completes the refrigeration system assessmentsContinue with assessment of electrical system if required. If after systems are operational, prepare to report.

B ELECTRICAL SYSTEM.

1 VISUALLY INSPECT

a FUSES/CIRCUIT BREAKERS/TRANSFORMERSIRECTIFIERS/RELAYS

Inspect	Damage visible on: Fuse/circuit breaker: -Evaluate extent of damage using procedures in	CHAPTER 4.
	-Determine if.....	
No damage found	Damage can be repaired -Note repair requirements	Damage cannot be repaired -Note extent of damage
	Continue assessments	

b WIRE:

Inspect	Damage visible on: Insulation or wire: -Evaluate extent of damage using procedures in	CHAPTER 4 or specific TMs.
	-Determine if.....	
No damage found	Damage can be repaired -Note repair requirements	Damage cannot be repaired -Note extent of damage
	Continue assessments	

This completes assessment of the electrical systemSummarize assessment findings, and prepare to report assessment findings in operational system order to commander for operational status/disposition determination.

CHAPTER 3

REFRIGERATION SYSTEM

BDAR FIXES SHALL BE USED ONLY IN COMBAT OR FOR TRAINING AT THE DISCRETION OF THE COMMANDER (AUTHORIZED TRAINING FIXES ARE LISTED IN APPENDIX E) IN EITHER CASE DAMAGES SHALL BE REPAIRED BY STANDARD PROCEDURES AS SOON AS PRACTICABLE.

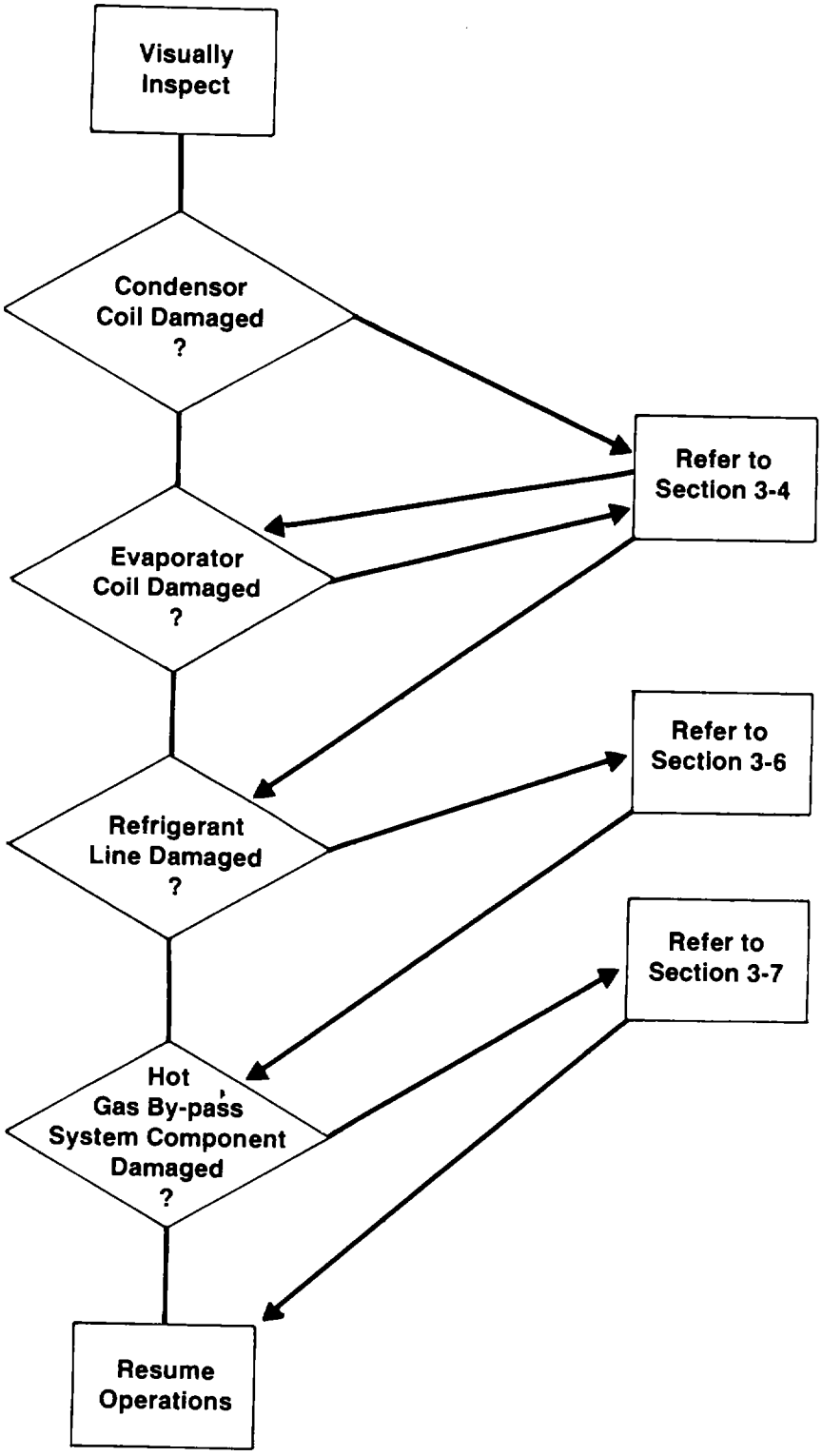
Section I. INTRODUCTION

3-1. Scope. Refrigeration system components within the DOD standard family of Environmental Control Units are essentially identical in function but differ in size and occasionally in different location of components within the various units. Standard bracing can be extended to perform splicing or by-passing of damaged refrigeration lines. Heat dissipation fins will require removal around the damaged areas within condenser or evaporator coils if by-passing is not feasible. Expansion valves and compressors generally cannot be expediently repaired unless merely nicked or punctured in such a way that internal components are undamaged. Patches may be improvised where this instance is observed in order to seal the system. Cannibalization is urged where compressors or expansion valves cannot be repaired.

3-2. Assessment Procedure. Refrigeration system assessment procedures are structured using the logic process. (See Table 3-1) Visually inspect the system for damage. If leak cannot be found, use standard maintenance procedures to locate. (See TM9-4840-435-14.)

3-3. Repair Procedure Index.

Damage	Para
1. Condensor/Evaporator Coil Damaged	3-4
2. Refrigerant Line Damaged	3-6
3. Hot Gas By-Pass System Components Damaged	3-8



Refrigeration System Assessment Procedure

Table 3-1.

Section II. CONDENSOR/EVAPORATOR REPAIRS

3-4. General. Most copper tubing lines within condensor or evaporator coils are 3/8" diameter and can be brazed to repair minor damage. Other lines which may be larger can also be repaired though replacement line may not be readily available. This section concentrates on major line damage repair techniques offered through splicing, bypassing, or replacement of useful line.

3-5. By-Passing Damaged Line. In some instances, damage to a loop within a condenser or evaporator may be impossible to repair. This procedure allows by-pass of damaged lines where access to the end of a condensor or evaporator is feasible.

a. *General Information*

(1) Limitations.

Degraded cooling output.

(2) Personnel/Time required.

1 Soldier/8.0 hours.

(3)Materials/Tools.

Tool Kit, Service Refrigeration Unit (Appendix B, Item 12)
Copper Tubing Identical Size to that Damaged (Appendix C)

b. *Procedural Steps:*

WARNING

High Voltage exists in this equipment. **DEATH ON CONTACT** may result if personnel fail to observe safety precautions. Turning the switch on the ECU, to the OFF position, does not meet the requirements of disconnecting power from the ECU.

(1) Disconnect electrical power source from ECU.

(2) Gain access to end of damaged condensor or evaporator.

(3) Remove loop at end of damaged line and next loop in sequence.

(4) Measure replacement tubing and cut to ensure tight bends at each end of replacement loop.

NOTE

Loose bends will result in clearance problems upon reinstallation.

(5) Prebend each end of replacement loop to fit from the outside line of each removed loop.

(6) Check that replacement line is clean before installing into system.

NOTE

Any debris which can contaminate the system may prevent proper operation.

(7) Braze replacement copper tubing from each loop's outside line so that there is an even number of open lines between replacement tubing.

(8) Recharge refrigeration system using standard maintenance procedure.

(9) Test refrigeration system for leaks. (See TM9-4840-435-14.)

(10) Record BDAR action taken.

NOTE

When the mission has been completed, repairs are to be made using standard maintenance procedures.

Section III. REFRIGERANT LINE DAMAGE

3-6. General. Two options of splicing into a damaged refrigeration line are covered in this section. The preferred method is by brazing the connections. The alternate method of repair is with a section of hydraulic brake hose, hose clamps, and epoxy.

3-7. Splicing. If damaged line is within the condensor or evaporator, and damage is limited to four holes or less within one circuit, a circuit consisting of a loop from one end of the condensor/evaporator to the other and back again, follow the procedures in this Section. If more than four holes exist in the circuit, by-pass the damage using procedures given in Section II, paragraph 3-5.

a. *General Information:*

(1) Limitations-Degraded cooling capacity.

(2) Personnel/Time required.

1 Soldier/1.0 to 8.0 hours.

(3) Materials/Tools.

Copper Tubing (Appendix C)
Epoxy (Appendix C, Item 3)
Hose Clamps (Appendix C)
Hydraulic Brake Hose (Appendix C)
Tool Kit, Service Refrigeration Unit (Appendix B, Item 12)

WARNING

High Voltage exist in this equipment. DEATH ON CONTACT may result if personnel fail to observe safety precautions. Turning the switch, on the ECU, to the OFF position, does not meet the requirements of disconnecting the power from the ECU.

