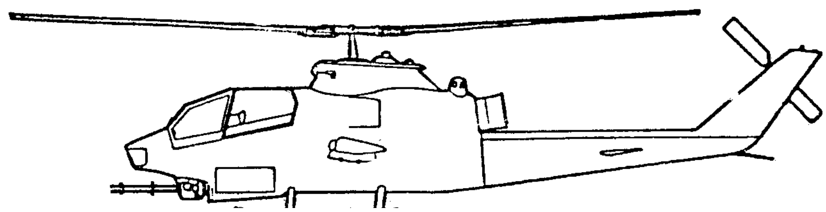
TM 55-1520-244-BD

TECHNICAL MANUAL

OPERATORS, AVIATION UNIT,
AND AVIATION
INTERMEDIATE MAINTENANCE



# BATTLEFIELD DAMAGE ASSESSMENT AND REPAIR

FOR
HELICOPTER,
ATTACK

**AH-1E**
**1520-01-192-2478**

**AH-1 F**
**1520-01-168-4260**

**AH-1P**
**1520-01-168-4259**




**HEADQUARTERS, DEPARTMENT OF THE ARMY**
**26 NOVEMBER 1990**

## WARNING DATA

Personnel performing operations, procedures, and practices which are included or implied in this technical manual shall observe the general following warnings. Disregard of these warnings can cause serious injury or death.

### FLIGHT SAFETY

The standards contained herein allow aircraft to be flown with battle damage substantially in excess of peacetime limits. Under no circumstances shall this manual be used entirely or in part for peacetime maintenance of the aircraft. Assessment of aircraft battle damage requires extreme care and diligence and strict adherence to the instructions and standards contained in this manual. If at any stage of damage assessment the assessor believes that oversights or errors have been made, the assessment shall be stopped at that point and repeated from the beginning. Under no circumstances shall the requirements of this manual be waived or circumvented without the express approval of the commander or his designated representative.

**WARNING**

### EXPLOSIVES

Battle damaged areas should be inspected for unexploded ordnance before attempting repairs. Disposal of unexploded ordnance should be accomplished by qualified personnel.

### ARMAMENT

Loaded weapons or weapons being loaded or unloaded shall be pointed in a direction which offers the least exposure to personnel or property in the event of accidental firing. Personnel shall remain clear of hazardous area.

### CANOPY REMOVAL SYSTEM

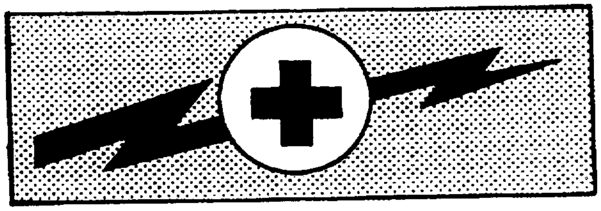
Ground safety pins must be installed in pilot and gunner arming/firing handles of canopy removal system whenever the helicopter is on the ground.

### CLEANING SOLVENTS

Cleaning solvents may be flammable and toxic. Use only in well-ventilated areas. Avoid inhalation of vapor and skin contact. Do not use solvents near open flame or in areas where very high temperatures prevail. Solvent flash point must not be less than 100°F.

### COMPRESSED AIR

Compressed air can blow dust into eyes. Wear eye protection. Do not exceed 30 psig air pressure.



# HIGH VOLTAGE

is used in equipment.

# DEATH ON CONTACT

may result if personnel fail to observe safety precautions.

Never work on electronic equipment unless there is another person nearbv 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 the nature of the operation permits, keep one hand away from the equipment as to reduce the hazard of current flowing through vital organs of the body.

Do not be mislead by the term “low voltage.” Potentials as low as 50 volts may cause death under adverse conditions. For Artificial Respiration, refer to FM 21-11.

## LIFTING

Lifting or moving heavy equipment incorrectly can cause serious injury. Do not try to lift or move more than 50 pounds by yourself. Bend legs while lifting. Do not support heavy weight with your back. Always use assistants during lifting operations. Use guide ropes to move hanging assemblies. Lack of attention or being in an improper position during lifting operations can result in serious injury. Pay close attention to movements of assemblies being lifted. Do not stand under lifted assembly or in a position where you could be pinned against another object. Watch your footing.

## ELECTROLYTE

Battery Electrolyte (Potassium Hydroxide) is corrosive. Wear rubber gloves, apron, and face shield when handling leaking batteries. If potassium hydroxide is spilled on clothing or other material, wash immediately with clean water. If spilled on personnel, immediately start flushing the affected area with clean water. Continue washing until medical assistance arrives.

## EXTERNAL STORES

Prior to any helicopter maintenance functions that require external stores be removed, JETTISON cartridge shall be removed. To prevent injury to personnel and damage to equipment, remove jettison cartridges from stores ejection device prior to placing helicopter in a hangar.

All ground safety pins must be removed before flight. Failure to do so will prevent emergency jettison of stores.

## FIRE EXTINGUISHER

Exposure to high concentrations of monobromotrifluoromethane ($CF_3BR$) extinguishing agent or decomposition products should be avoided. The liquid should not be allowed to come into contact with the skin, as it may cause frost bite or low temperature burns.

## FUELING AND FUEL REPAIRS

When refueling helicopter, the refueling vehicle must be parked a minimum of 20 feet from the helicopter. Before starting the fueling operation, always insert fueling nozzle grounding cable of fuel truck into GROUND HERE receptacle. Refer to FM 10-68. When defueling, turn off all electrical switches and disconnect external power from the helicopter. The helicopter must be electrically grounded prior to defueling.

Fuel line and tank repairs often involve handling of highly flammable material. Mishandling can result in serious injury or death.

## GROUNDING HELICOPTER

The helicopter should be electrically grounded when parked to dissipate static electricity. Turn off all power switches before making electrical connections or disconnections.

## HIGH PRESSURE

Extremely high pressure can occur during and after operation of certain equipment. If this pressure is not relieved before working on this equipment, serious injury or death may occur. Be sure to open all drains and vents before beginning disassembly.

## HYDRAULIC FLUID

Prolonged contact with liquid or mist can irritate eyes and skin. Wear rubber gloves when handling liquid. After contact with skin, immediately wash contacted area with soap and water. If liquid contacts eyes, flush immediately with clear water. If liquid is swallowed, do not induce vomiting. Get immediate medical attention. If prolonged exposure with mist is likely, wear an appropriate respirator. When fluid is decomposed by heating, toxic gases are released.

## NOISE

Sound pressure levels in and around this aircraft during operating conditions exceed the Surgeon General's hearing conservation criteria, as defined in TB MED 501. Hearing protection devices such as aviator helmet or ear plugs are required to be worn.

## SANDING DUST

Sanding on reinforced laminated glass produces fine dust that may cause skin and lung irritations. Observe necessary protective measures.

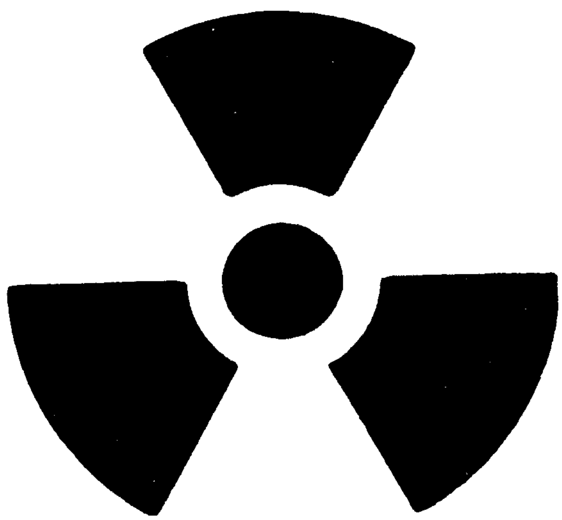
## TOXIC POISONS

Turbine fuels, lubricating oils, and adhesives contain additives which are poisonous and readily absorbed through the skin. Do not allow them to remain on skin longer than necessary. Wear protective equipment.


LASER LIGHT

You can be blinded if you look into a laser beam when you are not wearing laser safety goggles. Never aim the laser range finder (LRF) at personnel.

If laser beam reflects from a flat, mirror-like surface, it can blind you unless you are wearing laser safety goggles.



RADIOACTIVE MATERIALS

Self-luminous dials and ignition units may contain radioactive materials. If such an instrument or unit is broken or becomes unsealed, avoid personal contact. Use forceps or gloves made of rubber or polyethylene to pick up-contaminated material. Place materials and gloves in a plastic bag. Seal bag and dispose of it as radioactive waste in accordance with AR 708-1 and TM 3-261 (Refer to TB 43-0108). Repair shall conform to requirements in AR 385-11.

Technical Manual

No. 55-1520-244-BD

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., 26 November 1990

# TECHNICAL MANUAL

# OPERATORS, AVIATION UNIT, AND AVIATION INTERMEDIATE MAINTENANCE

# BATTLEFIELD DAMAGE ASSESSMENT AND REPAIR

# FOR

# HELICOPTER, ATTACK

**AH-1E 1520-01-192-2478**
**AH-1F 1520-01-168-4260**
**AH-1P 1520-01-168-4259**

**REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS**

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedure, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, U.S. Army Aviation Systems Command, ATTN: AMSAV-MC, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be provided to you.

## TABLE OF CONTENTS

TABLE OF CONTENTS (Cont)

TABLE OF CONTENTS (Cont)



LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Cont)

## LIST OF ILLUSTRATIONS (Cont)

LIST OF ILLUSTRATIONS (Cent)

LIST OF ILLUSTRATIONS (Cont)

LIST OF ILLUSTRATIONS (Cont)



LIST OF TABLES

LIST OF TABLES (Cont)

## HOW TO USE THIS MANUAL

This manual is developed to assist the soldier in a battlefield environment make assessment and repair of damage to the AH-1 attack helicopter which cannot, due to asset availability or environmental factors, be repaired in the normal prescribed manner. Within this technical manual, the word shall is used to indicate a mandatory requirement. The word should is used to indicate a nonmandatory but preferred method of accomplishment. The word may is used to indicate an acceptable method of accomplishment.

1. Organization of the Manual. This manual contains a general information chapter (chapter 1), a general assessment chapter (chapter 2), and specific repair chapters (chapters 4 thru 17). Chapter 3 is not used. It also contains five appendixes.

2. Chapter 2 is used to assess the helicopter in general and references specific chapters for detailed repair procedures of the major functional groups. The major functional groups correspond with the functional groups of the -23 series manuals that are employed in routine repairs to the helicopter.

3. Chapter 3 is not used in this manual. It would normally contain repairs for equipment which does not fall under one of the standard helicopter functional groups.

4. Each functional group chapter is organized as follows:

a. Section I - Introduction.

(1) Scope. Purpose of the chapter.
(2) Assessment Procedures. General assessment information for the repairs covered therein.
(3) Repair Procedure Index.

b. Section II - Repair Item. A subsection is included for each repair item covered in that functional group. It contains the following:

(1) General. About the nature and cause of damage and repair.
(2) Item and trouble statement with:

(a) Limits given.
(b) Personnel and time required to effect repairs.
(c) Materials and tools needed.
(d) Procedural steps to accomplish the repair.

(3) If more than one method of repair can be used, the various options will be included next.

**NOTE**

The first option is the preferred choice, the second option is the next preferred, etc. Selection of the option should be the most preferred method possible under the circumstances and with the available materials and manpower.

## HOW TO USE THIS MANUAL (Cont)

5. Finding Repairs in this Manual.

a. When the damage is obvious and known, find the functional group chapter of which the damaged item is a part. Turn to the repair procedure index, section I, subparagraph 3 of each chapter to locate the item being repaired. Then turn to the repair section and review each option to ascertain the appropriate fix. Read the entire section for the option, then effect the repairs following the procedures given.

b. When the damage is hidden or unknown, follow the overall assessment procedures provided in chapter 2, and follow the procedures and directions provided.

6. Preparation.

a. Each mechanic/technician shall read chapters 1 and 2 and shall be familiar with the repairs and layout of the manual prior to attempting to accomplish BDAR repairs.

b. All warnings, cautions, and standard safety precautions shall be followed, inasmuch as possible, at all times during BDAR procedures so as not to further damage or jeopardize either personnel or the equipment during or subsequent to the BDAR action. Ensure all documentation is completed as directed in this manual and by local command.

7. Expendable/Durable Supplies and Materials.

a. Each fix or repair option contains a short listing of materials and tools considered basic to the repair. It is important to note that the expendable materials listed usually cover a wide range for any one item.

Example: **MATERIALS/TOOLS REQUIRED:**

- Drill with Bit
- Sheet Metal (items 131-142, App. C)
- Rivets (items 98-115, App. C)

In this example, sheet metal covers the range of items 131 thru 142 listed in Appendix C. This means that, depending on the circumstances and location of the fix, any one of these metals could be used. Likewise any one of the rivets, items 98 thru 115, may be used to attach the patch plate depending on the application.

b. One of the key points concerning successful BDAR repairs is flexibility. The users of this manual should strive to use the items on hand, provided a safe repair is made. The stringent requirements of normal maintenance may be lifted.

# CHAPTER 1

# GENERAL INFORMATION

**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

**1-1. PURPOSE.** The purpose of Battlefield Damage Assessment and Repair (BDAR) is to quickly return the disabled helicopter to the operational commander by expediently fixing, bypassing, or jury-rigging components to restore the minimum essential systems required for the support of the specific combat mission or for self-recovery. These repairs will be temporary and may not restore full performance capability. Standard repair will be completed as soon as practical.

**1-2. SCOPE.**

a. This technical manual (TM) describes BDAR procedures applicable to AH-1S attack helicopter series and these procedures are to be used by crew, operators, aviation unit maintenance (AVUM) teams, and aviation intermediate maintenance (AVIM) support teams.

b. Standard repair techniques for the attack helicopter are included in other technical manuals which are referenced in Appendix A of this TM. Details of these procedures are not duplicated in whole in this TM. If the repairs are more than one page in length, the repairs may only be referenced in appropriate chapter.

c. 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 helicopters 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 mechanic/operator to devise repairs as needed to rapidly return equipment to operation in a combat situation.

d. The direct replacement of a piece of equipment by its spare, even under battlefield conditions, is not a BDAR fix and may not be covered is in this TM. A standard procedure should be performed in preference to a BDAR fix when time and spares are available.

**1-3. APPLICATION.**

a. 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, necessary tools, and trained/qualified repair persons 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. They are not to be continued after the equipment is out of the battle environment.

b. 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, it will be accomplished.

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

1-4. DEFINITIONS.

a. Battlefield Damage. Any incident such as combat damage, random failures, operator errors, accidents, and wear-out failures which occur on the battlefield and which prevent the helicopter from accomplishing its mission.

b. Repair or Fix. 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 equipment that can be modified to fit or interchange with components on the damaged equipment.

(3) Repair using parts that serve a noncritical function elsewhere on the same equipment for the purpose of restoring a critical function.

(4) Bypassing of noncritical 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.

(8) Use of substitute materials.

c. Damage Assessment. 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., crew, maintenance team or maintenance support team), and where the repair should be made. The assessment procedure includes 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 or evacuation is necessary and to what location.

d. Fully Mission Capable (FMC). The helicopter can perform all its combat missions. To be FMC, the helicopter must be complete and fully operable with no faults listed in the aircraft inspection and maintenance record as prescribed in DA PAM 738-751.

e. Combat Capable. Equipment meets the minimum functional combat capability requirements. (See paragraph 1-8.)

f. Combat Emergency Capable. The equipment meets the needs for specific tactical missions; 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 or Controlled Exchange. Throughout this manual, cannibalization and controlled exchange are used interchangeably to mean the removal of an item of materiel from one piece of equipment for immediate use in another. Generally the rules for cannibalization/controlled exchange provided in TM55-1500-328-25, as modified by local authority, will prevail.

h. Evacuation. A combat service support function which involves the movement of recovered helicopters from a main supply route, maintenance collection point, or maintenance activity to higher categories of maintenance. The materiel may be returned to the user, to the supply system for reissue, or to property disposal activities.

i. Recovery. The retrieval of immobile, inoperative, or abandoned helicopter from the battlefield or immediate vicinity, and its movement to a maintenance collection point, the main supply route, or a maintenance activity for disposition, repair, or evacuation.

j. Self-Recovery. The ability of the helicopter to fly at reduced airspeed and altitude from the battlefield, or immediate vicinity to a maintenance collection point, main supply route, or maintenance activity for disposition, repair, or evacuation.

k. Maintenance Collection Point. A point operated by AVIM unit for the collection of equipment for repair.

l. Maintenance Support Team (MST). A team of AVIM mechanics and technical specialists who are trained in assessing battlefield damage and field repair procedures.

m. Maintenance Team (MT). Helicopter crew chief or AVUM mechanics/technicians who are trained in assessing battlefield damage and field repair procedures.

**1-5. QUALITY DEFICIENCY REPORT/EQUIPMENT IMPROVEMENT RECOMMENDATION (QDR/EIR).** If your helicopter and equipment needs improvement, let us know. Send us 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 Commander, U.S. Army Aviation Systems Command, ATTN: AMSAV-QRF, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. We'll send you a reply.

## Section II. STANDARDS AND PRACTICES

**1-6. BDAR CHARACTERISTICS.** BDAR capability requires simplicity, speed, and effectiveness. Some BDAR procedures include repair techniques that violate standard peacetime maintenance practices. In a combat emergency situation, greater risks are sometimes necessary and acceptable. Refer to Appendix I of FM 1-500 for additional information concerning BDAR concepts.

**1-7. WAIVER OF PRECAUTIONS.** Under combat conditions, BDAR may be performed on helicopters which are in flight or which are under power while on the ground. While some of these BDAR actions may require waiving of safety precautions, the cautions to protect personnel life should not be overlooked. Other similar precautions may be waived at the discretion of the commander. BDAR fixes maybe required in a chemically toxic environment or under other adverse battlefield conditions with severe limitations in personnel, facilities, equipment, and materials. Performance of repair tasks may be necessary while wearing protective gear. Decontamination procedures are described in FM 3-5.

**1-8. OPERATING CHARACTERISTICS.** This manual covers expedient repairs for the helicopter and its components. It is entirely possible that in a combat situation, the helicopter having undergone one or more of these repairs may suffer degradation of its normal operating characteristics (e.g., reduced speed, reduced load capability, reduced range, etc.), and still be able to carry out all or parts of an assigned mission. The minimum functional combat capability (M FCC) criteria is as follows:

**NOTE**

These criteria may be waived for recovery or to meet tactical situation demands otherwise.

a. Flight Capability for Self-Recovery.

(1) Must have power delivered to main and tail rotor at minimum acceptable limits.

(2) Lift capability for crew members.

(3) Flight controls at minimum function level acceptable for flight.

**NOTE**

Careful consideration shall be given to the operation of the Identify Friend or FOE (IFF), Mode 4, avionics system. Failure of the IFF or failure to properly communicate with area air defense command prior to lift-off could result in an attack from friendly forces due to mistaken identity.

(4) Instruments/avionics as required to meet mission needs.

b. Flight Capability for Mission Completion.

(1) Sufficient power delivered to main and tail rotor to accommodate lift capability for helicopter crew and cargo.

(2) No fuel leaks which will curtail the intended length of flight.

(3) No degradation of any component/system which will end in failure and curtailment of intended mission.

(4) Communications. Must have intercom communications within aircraft and at least two tactical receiver-transmitter (R-T) units operating at full capability.

**1-9. TRAINING.**

a. BDAR by its nature involves fixes, bypasses, or jury-rigging, which is outside authorized standard repairs, and may degrade the inherent safety of the helicopter. Therefore, BDAR actions are not intended to supplement, or replace standard maintenance practices during peacetime, nor should they be employed indiscriminately to facilitate training.

b. Repairs described in this manual, which can be appropriately accomplished in order to provide training, are listed in Appendix E and are highlighted in each chapter's repair procedure index. The trainable repair in the index will be blocked in.

## Section III. TASKS AND RESPONSIBILITIES

### 1-10. TAGGING/IDENTIFYING BDAR REPAIRS.

a. All damage will be identified on aircraft inspection and maintenance record, DA Form 2408-13 and DA PAM 2408-18, per DA PAM 738-751. Refer to Figures 1-1 and 1-2.

b. Recording of BDAR repairs and the use of status symbols, as defined in DA PAM 738-750, will be completed as soon as practical to indicate any limitations and restrictions or required standard repairs.

c. In addition to recording all damage, the area damaged will be marked on aircraft or component part using damage assessment markings as shown in Figure 1-3.

d. Status Symbols. Status symbols used in aircraft logbooks to record defects are defined below.

(1) Red “X.” A red “X” shows that a defect exists and the aircraft is unsafe for flight.

(2) Circled red “X.” A red “X’ inside a red circle indicates a limiting defect. The aircraft may be flown under specific limits as directed by higher authority, or as directed locally until corrective action is taken.

(3) Red horizontal dash (-).

(a) This symbol indicates an inspection, special inspection, component replacement, maintenance operational check, or test flight is needed. The symbol is also used to indicate that a normal modification work order (MWO) is overdue.

(b) This symbol also shows that the condition of the equipment is unknown. A potentially dangerous condition may exist. The condition will be corrected as soon as possible.

(4) Red diagonal *(/).* This symbol indicates a defect exists that is not serious enough to ground the aircraft.

e. Maintenance of Forms. Instructions for the maintenance of forms, records, and reports are listed in DA PAM 738-751. When battle damage repair (BDR) becomes necessary, the procedures in DA PAM 738-750 will apply. Refer to Figures 1-1 and 1-2 for examples.

(1) In block 17 of DA Form 2408-13, list the fault.

(2) In block 16 of DA Form 2408-13, enter the status symbol.

(3) In block 18 of DA Form 2408-13, enter the corrective action taken.

(4) The individual completing the repair will sign the form in block 19 opposite the first line of the action taken, and will place his last name initial over the status symbol in block 16.

f. Temporary Repair. If the repair is temporary, take the following additional action:

(1) In block 18 of DA Form 2408-13, enter the corrective action and a statement that the repair is temporary. Then make an entry in DA Form 2408-14, block b. The entry will be a duplicate of the entry in block 17 of DA Form 2408-13 to include a statement that a temporary repair has been made.

(2) If the temporary repair limits the capability of the aircraft, the following entry will be made on DA Form 2408-13:

(a) Place a circled red “X” in bolck 16.

| 1. DATE | 2. MODEL | 3. SERIAL NO. | 4. NAME OF CREW CHIEF/MECHANIC | 5. STATION | 6. PAGE NO. | 6a. NO. OF PAGES |
|---|---|---|---|---|---|---|
| | | | | | | |

| 7 STATUS TODAY | | | | | | 8. AIRCRAFT TIME | | 9. NEXT INSPECTION DUE | | 10. | HOT STARTS | | LANDINGS | OTHER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AIRCRAFT | | | ELEC-TRONIC | ARMA-MENT | OTHER | TIME TO DATE | : | INTMED NO | : | | NO. 1 ENGINE | NO. 2 ENGINE | *b* | *c* |
| 1 | | 4 | | | | | | | | PREVIOUS | | | | |
| 2 | | 5 | | | | TIME TO-DAY | . | P E. NO. | . | TODAY | | | | |
| 3 | | 6 | | | | TOTAL TIME | : | OTHER | : | TOTAL | | | | |

| 11. FUEL (*Gals or Lbs*) | | | | 12. OIL (*Quarts*) | | | | | | 13. | 14. | 15. SERVICED | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SERV-ICE NO. | GRADE | ADDED | TOTAL IN TANKS | GRADE | ADDED NO. 1 ENG | TOTAL IN TANKS | ADDED NO. 2 ENG | TOTAL IN TANKS | APU | OXYGEN (*PSI*) | ANTI-ICING FLUID (*Gals*) | BY | STATION |
| 1 | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | |

| 16. STATUS | 17. FAULTS AND/OR REMARKS | 18. ACTION TAKEN | 19. SIGNATURE |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

DA FORM 2408-13, 1 DEC 66 REPLACES EDITION OF 1 JAN 64, WHICH WILL BE USED

AIRCRAFT INSPECTION AND MAINTENANCE RECORD

For use of this form, see DA PAM 738-751, the proponent agency is DCSLOG.

Figure 1-1. DA Form 2408-13

| 1. NOMENCLATURE | 2. MODEL | 3. SERIAL NUMBER | | 4. PAGE NO. / NO. OF PAGES |
|---|---|---|---|---|
| 5. ITEM TO BE INSPECTED | 6. REFERENCE | | 7. FREQUENCY | 8. NEXT DUE |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

DA FORM 2408-18, 1 JAN 64

**EQUIPMENT INSPECTION LIST**
For use of this form, see TM 38-750;
the proponent agency is DCSLOG.

Figure 1-2. DA Form 2408-18

| MEANINGS | MARKINGS |
|---|---|

TO INDICATE DAMAGE HAS BEEN ASSESSED AND EVALUATED:

Draw a circle around the damage.

TO INDICATE NO BDAR REPAIR REQUIRED:

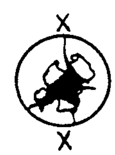
Write "OK" inside the circle.


TO INDICATE STRUCTURAL REPAIRS ARE REQUIRED:

Draw a second line about 1/4 to 1/2 way around the initial circle then draw slashes or crosshatch between the two circular lines.

STRINGER REPAIR: Place an X to the left and right of the circle.


FRAME REPAIR: Place an X above and below the circle.




TO INDICATE DAMAGE TO SYSTEMS REQUIRING REPAIRS:

Draw a series of ''curly cue" lines about 1/4 to 1/2 way around the initial circle.

TO INDICATE REPAIR INSTRUCTIONS:

For internal damage - draw a dashed circle around the repair instructions.


REPAIR
INSTRUCTIONS

For external damage - write repair instructions but do NOT enclose with a circle.

REPAIR
INSTRUCTIONS

PARTIAL

Figure 1-3. Damage Assessment Markings (Sheet 1 of 3)

| WRITTEN INSTRUCTIONS | MEANING |
|---|---|
| See me - print name & rank. (Signature) | See assessor or whoever has signed written instructions for additional information. |
| Names of parts to be repaired, (item, skin, stringer. | Where compound damage occurs, the names or abbreviation: of specific items can be written adjacent to the damage to clarify repair instructions. |
| Full | A full strength repair is required. |
| Partial | Partial strength repair required in accordance with specific aircraft BDAR manual. |
| OK | No repairs required - damage is within acceptable limit: for battle conditions. |
| ? | Continual assessment or reinspection is required after each sortie. |

Instruction markings for system are in two parts:

(1) Repair instruction markings and meanings are shown on this sheet and are used to indicate repair actions required.

(2) System Identification - When known, identify the system using markings shown on sheet 3 of this figure.

| MARKINGS | MEANING |
|---|---|
| Fix | Repair the damaged system in accordance with approved standard BDAR techniques for type of system, item, high pressure, low pressure, etc. |
| Cap | Terminate or block the system to prevent leakage. |
| Repl | Replace damaged part - repairs not acceptable. |
| OK | No repairs required. |
| Tag | Repair instructions are written on tags tied to individual damaged lines/components. |

Figure 1-3. Damage Assessment Markings (Sheet 2 of 3)

System identification markings are primarily abbreviations of the system.

| MARKINGS | SYSTEM/MEANING |
|---|---|
| Sys | Damage to unknown system. |
| Fuel | Fuel |
| Hyd | Hydraulic |
| HP | High Pressure |
| LP | Low Pressure |
| Elect | Electrical |
| AV | Avionics |
| Flt Cent | Flight Control |
| Main Rotor | Main Rotor Group |
| Tail Rotor | Tail Rotor Group |
| Air | Pneumatic |
| Air Cond | Air Conditioning |
| BL Air | Bleed Air System |
| BLC | Boundary Layer Control |
| $N_2$ | Nitrogen |
| $O_2$ | Oxygen |
| Eng Contr | Engine Control |
| Pow Tr | Power Train |
| EJ | Ejection |

NOTE

More than one identification marking may be used to describe the system (e.g., HP, Hyd).

Figure 1-3. Damage Assessment Markings (Sheet 3 of 3)

(b) State the limitation in block 17.

(3) If the temporary repair requires an inspection at intervals, list the required inspection on DA Form 2408-18.

(a) Enter item to be inspected in block 5.

(b) List the applicable TM in block 6.

(c) State the frequency of the inspection in block 7.

1-11. REPORTS. All required written reports for BDAR fixes are found in DA PAM 738-751. If communication capability is damaged, the aircraft commander should approach the nearest friendly radio and make his report if possible. The report should include these essentials:

a. Aircraft damage (out-of-action or function partially impared).

b. Location of aircraft.

c. Defense status.

d. Mobility.

e. Personnel report.

f. Current and anticipated hostile action.

Anticipated BDAR fixes and repair time.

# 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.

a. This chapter provides guidelines for use in assessing battlefield damage to the AH-1 E/F/P attack helicopter. It directs you to an expedient BDAR fix or to the standard system fix toTM 55-1520-236-23 if an expedient BDAR repair does not exist. General decision logic chart, Table 2-1, assists in BDAR discussions.

b. Each chapter will have a specific fault assessment table for each functional group and this flow chart will direct you to specific BDAR fixes for and within the functional group.

c. Use the following guidelines to find and fix sustained damage or suspected damage to your helicopter. Keep in mind that damage can be sustained while on the ground or in flight. The helicopter location can have a considerable effect on the assessment. The following appraisal shall be accomplished,

(1) If possible and if time permits, inspect, and check the helicopter using operator's checklist (CL), operator's manual (–1 O), and other records and forms kept in aircraft log book. At the same time be looking for obvious damage to aircraft.

(2) If applicable and possible, use standard troubleshooting recommendations in –23 series TMs.

(3) If you find a problem, determine its effect on helicopter's mobility, and capability.

(4) If you cannot fix the problem with standard fixes, then apply this TM and use general and specific assessment tables, charts, and BDAR action.

(5) If the damage does not affect aircraft's flying status, the aircraft or flight commander will decide whether to fix or defer fix, and whether to continue or to start a mission.

(6) If damage does affect flight status, do one of the following:

(a) Replace damaged part with a serviceable part.

(b) Replace damaged part with suitable substitute if it exists.

(c) Apply a BDAR fix.

(7) After repairing the damage, replace all lost fluids/lubricants. If one specified by aircraft TM is not available, refer to Appendix D for alternative materials/parts.

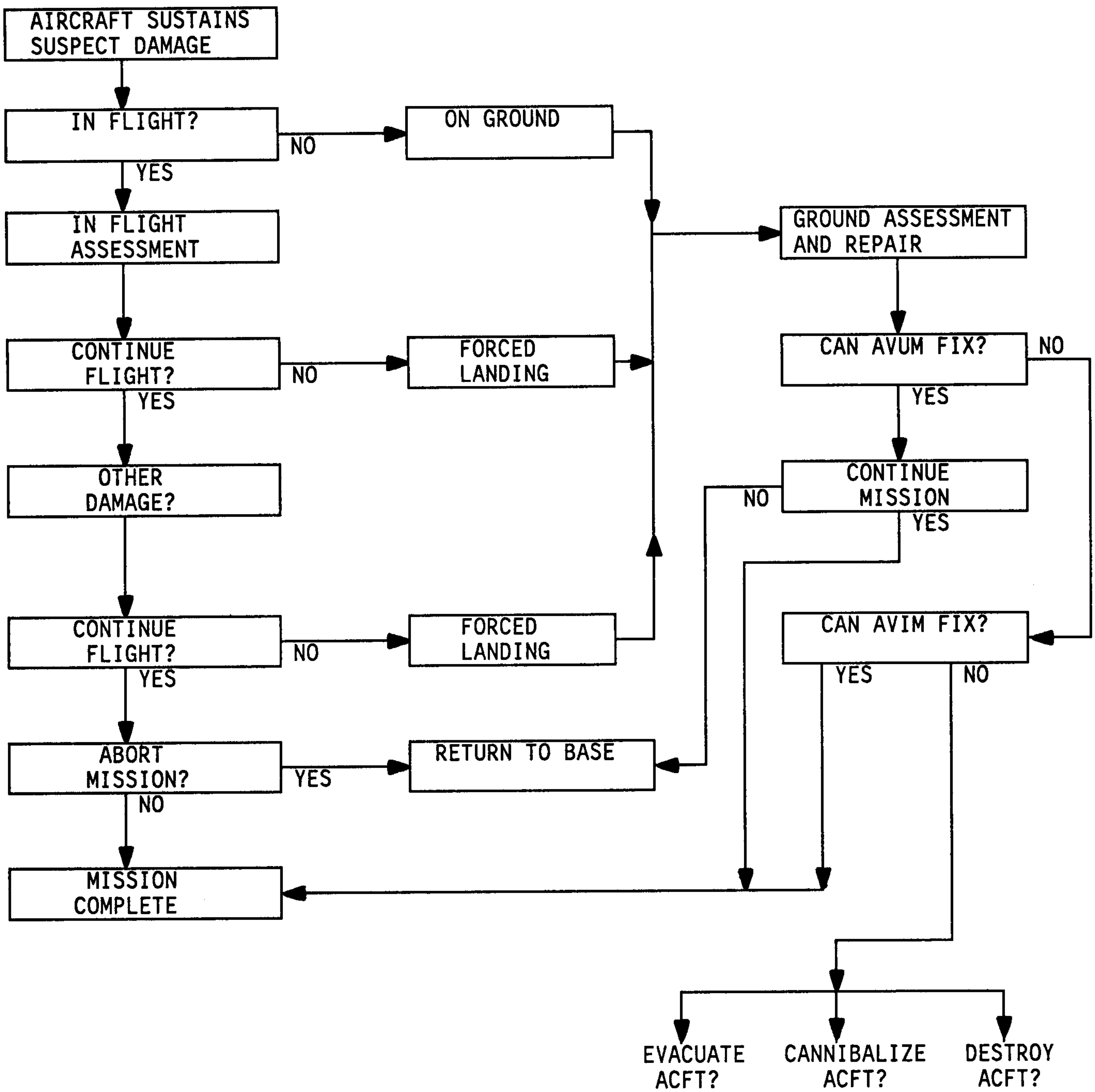



Figure 2-1. General Decision Logic

## Section II. GENERAL FAULT ASSESSMENT TABLE

**2-2. GENERAL FAULT ASSESSMENT.** Aircraft assessment chart, Table 2-2, guides you through the aircraft's capability so that all the necessary capabilities are evaluated. If a fault is found, Table 2-2 (assessment table) directs you to the chapter for the functional group which contains the fault. The BDAR assessment procedure will refer you to a guide fix in this manual, a standard TM 55-1520-236-23 repair if it is feasible, or a higher AVIM level of repair if extent of damage, time constraint, tooling requirements, repair part or material, and any other necessary requirements are only available at a higher level of maintenance.

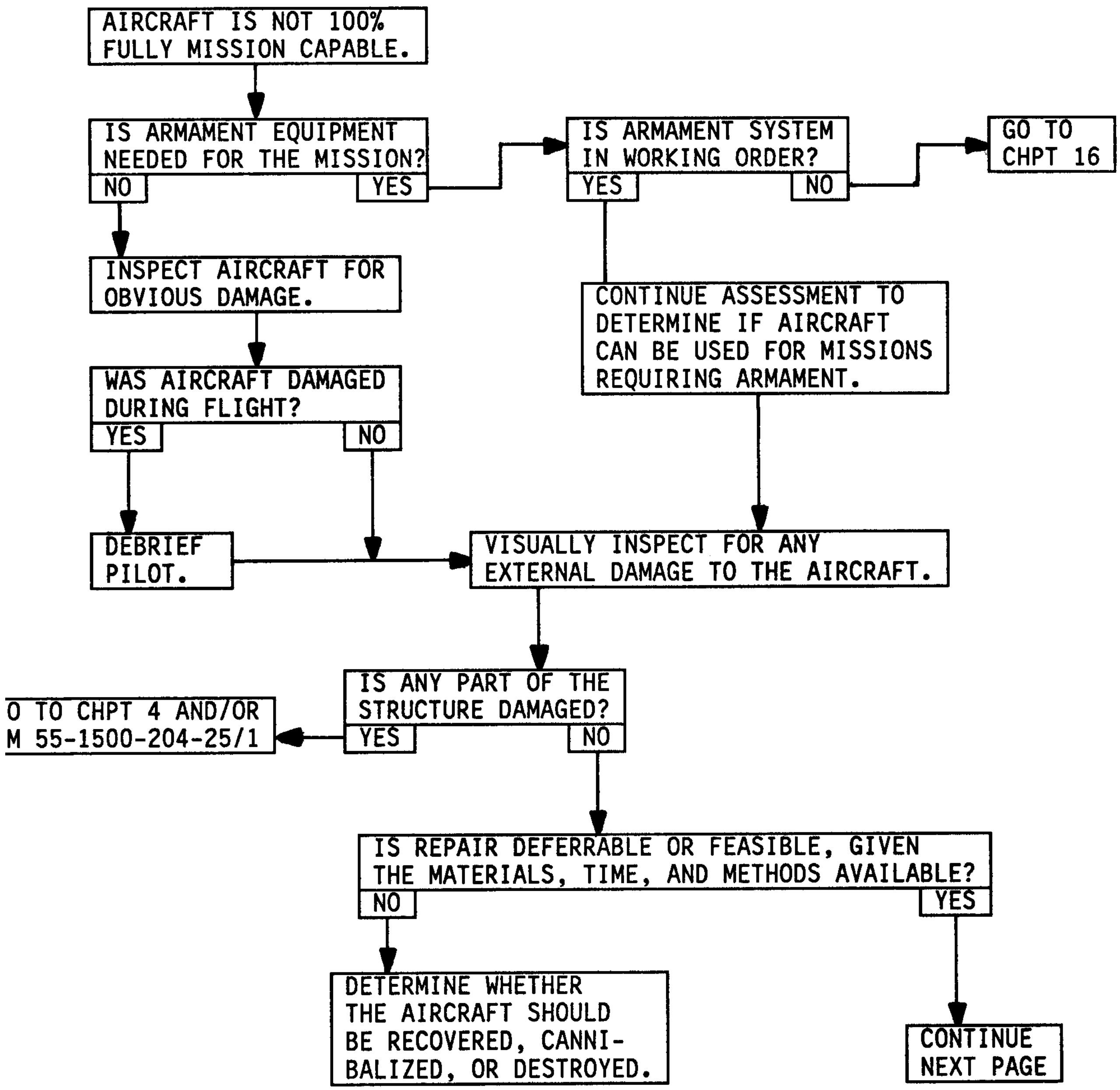



**Figure 2-2. Assessment Table**

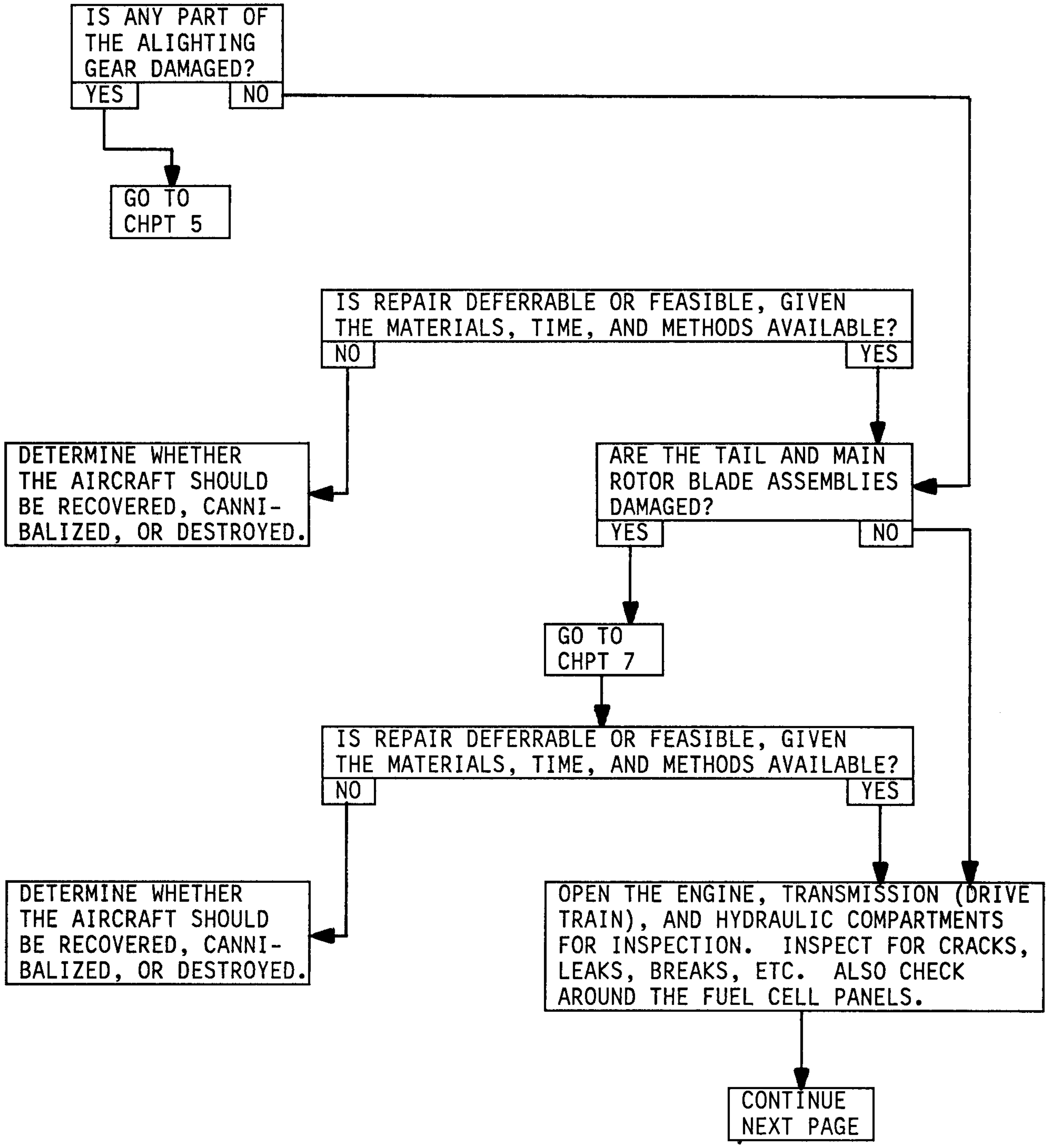



Figure 2-2. Assessment Table (Cont)

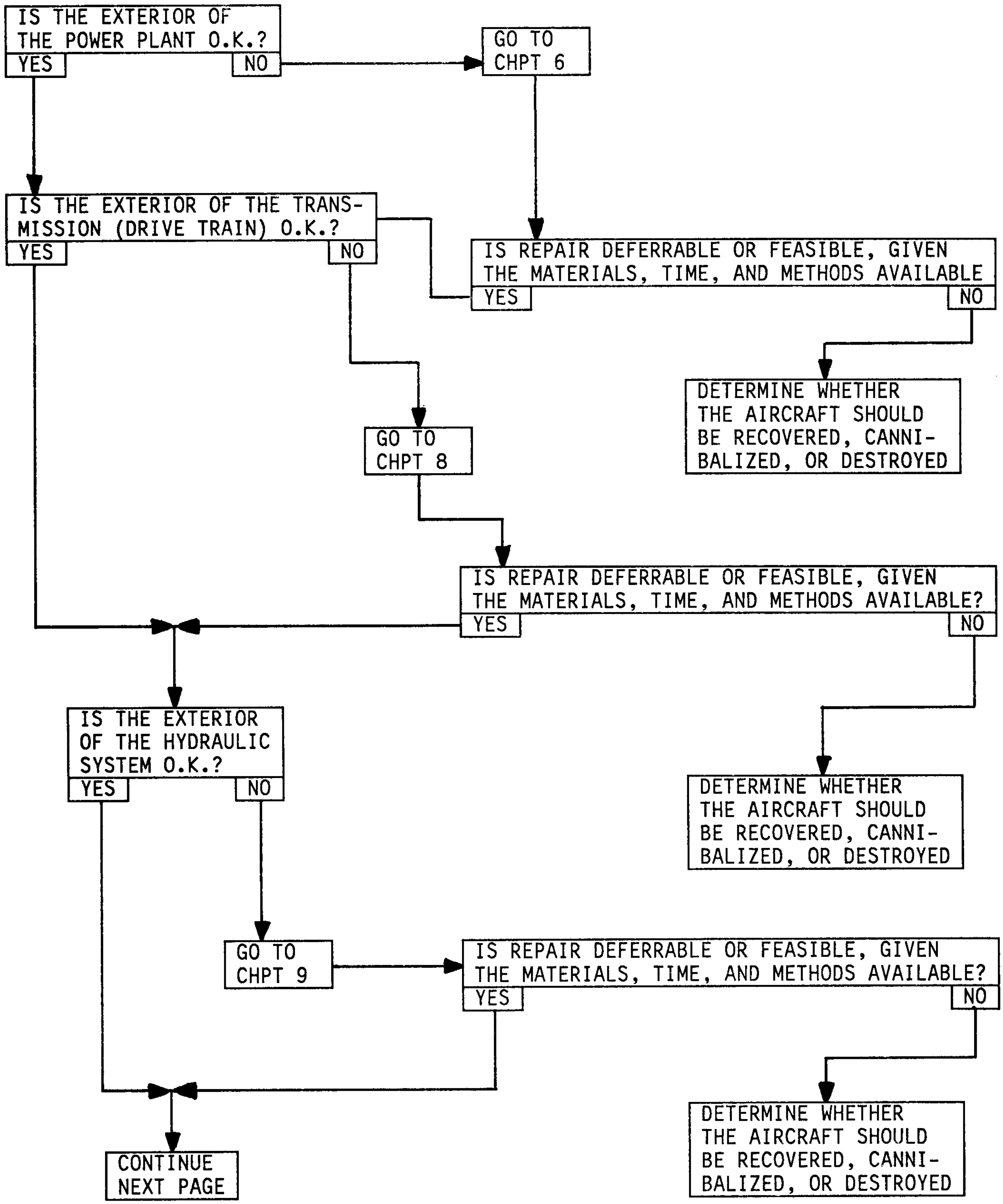



Figure 2-2. Assessment Table (Cent)

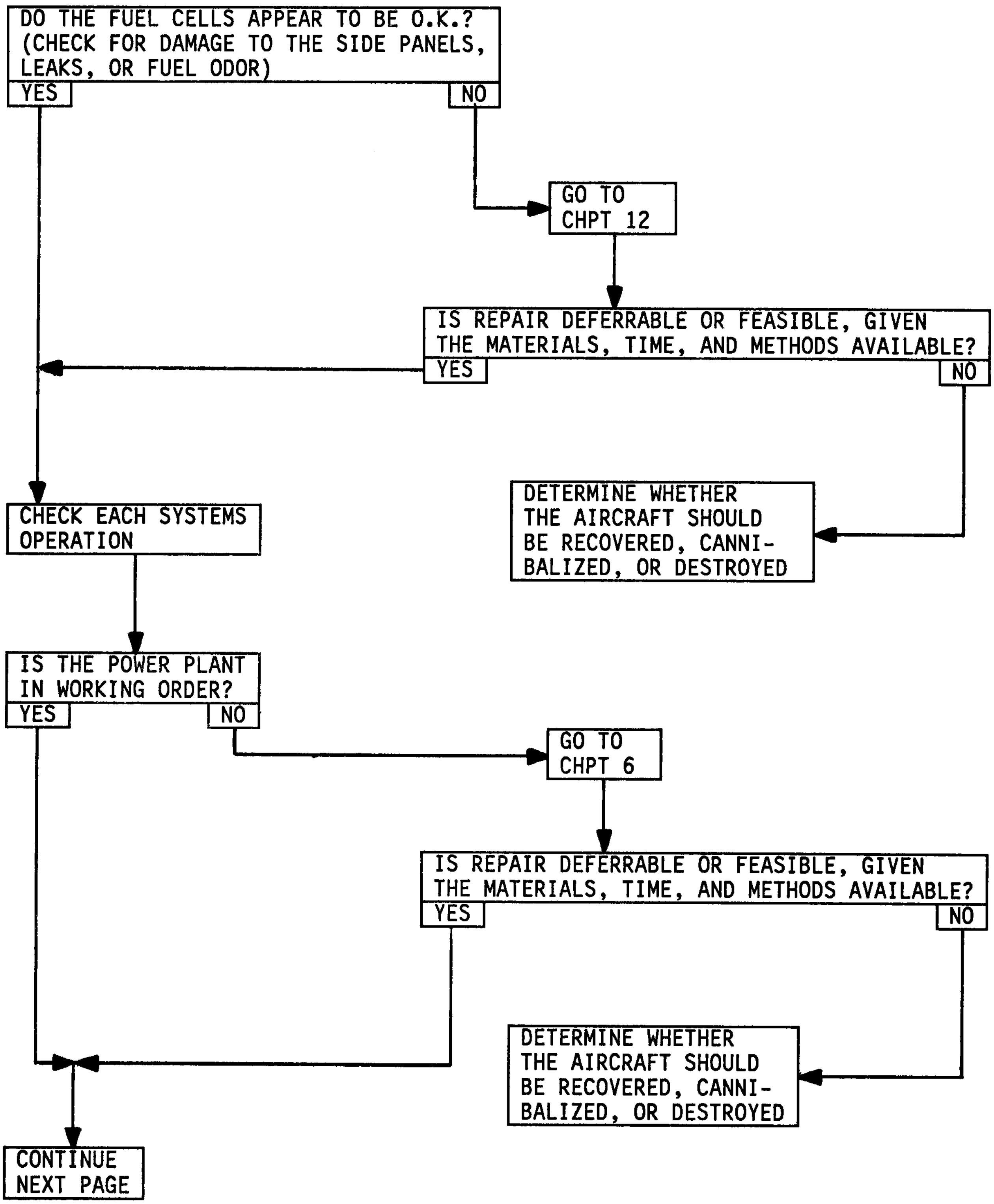



Figure 2-2. Assessment Table (Cent)

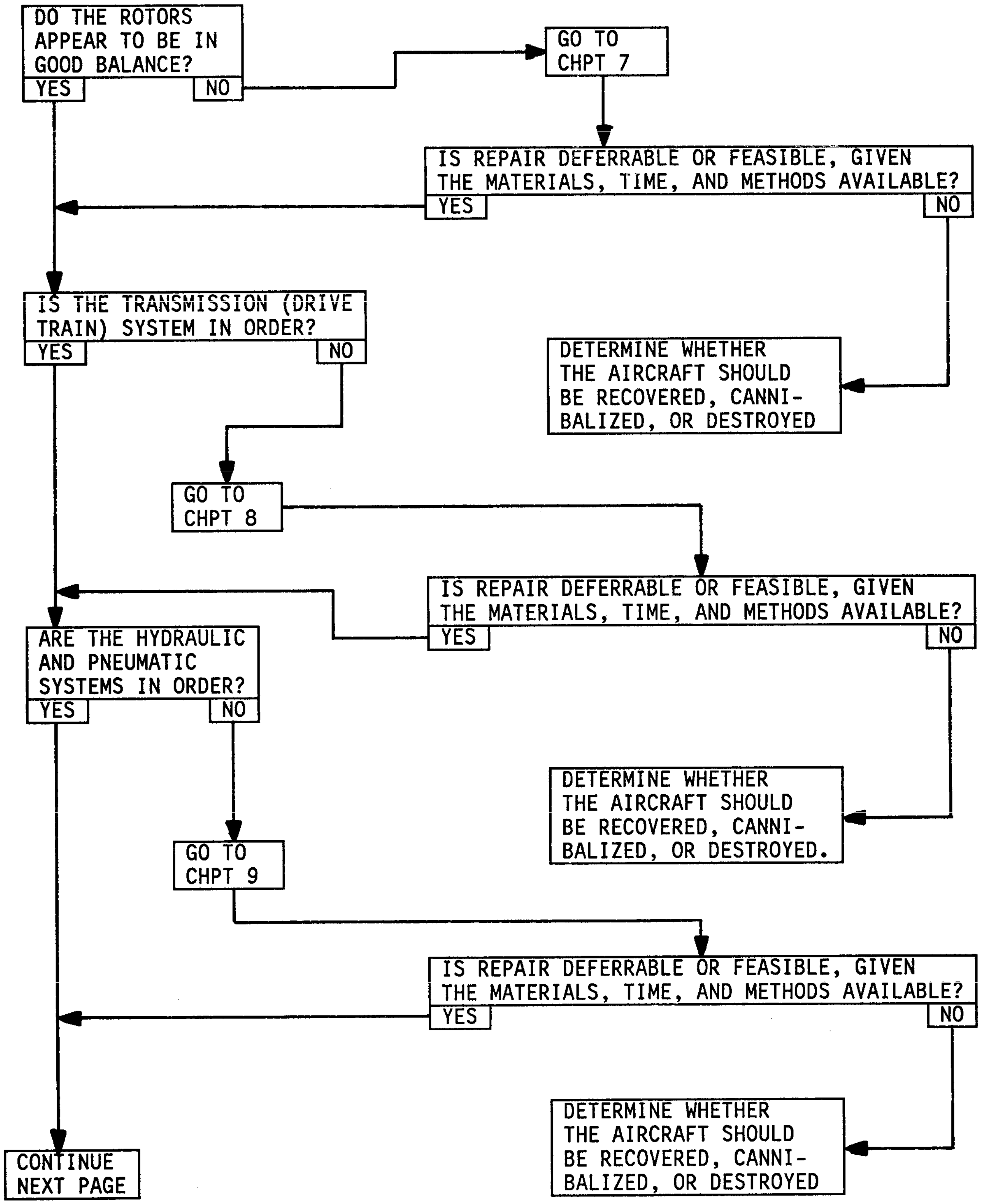



Figure 2-2. Assessment Table (Cont)

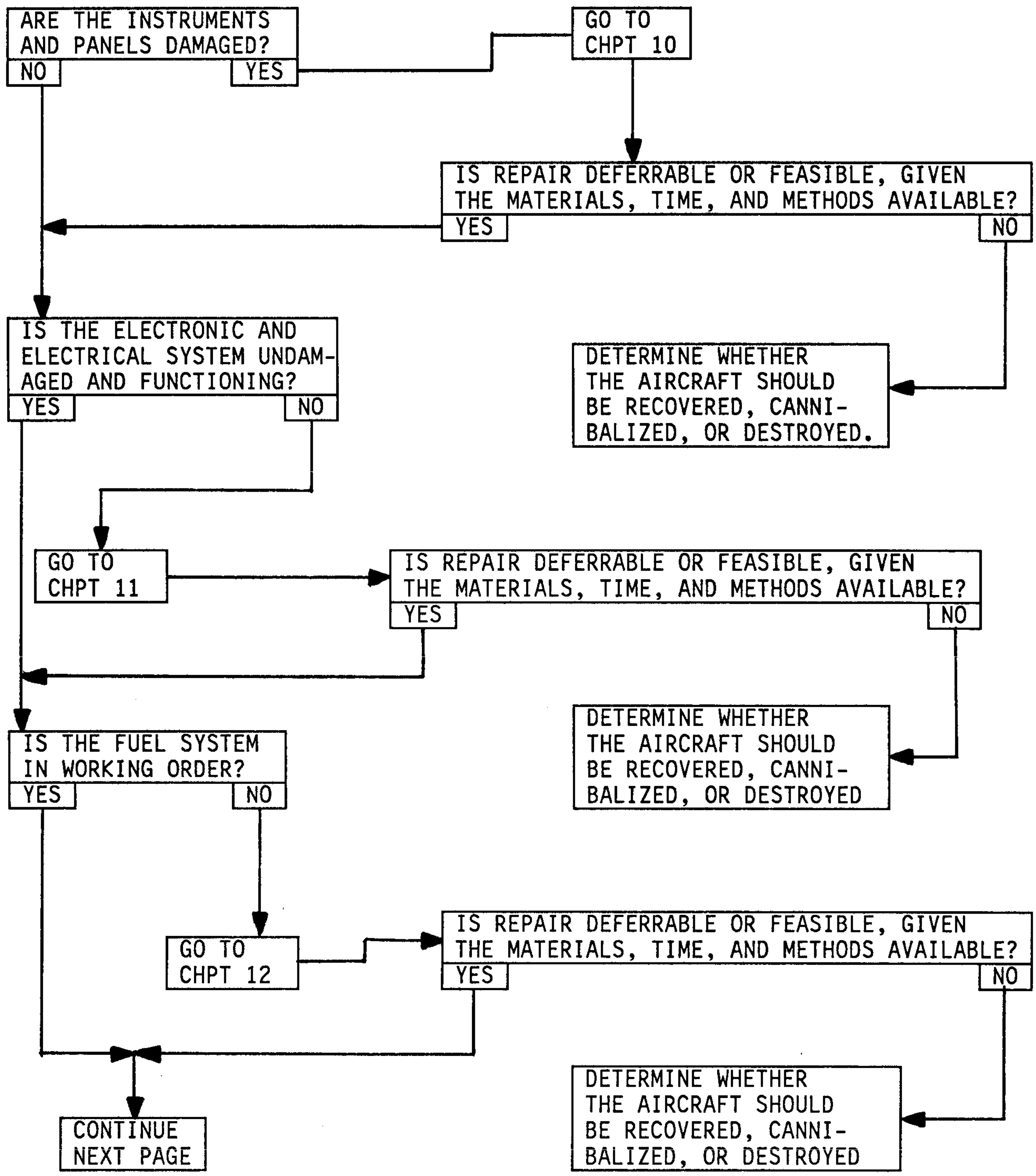



Figure 2-2. Assessment Table (Cont)

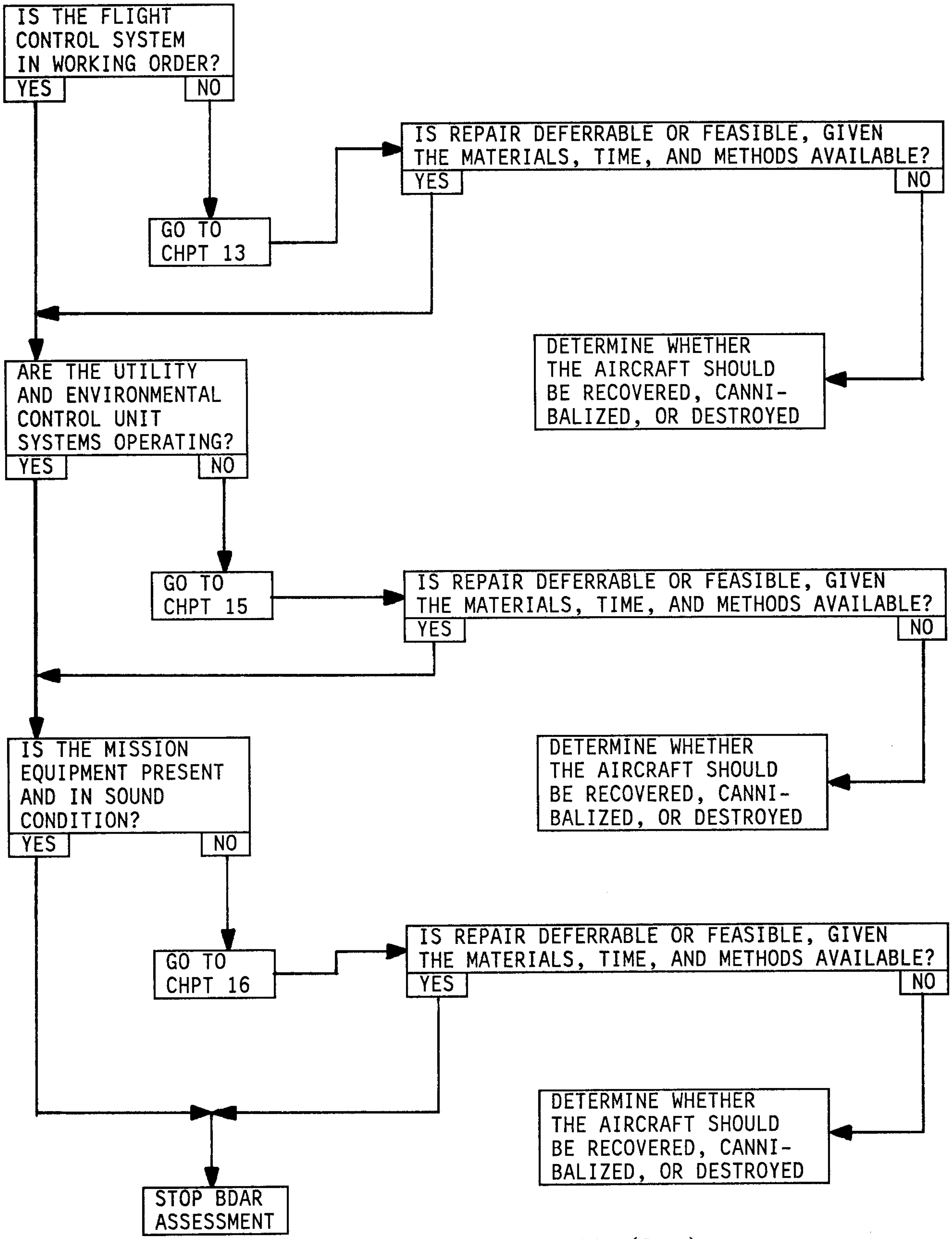



Figure 2-2. Assessment Table (Cont)

# CHAPTER 3

# GENERAL REPAIRS

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.

No general repairs have been identified for this model helicopter. Proceed to Chapters 4 thru 17 for functional group assessment and repair procedures.

# CHAPTER 4

# AIRFRAME

**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. SCOPE.

a. This chapter contains methods for assessing battlefield damage to the primary structure of the AH-1 airframe, classification of damage, rules for deferring repair, and expedient field fixes of battlefield damaged airframe structures.

b. Aircraft structure is classified as primary and secondary structure.

(1) The primary structure is the basic structure which holds the aircraft together. Any serious damage to any element of the primary structure will restrict the combat capability of the aircraft. The primary structures for each major airframe subassembly are defined throughout this chapter.

(2) Secondary structures are mounted on the primary structure. No amount of structural damage to secondary structures will restrict combat capability from a structural safety point of view; however, secondary structure may be required for aerodynamic reasons or to accomplish or support mission functions.

**4-2. ASSESSMENT PROCEDURES.** The battlefield structural damage assessment consists of two steps: an initial assessment, and a detailed assessment. The initial assessment is a quick visual assessment to decide whether or not a detailed assessment should be made. A detailed assessment involves the identification of all damage to primary structural elements, possibly some cleanup and measurement of the damage and of the damaged elements. This process requires damage measurement and determination of the corresponding damage limits. An overall view of all the aircraft zones used in damage assessment is shown in Figure 4-1.

**NOTE**

The standards contained herein allow aircraft to be flown with battle damage substantially in excess of peacetime limits. Under no circumstances shall this manual be used wholly or in part for peacetime maintenance of the aircraft. Assessment of aircraft battle damage requires extreme care and diligence and strict adherence to the instructions and standards contained in this manual. If at any stage of damage assessment the assessor believes that oversights or errors have been made, the assessment shall be stopped at that point and repeated from the beginning. Under no circumstances shall the requirements of this manual be waived or circumvented without the express approval of the commander or his designated representative.

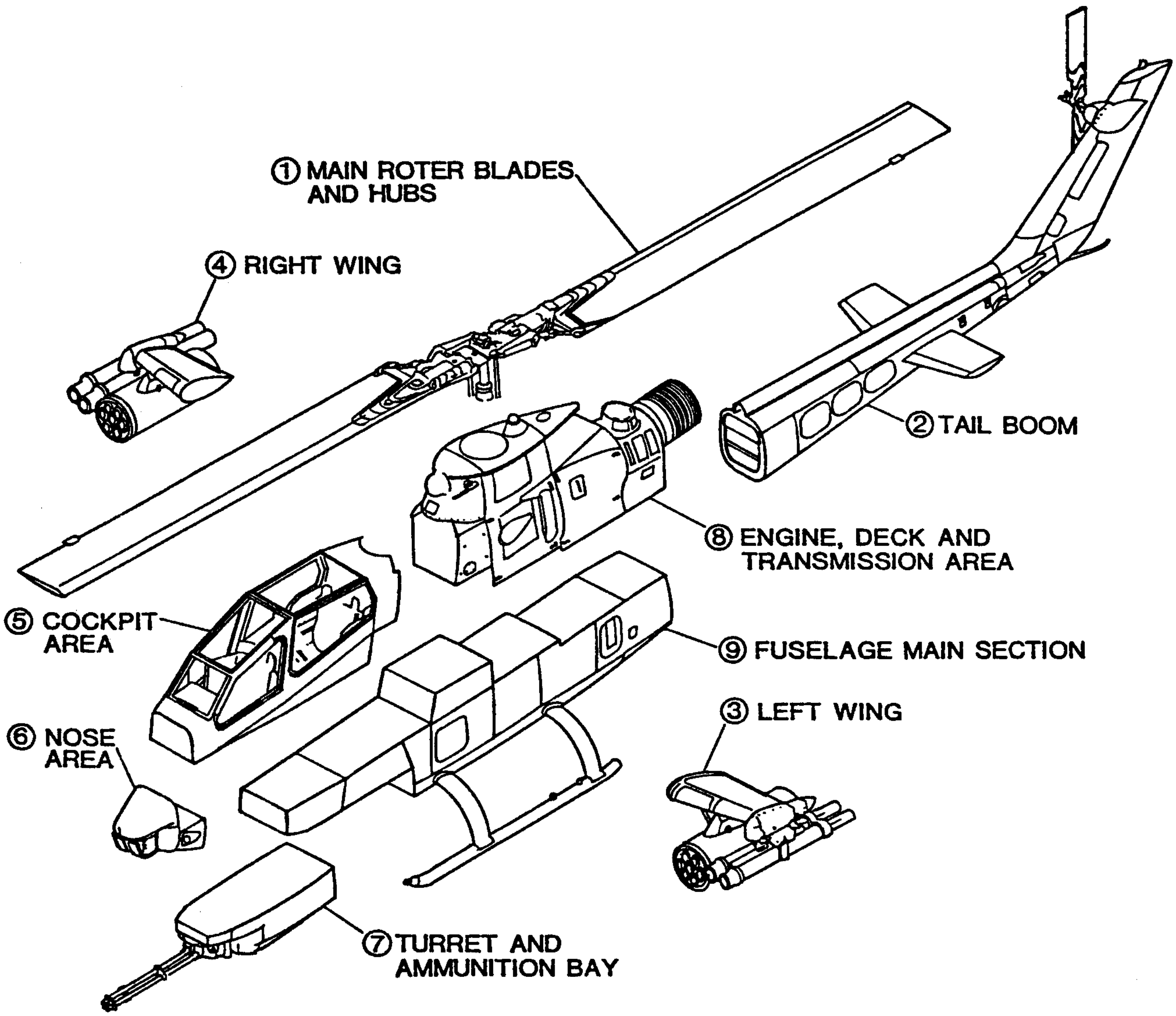



Figure 4-1. Aircraft Zones

**WARNING**

- Battle damaged areas should be inspected for unexploded ordnance before attempting repairs. Disposal of unexploded ordnance should be accomplished by qualified EOD personnel.

- Loaded weapons, or weapons being loaded or unloaded, shall be pointed in a direction which offers the least exposure to personnel or property in the event of accidental firing. Personnel shall remain clear of hazardous area of all loaded weapons.

- Ground safety pins must be installed in pilot and gunner arming/firing handles of canopy removal system whenever the helicopter is on the ground. Pins should be installed by crew.

a. Initial Assessment. Refer to Table 4-1. To perform an initial assessment, the assessor must be acquainted with structural damage modes and the primary structure. He shall be capable of differentiating between primary and secondary structure, and he must understand the function of primary structural elements. The initial assessment consists of a visual inspection of primary structure. The assessor determines if any primary caps, webs, or panels are damaged or fractured and decides whether–

(1) The damage appears to be deferrable;

(2) A detailed assessment can be made and the damage can be repaired by BDAR techniques within the time available to return the aircraft to service in the ongoing battle;

(3) An adequate assessment can be made and the damage can be repaired by BDAR techniques to enable the aircraft to self-recover;

(4) A detailed assessment cannot be made or the damage cannot be repaired by BDAR techniques within the available time; or

(5) The aircraft is damaged beyond repair, and its disposition shall be arranged (e.g., recovery, cannibalization, or destruction).

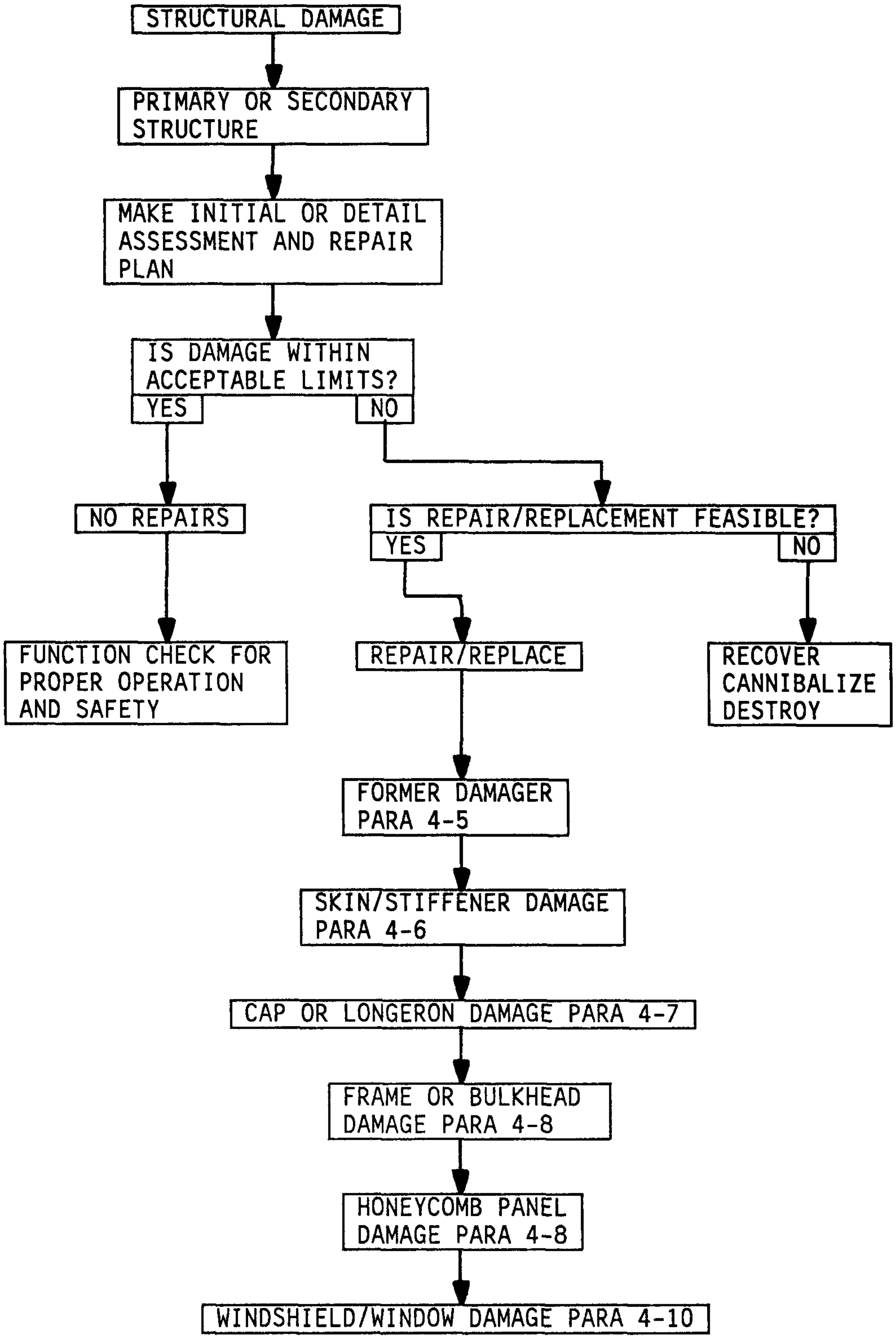
b. Detailed Assessment.

(1) Access to damaged structure. Locate all damage to airframe primary structure. Remove access panels, covers, and fairings in the damaged area. Remove aircraft components as required to inspect the structure. Use the location of entrance and exit wounds and the estimates of projectile paths to determine the areas where damage may be present and access to interior inspection will be needed. If an area of structure suspected of being damaged cannot be reached by other means, cut small inspection holes in the exterior skin. Then inspect internal members with an inspection light and mirror.

**NOTE**

Inspection holes cut in the exterior skin if left unrepaired will have to be treated as damaged structure in the damage evaluation. Allow for access to the areas immediately next to the area where damage is known to have occurred. This will ensure that damage caused by stray particles and dislodged sections of material can be found. All significant damage to the airframe primary structure must be located. Small damage can be critical to some components.

**Table 4-1. Structure Damage Assessment Procedures**



(2) Inspecting for cracks.

(a) Impact cracks. Cracks may be caused by projectile impact or penetration. They may also be caused as a direct result of blast pressures. Battle damaged elements carrying reduced loads will place more severe loads on surviving members and may also produce cracks. When cracks are a result of these last two factors, they may occur in regions away from the site of the primary damage.

(b) Projectile damage site cracks. Cracks will primarily be found at the site of the projectile damage. Holes, spans, and gouges caused by ricochets and embedded particles will often have cracks associated with them. These may be large and visible or hairline and microscopic. Small cracks may be as critical as large cracks because they may grow rapidly under continued loading, particularly when located at the edge of a hole.

(c) Airframe structure cracks. Locate all cracks in airframe primary structure. At each damage site, inspect the area for cracks. Use inspection aids such as magnifying glasses or dye penetrant to locate small cracks. Cracks may not go all the way through the material, so it is necessary to inspect both sides. When a structure shows signs of overstress, it is vital to inspect for cracks around fasteners.

(d) High explosive incendiary (HEI) explosion cracks. For aircraft damaged by an HEI strike, inspect all of the structure in the area of the explosion. Aircraft may have been flown with major structural battle damage or failure. It is vital to inspect for cracks in all areas to which additional load may have been distributed.

(3) Inspecting for structural changes.

(a) Structural changes. Inspect for structural changes when the aircraft has taken an HEI hit or the aircraft has flown with primary structure damaged or missing. Inspect both the damaged structure and the surrounding undamaged area for evidence of buckling, crippling, and misalignment. This type of damage is usually revealed by kinks or wrinkling and “oil canning” of skin panels. Sheared, pulled-through, and missing fasteners are also indications of structural changes.

(b) Buckling, crippling, and misalignment. Structural changes in the form of buckling, crippling, and misalignment can happen as a result of blast pressures. These could be associated with a HEI attack or as a result of the overstress placed on a member. Such members may have to carry the load of another member which has been broken or crippled by projectile damage. This type of damage can be critical to the structural performance of a member and may also cause interference with mechanical moving components which may bind or jam. This is especially true when the member has to support compression loads. A stringer that has been damaged can continue to support some tension; for example, but may be completely ineffective in compression.

(c) Twisting or bowing. Examine the component for alignment and signs of twisting or bowing. Use a straight edge to inspect these conditions.

(4) Inspecting for embedded projectiles and fragments.

(a) Embedded projectile. The effect of an embedded projectile or fragment in a tension member can be as severe as that of a hole or crack of the same size. The embedded object creates an interruption in the structural section. Since it is difficult to detect, it must be assumed that the projectile has nearly gone through the structure.

(b) Embedded projectile inspection. Inspect for embedded projectiles and fragments when either of the following conditions occur:

1 The aircraft has suffered HEI damage.

2 Inspection of the aircraft indicates that a solid projectile has not exited the aircraft, has broken apart, or has created shrapnel by striking internal components.

(C) Projectile path determination. The determination of projectile paths will aid in identifying internal structures that may contain embedded projectiles or fragments. Inspect all structures in the region using a bright light and magnifying glass. Clearly mark embedded objects and record them on DA Form 2404, Figure 4-2.

(5) Inspecting for fire damage.

(a) Armor piercing incendiary (API) and HEI fire damage. The API and HEI threats include the possibility of fire damage. These threats have a fire-starting capability if flammable materials are present.

(b) Fire effects. Some fires may not adversely effect metal airframe structures. When aluminum is exposed to temperatures above 300°F (149°C) for a prolonged period, the temper and strength of the material will be reduced.

(c) Initial fire damage evidence. The first signs of possible fire damage will be a discoloration of the structure. Any discoloration indicates that the member has been exposed to high temperature. Conduct a hardness test to determine if the temper of the material has changed. Such tests should be conducted in accordance with standard practices. If a hardness test shows heat damage, record the information on DA Form 2408 and clearly mark the member.

(6) Detecting substructural damage in adjoining areas.

(a) Secondary damage. When the airframe has been subjected to severe overstress, members undamaged by projectiles may bend or buckle. This might be caused by explosive blast or maneuvering loads imposed on damaged structures. Sometimes this secondary damage will occur in a region away from the primary area of damage. The airframe near the projectile damage should be inspected for evidence of secondary damage.

(b) Secondary damage indicators. Inspect the skin for creases, wrinkles, and dents. Inspect fasteners for chipped or flaked paint, looseness, and serviceability. These conditions are signs of damage to structure. Open or remove access panels and doors, determine whether the frame is warped, and inspect the interior members for cracks and structural changes. Clearly mark and record all damage.

(7) Inspecting for broken and missing fasteners.

(a) Fastener damage or loss. Some fasteners join parts together in an assembly, and some join one structural member to another. Sheared, pulled-through, torn-out, elongated fastener holes, and the damage or loss of fasteners can severely weaken the soundness of a structure.

**EQUIPMENT INSPECTION AND MAINTENANCE WORKSHEET**

For use of this form, see TM 38-750; the proponent agency is the Office of the Deputy Chief of Staff for Logistics.

| 1. ORGANIZATION | | | | | 2. NOMENCLATURE AND MODEL | |
|---|---|---|---|---|---|---|
| 3. REGISTRATION/SERIAL/NSN | 4a. MILES | b. HOURS | c. ROUNDS FIRED | d. HOT STARTS | 5. DATE | 6. TYPE INSPECTION |

| 7. APPLICABLE REFERENCE | | | |
|---|---|---|---|
| TM NUMBER | TM DATE | TM NUMBER | TM DATE |

COLUMN a — Enter TM item number.

COLUMN b — Enter the applicable condition status symbol.

COLUMN c — Enter deficiencies and shortcomings.

COLUMN d — Show corrective action for deficiency or shortcoming listed in Column c.

COLUMN e — Individual ascertaining completed corrective action initial in this column.

**STATUS SYMBOLS**

"X"—Indicates a deficiency in the equipment that places it in an inoperable status.

CIRCLED "X"—Indicates a deficiency, however, the equipment may be operated under specific limitations as directed by higher authority or as prescribed locally, until corrective action can be accomplished.

HORIZONTAL DASH "(-)"—Indicates that a required inspection, component replacement, maintenance operation check, or test flight is due but has not been accomplished, or an overdue MWO has not been accomplished.

DIAGONAL "(/)"—Indicates a materiel defect other than a deficiency which must be corrected to increase deficiency or to make the item completely serviceable.

LAST NAME INITIAL IN BLACK, BLUE-BLACK INK, OR PENCIL-Indicates that a completely satisfactory condition exists.

FOR AIRCRAFT-Status symbols will be recorded in red.

*ALL INSPECTIONS AND EQUIPMENT CONDITIONS RECORDED ON THIS FORM HAVE BEEN DETERMINED IN ACCORDANCE WITH DIAGNOSTIC PROCEDURES AND STANDARDS IN THE TM CITED HEREON.*

| 8a. SIGNATURE *(Person(s) performing inspection)* | 8b. TIME | 9a. SIGNATURE *(Maintenance Supervisor)* | 9b. TIME | 10. MANHOURS REQUIRED |
|---|---|---|---|---|
| | | | | |

| TM ITEM NO. a | STATUS b | DEFICIENCIES AND SHORTCOMINGS c | CORRECTIVE ACTION d | INITIAL WHEN CORRECTED e |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

DA FORM 1 APR 79 2404 — Replaces edition of 1 Jan 64, which will be used

Figure 4-2. DA Form 2404

(b) Riveted and bolted joints. Inspect all riveted and bolted joints near the battle damage. Look for sheared, pulled-through, torn-out fasteners, and elongated fastener holes. Carefully inspect members showing signs of structural change and for fasteners with chipped or cracked paint. Where possible, inspect fasteners from both sides. Clearly mark and record all damaged fasteners on DA Form 2404.

(8) Inspecting for delamination. To verify suspected damage to honeycomb structures, use coin tapping method to determine size and shape of disbonds/delaminations.

NOTE

Resonation of coin tapping on the structure will determine hollowness or existence of delamination.

(9) Marking and recording damage.

(a) Damage recording. Accurate recording of damage is an important part of battle damage assessment. Record all detected damage on DA Form 2404. Determine allowable damage limits. Establish an order of repair on DA Form 2404. Record individual areas of damage to a single structural element separately on the form. If a structural member is massively damaged or severed, recording individual areas of damage is unnecessary.

(b) Damage diagrams. Show the location and extent of damage on copies of the diagrams given in this chapter. The damage can be drawn by hand. Accurately locating damage on a diagram will greatly help the damage assessment procedure.

(c) Marking damage. Mark the damaged structure using grease pencil or paint. Use the labeling scheme given in Figure 1-3.

CAUTION

Use of lead pencil in some areas will cause corrosion.

1 Use a bright color to outline each area of damage as it is located and recorded on the DA Form 2404. Attempt to make the outline visible from all angles.

2 Draw arrows on inside skin panels, webs, and bulkheads to point toward areas of damage that are hidden.

c. Damage Measurement. If the assessment indicates that the damage should be repaired by BDAR or standard procedures, no damage measurement is necessary. Damage measurement is required to determine if structural repair (other than cleanup) can be deferred, or if self-recovery of the damaged aircraft is feasible. Damage measurement may also be required if a BDAR repair does not restore original strength. Begin damage measurement with the largest damage.

(1) Caps and longerons.

(a) The parameters involved in measuring damage to a cap or longeron are shown in Figure 4-3. The pertinent values are as follows:

CD = Depth of damage.
CL = Length (width) of damage.
A = CL x CD = area of damage.
D = Distance between damages.

In Figure 4-4, the length of the flattened cross section shown is a+b.

If CD is the depth of the damage into the flattened cross section, then CS Is the length of the remaining effective cross section still capable of supporting load, and CS= (a+b)-CD. Always measure CD.

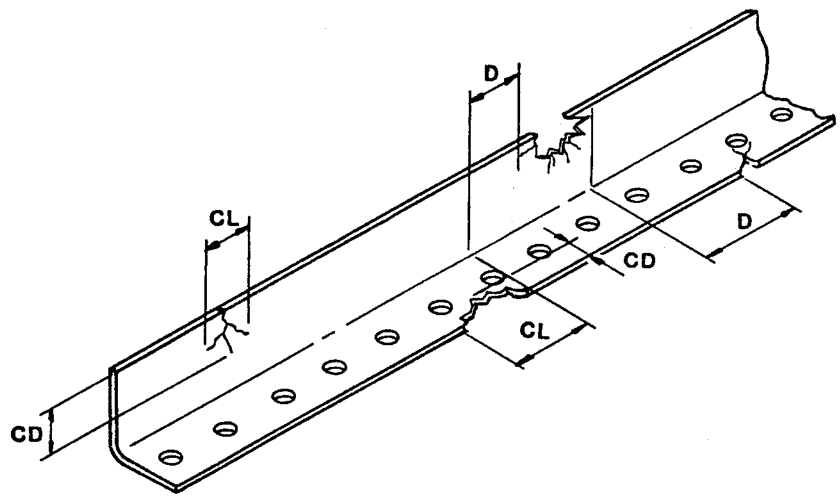



Figure4-3. Measuring Cap or Longeron Damage

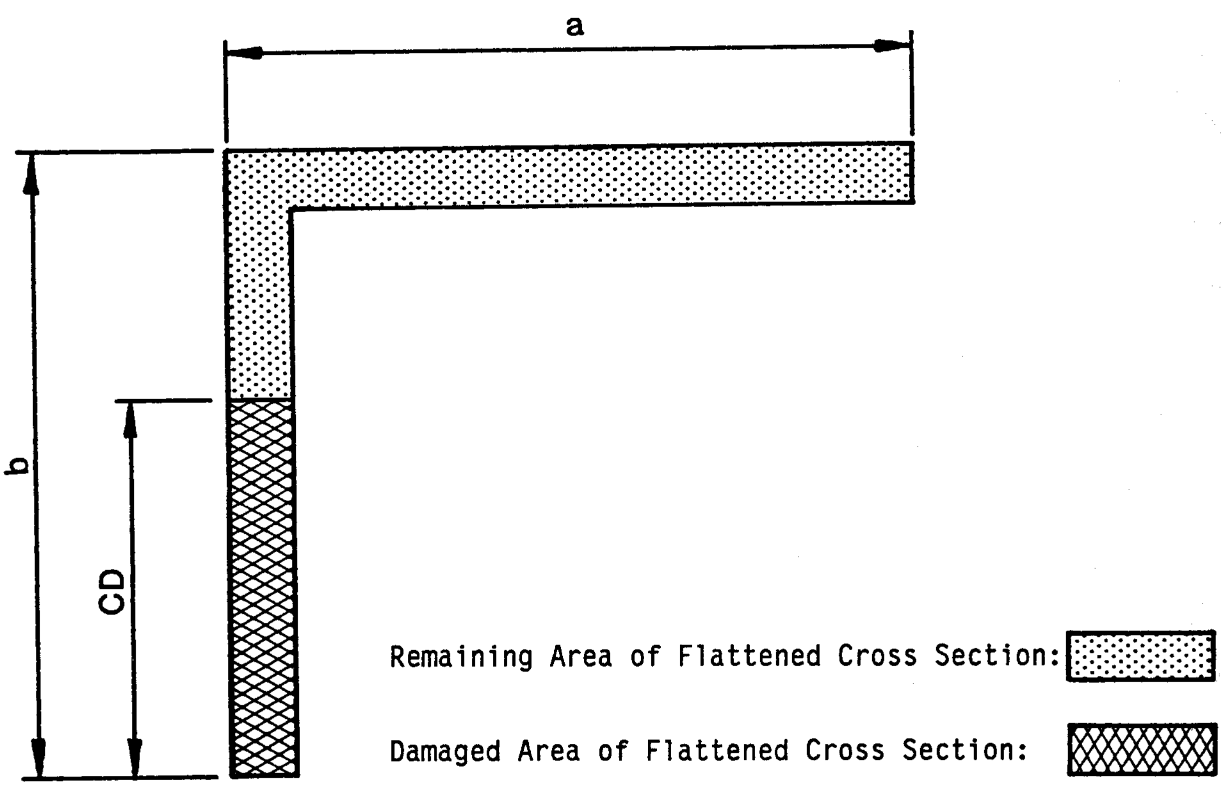



Figure 4-4. Damaged Cross Section

(b) Damage measurements apply after cleanup and smoothing or after BDAR has been accomplished; however, as a practical matter, measurements must often be taken before smoothing to make a decision on deferrability. Hence, when estimating damage limits before cleanup and smoothing, make allowance for the material that will be removed in smoothing. This applies particularly to cracks; the length of the crack must be included in the depth (CD) and length (CL) measurements. When measuring damage, use the following procedures if possible:

1 Clean all damaged areas thoroughly. Use brushes and rags to remove dirt and film from small crevices where damage may be present.

2 Smooth all jagged and rough edges and be sure to cut out all radiated cracks. Use largest corner radii possible in the cut-outs; avoid sharp corners.

3 Measure damage after smoothing or if measuring before smoothing, make allowance for the material which must be removed during smoothing.

4 Use a steel rule graduated in tenths of an inch and measure each damage dimension to the next higher tenth.

5 Include the size of the hole when measuring damage that extends into a fastener hole or lightening hole.

6 Record on DA Form 2404.

(2) Webs, panels, floors, and decks.

(a) Refer to Figures 4-5 and 4-6 for the measurements of "WL" and "D." "WL" is the largest dimension across the damage, regardless of direction and must include all radiated cracks. "D" is the distance between damages. Take and record measurements as described in paragraph 4-2.c(1) (b).

(b) Honeycomb sandwich structures. Refer to Figure 4-7 for the measurement of "WL" and "D." If a projectile hits a sandwich panel at an angle, the damages in the two skins may be off-set and of different sizes. Measure the damage on the side with the largest damage (usually the exit side), and make sure that the measurement includes the damaged area on the other side. "WL" is the largest dimension across the damage (both sides), regardless of direction, and must include all radiated cracks. "D" is the distance between damages. Take and record the measurements as previously described.

d. General Damage Limits.

(1) The allowable damage limits corresponding to the damage measurements of paragraph 4-2.c are designated for a given condition as follows:

CD' = Allowable depth of cap/longeron damage.

DL' = Allowable length (width) of cap/longeron damage.

A' = Allowable area of damage.

D' = Minimum allowable distance between damages.

WL' = Allowable largest dimension across web/panel damage.

N = Minimum Damage Factor.

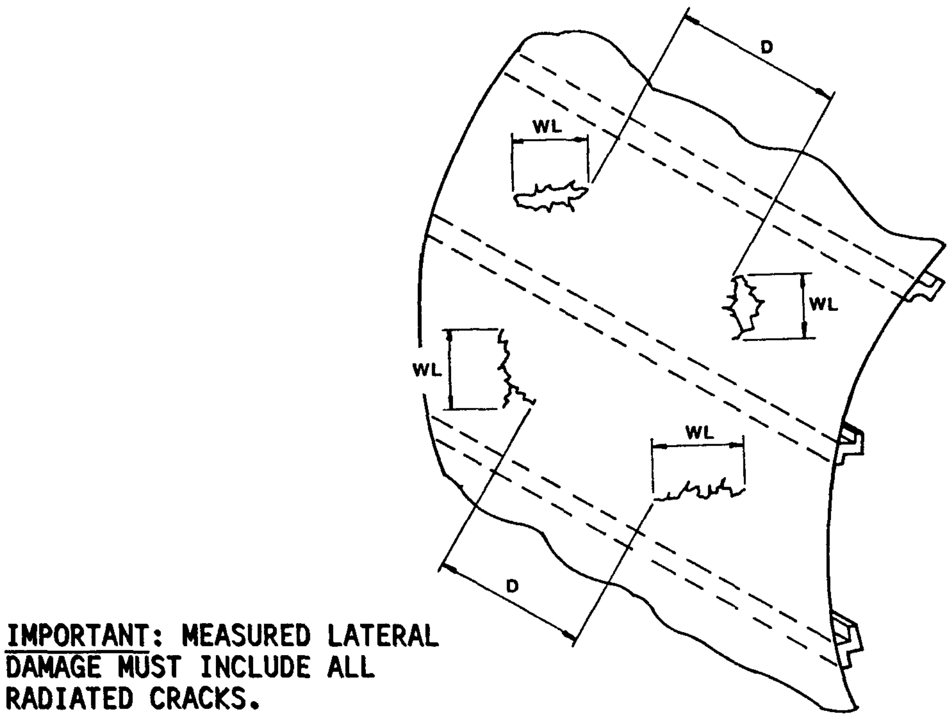



Figure 4-5. Measuring Skin Panel Damage

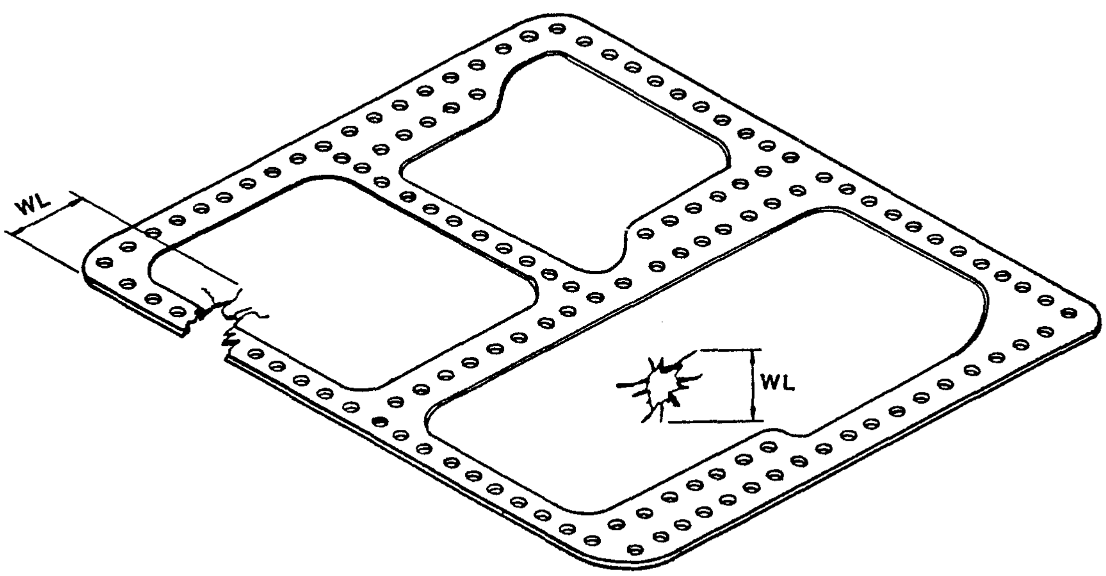



Figure 4-6. Measuring Damage in Floors and Decks

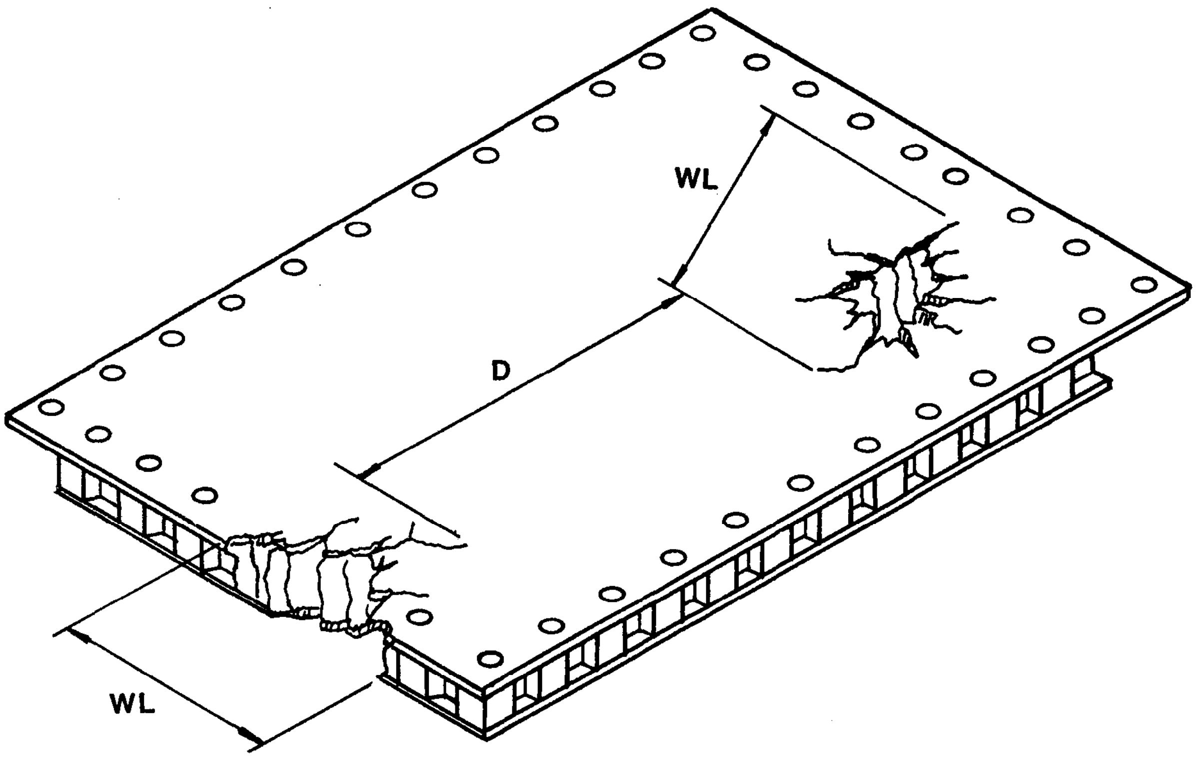



Figure 4-7. Measuring Damage in Honeycomb Panels

(2) Allowable damage limits are associated with the conditions of the primary structural elements as described below. A damage limit for a given condition is a measure of the amount of damage that a structural member can sustain and still support the loads associated with the given condition. These limits were developed from the aircraft manufacturer's original engineering design calculations.

(3) Condition is an indicator of the residual capacity of a damaged structural element to perform its function. Battlefield damaged structures or BDAR repair ed structures are classified in three conditions:

(a) Condition 1. Aircraft fully flight capable. No flight restri ctions; however, on a battlefield under the pressures of time and tactical situations', the assessment of structural damage may not have revealed all the damages. Therefore, aircraft with structural damage whether repaired or repair deferred should be inspected after every flight. The inspector should look for crack growth, evidence of overstress, growth of allowable deformation, or the development of new cracks at other locations.

(b) Condition 2. Self-recovery capable. Self-recovery may be required to move a damaged aircraft to a repair site or from one site to another, when towing is not feasible. Self-recovery is preferable to disassembly and boxing an aircraft for transportation. As time permits, proceed as follows:

1 Mark all visible cracks and the extent of other structural damage with chalk, grease pencil, paint, tape, or other available means so that any growth in the damage can be quickly recognized.

2 Perform any feasible on-site BDAR fixes as required for self-recovery.

(c) Condition 3. Structural damage not repairable by BDAR techniques, not self-recovery capable. The airframe is so extensively damaged that no useful or needed functions can be restored within the available time and resources. These aircraft will be:

1 recovered or evacuated to a facility with the resources to repair the airframe,

2 used as a source of cannibalized components, or

3 destroyed. This is a last resort.

(d) These conditions apply to the primary structure and should not be confused with the mission capability classifications. Mission capability is dependent on equipment condition.

(4) In a given condition if all damages are equal to or less than the corresponding allowable damage limits and the distance between damages are equal to or greater than the corresponding minimal allowable limit, that is,

$$CD < CD'$$
$$CL < CL'$$
$$WL < WL'$$
$$D > D'$$

the aircraft may be released for flight in that condition. Repair may be deferred although some clean-up and smoothing of the damage will be required as will inspection for damage growth after every flight. Special consideration should be given to damage exposed to the airstream, particularly to the effects of ram air, rain, and petaling. Petals may vibrate in the passing airflow, rapidly creating cracks in the supporting base metal. Large pieces of metal may peel off and damage other parts of the aircraft. The distance D between damage sites for most structures has a minimum required spacing. The spacing requirement is expressed as a multiple factor (N) of the measured area of damage.

(a) The factor applies to the damage actually measured not to the maximum damage limit for the structure.

(b) The factor applies to the largest dimension of the largest damage between which separation is being measured.

(c) The factor applies only if the dimensions of both damages, when added together, exceed the single damage limit.

(5) Continuous members. Allowable damage limits for caps, longerons, webs, floors, decks, and stiffness are given throughout this section as appropriate.

(6) Damaged fittings, attachments, and splices are classified as unserviceable and must be repaired, reinforced, or replaced if any of the following conditions exist:

(a) Damage to the fitting has removed more than 20 percent of the structural cross section at any one location.

(b) One or more fasteners connecting the fitting to a continuous aircraft component are bent, sheared, stripped, or loose.

(c) The fitting shows signs of overstress or structural distortion.

(7) Damage limits are calculated on the basis of the AH-1S structural analysis and tend to be conservative. Assessors using damage limits to prepare damage assessments should consider them as guides and balance the damage limits against the judgment resulting from their own experience.

e. Fuselage Damage Assessment.

(1) General.

(a) The fuselage midsection primary basic structure consists of a box beam starting at FS 148.5 and extending to FS 300.68, Figure 4-8. Forward of the box beam (FS 148.5), two fuselage beams and cockpit floors extend forward to FS 61.25 to support the cock-pit and gun turret. The tail boom attaches to the fuselage at FS 300.68 and extends to the fin which supports the tail rotor and the stinger (tail bumper).

(b) The fuselage box beam consists of 4 caps (Figures 4-9 and 4-11) connected vertically by the webs of the fuselage beams (Figures 4-10 and 4-12) and connected horizontally by the upper and lower panels (Figure 4-13). Bulkhead flanges act as spacers between the caps, both vertically and horizontally, and should be treated as caps in a damage assessment. The bulkheads also hold the shape of the aircraft and distribute concentrated loads into the vertical panels and/or horizontal panels. The concentrated loads include the loads from the landing gear, pylon, wing attachments, elevator, tail rotor, fin, and tail bumper.

(2) Damage measurement.

(a) Reproduce Figures 4-14 to 4-17 as required, and use to mark up damaged areas.

(b) Refer to Figures 4-9 to 4-13 for definition and identification of primary fuselage structural elements.

(c) Mark all detected damage on the appropriate figure, and add remarks to clarify markings as described in paragraph 4-2.b(9).

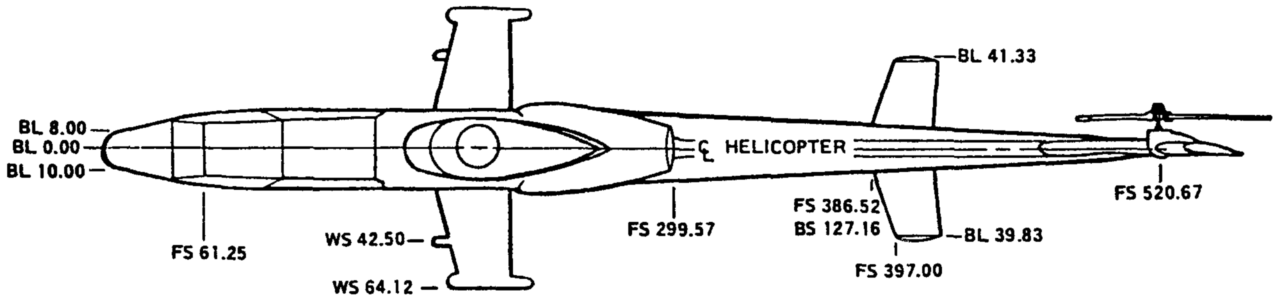
(d) Refer to paragraph 4-2. c and for each damaged element, measure the depth "CD" and the length (width) "CL" or "WL" of each damage. Count the number of damages and measure the "D" between damages. Start with the worst damage. Record the values on DA Form 2404 and compare therewith the allowable damage limits given in this section. Select the set of allowable damage limits which are next larger than the measured damage, determine the corresponding condition. Consider whether damage could result in flight failure of other elements. Attempt to visualize what effect large defections of damaged member will have on adjacent structure.

(e) Decide on whether repair can be deferred or whether damage should be fixed and what the condition of deferred or repaired damage would be.

(f) Determine the priority of the various required repairs based on repair time, difficulty of repair, resources available, tactical situation, and need for the aircraft, etc. The longest repair time normally is given the highest priority and is most critical.

(g) Enter repair requirements on DA Forms 2404.

(3) Allowable fueslage damage




| | |
|---|---|
| BL | BUTTLINE |
| BS | BOOM STATION |
| FS | FUSELAGE STATION |
| WL | WATERLINE |
| WS | WINGSTATION |

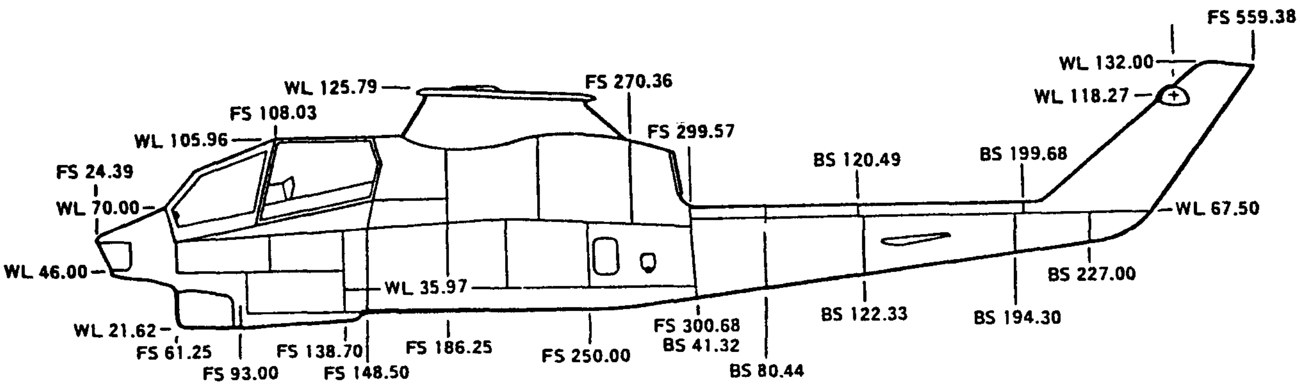



Figure 4-8. Airframe Reference Lines

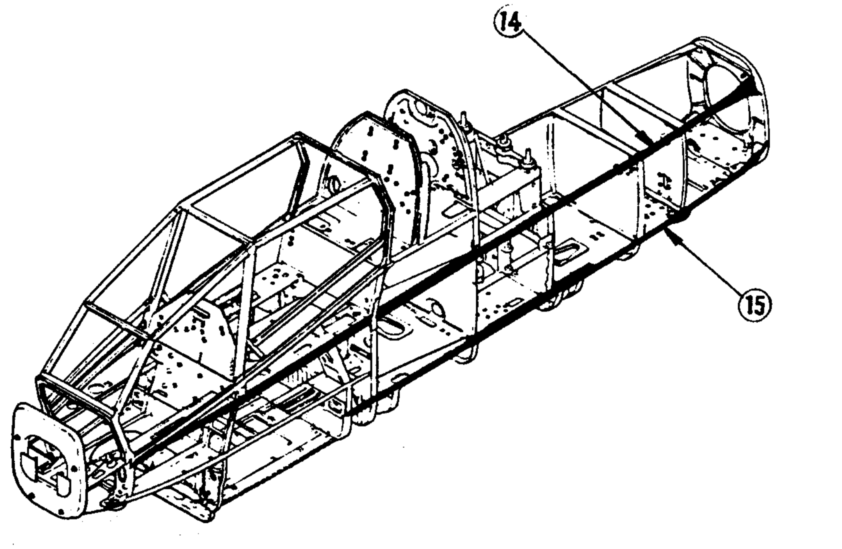



Figure 4-9. Primary Structural Caps L/H

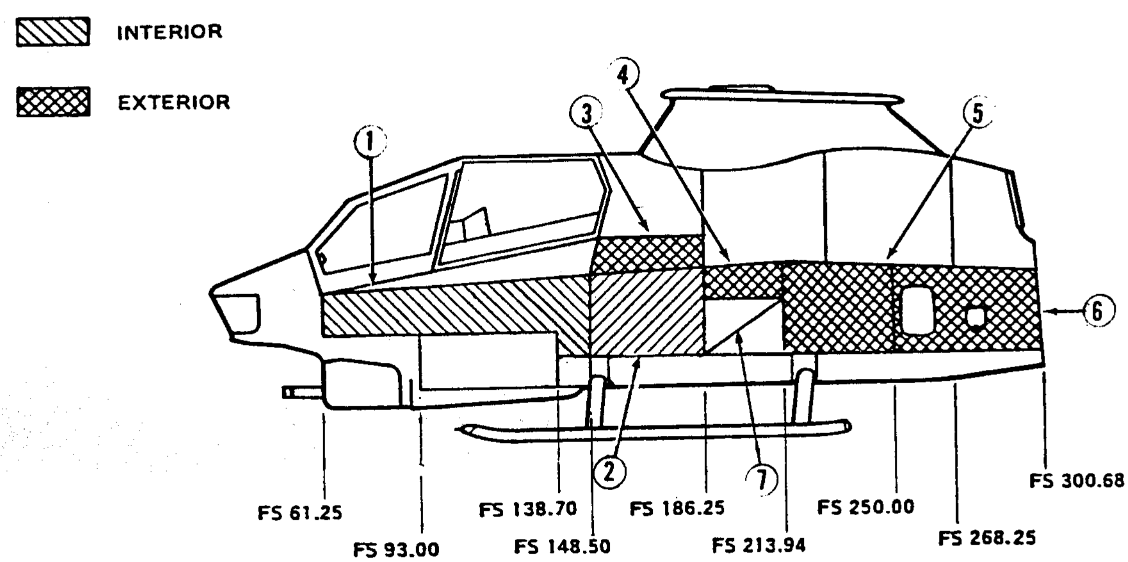



Figure 4-10. Structural Webs L/H

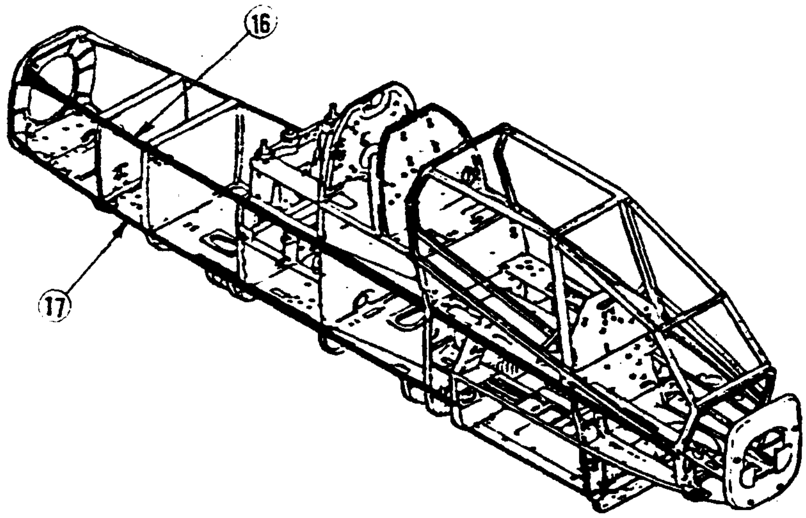



Figure 4-11. Primary Structural Caps R/H

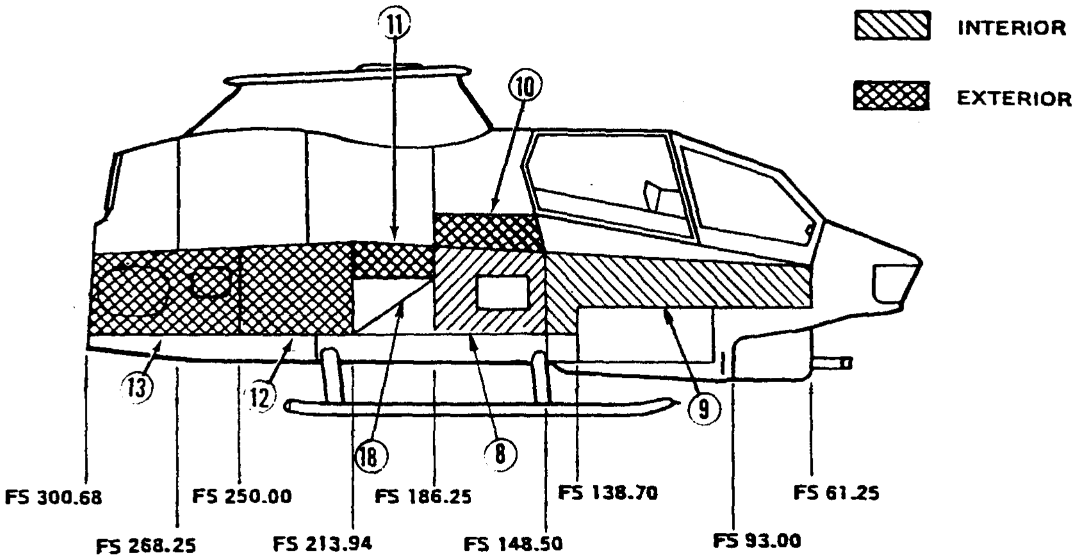



Figure 4-12. Structural Webs R/H

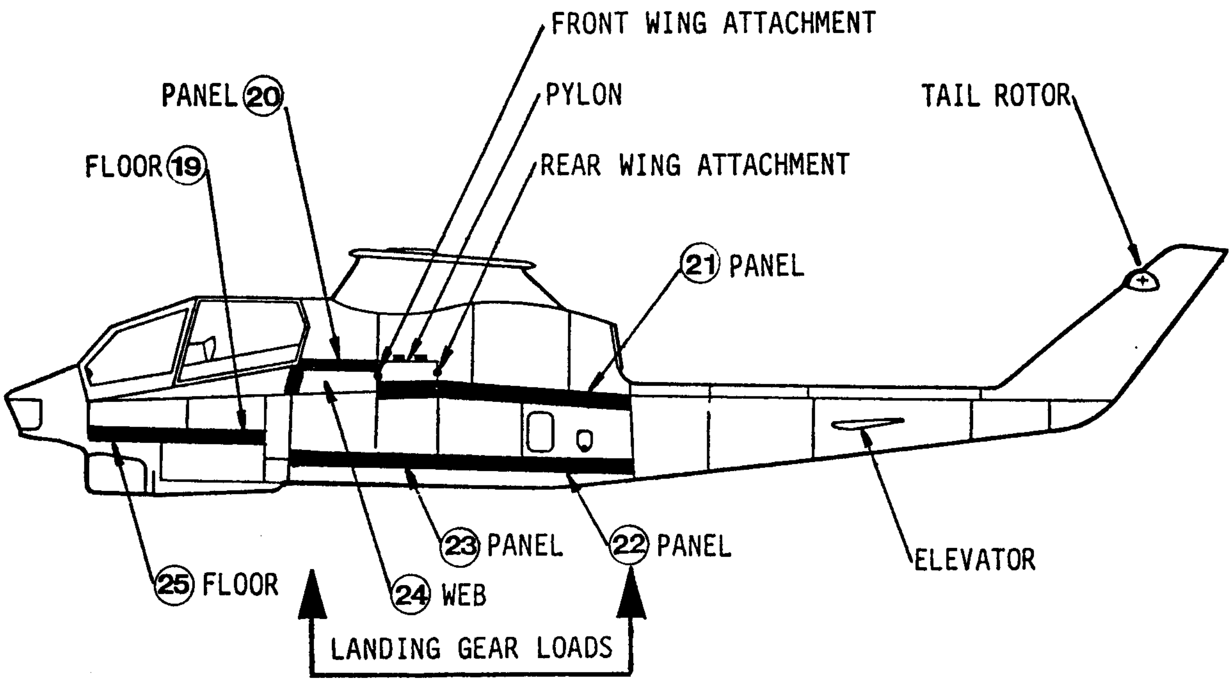



Figure 4-13. Fuselage Box Beam Panels

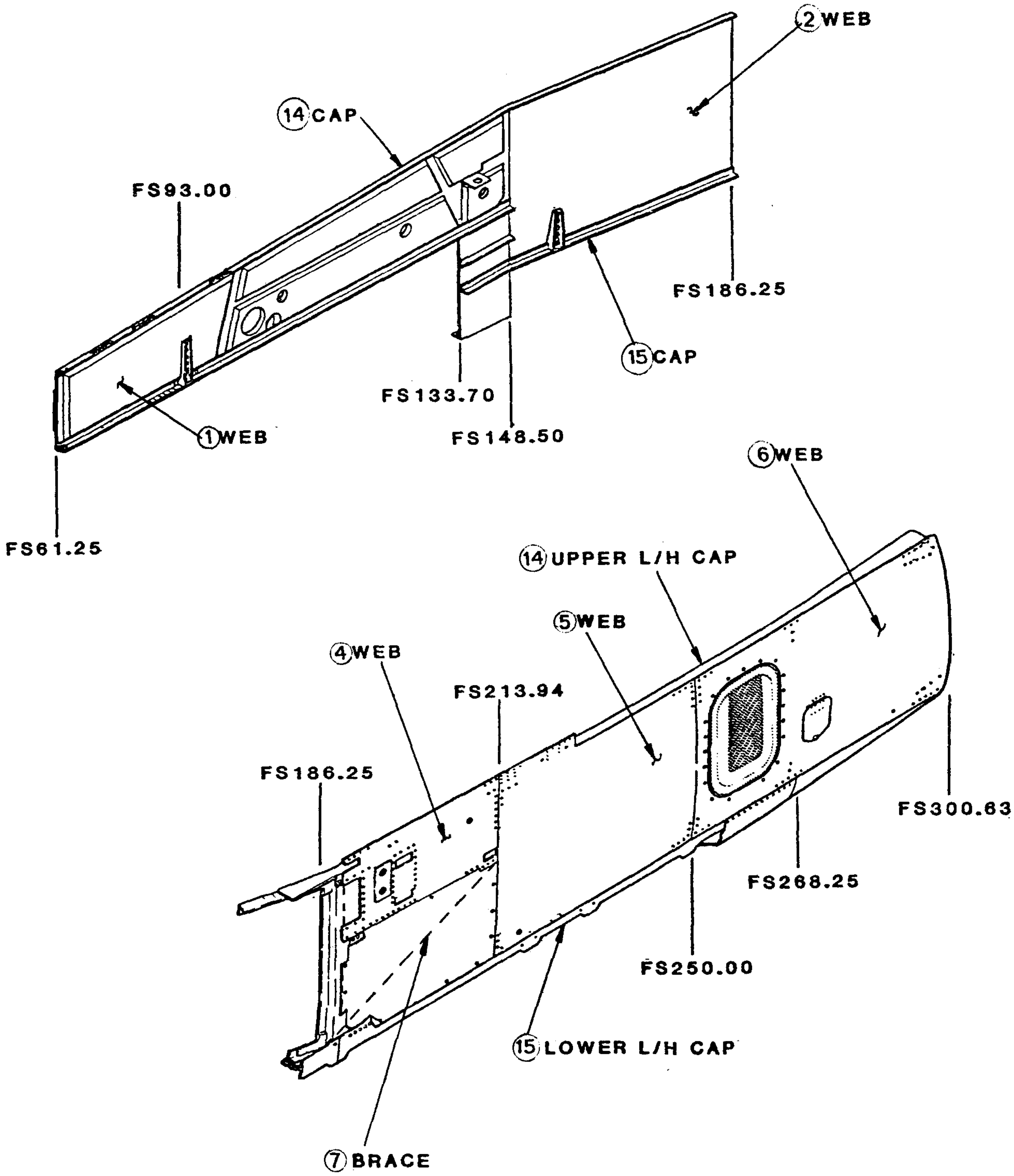
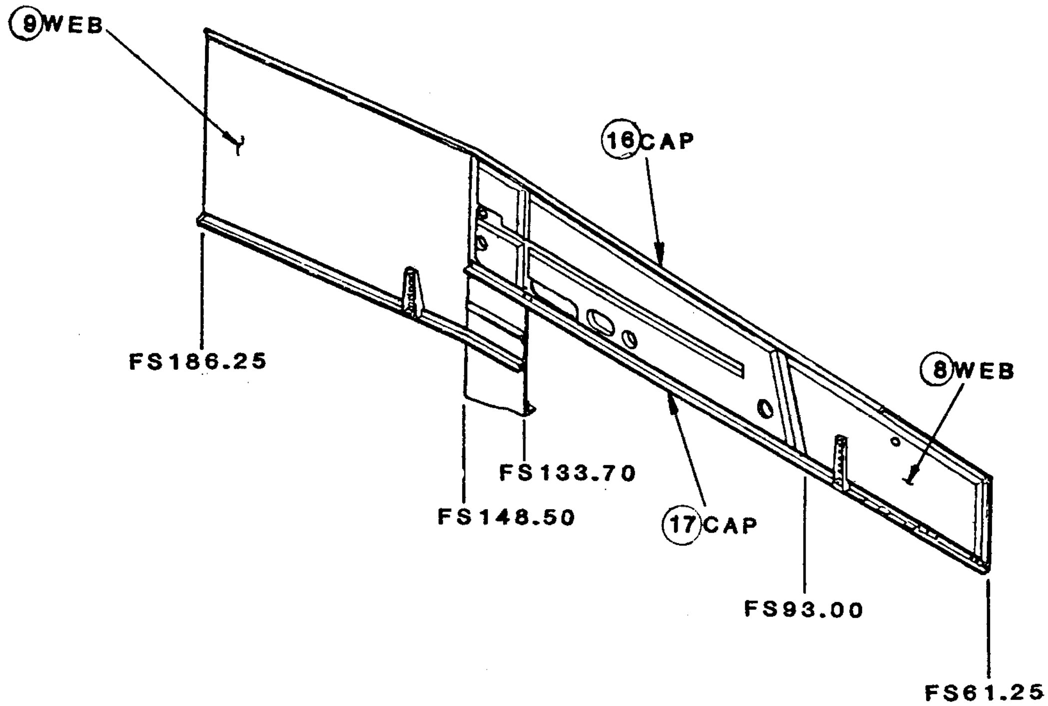



Figure 4-14. L/H Fuselage Beam



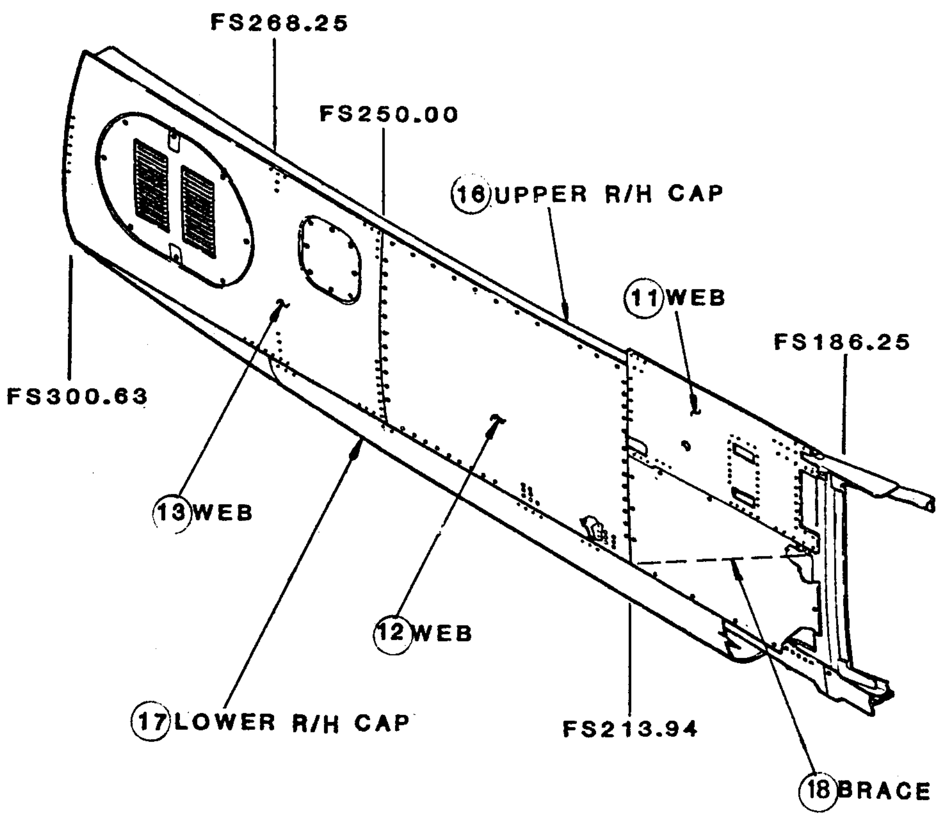




Figure 4-15. R/H Fuselage Beam

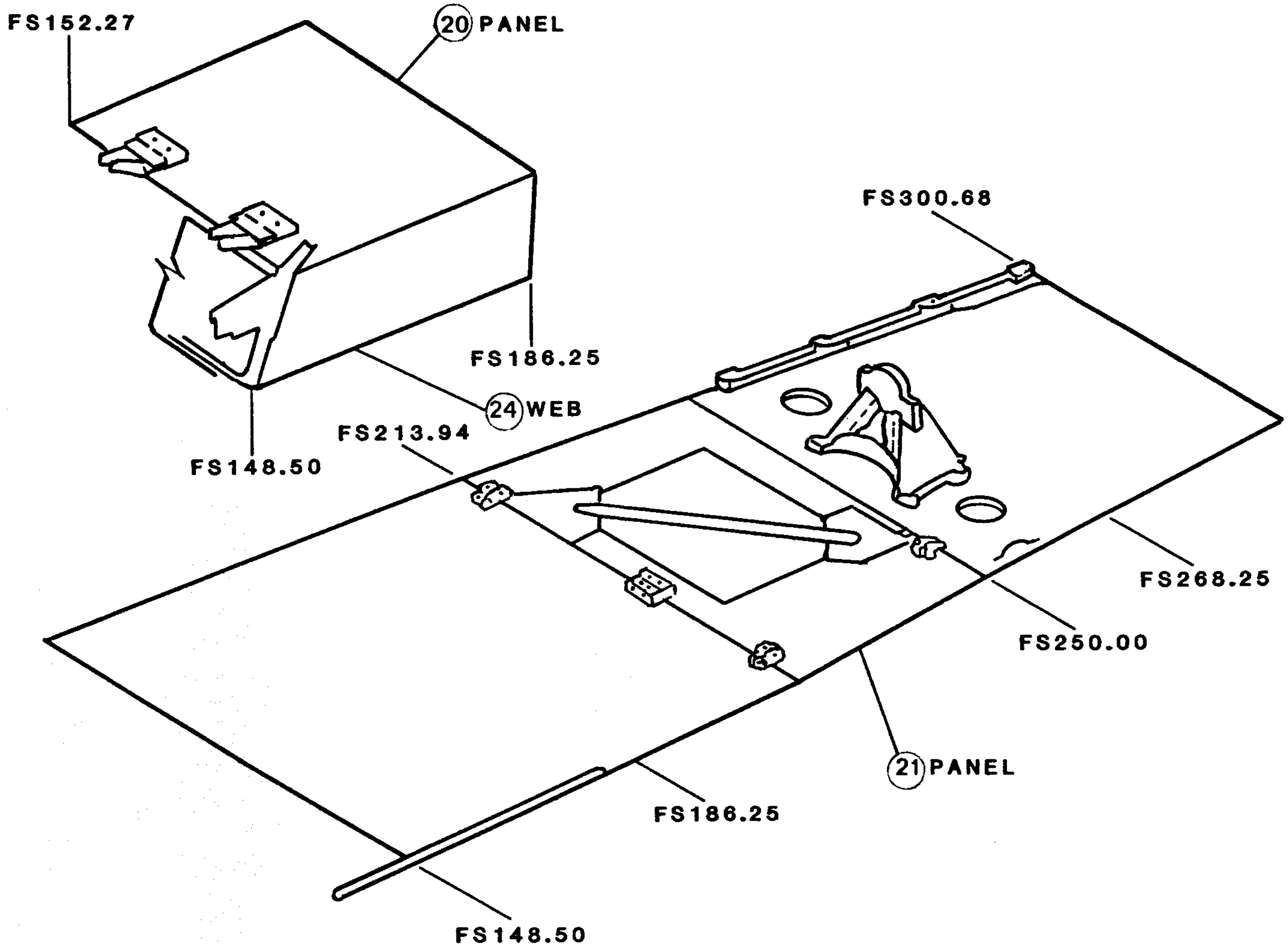



Figure 4-16. Upper Panels

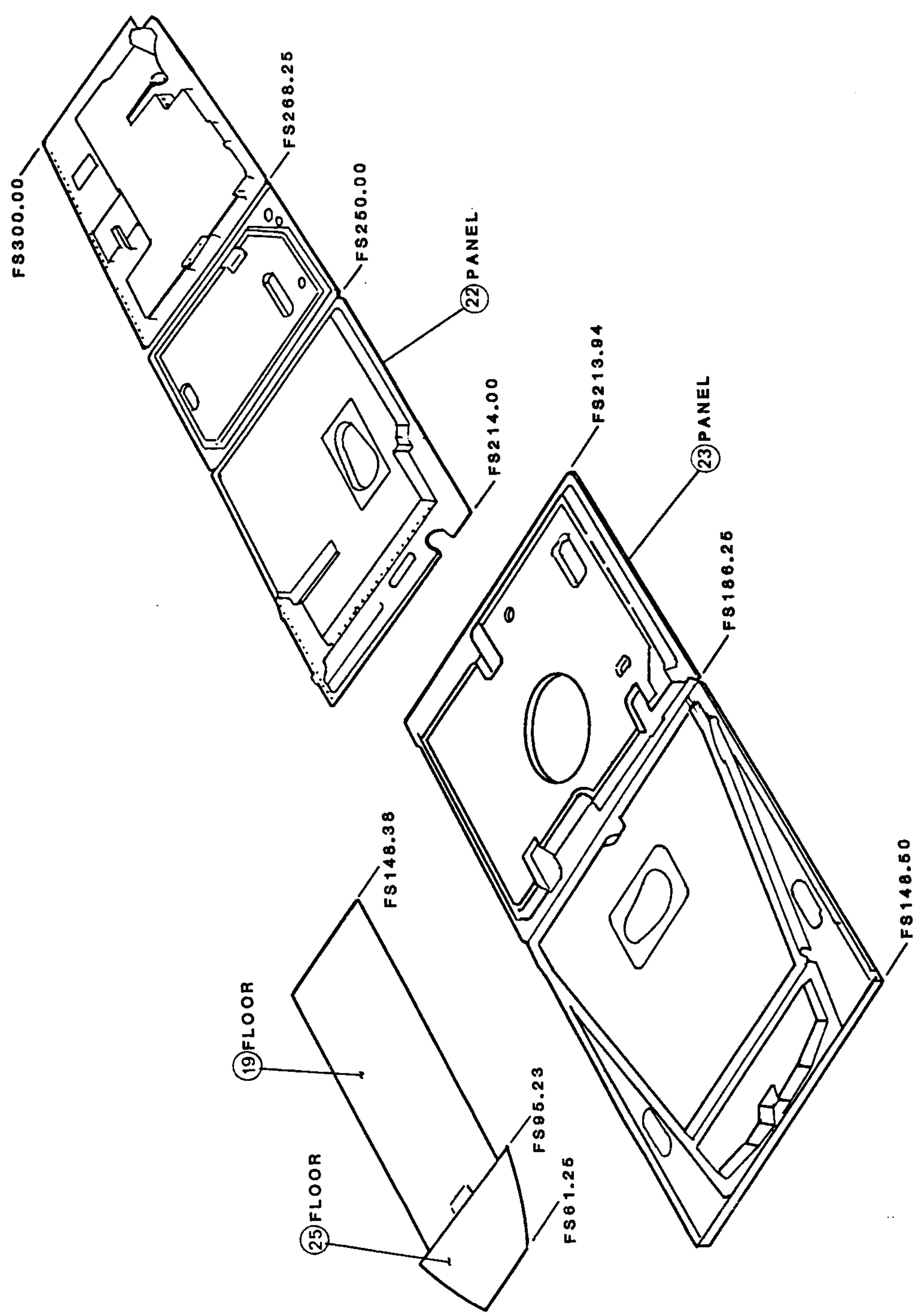



Figure 4-17. Lower Panels

(a) Fuselage caps. Mark damage to fuselage caps on Figures 4-14 and 4-15.

1 Condition 1. The damage limits for cap damage for condition 1 are shown in Table 4-2. The damage limits are given in terms of CL , CD', and D .

2 Condition 2.

a If a damaged aircraft has been flown back from a mission, it can be assumed that a degree of structural integrity remains.

b For the self-recovery flight of paragraph 4-2.d(3) (b), damage may exceed the maximum allowable of Table 4-2 except that:

[1] No cap may be completely ruptured; local CS may be 3/8 to 1/2 inch and attached to either a web or a floor.

[2] If a cap has ruptured or appears near rupture, apply a quick external patch before self-recovery.

[3] If a cap is badly damaged in a number of locations close together, apply a long external stringer over the damaged area, and secure to undamaged structure at the ends and at each opportunity in between.

3 Condition 3. If any cap is completely ruptured and available resources to apply an external patch are not available, the aircraft should not be flown.

(b) Bulkhead flanges. Bulkhead flanges act as vertical and horizontal spacers between the caps. CL', CD', and D' damage limits on the bulkhead flanges are the same as the cap damage limits in that fuselage station. The limit values are found in Table 4-2 for condition 1. Criteri a for conditions 2 and 3 for cap damage also applies to damage limits for bul khead flanges.

(c) Webs, panels, decks, floors. Refer to Figure 4-14 thru 4-17.

1 Condition 1.

a Web 1 (1, Figure 4-14 and 9, Figure 4-12) between FS 61.25 and FS 138.70.

Largest allowable damage - WL' = 2 inches.

Closest allowable damage spacing - D' = 4 inches.

Allowable number of damages per panel - 2.

Other: see d below.

b Web (1, Figure 4-10 and (9, Figure 4-12) between FS 138.70 and FS 148.5.

Largest allowable damage - WL' = 2 inches.

Allowable number of damages - 1.

Other: see d below.

c For item numbers: 2, 4, 6, 7, Figure 4-14.

Largest allowable damage - WL' = 2 inches.

Closest allowable damage spacing - D' = 4 inches.

Allowable number of damages per panel - 4.

Other: see d below.

qdApplicable to a, b, and c above:

**Table 4-2. Allowable Fuselage Damage Limits-Condition 1, Fuselage Caps (1)**

| FUSELAGE STATION | UPPER LEFT CAP DAMAGE | | | | UPPER RIGHT CAP DAMAGE | | | |
|---|---|---|---|---|---|---|---|---|
| | LENGTH CL' | DEPTH CD' | REMAIN-ING CS' (2) | DISTANCE D' (3) D'=NxCL' | LENGTH CL' | DEPTH CD' | REMAIN-ING CS' (2) | DISTANCE D'(3) D'=NxCL' |
| 61.25- 93.00 | 1.80 | .90 | 1.05 | 9 | 2.00 | 1.00 | 1.12 | 10 |
| 93.00-138.70 | 1.00 | .50 | 1.58 | 5 | 1.00 | .50 | 1.62 | 5 |
| 138.70-148.50 | 1.00 | .50 | 1.60 | 5 | 2.00 | 1.00 | 1.12 | 10 |
| 148.50-186.25 | 2.00 | 1.00(4) | 1.12 | 10 | 2.00 | 1.00(4) | 1.12 | 10 |
| 186.25-213.94 | 1.20 | .60(4) | 1.57 | 6 | 1.80 | .90(4) | 1.22 | 9 |
| 213.94-250.00 | .60 | .30 | 1.74 | 3 | .80 | .40 | 1.72 | 4 |
| 250.00-268.25 | 1.40 | .70 | 1.38 | 7 | 1.00 | .50 | 1.62 | 5 |
| 268.25-299.57 | 1.40 | .70 | (5) | 7 | 2.00 | 1.00 | (5) | 10 |
| | LOWER LEFT CAP DAMAGE | | | | LOWER RIGHT CAP DAMAGE | | | |
| | LENGTH CL' | DEPTH CD' | REMAIN-ING CS' (2) | DISTANCE D' (3) D'=NxCL' | LENGTH CL' | DEPTH CD' | REMAIN-ING CS' (2) | DISTANCE D' (3) D'=NxCL' |
| 61.25- 93.00 | 1.40 | .70 | 1.47 | 7 | 1.60 | .80 | 1.37 | 8 |
| 93.00-138.70 | 2.00 | 1.00 | 1.07 | 10 | 2.00 | 1.00 | 1.07 | 10 |
| 138.70-148.50 | 2.00 | 1.00 | 1.12 | 10 | 2.00 | 1.00 | 1.12 | 10 |
| 148.50-186.25 | 2.00 | 1.00(4) | 1.11 | 10 | 1.60 | .80(4) | 1.31 | 8 |
| 186.25-213.94 | 1.60 | .80(4) | 1.44 | 8 | 2.00 | 1.00(4) | 1.10 | 10 |
| 213.94-250.00 | 2.00 | 1.00 | (5) | 10 | 1.00 | .5 | (5) | 5 |
| 250.00-268.25 | 1.60 | .80 | 1.29 | 8 | 1.00 | .5 | 1.59 | 5 |
| 268.25-300.68 | 1.80 | .90 | (5) | 9 | 1.40 | .70 | (5) | 7 |

(1) All dimensions in inches. See Figure 4-3.
(2) Always measure CD. CS' is an approximate value and is listed here only as a reference dimension.
(3) The D' limit may be waived if the CL' values of both adjacent damages combined do no exceed the CL' value for that member.
(4) All damage 10 inches fore and aft of station 186.25 must be repaired per TM 55-1500-204-25/1, Chapter 4.
(5) CS' varies-cap is tapered and changes in cross section.
(6) Damage limit values for caps, CL', CD', and D', also apply to damage limits for bulkhead flanges in that fuselage station for a given condition.

[1] Three cap/bulkhead to web/panel attachments may be damaged.

[2] No visible deformation or buckling.

[3] Any damage 10 inches fore and aft of station 186.25 must be repaired.

2 Condition 2.

a Web (1, Figure 4-10 and 9, Figure 4-12) between FS 61.25 and FS 138.70.

Largest allowable damage - WL' = 4 inches.

Closest allowable damage - spacing D' = 3 inches.

Allowable number of damages per panel - 2.

b Web (1, Figure 4-10 and 9, Figure 4-12) between FS 138.70 and FS 148.5.

Largest allowable damage - WL' = 4 inches.

Allowable number of damage - 1.

c For item numbers: 2, 4, 7, Figure 4-14. The maximum limit for any adjacent webs or panels are as follows:

Largest allowable damage - WL' = 4 inches.

Closest allowable damage - spacing D′ = 3 inches.

Allowable number of damages per panel 10.

On non-adjacent panels as much as 25 percent of the area may be missing (blast damage). Within reason, visible buckling and deformation (blast damage) are allowable, provided that they do not occur at the same place as major fragmentation damage and aggravate flight loads on the damaged members. Heavily damaged capstrips (say CS=O.375 to 0.5 inch) must be relatively straight in the area of maximum-damage and the remaining cross-sectional area must be attached to a side panel or web.

3 Condition 3. Damage exceeds the damage limits of condition 2.

(d) Pylon support.

1 General.

a The pylon support extends from FS 186.25 to FS 213.94, and is located directly above the deck at about WL 65, Figure 4-18. It provides five flexible mounts for the transmission one at each corner and one approximately at FS 213 at aircraft center line and under the transmission/engine attachment point.

b The wing carry-through structure for the center wing spar is located directly under the pylon support, approximately one third the length of the bay behind FS 186.25. The transmission is attached by link (1) to the top of the wing carry-through.

c Link (1) provides a direct load path from the rotor shaft to the wing carry-through which distributes the rotor thrust to the aircraft side skin. The pylon support with its five flexible mounts provides stability to the transmission and pylon installation, and distributes loads other than the direct tension in link (1) to adjacent bulkhead and skin panels. Such loads are primarily due to the inertia of the transmission and pylon during violent maneuvers.

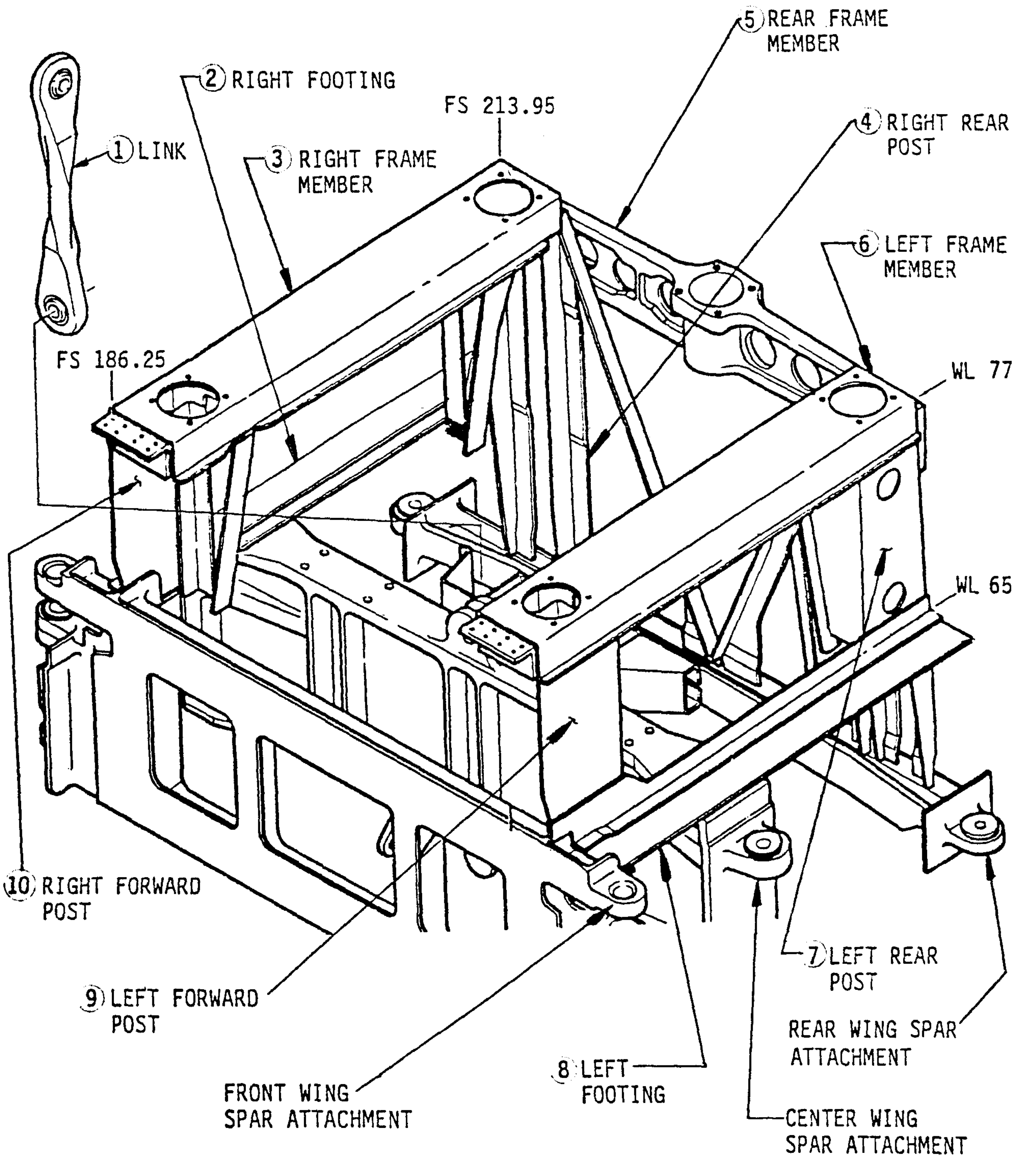



Figure 4-18. Pylon Support

d The pylon support consists primarily of built-up sheet metal members. It consists of an open frame (6), (5), (3) at about WL 77, held in place by four posts (9), (7), (4), and (10), one at each corner. Bulkhead 186.25 forms the front edge of the frame but is not shown on Figure 4-18.

2 Damage measurement.

a Reproduce Figure 4-18 as required for markup.

b Mark all detected damage on Figure 4-18, add remarks to clarify markings as described in paragraph 4-2.(b)(9). This paragraph contains instructions for marking damages on the aircraft itself.

c Refer to paragraph 4-2.c and, for each damaged member, measure the depth "CD" and the maximum length (width) "WL" of each damage. Count the number of damages and measure the distance “D” between damages. Compare them with the damage limits given in paragraph 4-2.e. Select the set of allowable damage limits which are next larger than the measured damage and determine the corresponding condition.

d Consider whether damage could result in flight failure of other members. Attempt to visualize what effect large deflections of damaged members will have on adjacent structure.

e Decide on whether repair can be deferred or whether damage should be fixed and what the condition of the deferred or repaired damage would be.

3 Allowable damage limits.

a Condition 1. Built-up metal members (frame, posts):

CD' = 0.5 inch
WL' = 1.0 inch
D' = 8.0 inches

No damage to transmission mounts. Geometry of mounts is not compromised by warpage or deformation of frame, posts, or other structure.

Machined members:

CD' = 0.5 inch
WL' = 1.0 inch
D' = 8.0 inches

No damage within 3 inches of an attachment boss. No warpage or permanent deformation.

Link (1, Figure 4-18):

No visible damage except for nicks and scratches, in which case inspect after every flight for development of cracks.

b Condition 2. Built-up sheet metal members (frame, posts):

CD' = 1.5 inches
WL' = 75 percent of the width of any one element in a member may be missing. See Figure 4-19 for definition of an element.

Two transmission mounts may be damaged and in effective.

Machi ned members:

CD' = 1.5 inches
WL' = 3.0 inches
D' = 6.0 inches

Warpage from blast damage may not interfere with functioning of other essential systems such as causing binding in the flight control system.

Link (1, Figure 4-18):

CD' = 0.25 inches

c Condition 3. The allowable damage of condition 2 is exceeded.

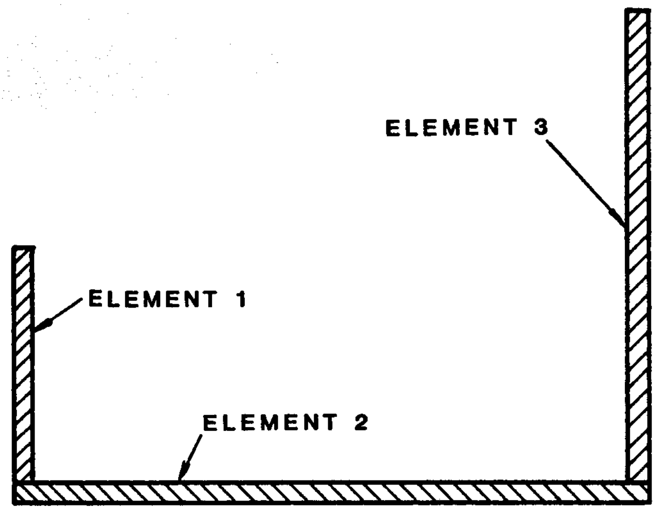



Figure 4-19. Post Member Consisting of Three Elements

f. Tail Boom Damage Assessment.

(1) General.

(a) The tail boom is attached to the fuselage midsection at FS 300.68, Figure 4-8. The tail boom and the fin each have their own sets of reference lines. At FS 300.68 the corresponding Boom Station (BS) is 41.32.

(b) The tail boom supports the elevator, fin, tail rotor, and tail boom stinger. The tail rotor and fin apply lateral loads to the tail boom at a point in space some 60 inches above the centroid of the tail boom. This results not only in a lateral bending moment on the tail boom and fuselage but also in a twisting action or torsion. The tail rotor driveshaft runs along the top of the tail boom and the leading edge of the fin.

(c) The tail boom is a semi-monocoque shell consisting of four longerons acting as caps, covered by a skin stiffened with stringers and bulkheads or frames. The bulkheads or frames act as spacers between the longerons and hold the shape of the shell. There are five structural bulkheads. The two at BS 41.32 and 59.50 distribute the fuselage-tail boom attachment loads into the shell. The one at BS 143.28 distributes the elevator loads. The two at BS 206.00 and 227.00 support the fin and tail boom bumper. The fin is a honeycomb core airfoil section.

(d) The damage assessment procedure described in paragraph 4-2 consists of damage measurement and determination of the corresponding allowable damage limits and associated condition. A repair plan is recorded on DA Form 2404.

(2) Damage measurement.

(a) Reproduce Figure 4-20 and Figure 4-21 as required. The figures identify primary boom structural members by bubble number.

(b) Mark all detected damages on the appropriate figure, add remarks to clarify markings as described in paragraph 4-2.b(9).

(c) Refer to paragraph 4-2.c and for each damaged element, measure the depth “CD” and length (width) “CL” or “WL” of each damage. Count the number of damages, N, and measure the distance “D” between damages. Record these values for each damaged element on DA Form 2404 and compare them with the allowable damage limits given in paragraph 4-2.f(3). Select the set of allowable damage limits which are next larger than the measured damage and determine the corresponding condition.

(d) Consider whether the damage could result in flight failure of other elements. Attempt to visualize what effect large deflections of damaged members will have on adjacent structure.

(e) Decide on whether repair can be deferred or whether damage should be fixed and what the condition of the deferred or repaired damage would be.

(f) The fin is attached to the tail boom in Bays 13 and 14 of Figure 4-20. Damage in these bays to the tail boom or fin may result in structural deformation or structural deflections under flight conditions that may prevent operation of the driveshaft to the tail rotor. Availability of tail rotor control will determine if the aircraft frame is in condition 1, 2, or 3.

(g) The areas around the tail boom/fin attachment and around the tail rotor attachment are particularly sensitive since the tail rotor gearboxes are mounted in these areas. If the structure supporting the gearboxes is damaged and deformed such that gearbox alignment is disturbed. the driveshafts will probably bind.

(3) Damage limits.

(a) Because ground fire aiming sometimes does not fully account for aircraft speed, the rear of the aircraft is more susceptible to combat damage than the front.

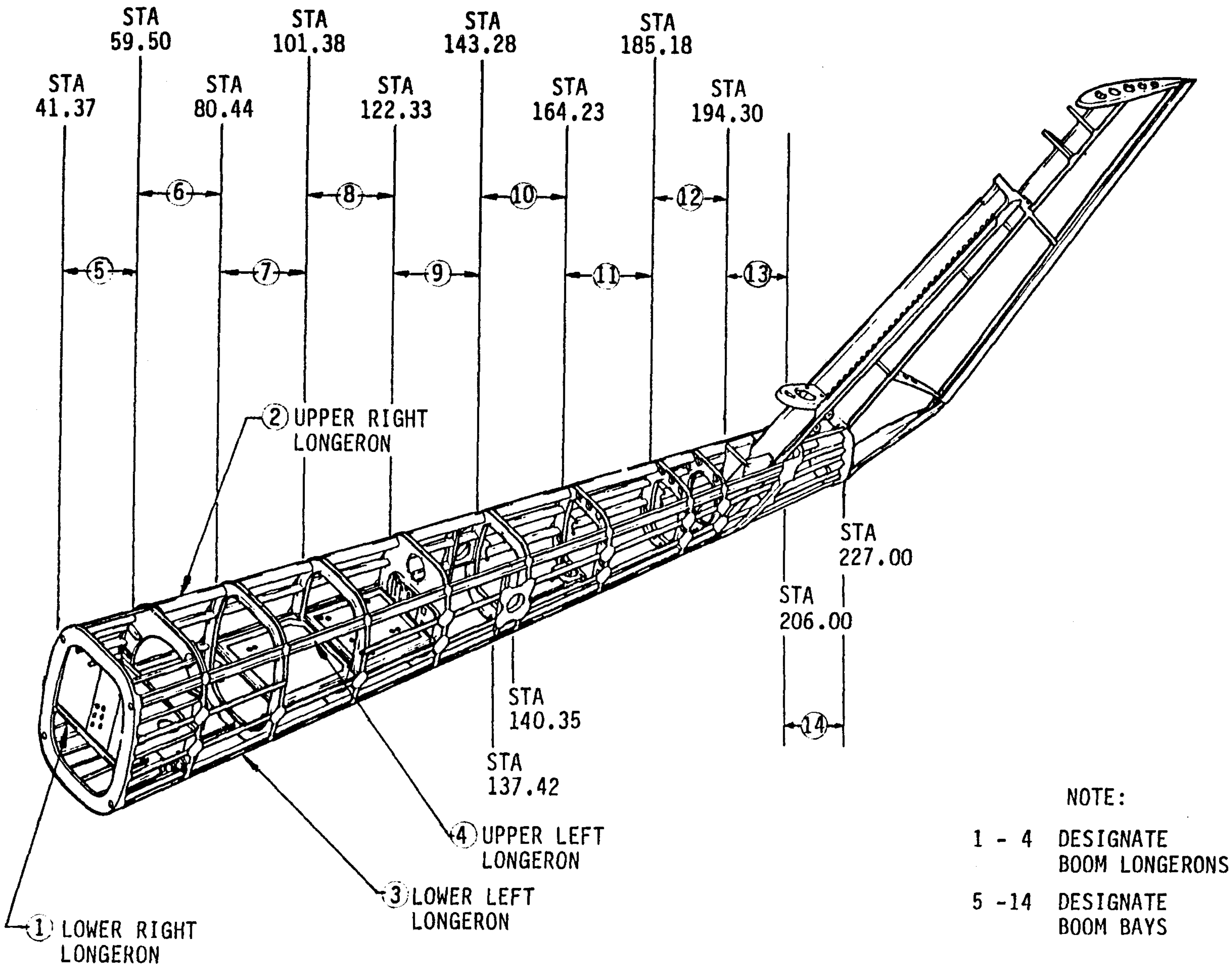
(b) Tail boom caps, bulkhead flanges (between caps), fin spar caps, and fin trailing edge.

1 Mark damage to continuous structural elements on Figures 4-20 and 4-21. The main continuous structural members are identified by bubble numbers.

2 Condition 1.

a The damage limits for condition 1 for the tail boom longerons, BS 41.37 to 194.30, are shown in Table 4-3. The damage limits are given in terms of CL', CD', and D'.

b If there is structural damage to the tail boom between BS 194.30 and 227.00 or to the fin but the fin does not visibly deflect under full rotor power and operation is normal, repair may be deferred and the aircraft released to fly in condition 1. Some cleanup and covering of openings may be required for aerodynamic purposes or to keep water out.

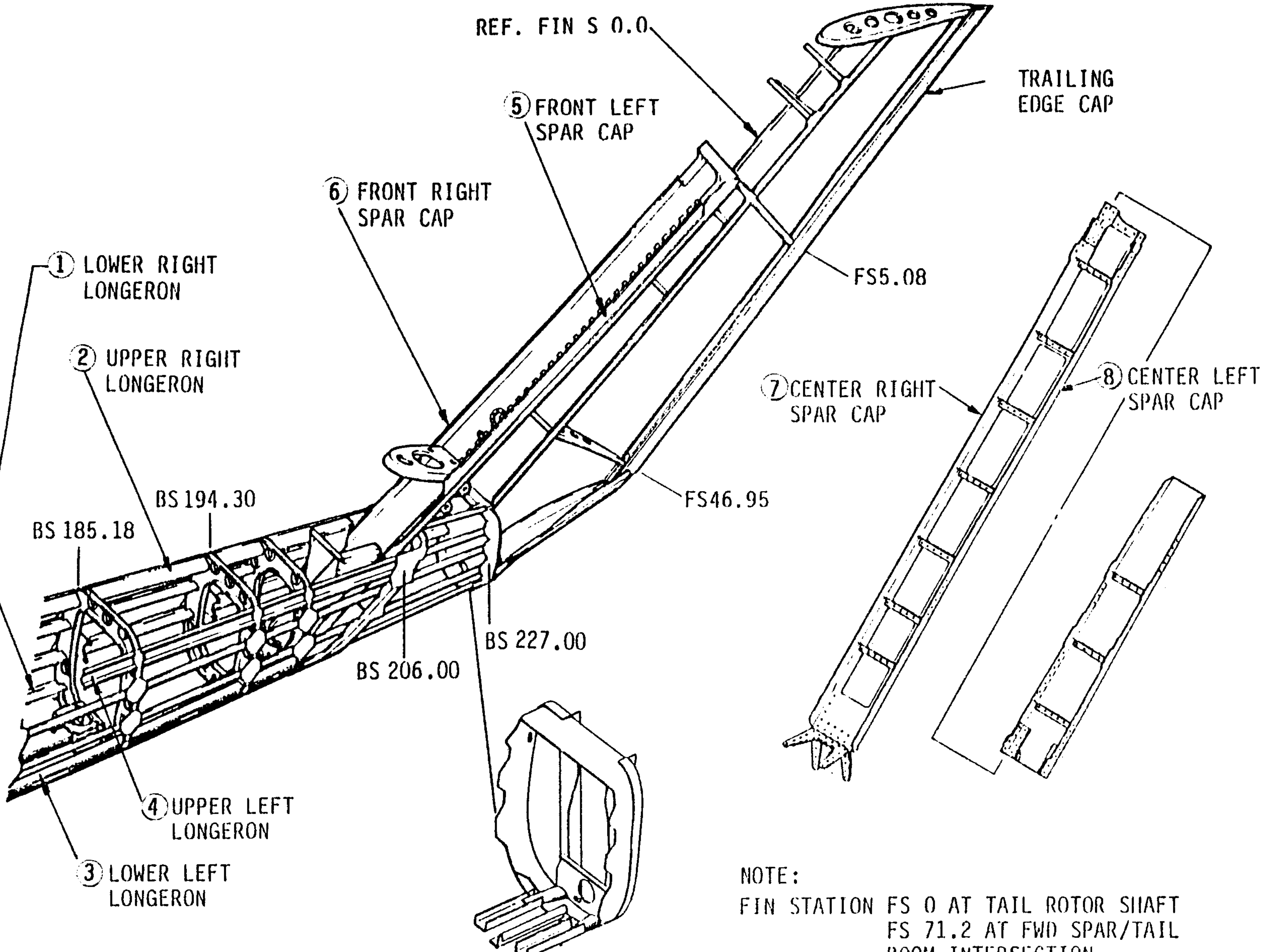



NOTE:

1 - 4 DESIGNATE BOOM LONGERONS

5 -14 DESIGNATE BOOM BAYS

Figure 4-20. Tail Boom




NOTE:
FIN STATION FS 0 AT TAIL ROTOR SHAFT
FS 71.2 AT FWD SPAR/TAIL BOOM INTERSECTION

Figure 4-21. Fin

**Table 4-3. Allowable Tail Boom Damage Limits-Condition 1, Tail Boom Longerons**

| TAIL BOOM STATION | UPPER LEFT LONGERON DAMAGE | | | | UPPER RIGHT LONGERON DAMAGE | | | |
|---|---|---|---|---|---|---|---|---|
| | LENGTH CL' | DEPTH CD' | REMAIN-ING CS' (3) | DISTANCE D' (2) D'=NxCL' | LENGTH CL' | DEPTH CD' | REMAIN-ING CS' (3) | DISTANCE D'(2) D'=NxCL' |
| 41.37- 59.50 | 4.0 | 2.0 | 4.57 | 10 | 4.0 | 3.0 | 3.57 | 10 |
| 59.50- 80.44 | 4.0 | 3.0 | 3.57 | 10 | 4.0 | 3.0 | 3.57 | 10 |
| 80.44-101.38 | 1.6 | .80 | 5.77 | 8 | 4.0 | 2.7 | 3.87 | 10 |
| 101.38-122.33 | 2.4 | 1.2 | 5.37 | 10 | 4.0 | 2.7 | 3.87 | 10 |
| 122.33-143.28 | 4.0 | 2.4 | 4.17 | 10 | 4.0 | 2.6 | 3.97 | 10 |
| 143.28-164.23 | 4.0 | 2.7 | 3.87 | 10 | 4.0 | 2.8 | 3.77 | 10 |
| 164.23-185.18 | 4.0 | 3.0 | 3.57 | 10 | 4.0 | 3.0 | 3.57 | 10 |
| 185.18-194.30 | 4.0 | 3.0 | 3.57 | 10 | 4.0 | 3.0 | 3.57 | 10 |
| 194.30-227.00 | See paragraph 4-2.f(3)(b) | | | | | | | |
| | LOWER LEFT LONGERON DAMAGE | | | | LOWER RIGHT LONGERON DAMAGE | | | |
| | LENGTH CL' | DEPTH CD' | REMAIN-ING CS' (3) | DISTANCE D' (2) D'=NxCL' | LENGTH CL' | DEPTH CD' | REMAIN-ING CS' (3) | DISTANCE D' (2) D'=NxCL' |
| 41.37- 59.50 | 4.0 | 3.0 | 3.57 | 10 | 4.0 | 2.6 | 3.97 | 10 |
| 59.50- 80.44 | 4.0 | 2.2 | 4.37 | 10 | 2.2 | 1.1 | 5.47 | 10 |
| 80.44-101.38 | 3.4 | 1.7 | 4.87 | 10 | 1.4 | .7 | 5.87 | 7 |
| 101.38-122.33 | 4.0 | 2.3 | 4.27 | 10 | 1.0 | .5 | 6.07 | 5 |
| 122.33-143.28 | 4.0 | 2.9 | 3.67 | 10 | 2.6 | 1.3 | 5.27 | 10 |
| 143.28-164.23 | 4.0 | 3.0 | 3.57 | 10 | 3.4 | 1.7 | 4.87 | 10 |
| 164.23-185.18 | 4.0 | 3.0 | 3.57 | 10 | 4.0 | 2.3 | 4.27 | 10 |
| 185.18-194.30 | 4.0 | 3.0 | 3.57 | 10 | 4.0 | 2.7 | 3.87 | 10 |
| 194.30-227.00 | See paragraph 4-2.f(3)(b) | | | | | | | |

(1) All dimensions in inches. See Figure 4-3.
(2) The D limit may be waived if the CL′ values of both adjacent damages combined do not exceed the CL′ value for that member.
(3) Always measure CO. CS′ is an appromixate value and is listed here only as a reference dimension. CS′ (inches) is given in terms of “length of flattened cross section” as defined in Figure 4-4, and must include at least one flange and attached 3/4 inches of effective inner and outer skin.

3 Condition 2.

a Considerable damage to the longerons can be tolerated. If the lower right longeron is not damaged, any one of the other longerons can be completely severed in one place. Otherwise, the minimum allowable CS' for any longeron is 1.5 inches.

b With respect to the fin structure and the tail boom/fin attachment area, BS 194.30 to 227.00, the critical consideration is tail rotor operation. As long as the tail rotor provides sufficient control for condition 2 flight and the structural fractures do not grow, the airframe may be released for condition 2 flight.

(c) Stringers and Skin Panels.

1 Mark the damage to stringers and skin panels on Figures 4-20 and 4-21. A skin panel is bounded by a longeron and a stringer or two stringers and two frames. A bay is bounded by two longerons and two frames.

2 Condition 1.

a BS 41.37 to 59.50 and 194.30 to 227.06. Damage to a skin panel, WL, may neither exceed 1.5 inches nor one half the distance between frames (S, Figure 4-22) and the distance, D, between damages in adjoining panels must exceed 3 inches. See Figure 4-5 for measurement techniques. Stringer or frame damage, CD, may not exceed 50 percent of the length of the flattened stringer or effective frame cross section. For typical damage see Figure 4-23.

b BS 59.50 to 194.30. Two individual non-adjacent panels in different bays may be missing. Fifty percent of the length of the flattened cross section, CD, of bordering stringers of frames may be damaged provided that 75 percent of the skin to stringer or frame fasteners along adjacent panels are intact. Stringer or frame damage, CD, may not exceed 50 percent of the length of the flattened stringer or effective frame cross section.

3 Condition 2.

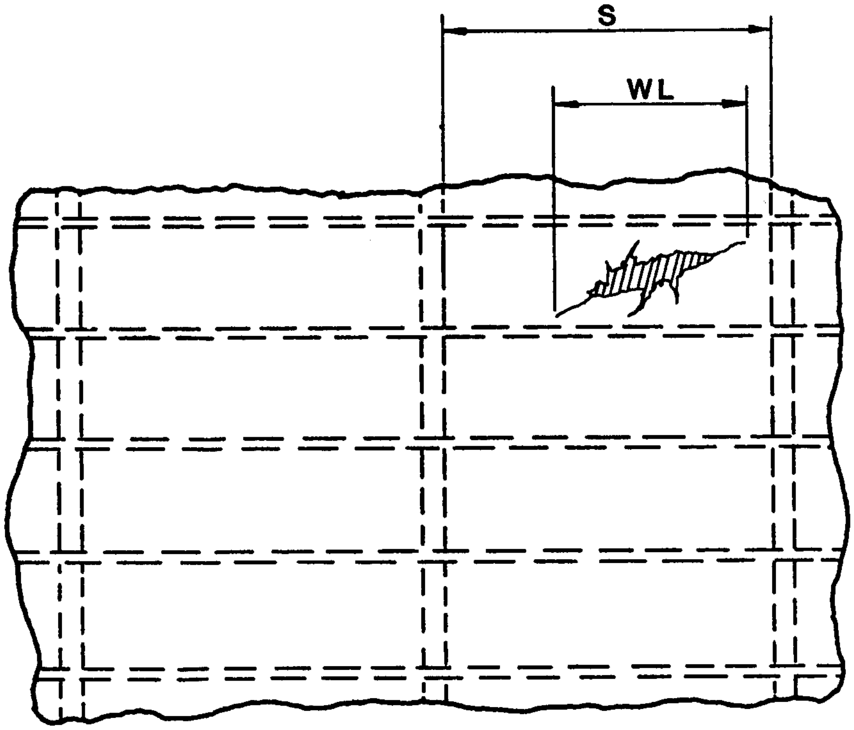
a Between BS 41.37 and 59.50 and 194.30 and 227.00, one skin panel may be missing. Other allowable damages are the same as paragraph 4-2.f(2)(b).

b Between BS 59.50 and 194.30, two complete adjacent bays may be missing provided the longerons are intact. Other damage to skin panels may not exceed 25 percent of the area of the panel, and stringers may be severed in connection with such damage.

4 Condition 3. The damage exceeds the allowable criteria listed for condition 2.

(d) Fin Panels. The fin panels consist of an honeycomb core sandwich and damage should be evaluated by the criteria given for the fuselage panels, paragraph 4-2.e(3)(b).

(e) Elevators. The elevators are not required for flight. If one elevator is badly damaged and cannot function and quick repair is not feasible, remove both elevators. However, without elevators, the SCAS system will not work so it should be disengaged at the pilot's or gunner's cyclic stick. It may be difficult to perform certain missions without the SCAS.




Note:THE MEASURED LONGITUDINAL DAMAGE MAY BE AN ACCUMULATION OF SEVERAL DAMAGES.

Figure 4-22. Skin Panel Damage WL Versus Frame Spacing S

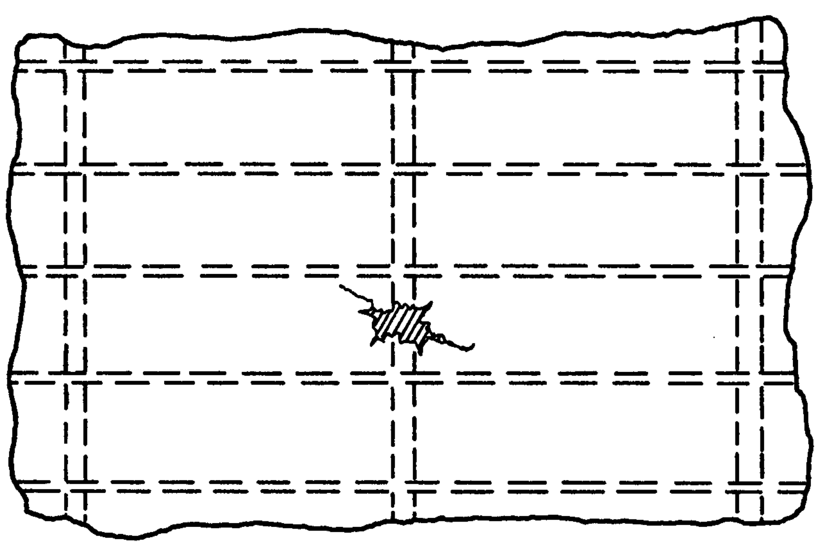


Figure 4-23. Typical Skin Panel and Frame Damage

g. Wing Damage Assessment

**WARNING**

- Prior to any helicopter maintenance functions that require external stores be removed, JETTISON cartridge shall be removed. Remove jettison cartridges from stores ejection device prior to placing helicopter in a hangar, to prevent injury to personnel and damage to equipment.

- Loaded weapons, or weapons being loaded or unloaded, shall be pointed in a direction which offers the least exposure to personnel or property in the event of accidental firing. Personnel shall remain clear of hazardous area of all loaded weapons.

- Ground safety pins must be installed in pilot and gunner arming/firing handles of canopy removal system whenever the helicopter is on the ground. Pins should be installed by crew.

(1) General Information.

(a) The wing is an airfoil section with three spars as shown in Figure 4-24. The spars are machined precision forgings of 7075-T3 aluminum alloy.

(b) The wing has two functions. Its main function is to support two pylon stations for mounting stores. As a secondary function, it includes a jacking point above the inboard pylon.

(c) The wing is designed primarily for stiffness as required by the weapon delivery system. Critical design conditions include recoil and flight fatigue and jacking. The wing is not necessary for flight; hence, no criteria for damage assessment can be made from a flight worthiness viewpoint.

(d) The forged spars are so heavy that small arms projectiles will probably do little damage. However, such a projectile could first hit the maze of stores hanging on the pylons and detonate before reaching the wing or even inside the wing. In this case, considerable damage could be done. Because accurate weapons delivery requires a stiff platform, any substantial damage to the wing structure cannot be deferred and the wing should be replaced.

## 4-3. REPAIR PROCEDURE INDEX.

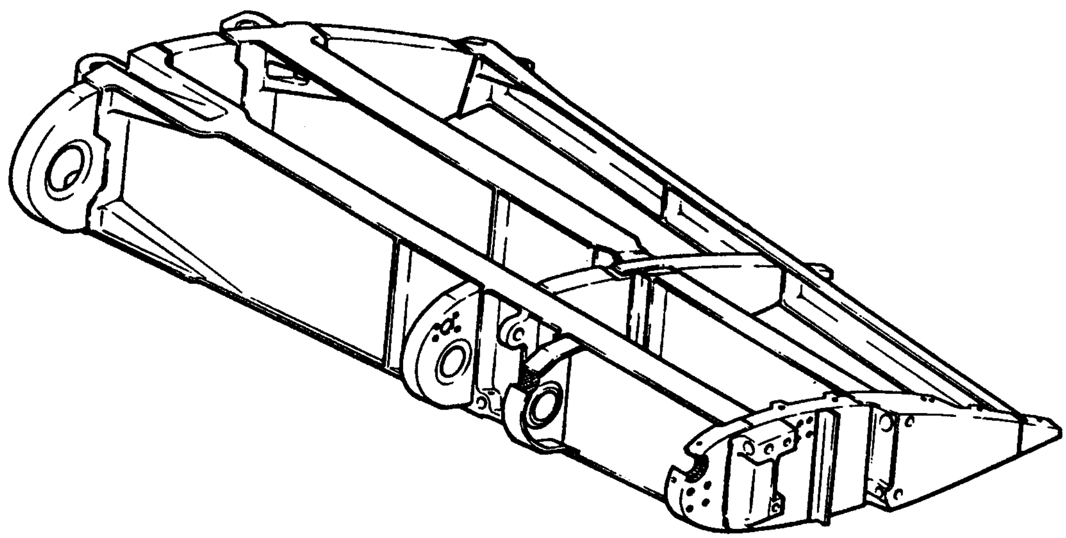


Figure 4-24. AH-1S Left Wing - Skins Removed

## Section II. AIRFRAME REPAIRS

4-4. GENERAL. Many of these repairs will restore the airframe to condition 1 although inspection for damage growth will generally be required after every flight, and damage should be repaired as soon as feasible by standard maintenance procedures. TM 55-1500-204-25/1 describes many structural repairs suitable for BDAR use.

a. Multiple Damage. Special attention should be given to structural components which have sustained damage in multiple locations. It is essential that damage to an individual structural item not be considered by itself. Suitable repair will often depend on the condition of the adjacent structure. In some cases undamaged adjacent structure may satisfactorily take the load of the damaged item. Since time is an overriding consideration on the battlefield, BDAR airframe repairs are usually performed on the outside of the aircraft to save the time required to gain access to the interior. If, however, access to the interior damaged structure is already available, inside BDAR repairs may be made.

b. Fasteners. BDAR can be carried out using any form of fastening device which is available at the time (e.g., nuts, bolts, and rivets, etc.), as long as strength requirements are met. Use accepted practices regarding fastener edge distance and spacing. The fasteners used in a single repair should be of the same type.

c. Metal Selection. All repair patches should be manufactured from material of the same or similar specification as the damaged area but at least one gage or 10 percent thicker. When required repair materials are unavailable, substitutions can often be made to produce a desired strength. Table D-9, Appendix D, lists metals and cross references factors for obtaining the equivalent strength using various other metals. Alternate repair materials can be obtained from scrapped aircraft. It is also permissible to fabricate from thinner gage material and use multiple thickness.