WARNING

Use protective equipment, such as safety glasses/goggles, gloves, and hearing protection, to avoid serious injury.

b. *Procedural Steps:*

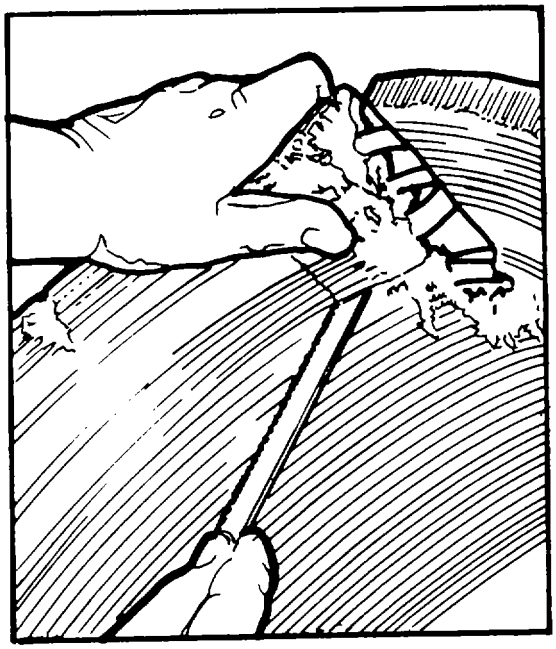
(1) Option 1: Splicing Brazing refrigerant tubing by

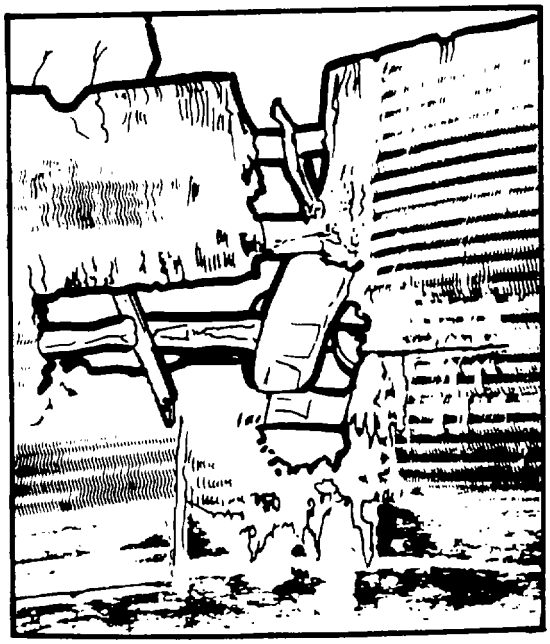
(a) Disconnect electrical power source from ECU.

(b) Gain access to damaged area.

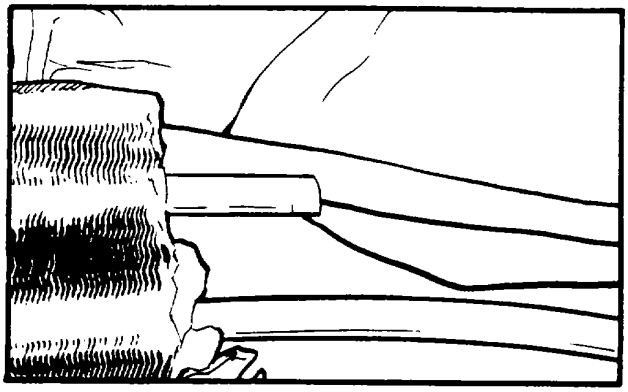
(c) Remove enough heat dispersing fins to gain access to damaged refrigerant lines.

(d) Cut damaged section of refrigerant line out.



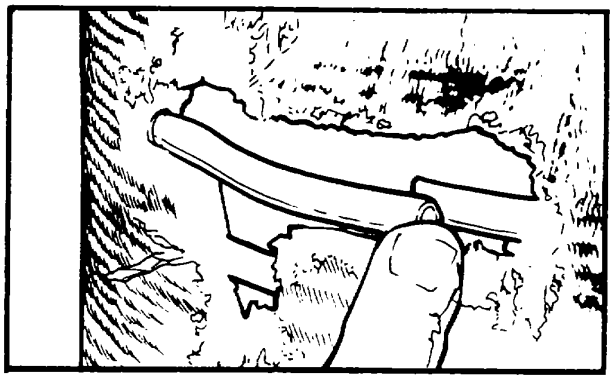


(e) Expand (bell) exposed ends of refrigerant line to form a female coupling.



(f) Cut replacement tube long enough to be inserted tightly in each female coupling.

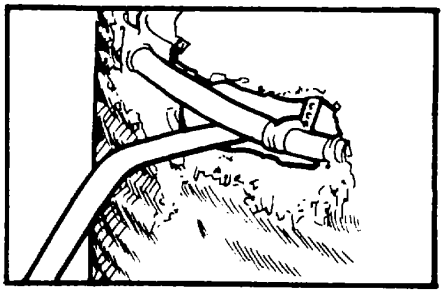
(g) Install replacement line.



(h) Braze each connection closed.

(i) Recharge refrigeration system using standard maintenance procedures.

(j) Test refrigeration system for leaks. (See TM9-4840-435-14.) (k) Record all BDAR action taken.



NOTE

When the mission has been completed, repairs are to be made using standard maintenance procedures.

(2) Option 2: Splicing refrigerant tubing with hydraulic brake hose, clamps, and epoxy.

(a) Perform procedural steps a, b, and c, in option 1.

NOTE

A minimum of three inches of tubing must be cut out of damaged section, to prevent crimping of refrigerant tubing, when installing hydraulic brake hose.

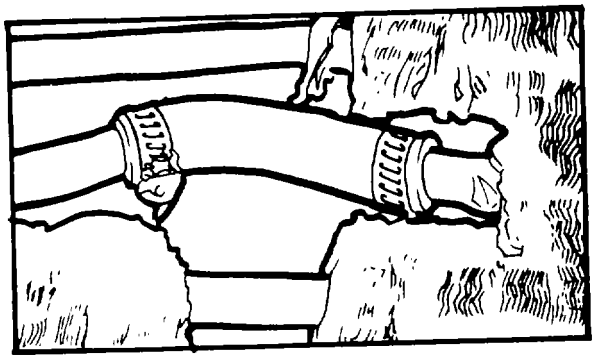
(b) Cut out damaged section of refrigerant tubing from system.

(c) Cut hydraulic brake hose approximately 11/2 inches (3.87 cm) longer than section of refrigerant tubing removed.

(d) Install one end of hydraulic brake hose over one end of refrigerant tubing.

(e) Slide two hose clamps on hydraulic brake hose.

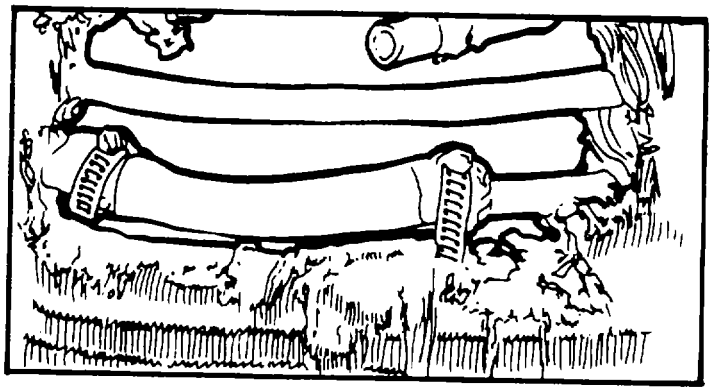
(f) Install opposite end of hydraulic brake hose over opposite end of refrigerant tubing.



3-7

(g) Position hose clamps over each end of hydraulic brake hose. **DO NOT** tighten clamps down to a snug fit.

(h) Insert a liberal amount of epoxy between hydraulic brake hose and refrigerant tubing.



(i) Tighten hose clamps without crushing refrigerant tubing.

(j) Allow adequate amount of time to allow epoxy to dry.

(k) Recharge refrigeration system using standard maintenance procedures.

(l) Test refrigeration system for leaks. (See TM9-4840-435-14.)

(m) Record all BDAR action taken.

NOTE

When the mission has been completed, repairs are to be made using standard maintenance procedures.

Section IV. HOT GAS BY-PASS SYSTEM

3-8. General. The hot gas by-pass system of DOD standard environmental control systems is present to keep the compressor running continuously to avoid Electro-Magnetic Interference (EMI) surges which could effect frequency and voltage sensitive equipment and can be detected by enemy forces.

3-9. By-Pass of Hot Gas By-Pass System. To prevent refrigerant from entering the by-pass mode, the liquid line solenoid must be closed, ensuring thermostat setting is never satisfied. A jumper then can be installed across thermostat contacts.

a. *General Information:*

(1) Limitations-None.

(2) Personnel/Time Required.

1 Soldier/0.3 hours.

(3) Materials/Tools.

Wire (Appendix C)
Tape, Electrical (Appendix C, Item 10)
Crimping Tool (Appendix B, Item 2)

b. *Procedural Steps*:

(1) Locate wires emerging from thermostat.

(2) Cut both wires, leaving enough wire remaining to reattach later.

(3) Remove approximately one inch of insulation from each wire NOT attached to thermostat.

(4) Twist exposed wire together.

(5) Tape twisted connection covering exposed wire.

(6) Resume operations.

NOTE

When the mission is completed, repair using standard maintenance procedures.

(7) Record BDAR action taken.