**WARNING**

- Compressed air can blow dust into the eyes. Wear eye protection. Do not exceed 30 psig air pressure.

- Sound pressure levels in this aircraft during some operating conditions exceed the Surgeon General's hearing conservation criteria, as defined in TB MED 501. Hearing protection devices such as aviator helmet or ear plugs are required to be worn by all personnel in and around the aircraft during its operation.

**WARNING**

- Sanding on reinforced laminated glass produces fine dust that may cause skin and lung irritations. Observe necessary protection measures.

- Lifting or moving heavy equipment incorrectly can cause serious injury. Do not try to lift or move more than 50 pounds by yourself. Get an assistant. Bend legs while lifting. Do not support heavy weight with your back. Always use assistants during lifting operations. Use guide ropes to move hanging assemblies. Lack of attention or being in an improper position during lifting operations can result in serious injury. Pay close attention to movements of assemblies being lifted. Do not stand under lifted assembly or in a position where you could be pinned against another object. Watch your footing.

**NOTE**

- Steel and aluminum are incompatible materials and normally require special precautions to prevent electrolysis corrosion. However, for BDAR, this is an acceptable materials mix.

- Refinements to patch repairs such as countersunk fasteners, chamfered edges, anti-corrosive treatment and radius corners of the patches are unnecessary.

**WARNING**

Battle damaged areas should be inspected for unexploded ordnance before attempting repairs. Disposal of unexploded ordnance should be accomplished by qualified EOD personnel.

## 4-5. FORMER DAMAGE.

**GENERAL INFORMATION.** One method to create a complex curve in a normally straight angle or T-angle member is to place appropriate cuts and stop drill holes to allow bends as given in Figures 4-25 and 4-26. This field expedient procedure will allow former repair from stray stock.

**OPTION 1:** Fabricate Former with Large Radius.

**LIMITATIONS:** None

**PERSONNEL/TIME REQUIRED:**
- 2 Soldiers
- 2 Hours

MATERIALS/TOOLS REQUIRED:
- T or 90° Angle Stock (items 35-48, App. C)
- Stock (items 131-142, App. C)
- Fasteners (item 8-24, 63-70, or 98-114, App. C)
- Drill and Bit
- Structures Repair Kit (item 12, App. B)

PROCEDURAL STEPS:

1. Cut and hand form angle stock as shown in Figure 4-25.

2. Cut Sheet stock as shown in Figure 4-25.

3. Hold sheet and angles in place on aircraft and drill proper size fastener holes.

4. Install fasteners.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

OPTION 2: Fabricate Former with Small, Complex Radius/Bends.

LIMITATIONS: None

PERSONNEL/TIME REQUIRED:
- 2 Soliders
- 2 Hours

MATERIALS/TOOLS REQUIRED:
- T or 90° Angle Stock (items 35-48, App. C)
- Fasteners (items 8-24, 63-70, or 98-114, App. C)
- Drill and Bit
- Structures Repair Kit (item 12, App. B)

PROCEDURAL STEPS:

1. Measure damaged former with flexible tape or rule.

2. Cut equivalent length of T or angle stock to suit.

3. Drill and cut stock as shown in Figure 4-26.

4. Bend fabricated former to fit aircraft damaged area.

5. Hold fabricated former in place and drill mounting holes.

6. Install fasteners.

7. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

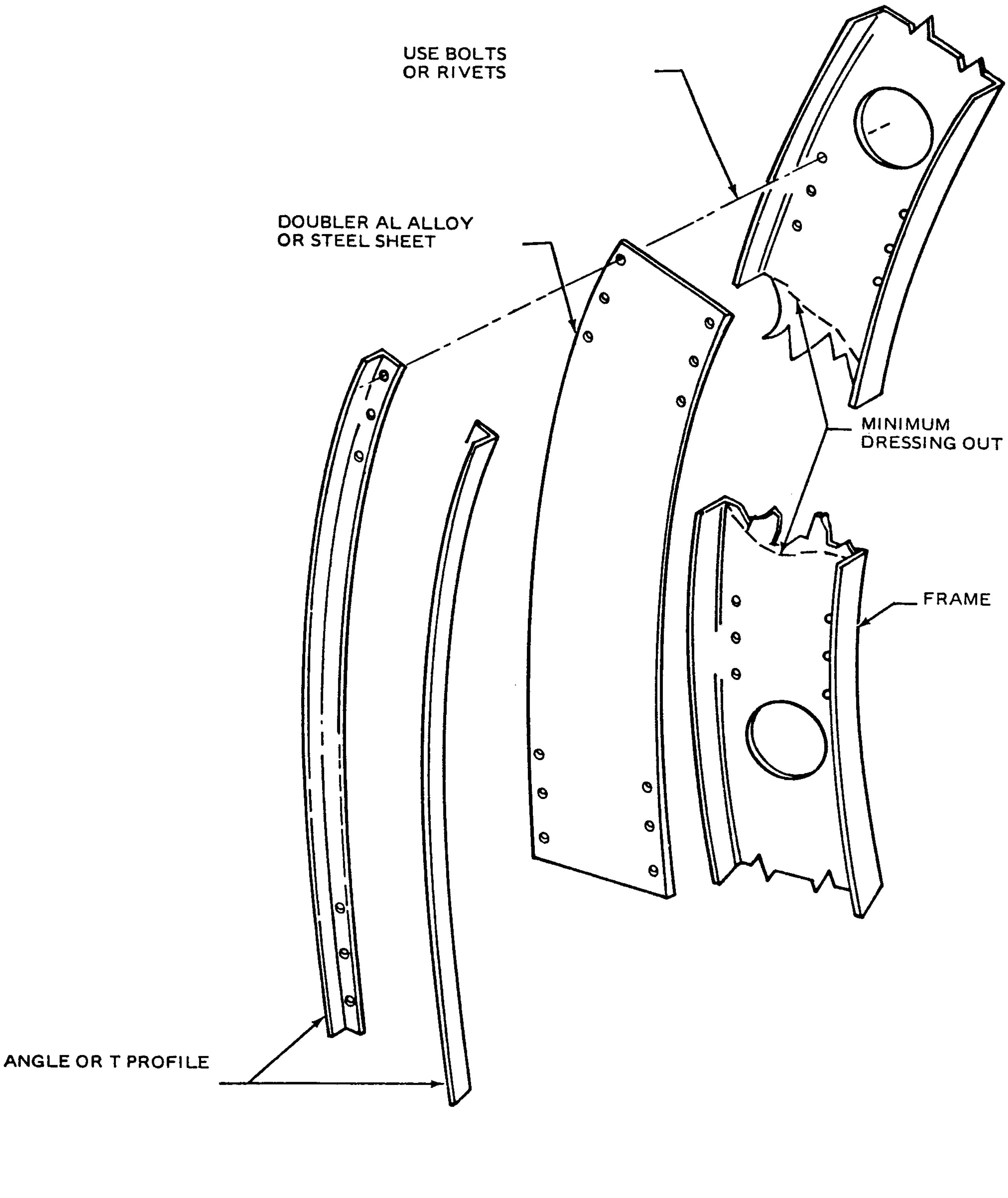



Figure 4-25. Typical Former Repair

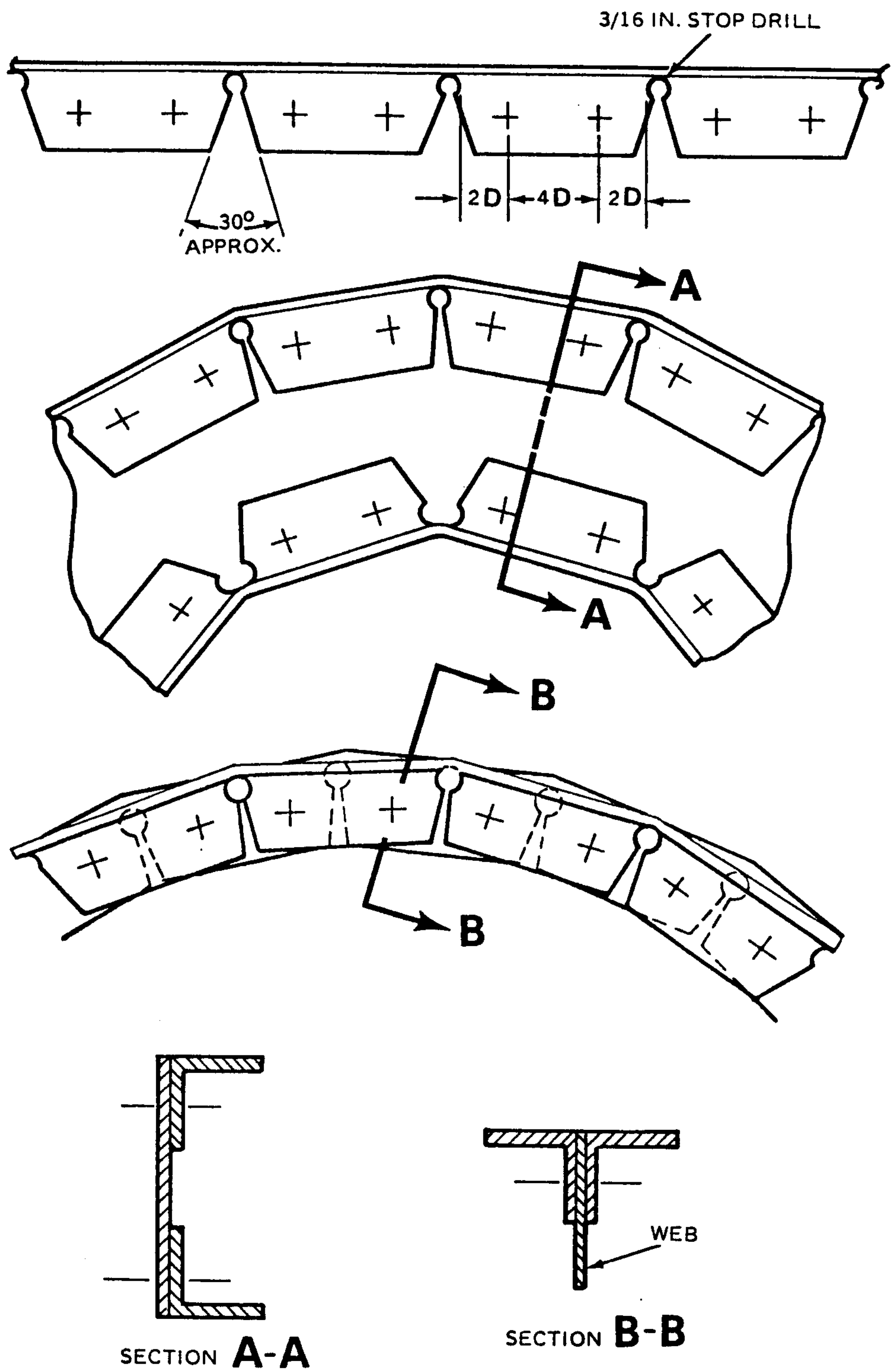



Figure 4-26. Cut and Drill Former Repair

## 4-6. SKIN-STIFFENER DAMAGE.

**GENERAL INFORMATION:** These repairs are applicable to any skin-stiffener structure such as the tail boom, fairings, and many secondary structures other than sandwich construction.

**OPTION 1:** Patch Plate and Substitute Stiffener/-Stringer.

**LIMITATIONS:** None – Condition 1. Inspect after every flight for damage growth.

**PERSONNEL/TIME REQUIRED:**
- 2 Soldiers
- 2 Hours

**MATERIAL/TOOLS REQUIRED:**
- Substitute Stiffener or Stringer (items 35-48, App. C)
- Skin Patch Metal (items 131-139, App. C)
- Drill and Bit
- Rivets (items 98-115, App. C)
- Structures Repair Kit (item 12, App. B)

**PROCEDURAL STEPS:**

1. With sheet metal snips, cut hole in sheet including all cracks. Do not cut stringers but cut off ragged ends, Figure 4-27.

2. Make a patch plate. Plate should be as strong or stronger than original skin. Overlap the hole at least 1-1/2 inches on all sides, Figure 4-28.

3. Cut a piece of substitute stringer or stiffener to extend at least 10 inches on each side of damaged section. Sometimes a single substitute stringer or stiffener can be extended to provide support for several damages. This is better than individual repairs, as it will stiffen the airframe.

4. In the areas where the substitute stringer/stiffener will overlap on the damaged stringer/stiffener, sections, remove rivets which attach the damaged stringer/stiffener to skin.

5. Drill rivet holes on the substitute stringer/stiffener and the installed skin patch to match the existing rivet holes of the damaged stringer/stiffener.

6. Rivet the substitute stringer/stiffener in place. Stiffener can be placed on outside; however, this configuration is nonpreferred.

7. Rivet patch plate over hole using rivets.

8. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Tape Repair.

**LIMITATIONS:** Repair may only be used on secondary structure to keep moisture out. No damage to stringer/stiffener allowed.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 10 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Green Tape or Aluminum Tape (item 150 or 153, App. C)
- Brush (item 25, App. C)
- Sand Paper (items 117-121, App. C)

**PROCEDURAL STEP:**

1. Smooth off ragged edges on damaged skin.

2. Tape over hole. Use several layers as necessary and overlap onto skin well beyond damaged area.

3 Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

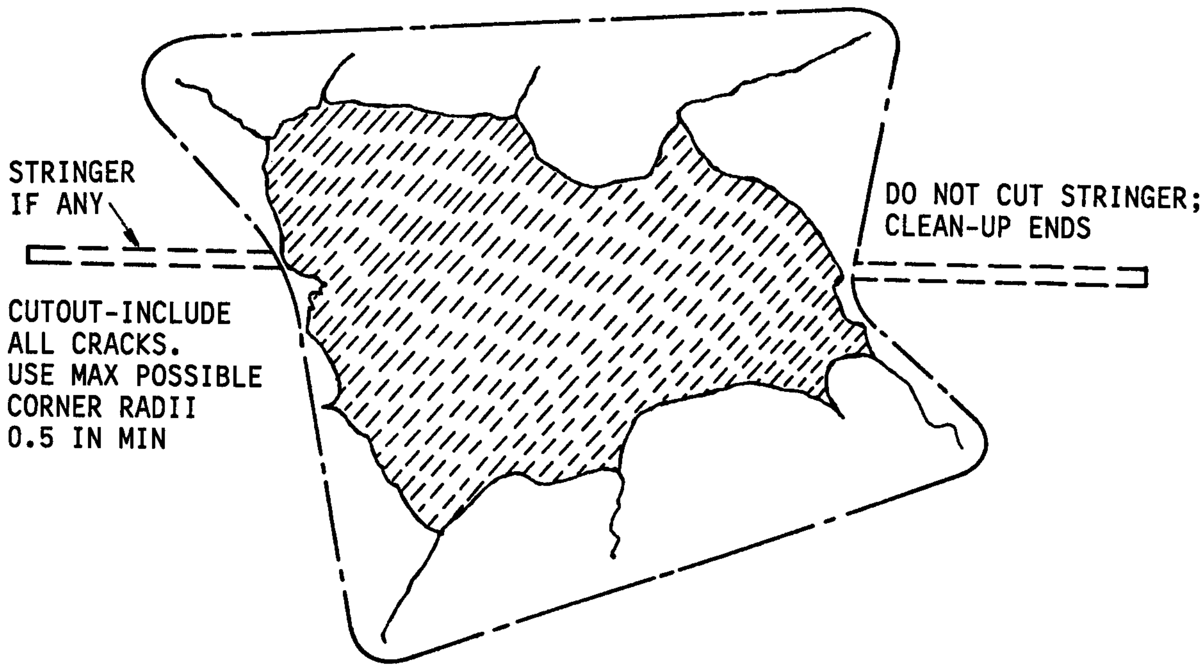



Figure 4-27. Cutout in Damaged Skin

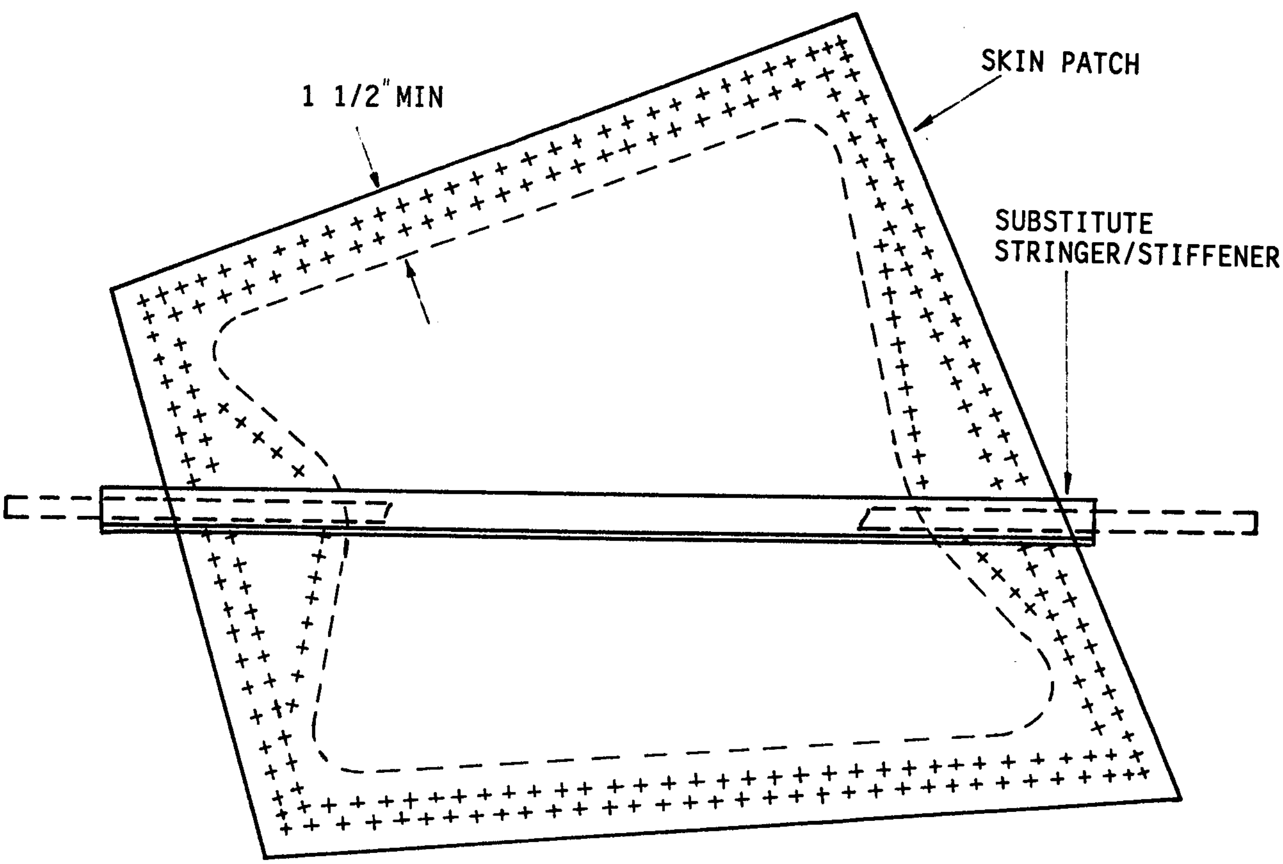



Figure 4-28. Stringer/Stiffener Repair

## 4-7. CAP/LONGERON, DAMAGE.

**GENERAL INFORMATION:** Non-deferrable cap/longeron damage may be substantial, combined with skin damage. It will generally be necessary to repair the cap and longeron first and then the skin. It may not be necessary to repair the skin for structural reasons, but generally skin repair is recommended to make a watertight repair.

**LIMITATIONS:** None – Condition 1. Inspect after every flight for damage growth.

**PERSONNEL/TIME REQUIRED:**

Ž 2 Soldiers
Ž 2 Hours

**MATERIAL/TOOLS REQUIRED:**

- Rivets (items 98-115, App. C)
- Riveter (items 8-10, App. B)
- Drill and Bit
- Structures Repair Kit (item 12, App. B)

**NOTE**

Cap/Longeron - Sections used in outside repairs should be angular. The strength of the new cap/longeron (or caps, if 2 are used) should be at least that of the damaged cap/longeron. Refer to App. D for substitute materials to use on repair if a cap/longeron section is not available.

**PROCEDURAL STEPS:**

1. With sheet metal snips, cut hole In sheet including all cracks. Do not cut cap/longeron but cut off ragged ends, Figure 4-29.

2. Make a patch plate. Plate should be as strong or stronger than original skin. Overlap the hole at least 1-1/2 inches on all sides.

3. Cut a piece of substitute cap/longeron to extend at least 10 inches each side of damaged section. Sometimes a single substitute cap/longeron can be extended to provide support for several damages. This is better than individual repairs, as it will stiffen the airframe.

4. In the areas where the substitute cap/longeron will overlap on the damaged cap/longeron sections, remove rivets which attach the damaged cap/longeron to skin.

5. Rivet the substitute cap/longeron in place, using the same size rivets as those removed in step 4.

6. Rivet patch plate over hole using rivets, 2 rivet diameters (2D) minimum edge distance. If possible, apply sealant to edge of patch plate on side against skin to assure water tight seal.

7. Drill rivet holes on the substitute cap/longeron and the installed patch plate to match the existing rivet holes of the damaged cap/longeron. (Rivets previously removed in step 4.)

8. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## 4-8. FRAME OR BULKHEAD, DAMAGE.

**GENERAL INFORMATION:** A damaged flange on a bulkhead or frame could be repaired from the outside in the same way as is a cap/longeron. However, it is not desirable to have a section on the outside of the aircraft sticking out normal to the airstream. Frame flanges are therefore repaired by applying a strap over the damage. If the damage to a highly loaded bulkhead is severe, then treat it like a cap and let the section stick out in the airstream. Only the front one third of the aircraft is really important to aerodynamics.

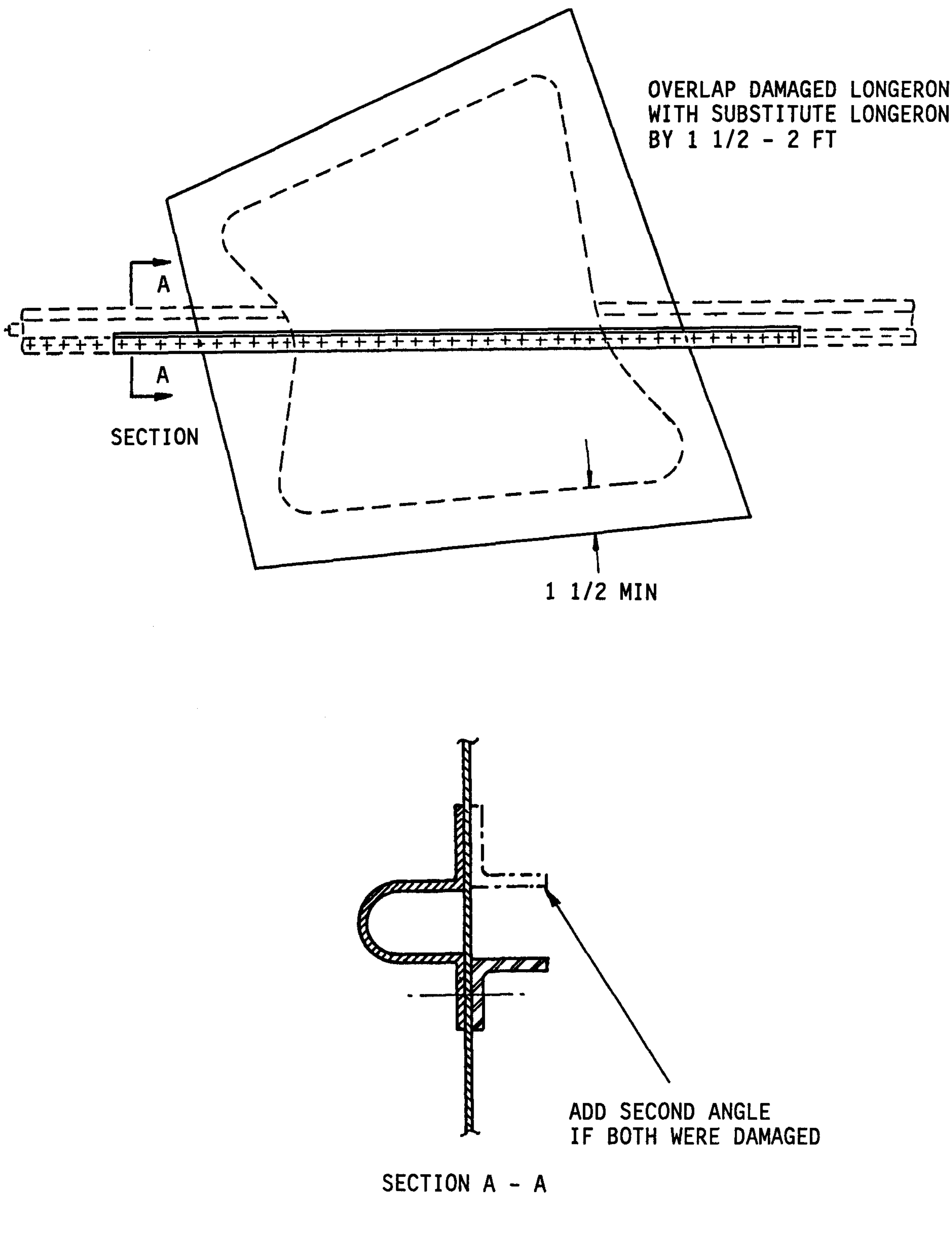



Figure 4-29. Expedient Cap/Longeron Repair

**OPTION 1:** Fabricated Repair Strap.

**LIMITATIONS:** None – Condition 1.
Inspect after every flight.

**PERSONNEL/TIME REQUIRED:**
- 2 soldiers
- 2 Hours

**MATERIALS/TOOLS REQUIRED:**
- Sheet Metal (items 131-142, App. C)
- Rivets (items 98-115, App. C)
- Riveter (items 8-10, App. B)
- Drill and Bit
- Tape (item 153, App. C)
- Sheet Metal Snips
- Structures Repair Kit (item 12, App. B)

**PROCEDURAL STEPS:**

1. Drill small stop holes at the ends of all cracks, Figure 4-30.

2. Cover the damage with tape. Be sure to cover the ends of all cracks.

3. Fabricate a repair strap using sheet metal. The sheet metal should be 2 times thickness of the original flange material. The repair strap should overlap both ends of the damaged bulkhead flange to allow for 2 rows of fasteners. Apply a skin patch first as follows:

a. Make a patch plate. Plate should overlap the hole at least 1-1/2 inches on all sides.

b. Rivet patch plate over damaged skin using rivets at 2D minimum edge distance. If possible, apply some sealant to edge of patch plate on side against skin to assure water tightness.

4. Drill rivet holes along the center of the repair strap and installed patch plate to match the existing rivet holes of the damaged bulkhead flange.

5. Rivet the repair strap in place using the same size rivets as those removed. Refer to Figure 4-30.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Combination Repair for Major Frame or Bulkhead Damage.

**LIMITATIONS:** None - Condition 1.
Inspect after every flight.

**PERSONNEL/TIME REQUIRED:**
- 2 Soldiers
- 3 Hours

**MATERIALS/TOOLS REQUIRED:**
- Sheet Metal (items 131-142, App. C)
- Brush (item 25, App. C)
- Rivets (items 98-115, App. C)
- Structures Repair Kit (item 12, App. B)

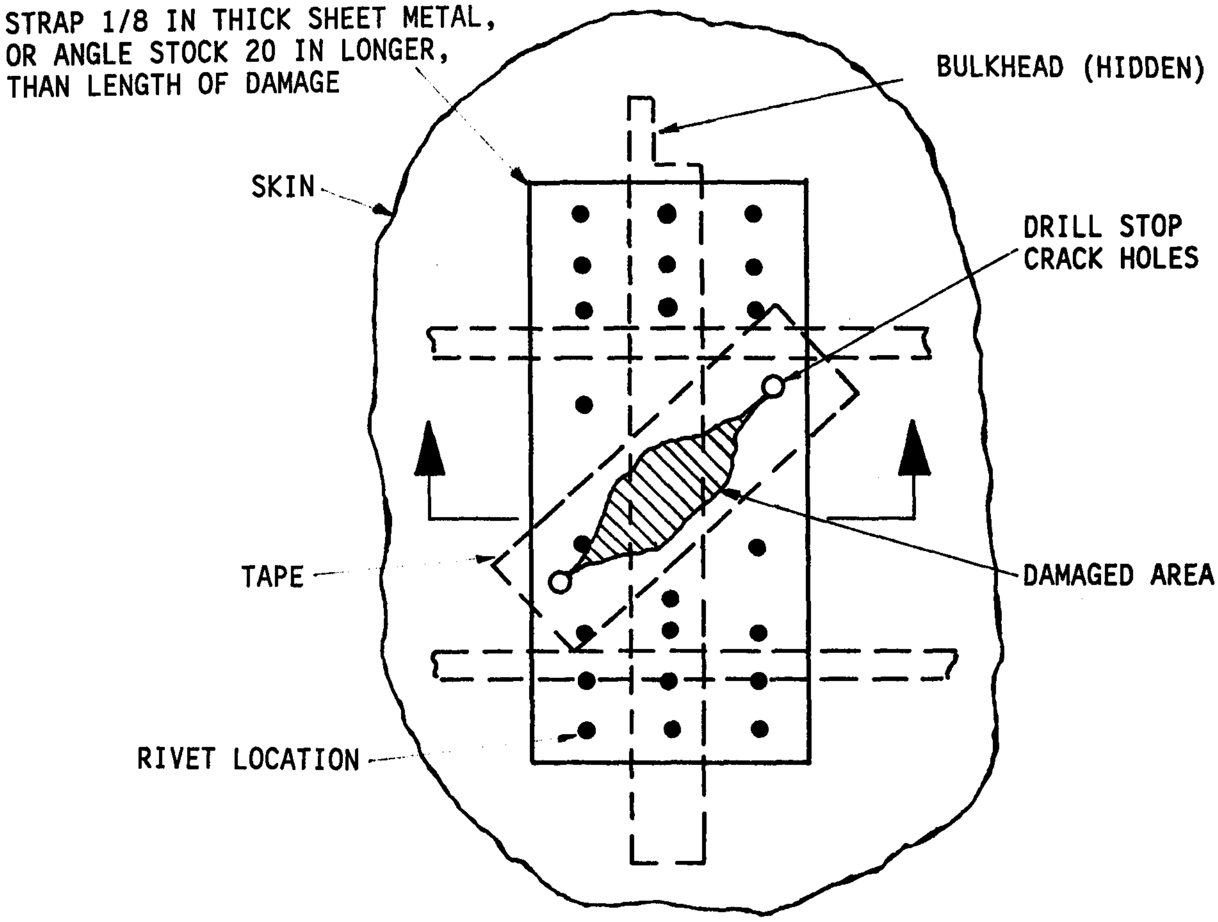
**PROCEDURAL STEPS:**

1. Remove sections of the skin and frame or bulkhead containing the damage. Smooth and round the cutouts, Figures 4-31 and 4-32.

2. Cut and fit repair doubler for frame or bulkhead. Cut skin patch allowing overlap for at least two rows of rivets. Repair patch and doubler should be the same material and one gage thicker than original material.

3. Remove existing rivets where the repair parts will overlap existing rivets if the area is accessible for back drilling holes. If not, install rivets between existing rivets if space permits.

4. Rivet the repair parts in place using original diameter rivets or larger if necessary.



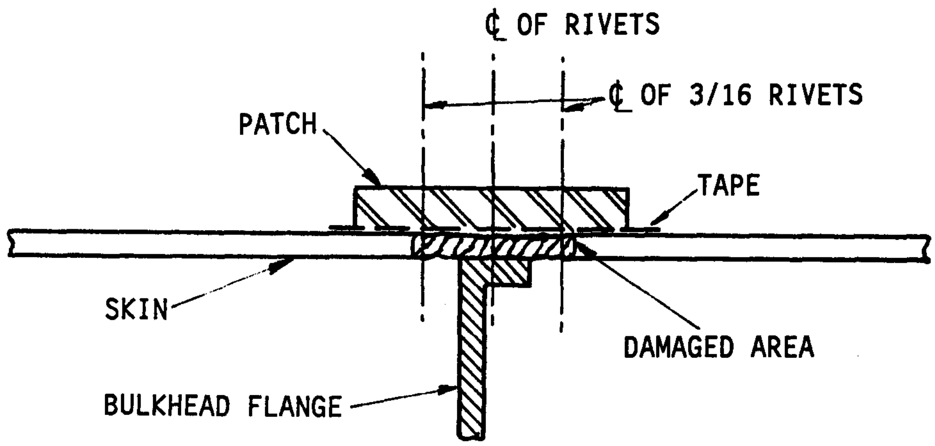




Figure 4-30. Repair of Damaged Bulkhead Flange

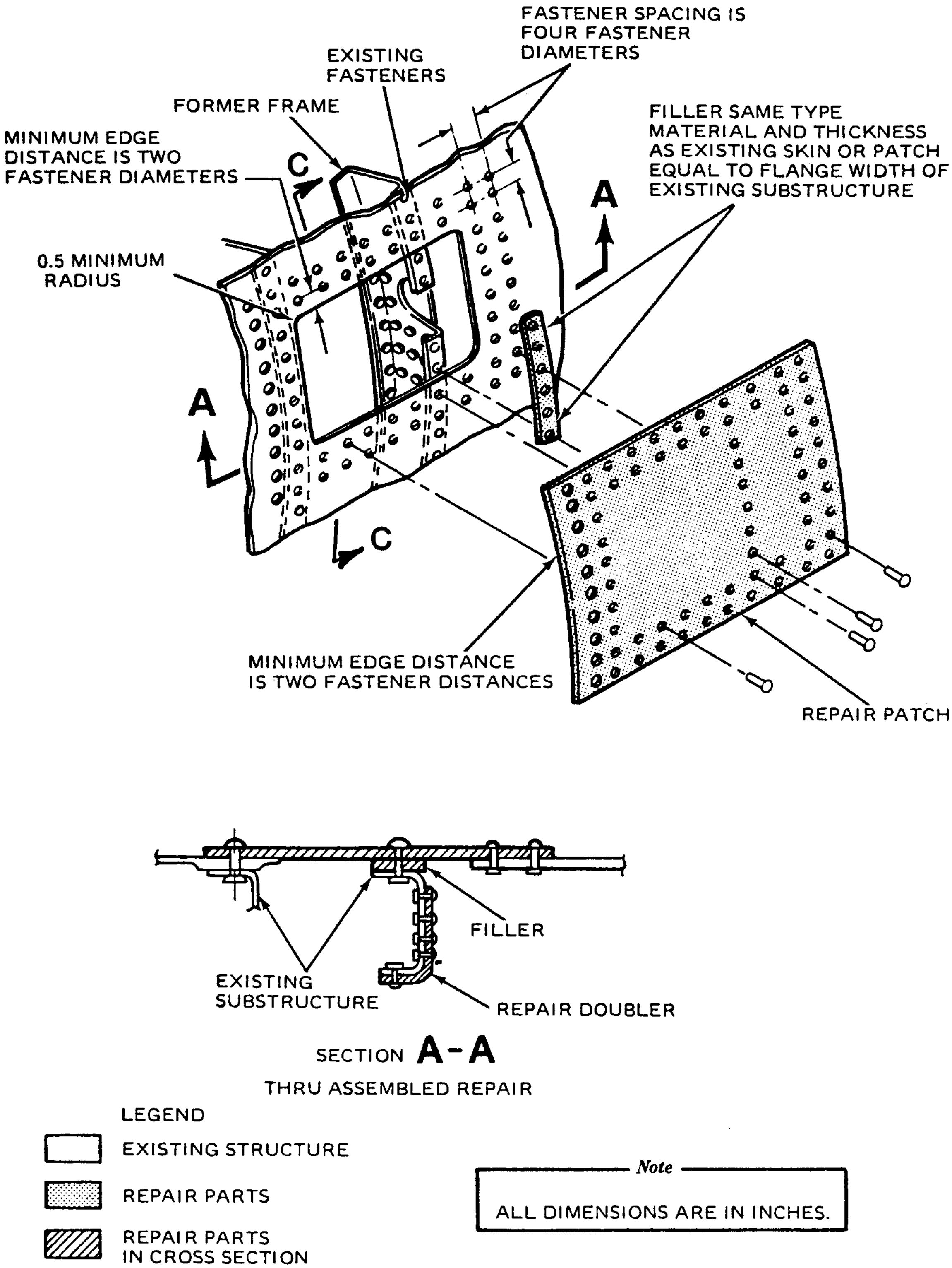



Figure 4-31. Typical Combination Repair (Angle View)

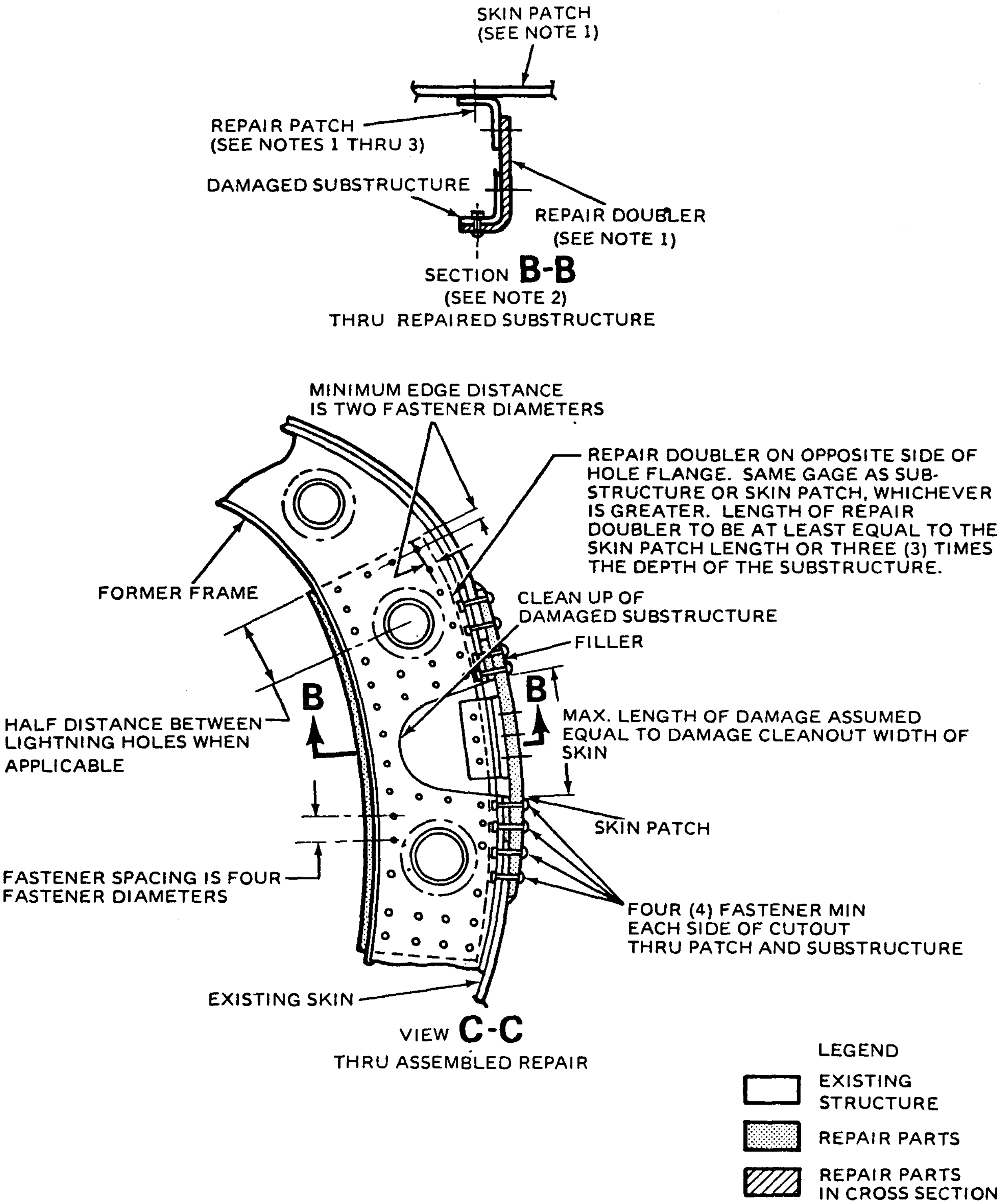



Figure 4-32. Typical Combination Repair (Side View)

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

### 4-9. HONEYCOMB CORE FLOOR/PANEL DAMAGE.

**GENERAL INFORMATION:**

a. Most of the floors, decks, side panels in the fuselage, and the fin panels are honeycomb core structures.

b. Various repair options are given for a range of damage size.

**OPTION 1:** Small Damage to One or Both Skins and Core (1 inch max. in any direction).

**LIMITATIONS:** Procedure is designed only to keep moisture out. No additional strength has been added.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1/4 Hour

**MATERIALS/TOOLS REQUIRED:**
- Green Tape or Aluminum Tape (item 150 or 153, App. C)

**PROCEDURAL STEPS:**

1. Apply tape over repair to keep out moisture, Figure 4-33.

2. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** 2 to 8 Inch Damage (One Skin and Core).

**LIMITATIONS:** None

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1-1/2 Hours

**MATERIALS/TOOLS REQUIRED:**
- Drill and Bit
- Router
- Metal Set or Equivalent Filler (item 4 or 127, App. C)
- Patch Plate Metal (items 131-142, App. C)
- Rivets (items 98-115, App. C)
- Riveter (items 8-10, App. B)
- Solvent (item 7 or 129, App. C)
- Structures Repair Kit (item 12, App. B)

**PROCEDURAL STEPS:**

1. Remove damaged skin and core, Figure 4-34. Clean surface 6 inches around holes with cleaner. The maximum damaged area that may be cut out is 8 inches.

2. Make a patch plate as shown in Figure 4-35. Make plate 2 inches larger than cutout. Lay out and drill rivet pattern.

3. Completely fill void with metal set fill compound. Add slight excess to allow for shrinkage.

4. Assemble patch plate to panel with rivets.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 3:** 2 to 8 Inch Damage to Both Skins and Core.

**LIMITATIONS:** None

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 2 Hours

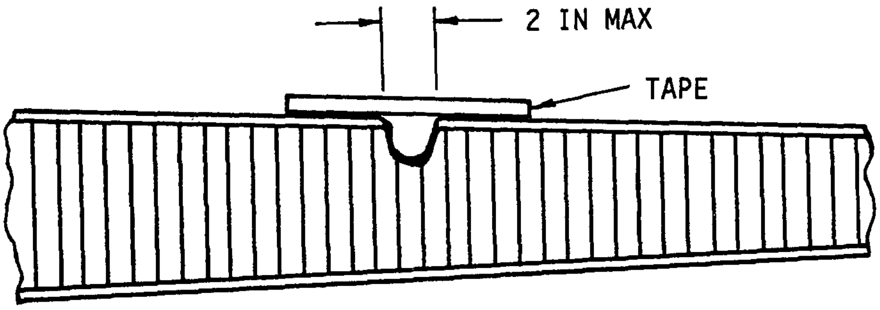



Figure 4-33. Damaged Honeycomb Core Panel - Small Damage to One Skin and Core

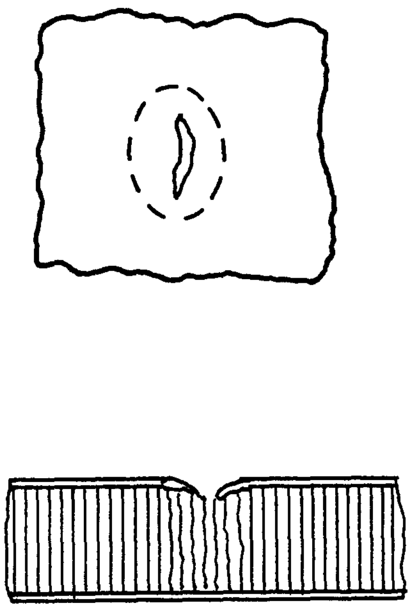


Figure 4-34. Damaged Honeycomb Core Panel, 2-8 Inch Damage - One Skin and Core

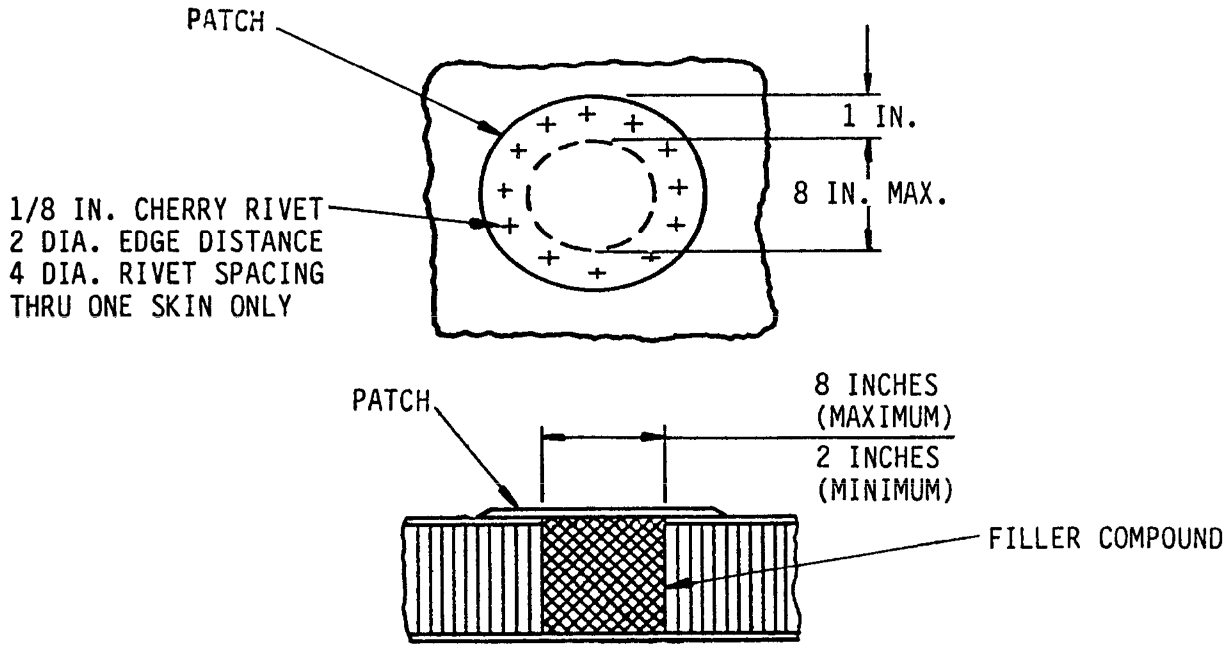



Figure 4-35. Repaired Honeycomb Core Panel, 2-8 Inch Damage-One Skin and Core

**MATERIALS/TOOLS REQUIRED:**

- Drill with Bit
- Router
- Metal Set or Equivalent Filler (item 4 or 127, App. C)
- Patch Plate Metal (items 131-142, App. C)
- Rivets (items 98-115, App. C)
- Riveter (items 8-10, App. B)
- Solvent (item 7 or 129, App. C)
- Structures Repair Kit (item 12, App. B)

**PROCEDURAL STEPS:**

1. Remove damaged skin and core, Figure 4-36. Clean top and bottom skins 6 inches around holes with cleaner. The maximum damaged area that may be cut out is 8 inches.

2. Make two patch plates as shown in Figure 4-37, Make plates 2 inches larger than the cutout. Lay out and drill rivet pattern.

3. Apply sealant to the area between patch plate and panel. Assemble it to the lower skin with rivets.

4. Completely fill void with metal set fill compound. Add slight excess to allow for shrinkage.

5. Assemble plate on upper surface of panel with rivets.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

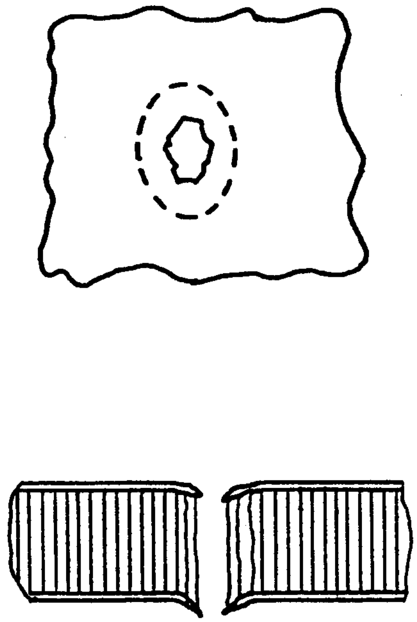


Figure 4-36. Damaged Honeycomb Core Panel, 2-8 Inch
Damage - Both Skins and Core

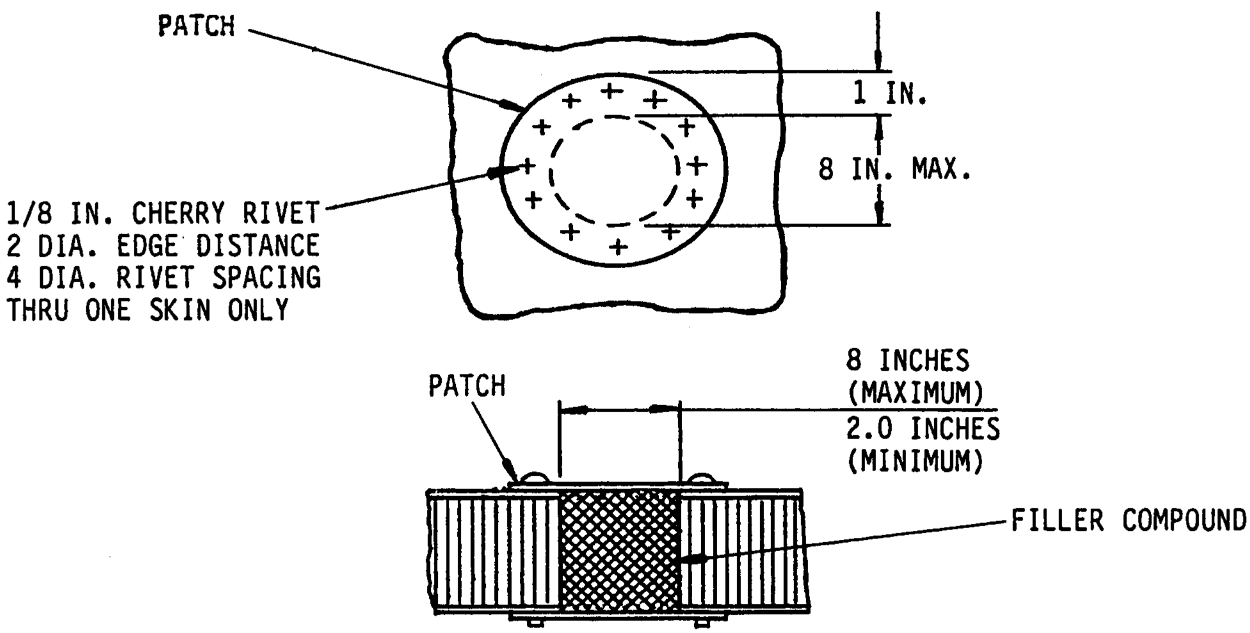



Figure 4-37. Repaired Honeycomb Core Panel, 2-8 Inch
Damage - Both Skins and Core

**OPTION 4:** Damage to Both Skins and Core, Only One Side of Panel is Accessible.

**LIMITATIONS:** None

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 2 Hours

**MATERIALS/TOOLS REQUIRED:**
- Drill and Bit
- Router
- Metal Set or Equivalent Filler (item 4 or 127, App. C)
- Patch Plate Metal (items 131-142, App. C)
- Rivets
- Riveter (items 8-10, App. B)
- Solvent (item 7 or 129, App. C)
- Structures Repair Kit (item 12, App. B)

**PROCEDURAL STEPS:**

1. Remove damaged skin and core using a router to route all damage on outer and inner skins. Enlarge the hole on the outer skin and honeycomb so that a one inch rim surface of the inner skin is exposed, as shown in Figure 4-38.

2. Make two patch plates. One patch plate for inner skin. The other for the outer skin, Figure 4-39.

**OPTION 5:** Damage Over 8 Inches to Both Skins and Core.

**LIMITATIONS:** None - Condition. Inspect after every flight.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 2 Hours

**MATERIALS/TOOLS REQUIRED:**
- Patch Plate Metal (items 131-142, App. C)
- Rivets (items 98-115, App. C)
- Riveter (items 8-10, App. B)

**PROCEDURAL STEPS:**

1. Remove damaged skin and core, Figure 4-40. The maximum damaged area that may be cut out is 12 inches.

2. Make two patch plates, 0.040 inch thick. Make plates two inches larger than the cutout. Lay out and drill a rivet pattern, two rows as shown. If damage is in an area where installing an interior patch is not possible or where sharp edges from rivets on an interior patch might cause damage (example for fuel cell panels), a single exterior patch plate, 0.050 inch, may be used.

3. Make a stiffener as shown in Figure 4-40. For damage exceeding 12 inches, install additional stiffeners at 6 inch maximum spacing. Assemble with rivets, 2D minimum edge distance.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

## 4-10. WINDSHIELD/WINDOW, DAMAGE.

**GENERAL INFORMATION:** Repairs to transparent plastics will provide good service if laced tight. Drill stop holes at the end of ALL cracks.

**OPTION:** Lacing with Safety-Wire.

**LIMITATIONS:** Restricted vision. Inspect after every flight for damage growth.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1 Hour

**MATERIALS/TOOLS REQUIRED:**
- Drill
- Safety Wire (items 60-62, App. C)
- Tape (item 153, App. C)
- Sealant (item 123-128, App. C)

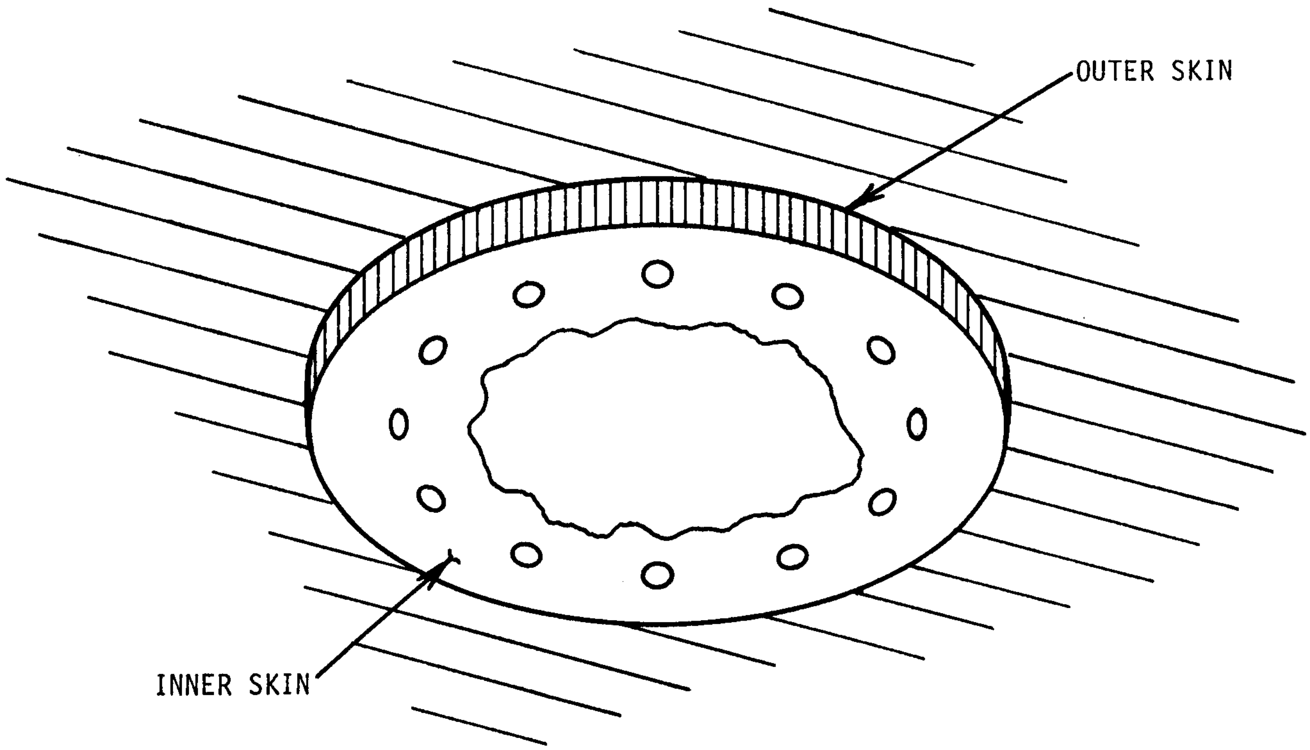



Figure 4-38. Damage Repair, Accessible One Side Only

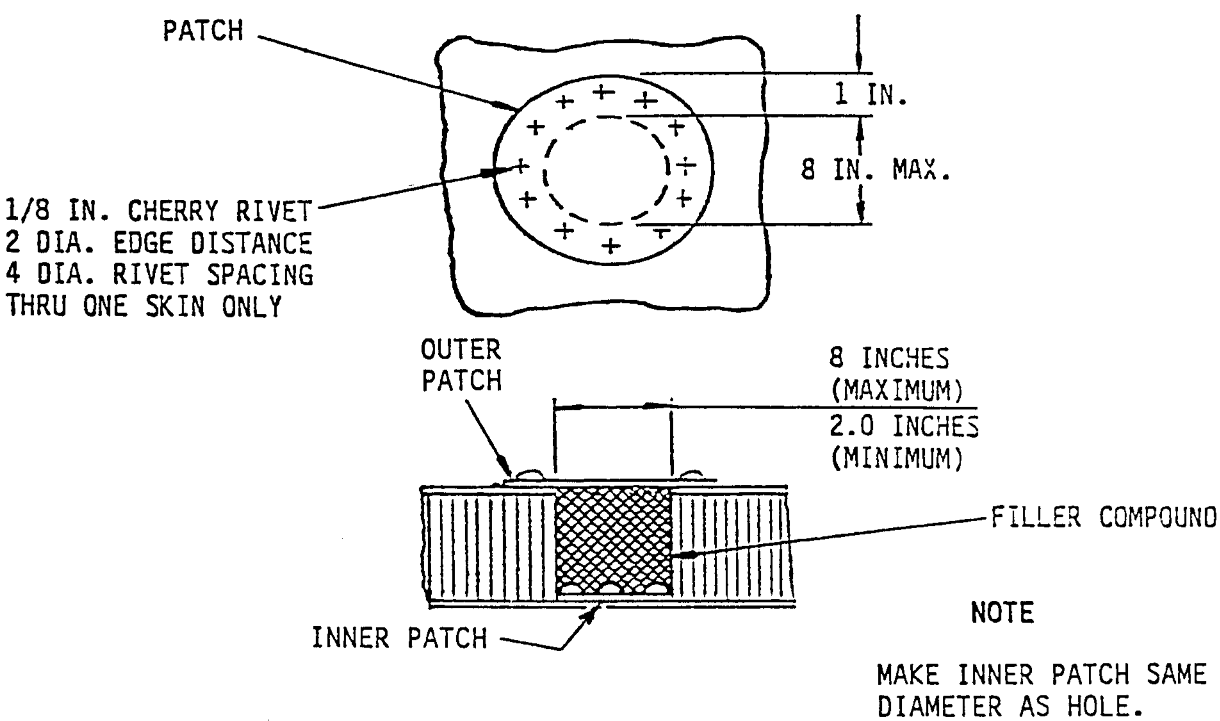



Figure 4-39. Fabrication of Patch Plate

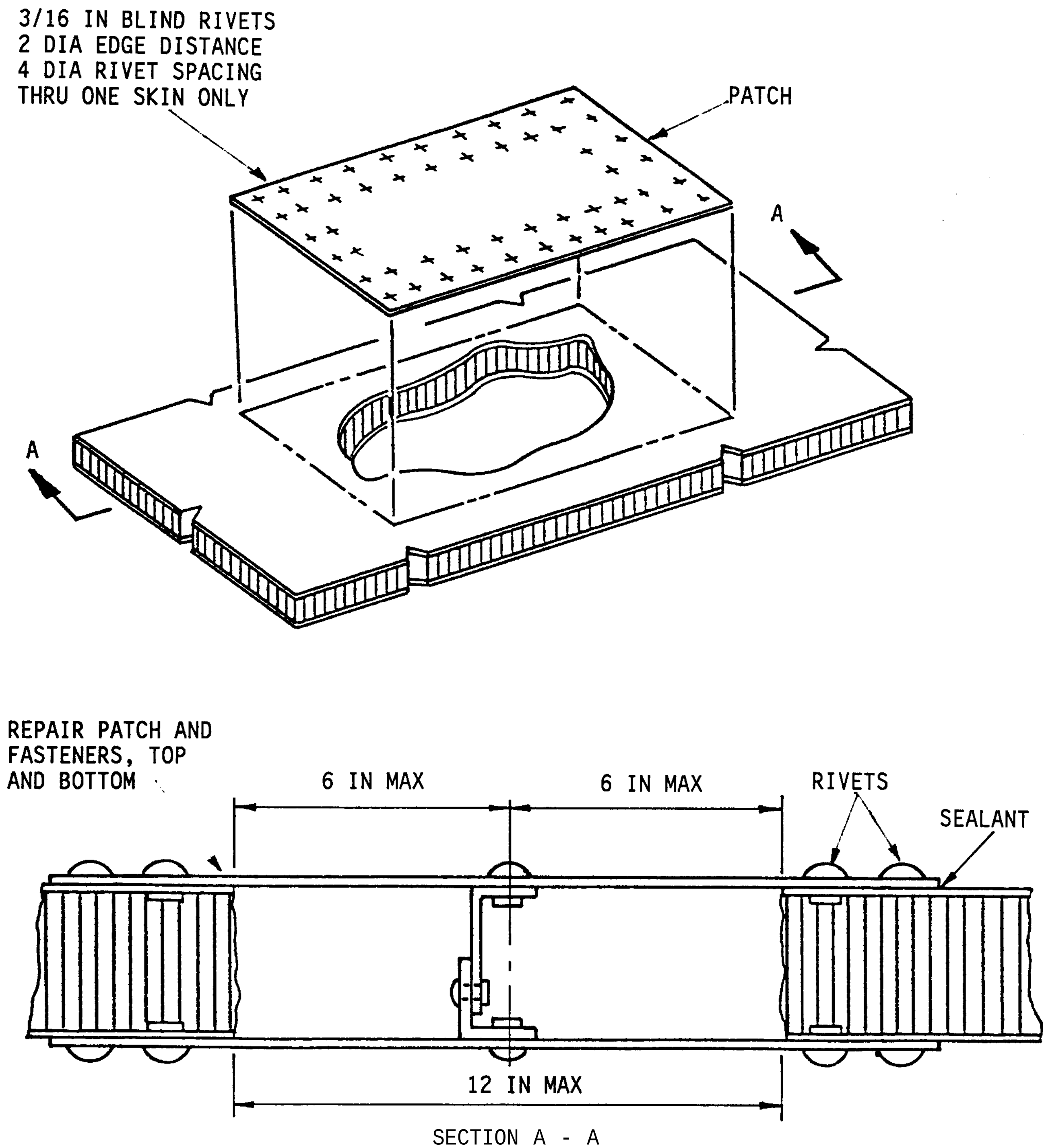



Figure 4-40. Repair of Honeycomb Core Panel - Damage Over 8 Inches - Both Skins and Core

PROCEDURAL STEPS:

1. Drill a small stop hole at the end of each crack, Figure 4-41. If tolerable, cutout a hole to include the ends of all cracks. This will restrict vision further. Smooth ragged edges.

2. Drill small holes 1/2 to 3/4 inch spacing, 3/8 inch edge distance along both sides of any crack and along the sides of the hole.

3. Lace safety-wire with needle nose pliers through holes and across cracks and over hole forming a web with 1/2 to 3/4 inch spacing between wires. Pull wires tight.

4. Brush sealant over safety wire and crack to make a water tight seal.

NOTE

Holes too large to be closed with safety-wire and epoxy may be sealed temporarily with green tape or aluminum tape.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

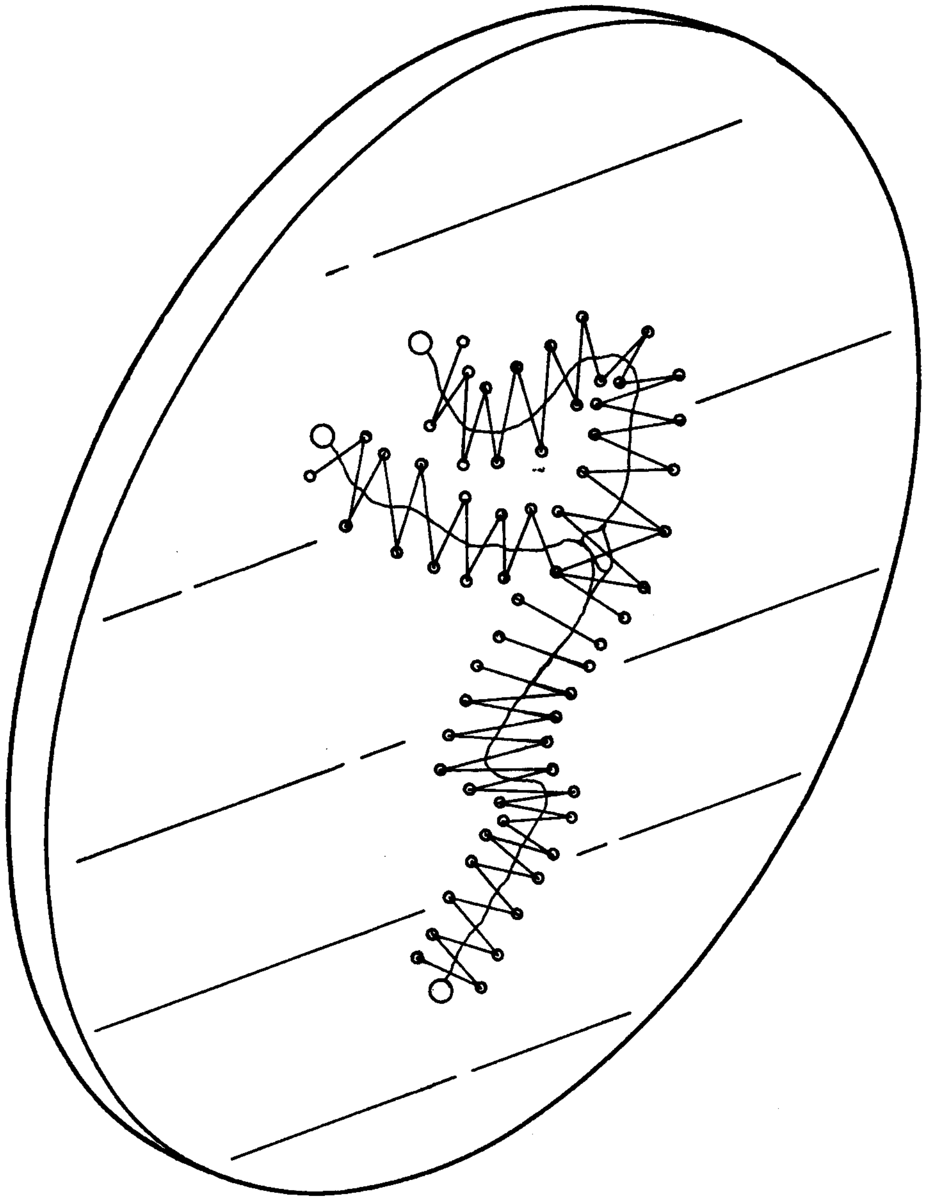


Figure 4-41. Fracture Lacing with Safety Wire

# CHAPTER 5

# ALIGHTING GEAR

**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

**5-1. SCOPE.** This chapter contains the fault assessment and expedient repair procedures for locating and fixing damage to the alighting gear (landing gear and supports). The landing gear assembly, Figure 5-1, consists of two skid tubes (1) and two arched cross tubes (2) and (3) of formed aluminum alloy fastened together with skid saddles (4) and attaching hardware. The assembly is attached to the lower fuse- Iage structure with support assemblies (5) and (6) at four points. To prevent damage from contact with the ground, replaceable steel skid shoes (7) attach to the bottom side of the skid tubes.

**5-2. ASSESSMENT PROCEDURES.** Assessment procedures are contained in Table 5-1. Assessments refer to parts identified in Figures 5-1 and 5-2.

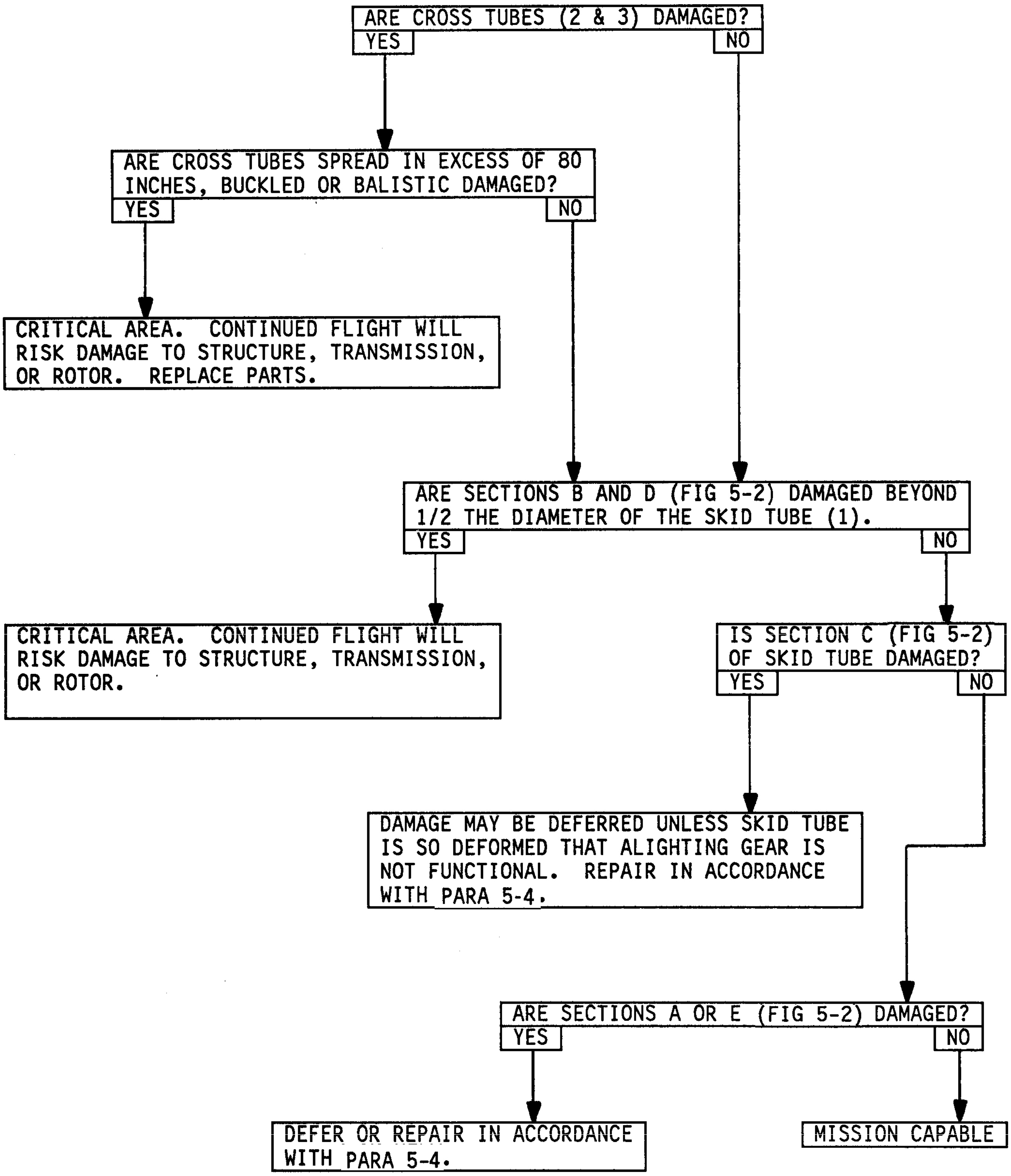
a. Visually inspect structures supporting alighting gear attachment points and transmission attachment points for any signs of structural distress such as buckling, cracks, rupture, deformations, popped rivets, or elongated rivet holes. If no such damage is found, replacement of alighting gear may be deferred if it is still functional and aircraft may be released for fully mission capable flight. Watch for any unusual vibrations in flight. Inspect after every flight until alighting gear can be replaced.

b. If alighting gear supporting structure is damaged but still functional and the transmission attachment and supporting structure show no damage, release for flight. Watch for any unusual vibrations in flight. Inspect after every flight until structure and alighting gear can be replaced.

c. If alighting gear or its supporting structure is not functional or the transmission or its supporting structure show any sign of damage, aircraft will be grounded until problem is corrected. This will probably go beyond the scope of BDAR; if so, use Standard Maintenance procedures.

**5-3. REPAIR PROCEDURE INDEX.**

Table 5-1. Alighting Gear Assessment Procedures



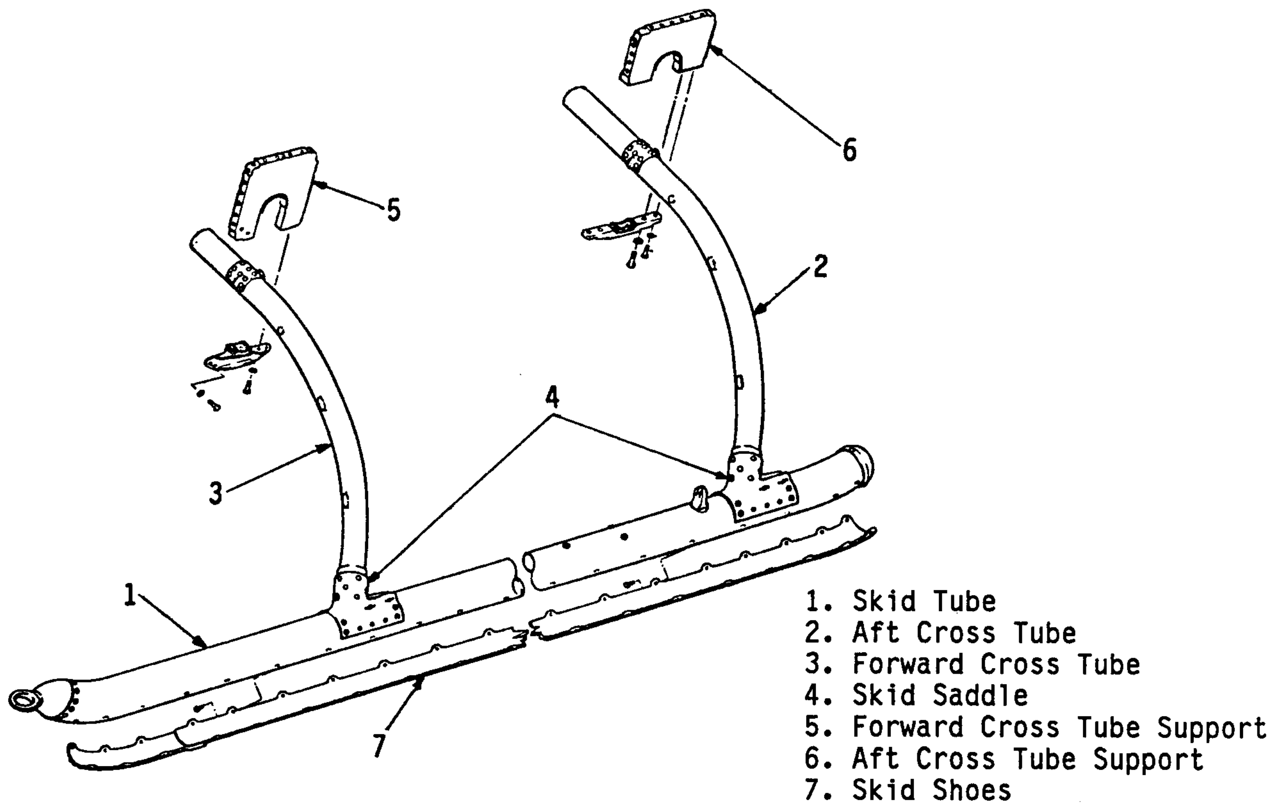



Figure 5-1. Landing Gear and Support Installation

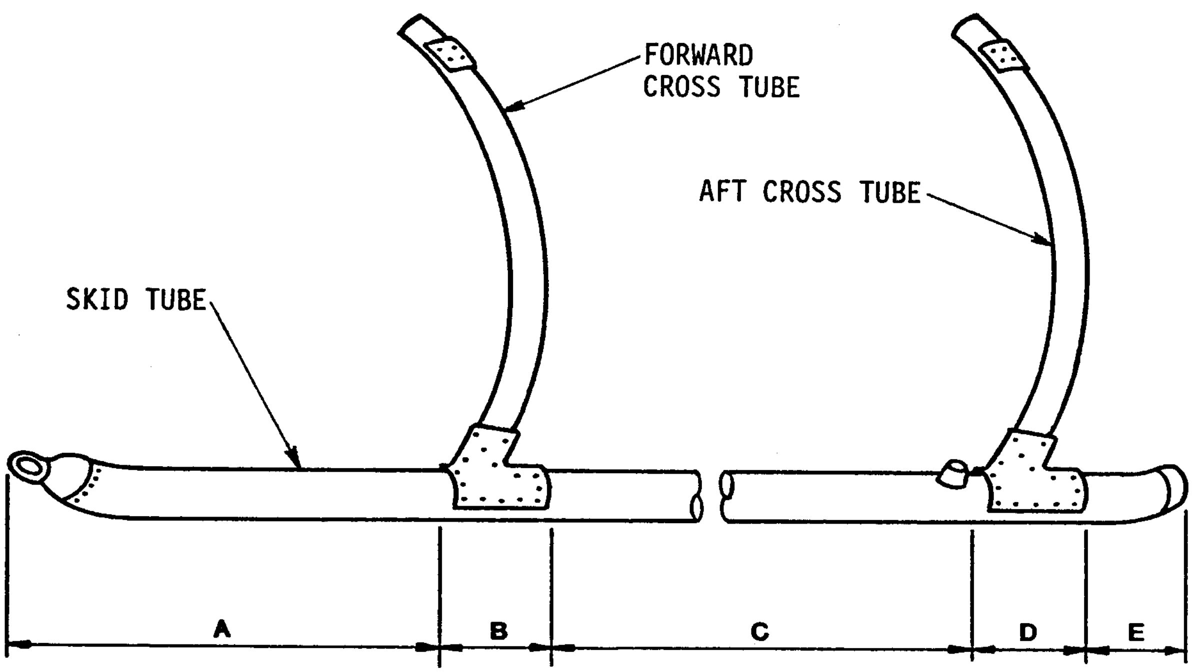



Figure 5-2. Skid Tube Damage Zones

## Section II. SKID TUBE

### 5-4. SKID TUBE DAMAGE.

**GENERAL INFORMATION:**

a. In battle conditions, parts of the skid tube may sustain various amounts of damage which may be deferred or even removed.

b. Skid shoes (7, Figure 5-1) maybe damaged by wear or enemy fire. The most critical areas are 12 inches fore and aft of the cross tube attachments. If time to replace shoes is not available, damage may be deferred provided that the damage to the skid tube does not exceed the criteria of paragraph 5-2. If time is available and replacement shoes are not available, substitute shoes can be fabricated to prevent future damage to skid tubes.

**OPTION:** Fabricate Skid Shoe.

**LIMITATIONS:** Use care in landing.

**PERSONNEL/TIME REQUIRED:**
- 2 Soldiers
- 2 Hours

**MATERIALS/TOOLS REQUIRED:**
- 0.032 In. Sheet Metal (item 131, App. C)
- Blind Fasteners or Steel Clamps items 98-115,59, App. C)
- Drill Bit
- Aircraft Jack
- Drill

**PROCEDURAL STEPS:**

1. Form steel plate to fit snug around skid.

2. Drill oversize holes along each edge to match attachment holes in skid tube. Plate should extend one foot on each side of damaged area.

3. Locate center of plate at center of skid tube. If there are no impediments, the new plate maybe installed over the old shoes otherwise remove-shoes.

4. Install plate using blind fasteners or steel clamps, Figure 5-4.

5. Clamps maybe fabricated if not available, Figure 5-5.

**WARNING**

- Compressed air can blow dust into eyes. Wear eye protection. Do not exceed 30 psig air pressure.
- Sound pressure levels during some repair operations exceed the Surgeon General's hearing conservation criteria as defined in TB MED 501. Hearing protection devices such as aviator helmet or ear plugs are required to be worn by all personnel in and around the aircraft.
- Sanding on reinforced laminated glass produces fine dust that may cause skin and lung irritations. Observe necessary protection measures.

**NOTE**

The aft end of the skid tube is bent up and a steel plate cannot be formed to follow this contour. Do not extend steel plate beyond start of curvature.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

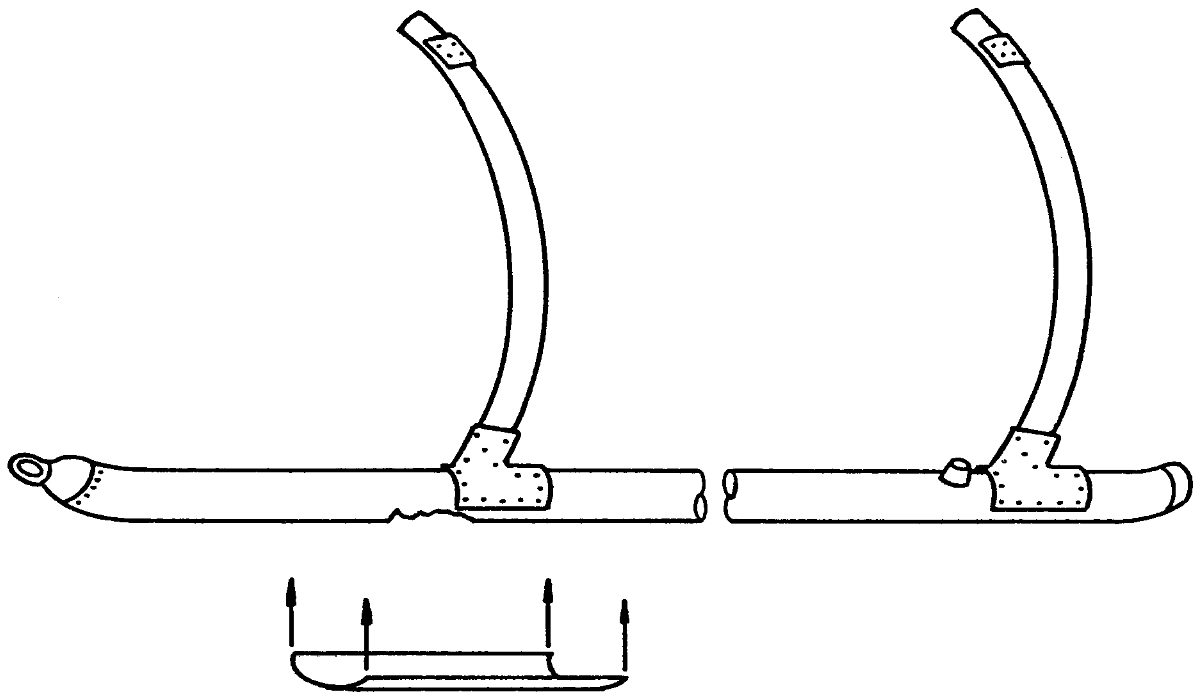


Figure 5-3. Skid Shoe Repair

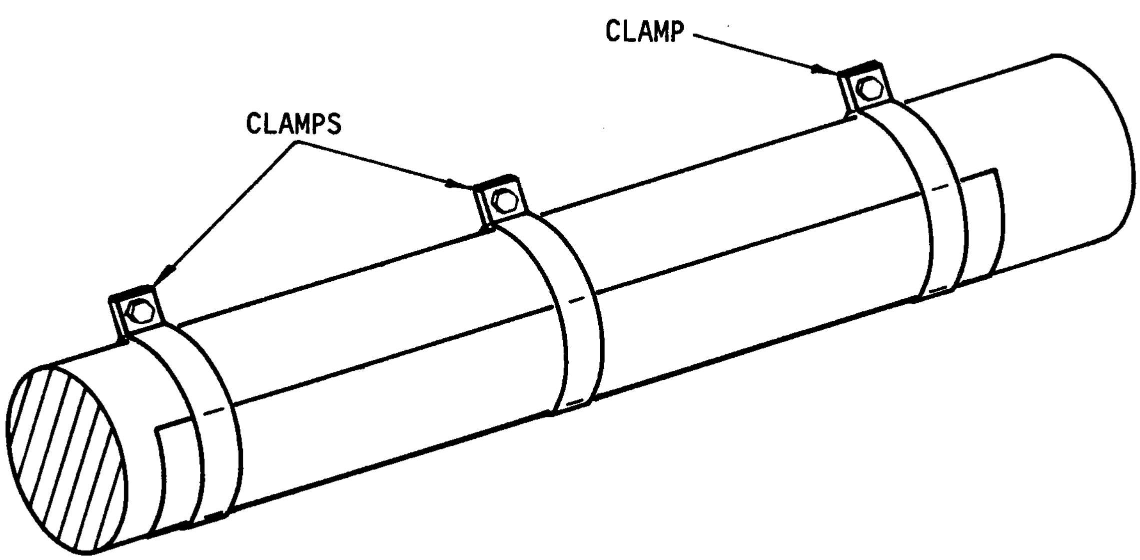



Figure 5-4. Clamp Repair

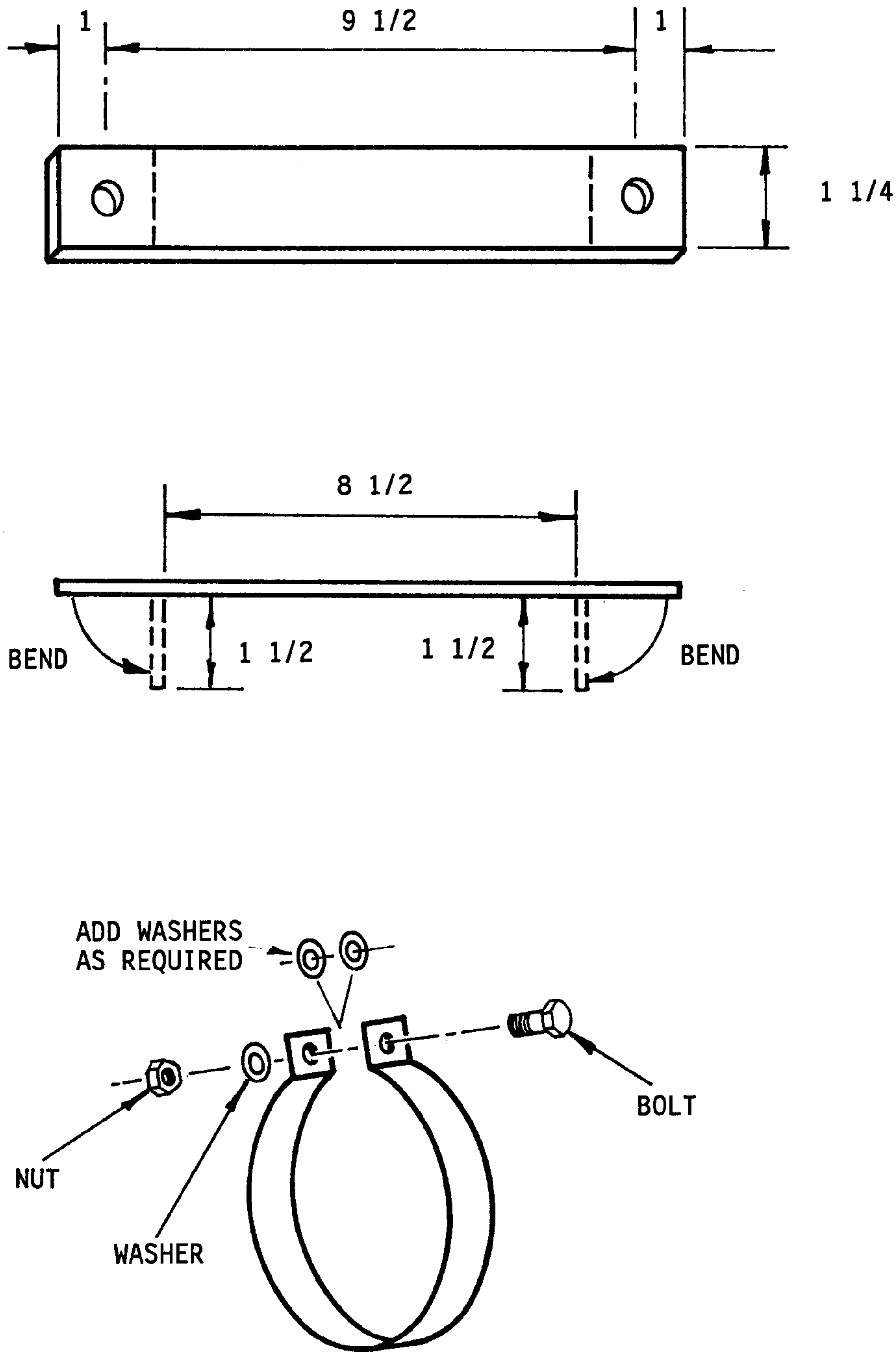



Figure 5-5. Fabricated Clamp

# CHAPTER 6

# POWER PLANT INSTALLATION

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

6-1. SCOPE. This chapter contains the fault assessment and expedient repair procedures for locating and fixing damage to the power plant. The power plant consists of a T53-L-703 series shaft turbine engine mounted horizontally on the fuselage behind the main rotor pylon, Figures 6-1 and 6-2. Engine connections are provided for the fuel, oil, electrical, instrument, and engine control systems. Major sections of the engine are the air-inlet, compressor, diffuser, combustion, and exhaust.

6-2. ASSESSMENT PROCEDURES. Combat damage to the engine usually requires engine replacement, not BDAR. Some engine accessories may be repaired. The fault assessment, Table 6-1, refers to BDAR repair procedures in this chapter.

6-3. REPAIR PROCEDURE INDEX.

| | PARA. |
|---|---|
| Oil Tank Punctured . . . . . . . | 6-4 |
| Low Oil Pressure, Defective Indicator/Transmitter . . . . | 6-5 |
| Fuel Filter Clogged . . . . . . . | 6-6 |
| Housing Cracks, Fuel Control and Accessory Gearbox . . . . | 6-7 |
| Jump Start Engine . . . . . . . . | 6-8 |

## Section II. OIL TANKS

6-4. OIL TANK, PUNCTURED.

GENERAL INFORMATION: The engine oil tank is located in the upper pylon fairing, Figure 6-3. The oil level may be checked by the sight glass adjacent to the filler cap. The engine will seize in a matter of minutes if run without oil. This procedure lists several methods to fix a leaking oil tank, depending on the size of the leak and the materials available. If fuel cell repair kit is available, utilize its contents.

WARNING

Compressed air can blow dust into eyes. Wear eye protection. Do not exceed 30 psig air pressure.

WARNING

- Turbine fuels and lubricating oils contain additives which are poisonous and readily absorbed through the skin. Do not allow them to remain on skin longer than necessary. Wear protective equipment.

- Extremely high pressure can occur during and after operation of certain equipment. If this pressure is not relieved before working on equipment, serious injury or death may occur. Be sure to open all drains and vents before beginning any disassembly.

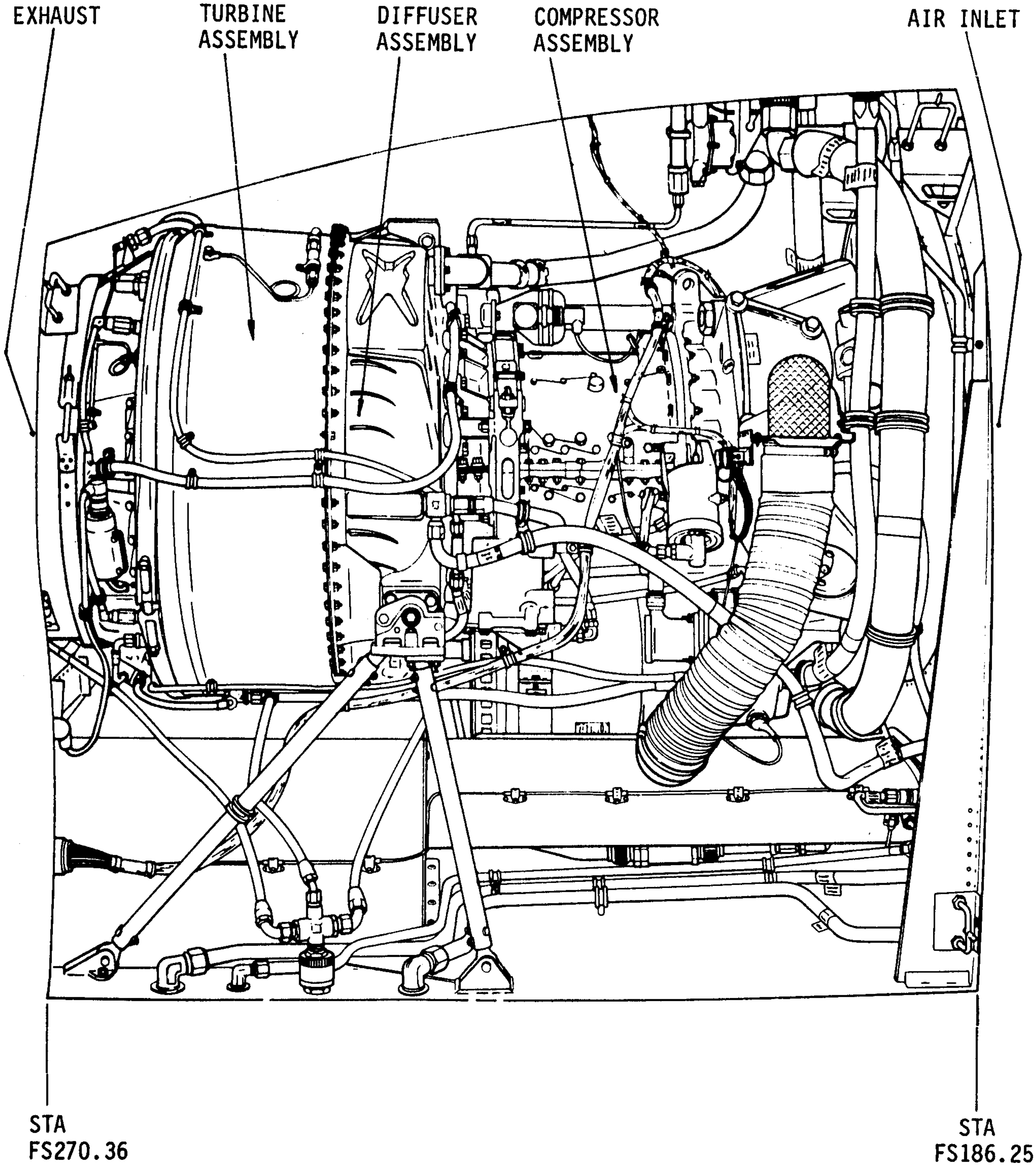



Figure 6-1. Engine, Right-Hand View

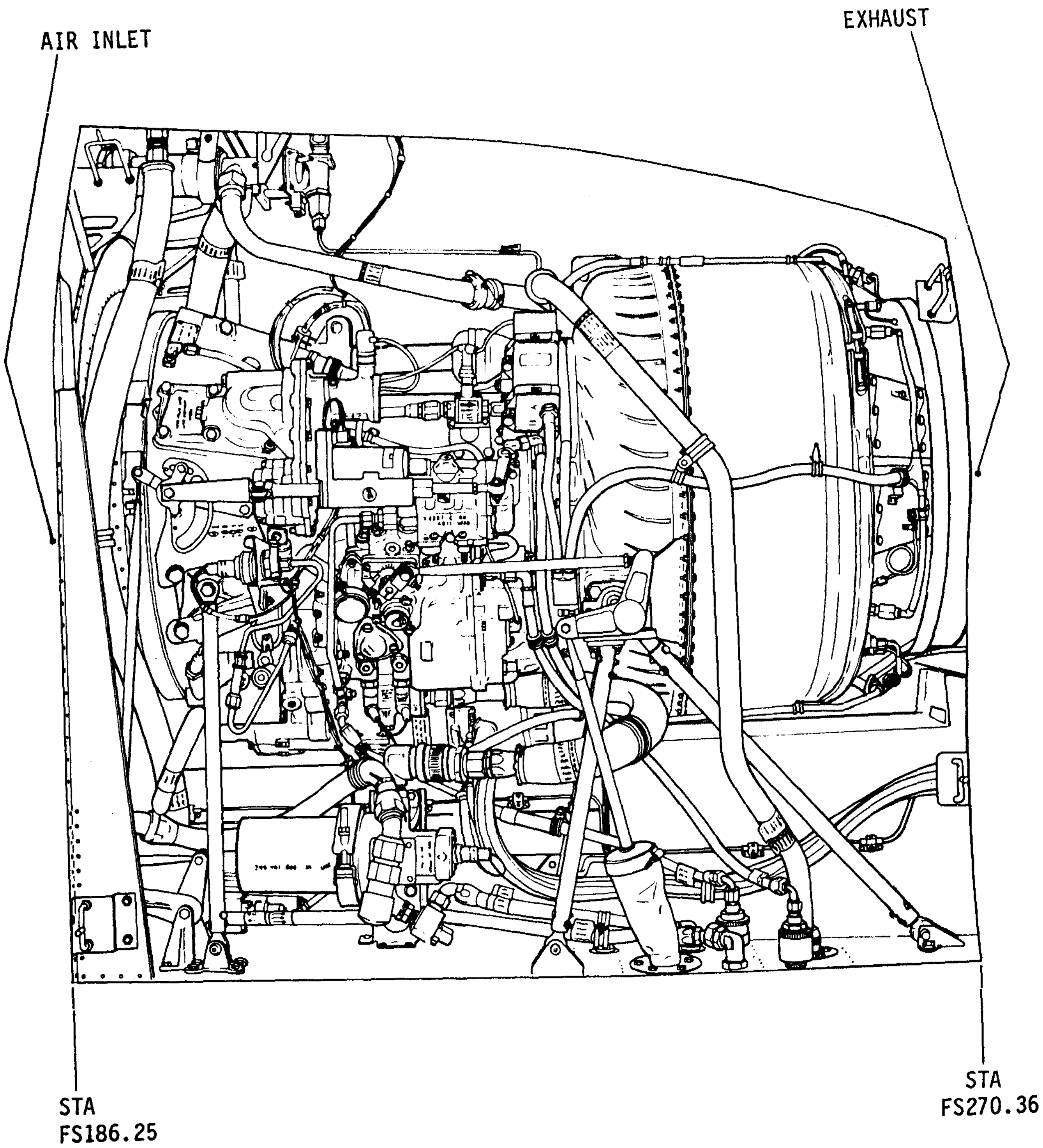
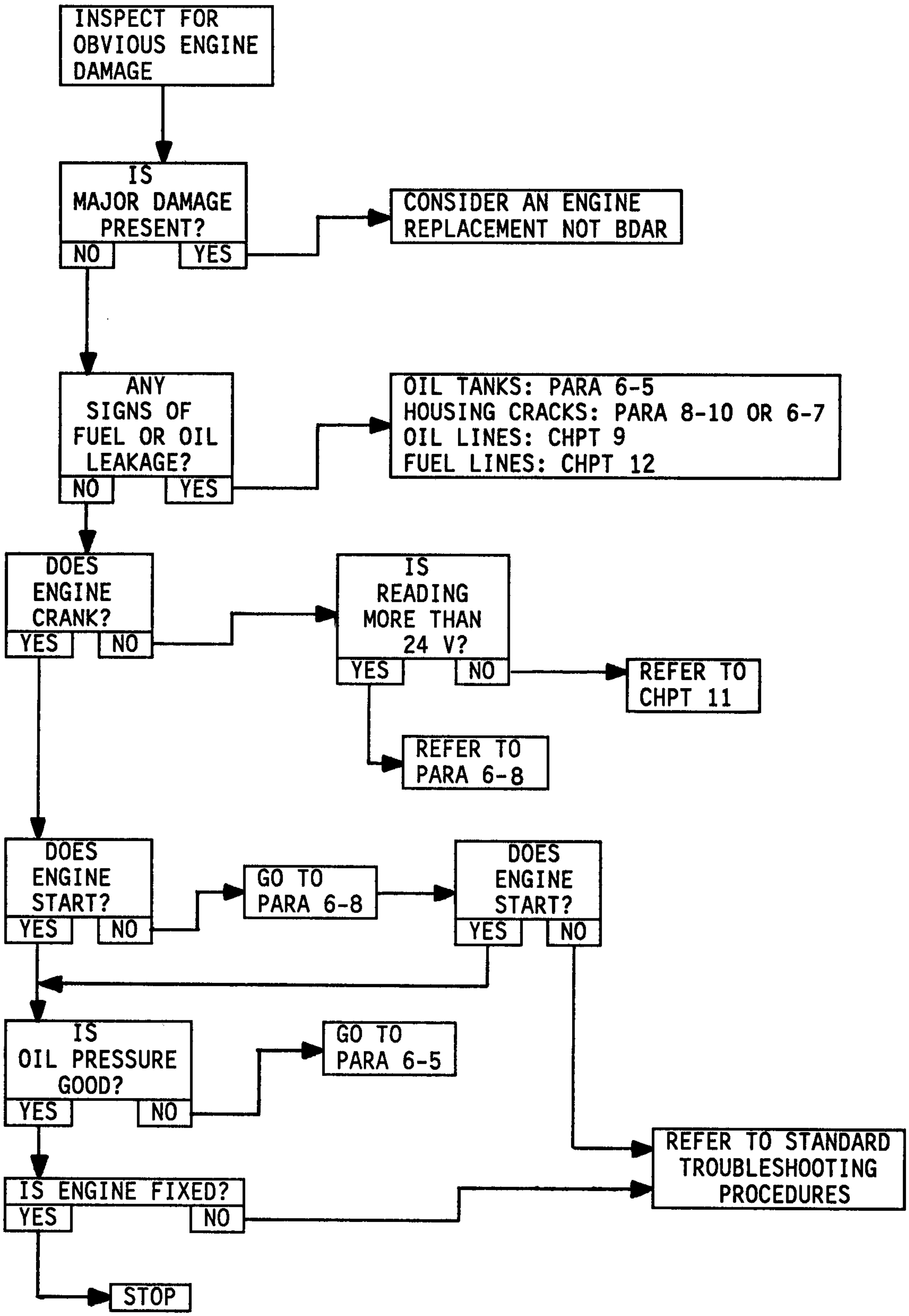



Figure 6-2. Engine, Left-Hand View

Table 6-1. Power Plant Assessment Procedures



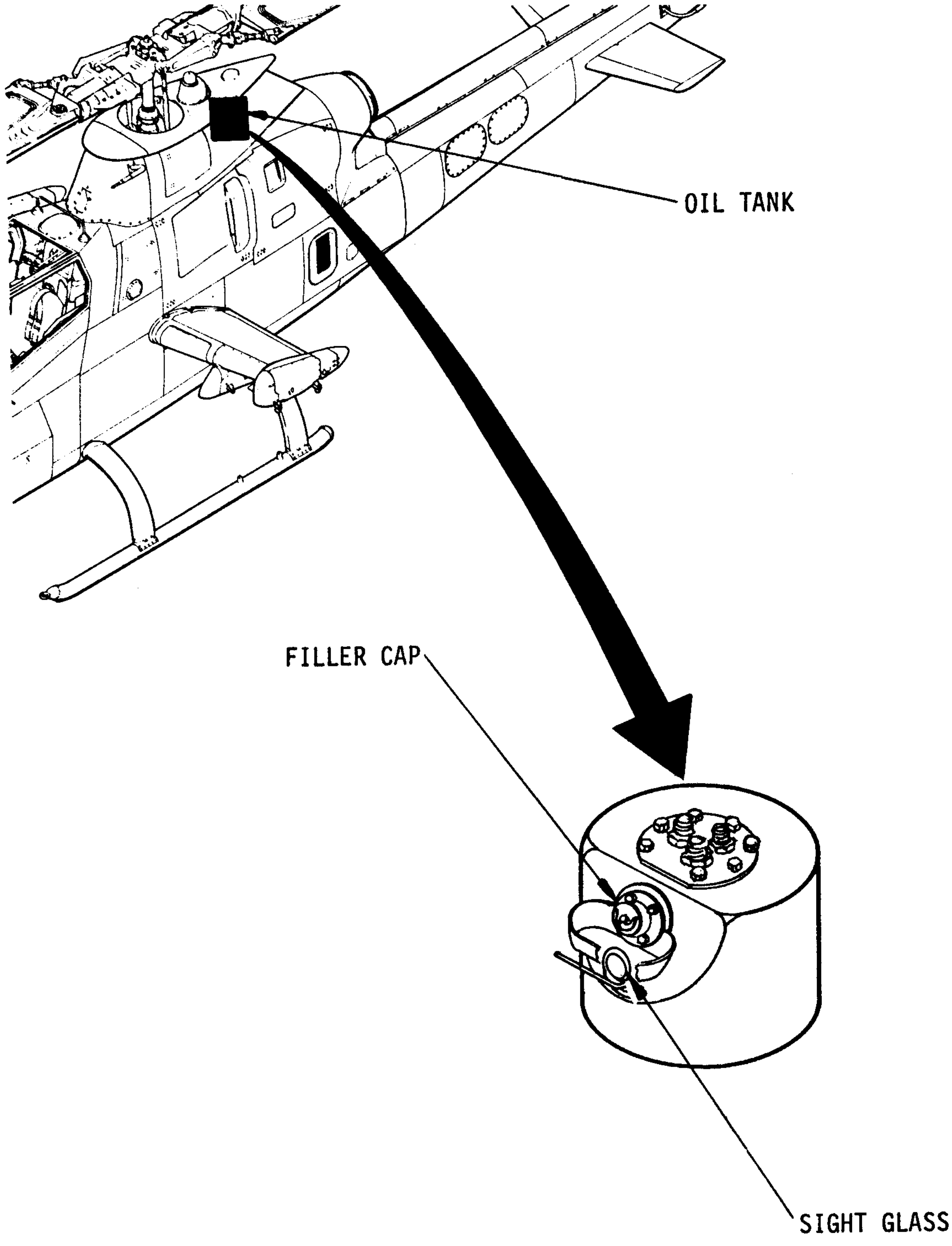



Figure 6-3. Oil Tank

**WARNING**

- Starting and operation of the helicopter will be performed only by authorized personnel.
- When refueling helicopter, the refueling vehicle or forward air refueling unit must be parked a minimum of 20 feet from the helicopter. Before starting the fueling operation, always insert fueling nozzle ground cable of fuel truck into GROUND HERE receptacle. Refer to FM 10-68. When defueling, turn off all electrical switches and disconnect external power from the helicopter. The helicopter must be electrically grounded.
- Fuel line and tank repairs often involve handling of highly inflammable material. Mishandling can result in serious injury or death.
- Self-luminous dials and ignition units may contain radioactive materials. If such an instrument or unit is broken or becomes unsealed, avoid personal contact. Use forceps or gloves made of rubber or polyethylene to pickup contaminated material. Place materials and gloves in a plastic bag. Seal bag and dispose of it as radioactive waste in accordance with AR 708-1 and TM 3-261 (refer to TM 43-0108). Repair shall conform to requirements in AR 385-11.

**CAUTION**

Some repairs may come loose due to heat and vibration.

LIMITATIONS: None

OPTION 1: Wood Plug (for smooth round holes).

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

MATERIALS/TOOLS REQUIRED:
- Plug, Wooden
- Hose or Tubing

**PROCEDURAL STEPS:**

1. Obtain a small piece of hose or tubing and insert the piece into the hole on the oil tank, Figure 6-4.

2. Insert a tapered wooden plug inside the hose or tubing (wooden plug should be checked periodically and retightened if necessary).

3. Replenish oil supply.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Green (Duct) Tape (for thin cracks).

LIMITATIONS: None

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 30 Minutes

MATERIALS/TOOLS REQUIRED:
- Tape, Fiber glass or Green Tape (items 50,153, App. C)
- Solvent, Dry Cleaning, (items 7, 129, App. C)

**PROCEDURAL STEPS:**

1. Clean area around crack with solvent to remove the oil.

2. Seal crack with tape.

3. Replenish oil supply.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

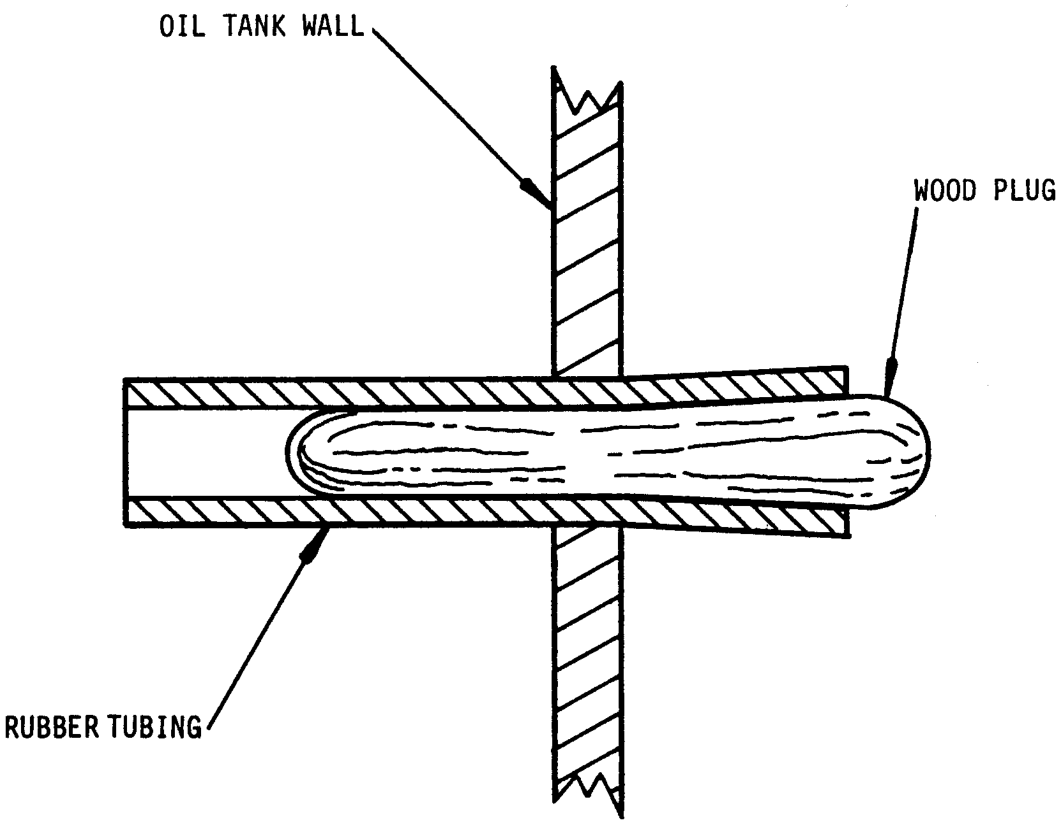



Figure 6-4. Wood Plug

**OPTION 3:** Sealant (for small holes).

**LIMITATIONS:** None

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1 Hour

**MATERIAL/TOOLS REQUIRED:**
- Solvent, Dry Cleaning, Naptha (items 7, 129, App.C)
- Silicon Sealant or Equivalent (items 5,6,123, 124, 125, 126,128, App. C)
- Wood Plug

**PROCEDURAL STEPS:**

1. Clean area around hole with solvent to remove all traces of oil so sealant will stick.

2. Fill hole and surrounding area with sealant.

3. If hole is large enough, use wood plug as a filler while filling hole with sealant, Figure 6-5.

4. After sealant has dried, replenish oil supply.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

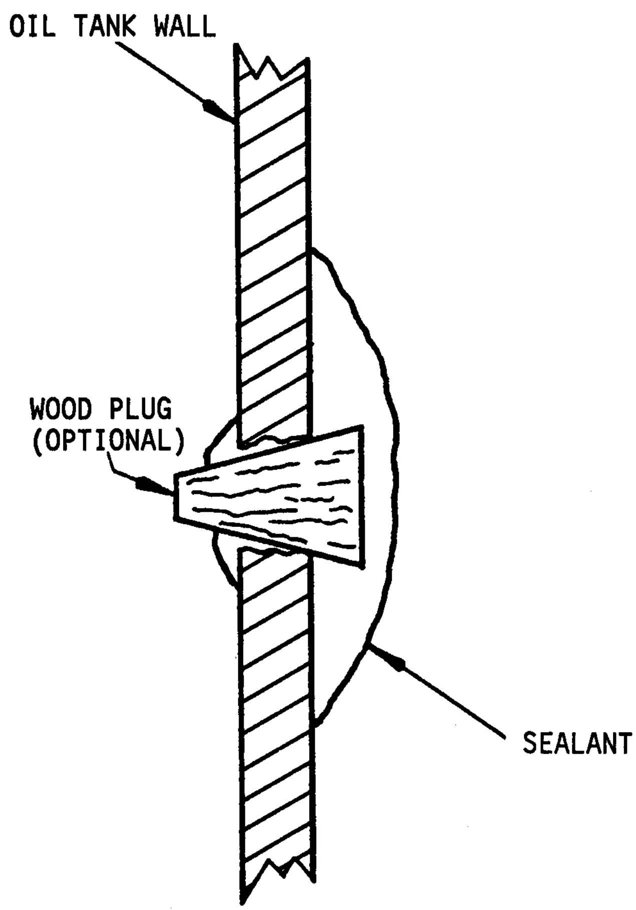



Figure 6-5. Sealant Repair

**OPTION 4:** Screw, Washer, and Gasket

**LIMITATIONS:** None

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Screw, Sheet Metal (items 143, 144, App. C)
- Gasket Material (items 52 or 116, App. C)
- Washer

**PROCEDURAL STEPS:**

1. Cut a piece of gasket material that will over lap the hole by about 1 inch from the center of the hole.

2. Pierce a small hole in the center of the gasket material.

3. Using the sheet metal screw and washer, screw the gasket material through the pierced hole and through the small hole on the oil tank on to the oil tank wall to stop the leak, Figure 6-6.

4. Replenish oil supply.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

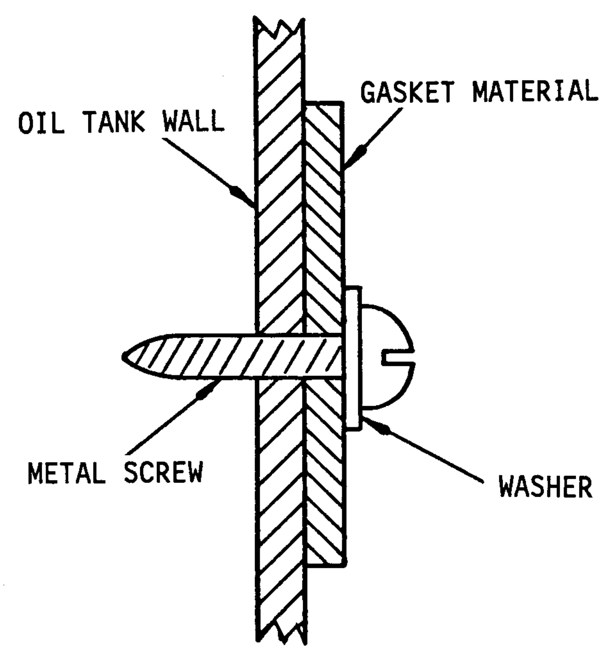



Figure 6-6. Screw, Washer, and Gasket

**OPTION 5:** Hose Assembly, Sealant, Nut and Bolt.

**LIMITATIONS:** None

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 2 Hours

**MATERIAL/TOOLS REQUIRED:**
- Nut, Bolt, and Washer (items 8-24, 63-70, & 162-169, App. C)
- Sealant (items 123-128, App. C)
- Hose or Tubing
- Solvent (item 7 or 129, App. C)

**PROCEDURAL STEPS:**

1. Clean area around hole with solvent to remove all traces of oil so sealant will stick.

2. Use a piece of hose/tubing about the same diameter of the hole. Assemble bolt, hose/tubing, washer, and nut, Figure 6-7. Apply sealant to all edges. Start nut on bolt and tubing until assembly is snug.

3. File edge of hole until round and smooth. Push hose assembly about half way through hole. Tighten nut on bolt, expand hose to seal hole. If necessary, remove oil tank plate to allow a wrench or pliers inside of oil tank to hold nut while turning bolt.

4. If oil tank plate was removed, reinstall.

5. After sealant has dried, replenish oil supply.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

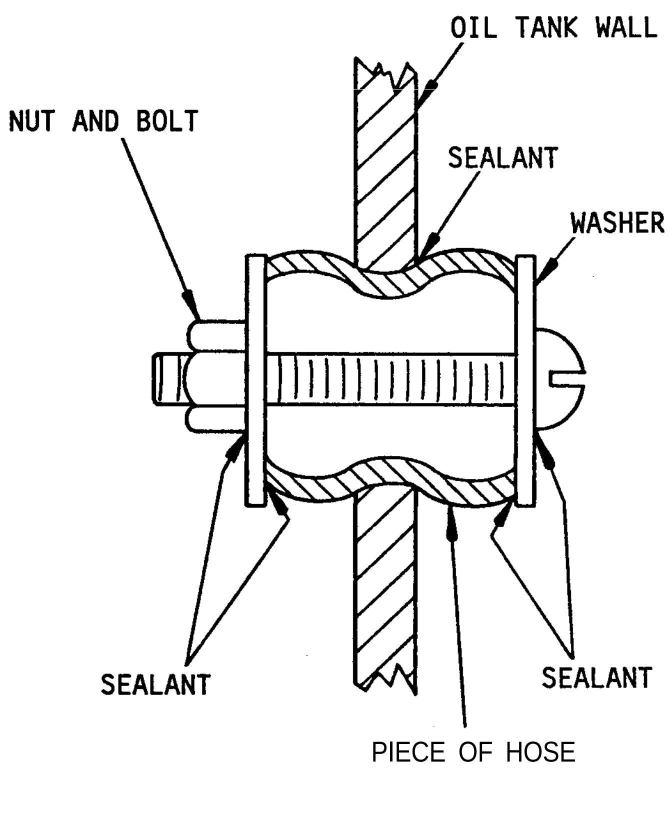



Figure 6-7. Hose Assembly, Sealant, Nut and Bolt

**OPTION 6:** Sheet Metal with Sealant Blind Rivets (for large holes),

**LIMITATIONS:** None

**PERSONNEL/TIME REQUIRED:**
- 2 Soldiers
- 3 Hours

**MATERIALS/TOOLS REQUIRED:**
- Sheet Metal (items 131-138, App. C)
- Sealant (items 68, 123-128, App. C)
- Blind Rivets (items 98-115, App. C)
- Sheet Metal Screws (items 143-144) App. C)
- Sandpaper (items 117-121, App. C)
- Solvent
- Gasket Material

PROCEDURAL STEPS:

1. Cut a piece of sheet metal that will overlap the hole by 1 1/2 inches at all points, Figure 6-8.

2. If sealant is to be used, clean area around hole with solvent so sealant will stick and sand rough.

3. Put sealant or gasket material over hole. Put sheet metal plate over hole and secure with sheet metal screws or blind rivets.

4. After sealant has dried, replenish oil supply.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## Section III. OIL PRESSURE INDICATOR/TRANSMITTER

### 6-5. LOW OIL PRESSURE INDICATOR/TRANSMITTER, DEFECTIVE.

**GENERAL INFORMATION:** This procedure explains how to check if a low oil pressure reading is being caused by a defective oil pressure indicator/-transmitter.

**OPTION**

**LIMITATIONS:** None

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 15 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Towels (item 161, App. C)

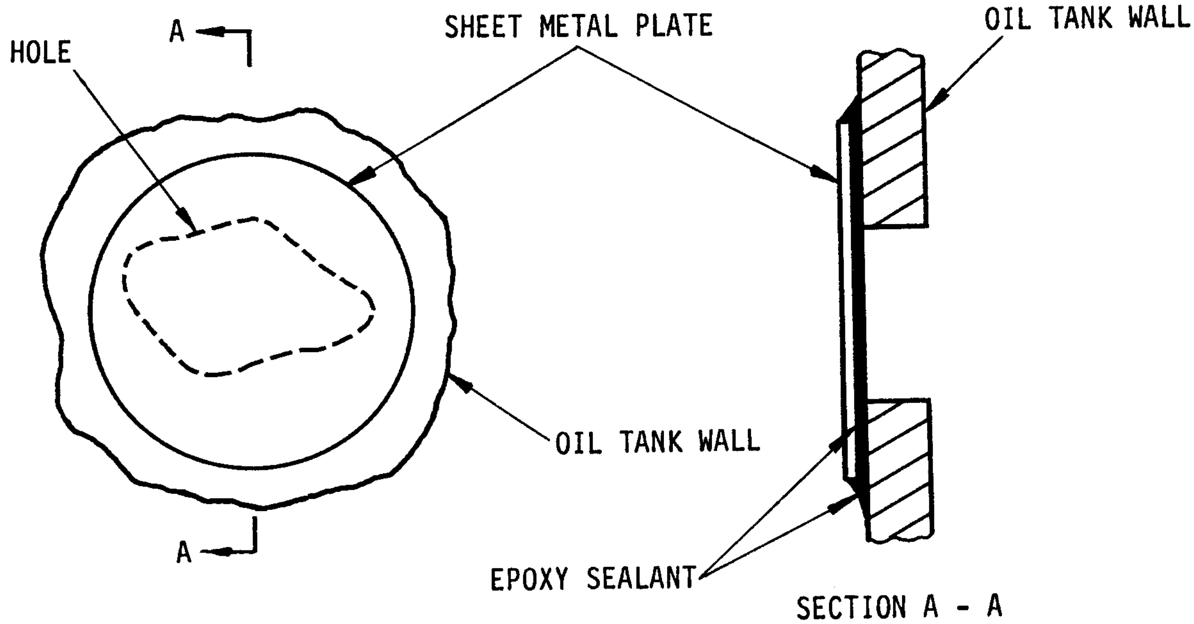
**PROCEDURAL STEPS:**

1. Remove oil pressure transmitter, Figure 6-9, and interchange it with one of the two engine torque transmitters. Refer to Figure 6-10 for location.

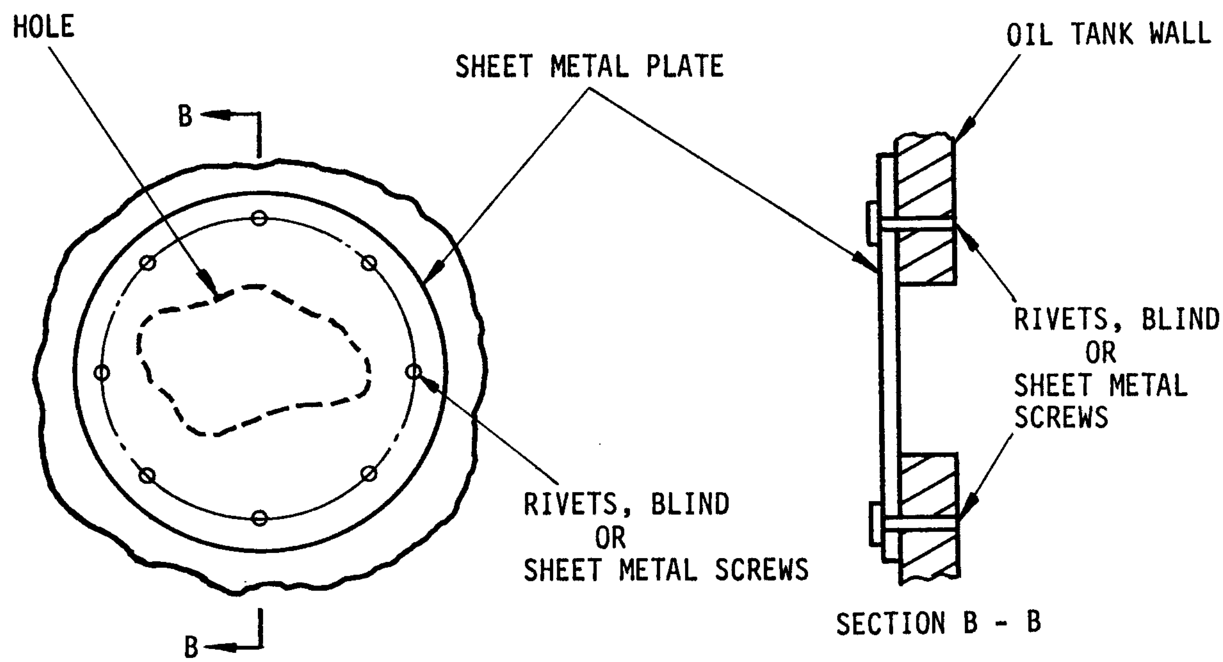
2. Start engine.

3. Check to see if reading on oil pressure gage is normal.

4. If the oil pressure indicator reading is good and the torque pressure indicator reading with which the transmitters were interchanged is not good, the problem is with the transmitter. Use the other torque indicator to monitor the engine torque during flight. Engine will be fully mission capable.

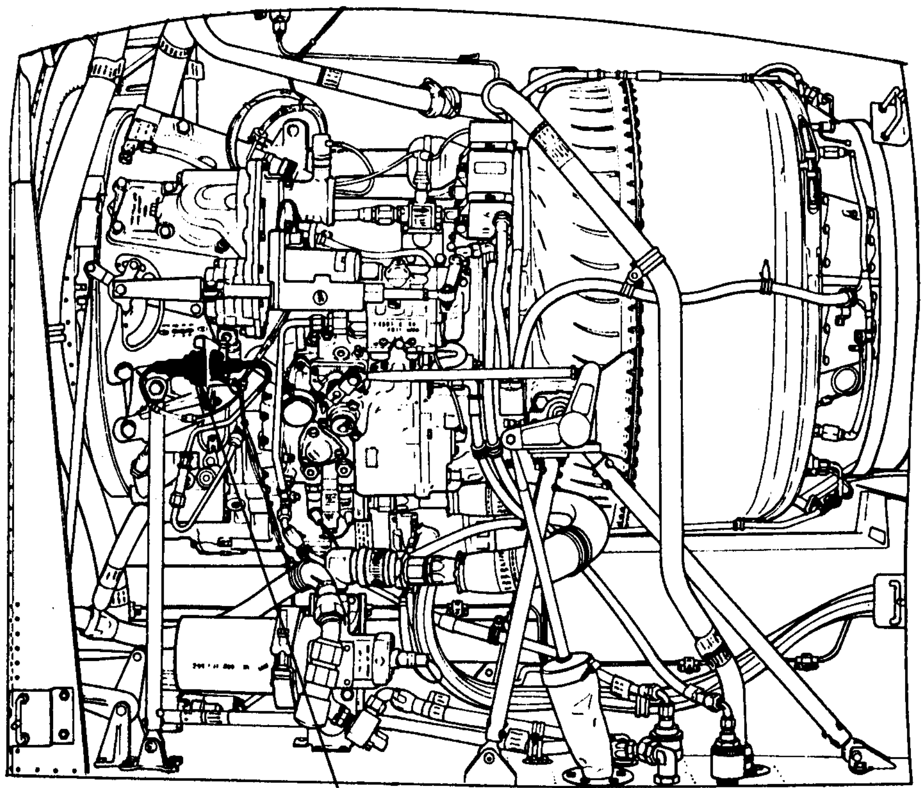



SHEET METAL PLATE WITH EPOXY




SHEET METAL PLATE WITH BLIND RIVETS

Figure 6-8. Sheet Metal with Sealant or Blind Rivets



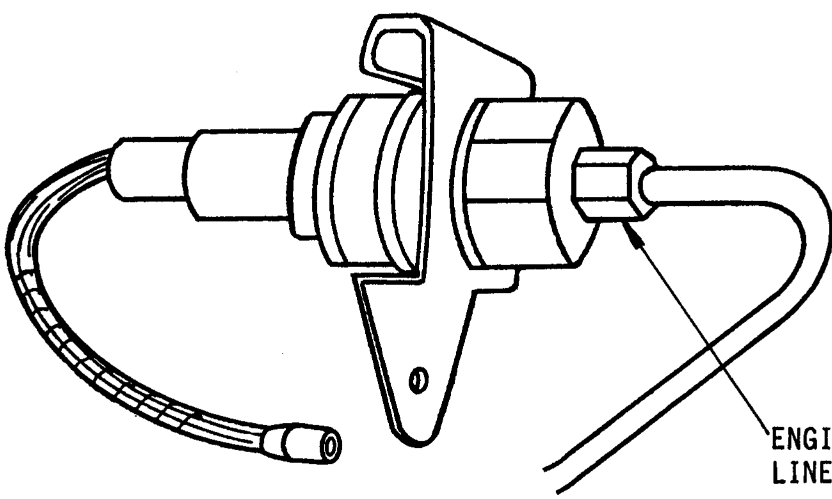




Figure 6-9. Oil Pressure Transmitter

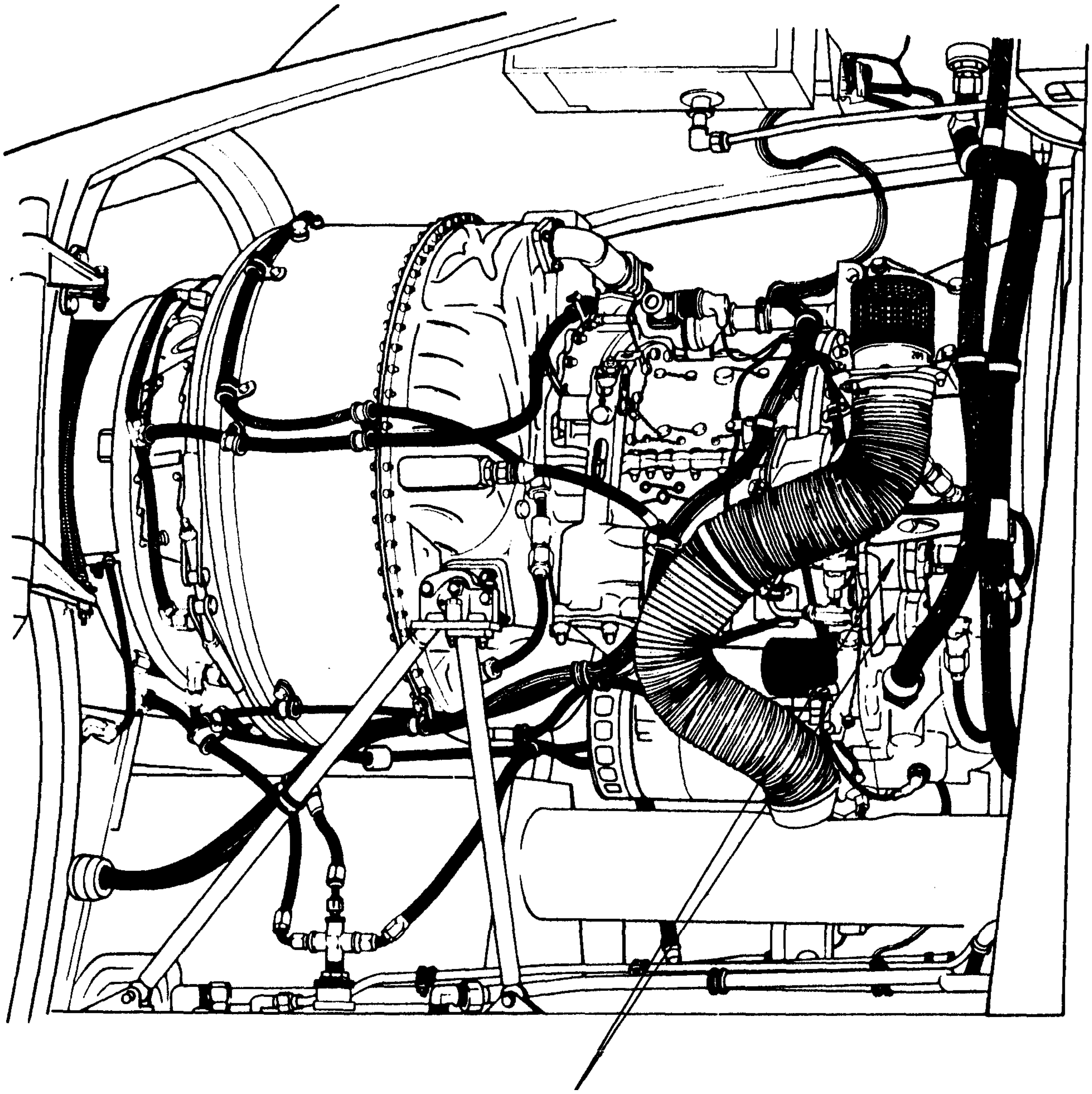



Figure 6-10. Torque Pressure Transmitters

5. If the oil pressure indicator reading is not good and the torque reading with which the transmitter was interchanged is good, do the following:

a. Place a rag over engine oil pressure line connection to transmitter. Gently loosen but do not unscrew connection.

b. If oil pressure exists, oil will spray from loosened connection. Tighten connection. Engine will be partially mission capable.

c. If oil pressure does not exist, troubleshoot problem using standard maintenance procedures.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

## Section IV. FUEL FILTER

### 6-6. FUEL FILTER CLOGGED.

**GENERAL INFORMATION:** If engine will not run and there is no fuel flow from the main fuel manifold, check the fuel filter for clogging.

OPTION: Options are described in paragraph 12-10 and 12-11.

## Section V. FUEL CONTROL AND ACCESSORY GEARBOX

### 6-7. HOUSING CRACKS-FUEL CONTROL AND ACCESSORY GEARBOX.

**GENERAL INFORMATION:** This procedure shows how silicon sealants can be used to temporarily seal small cracks on the fuel control and the accessory gearbox housings when crack edges do not protrude inward. The symptom will normally be loss of engine oil which results in engine temperature running higher than normal.

**LIMITATIONS:** Prolonged exposure to heat and pressure will cause patch to fail. Failure of seal will lead to oil loss and catastrophic engine failure.

**PERSONNEL/TIME REQUIRED:**
- 2 Soldiers
- 3 Hours

**MATERIALS/TOOLS REQUIRED:**
- Solvent (items 7 or 129, App. C)
- Sealant (items 6 or 128, App. C)

**PROCEDURAL STEPS:**

1. Visually locate crack wherever there is an oil leak on the fuel control housing or the accessory gearbox housing, Figure 6-11.

2. Check for internal damage or internal obstruction by manually inducing rotation to the entire engine assembly which includes turbines, compressors, the accessory gearbox, the fuel control, etc. To do this, follow these steps:

a. Remove the tach generator, Figure 6-12.

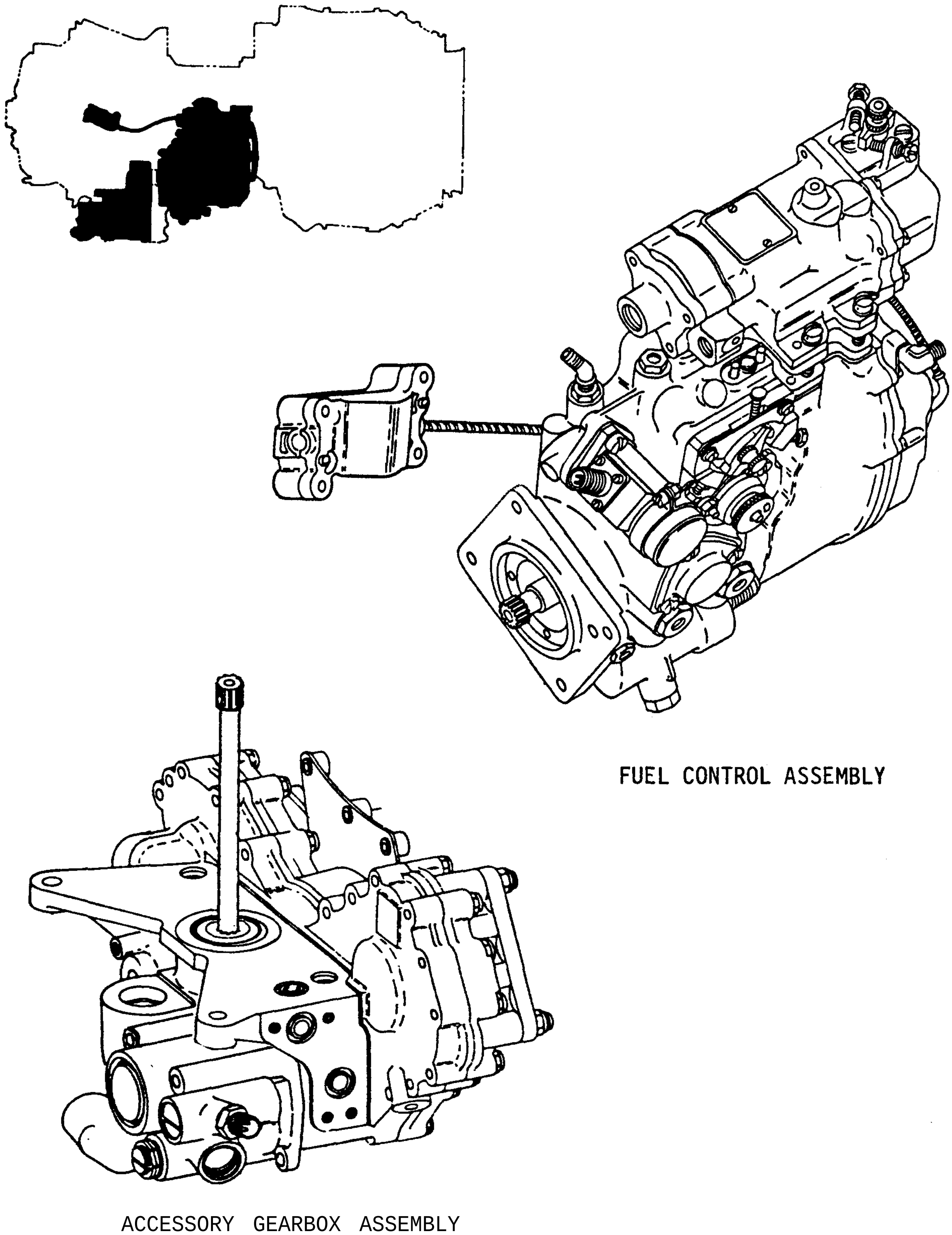



Figure 6-11. Fuel Control Assembly and Accessory Gearbox Assembly

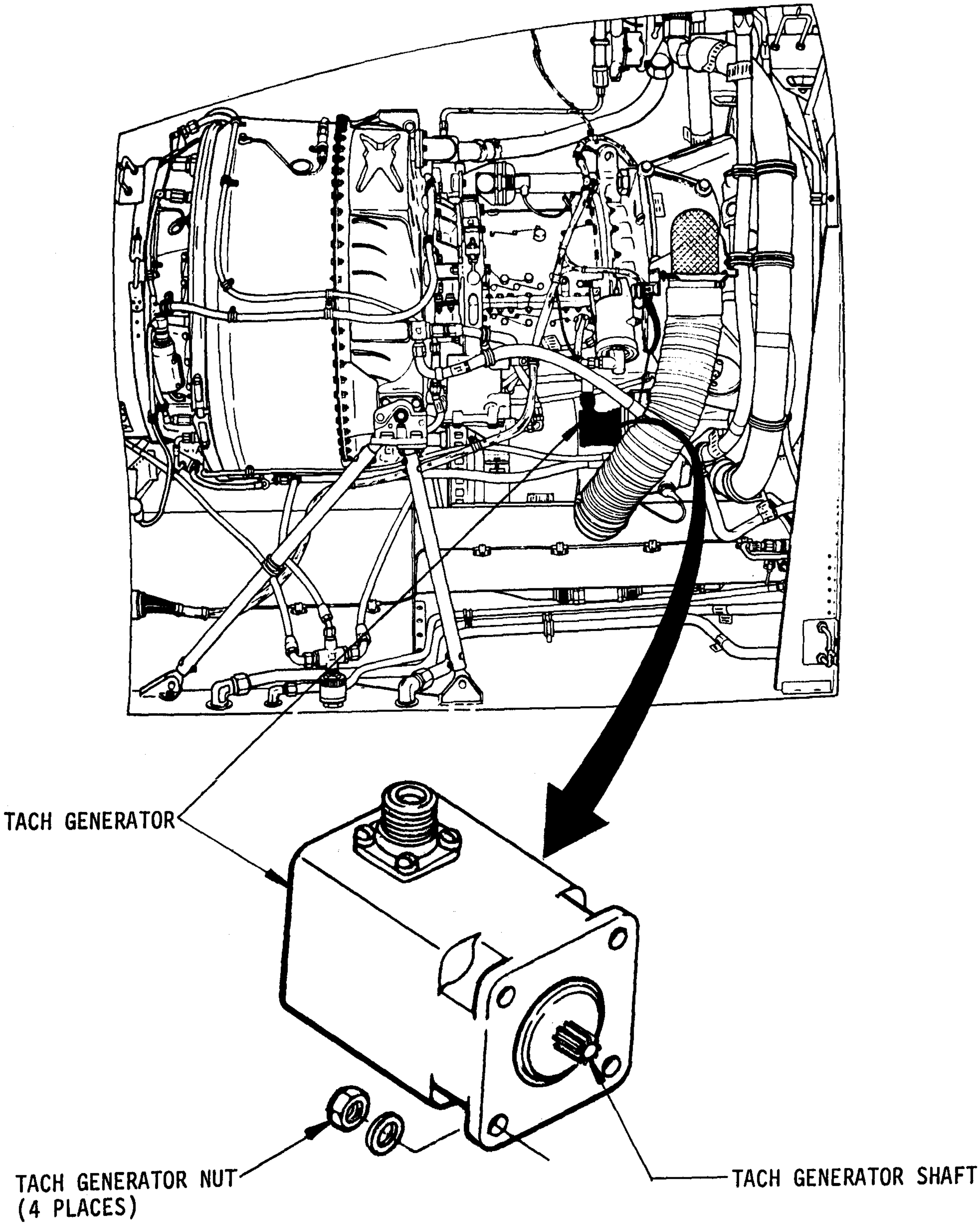



Figure 6-12. Tach Generator Removal

b. Insert a 1/4 inch ratchet into the square slot which engaged with the tack generator shaft.

c. Turn the ratchet which in turn will rotate the entire engine assembly including the accessory gearbox and the fuel control.

d. Listen and feel for any scraping or snagging in the accessory gearbox and fuel control assemblies that might disrupt the function of these parts.

e. If no scraping or snagging is felt or heard, proceed to step 3. If there is scraping or snagging present, there is internal damage and an inspection of the internal parts will be required.

3. Reinstall tach generator.

4. Clean area of crack thoroughly with solvent.

5. Apply sealant material. Allow curing or drying time. Use duct tape if possible.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## Section VI. EMERGENCY ENGINE START

### 6-8. JUMP START ENGINE.

**GENERAL INFORMATION:** If the aircraft starter-generator is not sufficiently powered by the battery and an auxiliary power unit (APU) is not available, the following procedure may be used to start the aircraft.

**LIMITATIONS:** Procedure must be repeated everytime aircraft engine is turned off until standard maintenance can be performed

**PERSONNEL/TIME REQUIRED:**
- 2 Soldiers
- 15 Minutes

**MATERIAL/TOOLS REQUIRED:**
- Jumper Cable 4 to 8 feet of No. 4 Awg Wire (2 each) (item 173, App. C)
- 28 V dc Power Supply or Batteries

Knife

**PROCEDURAL STEPS:**

1. Locate and open cover on external power plug, Figure 6-13 (use slot screwdriver).

2. Strip 1/4 inch of insulation from one end of both jumper cables.

3. Modify other end as needed and connect to power supply source.

**WARNING**

When making connections, DO NOT touch the uninsulated part of the slave cables. Wear protective gloves. Shield eyes from possible sparks.

**CAUTION**

Observe polarity (+) to (+) and (-) to (-) when making connections.

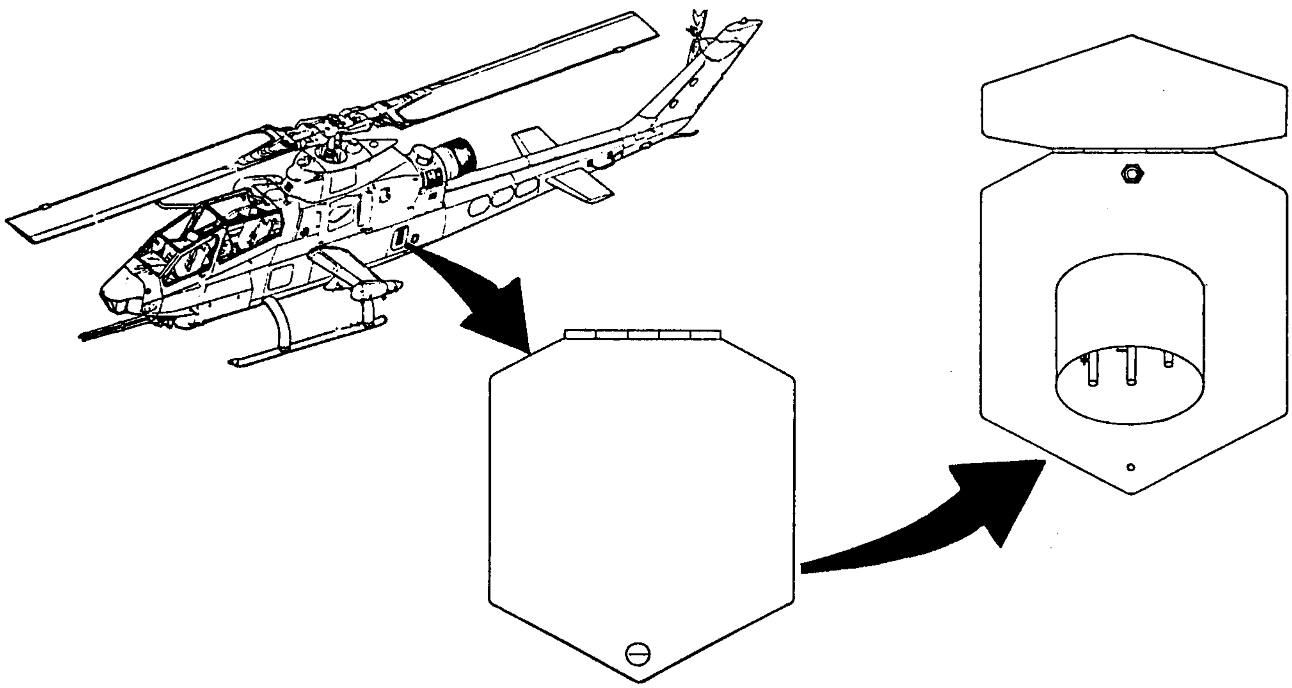


Figure 6-13. External Power Plug

NOTE

Firm contact must be maintained between jumper cable end and aircraft external power plug. Sparking will occur.

4. Connect one end of the jumper cables to the positive terminal of the power source and take the other end of the slave cable (modified in step 2) and hold against the positive terminal of the external power plug.

5. Follow the same instructions in step 4 for the negative connection.

6. Start aircraft.

7. Remove jumper cables when engine starts and secure external power-plug cover.

8. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

# CHAPTER 7

# ROTORS

**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

**7-1. SCOPE.** This chapter contains the fault assessment and expedient repair procedures for locating and fixing damage to the rotor systems. The two rotor systems are shown in Figures 7-1 and 7-13.

**7-2. ASSESSMENT PROCEDURES.** The main rotor systems include a number of components which cannot tolerate damage. If such components are damaged or deformed (bent) in any way, the rotor cannot perform properly. With the exception of items 6, 7, 19, and 24, none of the items listed in Figure 7-1 can tolerate any damage. Such components, when damaged, must therefore be replaced by standard procedures. Except for the blades (23) and the tail rotor gearbox (28), none of the components shown in Figure 7-13 can tolerate any damage. Such components when damaged, must therefore be replaced by standard maintenance procedures. For those components that are identified as repairable, repair procedures are provided. The fault assessment, Table 7-1, refers to those repair procedures.

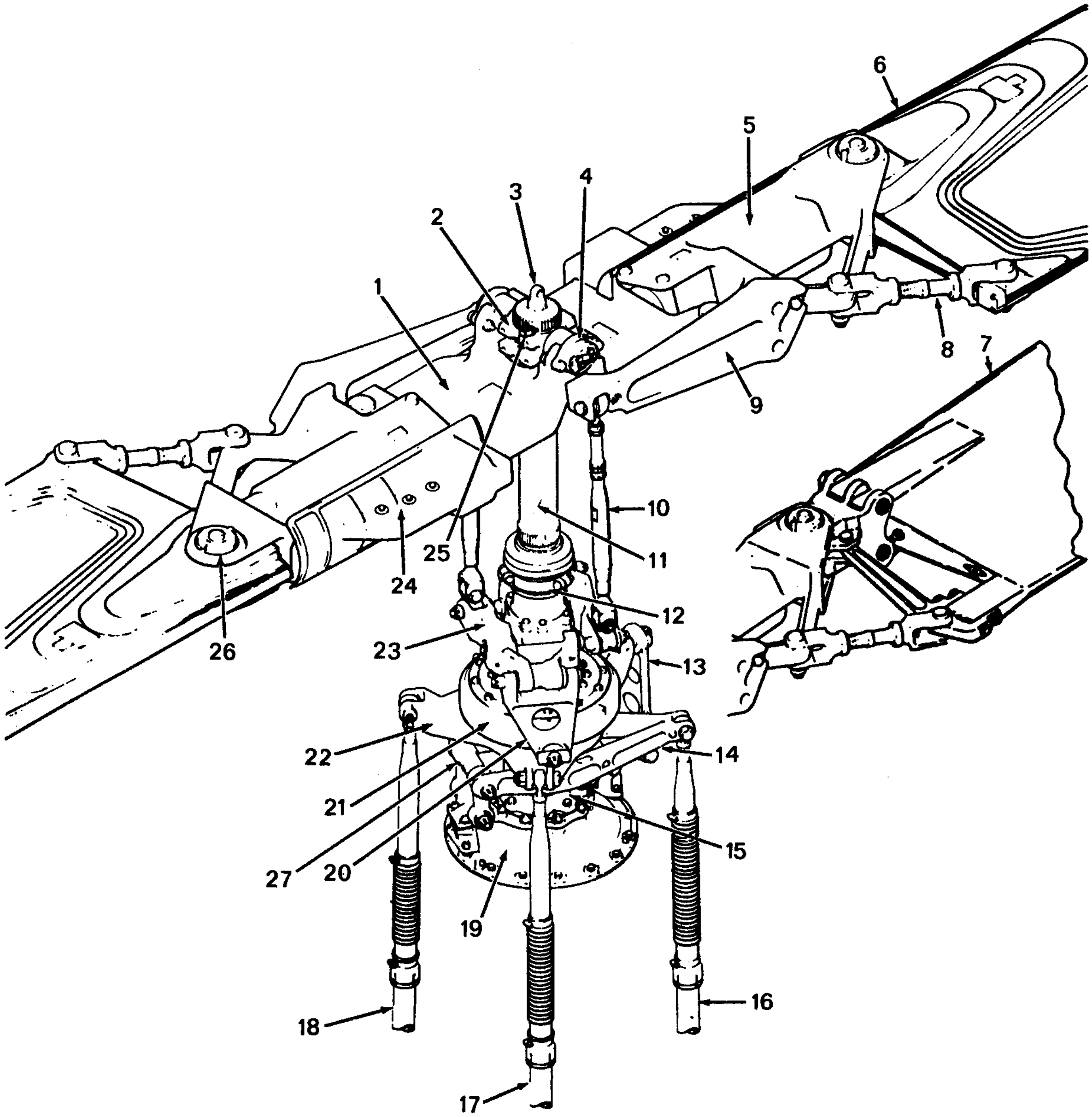
**7-3. REPAIR PROCEDURE INDEX.**



## Section II. MAIN ROTOR HUB AND BLADE

**7-4. MAIN ROTOR BLADE, HOLE 1 INCH OR LESS, THROUGH BOTH SKINS.**

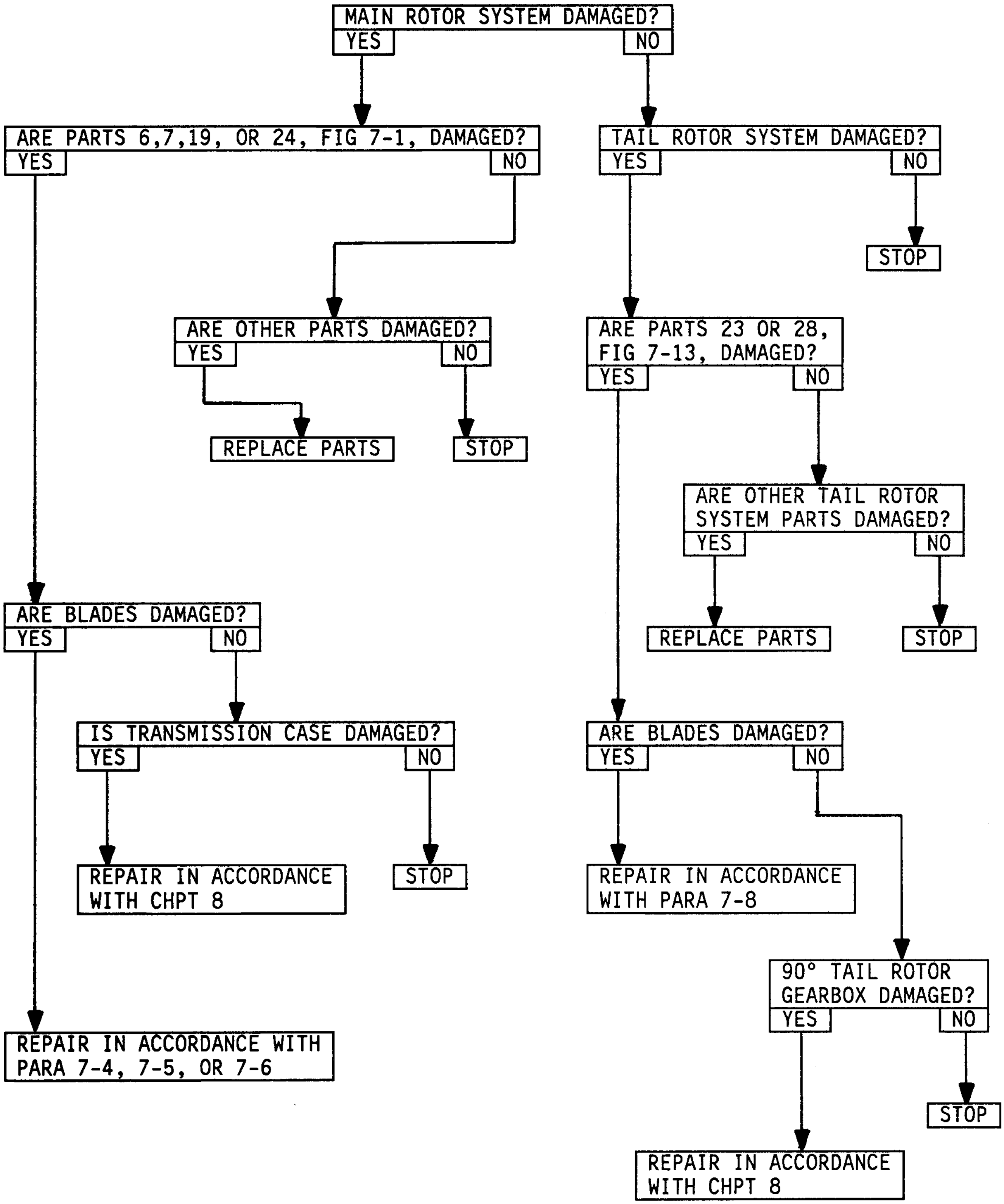
**GENERAL INFORMATION:** The following repairs can be made while blades are installed in aircraft. Blades must contain sufficient balance weight to permit adjustment of blade balance after repair. Use a lead pencil to mark blades; never use a grease pencil.




1. Main Rotor Hub Yoke
2. Trunnion
3. Mast Nut
4. Elastomeric Bearing
5. Grip
6. Main Rotor Blade B540
7. Main Rotor Blade K747
8. Drag Brace
9. Pitch Horn
10. Connecting Tube (Pitch Link)
11. Mast
12. Friction Collet
13. Antidrive Link
14. Collective Lever
15. Swashplate Support
16. Collective Control Hydraulic Cylinder
17. Lateral Cyclic Control Hydraulic Cylinder
18. Fore and Aft Cyclic Control Hydraulic Cylinder
19. Transmission
20. Drive Link
21. Swashplate Outer Ring
22. Swashplate Inner Ring
23. Scissors and Sleeve Assembly
24. Sand Deflector
25. Mast Nut Lock
26. Main Rotor Blade Retention Bolt
27. Collective Idler

Figure 7-1. Main Rotor System

Table 7-1. Rotor Assessment Procedures



**WARNING**

- Cleaning solvents, adhesives, and fillers may be flammable and toxic. Use only in well-ventilated areas. Avoid inhalation of vapors and skin contact. Do not use solvents near open flame or in areas where very high temperatures prevail. Solvent flash point must not be less than 100° F.
- Sanding on reinforced laminated glass produces fine dust that may cause skin and lung irritations. Observe necessary protective measures.
- Operation of power tools may exceed recommended noise thresholds. Wear hearing protection equipment.
- Compressed air can blow dust into eyes. Wear eye protection. Do not exceed 30 psig air pressure.

**NOTE**

The sand deflector (24, Figure 7-1 ) can sustain any amount of damage without restricting aircraft capability as long as no sections become loose. Inspect after every flight. Replace as soon as possible and record damage.

**OPTION 1:** Tape Over Damage.

**LIMITATIONS:** Restricted from combat capable.

**PERSONNEL/TIME REQUIRED:**
- 2 Soldiers
- 15 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Green Tape or Aluminum Tape (item 150 or 153, App. C)
- Cleaning Solvent (item 7 or 129, App. C)

**PROCEDURAL STEPS:**

1. Position blades for access to damaged area. Support blades to prevent movement and droop.

2. Smooth damage; remove all rough edges.

3. Clean area around damage and completely around blade where tape is to be applied.

4. Cover hole with a chordwise layer of tape, top and bottom of blade. Extend ends of tape 2 inches beyond area of damage, Figure 7-2.

5. Wrap a second layer of tape chordwise over the first layer and around the entire blade, Figure 7-2. Overlap ends by 3 inches with outside edge of top toward trailing edge.

6. Adjust blade balance by adding approximately the same amount of tape to the opposite blade at approximately the same distance away from the hub.

7. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Skin Patch Repair (K747 blade only).

**LIMITATIONS:** None

**PERSONNEL/TIME REQUIRED:**
- 2 Soldiers
- 2 Hours

**MATERIALS/TOOLS REQUIRED:**
- Clock or Watch
- Adhesive Package (item 1 or 2 App. C)
- Skin Patch Repair Kit (items 72-77, 88-96, App. C)
- Sealing Iron (item 11, App. B)

**PROCEDURAL STEPS:**

1. Place the kit template on the blade. Position the inner circle to enclose the damage. Hold the template from slipping and draw a pencil-line around the outer circle of the template, Figure 7-3.

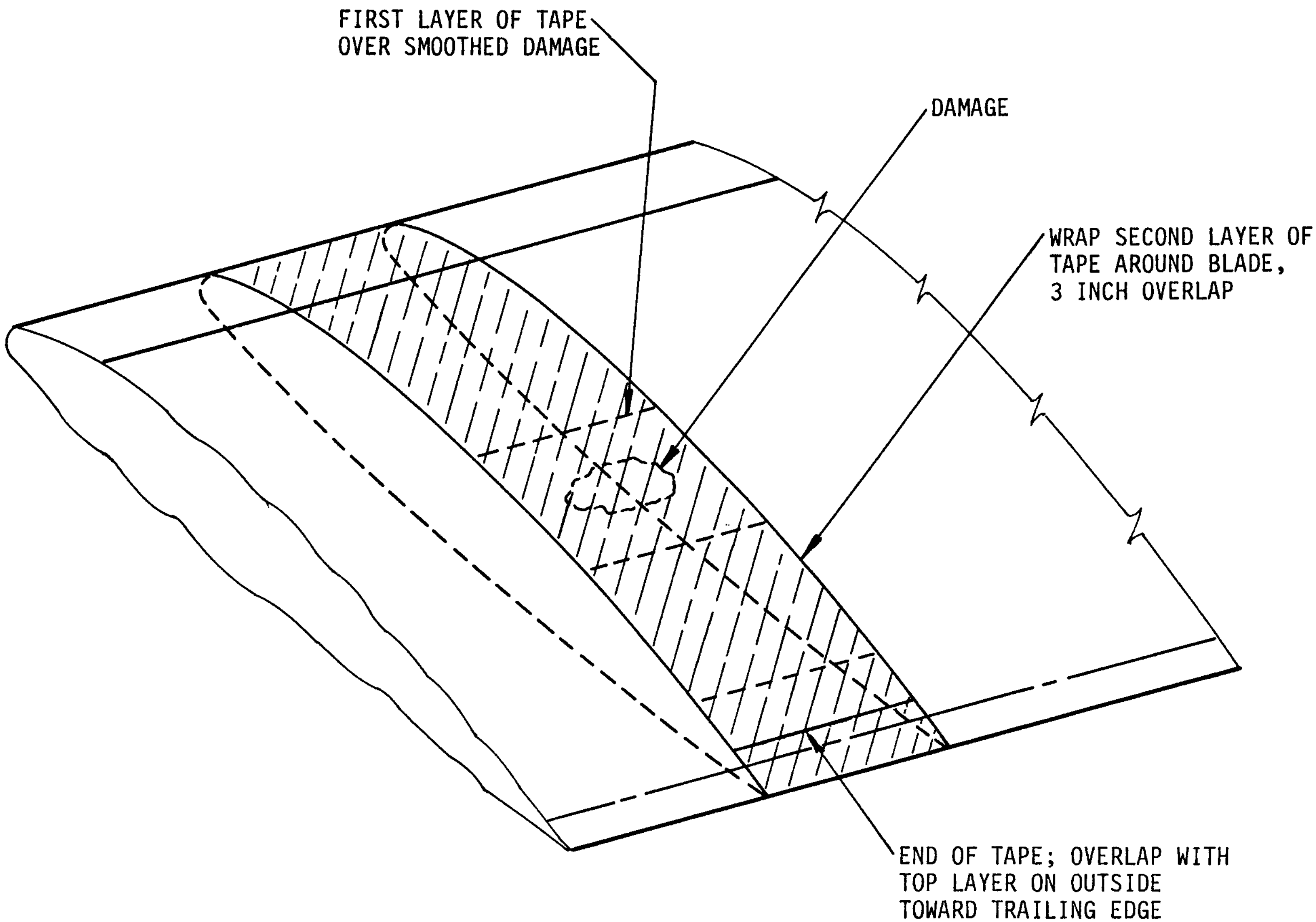



Figure 7-2. Application of Tape

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Care shall be taken to prevent solvent from entering core area of blade. Spillage shall be avoided. Solvent can damage leading edge erosion guard.

2. Put on cotton gloves (kit) and then plastic gloves (kit). Dampen cheesecloth (kit) with solvent and rub off paint from skin in area within the guide circle.

CAUTION

Excessive sanding will weaken blade skin. Sand only until yellow color is removed.

3. Starting with 120 grit and finishing with 220 grit abrasive paper (from kit), sand the paint and the yellow primer from the blade in the area within the guide circle. Sand only until yellow color is removed. Do not sand fibers. Also, sand off any damaged material raised above normal contour of blade, Figure 7-3.

4. Wipe off all sanding dust.

5. Use template to redraw guide circle.

6. Cut short lengths of the masking tape (kit) and mask around the outside of guide circle, Figure 7-4.

7. Put on cotton gloves (kit) and then plastic gloves (kit). Leave gloves on until completion of step 13.

CAUTION

Surfaces to be bonded must be clean, dry, and free of finger prints and all foreign material.

8. Dampen clean cheesecloth (kit) with solvent and clean inside masked area. Wipe with clean, dry cheesecloth before dampness evaporates.

WARNING

Adhesive contains toxic ingredients. Provide adequate ventilation and protect the skin and eyes from contact with uncured resins and curing agent. Wash off uncured resins and curing agent from skin with warm water and soap. Avoid use of solvents for cleaning human skin.

NOTE

Never mix less than a complete 32 gram two part package of adhesive. Mix the full batch and then discard the excess after the repair is completed.

9. Open the envelope containing the adhesive and empty both components of the curing agent into the cup. Stir with kit wooden spatula until both components have been throughly intermixed.

NOTE

Pot life of adhesive is 15 minutes at 72°F (22°C). It is shorter at higher temperatures. Repair procedures shall be completed without delay.

10. Using clean 1 inch brush, apply a light coat of adhesive to blade skin within guide circle and to underside of skin patch, Figure 7-4.

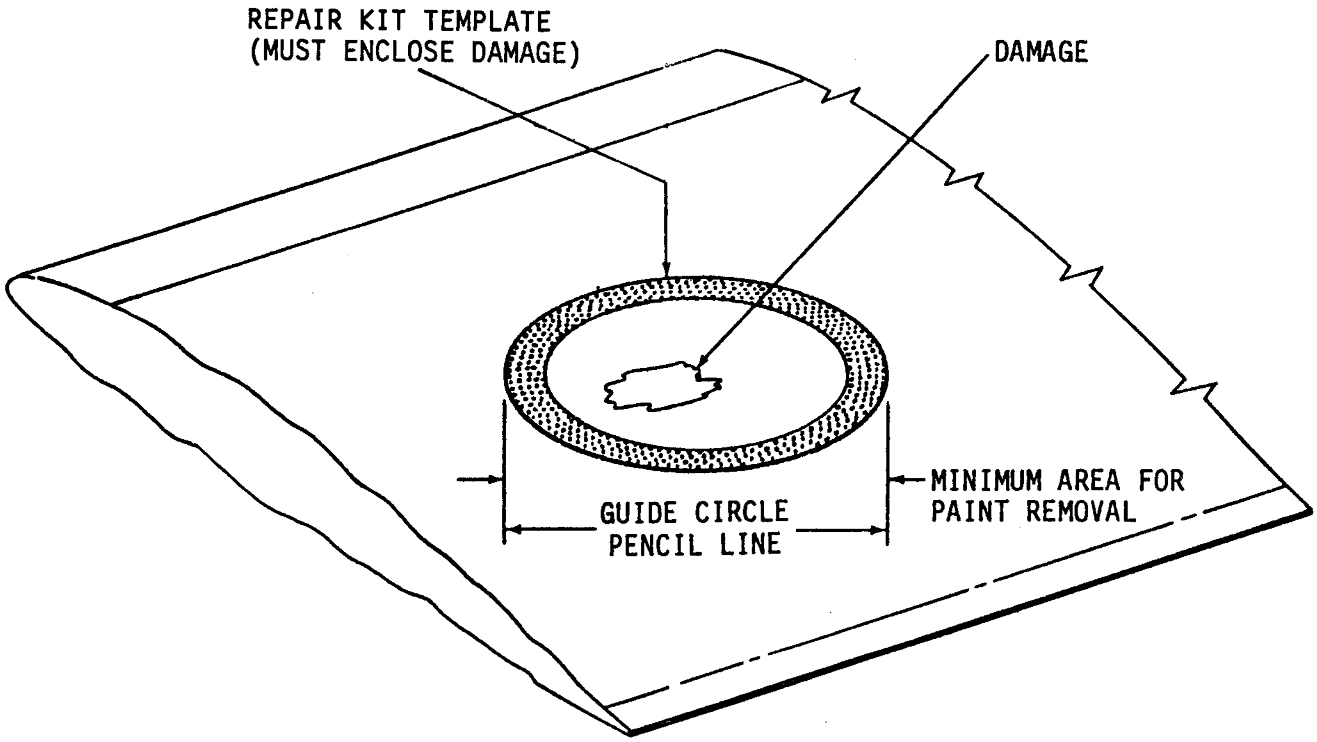



Figure 7-3. Marking Work Area

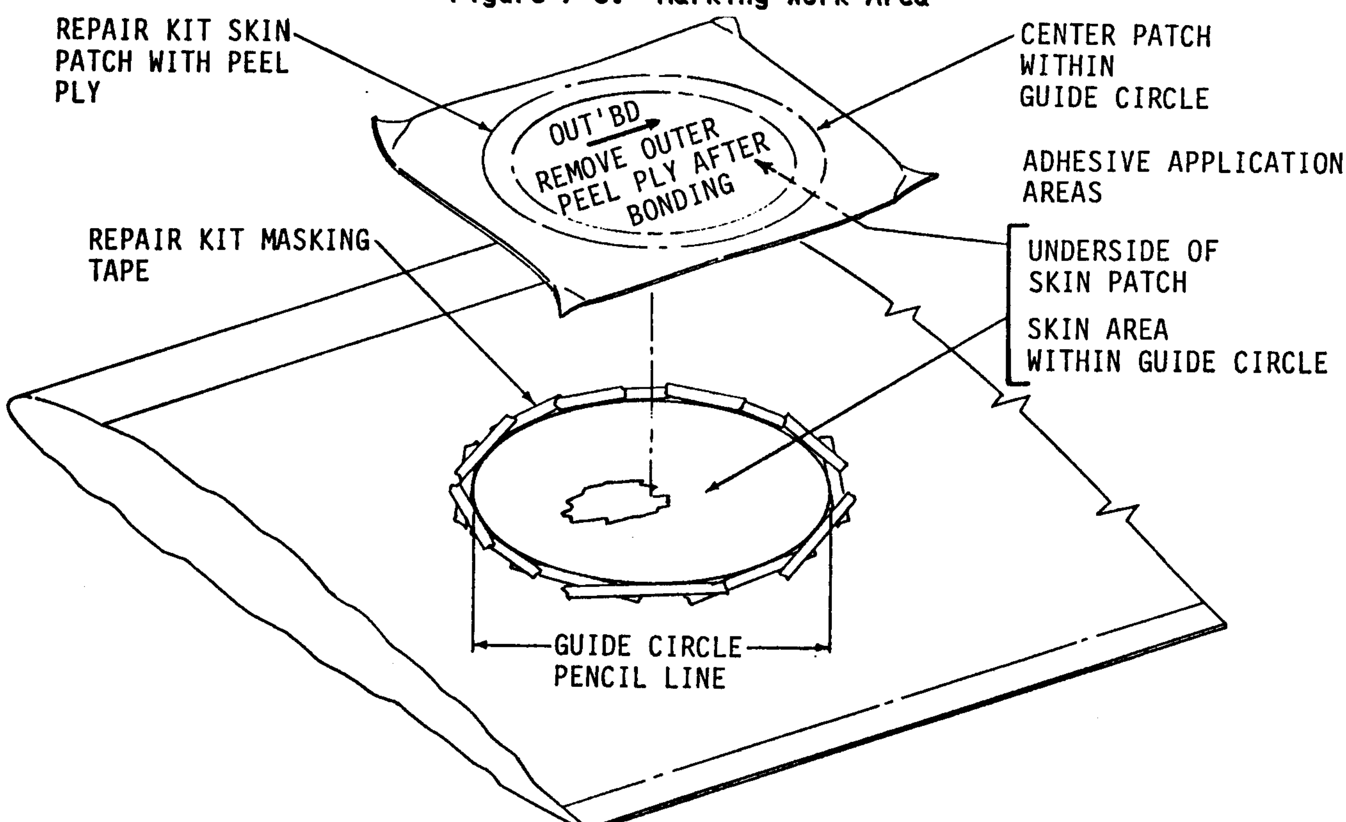



Figure 7-4. Application of Adhesive and Position of Patch

11. Center skin patch within guide circle with stenciled arrow pointing outboard (spanwise) and press firmly into place. Slide patch back and forth slightly under hand pressure to even adhesive. Use light hand pressure to squeeze the patch from the center to edge to work out any air bubbles.