CHAPTER 4

ELECTRICAL SYSTEM

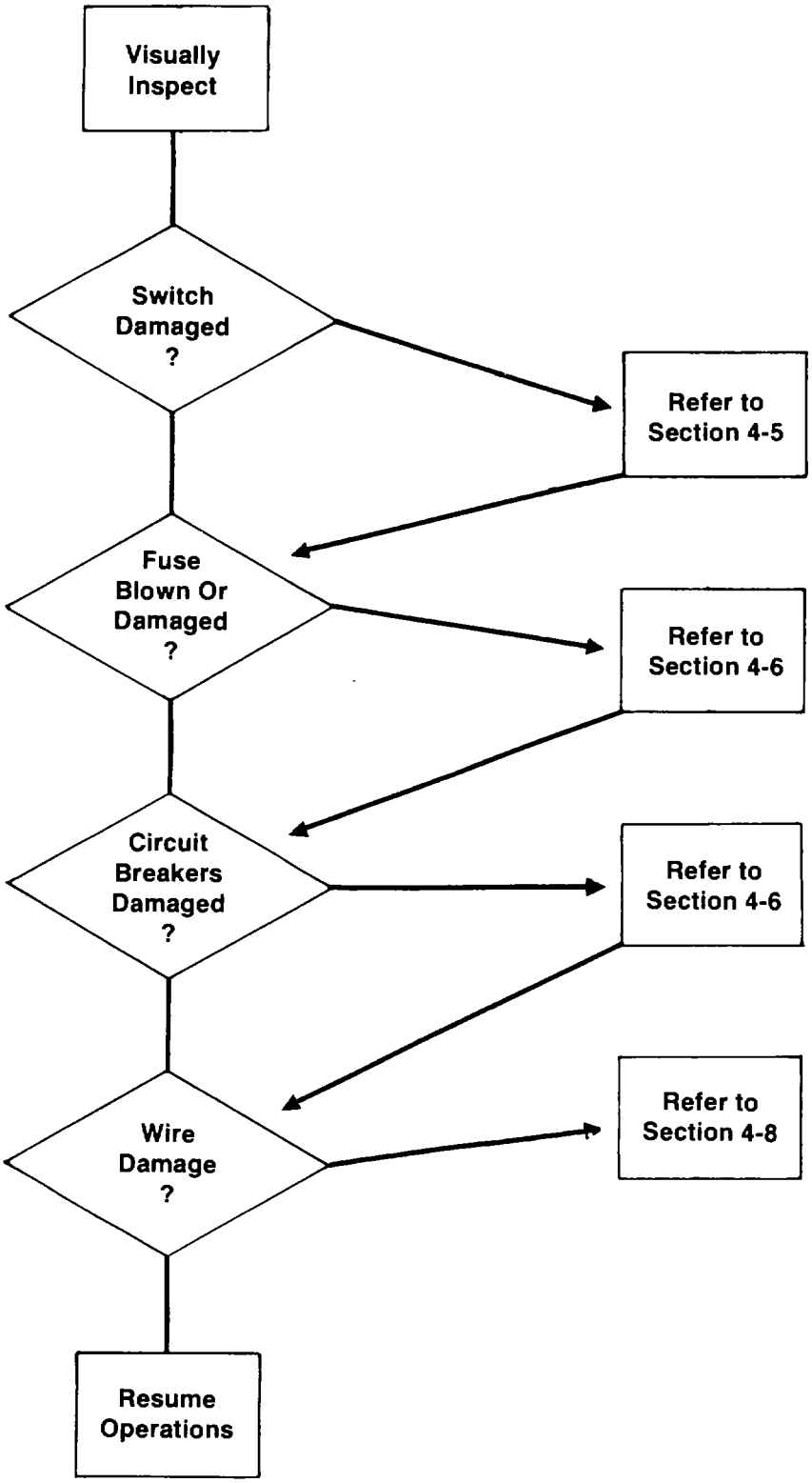
BDAR FIXES SHALL BE USED ONLY IN COMBAT OR FOR TRAINING AT THE DISCRETION OF THE COMMANDER (AUTHORIZED TRAINING FIXES ARE LISTED IN APPENDIX E) IN EITHER CASE DAMAGES SHALL BE REPAIRED BY STANDARD PROCEDURES AS SOON AS PRACTICABLE.

Section I. INTRODUCTION

4-1. General. Environmental Control Units (ECU) contain many basic electrical components which can be repaired or by-passed or replaced. Switches can be cannibalized or replaced, wire can be spliced or soldered, fuses can be shorted, and other repairs are sometimes possible. Care must be taken to avoid contact with live circuits since some units draw enough current to cause severe injury. Fan meters are not expediently repairable if damaged or worn out and should be replaced or cannibalized.

4-2. BDAR Procedure Index.

Damage	Para
Switch Defective	4-5
Fuse or Circuit Breaker Failure	4-6
Wiring Harness Damage	4-8
Connector Pin Damaged (Broken or Missing)	4-9
Wires Broken	4-10



Electrical System Assessment Procedure

Table 4-1

Section II. ELECTRICAL COMPONENTS

4-4. General. Electrical circuits contain switches and protection devices. By-passing a failed switch or protection device is a rapid repair but may create more damage. The circuit must be checked for shorts before by-passing a protection device.

4-5. Switch Defective. Environmental Control Unit will not operate due to switch failure. This procedure will allow the equipment to operate until switch replacement can be effected.

a. *General Information.*

(1) Limitations. High/low pressure switches, if shorted across, could effect the compressor and/or other components.

(2) Personnel/time required.

1 soldier/0.3 hours.

(3) Materials/tools.

Electrical tape (Appendix C, Iteml0)
Duct tape (Appendix C, Item 10)

b. *Procedural Steps.*

(1) Locate switch.

(2) Disconnect both wires.

(3) Slide protective insulation boots back on the wires to expose the electrical connectors.

(4) Lay the two connectors side by side and secure with tape.

Record the BDAR action taken. When the mission is completed, as soon as practicable, repair the generator using standard maintenance procedures.

4-6. Fuse or Circuit Breaker Failure. A short or overload in a circuit will cause the fuse to burn out or the circuit breaker to trip. The circuit becomes inoperative. A temporary repair can be made by bypassing the protection device with straight wiring or by replacing the fuse with tinfoil, wire, ball point pen spring, or similar conductor. Use of solder will provide some amount of circuit protection. Damage to the equipment can occur when the circuits are not properly fused.

Section III. WIRING HARNESS

4-7. General. Wiring harnesses are normally replaced when extensive damage occurs. Because of improvements or different configurations, replacement harnesses from other equipment of the same family may use some different style connectors. Try to obtain harnesses from an identical model; however, connectors can be exchanged with the damaged harness. The same procedure is followed to change a complete connector or splice a complete harness. If a wire is damaged but the fault cannot be located, it should be replaced with a jumper wire.

4-8. Wiring Harness Damage. Wire harness repairs are generally a series of single wire repairs. Establishing circuit continuity in a bundle of wires is difficult because individual wires are not color coded. Wires must be identified before they are connected. Most essential electrical functions can be rapidly restored by using jumper wires. An alphanumeric code is imprinted onto the outer insulating jacket of each wire. A point to point run of each wire can be determined from the troubleshooting diagram plate and the alphanumeric code.

a. *General Information.*

(1) Limitations.

None.

(2) Personnel/time required.

1 Soldier/1-2 hours

(3) Materials/tools.

Wire (Appendix C)
Splices (Appendix C)
Electrical tape (Appendix C, Item 10))
Solder, rosin-core (Appendix C)
Soldering iron (Appendix B)
Plastic ties (Appendix C, Item 11)

b. *Procedural Steps.*

(1) Option 1: Wire bundle repairs. (See figure 4-1.)

(a) Repair the first wire and tape. Leave the tape hanging from the repair.

(b) Repair the next wire, lay it on top of the first repair.

(c) Continue wrapping with insulation tape.

(d) Repeat these steps as often as necessary to repair the wire bundle without cutting or breaking the tape until the repair has been completed.

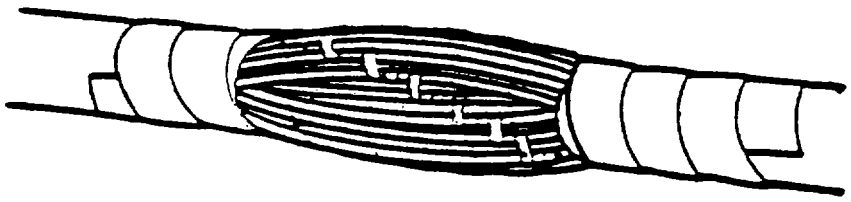


Figure 4-1. Wire Bundle Repair of Wiring Harness.

(e) Stagger splices, when possible, at least one splice length.

(f) Insure that minimum essential cable clamps have been replaced.

(g) Clamp cushions can be replaced by tape.

(2) Option 2: Jumper wire.

(a) Identify the connector pin at each end of the harness.

(b) Cut off the end of the defective wire.

(c) Thread the jumper wire along the path of the cable harness passing the wire through the clamps.

(d) Attach the jumper wire.

(e) Tape the jumper wire securely to the harness at intervals that will provide protection from vibration or sagging.

Record the BDAR action taken. When the mission is completed, as soon as practicable, repair the equipment using standard maintenance procedures.

4-9. Connector Pin Damaged (Broken or Missing). If the pins are too small, or time is insufficient, the entire connector should be replaced. A replacement connector complete with a pigtail removed from another environmental control unit can be spliced to the wiring harness (see figure 4-2). If the connector is attached to shock mounted equipment, the wires should be long enough to insure free movement of the equipment on its shock mounts. Procedures are the same as repairing a wire bundle.