**WARNING**

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

12. Using clean cheesecloth (kit) dampened with solvent, temporarily lift edges of peel-ply and wipe off excess adhesive.

13. Place masking tape over edge of patch in four places to prevent movement of patch. Place two long pieces of masking tape at right angles centered over the patch spanwise and chordwise. Remove gloves,

14. Cure patch adhesive with sealing iron

a. Connect sealing iron to 110 V ac electrical outlet and allow iron to heat up.

b. Heat patch with sealing iron for a minimum of 15 minutes to cure adhesive. Press down hard on patch and keep moving the sealing iron.

c. Following the curing time, disconnect the sealing iron.

15. Refinish repair area,

a. Remove peel-ply and masking tape from blade.

**CAUTION**

Sanding skin fibers can weaken blade.

b. Using 220 or finer grit abrasive paper, feather edge of adhesive squeezed-out around patch.

c. Painting may be deferred until termination of the emergency.

16. Adjust blade balance weights as required by Figure 7-5.

17. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## 7-5. MAIN ROTOR BLADE DAMAGE, HOLE LARGER THAN 1 INCH DIA; 1 1/2 INCHES WIDE X 4 INCHES LONG MAX.

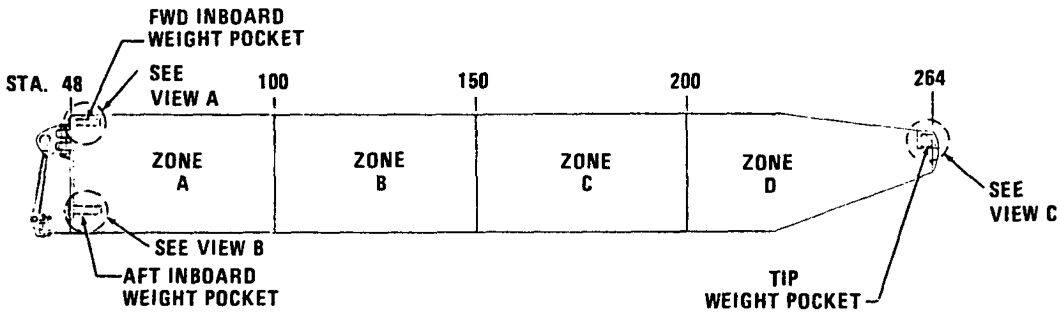
**GENERAL INFORMATION:** Size and location of repairable damage to a rotor blade is shown in Figure 7-6. Repairs can be made provided blades contain sufficient balance weight to permit adjustment of blade balance after repair. Repairs can be made while blades are installed on aircraft. Use a lead pencil to mark blades; never use a grease pencil. Damage to the shaded areas in Figure 7-6 is structurally sensitive; clean holes up to 1 inch diameter will result in partial mission capability. Smooth any such damage which extends above the external surface of the blade and cover hole with Army green tape. Inspect after every flight.

**OPTION:** Plug Patch Repair Kit (K747 blade only).

**LIMITATIONS:** None. This repair will produce Condition 1 aircraft.

**PERSONNEL/TIME REQUIRED:**
- 2 Soldiers
- 6 Hours

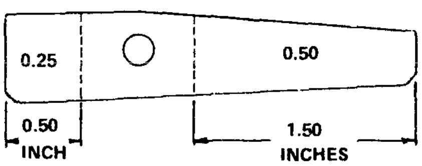
**MATERIALS/TOOLS REQUIRED:**
- Clock or Watch
- Adhesive Package (item 1 or 2, App. C)
- Plug Patch Repair Kit (items 79-84, 90-96, App. C)
- Sealing Iron (item 11, App. B)




| TYPE OF PATCH | SPANWISE CORRECTION SEE NOTES 1 AND 2 | | | | CHORDWISE CORRECTION SEE NOTE 3 |
|---|---|---|---|---|---|
| | ZONE A | ZONE B | ZONE C | ZONE D | QUANTITY OF WEIGHTS |
| TRAILING EDGE DOUBLER | 0.75 | 1.25 | 1.75 | 2.00 | 3 |
| 3 - IN. SKIN | 0.00 | 0.25 | 0.25 | 0.25 | 0 |
| 5 - IN. SKIN | 0.50 | 0.75 | 1.00 | 1.25 | 1 |
| 9 - IN. SKIN | 1.25 | 2.00 | 2.75 | 3.75 | 3 |
| 3 x 0.25 - IN. PLUG | 0.25 | 0.75 | 1.00 | 1.25 | 1 |
| 3 x 0.50 - IN. PLUG | 0.50 | 0.75 | 1.00 | 1.25 | 1 |
| 3 x 1.25 - IN. PLUG | 0.75 | 1.25 | 1.75 | 2.00 | 1 |
| 3 x 1.75 - IN. PLUG | 0.75 | 1.25 | 1.75 | 2.00 | 1 |
| 7 x 0.25 - IN. PLUG | 1.75 | 2.75 | 3.75 | 4.75 | 4 |
| 7 x 0.50 - IN. PLUG | 1.75 | 2.75 | 3.75 | 4.75 | 4 |
| 7 x 1.25 - IN. PLUG | 2.25 | 3.75 | 5.00 | 6.25 | 4 |
| 7 x 1.75 - IN. PLUG | 2.50 | 4.25 | 5.75 | 7.00 | 4 |
| EROSION GUARD PATCH | 0.50 | 0.75 | 1.00 | 1.25 | 1 |

NOTES

1. Remove listed quantity of K747-063-11 tip weights for each patch made in each zone. See view C, sheet 2.
2. To remove partial K747-063-11 tip weights, cut off 0.25 and/or 0.50 using following dimensions:




3. Move listed quantity of K747-056-11 weight washers from aft inboard weight pocket to forward inboard weight pocket for each blade patch made. See views A and B, sheet 2.
4. For each leading edge erosion guard patch made, move one K747-056-11 weight washer from forward inboard weight pocket to aft inboard weight pocket. See views A and B, sheet 2.
5. If a single patch is in two zones, use data for the most outboard of the two zones.

Figure 7-5. Balance Adjustment for Patches (K747 Blade) (Sheet 1 of 2)

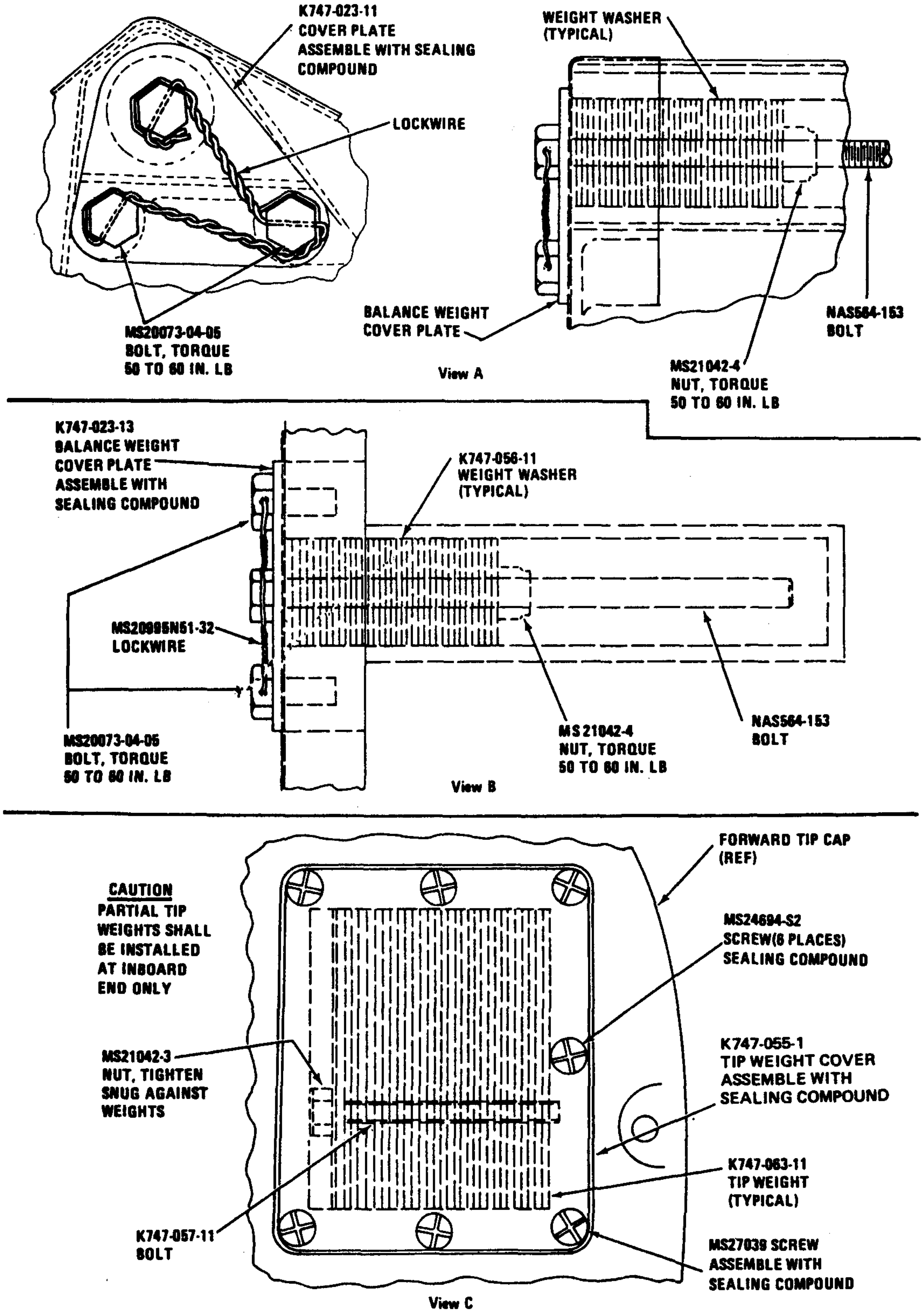
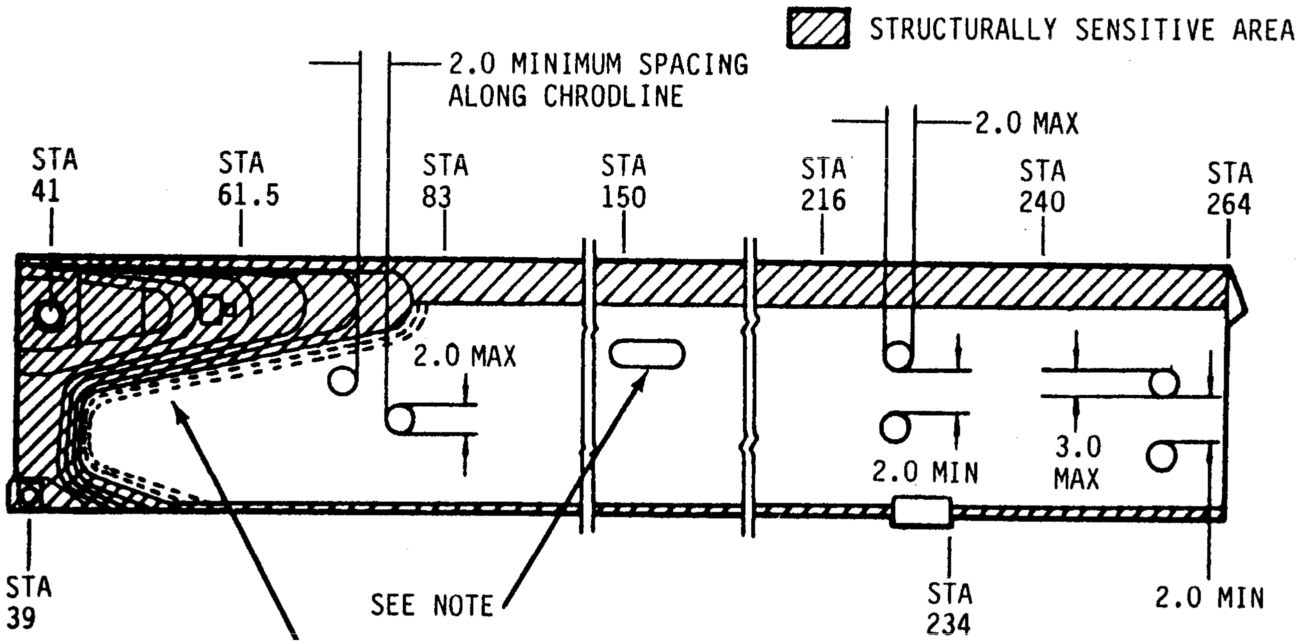



Figure 7-5. Balance Adjustment for Patches (K747 Blade) (Sheet 2 of 2)




NO PATCHES PERMITTED
WITHIN ONE INCH OF
DOUBLERS OR FRONT SPAR

NOTE

AN OBLONG HOLE IS PERMISSIBLE IF THE GENERAL DIRECTION OF THE HOLE IS WITHIN 15 DEGREES OF A LINE PARALLEL TO THE LEADING OR TRAILING EDGE OF THE BLADE. MAXIMUM SIZE OF THE HOLE SHALL NOT EXCEED 1.5 INCHES WIDE BY 4 INCHES LONG. THE ENDS OF THE HOLE MUST HAVE A MINIMUM RADIUS OF 0.25 INCH TO BREAK CORNERS.

Figure 7-6. Maximum Allowable Repairable Damage to Rotor Blade

PROCEDURAL STEPS:

1. Position blade for access to damaged area. Support blade to prevent movement and droop.

2. Measure diameter and depth of damage.

3. Obtain plug patch repair kit no larger than necessary to replace damage. A core void 1 inch or less in diameter is permitted after repair. Plug patch kits are available as shown in Table 7-2.

Table 7-2. Patch Kits

| KIT PART NO. | DIAMETER | THICKNESS |
|---|---|---|
| 70072-15001-015 | 3.00 inch | 1/4 inch |
| 70072-15001-016 | 3.00 inch | 1/2 inch |
| 70072-15001-017 | 3.00 inch | 7/8 inch |
| 70072-15001-018 | 6.00 inch | 1/4 inch |
| 70072-15001-019 | 6.00 inch | 1/2 inch |
| 70072-15001-020 | 6.00 inch | 7/8 inch |

4. Damage deeper than 7/8 inch can be repaired with a single patch. Damage that passes completely through blade and is larger than 1 inch diameter will be repaired by installing plug patches from both top and bottom sides of blade. Install larger diameter and thicker plug patch first, Figure 7-7.

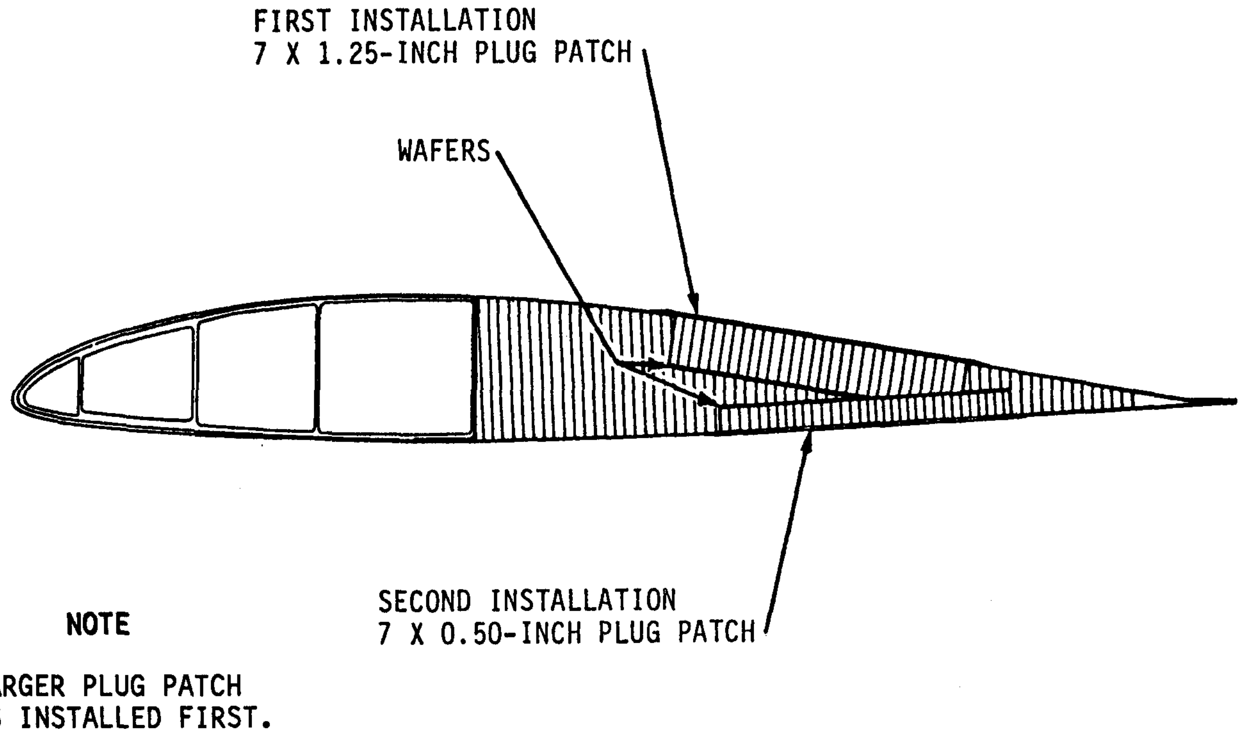



Figure 7-7. Typical Double Plug Patch Repair

5. Obtain at least four adhesive packages.

6. Obtain proper size plug patch kit, Table 7-2. Select proper template from kit. Use 3 to 7 inch template for 3 inch plug and 6 to 10 inch template for 6 inch plug.

7. Place the kit template on the blade. Position the inner circle to enclose the damage. Hold the template from slipping and draw pencil lines around the inner and outer circles of the template, Figure 7-8.

**WARNING**

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Care shall be taken to prevent solvent from entering core area of blade. Spillage shall be avoided.

8. Put on cotton gloves (kit) and then plastic gloves (kit). Dampen cheesecloth (kit) with solvent and rub off paint from-skin in area between circles A and B. Remove gloves.

CAUTION

Excessive sanding will weaken blade skin. Sand only until yellow color is removed.

9. Sand the paint from the blade area between circles A and B. Start with 120 grit, and finish with 220 grit abrasive paper. Sand only until yellow color is removed. Do not sand skin fibers, Figure 7-8.

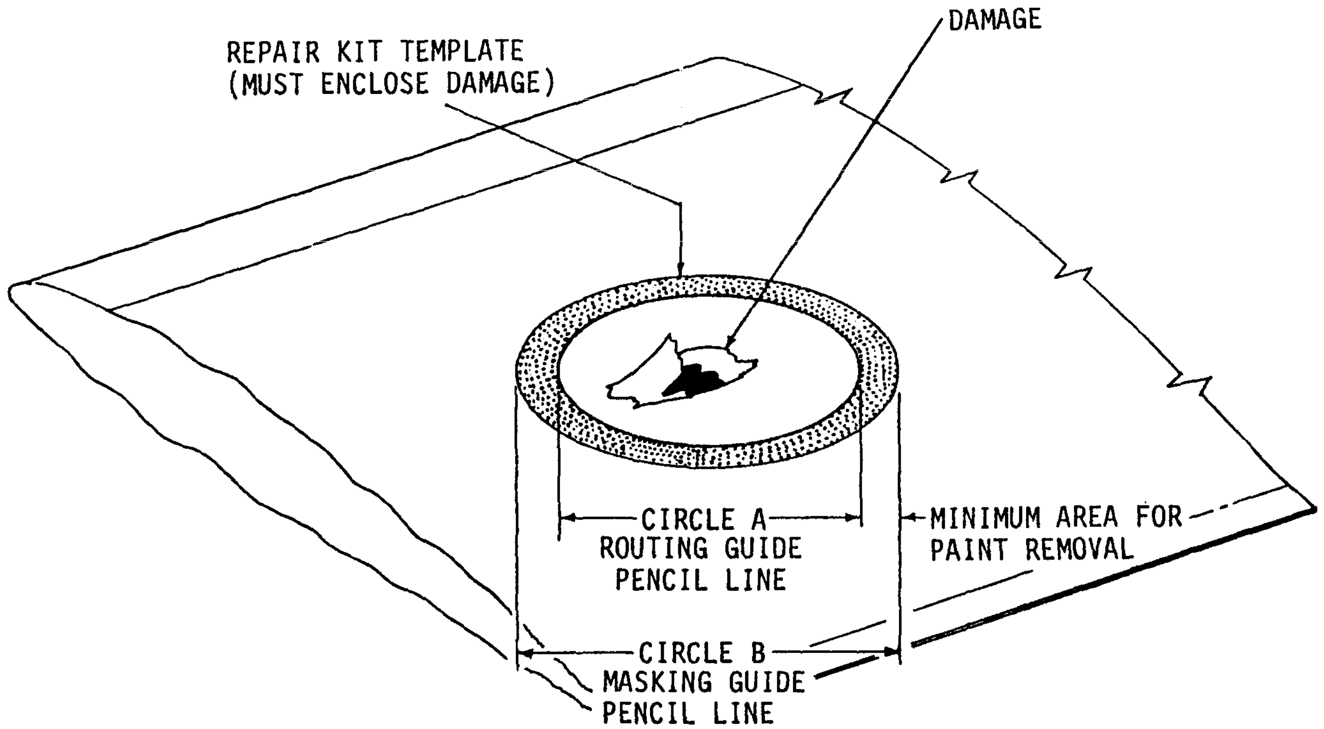



Figure 7-8. Marking Work Area

10. Redraw circle A. This circle is the routing guideline.

WARNING

- Disconnect router cord from outlet before changing or installing bits or end mills, or making adjustments. Ensure router switch is in off position before connecting router to electrical power. Keep hands and fingers away from rotating bits and end mills. Guide router with both hands on router grip. Use personnel protection equipment (e.g., respirator, goggles, apron, etc.).

- Adhesive contains toxic ingredients. Provide adequate ventilation and protect the skin and eyes from contact with uncured resins or curing agent. Wash off uncured resins and curing agent from skin with warm water and soap. Avoid use of solvents for cleaning human skin.

CAUTION

During all routing operations, long dimension of route base shall be kept in spanwise direction. End mills will burn out if used to cut skin.

11. Insert rasp-type bit, P/N 4-BR, in router collet.

12. Set router depth of cut for 0.020 inch.

13. Moving in a clockwise direction, route a complete circle through the skin, inside of, and following circle A, Figure 7-9.

14. Using duckbill pliers, lift the edge of the cut circle of skin and peel the cut circle of skin off core, Figure 7-9.

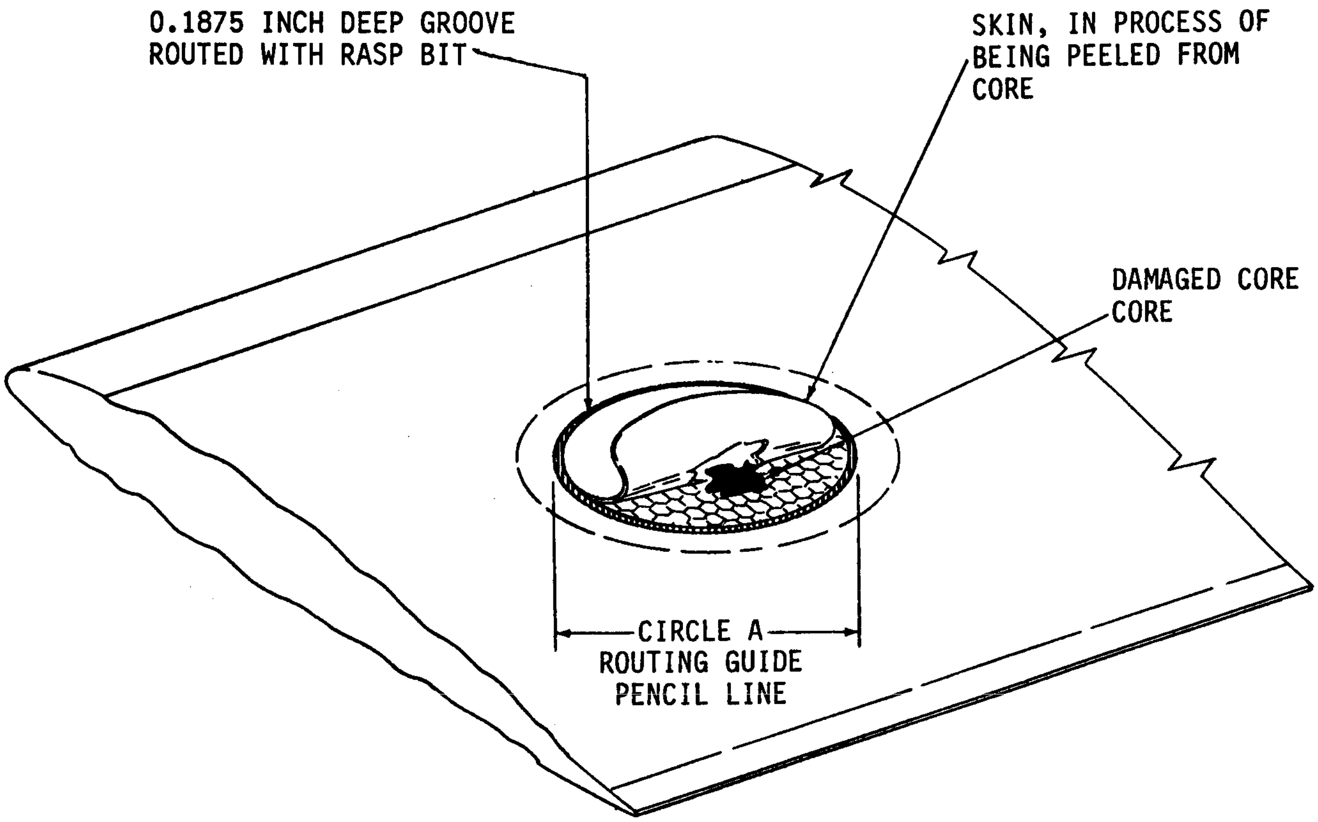



Figure 7-9. Removal of Damaged Skin

15. After removing skin, check depth of core at trailing edge of circle. If the core thickness at the trailing edge side is less than the depth of plug selected, a more shallow plug must be used.

16. Insert end mill in router collet.

17. Set router depth of cut to match depth of plug plus thickness of kit wafer, Figure 7-10.

18. Route out core. First route a complete circle following inside circle A. Then route out remainder of core moving router in chordwise direction, Figure 7-11.

CAUTION

Do not damage the spar and trailing edge during routing. The spar and trailing edge can be located by using Figure 7-6. Spare, core, and trailing edge assembly areas underlying the skin also can be verified by the difference in sound when the blade surface is tapped with a coin.

19. Wipe off all cuttings, sanding dust, etc. from repair area.

20. Use template to redraw circle B.

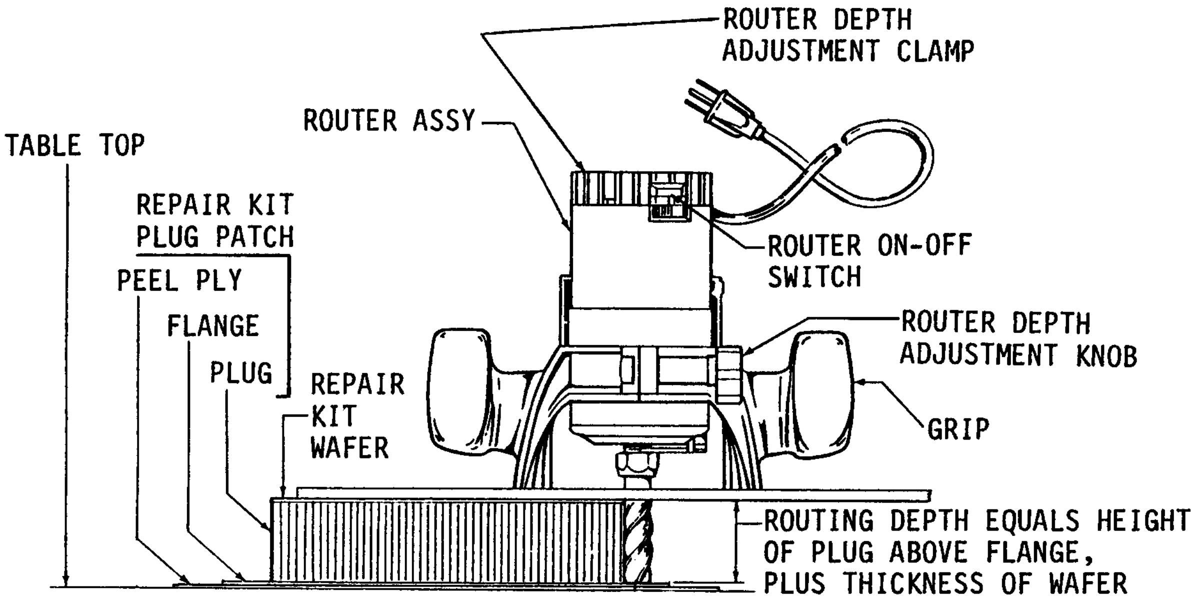



Figure 7-10. Setting Router Depth

21. Cut short lengths of the masking tape (kit) and mask around the outside of circle B, Figure 7-11.

22. Put on cotton gloves (kit) and then plastic gloves (kit). Leave gloves on until completion of step 30.

CAUTION

Surfaces to be bonded must be clean, dry, and free of finger prints and all foreign matter.

23. Dampen clean cheesecloth (kit) with solvent and clean skin inside masked area. Also, clean both sides of kit wafer and underside of plug patch flange. Wipe with clean, dry cheesecloth before dampness evaporates.

NOTE

- Wafer may be larger than cutout and have to be trimmed down.

- Never mix less than a complete 32 gram two part package of adhesive. When less than a full batch is required, mix the full batch and then discard the excess after the repair is completed.

24. Open the envelope containing the adhesive and empty both components of the curing agent into the cup. Stir with wooden spatula (kit) until both components have been throughly intermixed. Repeat if more than one package is required.

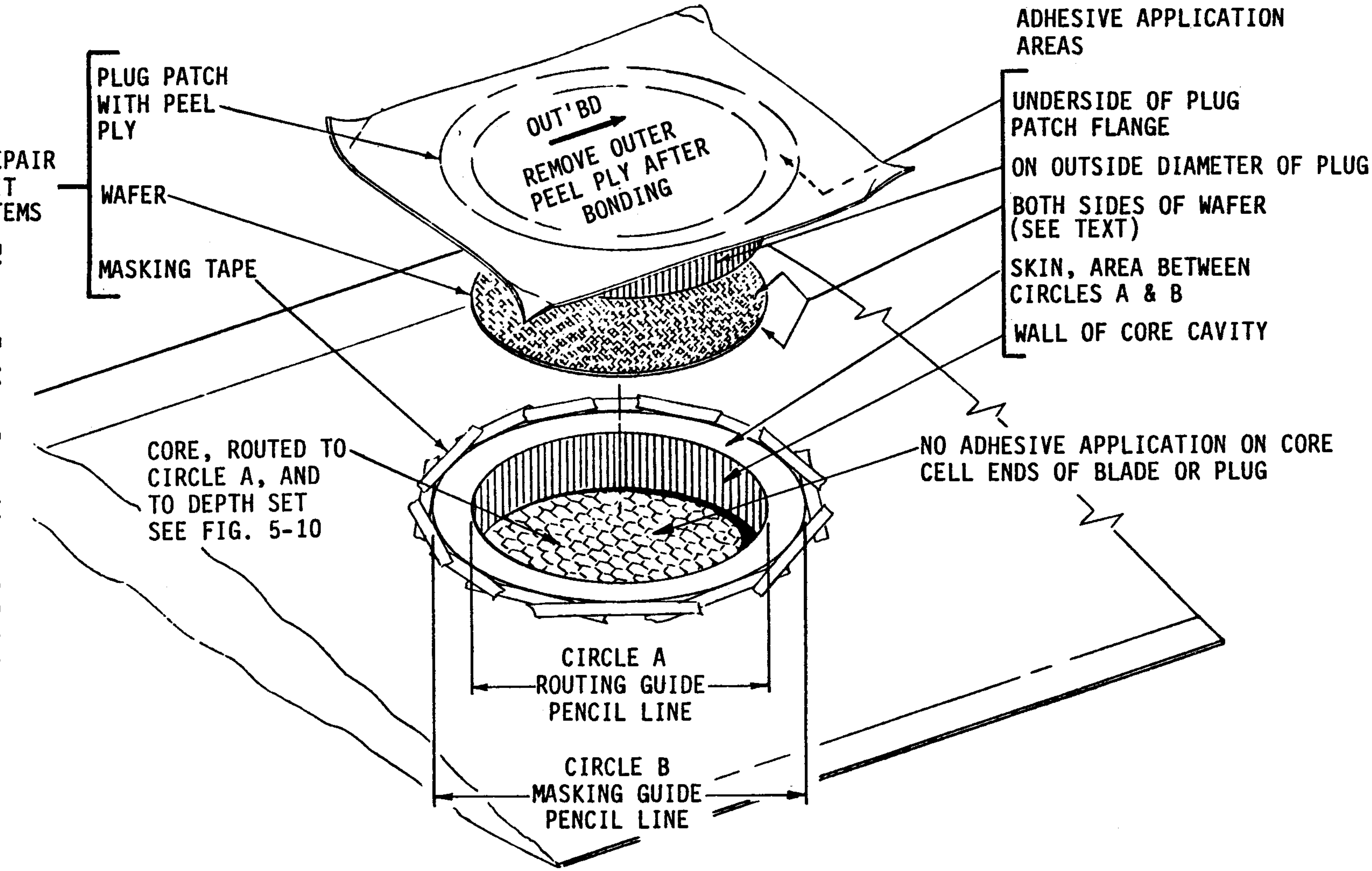



Figure 7-11. Insertion of Patch

NOTE

Pot life of adhesive is 15 minutes at 72°F (22°C). It is shorter at higher temperatures. Repair procedure shall be completed without delay.

25. Using clean 1 inch brush (kit), apply a liberal coat of adhesive to one side of wafer (kit), Figure 7-11.

a. If repair is on top of blade, place wafer in routed cavity with adhesive side down.

b. If repair is on bottom of blade, place wafer in routed cavity with adhesive side up.

CAUTION

Adhesive should not be packed into cells of blade core or plug patch. Excess adhesive can cause blade to be out of balance.

26. Using spatula or brush (kit), apply a liberal coat of adhesive to walls of cavity in blade core.

27. Using brush (kit), apply a light coat of adhesive to:

a. blade skin in masked off area around core cavity,

b. plug patch flange surrounding plug,

c. outside diameter of plug, and

d. second side of wafer (wafer was previously coated and placed in step 25).

28. Position plug patch in cavity with stenciled arrow pointing outboard (spanwise) and press firmly into place.

29. Use light hand pressure to squeeze patch area overlapping blade skin to expel excess adhesive and air bubbles.

30. Using clean cheesecloth (kit) dampened with solvent, temporarily lift edges of peel-ply and wipe off excess adhesive. Remove gloves.

31. Place two long pieces of masking tape at ring angles centered over the patch spanwise and chordwise.

32. Cure patch adhesive with sealing iron.

a. Connect sealing iron to 110 V ac aircraft electrical outlet and all ow iron to heat up.

b. Heat patch with sealing iron. for a minimum of 15 minutes to cure adhesive. Press down hard on patch and keep moving the sealing iron.

c. At end of the curing time, disconnect electrical power.

33. Refinish repair area.

a. Remove peel-ply and masking tape from blade.

CAUTION

Sanding skin fibers can weaken blade skin.

Using 220 grit abrasive paper (kit), feather edge of adhesive squeeze-out around plug patch.

c. Painting may be deferred until termination of the emergency.

34. Adjust blade balance wei ghts as required by Figure 7-5.

35. Record BDAR action taken When mission is complete. as soon as practical, repair the equipment/system using standard maintenance procedures.

## 7-6. LATERAL VIBRATIONS.

GENERAL INFORMATION:

a. To correct lateral vibrations, the barrel of the drag brace should be turned in small increments in the direction of the arrows on the decal on the barrel, Figure 7-12. There is a continuous red line on the barrel and adjacent bosses indicating the zero position, and adjustments may only be made by turning the barrel in the direction of the arrow away from the red line.

b. Occasionally, any adjustment in the direction of the arrow past the red line will not correct, or will even increase, lateral vibration. This procedure may correct this condition.

OPTION: Balance Weight Adjust.

LIMITATIONS: None

PERSONNEL/TIME REQUIRED:
- 2 Soldiers
- 30 Minutes

MATERIALS/TOOLS REQUIRED:
- Comnon Hand Tools

PROCEDURAL STEPS:

1. Rotate barrel opposite to the direction indicated by the arrow on the decal back to the zero position so that the red line on the barrel lines up with the lines on the adjacent bosses.

2. Turn the barrel in small increments in the direction opposite the arrow. Total adjustment in this direction may not exceed 1/3 of a turn.

2. Flight test after each adjustment.

3. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

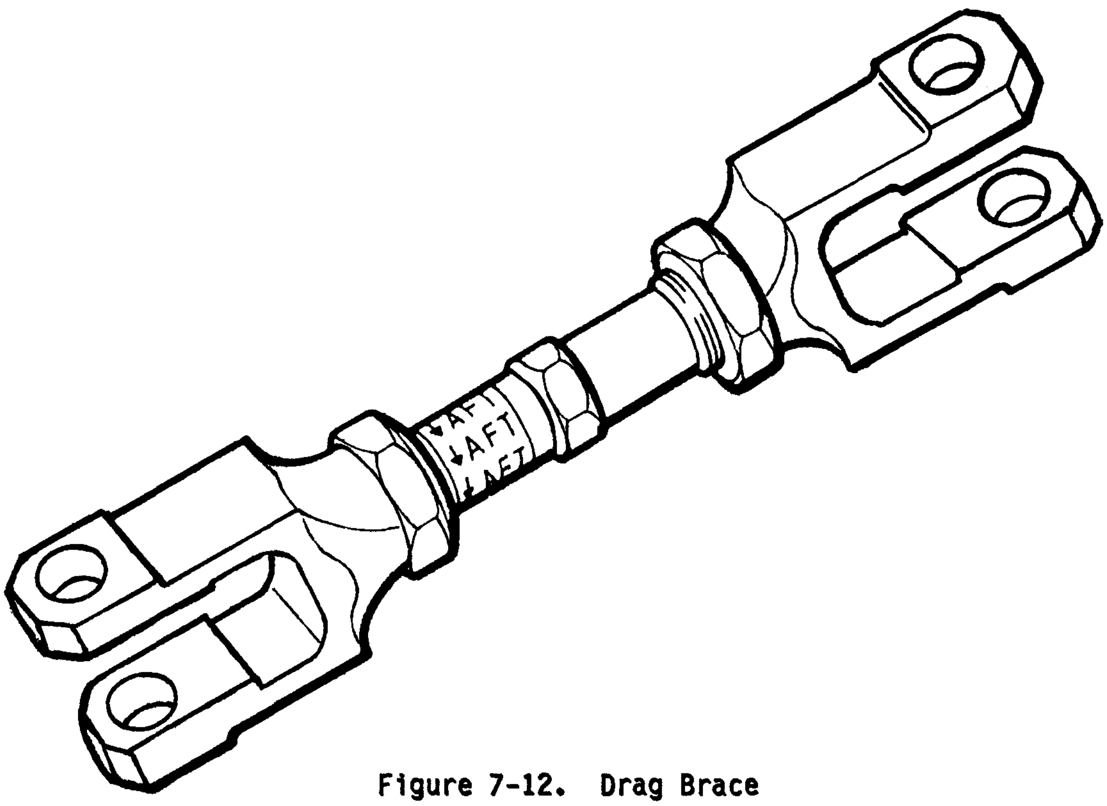



**Figure 7-12. Drag Brace**

## Section III. TAIL ROTOR SYSTEM

**7-7. GENERAL.** The tail rotor system, Figure 7-13, performs a critical roll in maintaining helicopter controllability. All damage and repair to this system should be considered critical in nature. Damaged linkages, bolts, hardware, or hub must be replaced with spares or cannibalized parts. Tail rotor gearbox damage is covered in Chapter 8. Flight control tubes and cables are covered in Chapter 13.

**7-8. TAIL ROTOR BLADE DAMAGE.**

**GENERAL INFORMATION:** Damage to the tail rotor blade that results in a crack or hole in the skin and is located in the authorized area for repair, Figure 7-14, maybe patch repaired.

**OPTION:** Patch Hole in Blade

**LIMITATIONS:** Maximum size of damage should not exceed 1-1 /2 inches.

**PERSONNEL/TIME REQUIRED:**
- 2 Soldiers
- 2 Hours

**MATERIAL/TOOLS REQUIRED:**
- Aluminum Skin Patches (items 72-77, App. C)
- Sealant (item 123, App. C)
- Sheet Metal Snips
- Rivets (items 98-101, App. C)
- Rivet Gun (items 8-10, App. B)
- Green Tape or Aluminum Tape (item 150 or 153, App. C)

**PROCEDURAL STEPS:**

1. Position blade for access to damaged area.

2. Smooth damage; remove all rough edges.

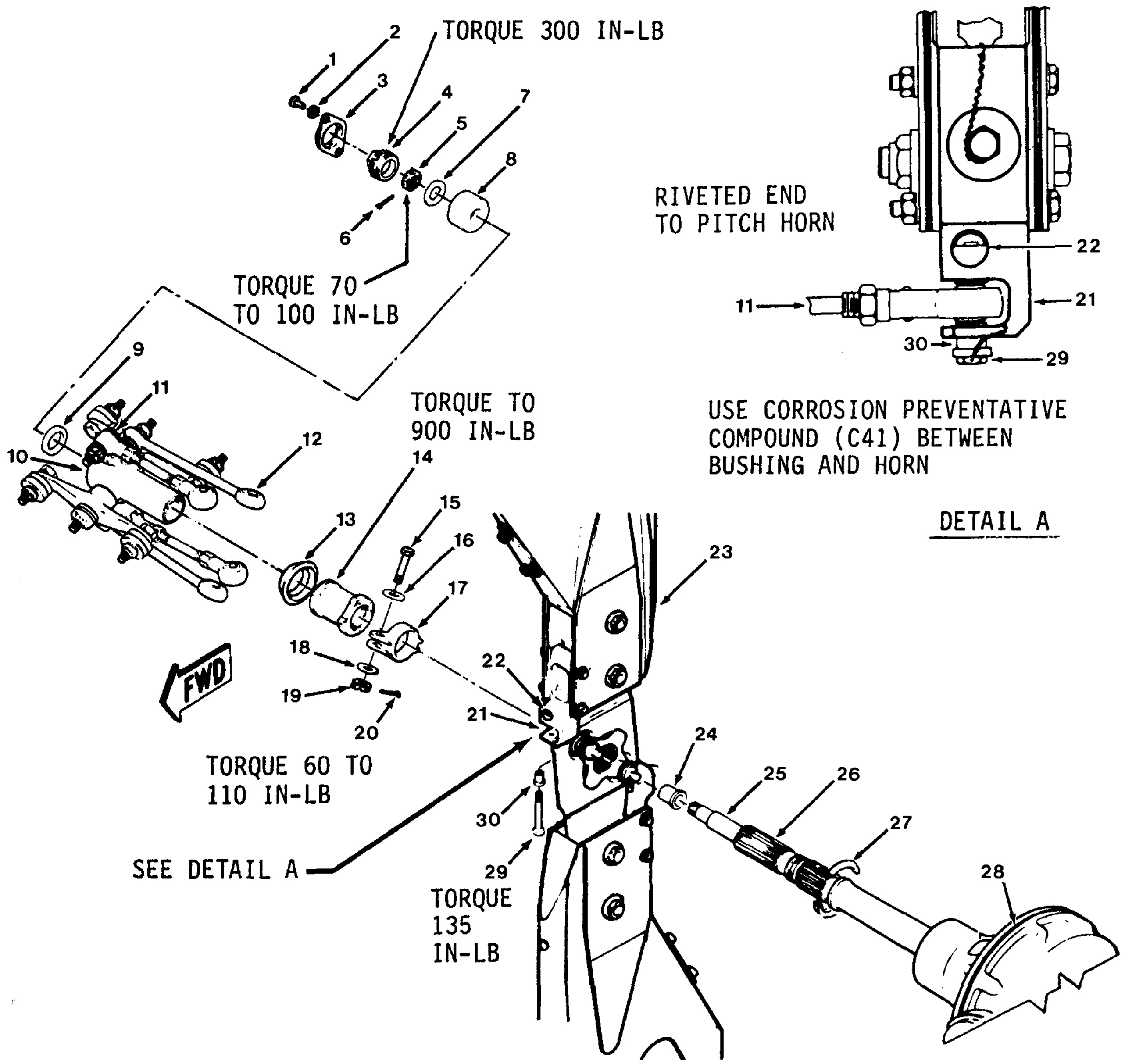
3. Clean area around damage and completely around blade where tape will later be applied.

4. Cut out an aluminum skin patch so that it overlaps hole by at least 1 inch on all sides, Figure 7-15.

5. Apply sealant to underside of skin patch, against blade, and place over hole.

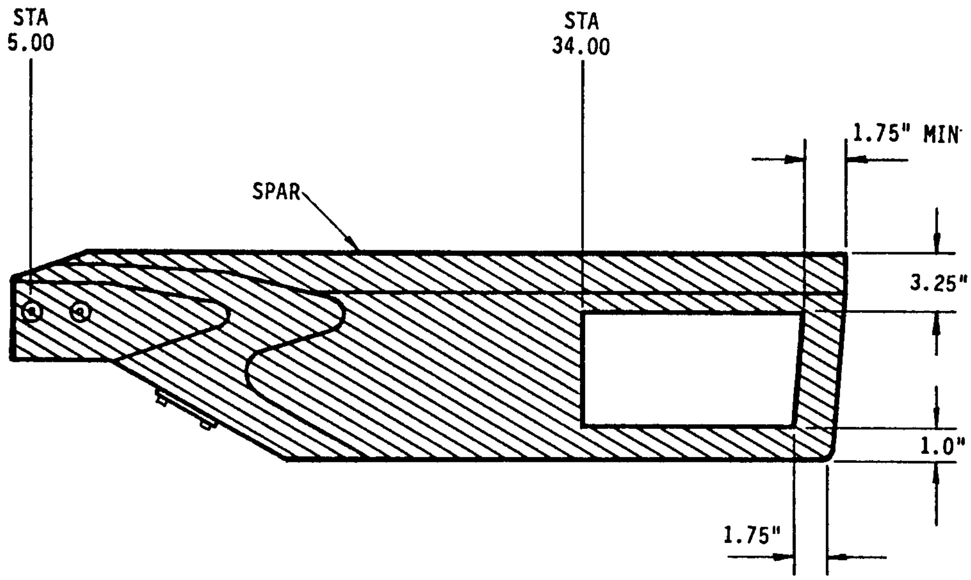
6. Wrap a layer of tape over skin patch and completely around entire blade to give repaired area a more streamlined surface, Figure 7-16.

7. Adjust blade balance by adding approximately the same amount of tape to the opposite blade at approximately the same distance away from the hub.



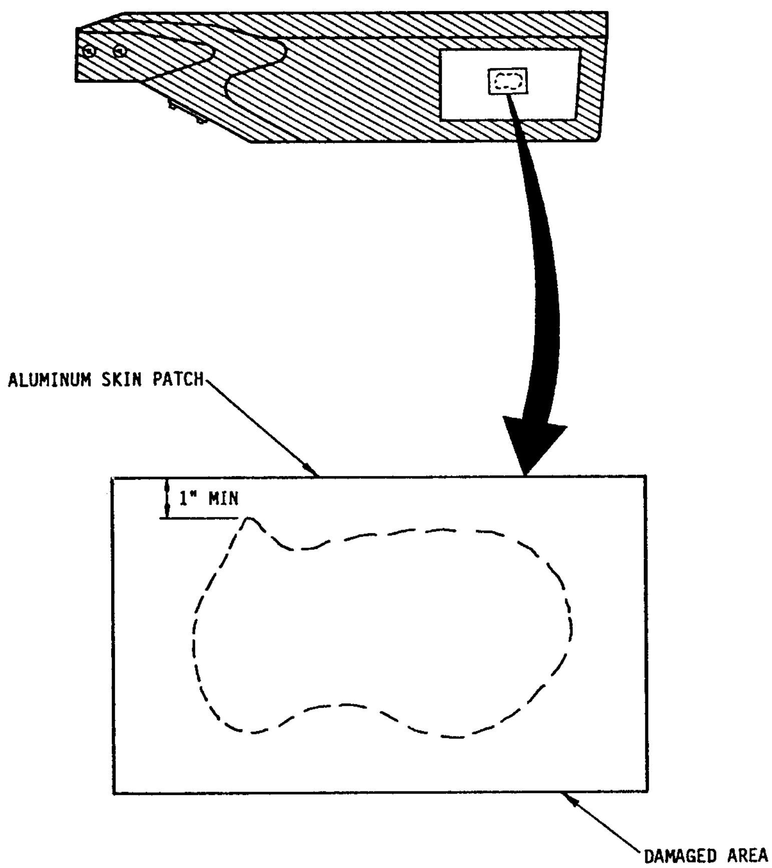

| | | |
|---|---|---|
| 1. Screw | 11. Pitch Link | 21. Pitch Horn |
| 2. Washer | 12. Counterweight Link | 22. Barrel Nut and Retainer |
| 3. Lock | 13. Shield | 23. Hub and Blade Assembly |
| 4. Retainer | 14. Retaining Nut | 24. Sleeve |
| 5. Nut | 15. Bolt | 25. Control Tube |
| 6. Cotter Pin | 16. Washer | 26. Gearbox Output Shaft |
| 7. Steel Washer | 17. Counterweight Support | 27. Split Cone Set |
| 8. Bearing | 18. Washer | 28. Tail Rotor Gearbox |
| 9. Nylatron Washer | 19. Nut | 29. Bolt |
| 10. Crosshead | 20. Cotter Pin | 30. Bushing |

Figure 7-13. Tail Rotor Installation



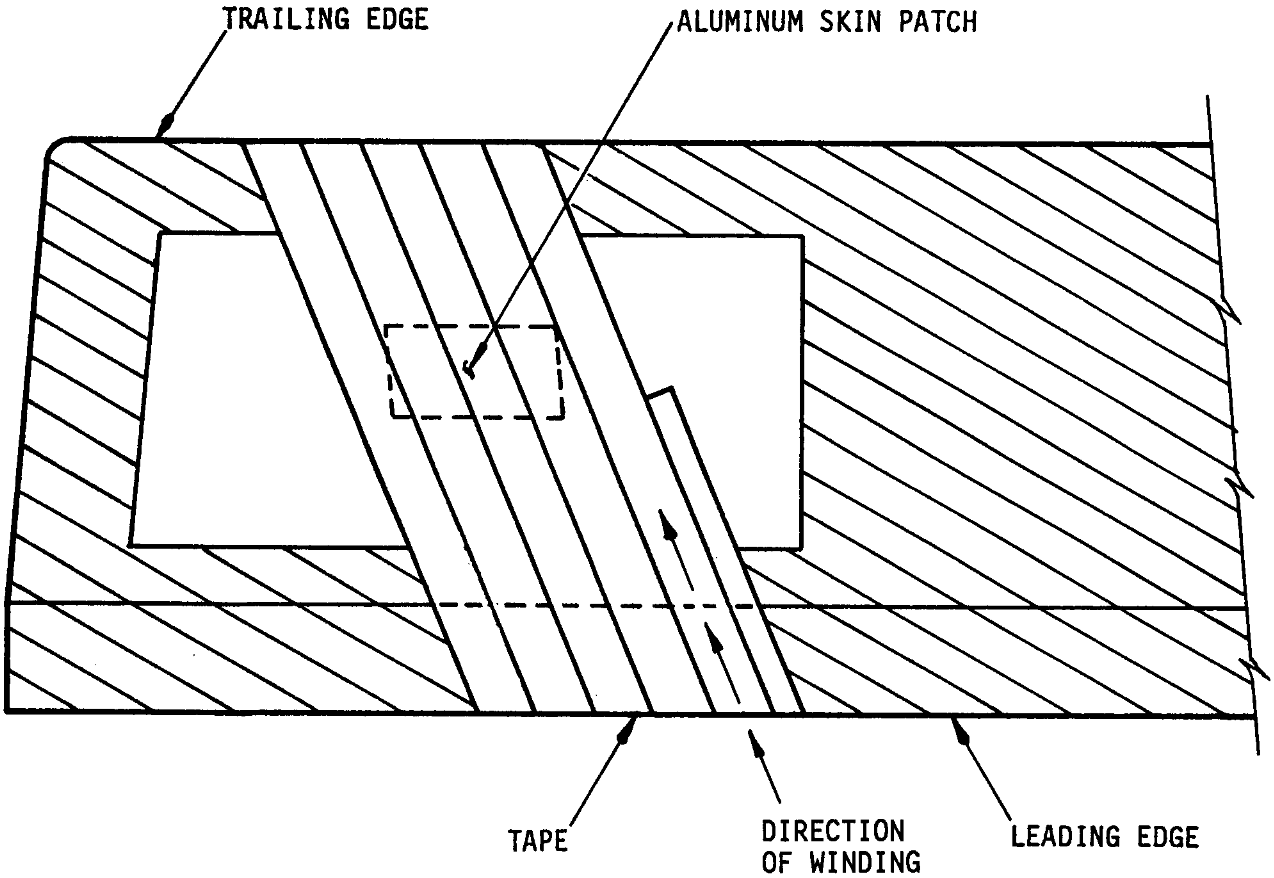

NOTE: NO REPAIR PERMITTED IN HATCHED AREA.

Figure 7-14. Tail Rotor Blade-Area Authorized for Patch-Type Repair




NOTE: NO REPAIR PERMITTED IN HATCHED AREA.

Figure 7-15. Aluminum Skin Patch




NOTE: NO REPAIR PERMITTED IN HATCHED AREA

Figure 7-16. Skin Patch Tape Cover

# CHAPTER 8

# DRIVE TRAIN 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

### 8-1. SCOPE.

a. This chapter contains the fault assessment and expedient repair procedures for locating and fixing damage to the drive train system.

b. The drive train is a system of shafts and gearboxes through which the engine drives the main rotor, tail rotor, and such accessories as rotor tachometer, generator, and hydraulic pump. Figure 8-1 shows an overall view of the drive train system on the aircraft.

### 8-2. ASSESSMENT PROCEDURES.

a. The drive train system includes a number of components which cannot tolerate damage. If such components are damaged or deformed (bent) in any way or fail internally, the drive train system is inoperable and safety is severely degraded if component is not replaced.

b. Refer to Table 8-1 for fault assessment logic flow.

### 8-3. REPAIR PROCEDURE INDEX.

| | PARA |
|---|---|
| Oil Pressure Switch Leak | 8-5 |
| Oil Pressure Transmitter Leak | 8-6 |
| Oil Filter Leak | 8-7 |
| Sump Outlet Hose Leak | 8-8 |
| Transmission Ballistic Damage | 8-9 |
| Gearbox Damage | 8-10 |
| Dents or Ballistic Damage to Shafts | 8-12 |

## Section II. TRANSMISSION

**8-4. GENERAL.** The transmission should be evaluated carefully for ballistic damage that may have cracked the cases. Small holes may be plugged and repaired. Damage that may propagate cracks, causing failure or separation, are of greatest concern. External damage to fittings or accessories can often be bypassed or repaired.

### 8-5. OIL PRESSURE SWITCH LEAK.

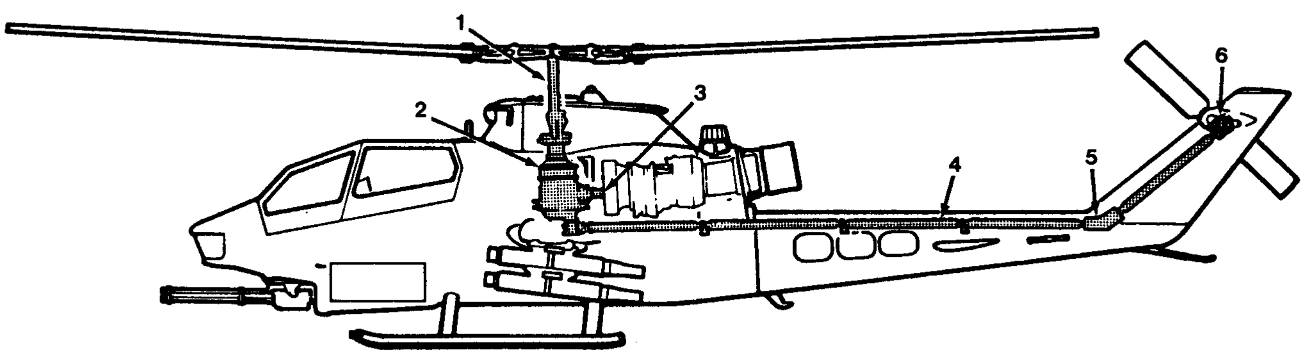
**GENERAL INFORMATION:** If oil is being lost due to damage at the oil pressure switch, eliminate switch from oil system.

**WARNING**

Turbine fuels and lubricating oils contain additives which are poisonous and readily absorbed through the skin. Do not allow them to remain on skin longer than necessary. Wear protective equipment.

**OPTION:** Remove Pressure Switch.

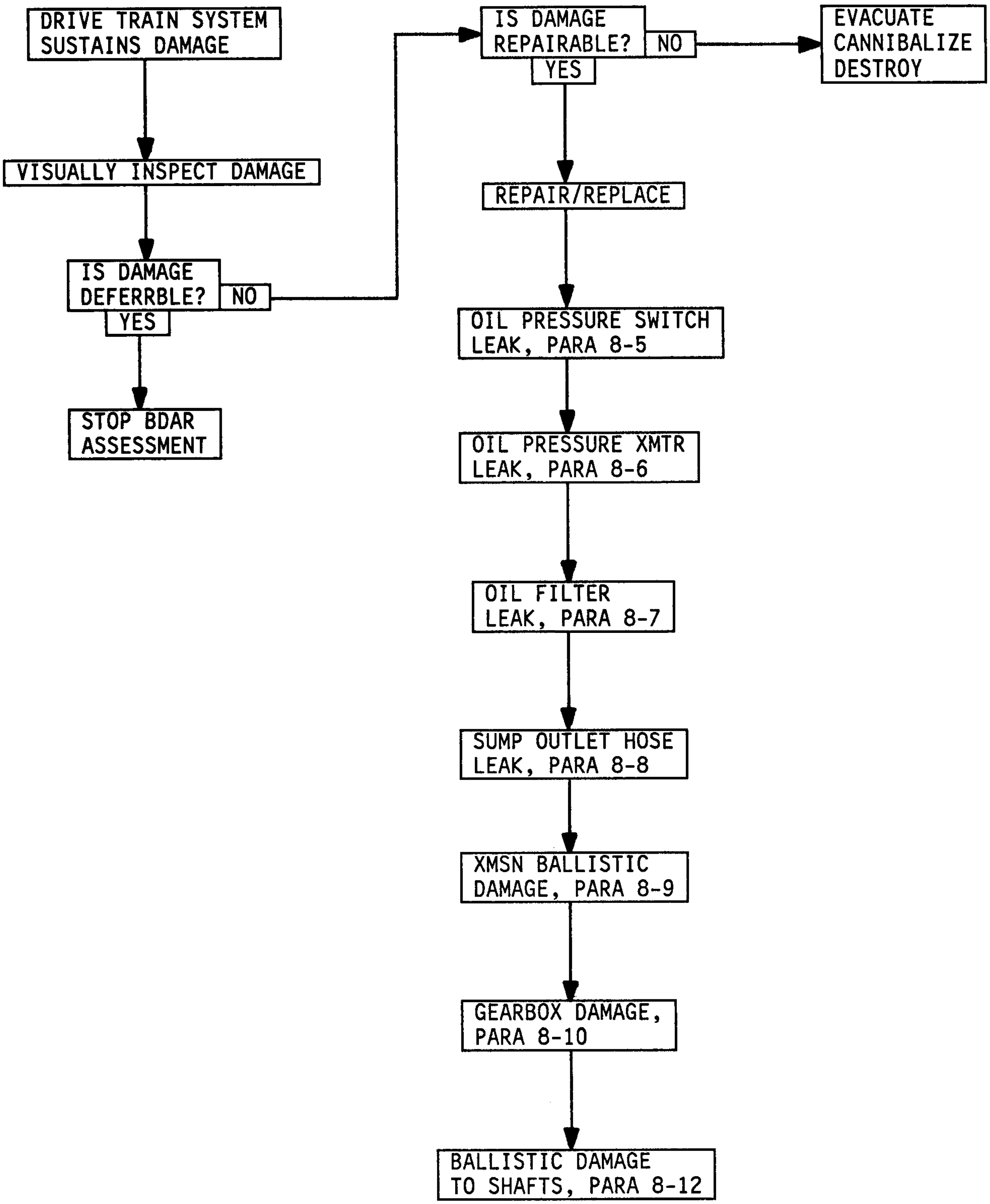
**LIMITATIONS:** Early warning of low oil pressure will be unavailable since Trans Oil Pressure segment at caution panels are inoperable. Oil pressure could be monitored at oil pressure gage, provided transmitter (3, Figure 8-2) is operable.




1. Mast
2. Transmission
3. Main Driveshaft
4. Tail Rotor Driveshaft
5. Intermediate Gearbox
6. Tail Rotor Drive Gearbox

Figure 8-1. Drive Train (Typical)

**Table 8-1. Drive Train Assessment Procedures**



**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 15 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Cable Ties (item 26 or 27, App. C)
- Fluid Repair Kit (item 4, App. B)
- Safety Wire (items 60-62, App. C)
- Packing Assortment (item 71, App.C
- Towels (item 161, App. C)

1. Cut safety wire and remove electrical connector from pressure switch (1).

2. Cut safety wire and remove pressure switch (1) and o-ring (2). Retain o-ring.

3. Install plug with o-ring (2) where switch(1) was removed.

4. Check for leaks.

5. Secure loose electrical connector with tie wraps.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

### 8-6. OIL PRESSURE TRANSMITTER LEAK.

**GENERAL INFORMATION:** If oil is being lost due to damage at oil pressure transmitter, eliminate the transmitter from the system.

**OPTION:** Remove Pressure Transmitter.

**LIMITATIONS:** Indication of oil pressure conditions would be eliminated since oil pressure gage would be inoperable. Caution panels would give early warning for low pressure conditions, provided switch (1, Figure 8-2) is still operable.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 15 Minutes

**MATERIAL/TOOLS REQUIRED:**
- Cable Ties (item 26 or 27, App. C)
- Fluid Repair Kit (item 4, App. B)
- Safety Wire (items 60-62, App. C)
- Packing Assortment (item 71, App. C)

**PROCEDURAL STEPS:** (Refer to Figure 8-2.)

1. Cut safety wire and remove electrical connector from pressure transmitter (3).

2. Cut safety wire and remove pressure transmitter (3) and o-ring (4). Retain o-ring.

3. Install plug with o-ring (4) where transmitter (3) was removed.

4. Check for leaks.

5. Secure loose electrical connector with tie wraps.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

### 8-7. OIL FILTER (EXTERNAL ASSEMBLY AREA LEAK).

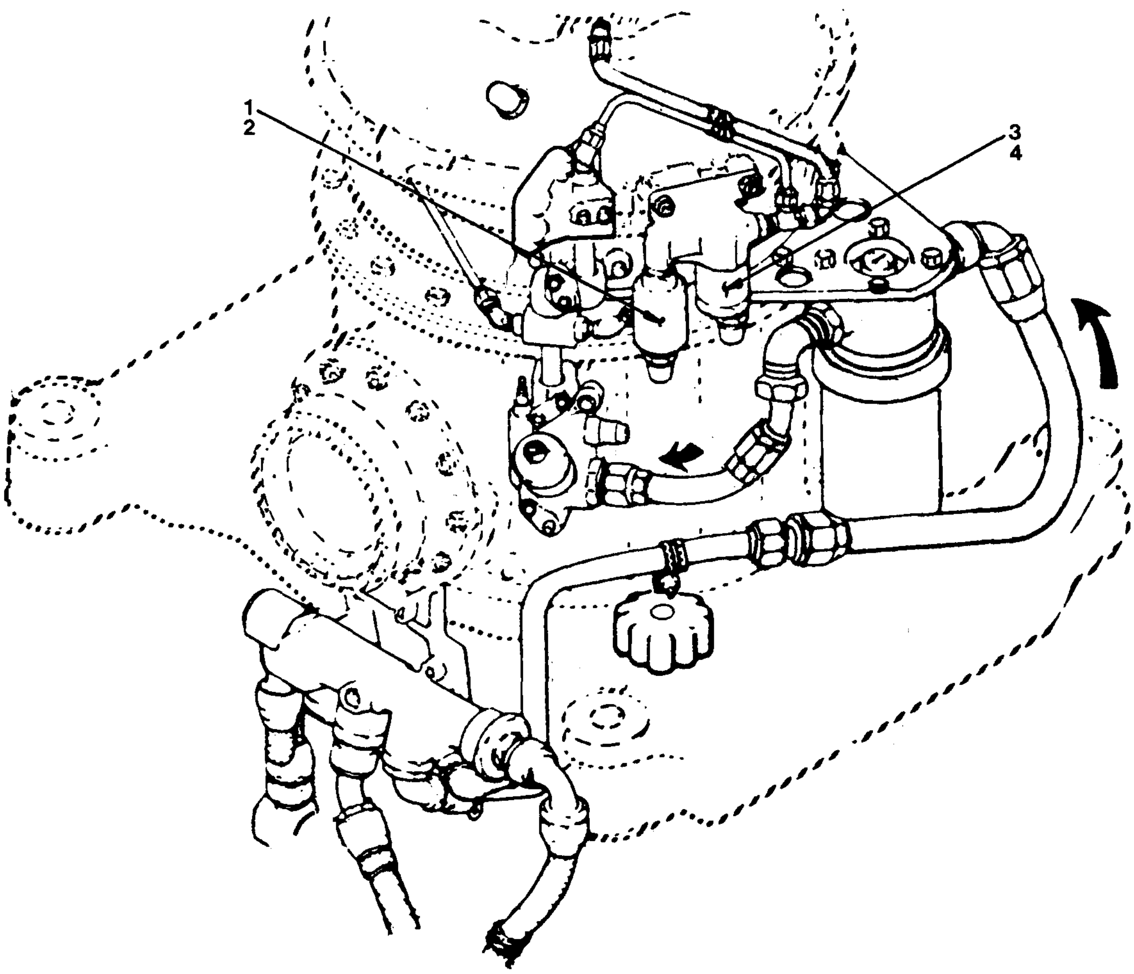
**GENERAL INFORMATION:** If oil is being lost due to a damage to the oil filter assembly area, isolate oil filter from oil system by relocating oil hoses.

**OPTION 1:** Bypass Oil Filter.

**LIMITATIONS:** Fine suspended matter would not be filtered from oil system. Rerouted hoses may chafe parts/structure.

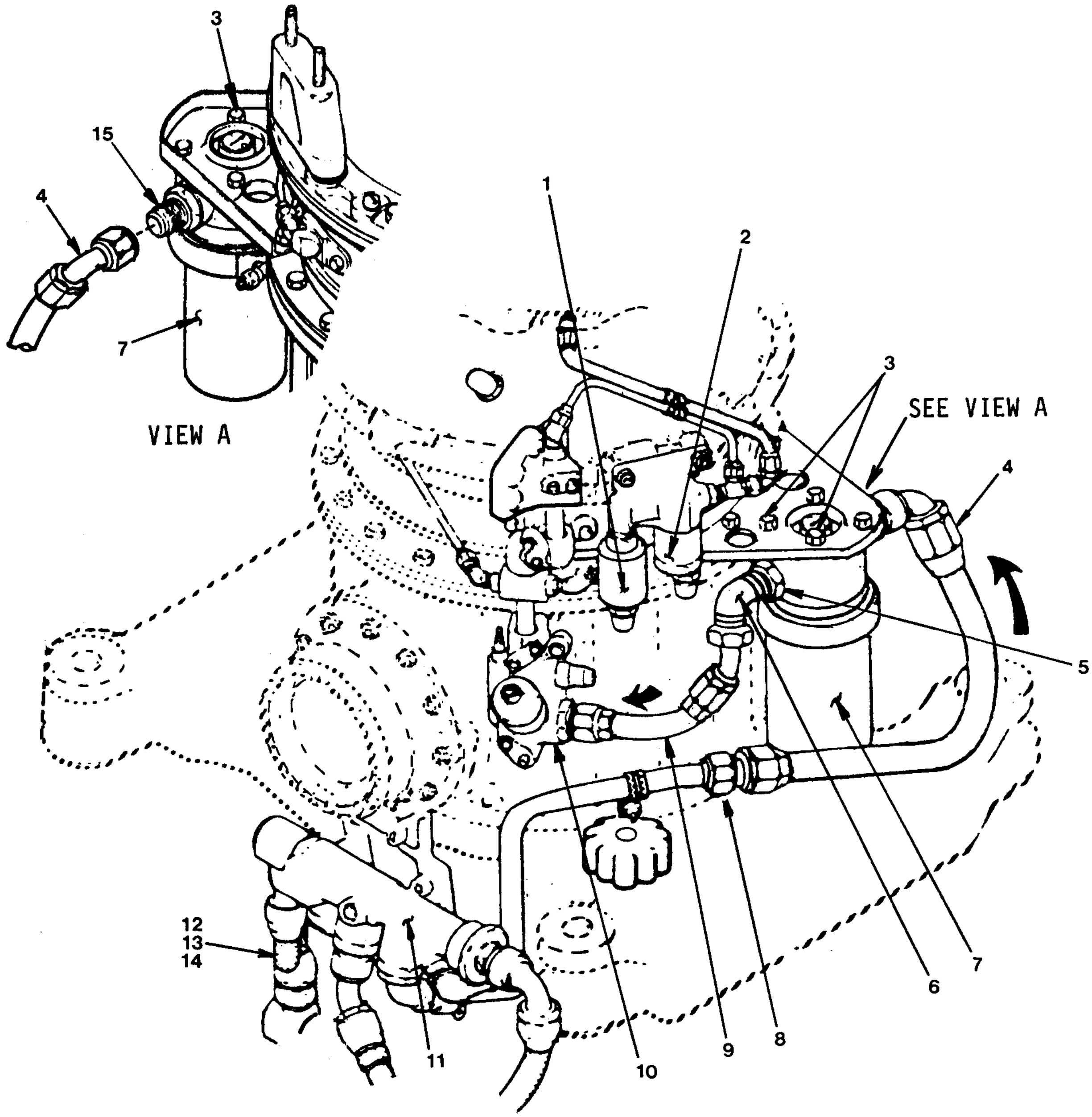
**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 15 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Cable Ties (item 26 or 27, App. C)
- Towels (item 161, App. C)



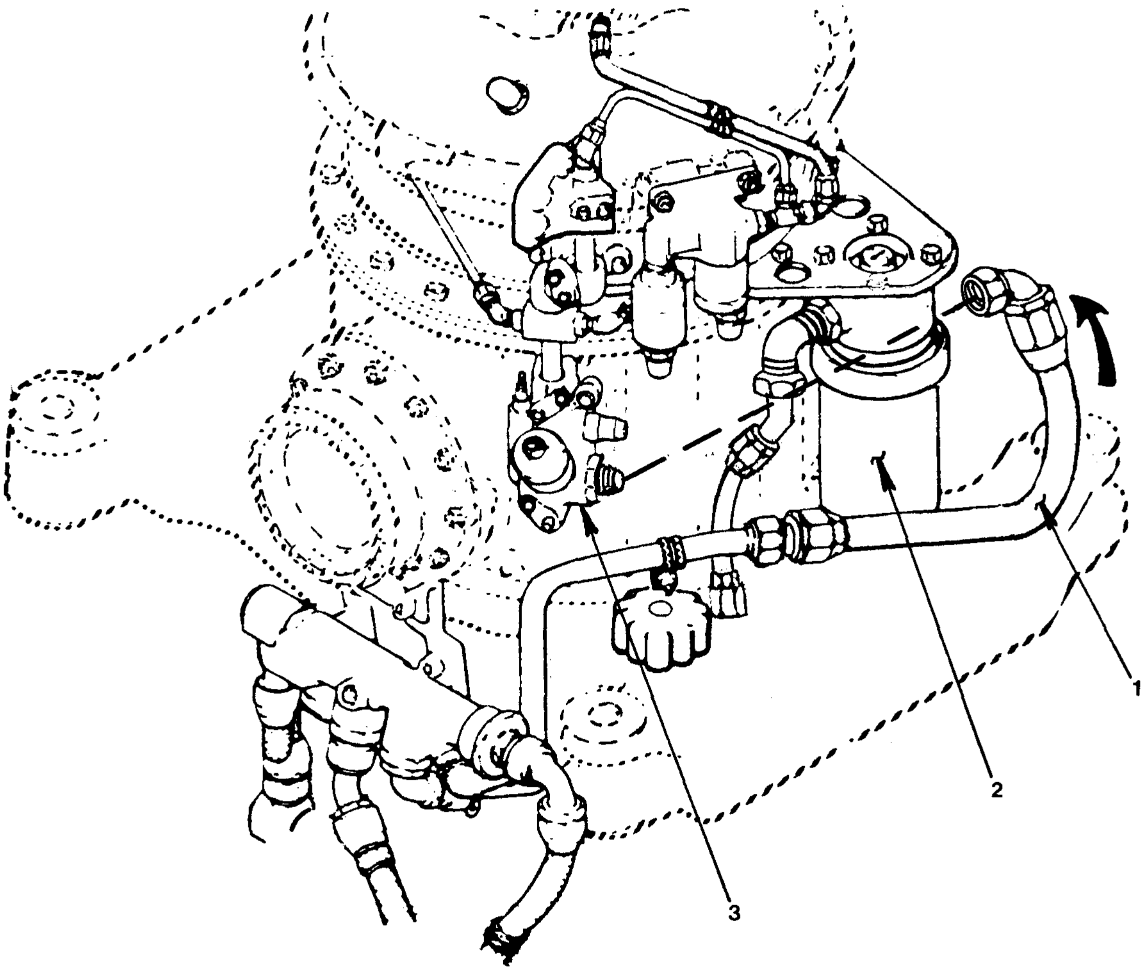

1. Transmission Oil Pressure Switch
2. O-Ring
3. Transmission Oil Pressure Transmitter
4. O-Ring

Figure 8-2. Transmission Oil Pressure Swithch and Transmitter Repair




1. Transmission Oil Pressure Switch
2. Transmission Oil Pressure Transmitter
3. Bolt
4. Oil Inlet Hose
5. Jam Nut
6. 90° Fitting
7. Oil Filter Assembly
8. Oil Line
9. Oil Outlet Hose
10. Oil Manifold Assembly
11. Emergency Oil Bypass Valve
12. O-Ring
13. Fitting
14. Oil Sump Outlet Hose
15. Fitting

Figure 8-3. Transmission Assembly, Unaltered




1. Oil Inlet Hose.
2. Oil Filter Assembly.
3. Oil Manifold Assembly

Figure 8-4. Altered Configuration (Transmission Oil System) Bypassing Filter and Outlet Hose

**PROCEDURAL STEPS:**

1. Disconnect inlet oilhose (4, Figure 8-3) from oil filter assembly (7), leave other end of hose connected.

2. Disconnect oil hose (9) from oil manifold assembly (10), leave other end connected.

3. Reroute and connect loose end of inlet oil hose (1, Figure 8-4) to oil manifold assembly (3) and tighten.

4. Check for leaks.

5. Use tie wraps where possible to minimize any chafing conditions caused by rerouting of hose.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Bypass Filter with Straight Fitting.

**LIMITATIONS:** Fine suspended matter would not be filtered from oil system. Rerouted hoses may chafe adjacent parts/structure.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 15 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Cable Ties (item 26 or 27, App. C)
- Towels (item 161, App. C)

**PROCEDURAL STEPS:**

1. Disconnect inlet oil hose (4, Figure 8-3) from oil filter assembly (7), leave other end of hose connected.

2. Disconnect outlet oil hose (9) from oil filter assembly 90° fitting (6), leave other end of hose connected.

3. Remove fitting (15) from oil filter assembly.

4. Connect the two hoses (1, 6, Figure 8-5) together using fitting (2). Tighten connections and check for leaks.

5. Use tie wraps where possible to minimize any chafing conditions caused by rerouting of hoses.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 3:** Bypass Filter with 90° Fitting.

LIMITATIONS: Fine suspended matter would not be filtered from oil system.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

**MATERIAL/TOOLS REQUIRED:**
- Towels (item 161, App. C)
- Hand Tools

**PROCEDURAL STEPS:**

1. Disconnect and remove inlet oil hose (4, Figure 8-3).

2. Disconnect outlet hose (9) from oil filter 90° fitting (6), leave other end of hose connected.

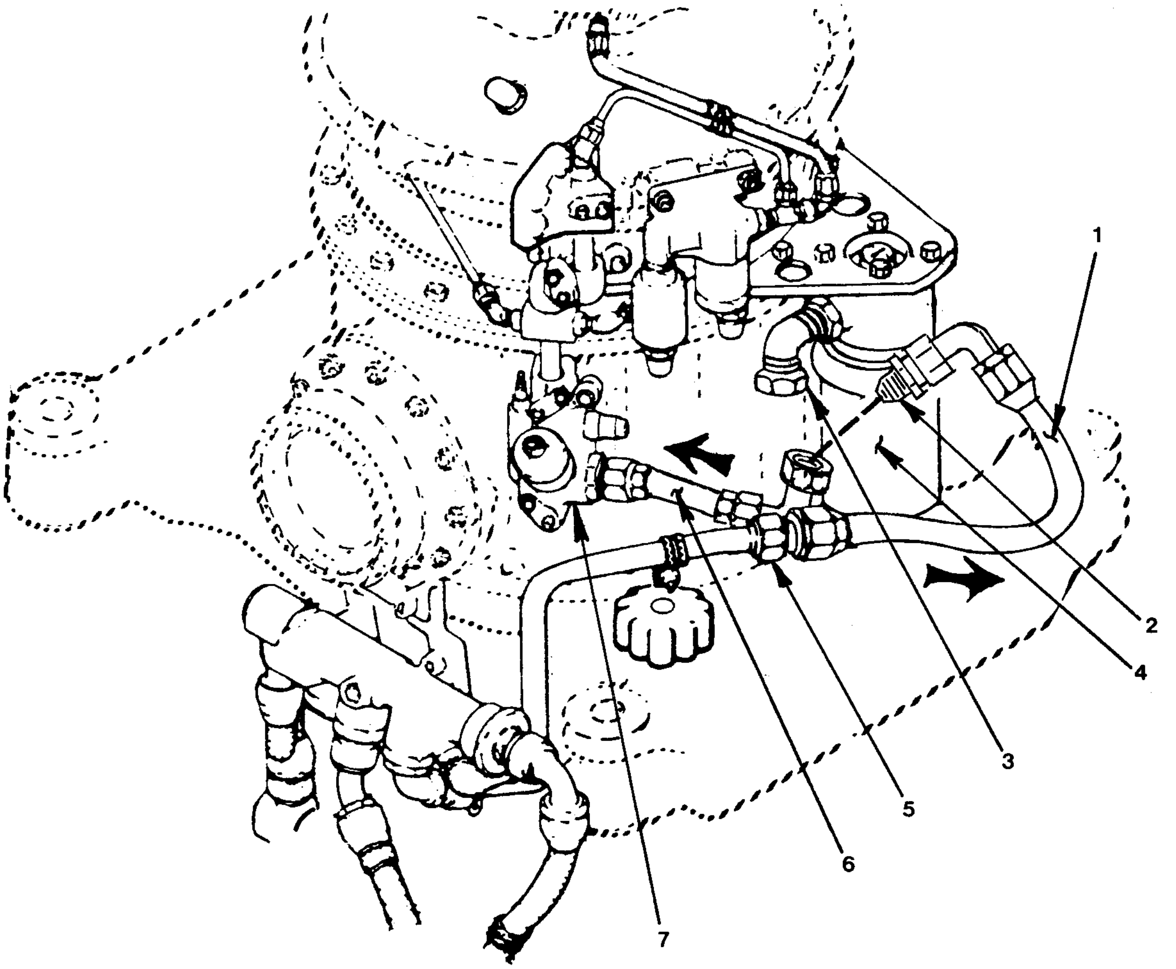
3. Loosen outlet hose (9) connection at oil manifold (10).

4. Loosen jam nut (5) on 90° fitting at oil filter.

5. Break safety wire and remove two bolts (3) on filter mount bracket.

6. Pull filter assembly slightly away from filter mounting bracket and remove 90° fitting (6) from filter assembly.

7. Reinstall bolts (3).




1. Oil Inlet Hose.
2. Fitting.
3. 90° Fitting.
4. Oil Filter Assembly.
5. Oil Line.
6. Oil Outlet Hose.
7. Oil Manifold Assembly.

Figure 8-5. Altered Configuration (Transmission Oil System) Bypassing Oil Filter

8. Remove jam nut (5) from 90° fitting and retain jam nut (5).

9. Install 90° fitting (1, Figure 8-6) on outlet hose (3). Do not tighten.

10. Connect outlet hose (3) to oil line, and tighten all loose connections.

11. Check for leaks.

12. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## 8-8. SUMP OUTLET HOSE LEAK.

**GENERAL INFORMATION:** If oil is being lost due to damage at the oil sump outlet hose, the leak may be repaired by one of the following repair procedures.

**OPTION 1:** Replace Hose.

**OPTION 2:** Substitute Transmission Oil Filter Line.

**LIMITATIONS:** Transmission oil filter would be isolated from oil system. Fine suspended matter would not be filtered from transmission oil system.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Towels (item 161, App. C)
- Hand Tools
- Packing Assortment (item 71, App. C)

**PROCEDURAL STEPS:**

1. Isolate oil filter from oil system as outlined in paragraph 8-7, OPTION 3, and remove the filter inlet hose (4, Figure 8-3) from the system.

2. Remove the sump outlet hose (14), fitting (13), and o-ring (12). Do not discard o-ring.

3. Install the oil filter inlet hose, removed in step 1, in place of the sump outlet hose as follows. Refer to Figure 8-7.

**NOTE**

The male end of the hose (1, Figure 8-7) must be threaded into oil sump outlet hole before the female end of hose is connected to oil bypass valve (2).

a. Install nut (3) on hose (1) at the male fitting end and hand tighten nut (3) until it is touching against the shoulder of male fitting.

b. Install o-ring (4) on hose (1) at male fitting.

c. Screw hose (1) into oil sump outlet hole (5) and hand tighten until nut (3) jams oil sump housing.

d. Position the other end of hose (1) to oil bypass valve (2).

**NOTE**

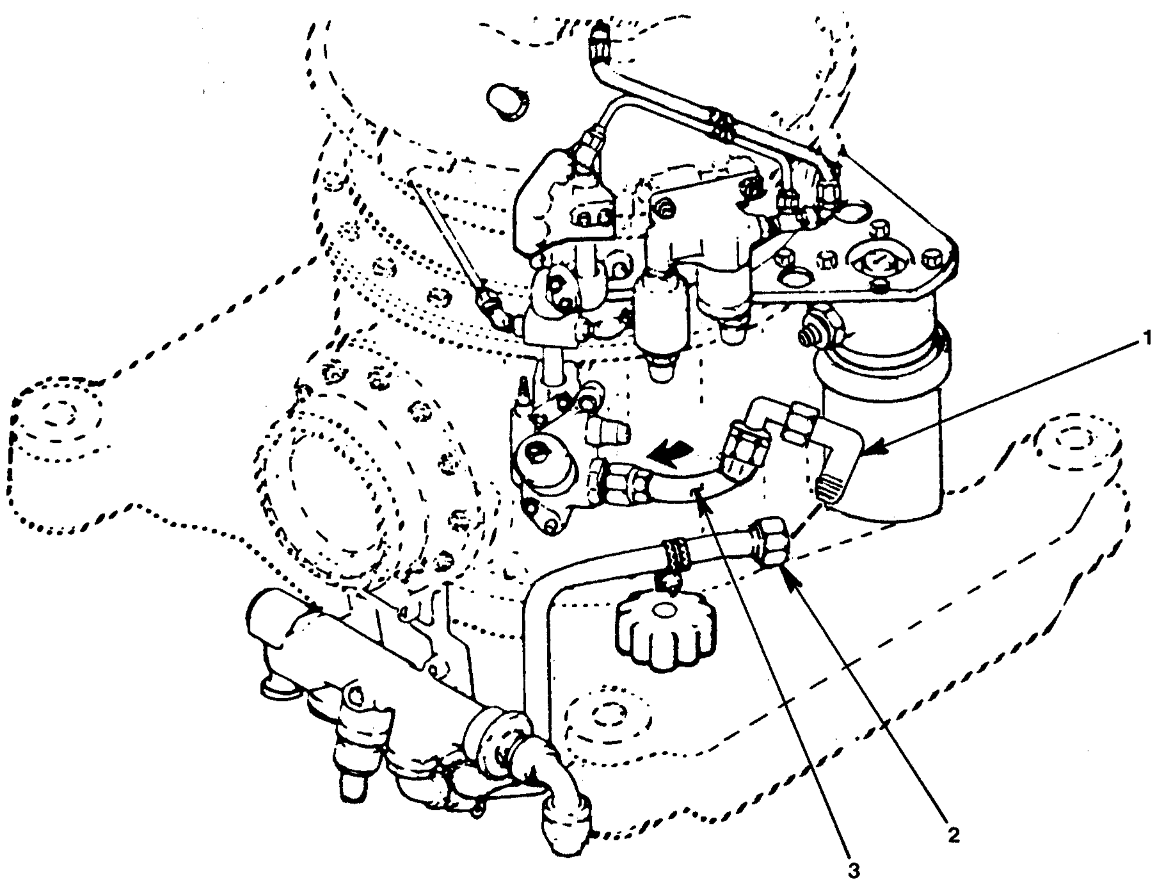
If elbow fitting at female end of hose (1) requires repositioning to facilitate hose connection at oil bypass valve (2), slowly back out hose (1) from oil sump hole (5) until the elbow is in an acceptable position.

e. Tighten hose (1) connection at the oil bypass valve (2).

f. Tighten jam nut (3) against oil sump housing.

4. Check for leaks.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.




1. 90° Fitting
2. Oil Line
3. Oil Outlet Hose

Figure 8-6. Altered Configuration (Transmission Oil System) Bypassing Filter and Inlet Hose

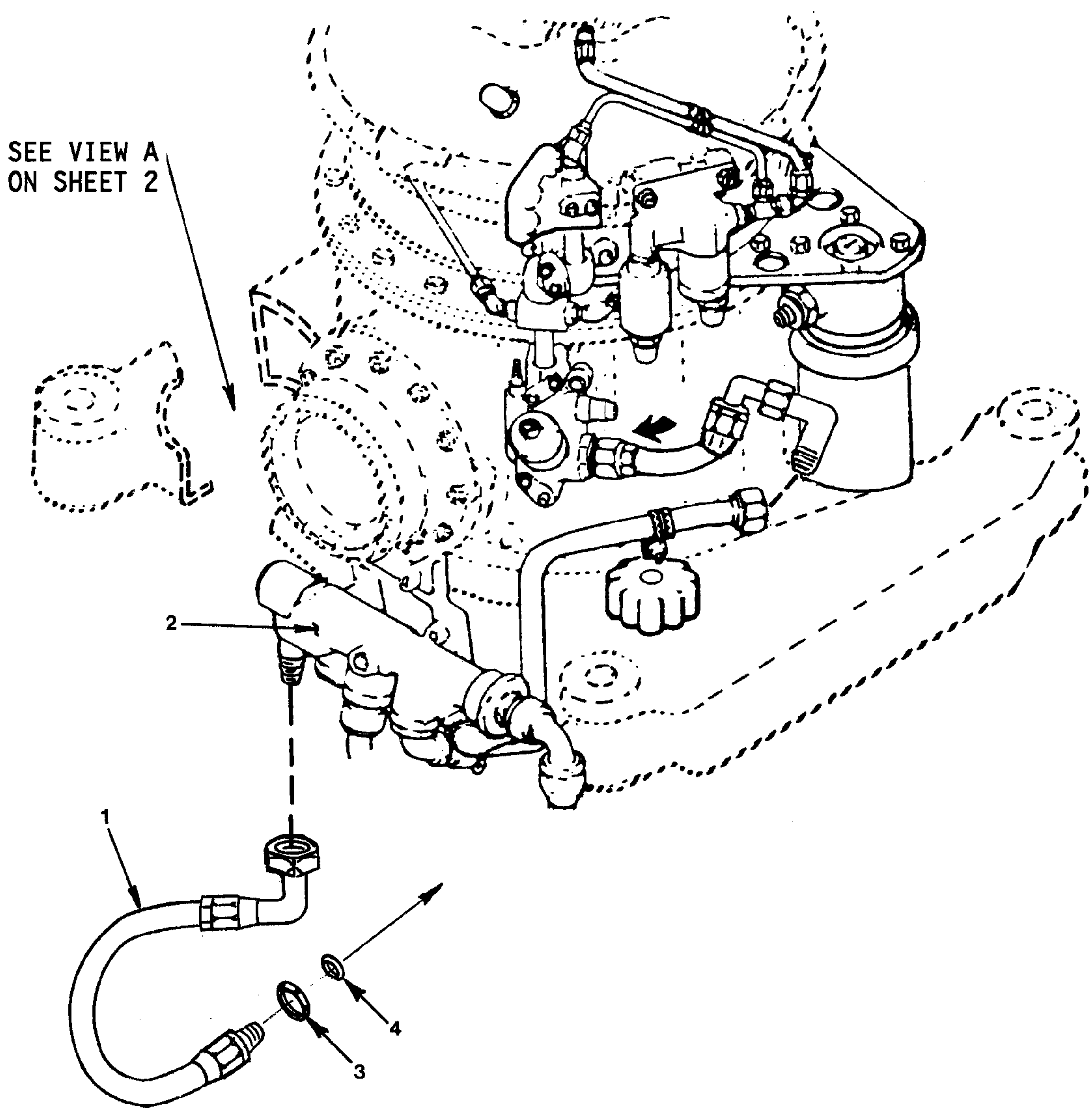
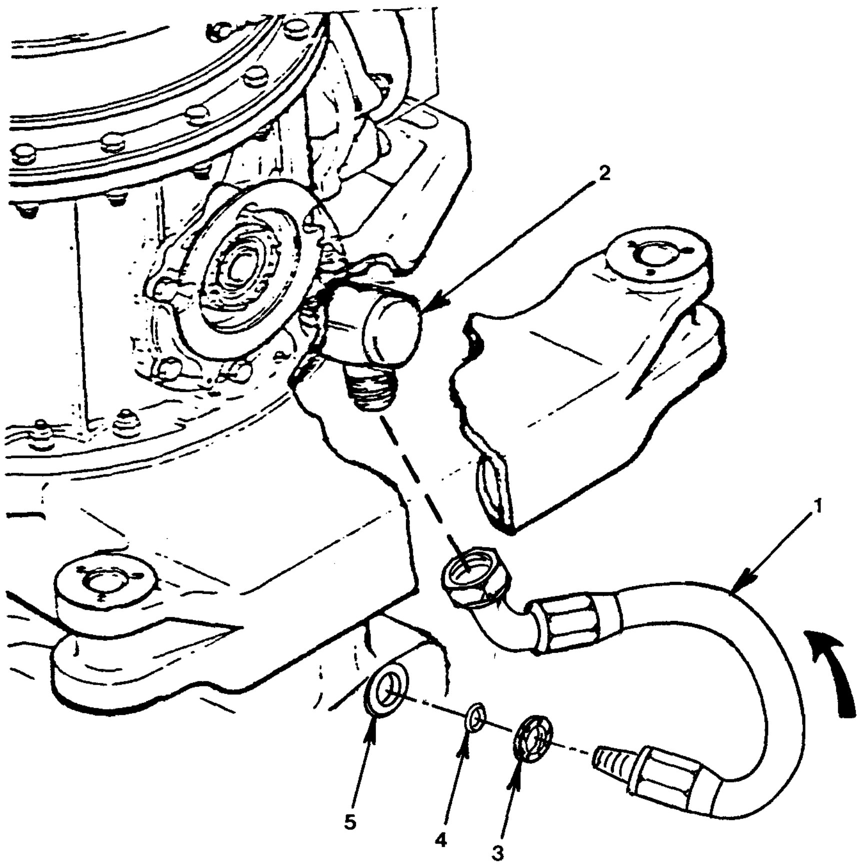



Figure 8-7, Altered Configuration (Transmission Oil System)
Substituting Hose at Sump Outlet (Sheet 1 of 2)




VIEW A

1. Hose.
2. Emergency Oil Bypass Valve.
3. Jam Nut.
4. O-Ring.
5. Oil Sump Outlet Hole.

Figure 8-7. Altered Configuration (Transmission Oil System) Substituting Hose at Sump Outlet (Sheet 2 of 2)

## 8-9. TRANSMISSION BALLISTIC DAMAGE.

**GENERAL INFORMATION:** If the transmission is hit by a bullet which exits on the opposite side, the transmission does not bind and there is no oil loss, repair may be deferred. Oil loss will require patching holes.

**OPTION:** Patch Hole with Tape.

**LIMITATIONS:** Small oil loss can be tolerated. inspect after every flight.

**NOTE**

Transmission will run for a maximum of 30 minutes without oil.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 15 Minutes

MATERIALS/TOOLS REQUIRED:
- Solvent (item 7 or 129, App. C)
- Green Tape (item 153, App. C)

**PROCEDURAL STEPS:**

1. Clean damaged area with solvent.

2. Close bullet inlet and exit hole with tape.

3. Inspect after every flight.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## 8-10. GEARBOX DAMAGE.

**GENERAL INFORMATION:** If a bullet strikes the gearbox and exits and the gears do not jam or bind and there is no loss of lubricant, repair may be deferred. Oil loss will require patching holes.

**OPTION 1:** Plug Repair. (Refer to para 6-4.)

**OPTION 2:** Tape Repair.

**LIMITATIONS:** Small oil loss can be tolerated. If aircraft is run for an extended period of time with little or no oil, gearbox will wear itself out and fail.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 15 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Solvent (item 7 or 129, App. C)
- Green Tape (item 153, App. C)
- Rubber for Patch (item116, App. C)

**PROCEDURAL STEPS:**

1. Clean damaged area with solvent.

2. Close bullet hole with a rubber patch, 3/4 inch larger than hole, and secure with tape.

3. Inspect after every flight.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

# Section III. TAIL ROTOR DRIVESHAFT

**8-11. GENERAL.** Due to high rotational speeds, damage to transmission shafts can induce vibrations which will cause failures in bearings, bearing housings, gearboxes, and couplings due to “whip” effects. Any repair should therefore include the restoration of balance.

## 8-12. DENTS OR BALLISTIC DAMAGE TO SHAFTS.

**GENERAL INFORMATION:** After any of the following repairs are made, the shaft should be mounted in its hanger bearings, unconnected and spun by hand to check for “whipping” deflection.

**OPTION 1:** Tape Patch, Figure 8-8.

**LIMITATIONS:** Entrance and exit holes 180° apart. Inspect after every flight.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1 Hour

**MATERIALS/TOOLS REQUIRED:**
- Green Tape (item 153, App. C)

**PROCEDURAL STEPS:**

1. Gain access to the damaged driveshaft.

2. Restore balance in shaft by straightening petals around the entrance/exit hole (i.e., damaged area is tapped back to a relatively smooth surface).

3. Wrap tape around the shaft over the holes. Tape should be wrapped opposite direction of shaft rotation.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Drill Balance Hole.

**WARNING**

- Operation of power tools may exceed recommended noise thresholds. Wear hearing protection.

- Compressed air can blow dust into eyes. Wear eye protection. Do not exceed 30 psig air pressure.

**LIMITATIONS:** Fragments or solid shot must avoid the center of a shaft, Figure 8-9. Inspect after every flight.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1 Hour

**MATERIALS/TOOLS REQUIRED:**
- Drill Motor and Bit
- String or Wire (item 149 or 60, App. C)
- Ruler

**PROCEDURAL STEPS:**

1. Gain access to the damaged driveshaft.

2. Straighten the petals around the entrance and exit holes.

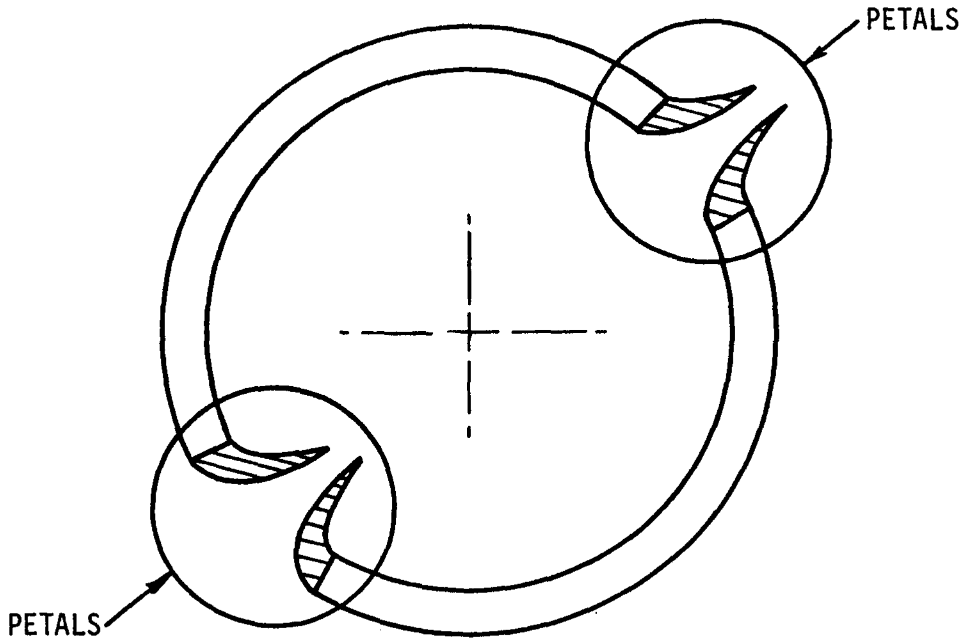
3. Measure arc S, Figure 8-10, by placing one end of a string or wire on the center of the entrance hole and stretching it across to the center of the exit hole and mark the string at the mid point of the exit hole. Then measure the string from the entrance hole end to the exit hole mark.

4. Determine the value of Y, Figure 8-10, by using the S value found in step 2.b and using the graph in Figure 8-11.

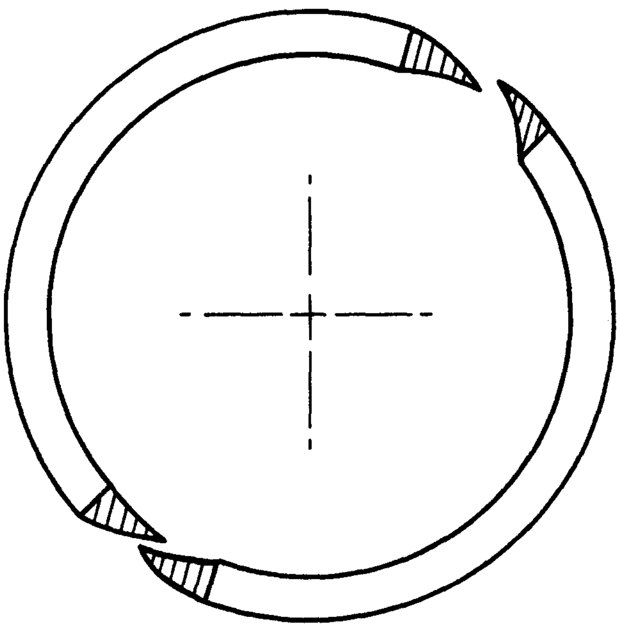
5. Estimate the amount of material (in square inches) removed from the entrance and exit holes. Let $a_1$ equal to the material lost in the entrance hole and $a_2$ equal to the material lost in the exit hole.

6. Calculate the area A of the counter hole using the following formula. (“A” will be in square inches.)

$$\text{"A"} = (a_1 + a_2) \times (Y/1.5)$$




A. DAMAGED SHAFT



B. PETAL STRAIGHTENED TO A RELATIVELY SMOOTH SURFACE

Figure 8-8. Damage Passing Through Center of Shaft

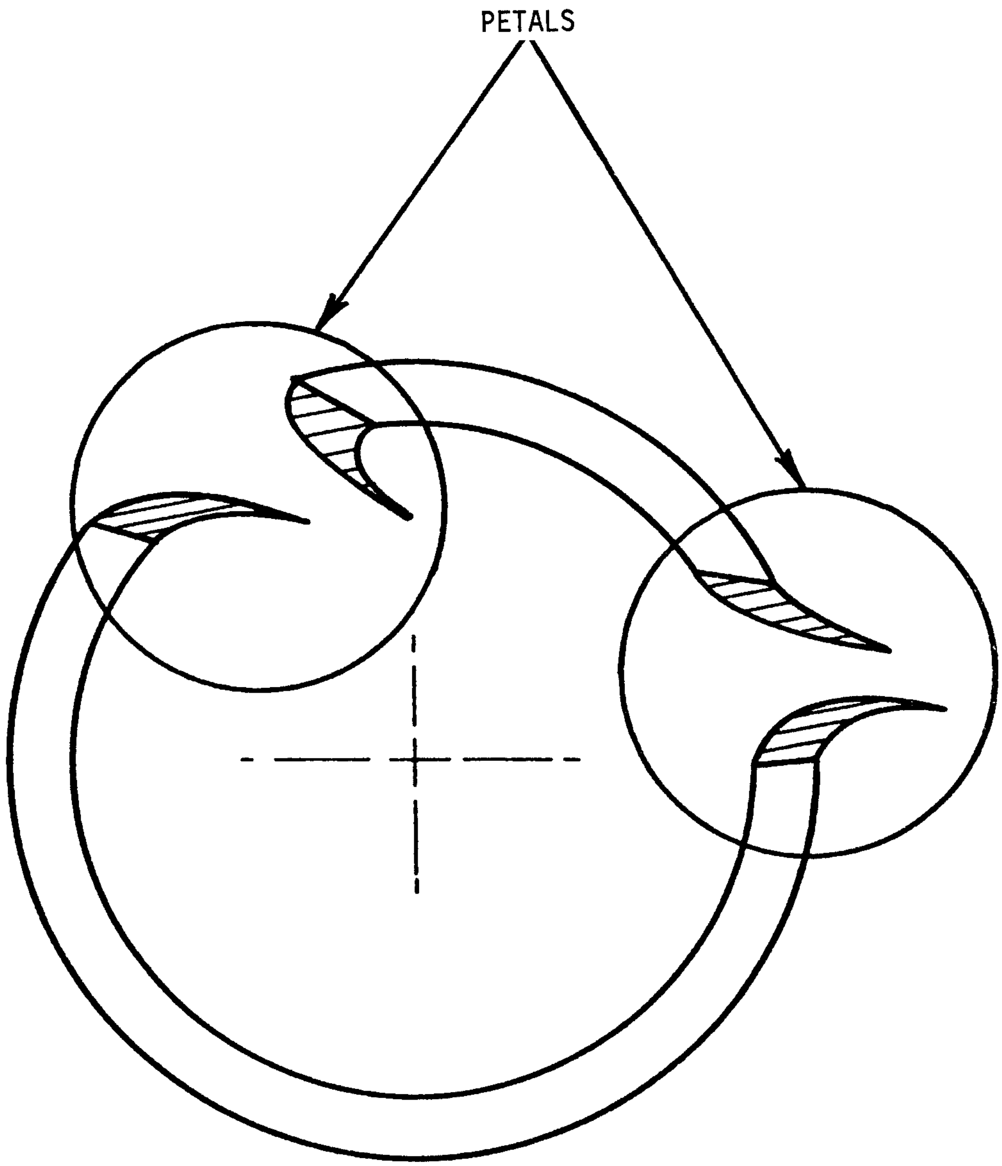



Figure 8-9. Damage Not Passing Through Center of Shaft

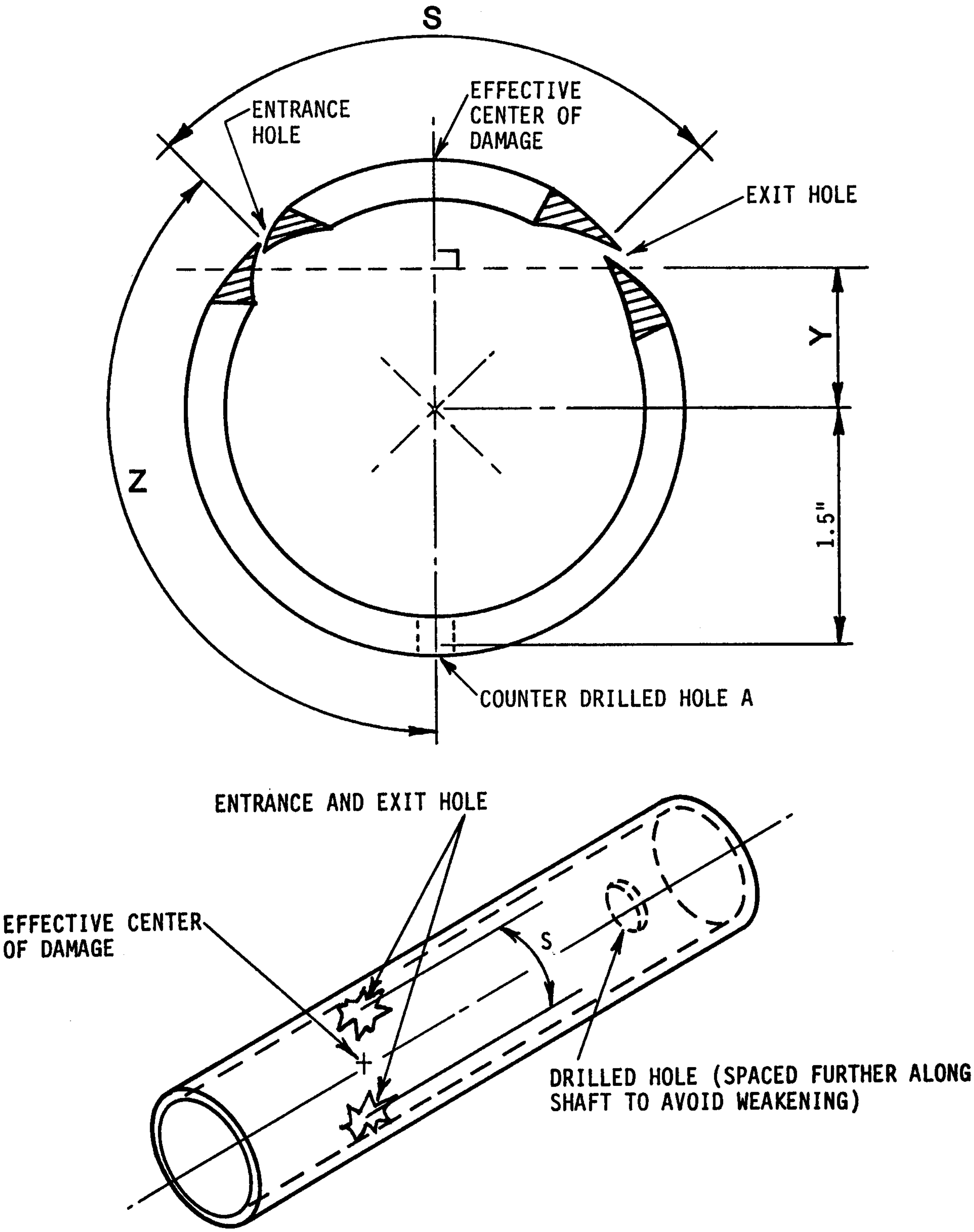



Figure 8-10. Balance Restoring Repair for Damage Not Passing Through the Center of Shaft

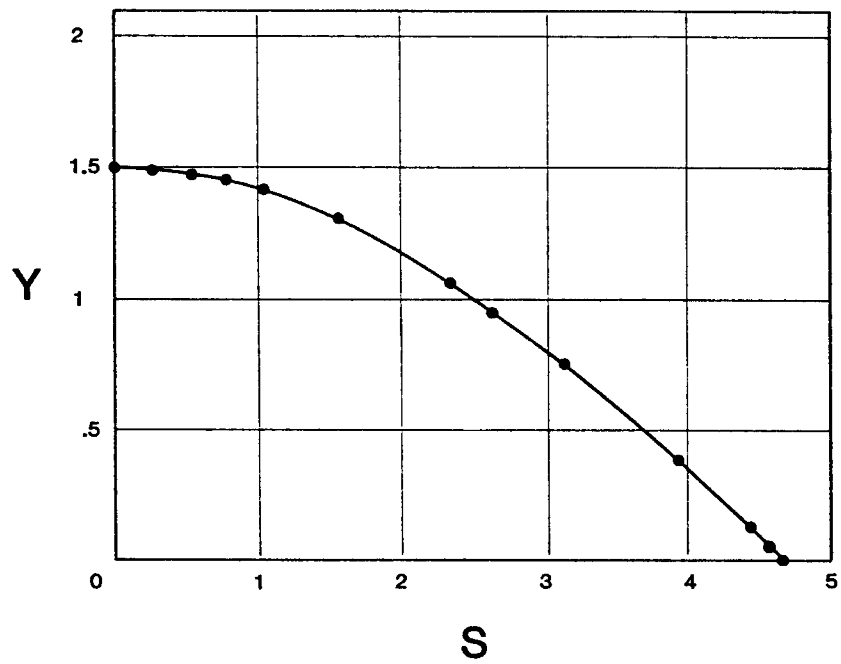



Figure 8-11. Y and S Graph

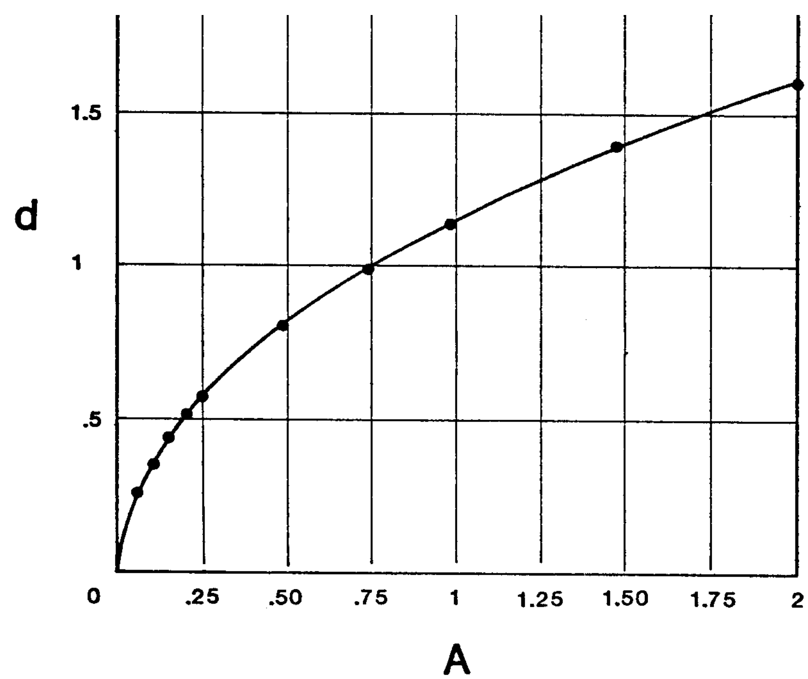



Figure 8-12. Area and Diameter Graph

7. Determine the value ford using the graph in Figure 8-12. The valued is the diameter (in inches) of hole A.

8. Calculate the value Z distance from the entrance hole to counter drilled hole by using the following formula.

$$z = 4.71 - \frac{a_2 S}{(a_1 + a_2)}$$

The hole is to be of diameter d which was determined in step 2.f. Drill the hole.

9. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 3: Metal Plate Patch.**

**LIMITATIONS:** Damaged area not to exceed one-third of total cross-sectional area. Restrict helicopter from high speed operation.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 2 Hours

**MATERIALS/TOOLS REQUIRED:**
- Sheet Metal (items 132, 134, 135, 139, or 142, App. C)
- Rivet, Blind (items 98-105, App. C)
- Drill Motor and Bit

**PROCEDURAL STEPS:**

1. Gain access to damaged driveshaft.

2. Straighten petals around the entrance and exit holes so that the damaged area has a relatively smooth surface, Figure 8-13.

3. Stop drill any cracks.

4. Fabricate a sheet metal plate to wrap around over damaged area. The length of the sheet metal plate should be approximately 9-7/16 inches the shaft circumference. The width of the plate should extend at least 3 inches beyond each side of the damaged area.

5. Wrap the sheet metal plate, fabricated in procedural step 4, around the damaged portion of driveshaft. The plate ends should come together 180° opposite the damaged area.

6. Apply a row of rivets, at preferred rivet spacing, across each end of plate and around edges, Figure 8-14.

7. Two rows of counter weight rivets are to be placed 180° opposite the rows which were used to secure the edges of the sheet metal plate.

8. Install directly over damaged area a number of rivets to compensate for the missing mass in the damaged area. See Figure 8-15 and/or Table 8-2 for data on number of rivets required forgiven shaft area.

9. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

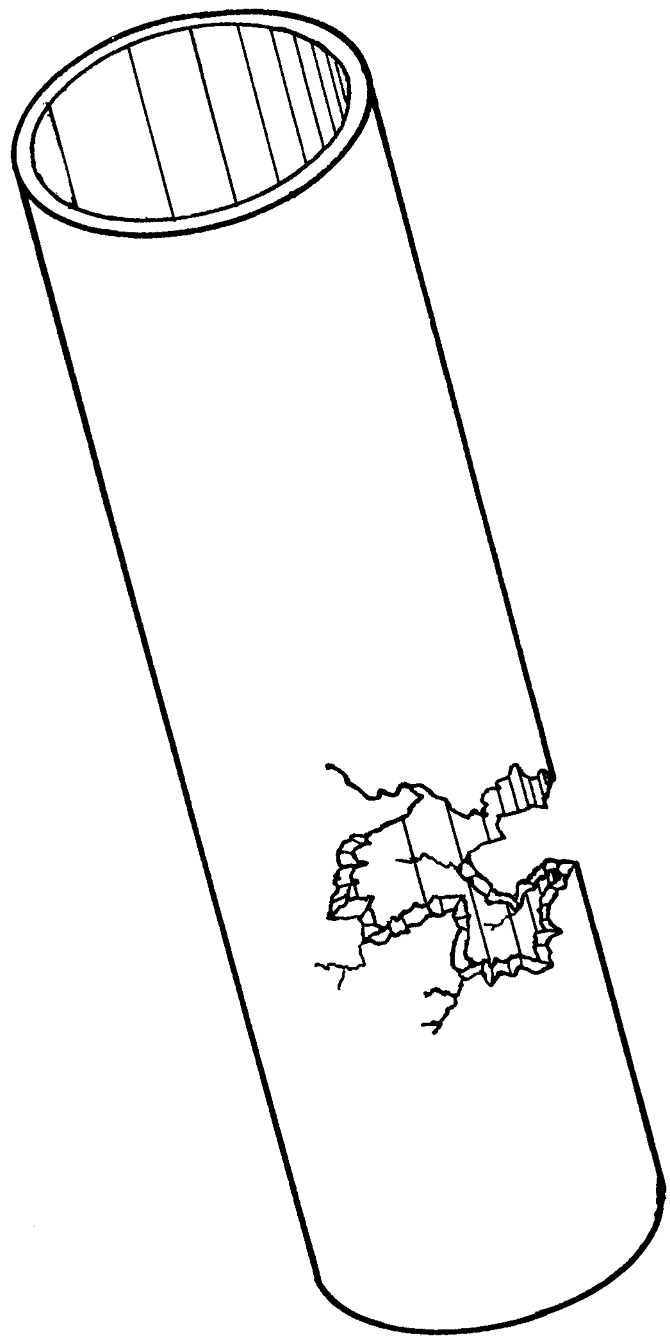


Figure 8-13. Damaged Shaft; Petals Straightened Smooth

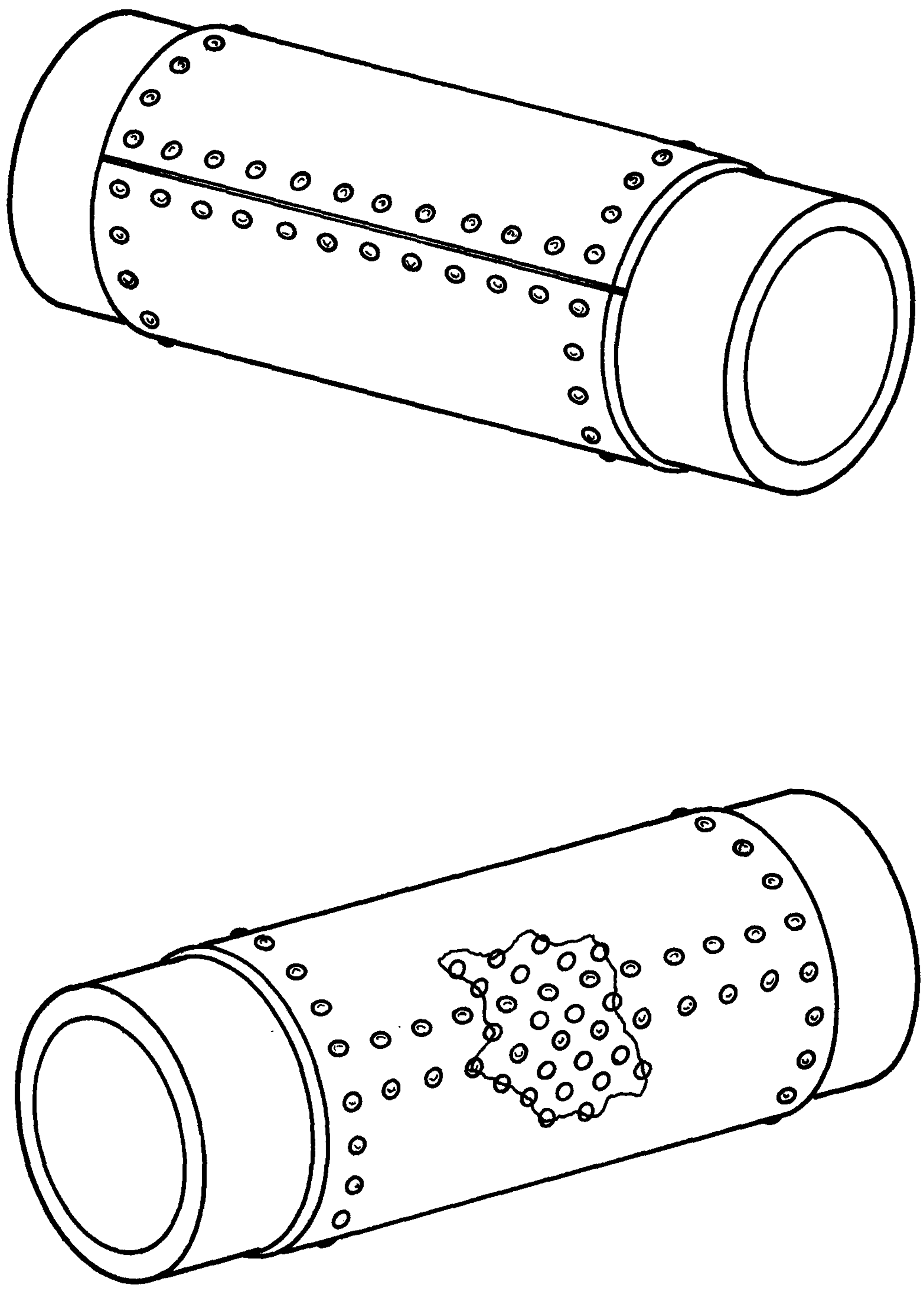


Figure 8-14. Repaired Shaft

Table 8-2. Shaft Area ($in^2$) vs. Number of Rivets

| AREA ($in^2$) | NUMBER OF RIVETS |
|---|---|
| 1 | 5 |
| 2 | 10 |
| 3 | 14 |
| 4 | 19 |
| 5 | 24 |
| 6 | 29 |
| 7 | 33 |
| 8 | 38 |
| 9 | 43 |
| 10 | 48 |

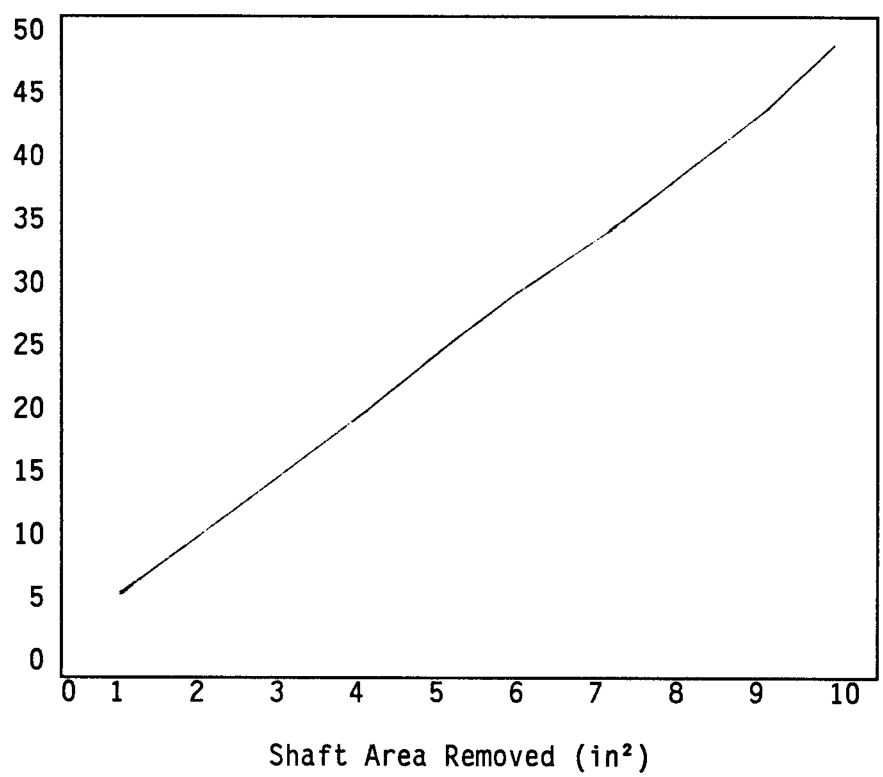



Figure 8-15. Shaft Area ($in^2$) vs. Number of Rivets

# CHAPTER 9

# HYDRAULIC SYSTEMS

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

**9-1. SCOPE.** This chapter contains the fault assessment and expedient repair procedures for locating and fixing damage to the hydraulic systems. A functional diagram of the hydraulic system is shown in Figure 9-1, and pictorially in Figures 9-2, 9-3, 9-4, and 9-5.

**9-2. ASSESSMENT PROCEDURES.**

a. The hydraulic system is redundant, consisting of two parallel systems. If one system is damaged, the aircraft can fly with the other system operating, but the components operated by the failed system will not operate.

**NOTE**

If the damaged component still operates satisfactorily and does not leak, repair may be deferred. However, the component should be inspected after every flight to assure that operation has not degraded or that a leak has not developed.

b. BDAR for a hydraulic system is generally confined to component replacement, expedient line repairs, or bypassing damaged circuits. If a hydraulic circuit cannot be repaired, it may be necessary to isolate it (cut it off) from the system to permit operation of some other needed hydraulic functions. Damage to the hydraulic system almost always requires replenishment of lost fluids.

**WARNING**

Bring hydraulic system to Zero Pressure before making repairs.

**CAUTION**

When checking the armament system, do not apply hydraulic power unless electrical power is applied.

e. No specific assessment procedures are needed to locate leaks and ruptured lines; therefore, the fault assessment flow chart, Table 9-1, is rather general in nature.

f. Each area of damage must be carefully evaluated and classified in order to differentiate between leaks which require immediate repair before flight and leaks which do not constitute a flight hazard. The exact location of a leak shall be determined and the leak area examined thoroughly.

**9-3. REPAIR PROCEDURE INDEX.**

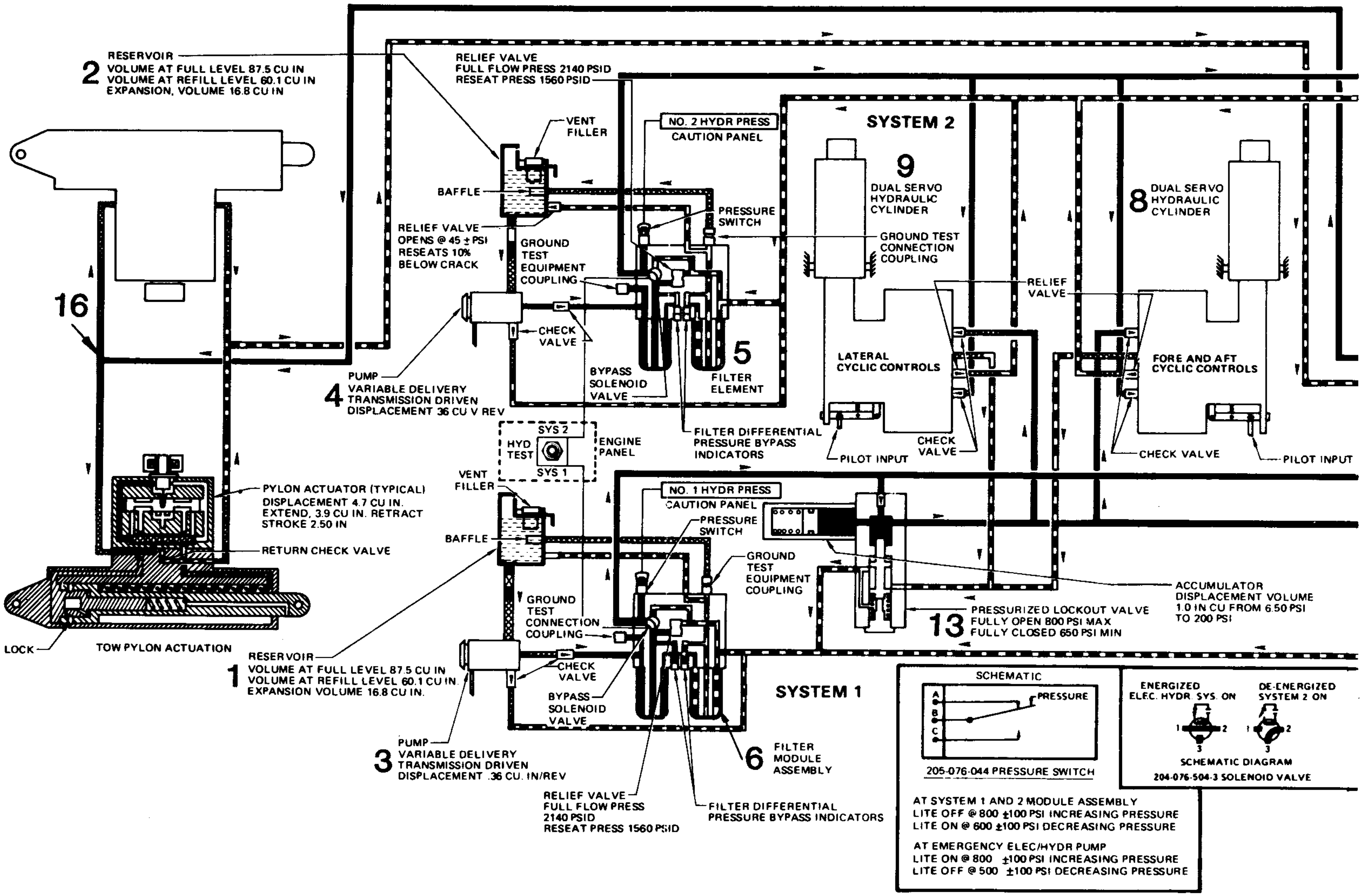



Figure 9-1. Hydraulic System Schematic (Sheet 1 of 2)

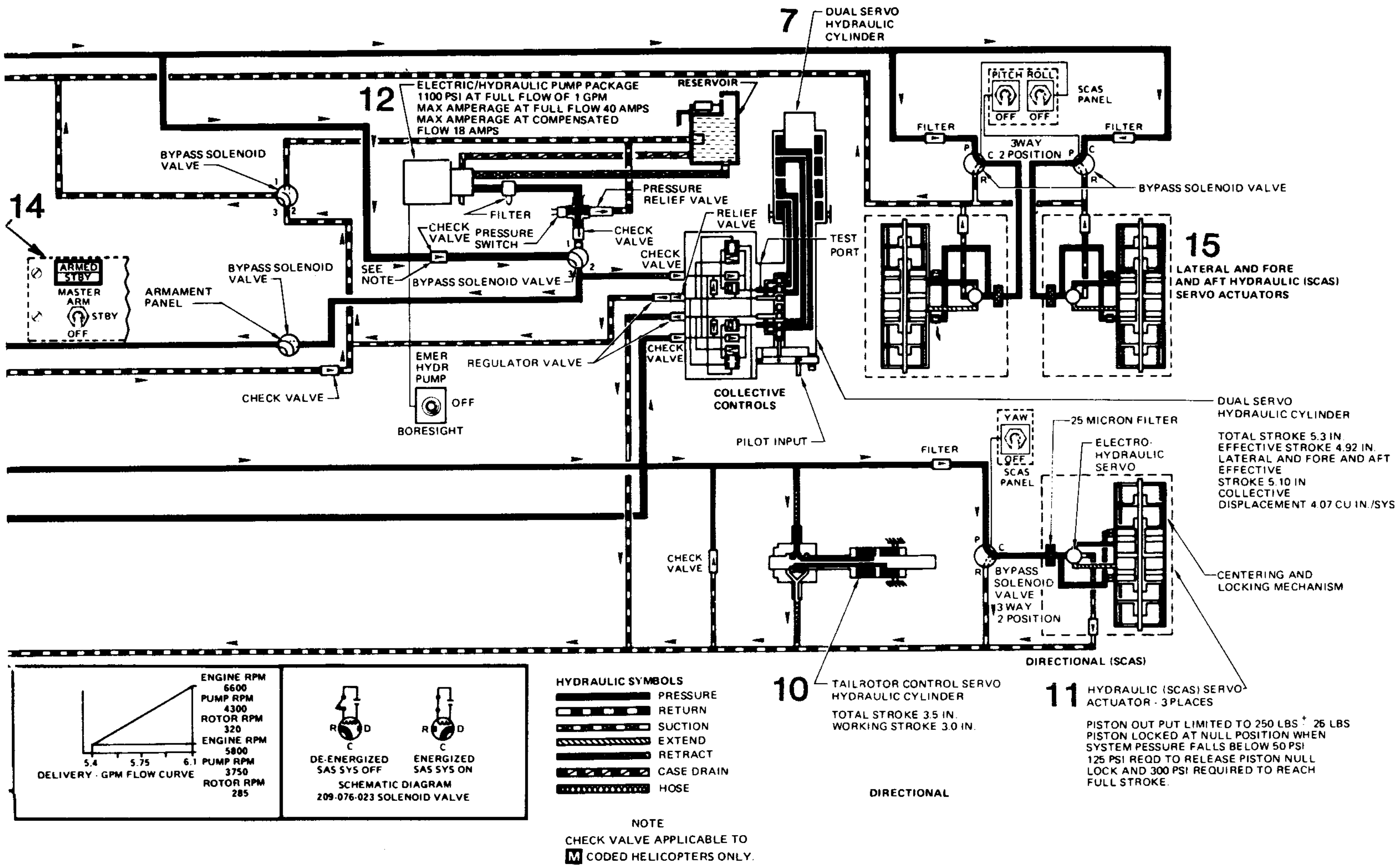



Figure 9-1. Hydraulic System Schematic (Sheet 2 of 2)

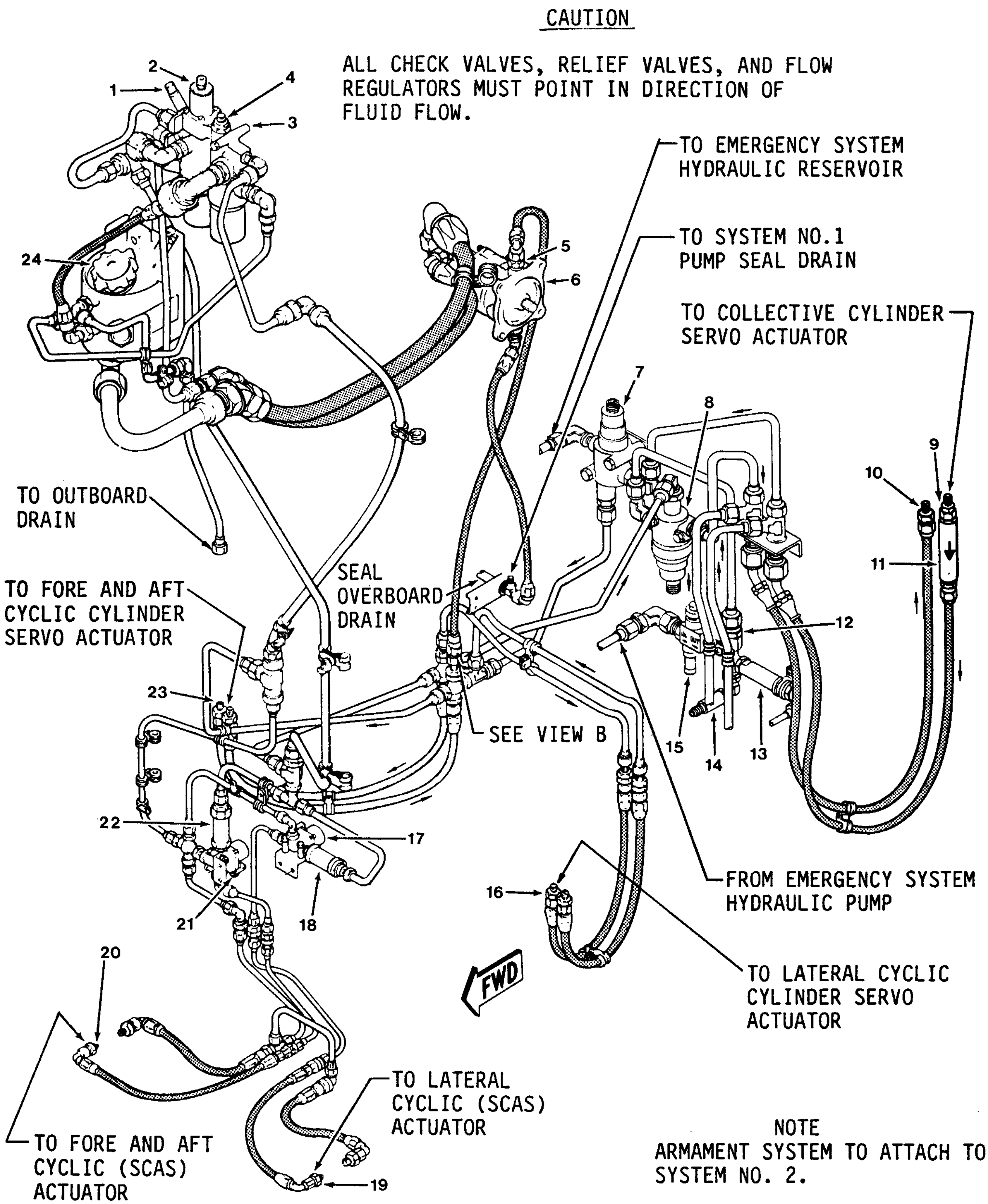
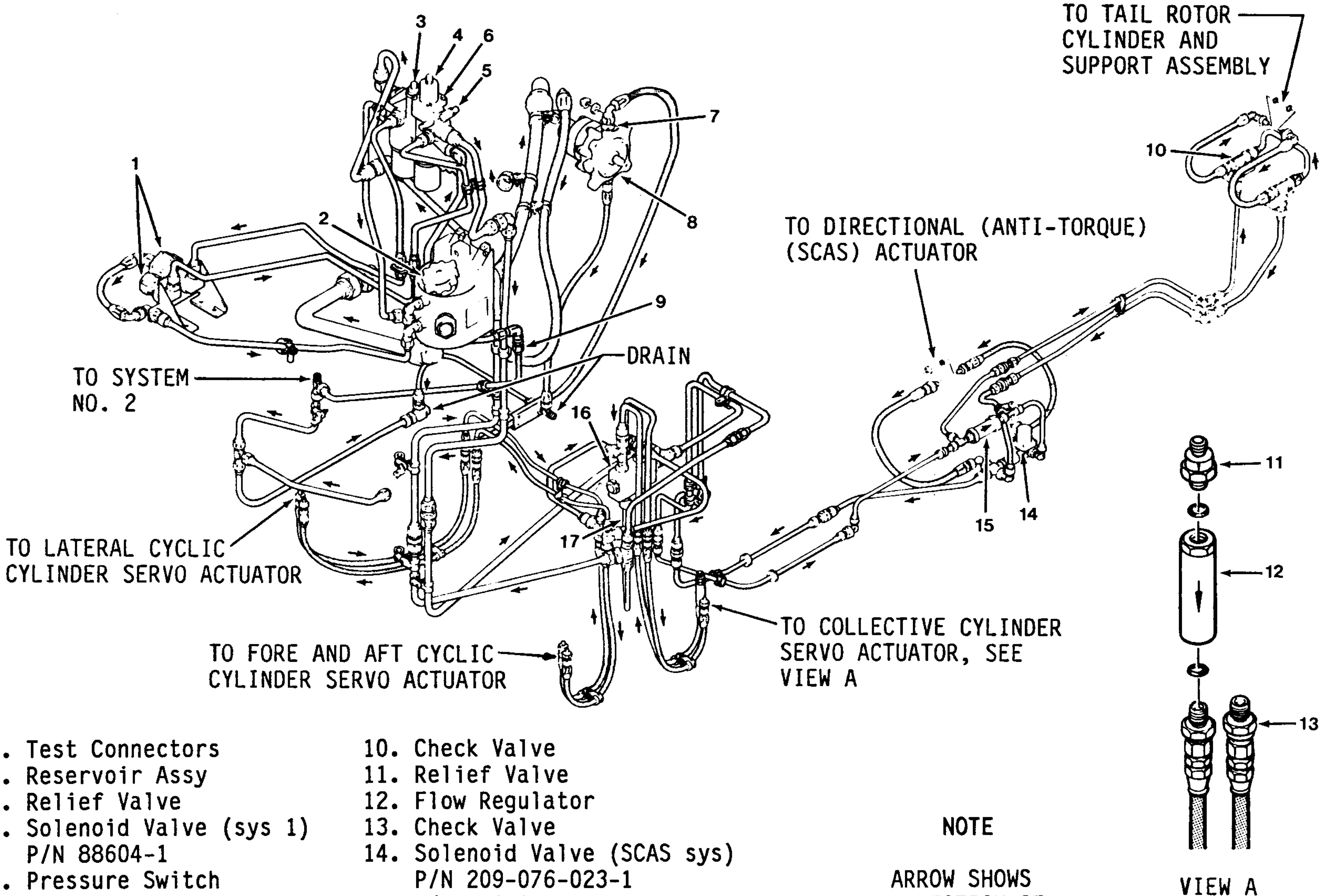



Figure 9-2. Hydraulic System - SYSTEM NO.

1. Pressure Switch
2. Solenoid Valve (sys 2)
   P/N 88604-1
3. Hydraulic Modular Unit
4. Relief Valve
5. Check Valve
6. Pump
7. Solenoid Valve P/N 204-076-054-3
   P/N 1-U-1025-63 or
   P/N 130027-5
8. Solenoid Valve P/N 204-076-504-3
   P/N 1-U-1025-63 or
   P/N 130027-5
9. Relief Valve
10. Check Valve
11. Flow Regulator
12. Check Valve
13. Pressure Relief Valve
14. Pressure Switch
15. Filter
16. Check Valve
17. Solenoid Valve (SCAS SYS)
    P/N 209-076-021-1
    PIN 15353
18. Filter
19. Check Valve
20. Check Valve
21. Solenoid Valve (SCAS sys)
    P/N 209-076-023-1
    P/N 15353
22. Filter
23. Check Valve
24. Reservoir Assembly

Figure 9-2. Hydraulic System - SYSTEM NO. 2 (Sheet 2 of 2)




1. Test Connectors
2. Reservoir Assy
3. Relief Valve
4. Solenoid Valve (sys 1) P/N 88604-1
5. Pressure Switch
6. Modular Unit
7. Check Valve
8. Pump
9. Check Valve
10. Check Valve
11. Relief Valve
12. Flow Regulator
13. Check Valve
14. Solenoid Valve (SCAS sys) P/N 209-076-023-1 P/N 15353
15. Filter
16. Lockout Valve
17. Accumulator Assy

NOTE

ARROW SHOWS DIRECTION OF REGULATED FLOW

Figure 9-3. Hydraulic System - SYSTEM NO. 1

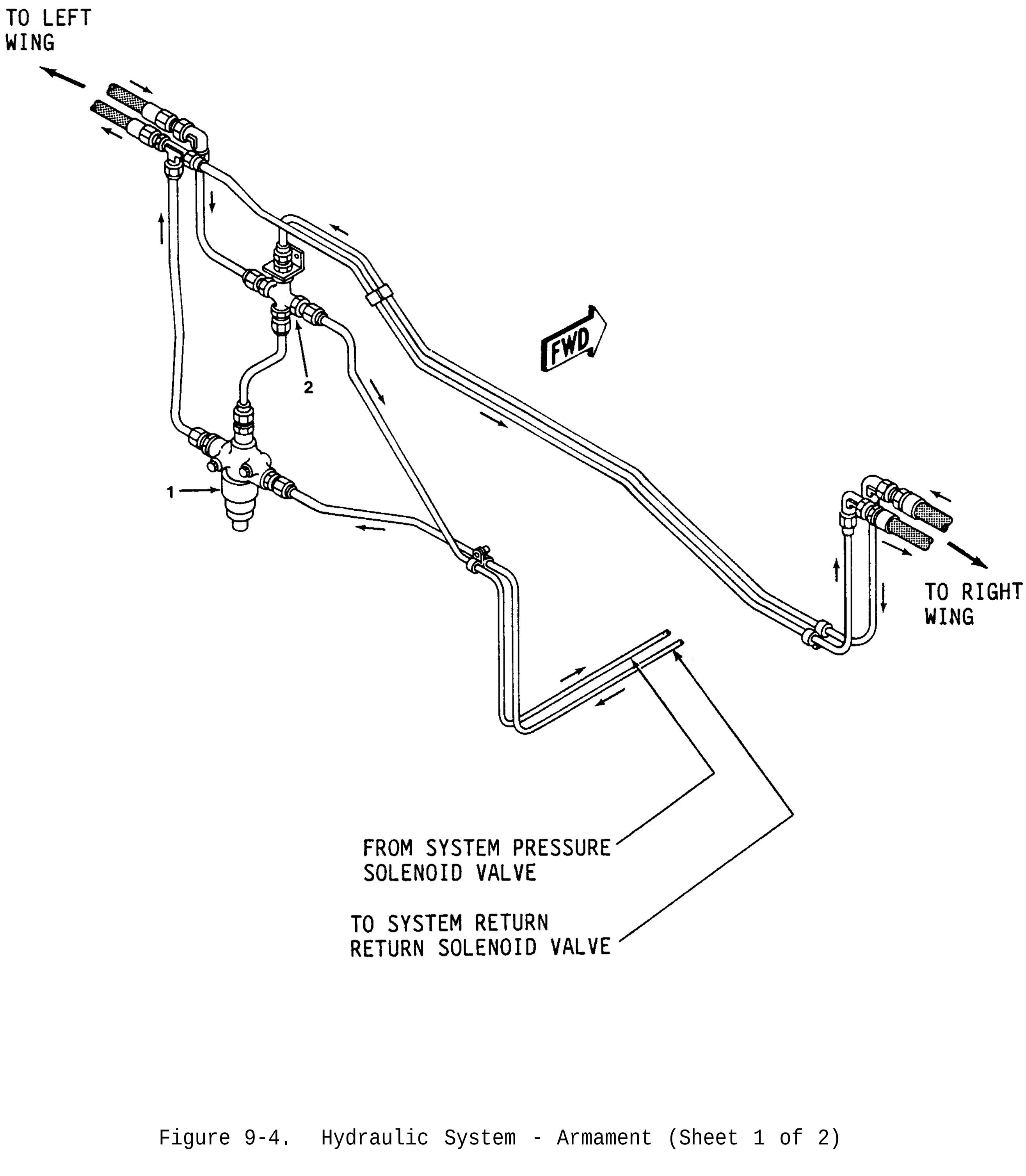
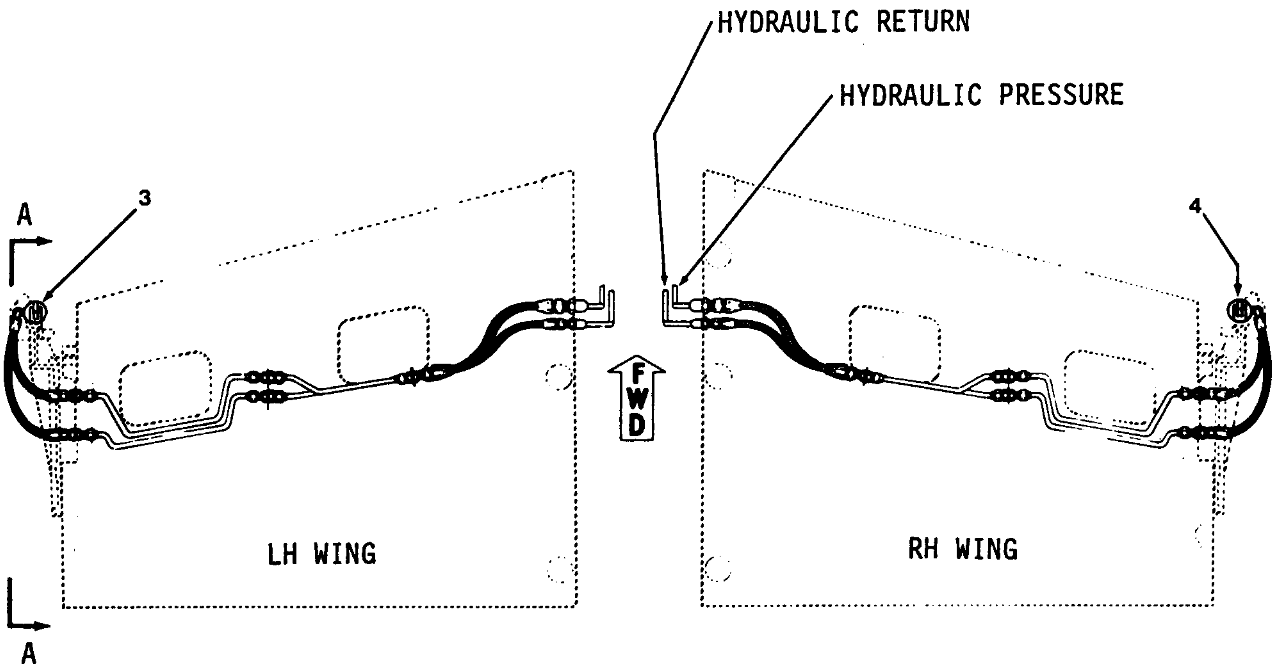
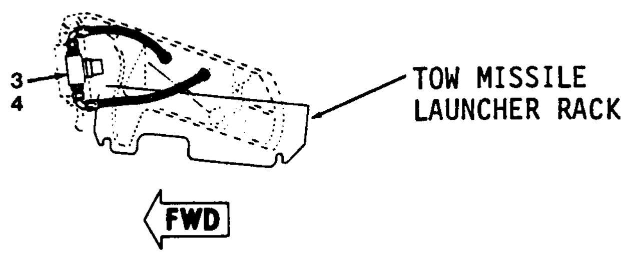
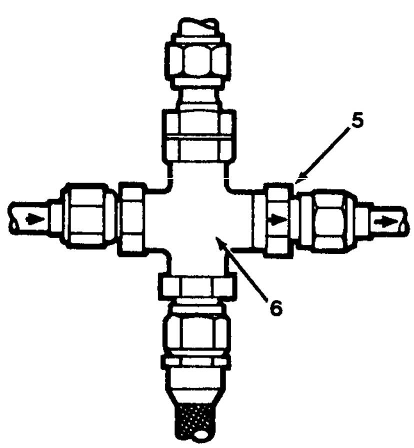



Figure 9-4. Hydraulic System - Armament (Sheet 1 of 2)



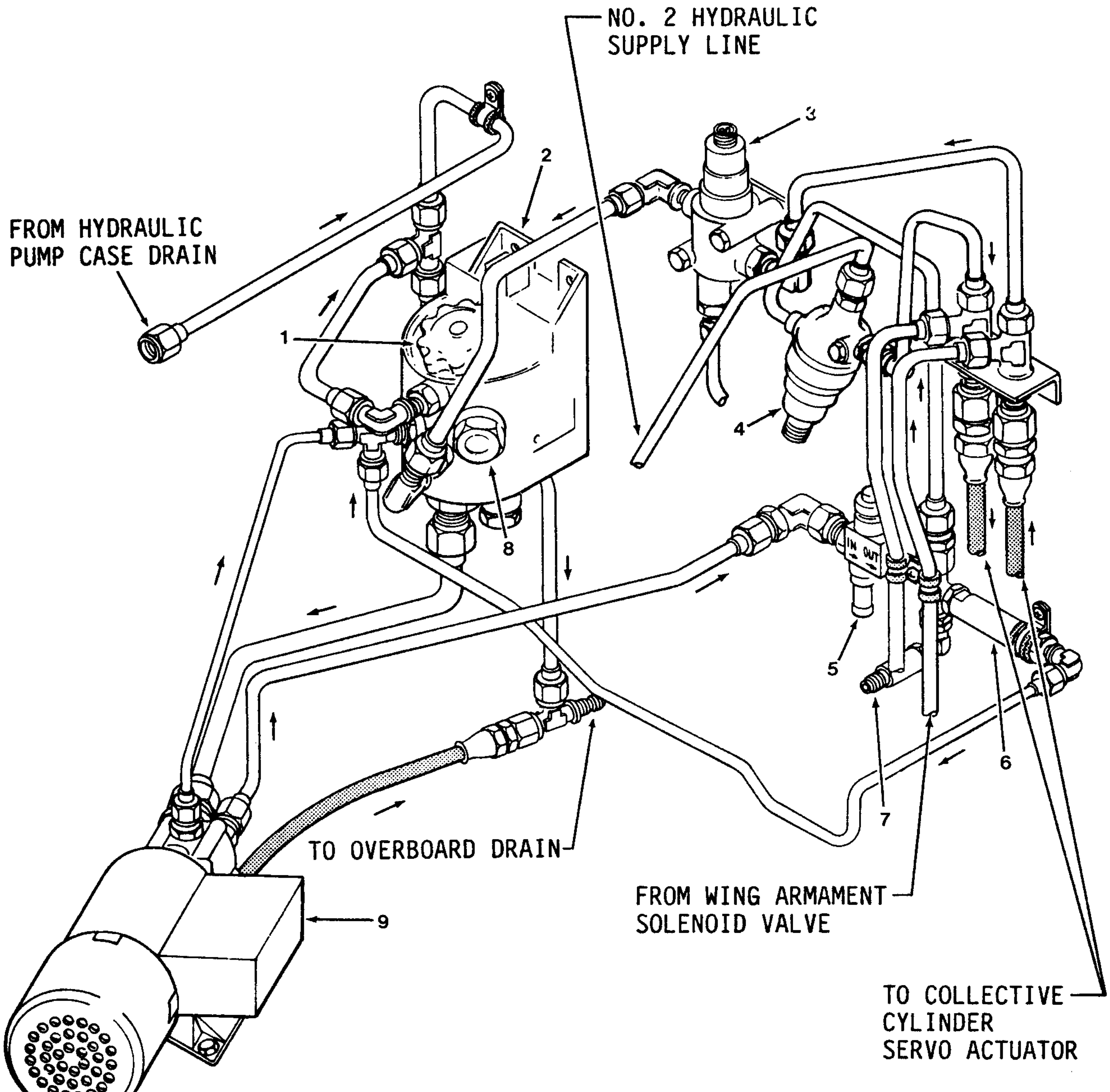

VIEW A-A




VIEW B

1. Solenoid Valve (armament)
   P/N 204-076-504-3 FSCM 94641
   P/N 1-U-1025-63 or
   P/N 130027-5
2. Check Valve
3. Servo Actuator
4. Servo Actuator
5. Check Valve (M) Only
6. Cross

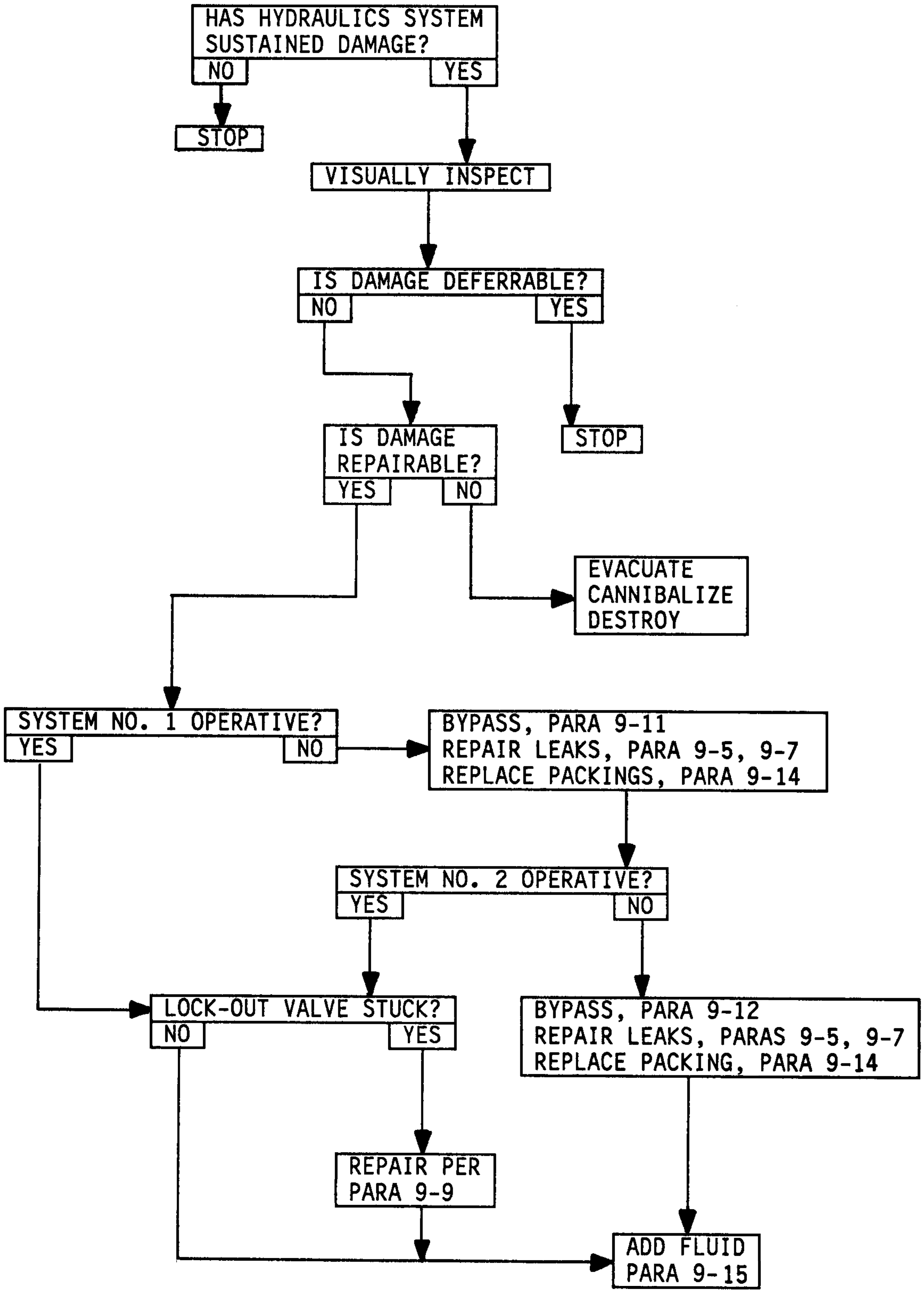
Figure 9-4. Hydraulic System - Armament (Sheet 2 of 2)




1. Filler Cap
2. Reservoir Assembly
3. Solenoid Valve (sys return) P/N 204-076-504-3, P/N 1-7-1025-63, or P/N 130027-5
4. Solenoid Valve (sys pressure) P/N 204-076-504-3, P/N 1-U-1025-63, or P/N 130027-5
5. Filter
6. Pressure Relief Valve
7. Pressure Switch
8. Sight Gage
9. Emergency Hydraulic Pump Package

Figure 9-5. Emergency (Electric Motor Driven) Hydraulic System

**Table 9-1. Hydraulic System Assessment Procedures**



## Section II. HOSES

### 9-4. GENERAL.

a. Replacement hoses maybe manufactured in the field if materials are available. It is considered quicker to make a replacement hose using the old fitting, if serviceable, than to repair a damaged hose. There are two types of fittings used. One fitting is a socket and nipple assembly (Figure 9-6), and the other type is a nipple, o-ring, sleeve, and socket (Figure 9-7).

b. Replacement hoses need not be routed along the path of the original installation. They maybe routed along any convenient path as long as they do not interfere with personnel or with operating equipment. Long hoses should be clamped to hard supports at convenient intervals not exceeding 24 inches. Hose may be used as a substitute for metal tubing.

c. The hydraulic hoses on the AH-1 are braided, wire covered, rubber or Teflon hose. Repair of damage or wear to the wire braids is deferrable for one more flight, provided the inner hose is not leaking under pressure. Kinks in the braided cover should be gently straightened by hand. If possible, wrap frayed wires with tape. If the inner hose is leaking, replace using BDAR fluid line kit or cannibalized parts. If an elbow fitting is not available, a hose with a large gentle loop can be used. MS detachable fittings from a damaged hose may be reused. Swaged fittings cannot be reused.

**WARNING**

- Prolonged contact with hydraulic fluid or mist can irritate eyes and skin. Wear rubber gloves when handling liquid. After any prolonged contact with skin, immediately wash contacted area with soap and water. If liquid contacts eyes, flush immediately with clear water. If liquid is swallowed, do not induce vomiting, get immediate medical attention. If prolonged exposure with mist is likely, wear an appropriate respirator. When fluid is decomposed by heating, toxic gases are released.
- Compressed air can blow dust into eyes. Wear eye protection. Do not exceed 30 psig air pressure.
- Extremely high pressure can occur during and after operation of certain equipment. If this pressure is not relieved before working on equipment, serious injury or death may occur. Be sure to open all vents before beginning any disassembly.

**9-5. LEAKING HOSES.** If leaks are not causing rapid fluid loss, repair may be deferred.

**OPTION 1:** Install New Hose Assembly-BDAR Kit.

LIMITATIONS: None

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 20 Minutes

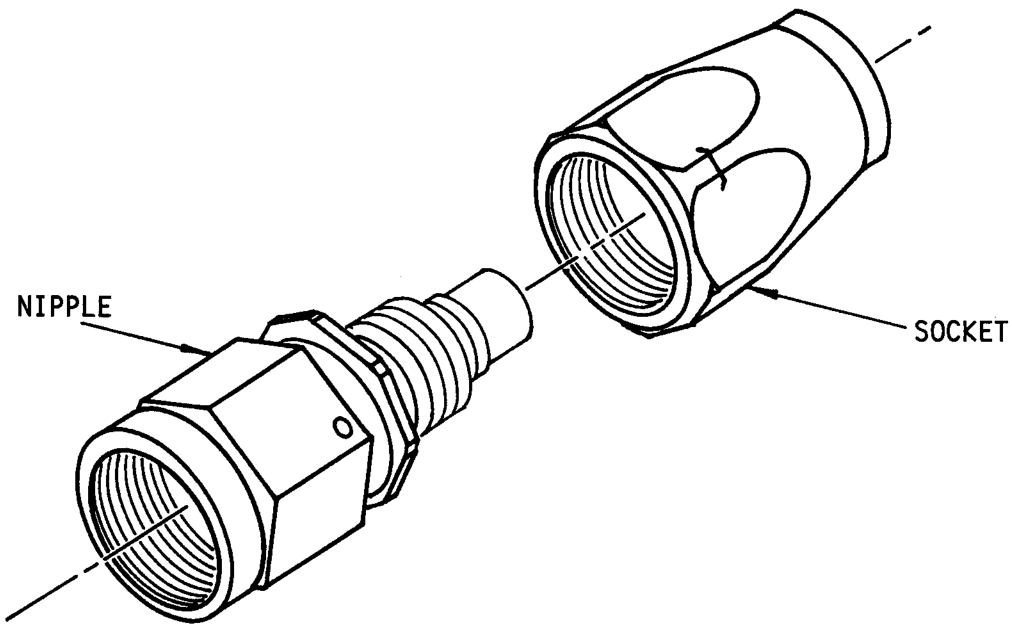



Figure 9-6. Two-Part Fitting

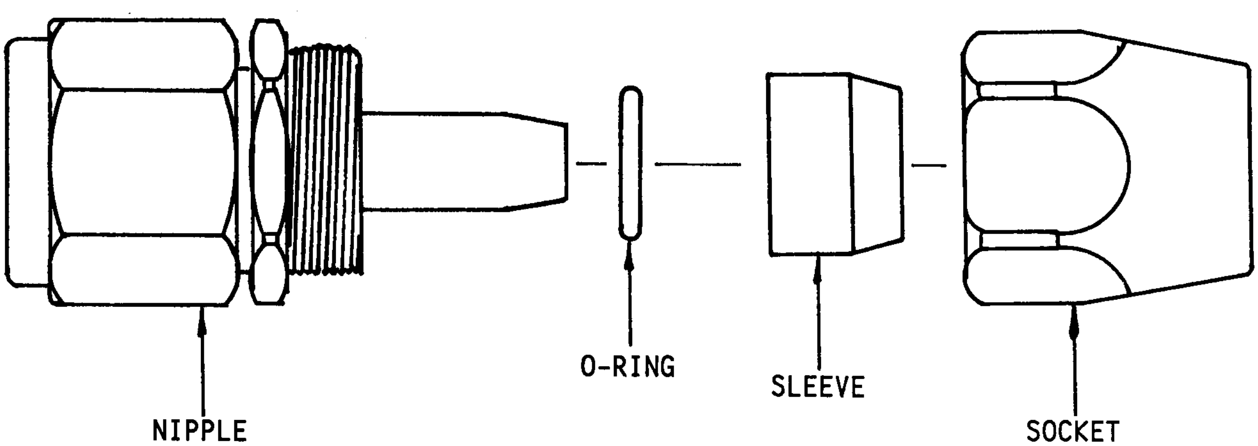



Figure 9-7. Four-Part Fitting

**MATERIAL/TOOLS REQUIRED:**
- Fluid Line Repair Kit (item 4, App. B)

**PROCEDURAL STEPS:**

1. Remove damaged hose assembly.

2. Install new hose assembly (BDAR kit). It maybe necessary to splice two or more hose assemblies together using MS unions to replace the damaged hose assembly. No harm will be done if the replacement hose is too long.

3. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Replace Hose Section.

**LIMITATIONS:** None.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

**MATERIAL/TOOLS REQUIRED:**
- Replacement Section of Hose or Tube (if needed)
- Masking Tape (item 152, App. C)
- Fine Toothed Hacksaw
- MS Fittings (socket, sleeve, and female fitting)
- MS Unions
- Fluid Line Repair Kit (item 4, App. B)

**PROCEDURAL STEPS:**

1. Wrap masking tape (or other available tape) around hose over the areas where cuts are to be made to contain the braided wires from unraveling.

2. Mark on tape where the cuts are to be made.

3. Hold in a vice and cut with a finetoothed hacksaw. Take care to make square cut. Do not remove tape.

**NOTE**

If the damage is small, the length of a single union may be sufficient to provide a repair. However, if the damage is longer, a replacement hose section will be required.

4. Slip the MS socket over the ends of the hose, Figure 9-8. Use care not to unravel the wire braids.

5. Insert the MS sleeve between the wire braid cover and the inner Teflon hose, Figure 9-8.

6. Force sleeve onto hose until the edge of the sleeve is even with the end of the inner hose liner.

7. Reem inside end of the Teflon hose with a tapered tool or a wooden plug so that the edge is smooth and flared to facilitate insertion of the nipple of the MS female fitting.

8. Slide the MS socket over end of hose as far as it will go and hold in vise. Insert nipple of MS female fitting into Teflon inner tube, Figure 9-9.

9. Insert female fitting until threads in socket and female fitting come together.

10. Tighten until the gap between the edge of the socket and the base of the female fitting is approximately 0-1/32 inch for rubber and 0.025 to 0.045 inch for Teflon.

11. Prepare the other damaged end of the hose in the same manner.

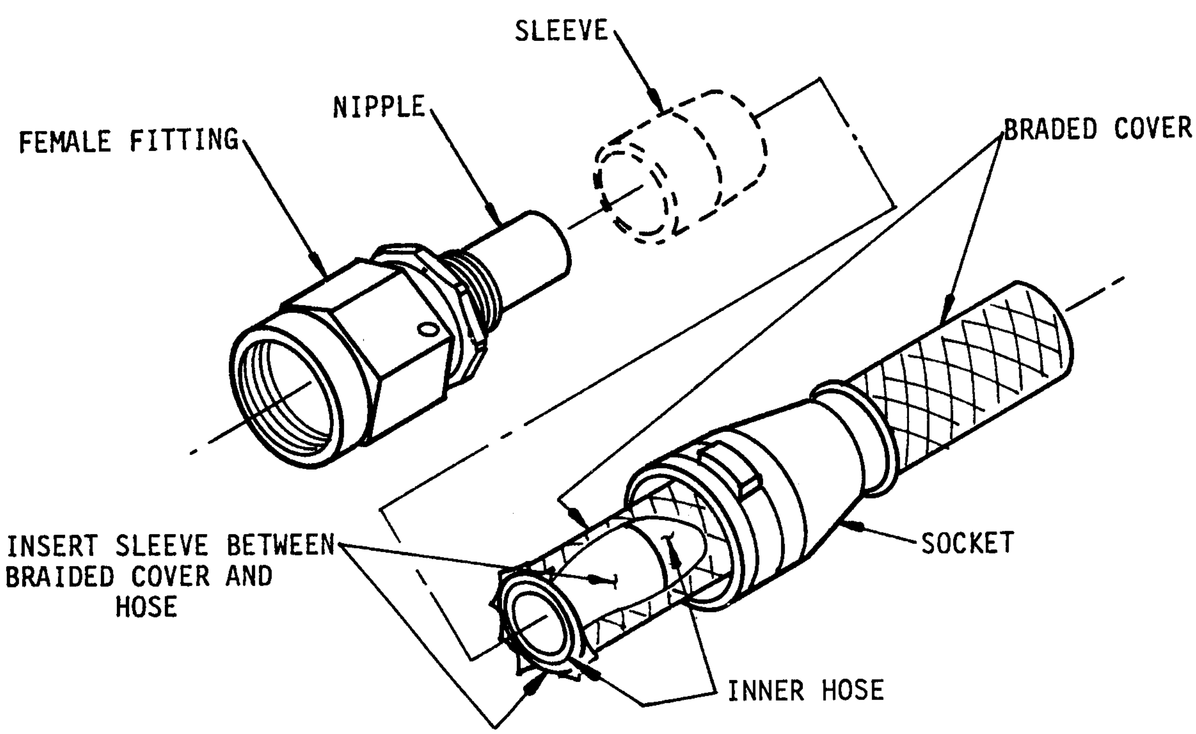



**Figure 9-8. Installation of MS Hose Fitting Socket and Sleeve**

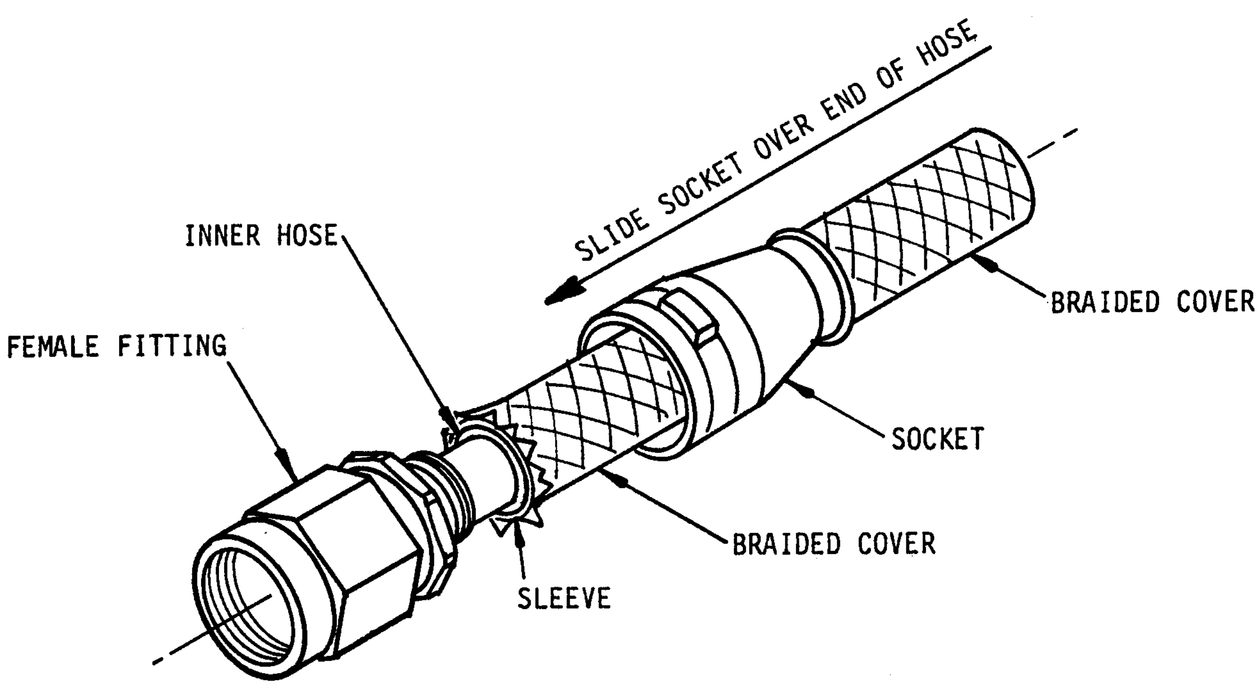



Figure 9-9. Assembly of MS Hose Fitting

12. If no replacement section is necessary, connect the MS fittings on the undamaged ends with an MS union, Figure 9-16. If a replacement section is needed, obtain replacement section and cut to desired length. Refer to step 1 for procedure for cutting hose. No harm will be done if replacement section is too long.