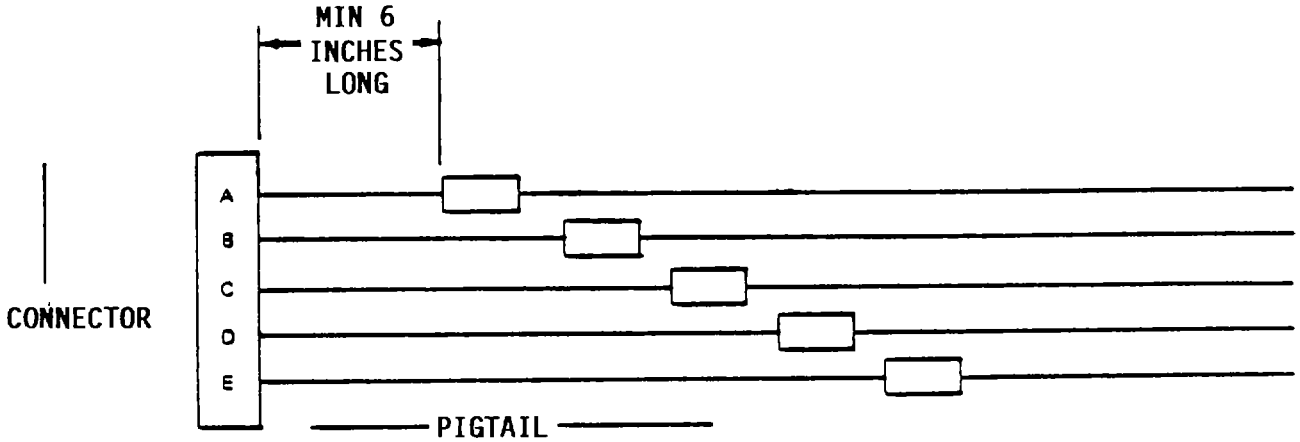


Figure 4-2. Connector Spliced to Generator Wiring

4-10. Wires Broken. Broken wires can be spliced several different ways to restore an electrical circuit. The available tools and materials will determine the method used. Soldered connections conduct current the best and should be used whenever possible.

a. *General Information*.

(1) Limitations.

None.

(2) Personnel/time required.

1 Soldier/10-20 minutes

(3) Materials/tools.

Crimping tool (Appendix B, Item 2)
Solder, rosin-core (Appendix C)
Wire (Appendix C)
Heat shrink tubing (Appendix C)
Soldering iron (Appendix B)

b. *Procedural Steps.*

(1) Option 1: Solder wire method.

(a) Strip end of broken wires (Detail A, figure 4-3).

(b) Install a section of plastic sleeving or shrink tubing, if available, over one end of the broken wire (Detail B, figure 4-3).

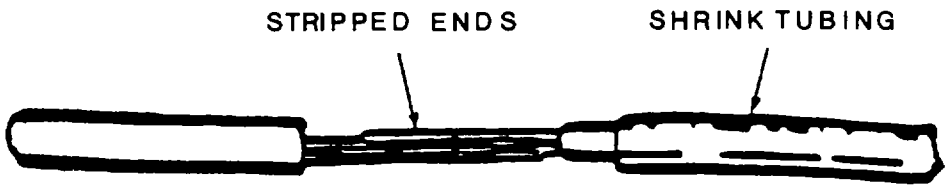
(c) Lay the stripped ends side by side.

(d) Twist the wire ends together.

(e) Solder wires together using rosin-core solder (Detail C, figure 4-3).

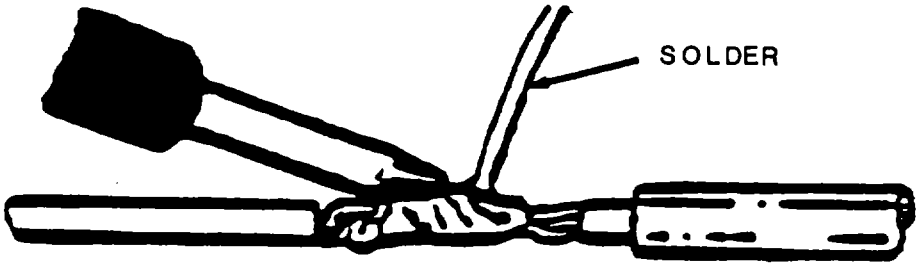
(f) Slide sleeve or tubing over the soldered wires or tape to insulate the conductor (Detail D, figure 4-3).

Record the BDAR action taken. When the mission is completed, as soon as practicable, repair the equipment using standard maintenance procedures.



DETAIL A

DETAIL B



DETAIL C

DETAIL D

Figure 4-3. Solder Method to Repair Wires.

(2) Option 2: Wire splice method.

(a) If terminal lug barrel is used for splicing, select barrel diameter large enough to accept both wires (Item1, figure 4-4).

(b) Cut off terminal flush wire pre-insulation (Item 2, figure 4-4).

(c) Cut insulating sleeve one inch longer than the barrel (Item 3, figure 4-4).

(d) Strip end of broken wires (Item 4, figure 4-4).

(e) Install insulating sleeve or shrink tubing, if available, over one end of broken wire (Item 5, figure 4-4).

(f) Insert wires into the prepared splice barrel and crimp to secure the wires (Item 6, figure 4-4).

(g) Slide sleeve or tubing over the splice or use tape to insulate the conductor and apply heat to shrink material. Ends of non-shrink sleeve must be tied (Item 7, figure 4-4).

Record the BDAR action taken. When the mission is completed, as soon as practicable, repair the equipment using standard maintenance procedures.

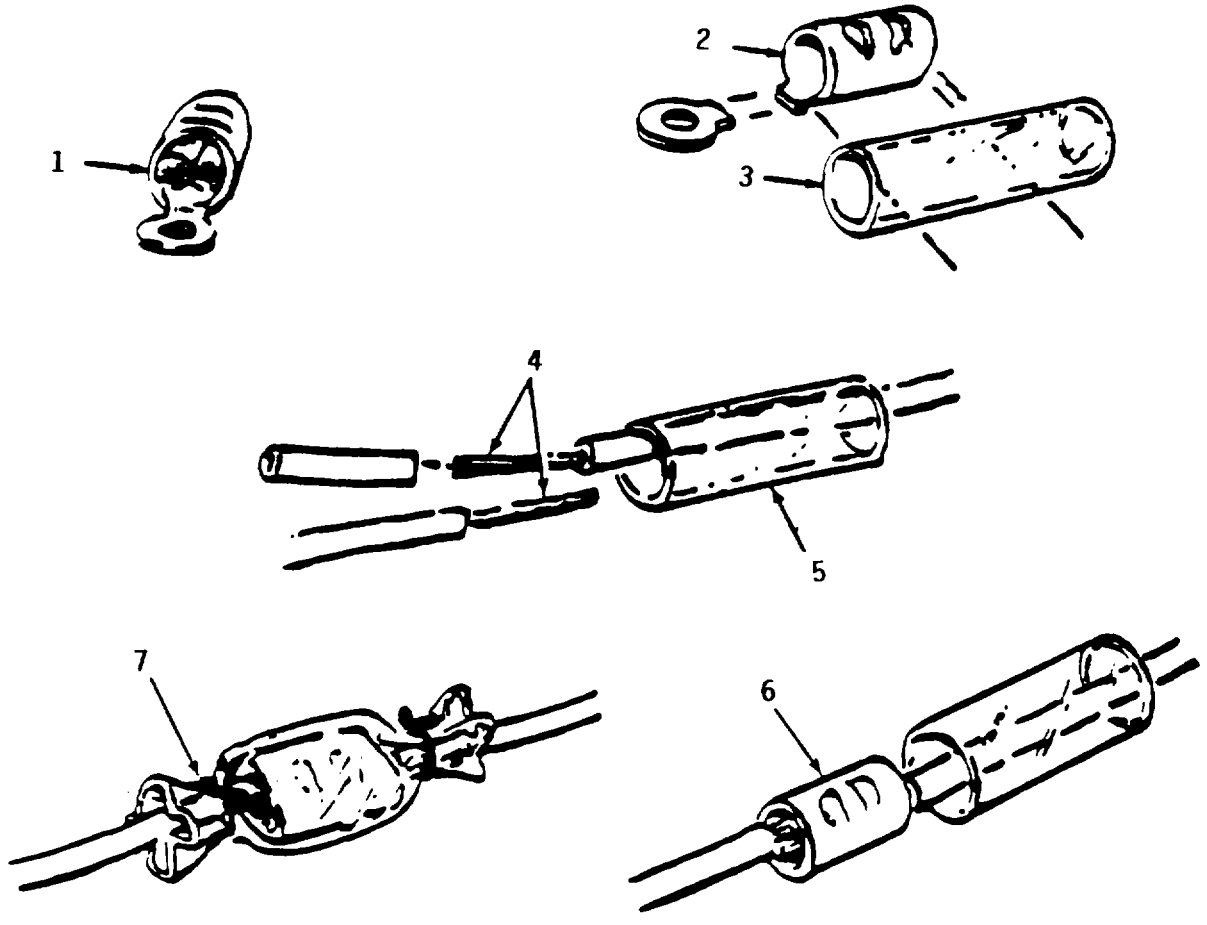


Figure 4-4. Solder Method to Repair Wires.

(3) Option 3: Splicing different size wires.

(a) Strip broken wire ends, strip enough insulation to allow the smaller wire to be doubled as shown (Detail A, figure 4-5).

(b) Install plastic sleeve or shrink tubing, if available, over one end of broken wire.

(c) Connect wires by using a splice or terminal lug prepared as in Option 2, Step 2a.

(d) Crimp splice or lug to secure wires.

(e) Slide the sleeve or tubing over the splice or tape to insulate the conductor (Detail B, figure 4-5).

Record the BDAR action taken. When the mission is completed, as soon as practicable, repair the equipment using standard maintenance procedures.