13. Attach MS fittings to both sides of the replacement section.

14. Refer to steps 4 thru 11 for MS fitting installation.

15. Install replacement hose section using MS unions.

16. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

## Section III. METAL TUBING

9-6. GENERAL. Metal tubing is subject to damage by projectiles and fragments. In BDAR, tubing and hose, AN and MS fittings, and other similar components can be substituted one for the other. Available time, tools, skills, and materials will determine which repair option to use. Whenever a line has complex bends, replacement of the damaged section with hose is usually the quickest fix.

9-7. LEAKING METAL TUBING. Preparation of tube ends. When cutting tubing, it is of utmost importance to produce a squared end free of burrs. Tubing may be cut with a tube cutter or a hacksaw. The tube cutter (Figure 9-10) is adaptable for use with metal tubing such as titanium, stainless steel, or aluminum alloy. The following steps may be used to prepare tube ends.

a. Place tubing in the cutting tool with the cutting wheel at the point where the cut is to be made.

b. Ratchet the cutter around the tubing applying a light pressure to the cutting wheel by intermittently tightening the setscrew. Too much pressure on the cutting wheel at one tightening could deform the tubing or cause excessive burring.

c. Carefully remove any burrs from the inside and outside of the tube. Use a knife or any other sharp instrument to deburr the tubing.

d. If a tube cutter is not available or if tubing of hard material is to be cut, use a fine toothed hacksaw, preferably one having 32 teeth per inch.

e. After sawing, file the end of tube square, smooth, and remove all burrs. Be sure all cuttings are removed from inside the tubing. Inspect the tubing end to verify its roundness, its being cut square, and that it is clean and free from draw marks and scratches. Figure 9-11 illustrates a properly burred tubing end.

NOTE

After tubing has been cut, flush any residue from the tube end. Flush with any available fluid, or if end connections are difficult to access, momentary activation of the system will suffice.

OPTION 1: In Line Repair.

LIMITATIONS: None.

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 30 Minutes

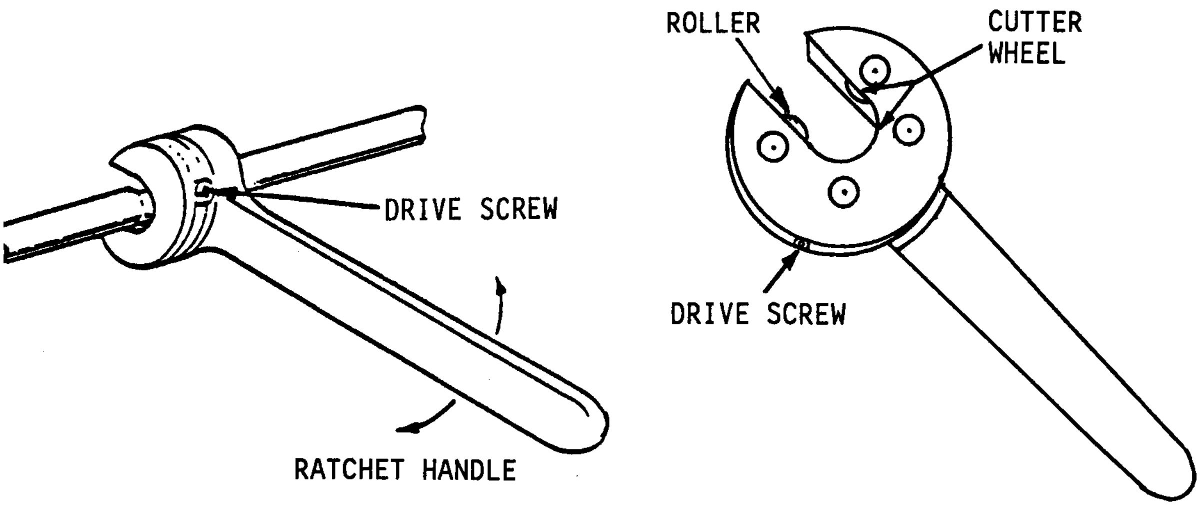



**Figure 9-10. Using Tube Cutter**

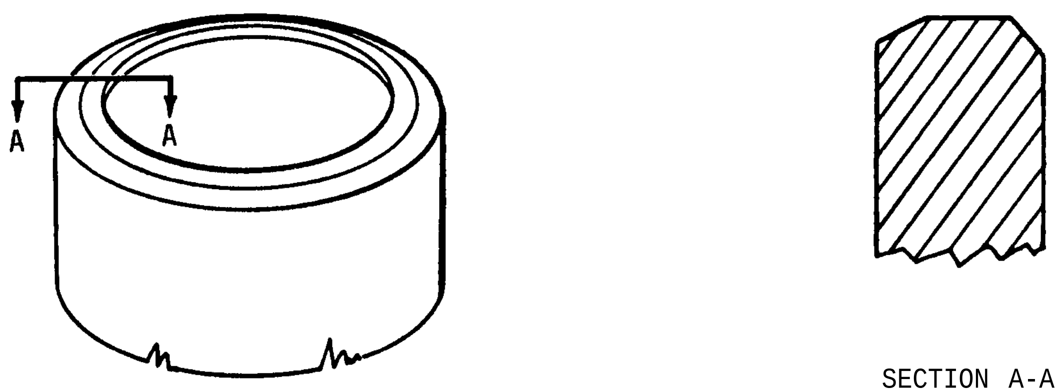



Figure 9-11. Properly Burred Tubing

MATERIALS/TOOLS REQUIRED:
- Fluid Line Repair Kit (item 4, Appx B)
- 4 MS Fittings
- 2 MS Unions
- Splice Tube
- Tubing Cutter
- Knife or File

1. Cut and remove damaged section of tubing, Figure 9-12. Tube ends must be cut square.

2. Clean ends of undamaged tubing with knife or file.

3. Prepare all tubing ends as instructed in paragraph 9-7.

NOTE

Replacement tubing need not be routed along the path of the original installation. Tubing may be routed along any convenient path as long as it does not interfere with personnel or with operating equipment. Long lines should be clamped to hard supports at convenient intervals not exceeding 24 inches.

4. Measure the distance between the two undamaged ends and cut a tube splice replacement section of this length.

5. Prepare ends of splice section.

6. Install a MS fitting on each end of the tubes, Figure 9-13.

7. Install splice tube in line along with 2 unions and tighten, Figure 9-14.

8. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

OPTION 2: Substitute with High Pressure Hose.

LIMITATIONS: None.

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 30 Minutes

MATERIALS/TOOLS REQUIRED:
- Hydraulic Hose Assy Complete with End Fittings
- MS Unions
- Tube Cutter
- Knife or File
- Fluid Line Repair Kit (item 4, Appx B)

PROCEDURAL STEPS:

1. Cut and remove damaged section of tubing, Figure 9-12. Tube ends must be cut square.

2. Clean ends of undamaged tubing with knife or file.

3. Install MS tube fittings as shown in Figure 9-13.

4. Connect MS unions to both tube ends and complete the repair by connecting a hydraulic hose assembly from one union to the other, Figure 9-15.

5. If the damaged length of tubing is long and more than one hose assembly is required, hose assemblies may be spliced together with unions.

NOTE

No harm will be done if the replacement hose is too long.

6. Clamp at convenient intervals, not exceeding 2 feet, to hard supports.

7. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

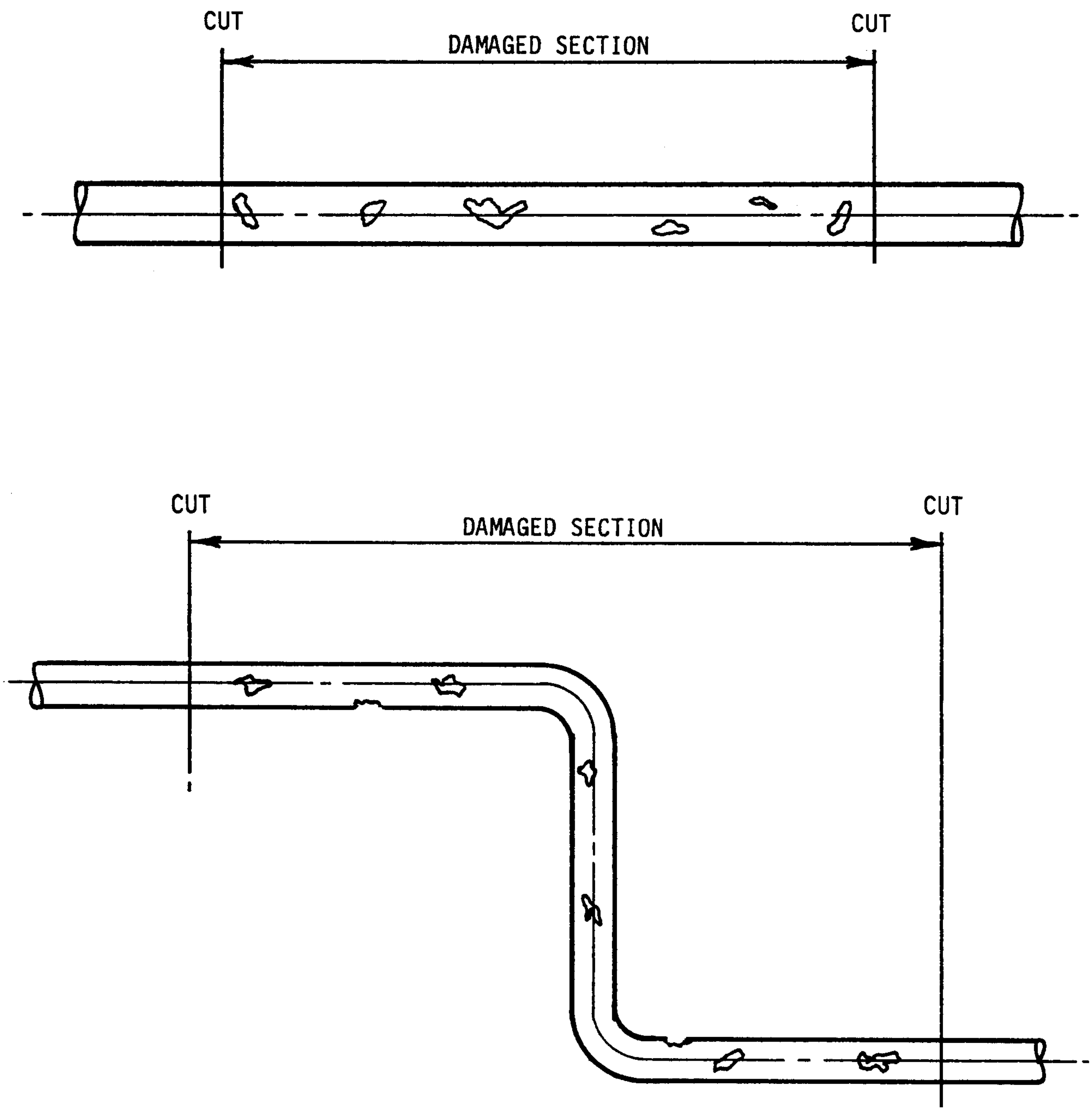



Figure 9-12. Damaged Tube Sections

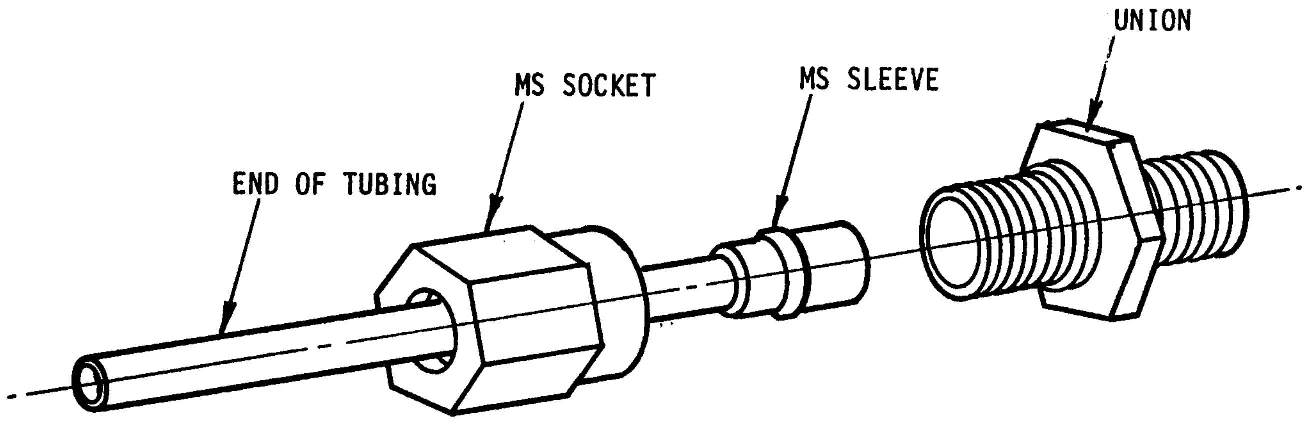



Figure 9-13. MS Tube Fitting Installation

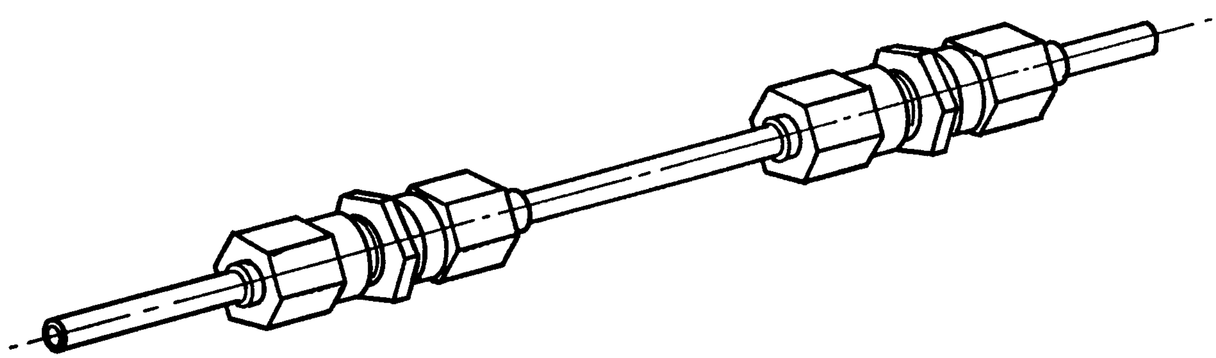


Figure 9-14. Completed Tubing Installation

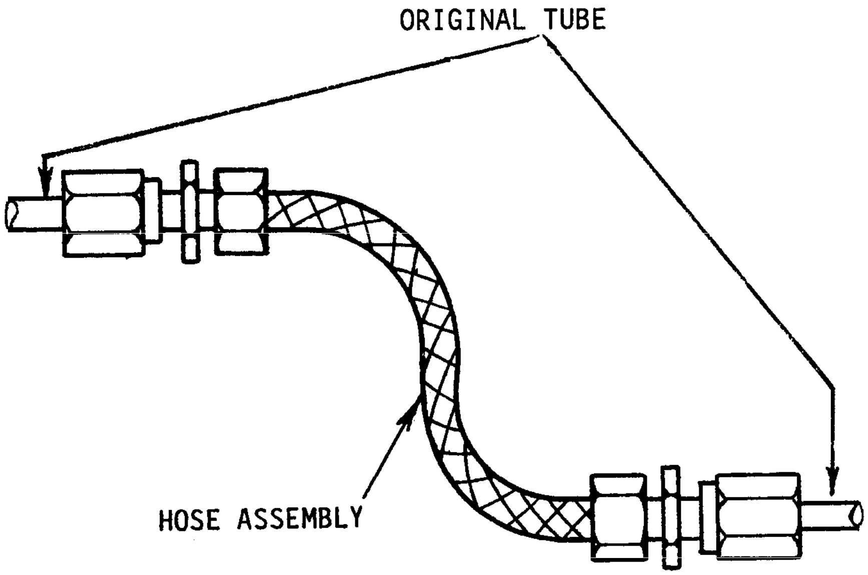



Figure 9-15. Completed High Pressure Hose Substitution

OPTION 3: Repair with MS Union (use to fix hole in existing hose).

LIMITATIONS: None.

PERSONNEL/TIME REQUIRED:
- 2 Soldiers
- 1 Hour

MATERIALS/TOOLS REQUIRED:
- Hydraulic Hose
- MS Fittings
- Tube Cleaner
- Tube Cutter
- Hacksaw
- Hand File
- Fluid Line Repair Kit (item 4, Appx B)

PROCEDURAL STEPS:

1. Cut and remove short damaged section of hose.

2. Clean ends of hose and slip an MS socket and sleeve over each end, as shown in Figures 9-8 and 9-9.

3. Install and tighten union, Figure 9-16.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

OPTION 4. Repair Return Lines. (Primarily for low pressure lines.) Refer to hose and tubing repair options in Chapter 12.

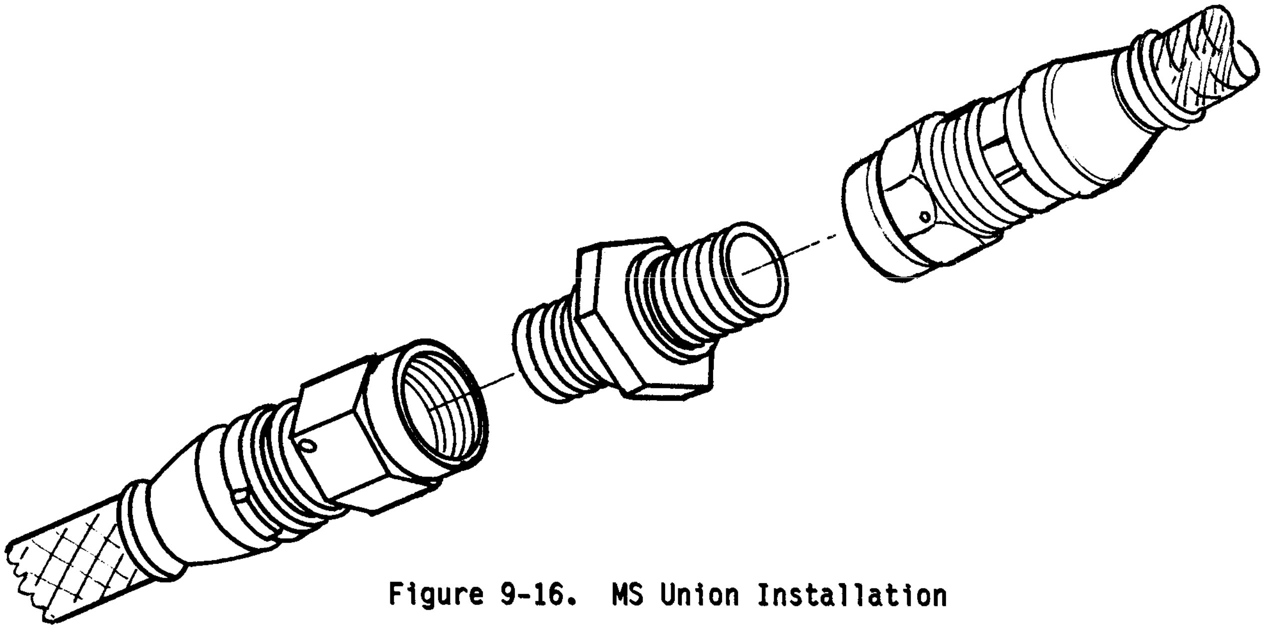


Figure 9-16. MS Union Installation

## Section IV. HYDRAULIC COMPONENTS

**9-8. GENERAL.** Hydraulic components receiving ballistic damage are prone to shattering or tearing. The component will usually require replacement, although items such as filters maybe by passed.

**9-9. LOCK-OUT VALVE STUCK IN CLOSED POSITION.**

**GENERAL INFORMATION:** If the hydraulic system is inoperable and the flight controls are binding with the pressure on, one reason might be that the lock-out valve (Figure 9-1 7) is stuck in the closed position. Turn one system off. If the other system then operates, the lock-out valve on the turned-off system probably is the cause for the failure of the combined system to operate.

**OPTION 1:** Disassemble and Clean.

**LIMITATIONS:** Self-recovery or one more mission not requiring abrupt maneuvers.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1 Hour Per Unit

**MATERIALS/TOOLS REQUIRED:**
l Common Hand Tools
l Packing Assortment (item 71, App. C)

**PROCEDURAL STEPS:**

1. Remove defective lock-out valve assembly from aircraft.

**NOTE**

During disassembly, take care not to damage packings.

2. Disassemble item 1 thru 12, Figure 9-17. Clean and inspect.

**NOTE**

- Replace packing with new packing if possible. Refer to App. D for packing substitutions.
- Relube parts before reassembly.

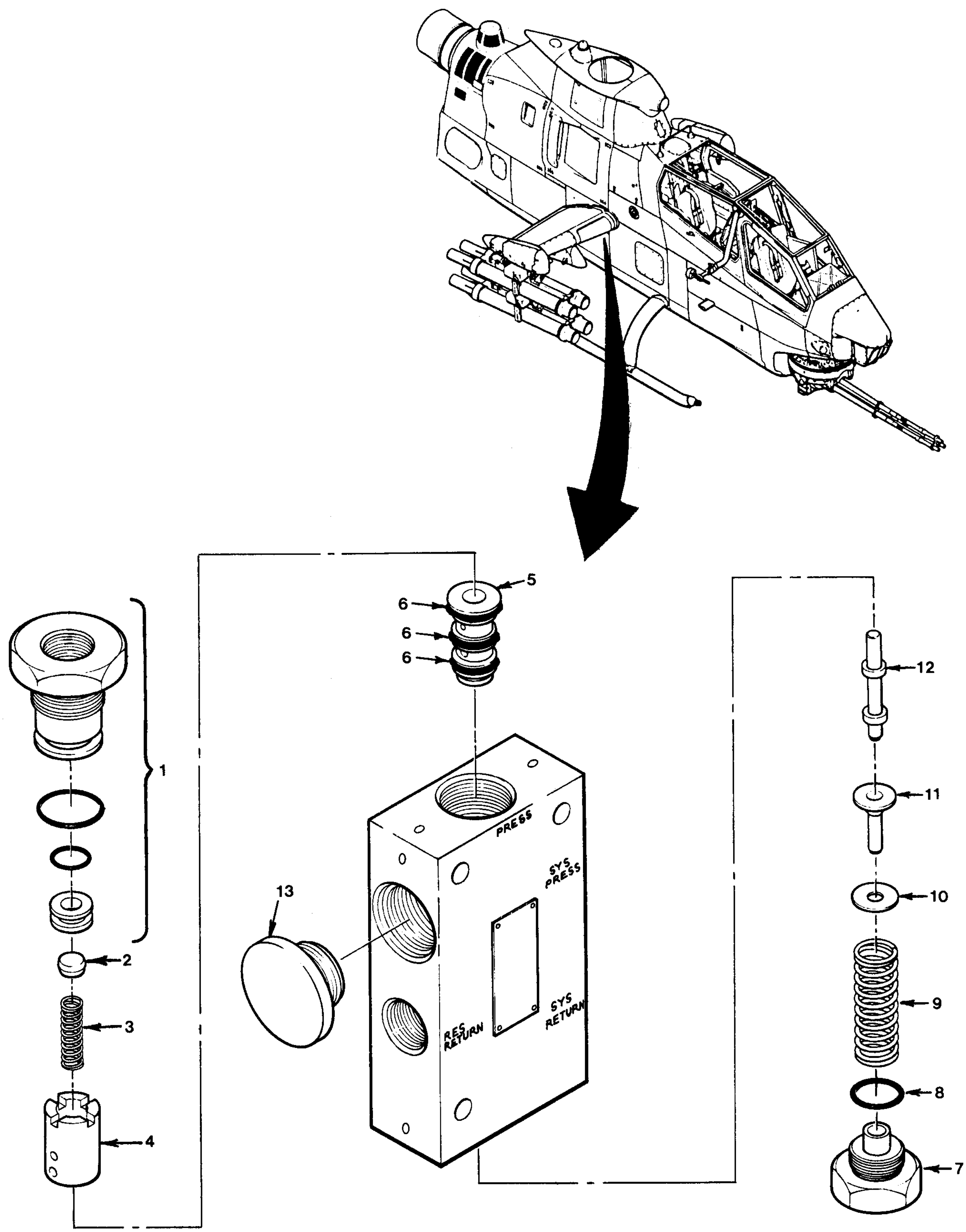



Figure 9-17. Lock-Out Valve Assembly

## Section V. HYDRAULIC SYSTEM ISOLATION

### 9-10. GENERAL.

a. Both hydraulic systems jointly operate the three flight control power cylinders: cyclic fore and aft, cyclic lateral, and collective. In addition, each system individually operates a set of several other subsystems.

b. If the No. 1 system hydraulic pump were to fail, the tail rotor control hydraulic cylinder and the yaw stability and control augmentation system SCAS servo-actuator would be inoperable. Without the tail rotor hydraulic cylinder, the pedal controls would be very stiff. It would be possible but very difficult to fly the aircraft through simple maneuvers. Without the services of the yaw SCAS servo actuator, it would be difficult to maintain control at speeds above 90 knots. Also, without the use of the yaw servo actuator, erratic airframe movements such as those caused by strong winds or armament recoil could cause the aircraft to drift.

c. If the No. 2 system hydraulic pump were to fail, the armament and tow missile launcher systems and the pitch and roll SCAS servo actuators would be inoperable. Without hydraulic pressure to the armament and tow missile launcher systems, these systems will not operate. Without the services of the pitch and roll SCAS servo-actuator, it would be difficult to maintain control at speeds above 90 knots. Also, without the pitch and roll SCAS actuators working, any erratic airframe movements such as those caused by strong winds or armament recoil could cause the aircraft to drift.

**WARNING**

When handling hydraulic fluid, observe the following: Prolonged contact with liquid or mist can irritate eyes and skin. After any prolonged contact with skin, immediately wash contact area with soap and water. If liquid contacts eyes, flush them immediately with clear water. If liquid is swallowed, do not induce vomiting; get immediate medical attention. Wear rubber gloves when handling liquid. If prolonged contact with mist is likely, wear an appropriate respirator. When fluid is decomposed by heating, toxic gases are released.

**CAUTION**

O-rings, wipers, gaskets or other plastic, or rubber parts of the hydraulic system may swell or shrink, and for that reason continued operability of the system cannot be guaranteed. Following such a substitution, instructions for bringing the system back to normal should include checking all moving parts of the hydraulic system and all hydraulic activated devices for proper operation and leaks. Where feasible, in critical areas, plastic and rubber parts should be inspected for swelling, deformation, and other damage.

### 9-11. NO. 1 HYDRAULIC SYSTEM PUMP INOPERATIVE.

**GENERAL INFORMATION:** If the No. 1 hydraulic pump fails, the system can be altered to isolate the No. 1 pump from the hydraulic system. The No. 2 hydraulic pump will operate all those systems operated by the No. 1 system in addition to those systems which it operates under normal usage.

**OPTION:** Isolate No. 1 Pump.

**LIMITATIONS:** Avoid any abrupt maneuvers. Inspect after every flight.

**PERSONNEL/TIME REQUIRED:**

Ž 2 Soldiers
- 3 Hours

**MATERIAL/TOOLS REQUIRED:**

- One Hose Assembly 3/8 X 24 inches
- One Tee Fitting-MS21912 D6
- One No. 6 Steel Plug Fitting MS21913-6
- One No. 6 Steel Cap Fitting MS21914-6
  Hydraulic Fluid
- Fluid Line Repair Kit (item 4, App. B)

**PROCEDURAL STEPS:**

1. Drain hydraulic fluid from reservoir system No. 2 by disconnecting bypass tube fitting (1, Figure 9-1 8). Leave tube disconnected.

2. Drain hydraulic fluid from reservoir system No. 1 by disconnecting fluid return tube fitting (11, Figure 9-1 8).

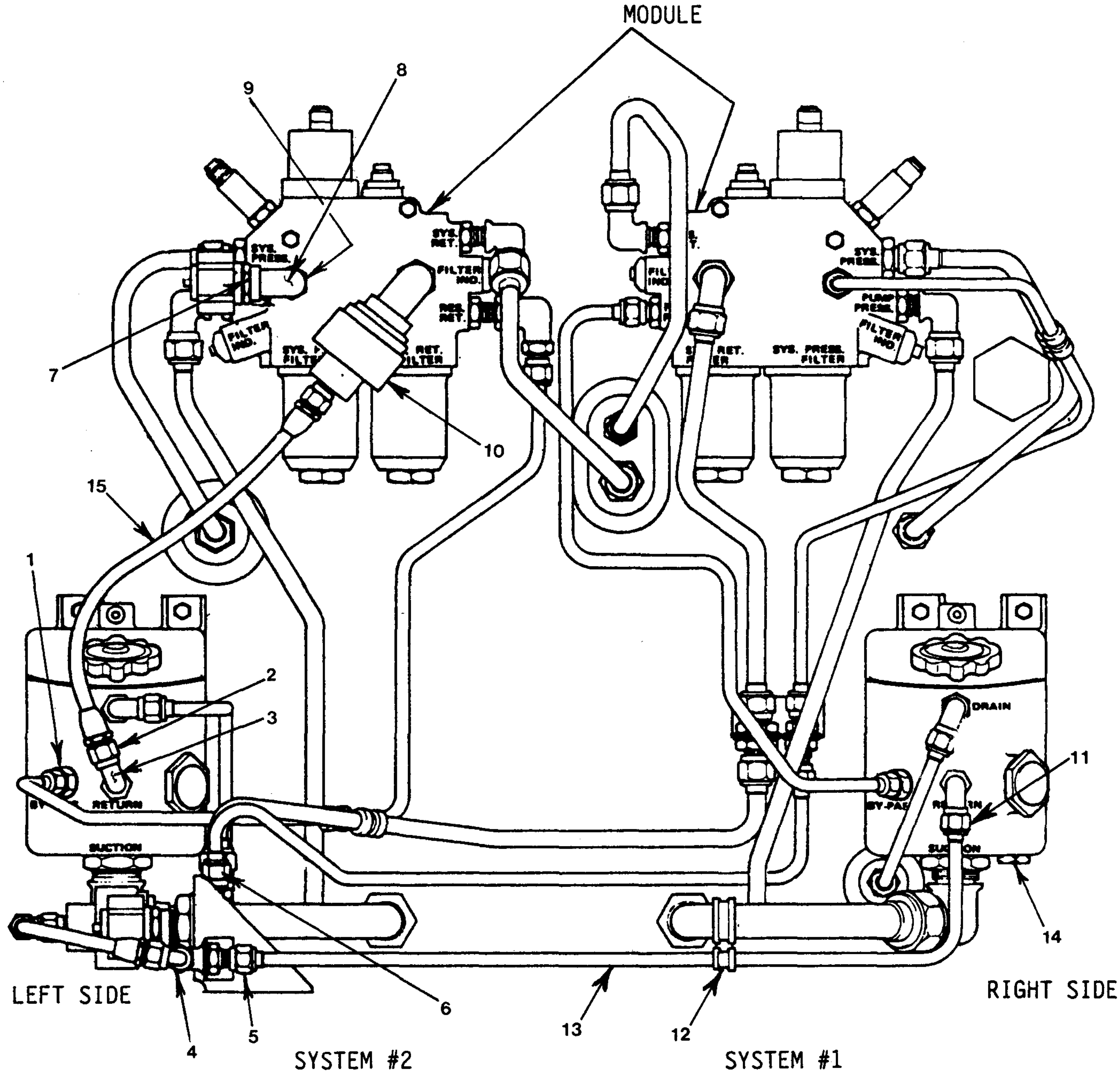
3. Plug elbow fitting by installing steel cap fitting (5, Figure 9-19).

4. Remove electrical wire clamp from return tube (12, Figure 9-18).

5. Disconnect tube fitting (5, Figure 9-18).

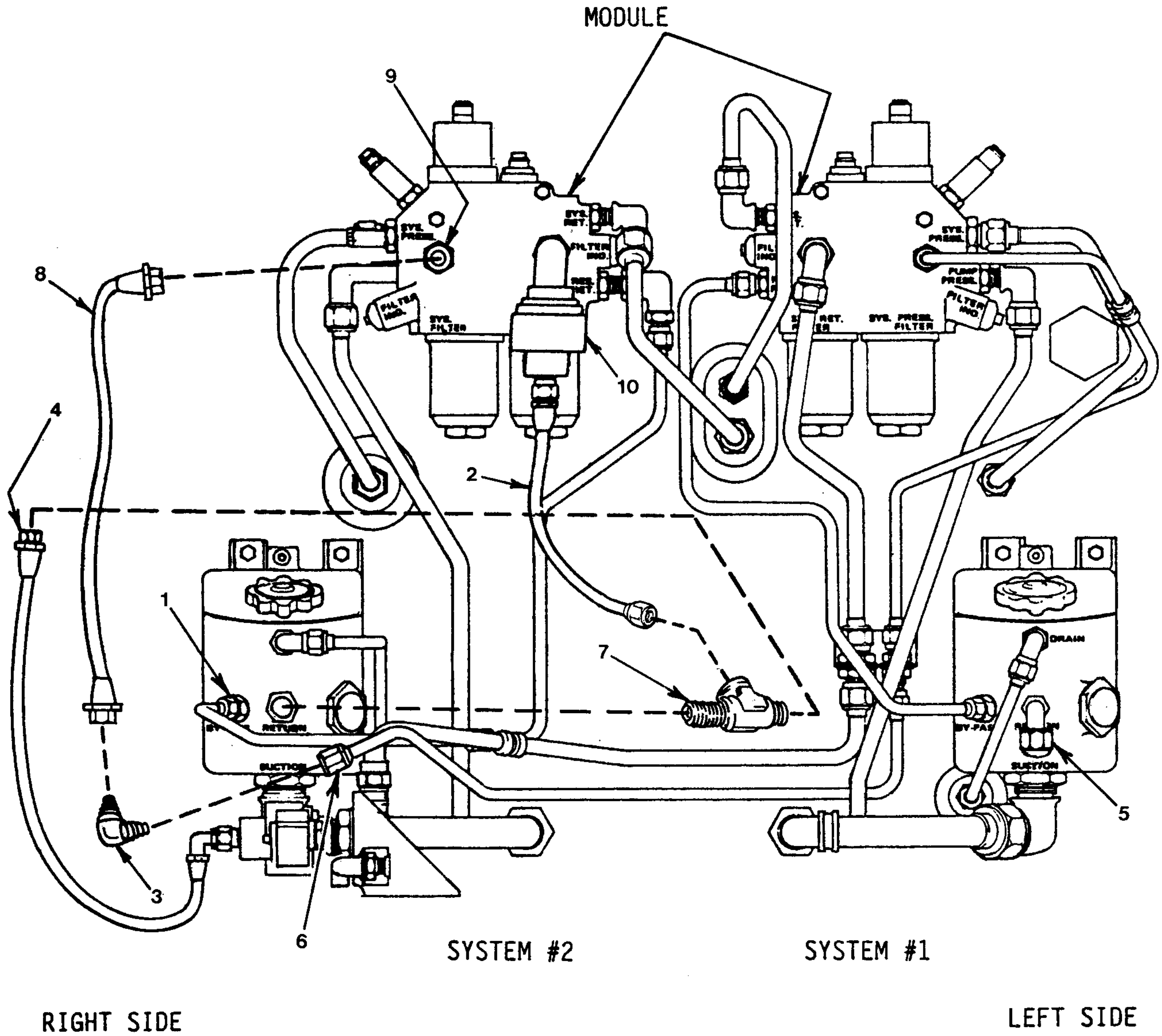
6. Remove return tube assembly (13, Figure 9-18) from aircraft.

7. Disconnect tube fitting (6, Figure 9-18).




1. Tube Fitting, Bypass
2. Hose Fitting, Return
3. Elbow Fitting
4. Hose Fitting
5. Tube Fitting
6. Tube Fitting
7. Quick Disconnect, Pressure
8. Elbow, Pressure
9. Union
10. Quick Disconnect, Return
11. Tube Fitting
12. Electrical Clamp
13. Tube Return Sys No. 1
14. Drain Plug
15. Hose, Return Sys No. 2

Figure 9-18. Hydraulic System, Unaltered




1. Tube Fitting, Bypass
2. Hose Fitting, Return
3. Elbow Fitting
4. Hose Fitting
5. Steel Cap
6. Tube Fitting
7. Tee Fitting
8. Hose Assembly
9. Union
10. Quick Disconnect, Return

Figure 9-19. Hydraulic System, Isolating No. 1 System

8. Disconnect hose fitting (2, Figure 9-1 8).

9. Remove elbow fitting (3, Figure 9-1 8) from system No. 2 reservoir.

10. Replace elbow with a “tee” fitting (7, Figure 9-1 9) as shown. Leave tee fitting loose.

11. Remove filter screen from elbow fitting (3, Figure 9-1 9) and connect elbow to tube fitting (6, Figure 9-1 9).

12. Disconnect hose fitting (4, Figure 9-1 8) and connect to “tee” fitting (9, Figure 9-21) as shown.

13. Connect hose fitting (2, Figure 9-19) to “tee” fitting (7, Figure 9-19) as shown.

14. Reconnect bypass tube fitting (1, Figure 9-19) as shown.

**NOTE**

Return quick disconnect (1O, Figure 9-18) needs to be pivoted down as shown (1O, Figure 9-1 8), in order to remove pressure quick disconnected and elbow fitting.

15. Disconnect and remove system pressure quick disconnect (7, Figure 9-18) and elbow fitting (8, Figure 9-18).

**NOTE**

Union (9, Figure 9-18) to remain in module.

16. Obtain a hose assembly (8, Figure 9-19). This hose should be 3/8 X 24 inches (two 12 inch hose assemblies may be spliced together with a MS union).

17. Connect one end of hose assembly (8, Figure 9-19) to system pressure union (9, Figure 9-19).

18. Connect the other end of hose to elbow fitting (3, Figure 9-19).

19. Tighten all connections that have been broken and remade in procedural steps above.

20. Refill hydraulic reservoir system No. 2.

21. Without disconnecting hydraulic lines, remove isolated hydraulic pump No. 1 from drive pad on right hand side of transmission sump case and set clear of transmission, Figure 9-20.

22. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## 9-12. NO. 2 HYDRAULIC SYSTEM PUMP INOPERATIVE.

**GENERAL INFORMATION:** If the No. 2 hydraulic pump fails, the system can be altered to isolate the No. 2 pump from the hydraulic system. The No. 1 hydraulic pump will operate all those systems operated by the No. 2 system in addition to those systems which it operates under normal usage.

**OPTION:** Isolate No. 2 Pump.

**LIMITATIONS:** Avoid any abrupt maneuvers.

**PERSONNEL/TIME REQUIRED:**
- 2 Soldiers
- 3 Hours

**MATERIALS/TOOLS REQUIRED:**
- Two Hose Assembly 3/8 X 24 inches.
- One Tee Fitting MS21912-D6
- One No. 6 Steel Plug Fitting MS 21913-6
- One No. 6 Steel Cap Fitting MS21914-6
- Hydraulic Fluid (App. D)
- Fluid Line Repair Kit (item 4, App. B)

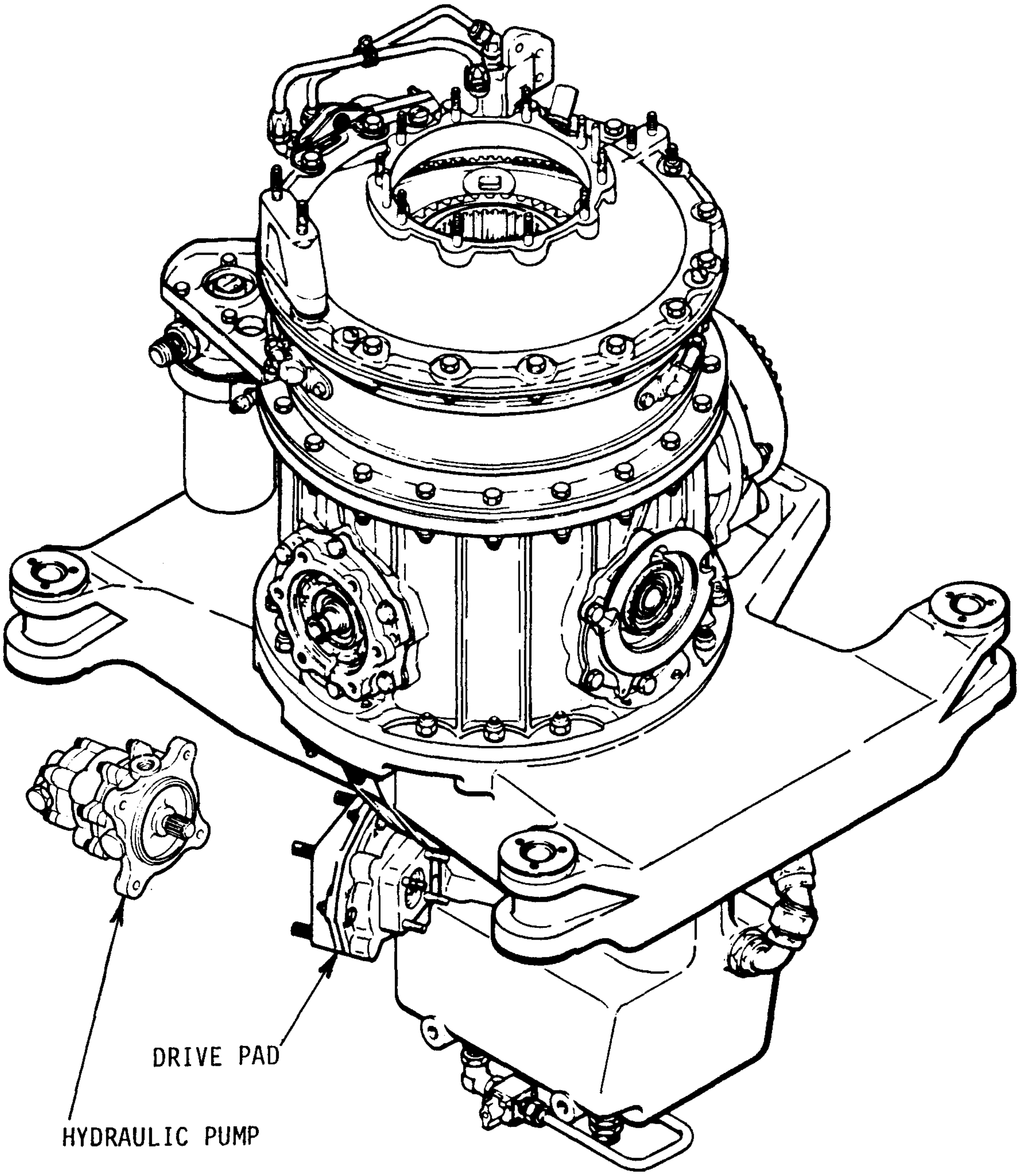



Figure 9-20. Hydraulic Pump and Drive Pad

PROCEDURAL STEPS:

1. Drain hydraulic fluid from reservoir system No. 1 by removing drain plug (14, Figure 9-18).

2. Reinstall drain plug.

3. Drain hydraulic fluid from reservoir system No. 2 by disconnecting bypass tube fitting (1, Figure 9-18). Leave tube disconnected.

4. Disconnect hose fitting (2 Figure 9-18) and remove elbow fitting (3, Figure 9-18).

5. Install steel plug fitting (7, Figure 9-21).

6. Reconnect bypass tube fitting (1, Figure 9-21).

Disconnect tube fitting (6, Figure 9-18) .

8. Remove filter screen from elbow fitting (3, Figure 9-21) and connect elbow to tube fitting (6, Figure 9-21).

9. Disconnect tube fitting (4, Figure 9-18) and hose fitting (5, Figure 9-18) from elbow fitting attached to bracket assembly.

10. Connect tube fitting (4, Figure 9-21) and hose fitting (5, Figure 9-21) to tee fitting (11, Figure 9-21). Tee fitting is to be placed directly above bracket assembly.

NOTE

Return quick disconnect (10, Fig. 9-18) needs to be pivoted down as as shown (10, Fig. 9-21), in order to remove pressure quick disconnect and elbow fitting.

11. Disconnect and remove system pressure quick disconnect (7, Figure 9-18) and elbow fitting (8, Figure 9-18).

NOTE

Union (9, Figure 9-18) to remain in module.

Obtain a hose assembly (8, Figure 9-21). This hose should be 3/8 X 24 inches (two 12 inch hose assemblies may be spliced together with an MS union). Connect one end of hose assembly (8, Figure 9-21) to system pressure union (9, Figure 9-21).

13. Connect the other end of hose to elbow fitting (3, Figure 9-21).

Remove hose assembly (15, Figure 9-18) .

15. Obtain a hose assembly (2, Figure 9-21) (two 12 inch hose assemblies may be spliced together with an MS union).

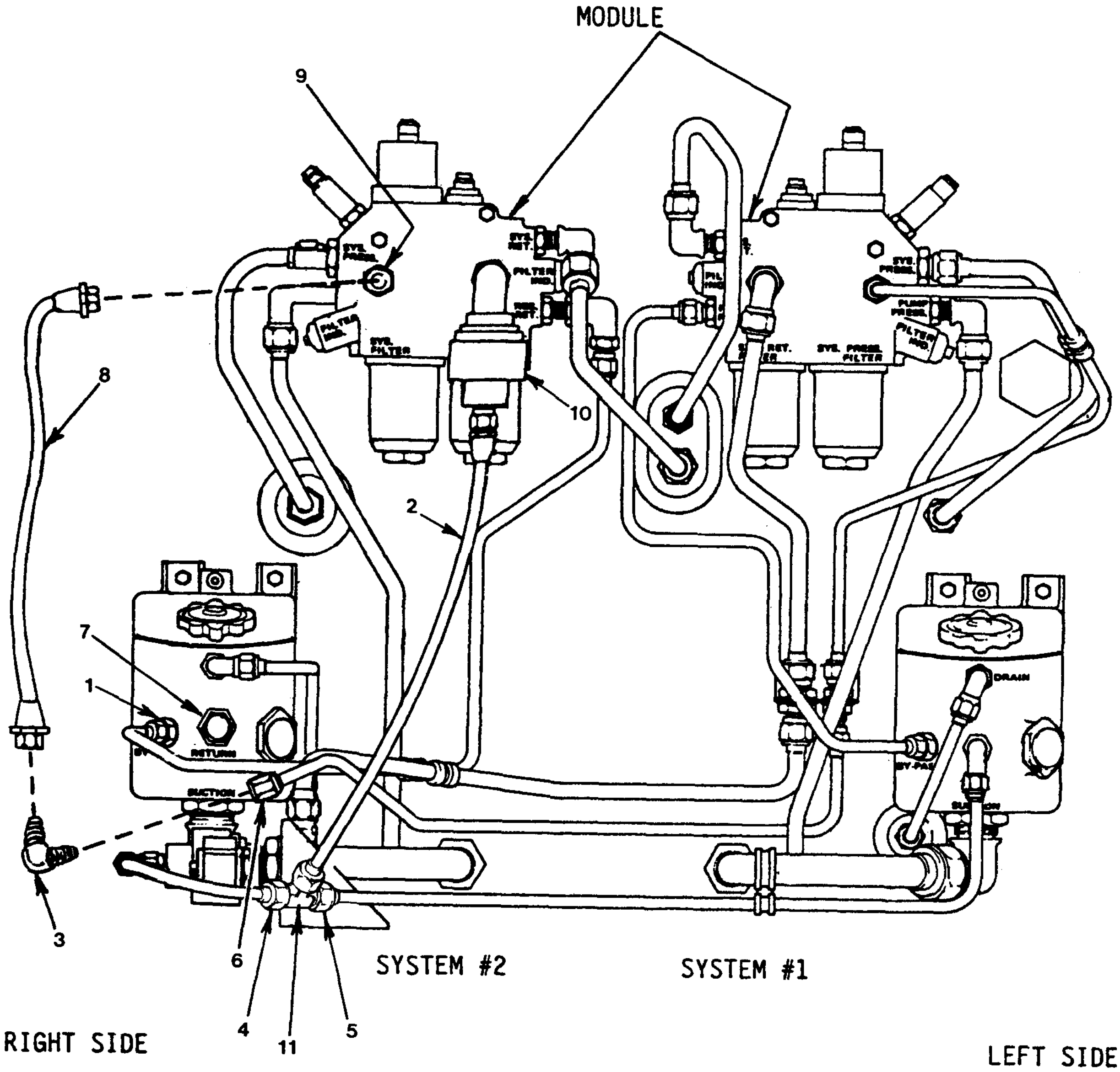
16. Connect one end of hose assembly to return quick disconnect (10. Figure 9-21) and the other end to tee fitting (11, Figure 9-21) as shown.

17. Tighten all connections that have been broken and remade in procedural steps above.

18. Refill hydraulic reservoir system No. 1.

19. Without disconnecting hydraulic lines, remove isolated hydraulic pump No. 2 from drive pad on right hand side of transmission sump case and set clear of transmission, Figure 9-20.

20. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.




1. Tube Fitting
2. Hose Assembly (from BDR kit)
3. Elbow Fitting
4. Hose Assembly
5. Tube Fitting
6. Tube Fitting
7. Steel Plug
8. Hose Assembly
9. Union
10. Quick Disconnect, Return
11. Tee Fitting

Figure 9-21. Hydraulic System, Isolating No. 2 System

## Section VI. O-RING, PACKING, AND GASKETS

### 9-13. GENERAL.

a. O-rings are used in static and dynamic applications.

(1) In static applications, the o-ring serves as a gasket when it is compressed within a recess. Leakage is not normally acceptable.

(2) In dynamic applications, the sealing action is dependent primarily on the resilience of the o-rings. When moving parts are involved, minor seepage may be normal and acceptable. A moist surface found on moving parts of a hydraulic unit (piston shaft is an indication that the seal is being properly lubricated.

(3) Seal replacement is required when the following steps occur:

(a) The amount of fluid being lost will cause system failure.

(b) The leak creates a hazard.

(c) The leak will not permit the system to function safely for one more flight.

NOTE

Packings and gaskets are identified by part number on packages. Do not remove from package until ready for use.

b. Selection of Proper Packing or Gasket. Selection of proper packing or gasket for a particular application is of the utmost importance. The exact size, shape, and material composition must be properly determined in order for various systems to function correctly. Packings, gaskets, or seals. Similar to fittings, packings are made to an AN, MS, or NAS standard.

### 9-14. REPLACEMENT OF PACKINGS.

While packings may look alike in general construction features and may be of the same size, they are not necessarily made from the same compound. Refer to Appendix D for a complete listing of interchangeable packings. The dimensional relationship between AN6227, AN6230, and MS 28775 series o-ring packings and gaskets in the various sizes is as follows:

- AN6227-B1 through B7 are equivalent to MS28775-006 through MS28775-012.
- AN6227-B8 through B14 are equivalent to MS28775-110 through MS28775-116.
- AN6227-B15 through B27 are equivalent to MS28775-210 through MS28775-222.
- AN6227-B28 through B52 are equivalent to MS28775-325 through MS28775-349.
- AN6227-B53 through B87 are equivalent to MS28775-426 through MS28775-460.
- AN6227B88 is equivalent to MS28775-425.
- AN6230-B1 through B25 are equivalent to MS28775-223 through MS28775-247.

## Section VII. HYDRAULIC FLUID SUBSTITUTIONS

9-15. GENERAL. If the original specified fluid is lost and standard replacement is not available, a substitute fluid must be used. Check Appendix D for a compatible fluid. If a compatible fluid is not available, any available non-flammable lubricant can be used in a BDAR action as a last resort. Consideration should be given to salvaging fluid during repairs. Contaminated fluid may be strained through fine weave linen or clothing fabric and reused.

# CHAPTER 10

# INSTRUMENT SYSTEMS

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.

There are no BDAR repairs offered for the instrument systems.

# CHAPTER 11

# ELECTRICAL AND AVIONICS 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

11-1. SCOPE. This chapter provides methods for assessing battle damage, deferring damage repair, and repairing electrical and avionics systems. Extensive repairs to complicated components or Line Replacement Units (LRUs) are not expected to be made in the field; therefore, more emphasis is placed on repairs to interconnecting cables and simple electrical and avionic components.

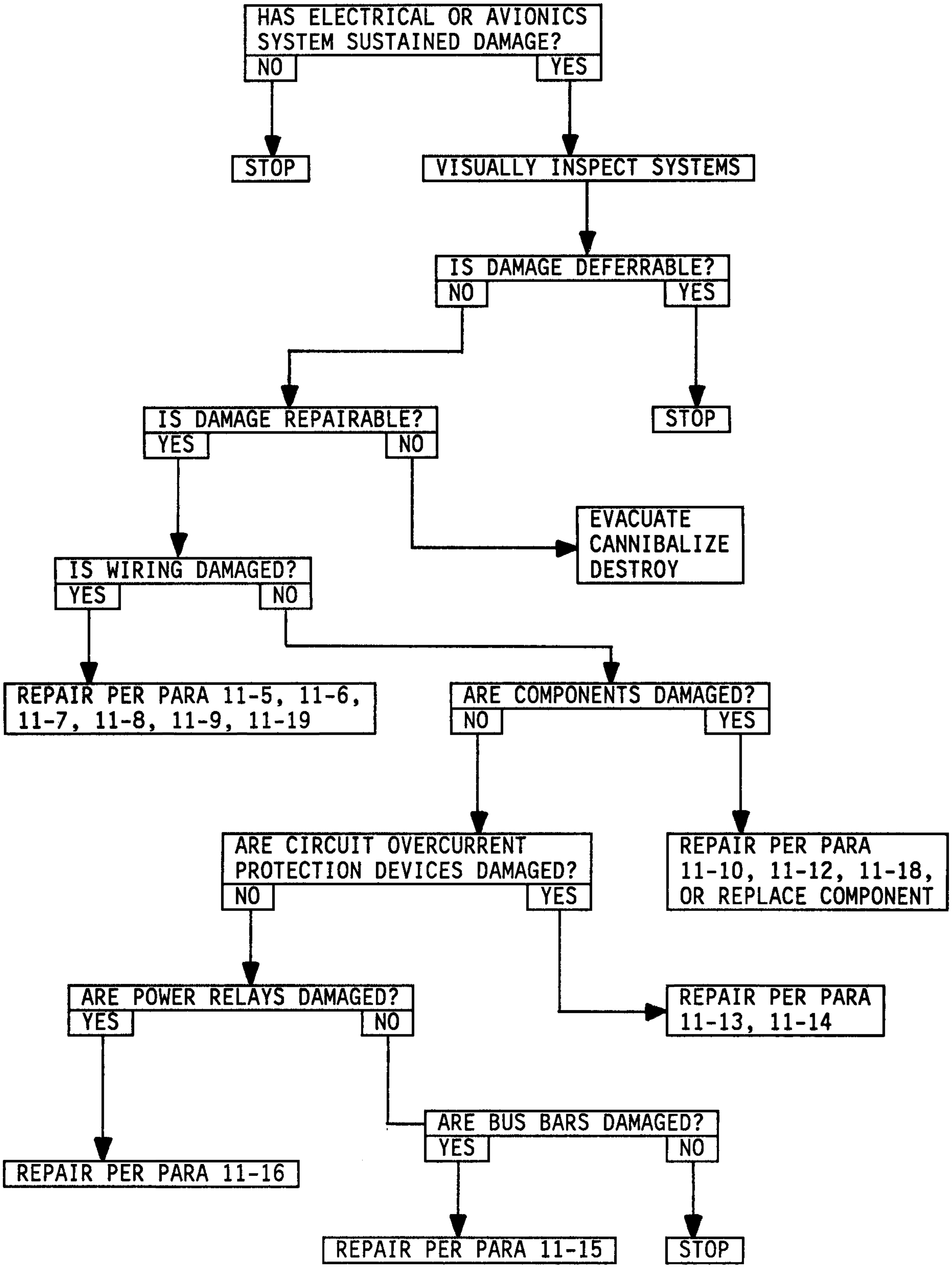
11-2. ASSESSMENT PROCEDURES. (Refer to Table 11-1 for assessment logic.)

a. Wire Identification. The most difficult and time consuming part of electrical and avionics battle damage assessment is wire identification. Added and repaired wiring should be identified to aid in troubleshooting. If time permits, tape or sleeving at each end of added wiring of a material suitable for the ambient temperature range may be used. Typical wire and circuit function and designation letters are shown in Figure 11-1 and Table 11-2. Appendix F lists and depicts the major components, cable routes, and wiring terminations for the more complex avionics systems.

b. Circuit Function. The unit number and circuit designation letter identify the type of circuits. The wire number consists of one or more digits. It is used to distinguish between wires in the same circuit. The wire segment letter is used to distinguish between conductor segments (a wire segment between two terminals or connections). The wire size number is used to identify the gage of the wire or cable. The ground, phase, or thermocouple letter(s) are used as suffixes to the wire identification code to further identify certain wires. Ground wires are identified with an N suffix. Phase letters A, B, or C are added to identify the phase of wires that are in the three-phase wiring of alternating current (AC) systems. For thermocouple wire, the following suffixes are added to the identification code: AL (Alumel), CR (Chromel), FE (Iron), CN (Constantan), and CU (Copper).

c. Deferral. Repair of systems and subsystems which have adequate redundancy or are not critical to mission accomplishment may be deferred if safety of flight is not significantly degraded. Requirements must be examined to determine if relaxed criteria for repair and aircraft performance can be accepted. The commander may defer combat maintenance and battle damage repair, even if doing so places operational limita- on the aircraft.

Table 11-1. Electrical and Avionics Assessment Procedures



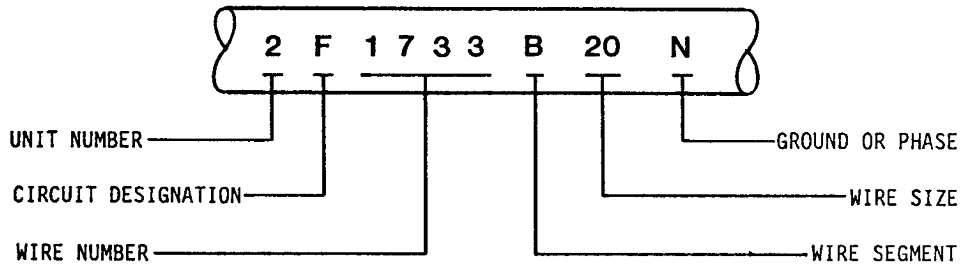



**Figure 11-1. Circuit Identification**

**Table 11-2. Function and Designation Letters**

| CIRCUIT DESIGNATION LETTER | CIRCUITS |
|---|---|
| A | ARMAMENT: |
| | Bomb suspension & release |
| | Guns |
| | Chemical |
| | Rocket |
| | Sight |
| | Turret |
| | Warning |
| | External pylons & stores |
| | Jettison fuel tanks |
| | Mine dispenser |
| B | PHOTOGRAPHIC: |
| | Gun camera |
| | Mapping camera |
| | Reconnaissance camera |
| | Camera intervalometer |
| | Camera doors |
| | Camera heaters |
| | Warning |
| C | CONTROL SURFACE: |
| | Horizontal stabilizer |
| | Warning |
| D | INSTRUMENT (other than flight or engine instruments): |
| | Ammeter |
| | Air pressure |
| | Free air temperature |
| | Hydraulic pressure |
| | Horizontal position stabilizer |
| | Voltmeter |
| | Clock |
| | Warning |
| E | ENGINE INSTRUMENT: |
| | Tailpipe temperature |
| | Fuel flow |
| | Fuel quantity |
| | Fuel capacity |
| | Oil temperature |
| | Oil pressure |
| | Manifold pressure |
| | Fuel pressure |
| | Engine oil quantity |
| | Tachometer |
| | Warning |
| F | FLIGHT INSTRUMENT: |
| | Bank and turn |
| | Rate of climb |
| | Directional gyro |
| | Air position |
| | Ground position |
| | Compass (including flux gate and other stabilized compasses) |
| | Gyro horizon |
| | Attitude gyro |
| | Driftmeter |
| | Altimeter |
| | Airspeed |
| | Accelerometer |
| | Pitot-static tube meter |
| | Warning |

Table 11-2. Function and Designation Letters (Cont)

| CIRCUIT DESIGNATION LETTER | CIRCUITS |
|---|---|
| H | HEATING, VENTILATING, AND DE-ICING:<br>Anti-icing (general)<br>Battery heater<br>Cabin heater<br>Cigarette lighter<br>De-icing (general)<br>Windshield defroster<br>Windshield defogger<br>Windshield de-icer<br>Heater blanket<br>Oil immersion heater<br>Refrigeration<br>Ventilation<br>Warning |
| I | In order to avoid confusion with the numeral one, the letter “I” shall not be used for circuit on cable identification. |
| J | IGNITION:<br>Booster<br>Vibrator<br>Distributor<br>Electronic<br>Warning |
| K | ENGINE CONTROL:<br>Blower ratio<br>Starter<br>Warning |
| L | LIGHTING:<br>Approach<br>Flasher-coder<br>Cockpit<br>Drift<br>Cabin<br>Formation<br>Cargo<br>Interior<br>Instrument<br>Section (fuselage)<br>Landing<br>Exterior<br>Running, position, navigation<br>Passing<br>Search<br>Taxi<br>Warning |
| M | MISCELLANEOUS ELECTRIC:<br>Windshield spray<br>Windshield wiper<br>Hoist<br>Enclosure operation<br>Positioner; seat, pedal<br>Special test equipment |
| N | UNASSIGNED |
| O | In order to avoid confusion with the numeral zero, the letter “O” shall not be used for circuit or cable identification. |
| P | DC POWER |
| Q | FUEL AND OIL:<br>Fuel valves<br>Fuel booster-pump motor<br>Moisture control<br>Oil dilution<br>Engine primer<br>Fuel-transfer-pump motor and control<br>Fuel-loading-pump motor<br>Oil transfer-pump motor and control<br>Oil booster pump<br>Oil scavenge pump<br>Throttle control<br>Fuel-pump motor<br>Oil diverter<br>Oil valves<br>Warning |

Table 11-2. Function and Designation Letters (Cont)

| CIRCUIT DESIGNATION LETTER | CIRCUITS |
|---|---|
| R | RADIO (Navigation and communication):<br>RA-Instrument landing<br>RC-Command<br>RD-Radio direction finding<br>RF-VHF liaison<br>RH-Homing<br>RL-Liaison<br>RM-Marker beacon<br>RN-Navigation<br>RP-Special systems<br>RS-SHF command<br>RT-Radio teletype<br>RU-UHF command<br>RV-VHF command<br>RX-Recorder<br>RZ-Interphone, headphone |
| S | RADAR :<br>SA-Altimeter<br>SF-Intercept<br>SG-Gunlaying<br>SM-Mapping<br>SN-Navigation<br>SQ-Bombing<br>SR-Recorder<br>SS-Search<br>SV-Special systems<br>SW-Warning<br>SX-Recognition (IFF) |
| T | SPECIAL ELECTRONIC:<br>TA-Adapter<br>TB-Radar control<br>TC-Radio control<br>TD-Airborne announcing<br>TE-Electronic countermeasure<br>TF-Repeat back<br>TG-GM homing<br>TH-Infrared<br>TK-Telemetering<br>TL-Attitude indicator<br>TM-Chaff dispenser<br>TN-Navigation<br>TP-Beacon (crash and locator)<br>TQ-Transmitters and receivers<br>TR-Receivers<br>TT-Transmitters<br>TU-Reconnaissance<br>TW-Weather devices<br>TZ-Bombing devices |
| U | MISCELLANEOUS ELECTRONIC:<br>Electronic wiring for which no "R", "S", or "T" designation has been assigned by the procuring activity shall have the circuit function letter "U" assigned. Examples of wiring for which the circuit function letter. "U" will be assigned are common leads to electronic equipments and systems interconnection wiring such as antenna or power circuits common to more than one equipment or system. |
| V | DC POWER and DC control cables for AC systems. |
| W | WARNING AND EMERGENCY<br>Enclosure release and locks<br>Fire extinguishers<br>Flare release<br>Fire detector<br>Intercrew buzzer or light |
| X | AC POWER:<br>Wiring in the AC power system. |
| Y | ARMAMENT SPECIAL SYSTEMS:<br>Y*A-Air to air<br>Y*B-Air to surface<br>Y*C-Multimode<br>Y*M-Missile-guidance<br>Y*T-Turret<br>* Armament special system number |
| Z | UNASSIGNED |

## 11-3. REPAIR PROCEDURE INDEX.



## Section II. WIRE AND CABLE SPLICING

### 11-4. GENERAL.

a. The objective of electrical and avionics system battle damage repair is to restore damaged circuits which are mission essential. It is also used to make non-essential circuits safe. Electrical and avionics equipment receiving significant battle damage will usually not be repairable. Avionics wiring, coaxial cables, and general aircraft wiring can be repaired using a variety of procedures and materials. Appendix F lists and depicts the major components, cable routes, and wiring terminations for the more complex avionics systems.

b. BDAR wiring repair provides for two types of aircraft electrical wiring repairs which are classified as "PERMANENT" or "TEMPORARY."

(1) A permanent repair returns the electrical wiring system to full capability, as manufactured, with no degradation of any system operating characteristics. No periodic inspection or replacement is required with a permanent repair.

(2) A temporary repair returns the electrical wiring system to a reduced level of capacity with a possible slight reduction of system operational capability. Temporary repairs must be reinspected at 100 flight hours. At this time, a permanent repair will be performed or an extension of use for the temporary repair will be granted.

### 11-5. SPLICING UNSHIELDED WIRES.

**GENRAL INFORMATION:** This procedure provides for repairing damaged unshielded wires.

**WARNING**

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

**CAUTION**

Ensure aircraft power is OFF. Disconnect battery before touching any wires.

**OPTION 1:** Crimp Splice.

**LIMITATIONS:** Only to be used for wire sizes 12-26. No more than one splice is made per 10 feet of wire. This is a permanent repair.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 10 Minutes

**MATERIAL/TOOLS REQUIRED:**
- Splice (items 130 or 145-148, App. C)
- Sealing Sleeve (item 53, App. C)
- Crimping Tool
- Strippers
- Heat Gun
- Wire Repair Kit (item 14, App. B)
- Emergency Repair Kit (item 3, App. B)
- Wire (items 170-178, App. C)

**PROCEDURAL STEPS:**

1. Strip wires. Refer to Table 11-3.

**Table 11-3. Unshielded Crimp Slice Application**

| WIRE SIZE | STRIPPING LENGTH INCH | TEMP. RATING DEG.ÉC |
|---|---|---|
| 20-26 | .25-.30 | >125 |
| 16-18 | .30-.35 | >125 |
| 12-14 | .30-.35 | >125 |
| 20-26 | .25-.30 | <105 |
| 16-18 | .30-.35 | <105 |
| 12-14 | .30-.35 | <105 |

2. Slide sealing sleeve onto one of the wires, Figure 11-2. On wire rated at 125°C or above, insert one prepared wire into small end of sealing sleeve and push crimp barrel out.

3. Crimp wires with crimp tool.

4. Shrink sealing sleeve over crimp with heat gun,

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Terminal Lug Splice.

**LIMITATIONS:** Only to be used on wire size awg No. 10 and smaller. This is a temporary repair.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- Minutes Per Splice

**MATERIALS/TOOLS REQUIRED:**
- Terminal Lug (items 154-160, App. C)
- Insulating Sleeve (item 53, App. C)
- Crimp Tool
- Wire (items 170-178, App. C)
- Emergency Repair Kit (item 3, App. B)
- Wire Repair Kit (item 14, App. B)

**PROCEDURAL STEPS:**

1. Select a terminal with a barrel large enough to accommodate both wires.

2. Cut off terminal lug tongue.

3. Prepare wire ends.

4. Slip an insulating sleeve, 1 inch longer than terminal lug barrel, over the end of one of the wires, and insert wire end into the barrel as shown in Figure 11-3.

5. Crimp barrel in center.

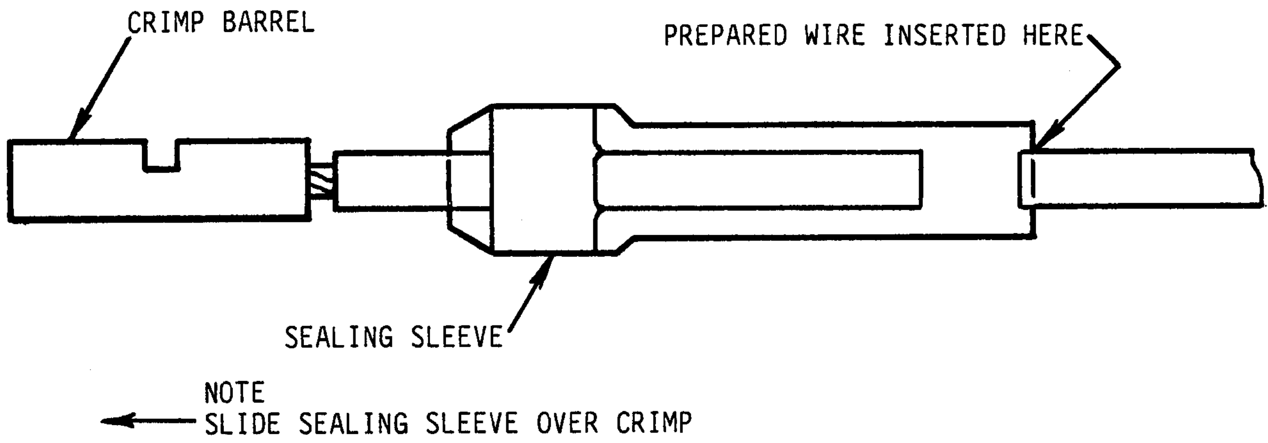
6. Slide insulating sleeve over the terminal lug barrel splice, and secure in place by using tie wraps or heating if heat shrink is used.

7. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

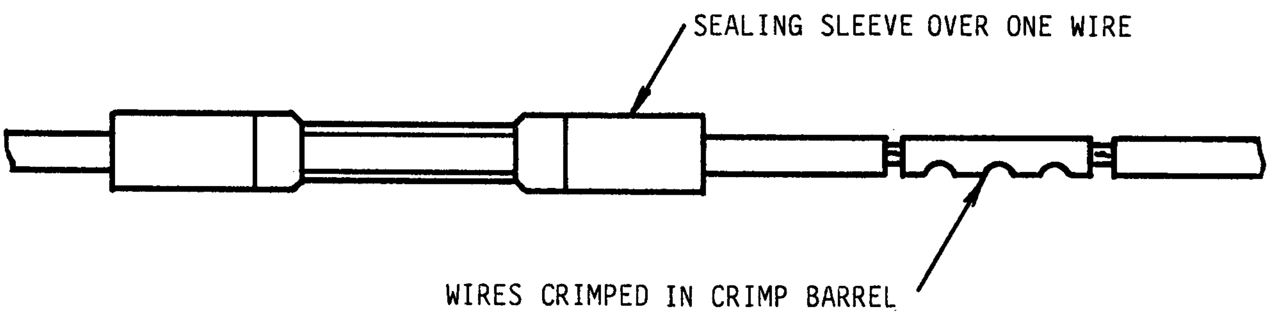
**OPTION 3:** Split Bolt Splice.

**LIMITATIONS:** Only to be used on wire sizes awg No. 4 through No. 10. This is a permanent repair.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 10 Minutes




**FOR WIRES 125°C OR ABOVE**




**FOR WIRES RATED 105°C OR BELOW**

Figure 11-2. Crimp Splice

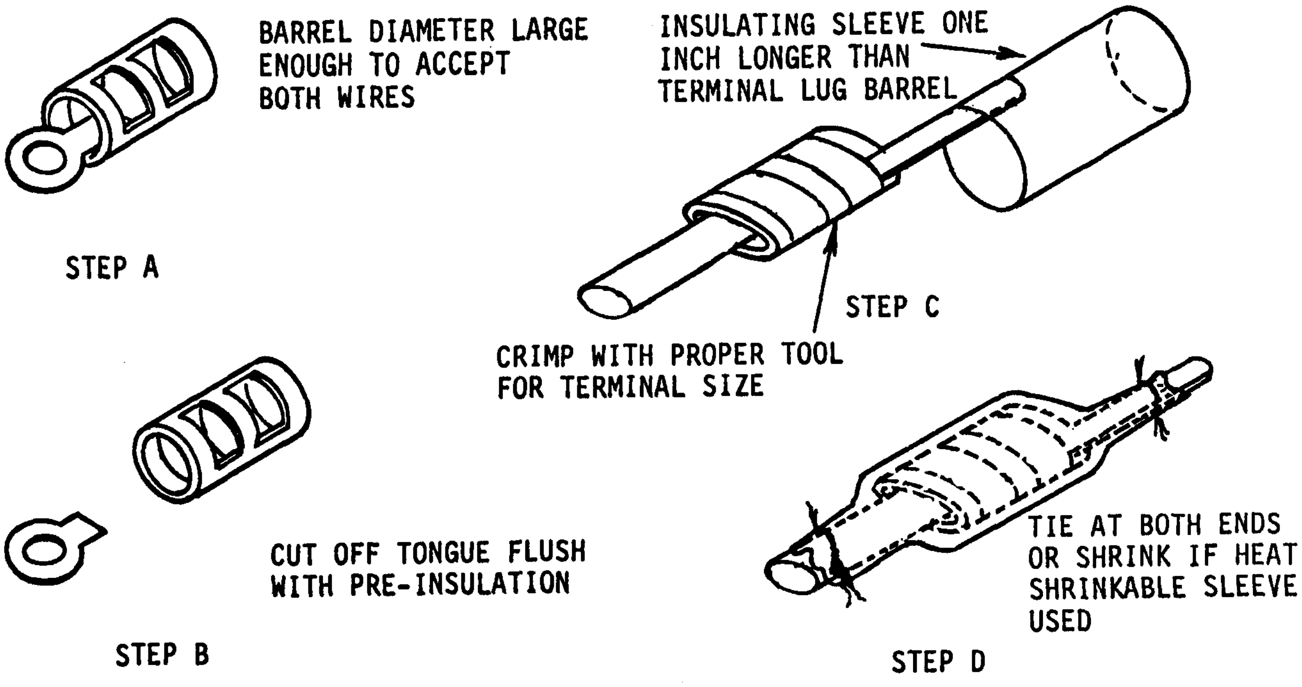



Figure 11-3. Splicing with Terminal Lug Barrel

**MATERIAL/TOOLS REQUIRED:**

- Strippers or Knife
- Heat Shrinkable Tubing (item 53, App. C)
- Tape (item 151, App. C)
- Emergency Repair Kit (item3, App.B)
- Wire Repair Kit (item14, App. B)

**PROCEDURAL STEPS:**

1. Slide a 3 inch length heat shrinkable tubing over one of the wires to be spliced.

2. Strip wires and insert into the connector from opposite sides.

**NOTE**

- Conductors maybe folded back one or more times to fill the connector opening and provide firm clamping.
- Strip wires 1/2 inch if folding back is not required.
- Strip wires 1-1/4 inch if single folding back is required.
- Strip wires 2-1/2 inch if double folding back is required.

3. Tighten nut securely.

4. Wrap the splice with heat shrinkable tape. Cover all metal parts and overlap onto insulation.

5. Heat the end of the tape to soften the adhesive layer and press it into position while warm.

6. Heat the tape to shrink it onto the splice and soften the adhesive layer.

7. Center the heat shrinkable tubing over the splice.

8. Heat the tubing to shrink it onto the splice. Begin in the middle and work toward the ends. Tubing may not shrink completely onto the wire insulation, this is normal.

9. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

OPTION 4: Twist Wire Splice.

**LIMITATIONS:** This is a temporary repair.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 10 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Tape, Electrical (item 151, App. C)
- Strippers or Knife

**PROCEDURAL STEPS:**

1. Cut ties and work broken wire to the outside of the bundle.

2. Pull sufficient slack from the wire run toward the break so that there will be no strain on the splice.

3. Wipe wire clean with a clean, dry rag or a rag dampened with solvent.

4. Trim broken ends of the wire.

5. Split all the wire ends.

6. Split the strands of wire apart and twist the matching wires together as shown in Figure 11-4.

7. Cover splice area with electrical tape,

8. If a section of wire needs to be replaced, a double repair can be made, Figure 11-5.

9. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 5:** Casing Splice.

**LIMITATIONS:** This is a temporary repair.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 10 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Metal Tubing such as ball point pen refills, expended cartridges, hydraulic line
- Insulation Sleeve or Tape (item 53 or 151, App. C)
- Crimp Tool (hammer, pliers, etc.)
- Wire (items 170-178, App. C)

**PROCEDURAL STEPS:**

1. Fabricate splices approximately 1 to 2 inches long from small metal casing.

**NOTE**

Metal ball point refills or expended cartridge shell casings when cut to length make excellent splices, Figure 11-6.

2. Strip 1/2 to 1 inch insulation from both ends of wire to be spliced.

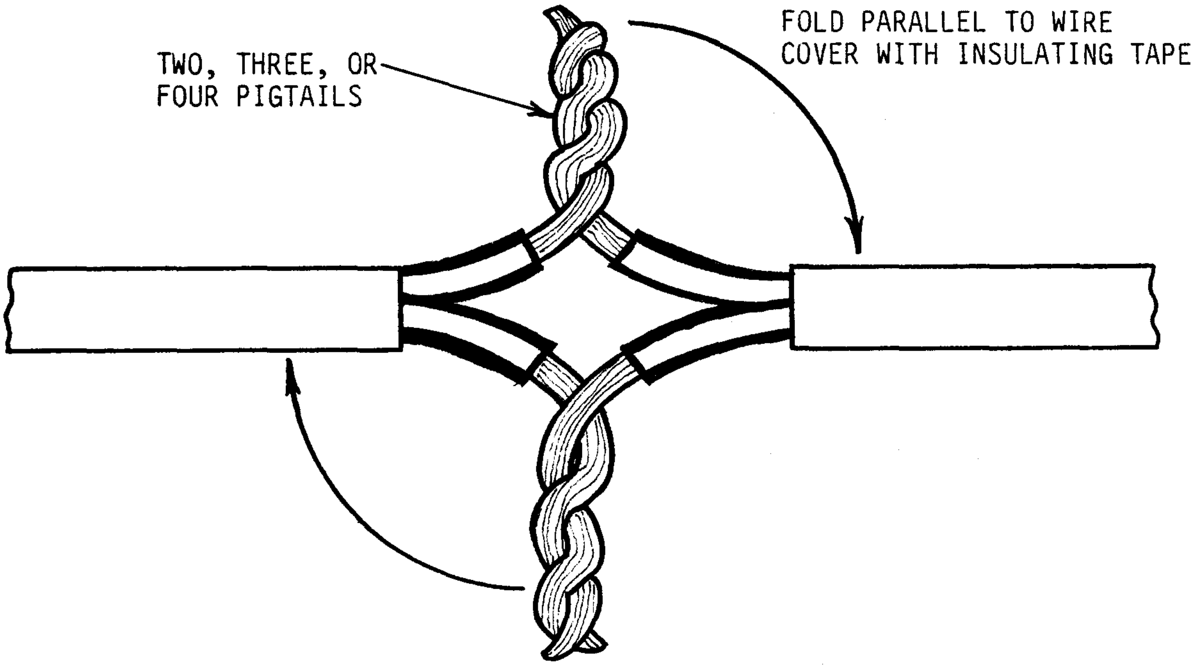



Figure 11-4. Twist Wire Splice

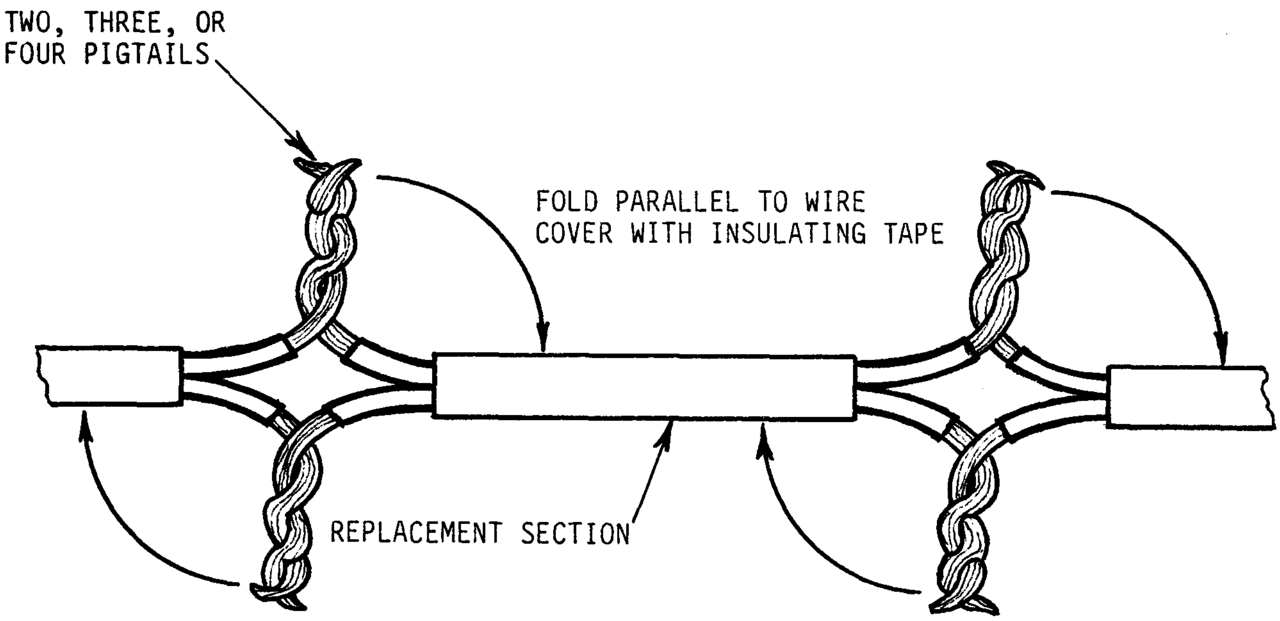



Figure 11-5. Replacement Section; Twist Wire Splice

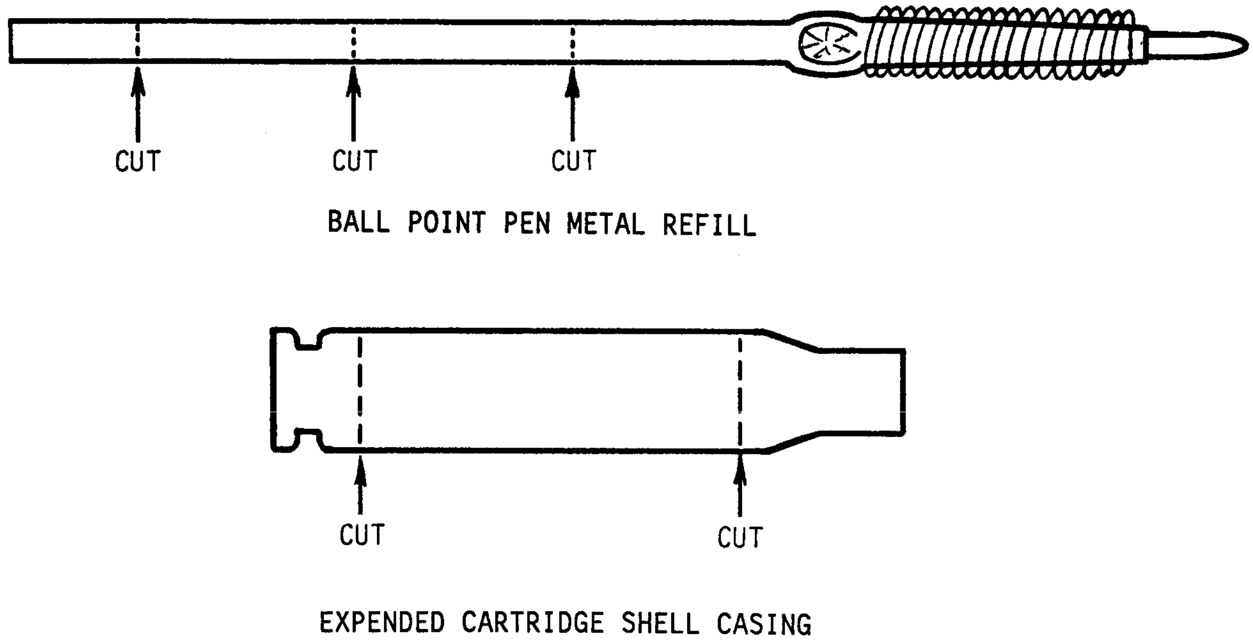



Figure 11-6. Metal Casing Splice

3. Insert wires into casing splice and crimp tightly with pliers or a hammer and small iron bar.

4. Insulate with tape or use plastic and string, tie in place.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

OPTION 6: Bolted Terminal Lug Splice.

WARNING

Cleaning solvents may be flammable and toxic. Use only in well-ventilated areas. Avoid inhalation of vapor and skin contact. Do not use solvents near open flame or in areas where very high temperatures prevail. Solvent flash point must not be less than 100°F.

LIMITATIONS: This is a temporary repair.

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 10 Minutes

**MATERIALS/TOOLS REQUIRED:**

- Terminal Lugs (items 154-160, App. C)
- Screw or Bolt (items 7-10, App. C)
- Nut (items 63-70, App. C)
- Washer (items 163-169, App. C)
- Insulating Sleeve or Tape (items 53, or 151, 153, App. C)
- Solvent (item 7 or 129, App. C)

**PROCEDURAL STEPS:**

1. Cut ties and work broken wire to the outside of the bundle.

2. Pull sufficient slack from the wire run toward the break so that there will be no strain on the splice.

3. Wipe wire clean with a clean, dry rag or a rag dampened with solvent.

4. Trim broken ends of wire and install an insulating sleeve over one end of the wire, and slide back and out of the way for now.

5. Strip both wire ends and crimp an insulated terminal lug of the proper size to each wire end.

6. Bolt terminal lugs together as shown in Figure 11-7.

7. Slide the insulating sleeve over the splice so that the ends of the insulating sleeve extend at least 3/4 of an inch beyond the ends of each terminal lug.