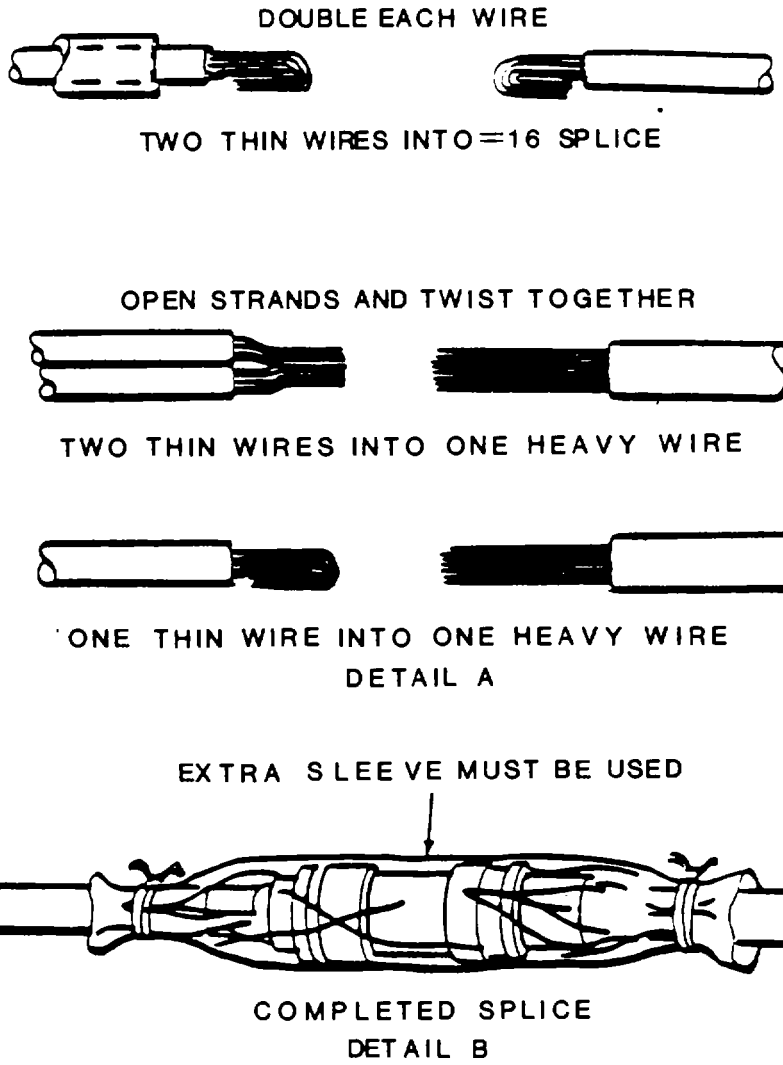


Figure 4-5. Splicing Various Size Wires.

APPENDIX A

REFERENCES

BDAR FIXES SHALL BE USED ONLY IN COMBAT OR FOR TRAINING AT THE DISCRETION OF THE COMMANDER (AUTHORIZED TRAINING FIXES ARE LISTED IN APPENDIX E) IN EITHER CASE DAMAGES SHALL BE REPAIRED BY STANDARD PROCEDURES AS SOON AS PRACTICABLE.

A-1. Scope. This appendix lists all forms and records, field manuals, technical manuals, and miscellaneous publications referenced in this manual.

A-2. Forms and Records.

Recommended Changes to Publications On Blank Forms	DA-2028
Recommended Changes to Equipment Technical Publications	DA-2028-2
Recommended Inspection and Work Sheet	DA Form 2404
Maintenance Request	DA Form 2407

A-3. Field Manuals.

Artificial Respiration (First Aid Procedures)	FM21-11
Decontamination Procedures	FM3-220

A-4. Department of the Army Publication.

The Army Maintenance Management System (TAMMS)	DA PAM 738-750

A-5. Technical Manuals.

Destruction of Equipment to Prevent Enemy Use	TM 750-244-3
Leak Detector, Refrigerant Gas	TM9-4840-435-14

APPENDIX B

SPECIAL AND FABRICATED TOOLS

BDAR FIXES SHALL BE USED ONLY IN COMBAT OR FOR TRAINING AT THE DISCRETION OF THE COMMANDER (AUTHORIZED TRAINING FIXES ARE LISTED IN APPENDIX E) IN EITHER CASE DAMAGES SHALL BE REPAIRED BY STANDARD PROCEDURES AS SOON AS PRACTICABLE.

SECTION I. General

B-1. Scope.

This appendix lists items recommended for the support of the environmental control units in a combat environment. The items listed may be required for Battlefield Damage Assessment and Repair at maintenance levels from crew through DS. Also listed are expedient tools for performing BDAR repairs using non-standard equipment.

SECTION II. Tools

B-2. General.

Tools listed in this appendix will enhance crew members and mechanics at all levels to accomplish Battlefield Damage and Assessment repairs in a more expedient manner. Some tools listed may already be on hand in the unit.

The column marked "Level" indicates the maintenance level at which it is recommended these items be stocked or carried. The unit commander may modify the items in the list and the maintenance levels carrying the items, based on current mission requirements and recent operational experience.

The items marked "C" (Crew) are recommended to be carried on the vehicle for use in combat emergencies at the discretion of the unit commander. Those items marked "MT" are recommended to be carried by each Battlefield Damage Assessment and Repair Maintenance Team (MT). Some of these items may already be available at organizational maintenance, however, additional items will be required to stock each MT. Those items marked "O" are recommended to be stocked at organizational and those marked "MST" are recommended to be carried by the DS maintenance support teams (MST).

SECTION II (Cont)

TOOLS LISTS

ITEM NUMBER	LEVEL	NSN	DESCRIPTION
1	C	5110-00-277-4591	Blade, hand hacksaw: 24 teeth per inch, 10 inches.
2	MT	5128-00-278-2423	Crimping Tool: terminal, hand w/cutting pin, stripper.
3	MT	5120-00-278-9153	Cutter, tubing, close quarters.
4	C	5110-00-241-9153 5110-00-241-9156	File, hand: half round, 10 inch.
5	C	5110-00-234-6559	File, hand: round.
6	C	5120-00-278-0352	Pliers, slip joint: angle nose, multiple tongue and groove, 10 inch.
7	C	5120-00-293-0448	Punch, aligning: 3/16 inch point, 8 inches long, 3/8 inch dia.
8	C	5120-00-595-9531	Punch, aligning: 1/4 inch point, 12 inches long.
9	MT	3439-00-204-3859	Iron, soldering.
10	MT	5940-00-500-8723	Splice, conductor, crimp style: 10 gauge wire.
11	MT	5940-00-840-0139	Splice, conductor, crimp style: 12 to 14 gauge wire.
12	MT	5180-00-596-1474	Tool kit, refrigeration service.

SECTION III. Test Equipment

B-3. Field Expedient Test Equipment.

General Information:

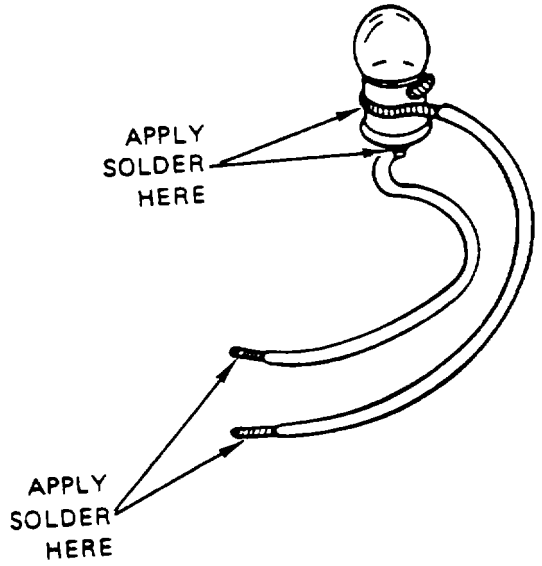
Sometimes, in the process of assessing the battlefield damage, it is necessary to make voltage and resistance measurements to determine where the fault is. Standard test equipment (voltmeter, ohmmeter, SWR meter, etc.) should be used whenever possible. If standard test equipment is not available, field expedient equipment can be fabricated using parts commonly found on the vehicle and in the forward maintenance areas. The following paragraph provides fabrication instructions for making a voltmeter, ohmmeter, and RF transmitter output tester.

NOTE

Accurate measurements are not available. These are Go-No-Go meters.

1. Making a Voltmeter.

A voltmeter can be made from a light bulb and two pieces of wire. The pieces of wire can be connected to the case and center terminal of the bulb by means of solder, twisting, or simply holding the wire ends against the bulb (see illustration). The voltage rating of the bulb should be close to the value of the expected voltage being measured. For voltages in the 18 to 30 vdc range, any light bulb on the driver's master panel, driver's instrument panel, gunner's panel, commander's panel, or gunner's primary sight can be used. For voltages of 5 vdc or less a two-battery cell flashlight bulb can be used. The presence of voltage will cause the bulb to glow. Polarity of dc voltage does not have to be observed; even ac voltage can be measured. Twist exposed wire ends together and apply solder, if available, and solder. Touch to voltage source when ready to make measurements.

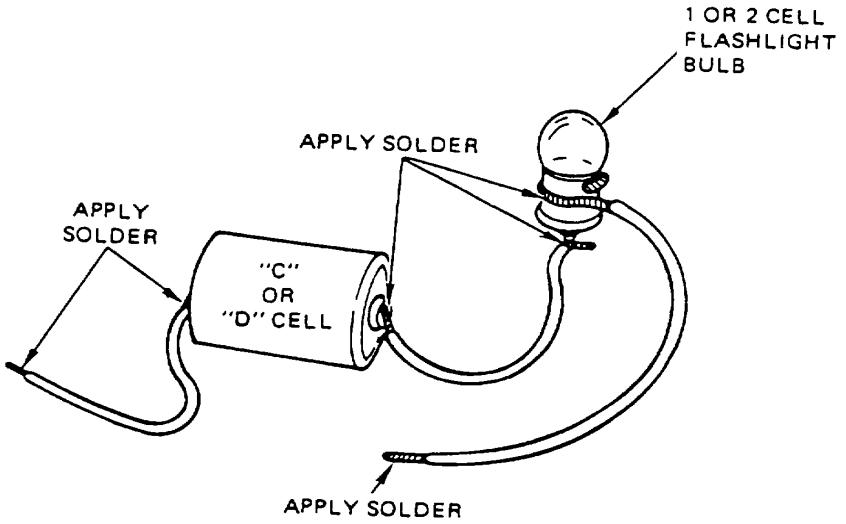


SECTION III (Cont)

Field Expedient Test Equipment (Cont):

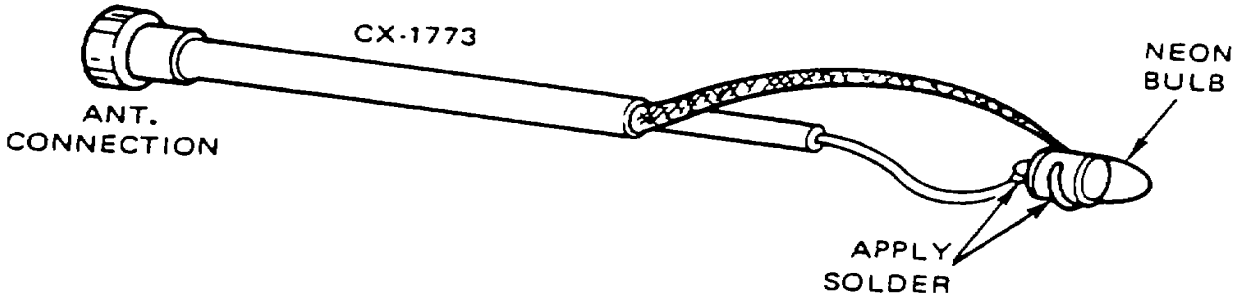
2. Making an Ohmmeter (continuity tester)

   An ohmmeter can be made from a flashlight bulb, flashlight battery, and three pieces of wire. When the free ends of the wires are touched to a circuit where continuity (or a short) exists, the bulb will glow. If a two-cell flashlight bulb is used with only one battery, the bulb will glow with one-half its normal brilliance.



3. Making an RF Transmitter Output Tester.

   This device is used to determine if the radio is sending a signal to the antenna.



a. An RF transmitter output tester can be made from a neon light bulb and a piece of CG-1773 RF cable. Solder the bulb to the cable as shown in the illustration. Connect the cable to the ANT connection on the front of the radio. When the radio is keyed, the bulb will glow if RF power is present at the antenna connection (this does not verify transmitter frequency accuracy).

b. Another way to check for transmitter output is to hold a common (wood) lead pencil tip 1/4-inch to 1/8-inch from the ANT connection. If RF power is present, a yellowish-white arc will jump from the connector to the pencil tip when the radio is keyed.

APPENDIX C

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS

BDAR FIXES SHALL BE USED ONLY IN COMBAT OR FOR TRAINING AT THE DISCRETION OF THE COMMANDER (AUTHORIZED TRAINING FIXES ARE LISTED IN APPENDIX E) IN EITHER CASE DAMAGES SHALL BE REPAIRED BY STANDARD PROCEDURES AS SOON AS PRACTICABLE.

SECTION I. General

C-1. General.

This appendix list items recommended for the support of combat environmental control units in a combat environment. The list includes expendable supplies and materials which may be used to expedite BDAR repairs in a combat situation. The items listed may be required for Battlefield Damage Assessment and Repair at maintenance levels from crew through DS.

The column marked "Level" indicates the maintenance level at which it is recommended that these items be stocked or carried. The unit commander may modify the items in the list and the maintenance levels carrying the items, based on current mission requirements and recent operational experience.

The items marked "C" (Crew) are recommended to be carried on the vehicle for use in combat emergencies at the discretion of the unit commander. Those items marked "MT" are recommended to be carried by each Battlefield Damage Assessment and Repair Maintenance Team (MT). Some of these items may already be available at organizational maintenance, however, additional items will be required to stock each MT. Those items marked "O" are recommended to be stocked at organizational level and those marked "MST" are recommended to be carried by the DS Maintenance Support Teams (MST).

SECTION II (Cont)

EXPENDABLE MATERIAL LIST

ITEM NUMBER	LEVEL	NSN	DESCRIPTION
1	C	4730-00-289-5909	Clamp, hose: 3/8 inch to 1 inch.
2	C/MT	4730-00-308-3193	Clamp, hose: 11/,6 inch to 2 inch.
3	C/MT	8040-00-738-6429	Epoxy.
4	C/MT		Hose, hydraulic, brake.
5	C/MT		Hose, hydraulic, brake.
6	C/MT		Hose, hydraulic, brake.
7	C/MT		Hose, hydraulic, brake.
8	C/MT		Hose, hydraulic, brake.
9	C/MT	7510-00-802-8311	Tape, duct.
10	C/MT	5970-00-543-1005	Tape, electrical.
11	MT	5975-00-451-5001	Ties, plastic.
12	MT		Tubing, copper: 3/8 inch.
13	MT		Tubing, copper:
14	MT		Tubing, copper:
15	MT		Tubing, copper: 11/8 inch.
16	MT	5970-00-812-2968	Tubing, heat shrink: 1/,6 inch.
17	MT	5970-00-812-2969	Tubing, heat shrink: 1/8 inch.
18	MT	5970-00-815-1269	Tubing, heat shrink: 1/4 inch.
19	MT	5970-00-812-2967	Tubing, heat shrink: 1 inch.

SECTION II (Cont)

EXPENDABLE MATERIAL LIST

ITEM NUMBER	LEVEL	NSN	DESCRIPTION
20	MT	6145-00-432-8613	Wire, electrical, stranded 18 gauge.
21	MT	6145-00-152-6499	Wire, electrical, stranded 14 gauge.
22	MT		Wire, electrical, stranded 12 gauge.
23	MT		Wire, electrical, stranded 10 gauge.

APPENDIX D

SUBSTITUTE MATERIALS/PARTS

BDAR FIXES SHALL BE USED ONLY IN COMBAT OR FOR TRAINING AT THE DISCRETION OF THE COMMANDER (AUTHORIZED TRAINING FIXES ARE LISTED IN APPENDIX E) IN EITHER CASE DAMAGES SHALL BE REPAIRED BY STANDARD PROCEDURES AS SOON AS PRACTICABLE.

SECTION I. General

D-1. General.

a. Environmental Control Units (ECU), available within the United States and NATO military supply systems, commercial parts, and captured parts, may be substitutes for the ECU.

b. ECU's are to be put back in service as soon as possible using the following equipment:

1. Primary. The correct piece of equipment for the system. (See FO-1.)

2. Alternate. A piece of equipment that closely matches the primary but will result in reduced performance. Using the alternate material/parts will have no effect on the durability of the system. There are no restrictions on the duration of use. (See FO-1.)

3. Emergency or Expedient. A piece of equipment that can be used for a short period of time only. These items are a last resort only and will result in both a significant reduction in performance and in serious harm to the system.

c. ECU replacement parts are usually identified by NSNs or part numbers which identify the product, however, specification numbers and product names may also be a means of identifying the product.

APPENDIX E

BDAR TRAINING PROCEDURES

BDAR TRAINING FIXES SHALL BE USED ONLY AT THE DISCRETION OF THE COMMANDER. DAMAGES SHALL BE REPAIRED BY STANDARD MAINTENANCE PROCEDURES AS SOON AS PRACTICABLE.

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SSN M-	Size Electrical Character Conf,	Evaporator Motor	Condenser Motor	Expansion Valve	Expansion Valve	Solenoid Valve Assy.	Press. Reg. Valve	Cylinder Assy.	Pressure Switch (L)	Pressure Switch (H)	Filter-Drier	Compressor	Pressure Switch Cutout	Safety Relief Valve
M-702	6K Vert 115V, 10, 50/60Hz	214E3728-11	—	214E3568-1	214E3785-1	214E3524	214E3742	—	214E3794	211E8404	214E3557	214E3538-1	221E9273-2	211E8369
M-701	6K Vert 208V, 30, 400Hz	214E3728-14	—	214E3568-1	214E3785-2	214E3524	214E3742	—	214E3794	211E8404	214E3557	214E3538-2	221E9273-2	211E8369
M-916	9K Horz 208V, 30, 60Hz	13216E6140-3	13221E9334-3	216E6160-1	216E6174-1	216E6172-1	216E6171	216E6128	216E6215-1	216E6215-3	216E5918-1	208E4182-7	—	—
M-716	9K Horz 230V, 10, 60Hz	216E6140-2	216E6140-2	216E6160-1	216E6174-1	216E6172-1	216E6171	216E6128	216E6215-1	216E6215-3	216E5918-1	208E4182-8	—	211E8369
M-773	9K Horz 115V,-10, 60Hz	216E6140-1	221E9334-1	216E6160-1	216E6174-1	216E6172-1	216E6171	216E6128	216E6215-1	216E6215-3	216E5918-1	208E4182-5	—	211E8369
M-915	9K Horz 208V, 30, 400Hz	—	—	—	—	—	—	—	216E6215-1	216E6215-3	—	—	—	—
M-912	9K Vert 115V, 10, 60Hz	214E3728-11	—	214E3568-2	214E3785-2	214E3524	214E3742	—	214E3794	211E8404	214E3557	208E4182-5	221E9273-2	211E8369
M-910	9K Vert 208V, 30, 60Hz	214E3728-13	—	214E3568-2	214E3785-2	214E3524	214E3742	—	214E3794	211E8404	214E3557	208E4182-7	221E9273-2	211E8369
M-911	9K Vert 208V, 30, 400Hz	—	—	—	—	—	—	—	—	—	—	—	—	—
M-891	9K Vert 230V, 10, 60Hz	—	—	—	—	—	—	—	—	—	—	—	—	—
M-917	18K Horz 230, 10, 60Hz	221E9311-1	221E9334-2	216E6160-2	216E6174-2	216E6172-2	216E6171	222E8985	216E6215-1	216E6215-3	214E3557	211E3793-9	—	211E8369
M-918	18K Horz 208V, 30, 60Hz	221E9311-2	221E9334-3	216E6160-2	216E6174-2	216E6172-2	216E6171	222E8985	216E6215-1	216E6215-3	214E3557	211E3793-4	—	211E8369
												211E3793-10		
												211E3793-12		
M-896	18K Horz 208V, 30, 400Hz	221E9311-3	221E9334-4	216E6160-2	216E6174-2	216E6172-2	216E6171	222E8985	216E6215-1	216E6215-3	214E3557	211E3793-5	—	211E8369
												211E3793-11		
M-899	18K Vert 208V, 30, 60Hz	225E8039-1	—	215E9839	214E3785-1	214E4224-5	211E3800	—	214E4309	211E8404	214E3793	211E3793-4	—	211E8369
						214E4224-6								
M-881	18K Vert 208V, 30, 400Hz	225E8039-2	—	215E9839	214E3785-1	214E4224-5	211E3800	—	214E4309	211E8404	214E3793	211E3793-5	—	211E8369
						214E4224-6								
M-810	18K Split Pack 208V, 30, 400Hz	221E9096	221E9097	219E9496	221E9099	216E6158	—	221E9092	219E9546-2	211E8404	214E3793	211E3793-5	—	211E8369
M-814	36K Vert 208V, 30, 400Hz	225E8080-1	225E8079-1	214E4037	214E3974	214E3971	211E3800	225E8187	214E4309	211E8404	214E4209	217E6796-2	—	211E8369
M-813	36K Vert 208V, 30, 60Hz	225E8080-2	225E8079-2	214E4037	214E3974	214E3971	211E3800	225E8187	214E4309	211E8404	214E4209	217E6796-1	—	211E8369
M-812	36K Horz 208V, 30, 400Hz	216E6140-4	216E6451-2	216E6160-3	216E6174-3	216E6172-4	216E6362-1	220E2356	216E6215-1	216E6215-3	216E5918-2	216E6309-2	—	211E8369
M-811	36K Horz 208V, 30, 60Hz	216E6140-3	216E6451-1	216E6160-3	216E6174-3	216E6172-4	216E6362-1	220E2356	216E6215-1	216E6215-3	216E5918-2	216E6309-1	—	211E8369
M-893	60K Vert 208V, 30, 400Hz	—	—	—	—	—	—	—	—	—	—	—	—	—
M-895	60K Vert 208V, 30, 60Hz	225E8080-2	228E4015	228E4008	214E3974	214E4224-1	211E3800	225E8187	214E4309	211E8404	214E4209	217E6806-2	—	211E8369
						214E4224-2								

NOTE

A 3-phase motor or compressor can be used in a 1-phase unit. However, this will cause an imbalance in the generator which is supply power. Wire size must also be checked on the unit.

SSNs 915, 911, 891, 893 have not been procured for 10 years.

FO-1. Substitute Parts

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN, II
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25A:

(qty rqr block No. 10) Operator Maintenance requirements for Air Conditioner System, LACV-30 (MOD 74-500013-1) (TM 5-4120-372-24P).

(qty rqr block No. 13) Operator Maintenance requirements for Air Conditioner, Base Mounted, Air Cooled, 38, 000 BTU, 416V, AC, 400HZ, 3PH (HAC-38-416) (TM 5-4120-232 Series).

(qty rqr block No. 16) Operator Maintenance requirements for Air Conditioner, Base Mounted, Air Cooled, 5 Stack Configuration, 18, 000 BTU, 120/208V, 50/60HZ, 3PH, (F18000-6, F18000-5MEC, G18000-5MEC, S18-104TM5, ACBM18) (TM 5-4120-298 Series).

(qty rqr block No. 19) Operator Maintenance requirements for Air Conditioner, Base Mounted, Air Cooled, Self-Contained, 38, 000 BTU Cool/35000 BTU Heat, (VEA43A) (TM 5-4120-287 Series).

(qty rqr block No. 22) Operator Maintenance requirements for Air Conditioner, Base Mounted, 38, 000 BTU, 208V, AC, 400HZ, 3PH (VEA4-5, VEA 3-102003MOD) (TM 5-4120-221 Series).

(qty rqr block No. 25) Operator Maintenance requirements for Air Conditioner, Base Mounted, 36, 000 BTU, 208V, AC, 50/60HZ, 3PH (AC36M) (TM 5-4120-310 Series). (qty rqr block No. 28) Operator Maintenance requirements for Air Conditioner, Base Mounted, 36, 000 BTU, 208V, AC, 60HZ, 3PH (VAC-40-5/6-08) (TM 5-4120-375 Series).

(qty rqr block No. 31) Operator Maintenance requirements for Air Conditioner, Floor Mounted, Air Cooled, 8.4HP, 35, 000/38, 000 BTU/HR, 416V, AC, 400HZ, 3PH (MODEL MAX-745) (TM 5-4120-213 Series).

(qty rqr block No. 37) Operator Maintenance requirements for Air Conditioner, Floor Mounted, Air Cooled, 9, 000 BTU, 3/4 HP, 60HZ, AC, 1PH (MAC-750M, F-9000-2, CAS9000, A-9000) (TM 5-4120-282-13).

(qty rqr block No. 40) Operator Maintenance requirements for Air Conditioner, Floor Mounted, Vertical Compact, 36, 000 BTU Cool/30, 000 BTU Heat, 208V, 3PH (MAC 4V40-340-3, 400HZ; MAC 6V40-340-2, 50/60HZ) (TM 5-4120-268 Series).

(qty rqr block No. 43) Operator Maintenance requirements for Air Conditioner, Floor Mounted, 9, 000 BTU, 3/4 HP, 60HZ, AC, 1PH (HAC-751) (TM 5-4120-341 Series).

(qty rqr block No. 46) Operator Maintenance requirements for Air Conditioner, Floor Mounted, 9, 000 BTU, 3/4 HP, 60HZ, AC, 1PH (HAC-751H) (TM 5-4120-351 Series).

(qty rqr block No. 49) Operator Maintenance requirements for Air Conditioner, Floor Mounted, Air Cooled, 8 HP, AC, 3PH, 400HZ (VEA4-3-102103, -26850, -28029: 38, 000 BTU, 416V; VEA4-3-28029MOD: 50, 000 BTU, 208V) (TM 5-4120-210 Series).

(qty rqr block No. 52) Operator Maintenance requirements for Air Conditioner, Floor Mounted, Air Cooled, 8 HP, AC, 400HZ, 3PH (F-0038, F-0038; MOD: 38, 000 BTU, 416V; F-0050: 50, 000 BTU, 208V) (TM 5-4120-215 Series).

(qty rqr block No. 55) Operator Maintenance requirements for Air Conditioner, Floor Mounted, Air Cooled, 50, 000 BTU, AC, 400HZ, 3PH (VEA 4-6) (TM 5-4120-217 Series).

(qty rqr block No. 58) Operator Maintenance requirements for Air Conditioner, Floor Mounted, Air Cooled, 60, 000 BTU, 208/416V, AC 50/60HZ, 3 PH, 4 Wire (TM 5-4120-261-15)

(qty rqr block No. 61) Operator Maintenance requirements for Air Conditioner, Floor Mounted, Air Cooled, 60, 000 BTU, 6HP, 208/416V, AC, 60HZ, 3PH (F-60) (TM 5-4120-288 Series)

(qty rqr block No. 64) Operator Maintenance requirements for Air Conditioner, Floor Mounted, Air Cooled, 60, 000 BTU, 208/416V, 50/60HZ, 3PH (76E34-104) (TM 5-4120-295 Series)

(qty rqr block No. 67) Operator Maintenance requirements for Air Conditioner, Floor Mounted, 36, 000 BTU, 208V, AC, 60HZ, 3PH (MA-3-F23A and CB-36-08-3-60) (TM 5-4120-259 Series)

(qty rqr block No. 2386) Operator Maintenance requirements for Air Conditioner, Horizontal Compact, 9, 000 BTU, Model A-9KH-115P (TM 5-4120-378 Series)

(qty rqr block No. 70) Operator Maintenance requirements for Air Conditioner, Horizontal Compact, 18, 000 BTU, 208V, 50/60HZ-400HZ, 3PH) (TM 5-4120-243 Series)

(qty rqr block No. 73) Operator Maintenance requirements for Air Conditioner, Horizontal Compact, 9, 000 BTU, 50/60HZ, 1PH (F9OOOH-1: 115V; F9OOOH-2: 23V) (TM 5-4120-340 Series)

(qty rqr block No. 2326) Operator Maintenance requirements for Air Conditioner, Horizontal Compact, 9, 000 BTU, 208V, 3PH, 50/60HZ, (F9OO0H-3S) (TM 5-4120-383 Series)

(qty rqr block No. 76) Operator Maintenance requirements for Air Conditioner, Horizontal Compact, 9, 000 BTU, 230V, 60HZ, 1 PH (F90OOOH-2A) (TM 5-4120-342 Series)

(qty rqr block No. 79) Operator Maintenance requirements for Air Conditioner, Horizontal Compact, 9, 000 BTU, 208V, 60HZ, 3PH (F90OOH-3) (TM 5-4120-347 Series)

(qty rqr block No. 82) Operator Maintenance requirements for Air Conditioner, Horizontal Compact, 9, 000 BTU, CH 609-3; Vertical Compact, 36, 000 BTU Cool, 28, 600 BTU Heat F38T-2; 208V, 50/60HZ, 3PH (TM 5-4120-353 Series)

(qty rqr block No. 85) Operator Maintenance requirements for Air Conditioner, Horizontal Compact, 36, 000 BTU, 208V, 3PH (CH-636-1: 50/60HZ; CH-436-1: 400HZ) (TM 5-4120-361 Series)

(qty rqr block No. 2323) Operator Maintenance requirements for Air Conditioner, Horizontal Compact, 36, 000 BTU Cooling/31, 000 Heat, 208V, 50/60HZ, 3 PH (CH 40-516-08) (TM 5-4120-376 Series)

(qty rqr block No. 88) Operator Maintenance requirements for Air Conditioner, Horizontal Compact, 18, 000 BTU (F18H: 230V, 50/60HZ, 1PH; F18H-4A: 208V, 400HZ, 3PH; F18H-3 208V, 50/60HZ, 1PH F18H-4: 208V, 400HZ, 3PH; F18H-3A: 208V, 50/60HZ, 3PH) (TM 5-4120-367 Series)

(qty rqr block No. 91) Operator Maintenance requirements for Air Conditioner, Horizontal Compact, 18, 000 BTU/HR, 208V, 50/60HZ, 3PH (MIL-AC-1832) (TM 5-4120369 Series) (qty rqr block No. 94) Operator Maintenance requirements for Air Conditioner, Horizontal Compact, 18, 000 BTU, 208V, 50/60HZ, 3PH (Tm18KH-208-3-60) (TM 5-4120379-14)

(qty rqr block No. 2329) Operator Maintenance requirements for Air Conditioner, Horizontal Compact, 18, 000 BTU, 208V, 3PH, 50/60HZ (F18H-3S) (TM 5-4120-384 Series)

(qty rqr block No. 97) Operator Maintenance requirements for Air Conditioner, Horizontal, 9, 000 BTU/HR (FM9000) (TM 5-4120-374 Series)

(qty rqr block No. 100) Operator Maintenance requirements for Air Conditioner, Lightweight, Compact, 208V, 50/60HZ, 3PH (MIL TYPE-A/E 32C-26) (F601) (TM 5-4120346-24P)

(qty rqr block No. 2404) Operator Maintenance requirements for Air Conditioner, Model 13226E8300 (TM 5-4120-388 Series)

(qty rqr block No. 2401) Operator Maintenance requirements for Air Conditioner, Model 3770 (TM 5-4120-387 Series)

(qty rqr block No. 103) Operator Maintenance requirements for Air Conditioner, Multi Purpose, 5 Stack Configuration, 18, 000 BTU, 120/208V, 50/60 HZ, 3PH (TM 18K-120/208-3-60) (TM 5-4120-364 Series)

(qty rqr block No. 106) Operator Maintenance requirements for Air Conditioner, Skid Mounted, Gas Driven, Trailer Mountable, 36, 000/60, 000 BTU (TM 5-4120-292 Series)

(qty rqr block No. 109) Operator Maintenance requirements for Air Conditioner, Split Package, 18, 000 BTU Cool/30, 000 BTU Heat, 208V, 400HZ, 3PH (F18H4-2) (TM 5-4120-359 Series)

(qty rqr block No. 112) Operator Maintenance requirements for Air Conditioner, Trailer Mounted, Generator Set Powered, 18, 000 BTU (MIL-A-52568) (TM 5-4120333-12)

(qty rqr block No. 115) Operator Maintenance requirements for Air Conditioner, Vertical Compact, Self-Contained, 600 BTU Cool/4500 BTU Heat, 115V, AC, 50/60 HZ, 1PH (CV-6-5/6-15) (TM 5-4120-336 Series)

(qty rqr block No. 118) Operator Maintenance requirements for Air Conditioner, Vertical Compact, Self-Contained, 9, 000 BTU Cool/6000 BTU Heat, 115V, AC, 50/ 60HZ, 1PH (CV-9-5/6-15) (TM 5-4120-337 Series)

(qty rqr block No. 121) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 18, 000 BTU Cool/12, 000 BTU Heat, 208V, 3PH (MAC 4V20-4950-03: 400HZ; MAC 6V20-4950-05: 50/60HZ) (TM 5-4120-285 Series)

(qty rqr block No. 124) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 18, 000 BTU Cool/12, 000 BTU Heat, 208V, AC, 400HZ, 3PH (CV-20-408 & F18T4-2) (TM 5-4120-307 Series)

(qty rqr block No. 127) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 18, 000 BTU Cool/12, 000 BTU Heat, 208V, 50/60HZ, 3PH (CH-620-2, F18T-2) (TM 5-4120-308 Series)

(qty rqr block No. 130) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 18, 000 BTU Cool/12, 000 Heat, 208V, 3PH (CH-420-1: 400HZ; CH6201: 50/60HZ) (TM 5-4120-312 Series)

(qty rqr block No. 133) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 18, 000 BTU Cool/12, 000 BTU Heat, 208V, 400HZ, 3PH (CV-20-4-08) (TM 5-4120-344 Series)

(qty rqr block No. 136) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 18, 000 BTU, 208V, 400HZ, 3PH (VM 18000-400) (TM 5-4120-350 Series)

(qty rqr block No. 139) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 18, 000 BTU, 208V, 50/60HZ, 3PH (F18T2) (TM 5-4120-360 Series)

(qty rqr block No. 142) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 18, 000 BTU, 208V, 50/60HZ, 3PH (F18T-25) (TM 5-4120-371 Series)

(qty rqr block No. 145) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 18, 000 BTU, 208V, 400HZ, 3PH (F18T4-2S) (TM 5-4120-377 Series)

(qty rqr block No. 151) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 36, 000 BTU Cool/28, 600 BTU Heat, 208V, 400HZ, 3PH (F36T4-2) (TM 5-4120-363 Series)

(qty rqr block No. 154) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 36, 000 BTU Cool/28, 600 BTU Heat, 208V, 400HZ, 3PH (F36T4-25) (TM 5-4120-370 Series)

(qty rqr block No. 157) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 60, 000 BTU Cool/49, 000 BTU Heat, 208V, 3PH (MAC6V60-360-2: 50/60HZ; MAC4V-360-3: 400 HZ) (TM 5-4120-270 Series)

(qty rqr block No. 160) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 6, 000 BTU/HR, (F600OT4-2: 208V, 400HZ, 3PH; F600OT-2: 115V, 50/60HZ, 1 PH) (TM 5-4120-348 Series)

(qty rqr block No. 163) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 6, 000 BTU (VM-6000-115: 115V, 50/60HZ, 1PH; VM 600Q-400: 208V, 400HZ, 3PH) (TM 5-4120-355 Series)

(qty rqr block No. 166) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 60, 000 BTU, 208V, 50/60HZ, 3PH (F60T-2/2A) (TM 5-4120-357 Series)

(qty rqr block No. 169) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 9, 000 BTU, 208V, 50/60HZ, 3PH (TM9KV-208-3-60) (TM 5-4120-339 Series)

(qty rqr block No. 172) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 9, 000 BTU, 115V, 50/60HZ, 1PH (VM 900-115) (TM 5-4120-345 Series)

(qty rqr block No. 175) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 18, 000 BTU, 208V, 50/60HZ, 3PH (18KV-208-3-60) (TM 5-4120-356 Series)

(qty rqr block No. 178) Operator Maintenance requirements for Air Conditioner, Vertical Compact, 18, 000 BTU Cool/12, 000 BTU Heat, 208V, 3PH (CE20VAL6: 50/60HZ; CE20VAL4: 400HZ) (TM 5-4120-222 Series)

(qty rqr block No. 184) Operator Maintenance requirements for Air Conditioner, Wall/Base Mounted, Self-Contained, 6, 000 BTU, 115V, AC, 50/60HZ, 1PH, 2Wire (CE-6A-60A2) (TM 5-4120-335 Series)

(qty rqr block No. 187) Operator Maintenance requirements for Air Conditioner, Wall or Base Mounted, 6, 000 BTU Cool/4, 000 BTU Cool, 115V, 50/60 HZ, 1PH, 2 Wire (F6000-7) (TM 5-4120-362 Series)

(qty rqr block No. 2395) Operator Maintenance requirements for Air Conditioner, 9, 000 BTU, Model 13218E9905 (TM 5-4120-385 Series)

(qty rqr block No. 2398) Operator Maintenance requirements for Air Conditioner, 9, 000 BTU, Model 13225E8455 (TM 5-4120-386 Series)

(qty rqr block No. 2407) Operator Maintenance requirements for Air Conditioner, 18, 000 BTU, (4120-00-916-9404) (TM 5-4120-390 Series)

(qty rqr block No. 2389) Operator Maintenance requirements for Air Conditioner, 24, 000 BTU, Model MOAC226 (TM 5-4120-380 Series)

(qty rqr block No. 190) Operator Maintenance requirements for Air Conditioner, 25, 000 BTU, 120/208V, 50/60HZ 3 PH, 4 Wire (MOAC-336) (TM 5-4120-343 Series)

(qty rqr block No. 2657) Operator Maintenance requirements for Air Conditioner,
36, 000 BTU, Model 3790 (TM 5-4120-389 Series)

(qty rqr block No. 2392) Operator Maintenance requirements for Air Conditioner, 5, 000 BTU, Model MOAC 226 (TM 5-4120-381 Series)

(qty rqr block No. 193) Operator Maintenance requirements for Air Conditioning Unit, Vertical Compact, 6, 000 BTU (CV-6-1-15-60: 115V, 50/60HZ, 1PH; CV-6-3-08400: 208V, 400HZ, 3PH) (TM 5-4120-273 Series)

(qty rqr block No. 196) Operator Maintenance requirements for Air Conditioning Unit, Vertical Compact, 9, 000 BTU, 50/60HZ (CV-9-1-15-60: 115V; CV-9-1-30-60: 230V; CV-9-3-08-60: 208V) (TM 5-4120-274 Series)

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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