8. Secure both ends of the insulation with tie wraps or string ties as shown in the figure.

NOTE

If a section of wire needs to be replaced, a double repair can be made to bridge the ends of the original wire back together.

9. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

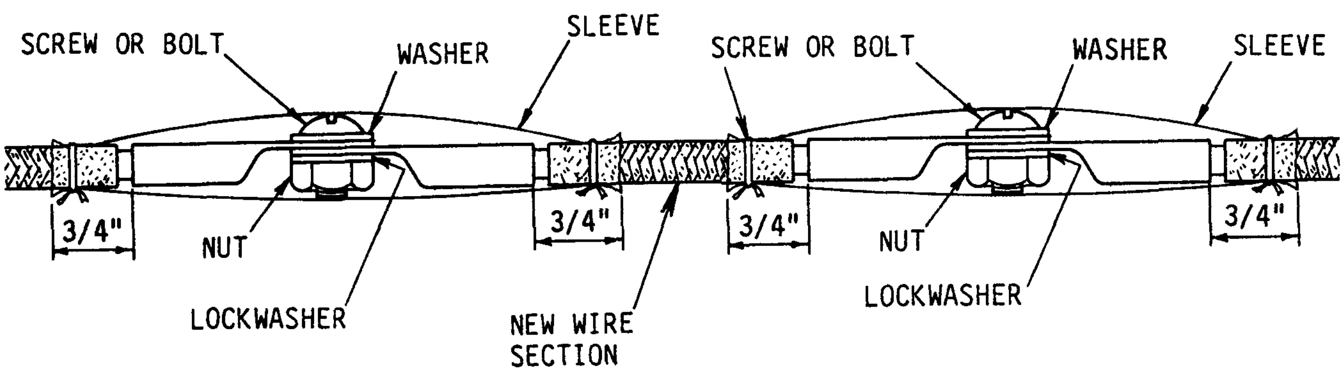



Figure 11-7. Replacement Section; Terminal Lug Repair

OPTION 7: Metal Clamp Splice.

LIMITATIONS: This is a temporary repair.

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 10 Minutes

MATERIALS/TOOLS REQUIRED:
- Screw Clamp, Control Cable Clamp
- Insulating Sleeve or Electrical Tape (item 53 or 151, App. C)
- Knife
- Cable lies (item 26 or 27, App. C)

PROCEDURAL STEPS:

1. Cut ties and work broken wire to the outside of the bundle.

2. Pull sufficient slack from the wire run toward the break so that there will be no strain on the splice.

3. Wipe wire clean with a clean, dry rag or a rag dampened with solvent.

4. Trim broken ends of wire.

5. Remove 2 inches of wire insulation from each end of the damaged wire.

6. Ram or push the two wire ends together so that the strands interlink.

7. Secure with screw clam, control cable clamp, safety wire, or other suitable means, Figure 11-8.

8. Insulate with tape or insulation sleeve.

9. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

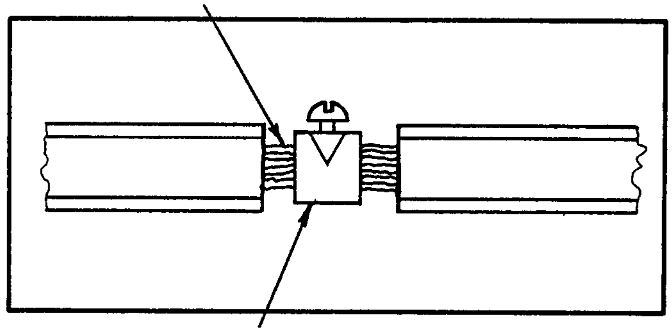



Figure 11-8. Ram Wire Repair

11-6. SPLICING SHIELDED CABLE.

GENERAL INFORMATION: The following procedures may be used to r epair severed shielded cables.

OPTION 1: Shielded Cab’ e Splice.

LIMITATIONS: Repair is good for cables rated at 125°C or above.

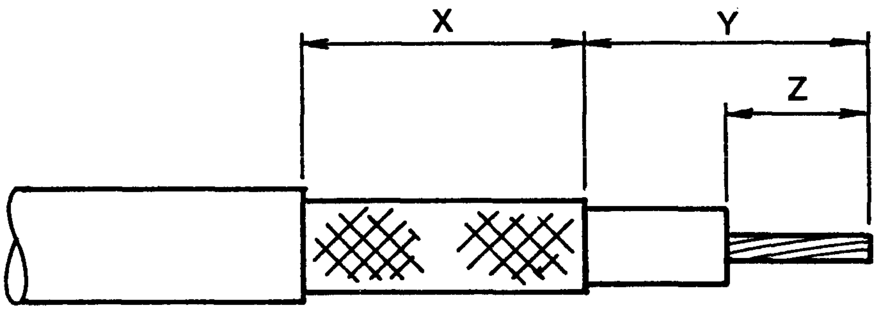
PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 15 Minutes

MATERIALS/TOOLS REQUIRED:
- Splice (items 145-148, App. C)
- Sealing Sleeve (item 53, App. C)
- Crimping Tool
- Strippers
- Heat Gun

PROCEDURAL STEPS:

1. Prepare cable for splice. Refer to Figure 11-9 and Table 11-4.

2. Slide the shield sleeve onto one of the cables.




NOTE: Refer to Table 11-4 for X, Y, and Z.

Figure 11-9. Shielded Cable Repair Preparation

**Table 11-4. Shielded Cable Repair**

| WIRE SIZE | X | Y | Z |
|---|---|---|---|
| 26,24 | .50-.55 | .65-.75 | .30-.35 |
| 22,20 | | | |
| 18,16 | .50-.55 | .65-.75 | .30-.35 |
| 14,12 | .50-.55 | .65-.75 | .30-.35 |

3. Slide the inner sealing sleeve onto the primary wires of one of the cables; then insert the other primary wire onto the other end of the inner sealing sleeve and crimp with AD-1377 crimp tool. Refer to Figure 11-10.

4. Shrink the inner sleeve of the splice. Keep hot air away from shield sleeve.

5. Center and shrink the shield over the splice area so that the solder melts and flows. Shield sleeve braid must overlap cable braid at both ends. Refer to Figure 11-11.

OPTION 2: Sheath Connector Splice.

LIMITATIONS: This is a temporary repair until heat shrink is installed; then it becomes a permanent repair.

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 1/2 Hour Per Wire

MATERIALS/TOOLS REQUIRED:
- Insulating Sleeving, Heat Shrinker Tape (items 53 or 151,153,App. c)
- Knife
- String, Nylon Braid, or Tie Wrap (to be used if insulating sleeve is used) (items 149, or 26, 27, App. C)
- Connectors (item 159 or 160, App.C)
- Conductor Splice (items 145-148, App. C)
- Wire Repair Kit (item 14, App. B)

PROCEDURAL STEPS:

1. Select a grounding sheath.

2. Prepare the severed ends of the cable for application of a grounding sheath connector, Figure 11-12, step A.

3. Position sheath connector and grounding sheath as shown in Figure 11-12, step B. (NOTE: Crimp sheath connector and grounding sheath only at one side at this time.)

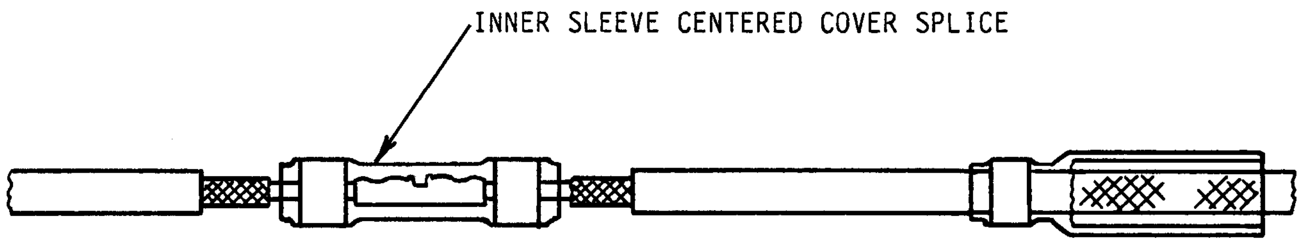



**Figure 11-10. Shielded Cable Splice Preparation**

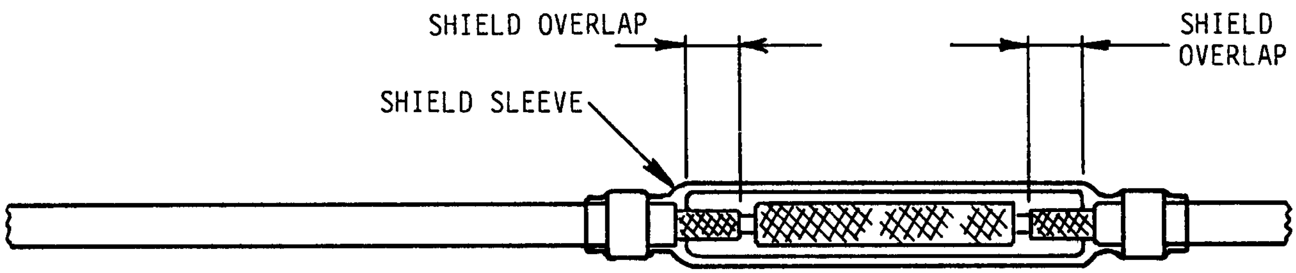



Figure 11-11. Completed Shielded Cable Splice

4. Slide insulating sleeve over uncrimped sheath connector as shown in Figure 11-12, step B. (NOTE: If insulating sleeve is not available, use shrink or alternate insulating such as electrical tape.)

5* Splice center conductor using a permanent splice or by using one of the splicing procedures in paragraph 11-5.

6. Push the free end of the grounding wire into the uncrimped grounding sheath connector. Crimp securely, Figure 11-12, step C.

7. If an insulating sleeve is used, slide into place and tie both ends, Figure 11-12, step D.

8. If heat shrink is used, slide into place and shrink into position. Tape may be used to cover repair.

9. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

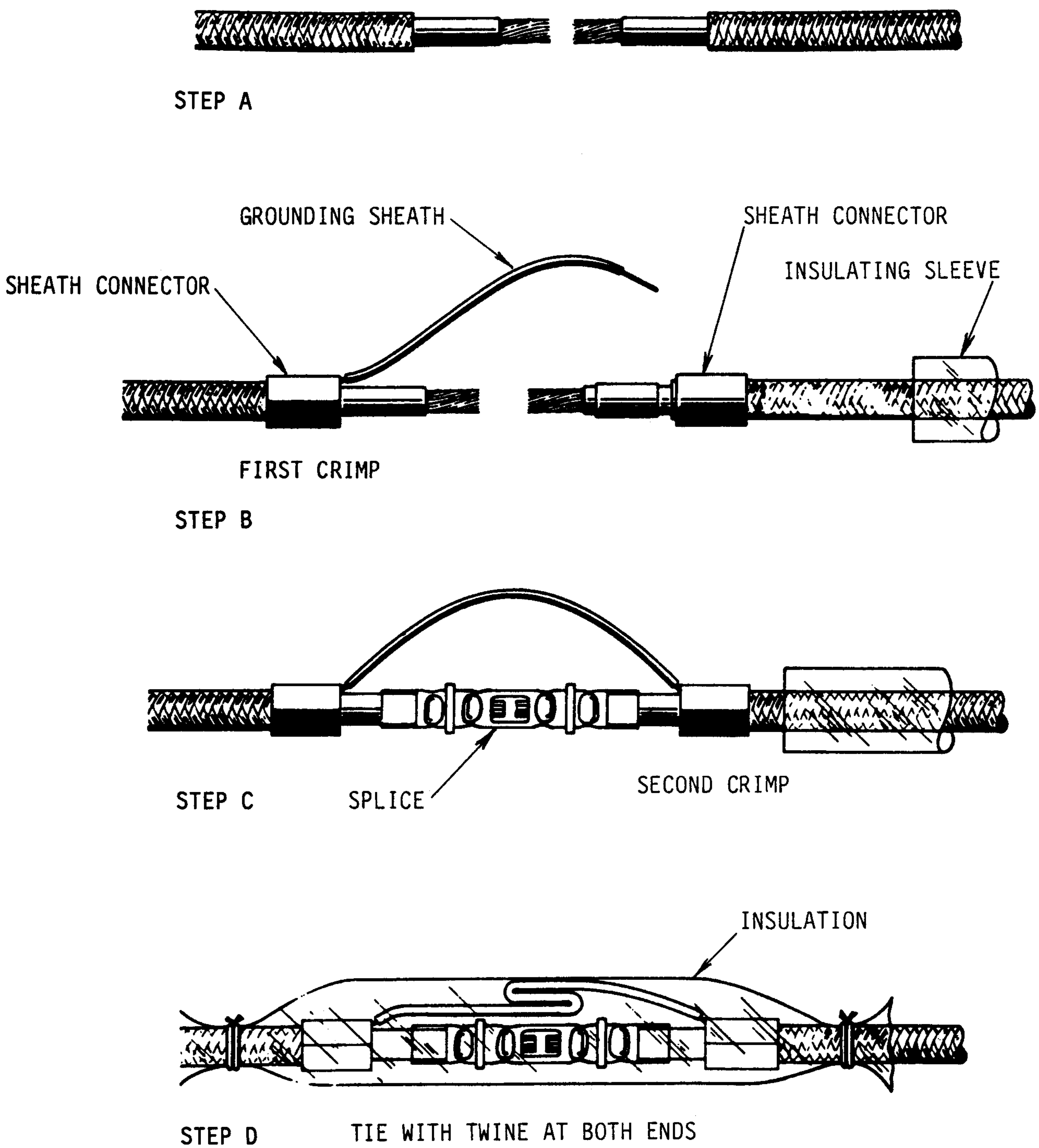



Figure 11-12. Sheath Connector Splice

**OPTION 3:** Pigtailed Sheath Splice.

**LIMITATIONS:** This is a temporary repair.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1/2 Hour Per Wire

**MATERIALS/TOOLS REQUIRED:**
- Knife
- Insulating Sleeving or Tape (item 53 or 151, App. C)
- String, Nylon Braid, or Tie Wrap (to be used if insulating sleeve is used) (items 149 or 26, 27, App. C)
- Splice (items 145-148, App. C)
- Wire Repair Kit (item 14, App. B)
- Wire (items 170-178, App. C)

**PROCEDURAL STEPS:**

1. Prepare severed ends of cable for pigtail method of shield terminations, Figure 11-13, step A.

2. Splice center conductor, Figure 11-13, step B, using a permanent splice or by using one of the splicing procedures in paragraph 11-5.

3. Use two splice connectors to add short length of insulated wire as extension to complete shield connection, Figure 11-13, step B.

4. Insulate repair, Figure 11-13, step C.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 4: Substitute Shielded Braid.**

**LIMITATIONS:** This is a temporary repair.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1/2 Hour Per Wire

**MATERIAL/TOOLS REQUIRED:**
- Substitute Shielded Braid
- Knife
- Splice (items 145-148, App. C)
- Metal Screw Clamp, Sheath Connector, or Equivalent
- Emergency Repair Kit (item 3, App. B)

**PROCEDURAL STEPS:**

1. Prepare severed ends of cable for application of repair splice and shielding, Figure 11-14, step A.

2. Select suitable shielding material and slide over one end of severed cable. Shielding must be long enough to overlap the shielding on both sides of the cable being repaired after the center conductor is repaired. Shielding material can be obtained from another shield cable or ground cable material.

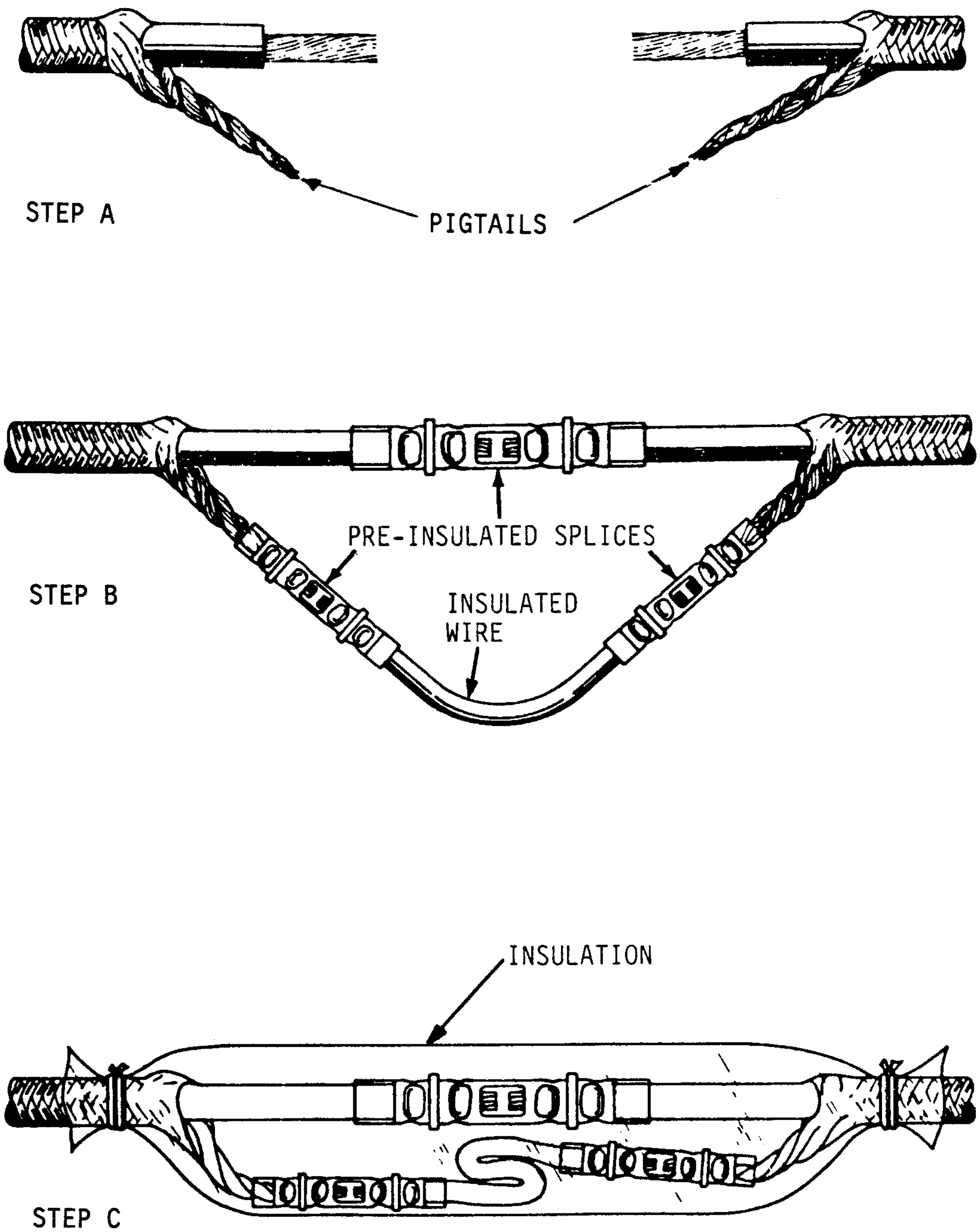
**NOTE**

It is essential that the shielding, as well as the inner conductor, be repaired properly to prevent electromagnetic interference (EMI) problems.

3. Splice center conductor using a permanent splice or by using one of the splicing procedures in paragraph 11-5 and Figure 11-14, step B.

4. Slide shielding material over repaired inner conductor and clamp at shielding overlap areas, Figure 11-14, step C.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.




COVER WITH VINYL SLEEVE AND TIE AT BOTH ENDS

Figure 11-13. Pigtail Sheath Splice

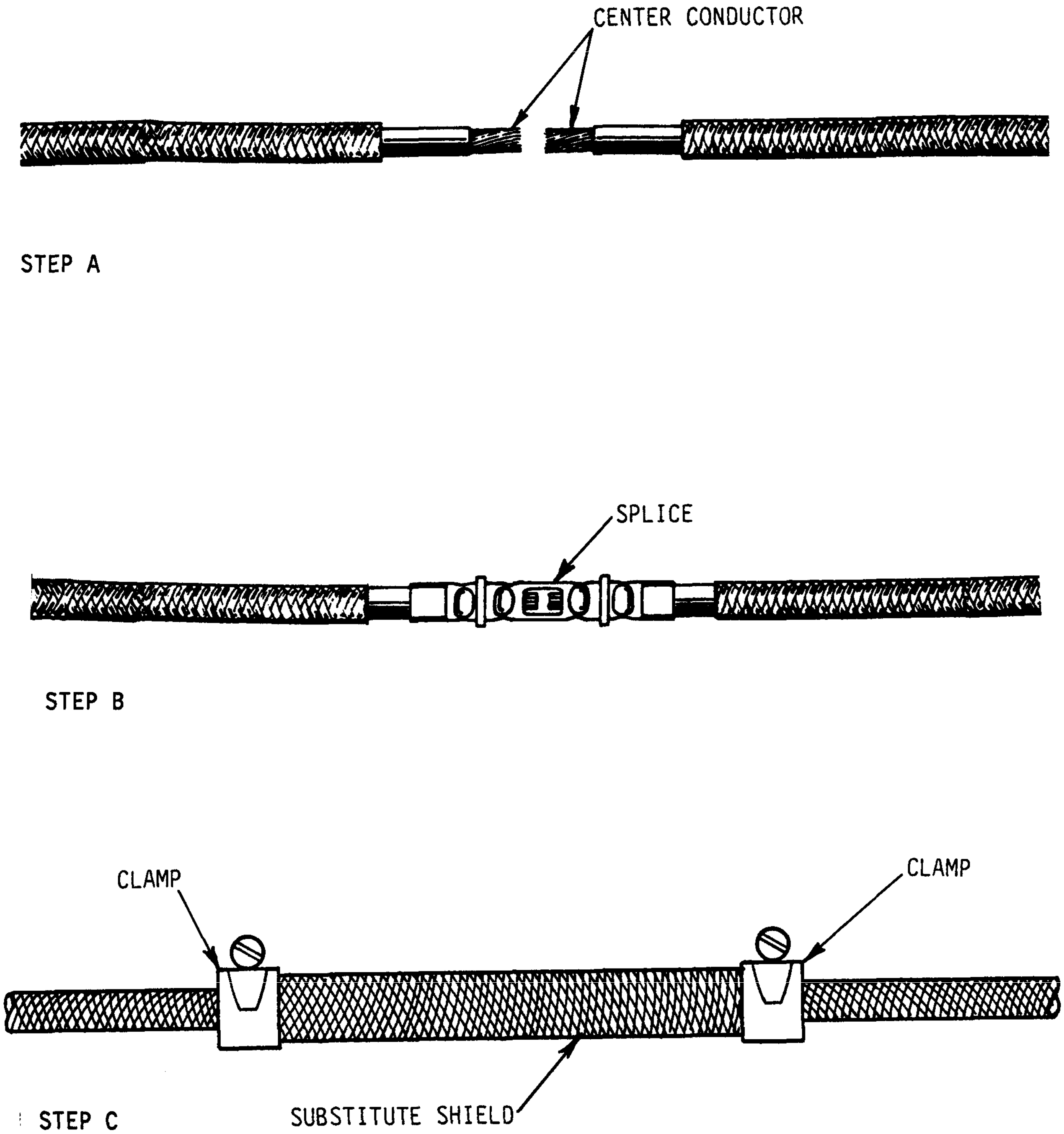



Figure 11-14. Substitute Shielded Braid Splice

## 11-7. SHIELDED CABLE REPAIR SEGMENTS.

**GENERAL INFORMATION:** The electrical wiring kit has wire replacement segments for replacement sections up to 9 inches in length.

**CAUTION**

Ensure aircraft power is OFF. Disconnect battery before touching any wires.

**OPTION:** Install New Cable Segment.

**LIMITATIONS:** None.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1 Hour

**MATERIALS/TOOLS REQUIRED:**
- Stripper or Knife
- Splice (items 145-148, App. C)
- Insulation Sleeve (item 53, App. C)
- Crimp Tool

**PROCEDURAL STEPS:**

1. Cut out damaged cable (up to 9 inches in length).

2. Prepare cable for splice. Refer to Figure 11-9.

3. Use one of the OPTIONS of paragraph 11-6 to splice the ends of the replacement segment onto the damaged cable.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## 11-8. SHIELD TERMINATORS.

**GENERAL INFORMATION:** The BDAR electrical kit contains various types of shield terminators for shielded cable.

**OPTION:** Install Shield Terminators.

**LIMITATIONS:** This is a temporary repair.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 15 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Shield Terminator
- Heat Gun/Heat Source
- Stripper or Knife
- Insulating Sleeve (item 53, App. C)
- Wire Repair Kit (item 14, App. B)
- Wire (items 170-178, App. C)

**PROCEDURAL STEPS:**

1. Prepare cable for repair, Figure 11-15.

2. Position shield terminator on cable as shown in Figure 11-16. (Select the smallest terminator that slides easily over the prepared cable.)

3. Heat shield terminator until solder melts and flows into wire strands, red color disappears, and seals melt and flow at both ends.

4. Terminate the ground lead as directed in aircraft wiring manual.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

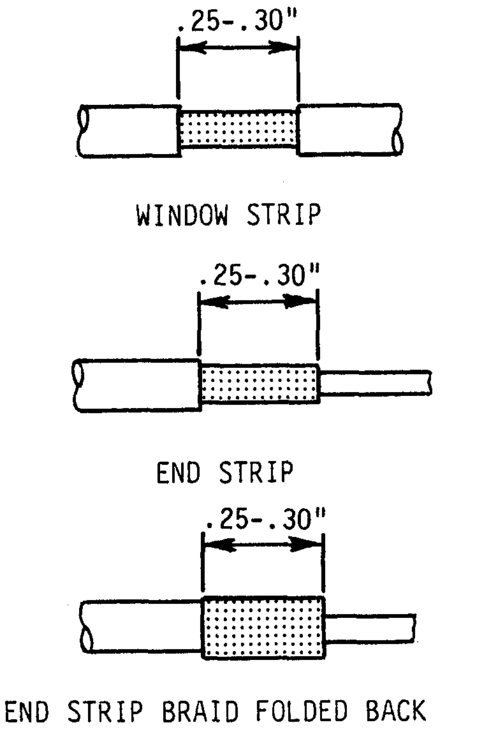



**Figure 11-15. Shield Terminator Repair Preparation**

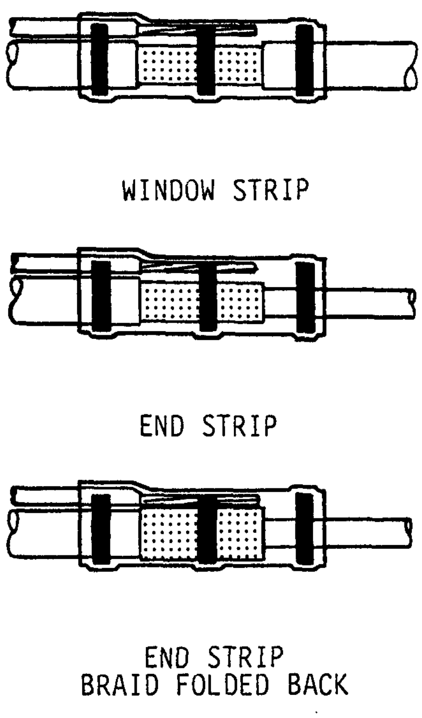



Figure 11-16. Shield Terminator Repair

## 11-9. COAX SPLICING USING WIRING REPAIR KIT.

GENERAL INFORMATION. There are various coax splices in the wiring repair kit that may be used for the different types and sizes of coax cable.

OPTION: Splice Coax.

LIMITATIONS: This is a temporary repair.

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 15 Minutes

MATERIALS/TOOLS REQUIRED:
- Emergency Repair Kit (item 3, App. B)
- Stripper or Knife
- Crimp Tool
- HeatGun/HeatSource
- Wire Repair Kit (item 14, App. B)

PERSONNEL/TIME REQUIRED:

1. Prepare coax cable, Figure 11-9. Refer to Table 11-4.

2. Slide the shield sleeve and inner sleeve onto one of the coaxial cables in the order given.

3. Splice the center conductor. Use the red cavity of the crimp tool.

4. Shrink the inner sleeve over the splice, Figure 11-10. Keep the hot air away from shield sleeve.

5. Center and shrink the shield sleeve over the splice area so that the solder melts and flows, Figure 11-11. Shield sleeve braid must overlap coax braid at both ends.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

## 11-10. COMPONENT BRIDGING AND SPLICING.

GENERAL INFORMATION: Inmost cases it will be quicker not to replace bulkhead connectors, junction boxes, or terminal strips. These circuits can be repaired by "bridging" the damaged area with jumper wires spliced in to eliminate the damaged area or component, Figure 11-17.

OPTION : Bypass Component.

LIMITATIONS: This is a temporary repair.

PERSONNEL/TIME REQUIRED:
- Will be dependent on the type of splice used.

MATERIALS/TOOLS REQUIRED:
- Will be dependent on the type of splice used.
- Wire (items 170-178, App. C)

PROCEDURAL STEPS:

1. Identify wires to be bridged together.

2. Splice wires and jumper wires together using one of the splicing techniques of this chapter.

3. Secure jumper wires after repair is made to prevent vibration chaffing.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

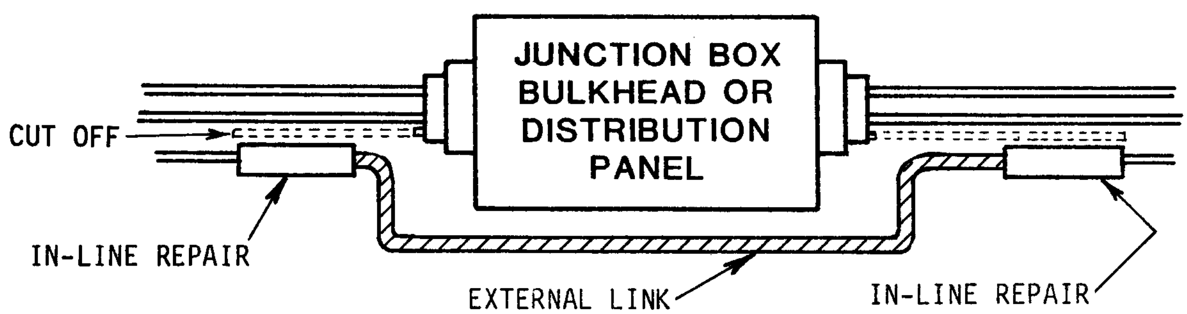



Figure 11-17. Component Bypass

## Section III. CONNECTOR REPAIR

### 11-11. DAMAGED CONNECTOR PINS.

GENERAL INFORMATION: Deformed, crushed, missing, or otherwise damaged connectors can be replaced or repaired. If a replacement connector is not available to replace a damaged connector, cleanup fragments of the connector and use jumper wires to bridge wire ends together. If only part of the connector has been damaged and there are unused pins/sockets on the connector which are undamaged, wires on both sides of the connectors can be moved to the unused good pins/sockets. Any available undamaged wires on the connector may be used.

OPTION 1: Replace Damaged Pins or Sockets; No Damage to Connector.

LIMITATIONS: None

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 10 Minutes Per Wire

MATERIALS/TOOLS REQUIRED:
- Replacement Pins/Sockets
- Insertion/Extraction Tool
- Knife
- Connector Repair Kit (item 2, App.B)

PROCEDURAL STEPS:

1. Solder or crimp wires to pin/sockets, Figure 11-18.

2. Insert the pins/sockets into the connector.

3. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

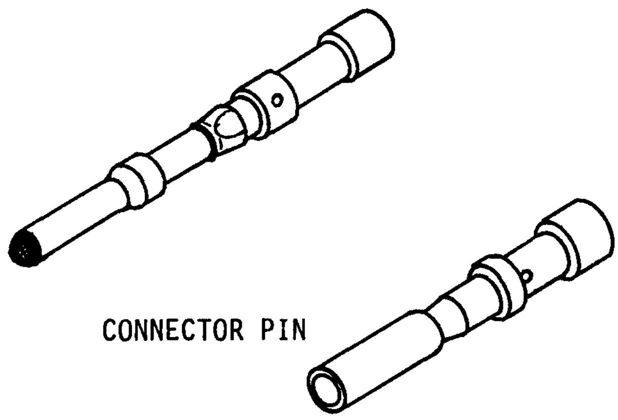



Figure 11-18. Connector Pin and Socket

NOTE

Superglue or epoxy may be used to secure the original or replacement pin back into place. Avoid getting glue or epoxy on contact surface of pin.

OPTION 2: Bridge Across Damaged Connector. Refer to paragraph 11-10, component bridging and splicing.

OPTION 3: Cannibalize Connector from Other Aircraft.

LIMITATIONS: None.

MATERIALS/TOOLS REQUIRED:
- Replacement Connector with Wires
- Splices (items 145-148, App. C)
- Knife
- Tape (item 151 or 153, App.C)
- Emergency Repair Kit (item 3, App. B)
- Wire Repair Kit (item 14 App. B)

PROCEDURAL STEPS:

1. Obtain a replacement connector with a wire. (Replacement may be obtained from a crash damaged aircraft.)

2. Cut wire so that splices can be staggered, Figure 11-19.

3. Remove damaged connector; stagger the wires being cut to remove the damaged connector. The staggered wires should match the staggered wire of the replacement connector of step 1, Figure 11-19.

4. Splice the appropriate wires together.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

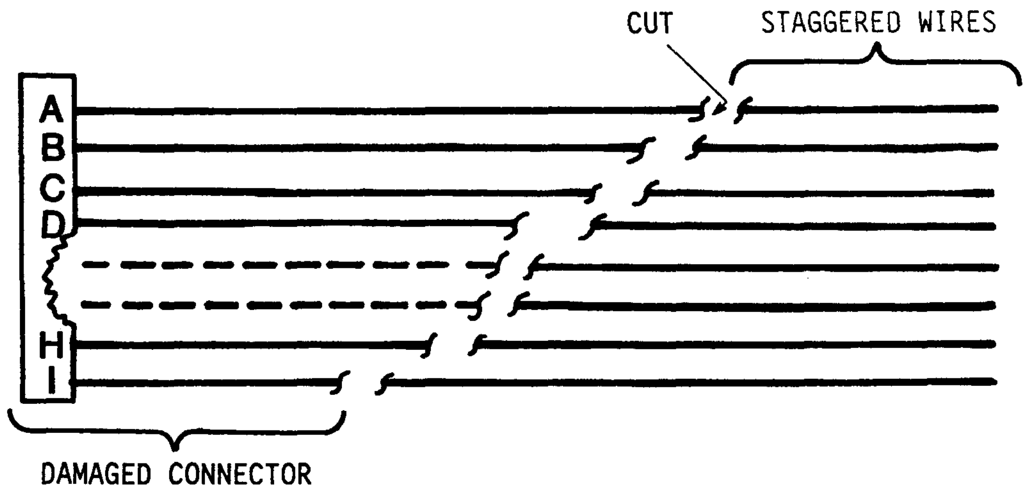



**Figure 11-19. Damaged Connector and Wire**

---

Section IV. OVERCURRENT PROTECTION DEVICES

11-12. DAMAGED CIRCUIT BREAKER REPAIR.

GENERAL INFORMATION: Attempt to maintain a protected system at all times. Circuits with damage circuit breakers can be repaired as follows:

a. Circuit breakers of the same rating salvaged from other nonflyable aircraft or removed from other nonessential circuits in the aircraft.

b. Replacing circuit breakers with a specified number of individual strands of No. 38 awg from No. 26 awg wire.

OPTION 1: Circuit Breaker Replacement.

LIMITATIONS: None

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 20 Minutes

MATERIALS/TOOLS REQUIRED:
- Salvaged Circuit Breaker
- Electrical Tape (item 151, Appx C)

PROCEDURAL STEPS:

1. Gain access to area behind circuit breaker panel by turning duzs fasteners counterclockwise.

2. Remove screws holding plastic face plate on circuit breaker panel.

3. Use pliers to remove nut and inside star lockwasher from damaged circuit breaker.

4. Use phillips screw driver to remove the two screws from the terminals of the circuit breaker.

5. Replace bad circuit breaker with the salvaged circuit breaker.

6. Connect back of circuit breaker to line and bus bar by reinstalling the two phillips screws. Bend bus bars as required to fit size difference of salvaged breaker.

7. Place lockwasher and nut on front of circuit breaker and tighten with pliers.

8. Replace plastic face plate on front of circuit breaker panel with screws previously removed.

9. Clean and remove any debris from inside circuit breaker panel and close panel.

10. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

OPTION 2: Individual Strands of No. 38 Awg as Circuit Breaker.

LIMITATIONS: None.

PERSONNEL/TIME
- 1 Soldier
- 20 Minutes

MATERIALS/TOOLS REQUIRED:
- No. 8 Terminal Lugs
- 1 Ft. of No. 22 Awg Stranded Wire (item 170, App. C)

PROCEDURAL STEPS:

1. Perform steps 1 through 4 of option 1, and remove circuit breaker.

2. Identify the wires hooked to each circuit breaker. Typical circuit breaker is shown in Figure 11-20.

3. Determine amperage of damaged circuit breaker(s) to be replaced. (Amperage is printed on the end of reset button.)

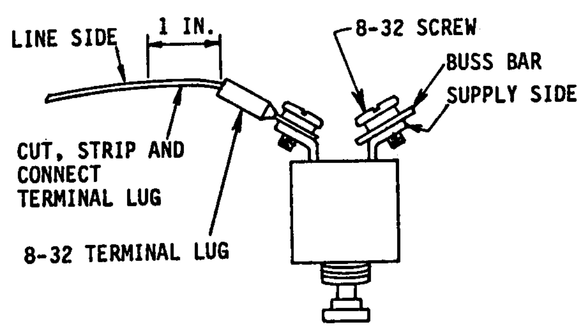



Figure 11-20. Typical Original Circuit Breaker Connection

4. Use Table 11-5 to determine number of strands of No. 38 awg wire needed to replace damaged circuit breaker.

5. Strip No. 22 awg wire, select number of No. 38 awg wire strands (6 to 8 inches long) as per Table 11-5.

6. Cut salvaged insulation into 1 inch lengths (one length from each fuse link required).

7. Cut line side wire 1 inch from terminal lug.

8. Strip both ends and crimp an 8-32 terminal lug where wire was cut and stripped.

**Table 11-5. Fuse Link Strands**

| CIRCUIT BREAKER AMPERAGE | AWG SIZE WIRE STRAND | NO. OF STRANDS |
|---|---|---|
| 1/2A | NO. 38 | 1 |
| 1A | NO. 38 | 1 |
| 2A | NO. 38 | 1 |
| 3A | NO. 38 | 1 |
| 4A | NO. 38 | 2 |
| 5A | NO. 38 | 2 |
| 10A* | NO. 38 | 5* |
| 15A* | NO. 38 | 7* |
| 20A* | NO. 38 | 10* |

*Signifies Calculated Values

**NOTE**

Try to use inner strands of wire that are not cut or nicked by knife used to remove insulation.

9. Twist the No. 38 awg strands of wire, from step 5, together and insert the end of line side of terminal lug, wrap and twist as shown in Figure 11-21.

10. Slip 1 inch piece of insulation over No. 38 awg strands of wire.

11. Insert the other end of No. 38 awg strands of wire into the other terminal into the other terminal lug (supply side), pull tight against the piece of insulation and twist tight, insulate bare end of terminal lugs on both sides of 1 inch piece of insulation with tape.

12. Use 8-32 screw to connect other terminal lug to bus side of bus bar.

13. Use this procedure to replace damaged circuit breaker.

14. Secure fuse link to other wiring with tape to avoid pinching wire when circuit breaker panel is closed.

15. Clean up damaged area behind circuit breaker panel to remove debris, and use tape to insulate any damaged parts that might cause electrical shorts.

16. Carefully close circuit breaker panel and secure by turning duzs fasteners clockwise.

17. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

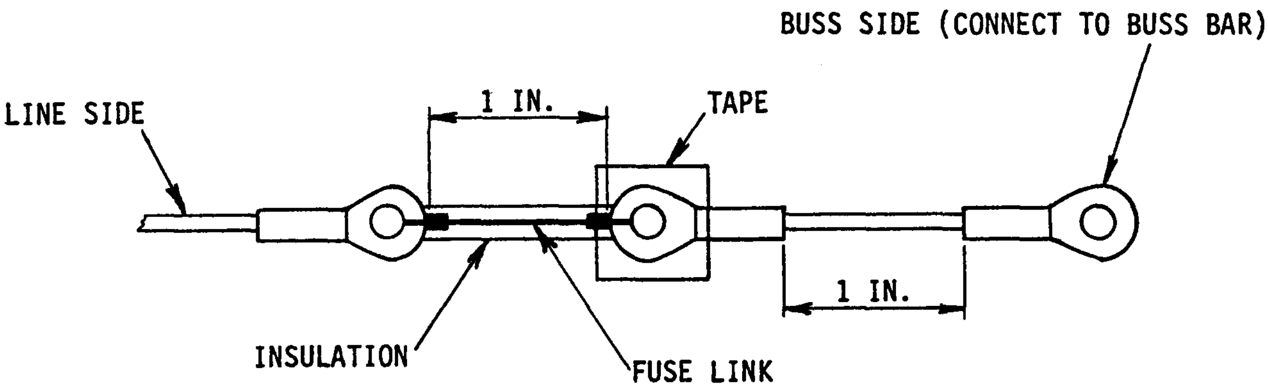



Figure 11-21. Construction of Fuse Link

11-13. DAMAGED FUSES.

GENERAL INFORMATION: If a fuse is broken, it may be replaced by another fuse or a piece of solder or wire. Where the same current rating fuse is not available, one as close to proper as possible should be used. A slow blow fuse could be replaced by a fast blow fuse of higher current rating while a fast blow fuse could be replaced by a slow blow fuse of lower current rating. The solder or wire should be used only when no fuse is available.

CAUTION

If the fuse is blown, the same procedure can be used but the cause of the overcurrent must be fixed. Substituting for the fuse without fixing the cause of overcurrent can cause more damage to the equipment.

CAUTION

If too low a current rating fuse is used, it will blow from the initial turn on surge current. If too high a current rating fuse or if the solder or wire is used, the equipment will not be properly protected in case of a short circuit.

OPTION 1: Salvaged Fuse Replacement.

LIMITATIONS: None.

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 1/2Hour

MATERIALS/TOOLS REQUIRED:
- Fuse
- Common Hand Tools

PROCEDURAL STEPS: Replace fuse with the following:

1. An identical spare fuse from other equipment.

2. An identical fuse from the other equipment of lower priority.

3. A similar fuse.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

OPTION 2: Individual Strands of No. 38 Awg as Fuse.

LIMITATIONS: Temporary use only.

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 1 Hour

MATERIALS/TOOLS REQUIRED:
- Wire (item 170, App. C)
- Small Dowel or Stick
- Electrical Tape (item 151, App. C)

PROCEDURAL STEPS:

1. Remove damaged fuse, Figure 11-22.

2. If type A fuse, break off glass and salvage end caps. If type B fuse, break off clear top portion.

3. For type A fuse, cut wire and dowel, stick or pencil piece to proper length. Refer to Table 11-5 to determine the number of No. 38 awg wire strands to use for the different site, amperage, and fuses. See Figure 11-23 for fuse assembly and assemble as follows:

a. Lay wire or wrap piece between ends of wood.

b. Trim dowel, stick, or pencil piece as necessary to fit into end caps, and hold wire in place. This stiffens the substitute fuse.

c. Wrap dowel, stick, or pencil and wire with electrical tape, but do not cover end caps.

4. For type B fuse, connect substitute No. 38 awg wire strand between two points, Figure 11-24. Use Table 11-5 to determine the number of No. 38 awg strand to use between points A and B for different size, amperage, and fuses.

5. Install fuse into equipment.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

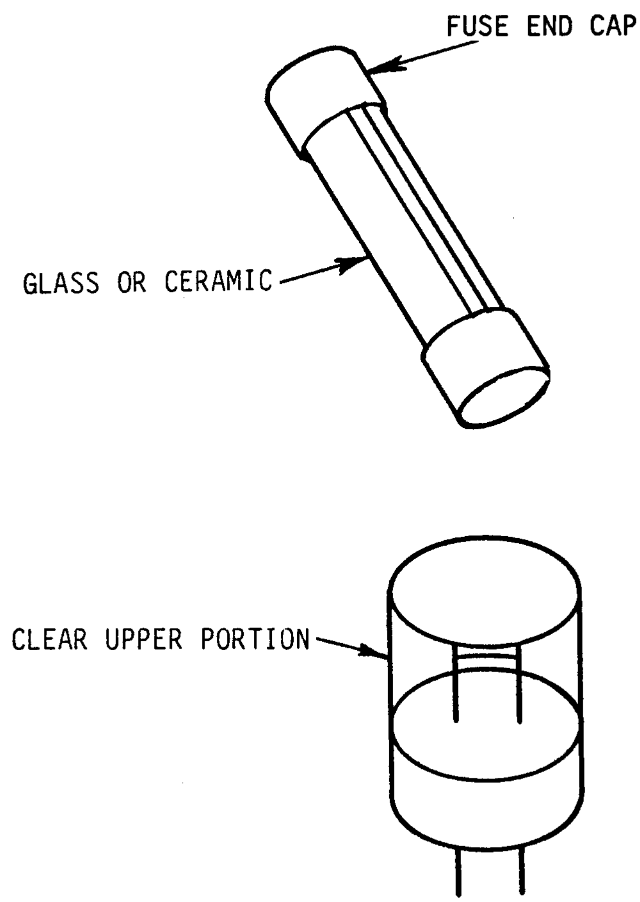



Figure 11-22. Typical Fuses

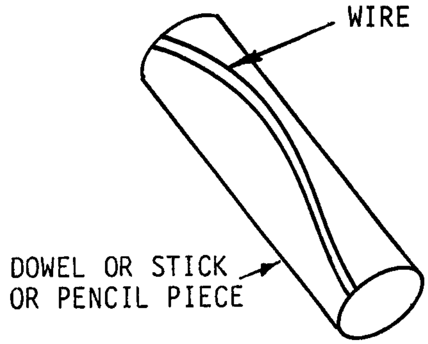



Figure 11-23. Fabricated Fuse, Type A

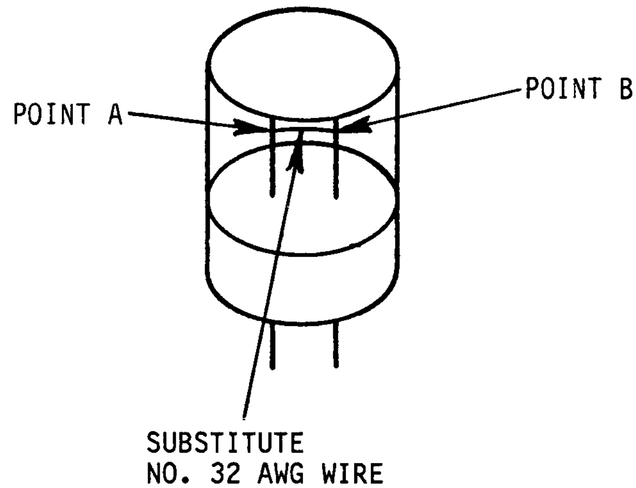



Figure 11-24. Fabricated Fuse, Type B

## Section V. BUS BARS

### 11-14. POWER BUS BAR REPAIR.

GENERAL INFORMATION: Rigid bus bars are used in the power distribution circuits of the aircraft. Replace damaged bus bars with aluminum or brass strips of the same or higher cross-sectional area.

OPTION: Fabricate Bus Bar.

LIMITATIONS: Repaired bus bars will have a somewhat higher resistance than the original circuit and a higher than normal voltage drop may occur. This is a temporary repair.

PERSONNEL/TIME REQUIRED:
- 2 Soldiers
- 2 Hours

**MATERIALS/TOOLS REQUIRED:**
- Drill and Bit
- Nuts (item 63, App. C)
- Bolts (items 8-24, App. C)
- Washers (item 162, App. C)
- Tape (item 151 or 153, App. C)
- Brush, Wire
- Hacksaw

**PROCEDURAL STEPS:**

1. Cut a section of another bus bar or piece of aluminum scrap to use for splice.

2. Drill matching holes in bus bar sections and splice, Figure 11-25.

3. Remove insulation from bus bar only where needed. Insure contact surfaces of cracked bus bar and splice are smooth, and clean to reduce resistance. If necessary, use file and wire brush to dress and prepare contact surfaces.

4. Install bolts and washers and tighten. Insure no contact of bolts with aircraft structure.

5. Insulate repair with tape or slit a piece of insulating tubing. Wrap it around the repair and tie it with string

6. Same repair procedure can be used to lengthen bus bars, Figure 11-26.

7. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## 11-15. BATTERY BUS BAR REPAIR.

GENERAL INFORMATION: Nickel-Cadmium (Ni-Cad) consists of a number of cells connected in series. Damage to a cell which does not result in destruction of the battery maybe repairable. This procedure gives instructions for locating and removing bad Ni-Cad battery cells and creating a bus bar jumper around the bad cell.

**WARNING**

- Ni-Cad batteries use potassium hydroxide, a strong caustic alkali, as the electrolyte. Do not get this electrolyte on your skin or in your eyes. Use rubber gloves, rubber apron, and protective goggles when handling the electrolyte. If accidental contact with the electrolyte is made, use ONLY clean water and immediately (seconds count) flush contaminated areas. Continue flushing with large quantities of clean water and get medical attention as soon as possible.

- Cell temperature should never exceed 120°F - 130°F. If steam or spewing electrolyte is observed or the battery is hot to the touch, DO NOT attempt to remove from the aircraft.

**CAUTION**

Penetration of battery case by small arms fire or shrapnel may cause thermal runaway. The battery cells will overheat and rupture, melt, or explode. Exercise extreme caution when repairing damaged battery.

**OPTION:** Jumper Cells.

**LIMITATIONS:** Some loss of battery voltage (1.25 to 1.50 V dc per cell removed) and amperage.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Multimeter with Leads
- Rubber Gloves
- Protective Goggles
- Rubber Apron
- Torque Wrench
- Test Equipment Repair Kit (item 13, App. B)

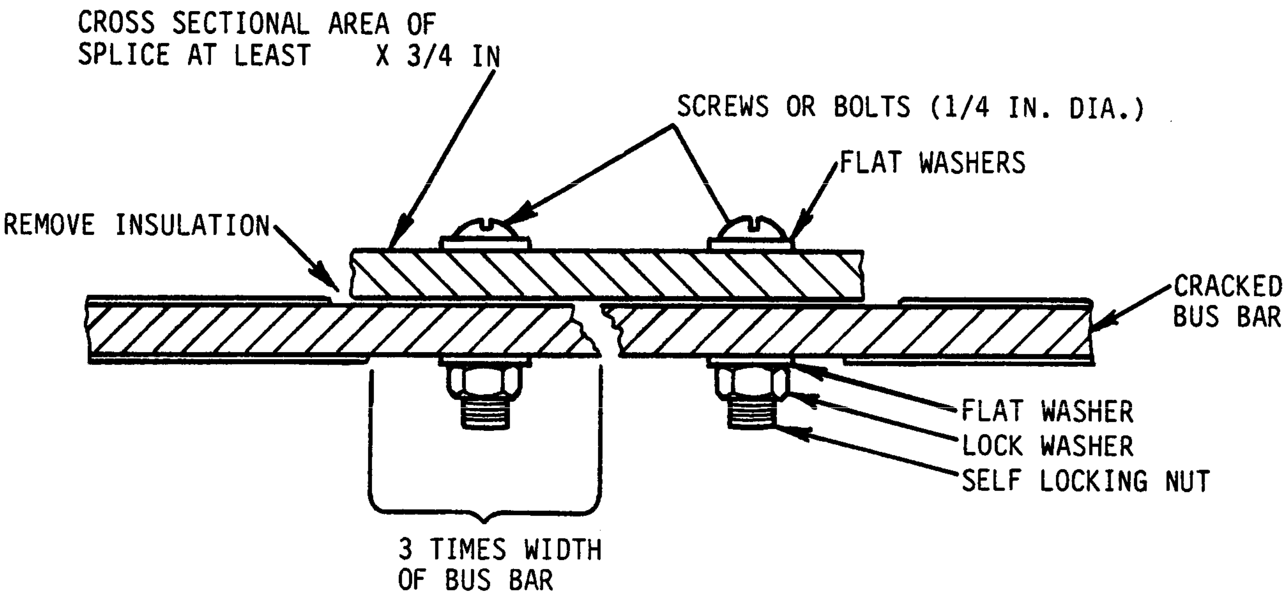



**Figure 11-25. Splicing Bus Bars**

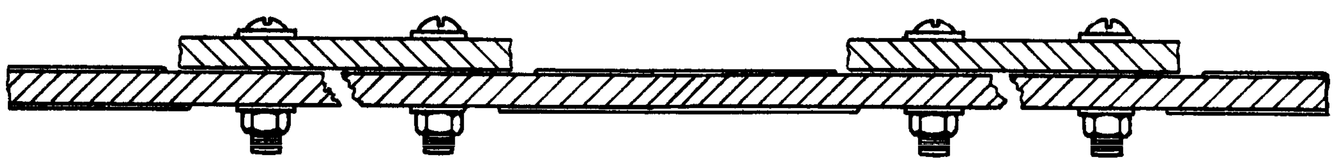


Figure 11-26. Lengthening Bus Bars

PROCEDURAL STEPS:

1. Disconnect battery and remove from aircraft if necessary.

2. Release snap fasteners and remove cover.

3. Use a multimeter to measure voltage across each cell. Normal readings should be 1.25 to 1.5 V dc per cell. Remove cells that are dead.

**WARNING**

Be extremely careful when removing or installing battery cells. Bodily injury and equipment damage may result if any metal tools or parts accidentally cause a short circuit.

NOTE

For engine cranking loads, cell voltages as low as 0.6 V dc are acceptable. Remove any damaged, cracked, or extremely hot cells leaking or spewing electrolyte.

4. To remove bad cells, use a 3/8 inch socket or equivalent to loosen and remove terminal screws.

5. Remove washers and terminal links.

6. To remove individual cells screw terminal screws back into each cell terminal, grasp these screws with pliers and lift the cell straight up.

7. Join several removed bus bars together or prepare jumper from 1 foot of No. 4 awg and two terminal lugs.

8. Remove 1/2 inch of insulation from one end of wire and crimp terminal lug on stripped end of wire.

9. Measure and cut wire to needed length, strip 1/2 inch of insulation and crimp terminal lug to other end of wire.

10. Install jumper across removed cells in place of terminal links. Cells are connected in series (positive to negative), Figure 11-27.

CAUTION

Battery terminal threads are soft brass.

11. Torque terminal screws to between 35 and 50 inch-pounds. If torque wrench is not available, tighten firmly with wrench or pliers.

12. Replace cover and install battery in aircraft.

13. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

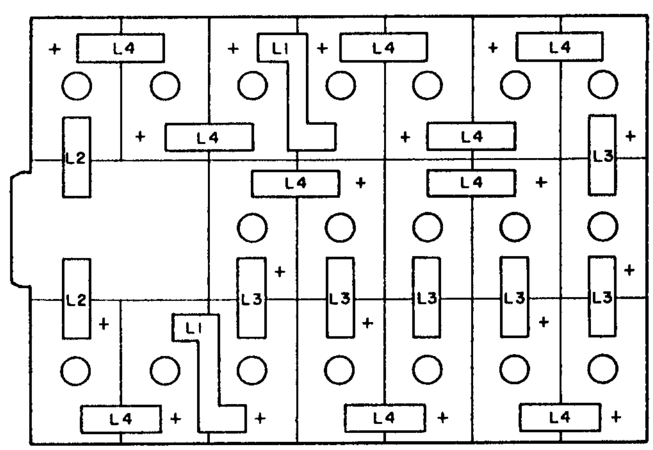



Figure 11-27. Battery Cell Layout

Section VI. Power Relays

## 11-16. POWER RELAY TEST AND REPAIR.

GENERAL INFORMATION:

a. A power relay is an electrically operated switch between the main buss and other electrical components in the aircraft. The relays are normally controlled by a switch in the cockpit.

b. To check power relay formalfunction, locate terminals Xl and X2 on the relay. With a multimeter set on the 0-50 V dc scale, check the voltage from terminals Xl and X2 to the aircraft fuselage (ground), Figure 11-28. One of the two terminals should have 24-28 V dc on it when the power relay control circuit is energized. No dc voltage indicates damage to the control circuit wiring. Repair control circuit wiring. With 24-28 V dc applied to terminals Xl or X2 of the power relay, check the voltage between terminals Al, A2, and the aircraft fuselage (ground), Figure 11-28. The voltage on terminals A1 and A2 should be identical. If there is no voltage on either one of the two terminals A1 or A2 with the relay energized, the relay should be considered defective and replaced or jumped.

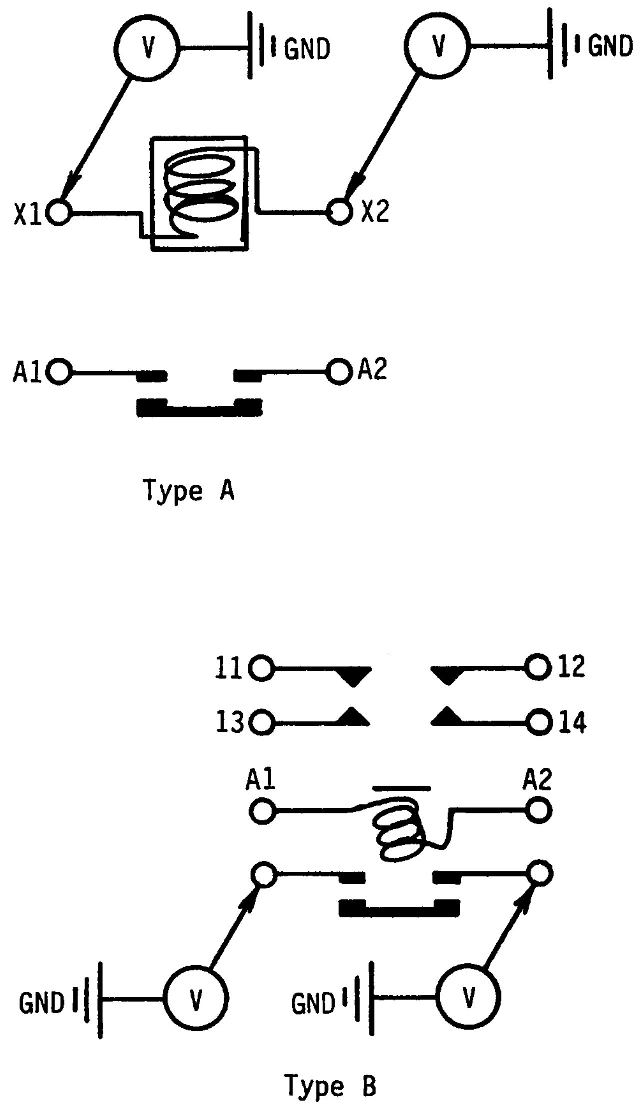



Figure 11-28. Block Diagram Power Relay, Check, and Test

**OPTION 1: Salvaged Power Relay Installation.**

**NOTE**

Identical P/N or NSN (Figures 11-29 thru 11-32) denotes interchangeability. If damage is extensive, salvaged relays may be difficult to attach to bulkheads.

**LIMITATIONS:** None

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Salvaged Power Relay
- Test Equipment Repair Kit (item 13, App. B)

**PROCEDURAL STEPS:**

1. Obtain salvaged power relay.

2. Disconnect battery.

3. Remove damaged power relay as follows:

**NOTE**

Note the position of wires/bus bar and what terminals they are connected to.

a. Remove attaching hardware, wires, and bus bar.

b. Remove attachment bolts, and lift relay free from compartment.

4. Position salvaged power relay, and install mounting hardware.

5. Install wires and bus baron correct terminals and secure with hardware.

**OPTION 2:** Jumper Damaged Power Relays, Figure 11-33.

**LIMITATIONS:** Temporary repair. No control over jumpered power relays, circuit cannot be turned on or off .

**CAUTION**

- Do not jumper battery relay on any aircraft.
- This procedure is to be used only for one time emergency evacuation and recovery of AH-1 helicopters.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 20 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Wire (items 170-178, App. C)
- Terminal Lugs (items 154-160, App. C)
- Test Equipment Repair Kit (item 13, App. B)
- Wire Repair Kit (item 14, App. B)

**PROCEDURAL STEPS:**

1. Disconnect battery.

2. Figure 11-33 shows two typical power relay configurations with jumper. This may be used as an aid in performing steps 3 through 7.

**NOTE**

Use wire with the same gage or larger than the one being replaced.

3. Prepare a jumper wire, Figure 11-34. (A 1/2 to 1 foot length of appropriate size wire with appropriate size terminal lugs crimped on each end.)

4. Locate terminals marked Al and A2 on power relay. Power relay terminals should be marked on case of relay, If markings are illegible, Al and A2 terminals will be the ones with the largest diameter terminal studs.

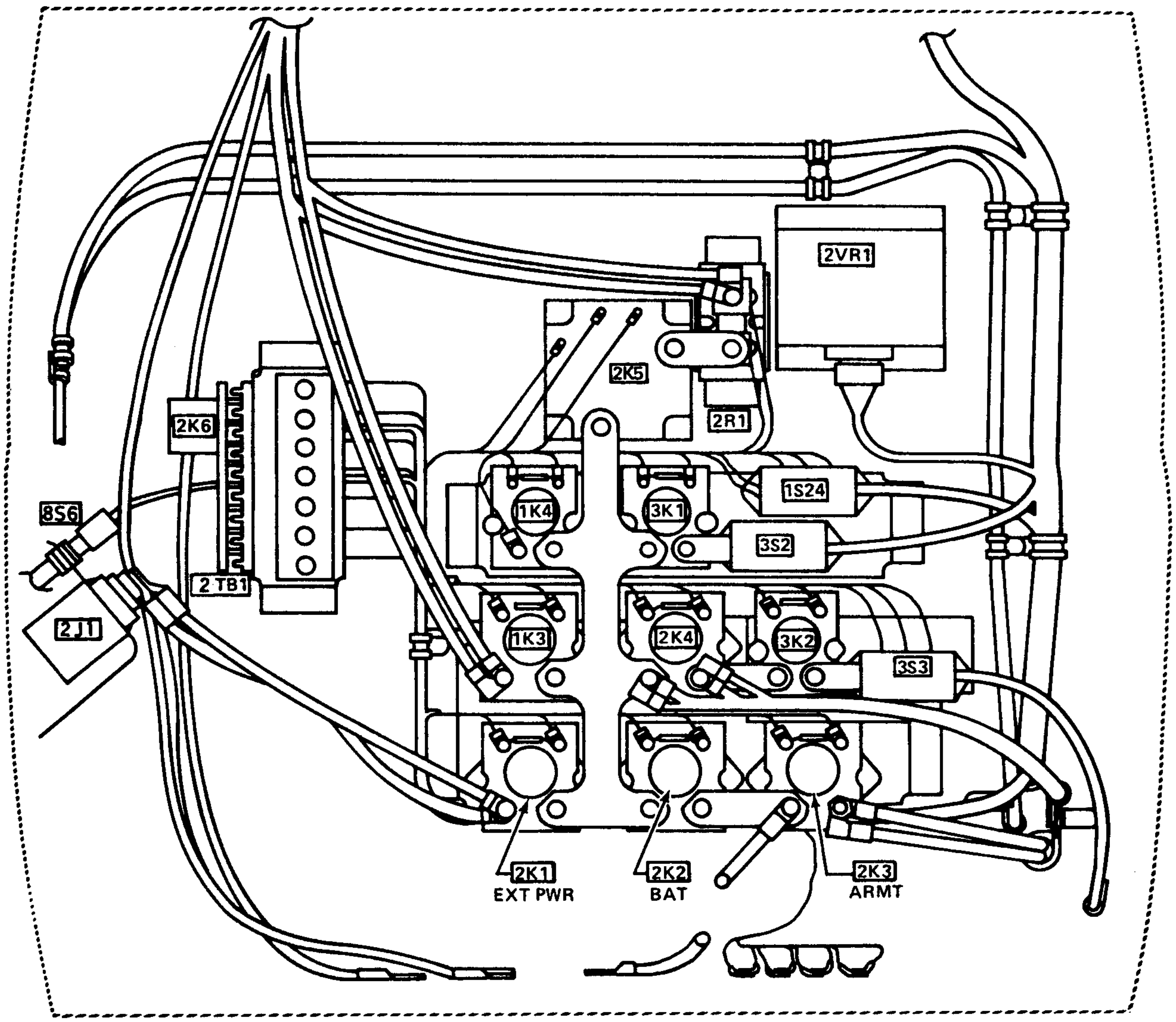



Figure 11-29. AH-1 PROD Battery Compartment, Forward View (Sheet 1 of 2)

| PART NUMBER | DRAWING DESIGNATION | FUNCTION |
|---|---|---|
| MS 24183-D1 | 1K3 | Relay, Starter |
| MS 24183-D1 | 2K1 | Relay, External Pwr |
| MS 24183-D1 | 2K2 | Relay, Battery |
| MS 24183-D1 | 2K3 | Relay, Turret Pwr |
| MS 24183-D1 | 2K4 | Relay, Non Ess Bus |
| MS 24140-D1 | 3K1 | Relay, Main Inverter Power |
| MS 24140-D1 | 3K2 | Relay, Standby Inverter Power |
| 212-075-236-17 | 1S24 | Sensor, EMG. HYD. Pump Overload |
| 212-075-236-17 | 3S2 | Switch, Main Inverted Overload |
| MS24140-D2 | 1K4 | Relay, EMG. HYD. Pwr |
| 205-075-642-1 | 2K5 | Relay, Reverse Current |
| MS25457-D1 | 2K6 | Relay, Generator Field |
| 204-075-152-1 | 2R1 | Shunt |
| 209-075-228-1 | 2VR1 | Regulator, Voltage |
| 212-075-236-15 | 3S3 | Sensor, Standby Inverter Pwr |
| M8805/1-008 | 8S6 | Switch, External Pwr Door |
| MS27212-1-8 | 2TB1 | Terminal Board, External Pwr |
| AN2552-3A | 2J1 | Receptacle, External Pwr |

Figure 11-29 AH-1 PROD Battery Compartment, Forward View (Sheet 2 of 2)

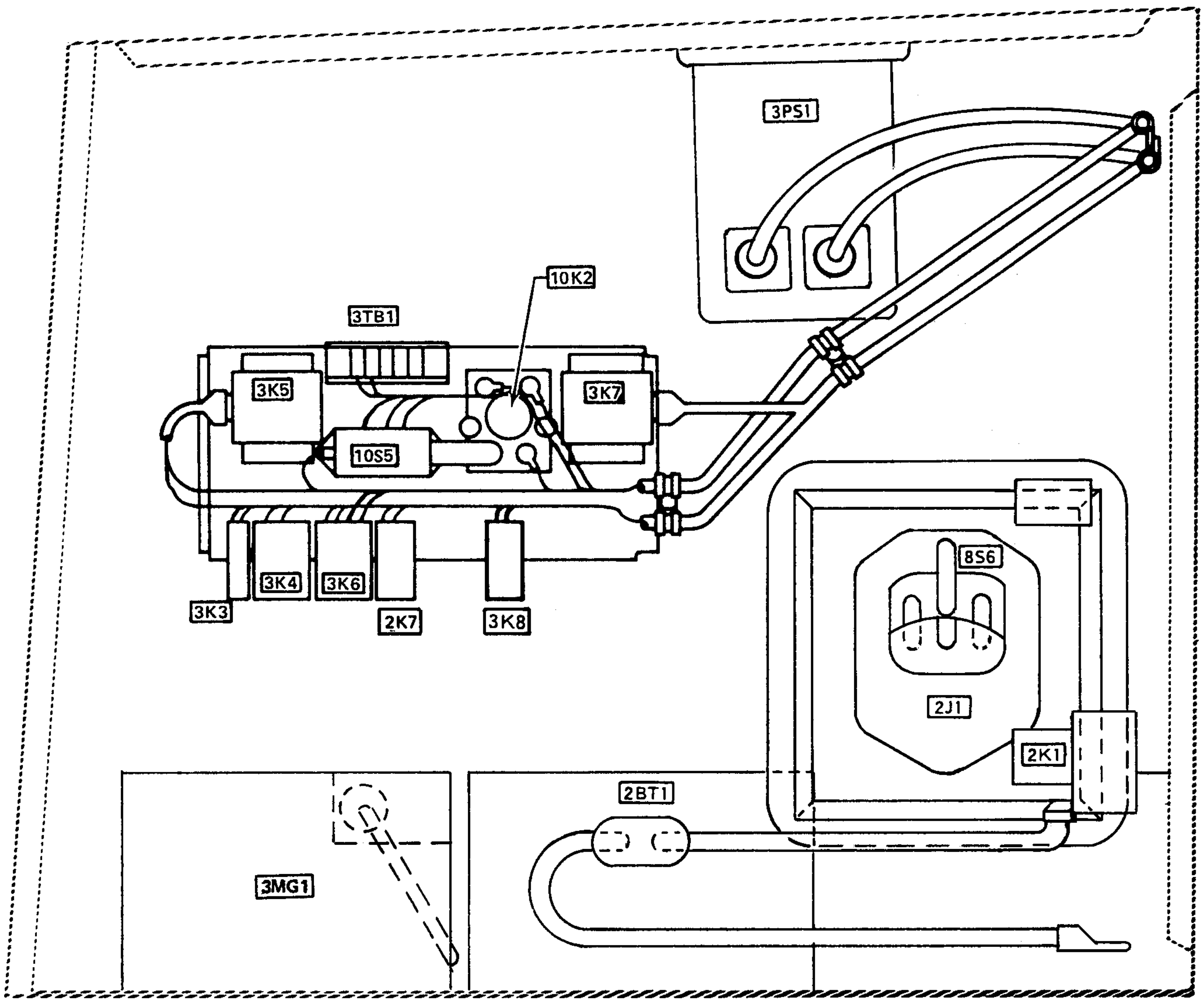



Figure 11-30. AH-1 PROD Battery Compartment, Side View (Sheet 1 of 2)

| PART NUMBER | DRAWING DESIGNATION | FUNCTION |
|---|---|---|
| 110-128-1 | 3K3 | Relay, AC Power Control |
| 110-128-1 | 3K8 | Relay, Main Inverter Light |
| 110-111-1 | 3K4 | Relay, Inverter Three Phase |
| 110-111-1 | 3K6 | Relay, Inverter Select |
| 214-075-150-1 | 3K5 | Relay, Main AC Fail |
| 214-075-150-1 | 3K7 | Relay, Standby AC Fail |
| 110-127-1 | 2K7 | Relay, Bus Control |
| MS24140-D1 | 10K2 | Relay, Heater Control |
| 212-075-236-15 | 10S5 | Sensor, TOW Overload |
| BB-649/A | 2BT1 | Battery |
| PU-543()/A | 3MG1 | Inverter, Standby |

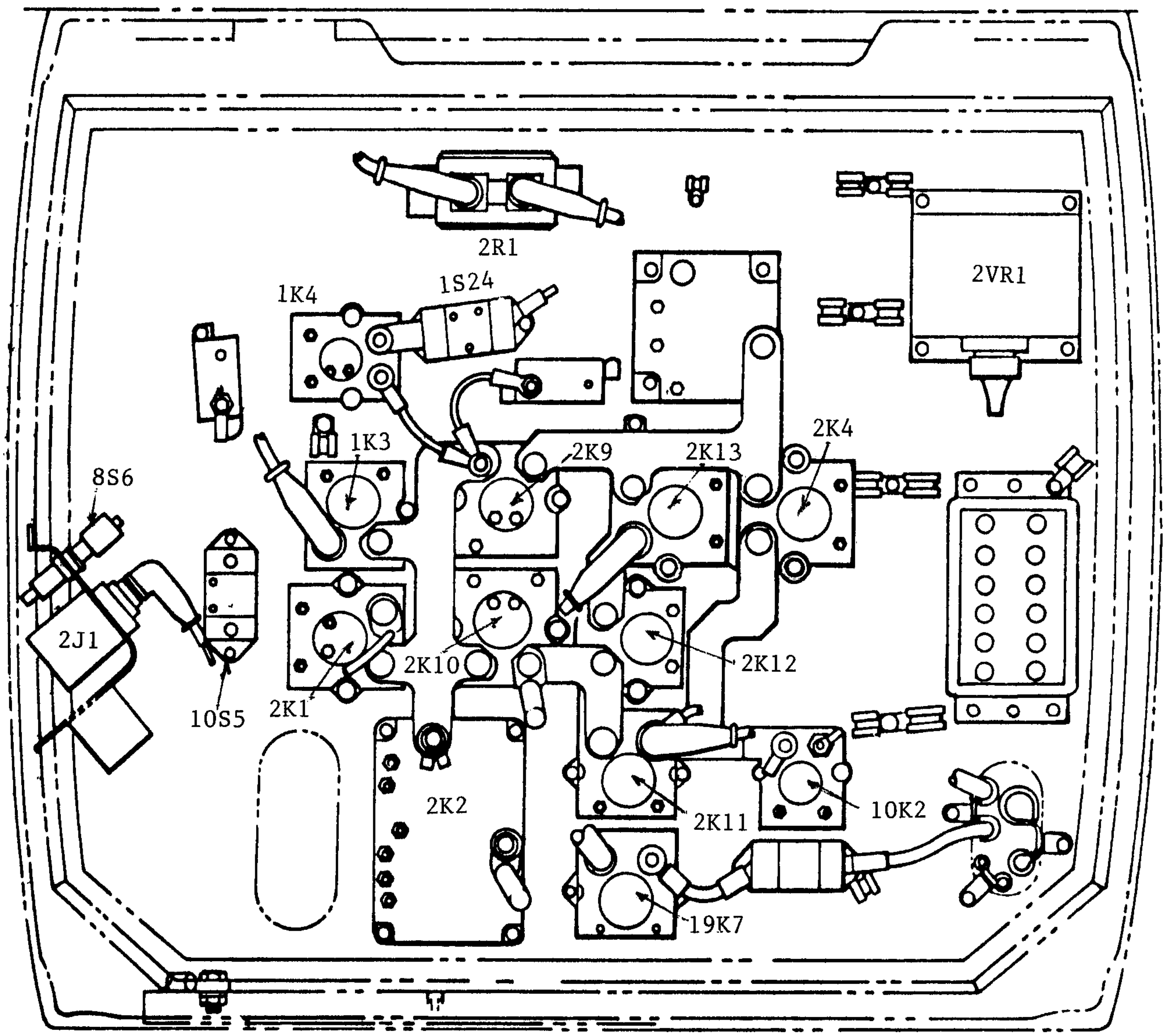
Figure 11-30. AH-1 PROD Battery Compartment, Side View (Sheet 2 of 2)

| PART NUMBER | DRAWING DESIGNATION | FUNCTION |
|---|---|---|
| 110-128-l | 3K3 | Relay, AC Power Control |
| 110-128-l | 3K8 | Relay, Main Inverter Light |
| 110-111-1 | 3K4 | Relay, Inverter Three Phase |
| 110-111-1 | 3K6 | Relay; Inverter Select |
| 214-075-150-l | 3K5 | Relay, Main AC Fail |
| 214-075-150-l | 3K7 | Relay, Standby AC Fail |
| 110-127-l | 2K7 | delay, Bus Control |
| MS24140-D1 | 10K2 | Relay, Heater Control |
| 212-075-236-15 | 10S5 | Sensor, TOW Overload |
| BB-649/A | 2BT1 | Battery |
| PU-543()/A | 3MG1 | Inverter, Standby |

Figure 11-30. AH-1 PROD Battery Compartment, Side View (Sheet 2 of 2)

| PART NUMBER | DRAWING DESIGNATION | FUNCTION |
|---|---|---|
| BB-649/A | 2BT1 | Battery |
| 110-111-1 | 2K16 | Relay (Ext Pwr Cont) |
| 110-111-1 | 2K14 | Relay (RVS Cur Cont) |
| 110-111-1 | 2K15 | Relay, (TRU Cont) |
| 110-111-1 | 2K21 | Relay |
| 110-127-1 | 2K8 | Relay (Bat Cont) |
| 110-127-1 | 2K17 | Relay (Armt Cont) |
| 110-128-1 | 2K3 | Relay (Bat Cont) |
| 110-128-1 | 3K2 | Relay (AC Cont) |
| MS25457-D1 | 2K6 | Relay (Gen Field) |
| 209-075-572-3 | 3PS1 | Inverter |
| 209-075-991-2 | 3PS2 | Unit, Transformer Rectifier |
| SM601BA20A1 | 3CB6 | Ckt Bkr TRU (U/O 77-22763 to 78-23092) |
| SM601BA20A1X | 3CB6 | Ckt Bkr TRU (78-23093 & Sub) |
| M6106/9-002 | 3K1 | Relay (AC Source) |
| M21480/16-5 | 3T3 | Cur XFMR |
| 209-075-998-1 | 3VR1 | Control; Alternator |
| M81714/5-1 | 2TB1 | Terminal Board; Relay Interface |

Figure 11-31. AH-IS ECAS and MC Battery Compartment, (Sheet 2 of 2)




FORWARD BULKHEAD OF BATTERY COMPARTMENT

Figure 11-32. AH-lS ECAS and MC Battery Compartment (Sheet 1 of 3)

| PART NUMBER | DRAWING DESIGNATION | FUNCTION |
|---|---|---|
| MS24142-D2 | 2K1 | Relay, External Pwr |
| MS24142-D2 | 2K4 | Relay, Non-Essential |
| MS24142-D2 | 2K9 | Relay, Essential |
| MS24142-D2 | 2K10 | Relay, (TRU) Essential |
| MS24142-D2 | 2K13 | Relay, Armament |
| MS24183-D1 | 1K3 | Relay, starter |
| MS24183-D1 | 2K11 | Relay, (TRU) Non-Essential |
| MS24183-D1 | 2K12 | Relay, (TRU) Armament |
| MS24183-D1 | 19K7 | Relay, Turrent Pwr |
| MS24140-D2 | 1K4 | Relay, EMG. Hyd. Pump |
| 212-075-236-17 | 1S24 | Switch, EMG. Hyd. Pump Sensor |
| AN2552-3A | 2J1 | Receptacle, EXT. Pwr |
| 209-175-200-l | 2K2 | Relay, Battery |
| 205-075-642-101 | 2K5 | Relay, Reverse Current |
| 204-675-152-l | 2R1 | Shunt |
| 209-075-228-l | 2VR1 | Regulator, Voltage |
| M83383/02-09 | 3CB7 | Ckt Bkr Inverter (RCCB) |
| M8805/1-008 | 8S6 | Switch, External Pwr Door |
| MS24140-D1 | 10K2 | Relay, Tow Blower |
| 212-075-236-15 | 10S5 | Sensor, Tow Blower Overload |
| M83383/01-10 | 3426K1 | RCCB |
| 212-075-236-27 | 19S18 | Sensor |

Figure 11-32. AH-1S ECAS and MC Battery Compartment (Sheet 2 of 3)

| PART NUMBER | DRAWING DESIGNATION | FUNCTION |
|---|---|---|
| 209-175-357-101 | 2K20 | Reverse Current in Action, Relay |
| MS3320-5 | 2CB1 | DC VM |
| MS3320-5 | 2CB2 | DC VM |
| MS3320-5 | 2CB6 | Battery Relay |
| MS3320-5 | 2CB7 | EXT. Pwr |
| MS3320-5 | 2CB8 | ESNTL BUS |
| MS3320-5 | 2CB9 | TRU BUS |
| MS3320-5 | 2CB10 | REV CUR |
| MS25244-5 | 8CB11 | XMSN Oil Level Lt. |
| MS25244-10 | 19CB126 | AMMO Load |
| MS25244-10 | 20CB2 | TSGMS Pwr |
| MS25244-35 | 20CB1 | TOW Pwr |

Figure 11-32. AH-IS ECAS and MC Battery Compartment (Sheet 3 of 3)

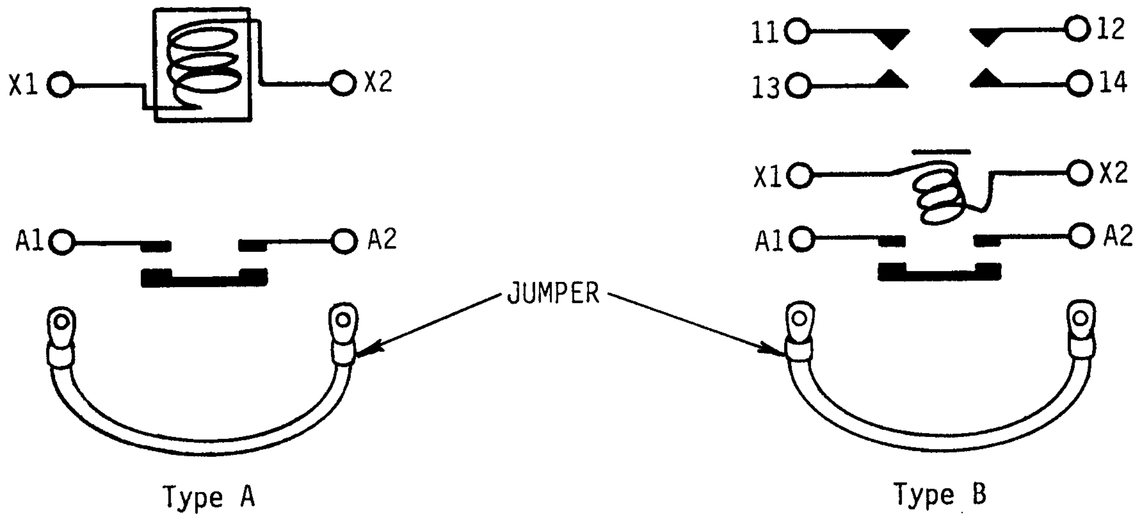



Figure 11-33. Block Diagram, Typical Power Relays

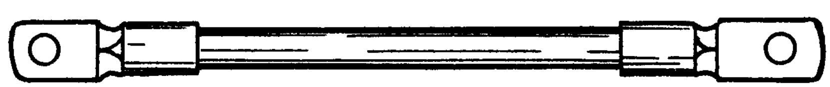


Figure 11-34. Jumper Wire Fabrication

5. Remove hardware from terminals Al and A2.

6. Install jumper from terminal Al to terminal A2. Reference Figure 11-33.

7. Install hardware on terminals Al and A2. Tighten hardware to hold jumper in place.

8. Remove jumper as soon as emergency evacuation flight is completed.

9. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## Section VII. ANTENNAS

**11-17. GENERAL.** This section contains expedient repair procedures to restore radio communication needed to complete the mission.

**WARNING**

> Avoid contact with expedient antennas. Bare wires could cause severe burns and electrocution hazard.

**11-18. SUBSTITUTE EMERGENCY ANTENNA.**

**GENERAL INFORMATION:** This procedure gives Instructions for construction of a replacement antenna that can be used to transmit and receive radio messages.

**OPTION:** Fabricate Antenna.

**LIMITATIONS:** Some loss of antenna gain and radio transmitter power.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1 Hour

**MATERIALS/TOOLS REQUIRED:**
- Cable, Coax RG-58U or Other Available Coax
- Tape (item 151 or 153, App, C)
- Resistor, Carbon, 1 Watt 51 Ω ±5% (item 87, App. C)

**PROCEDURAL STEPS:**

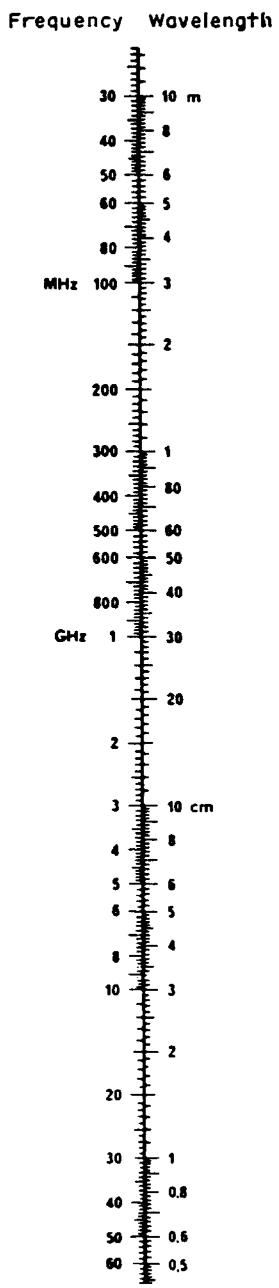
1. Determine length of wire needed for the radiating element by using Figure 11-35. Example:

- FM radio with frequency range of 30 to 69.95 MHz.
- Center of frequency range is 50 MHz.
- Using Figure 11-35, look under frequency column for 50 MHz on the wave length side of the Table, 6 M is shown.
- Use Figure 11-35 to convert meters to feet. Six meters multiplied by 3.280 = 19.68 feet for one wave length.
- Divide the one wave length by 8, for a 1/8 wave length antenna, $\frac{19.68}{8}$ = 2.46 feet.

  Multiply the 1/8 wave length by a .95 correction factor: 2.46 ft. X .95= 2.34 feet. This is the length of the radiating element.

2. Cut the coax cable to the length of the required radiating element. Remove the outer insulation and shield from the piece of coax cable and then strip a 1 inch piece of insulation from each end exposing the center conductor, Figure 11-36.

3. Wrap and solder the 51 Ω resistor to one end of the radiating element as per Figure 11-36. This completes the fabrication of the radiating element of the antenna.




| TO CHANGE | TO | MULTIPLY BY |
|---|---|---|
| Centimeters . . | Inches. . . . . . | 0.394 |
| Meters. . . . . | Feet. . . . . . . | 3.280 |

Figure 11-35. Frequency vs. Wave Length

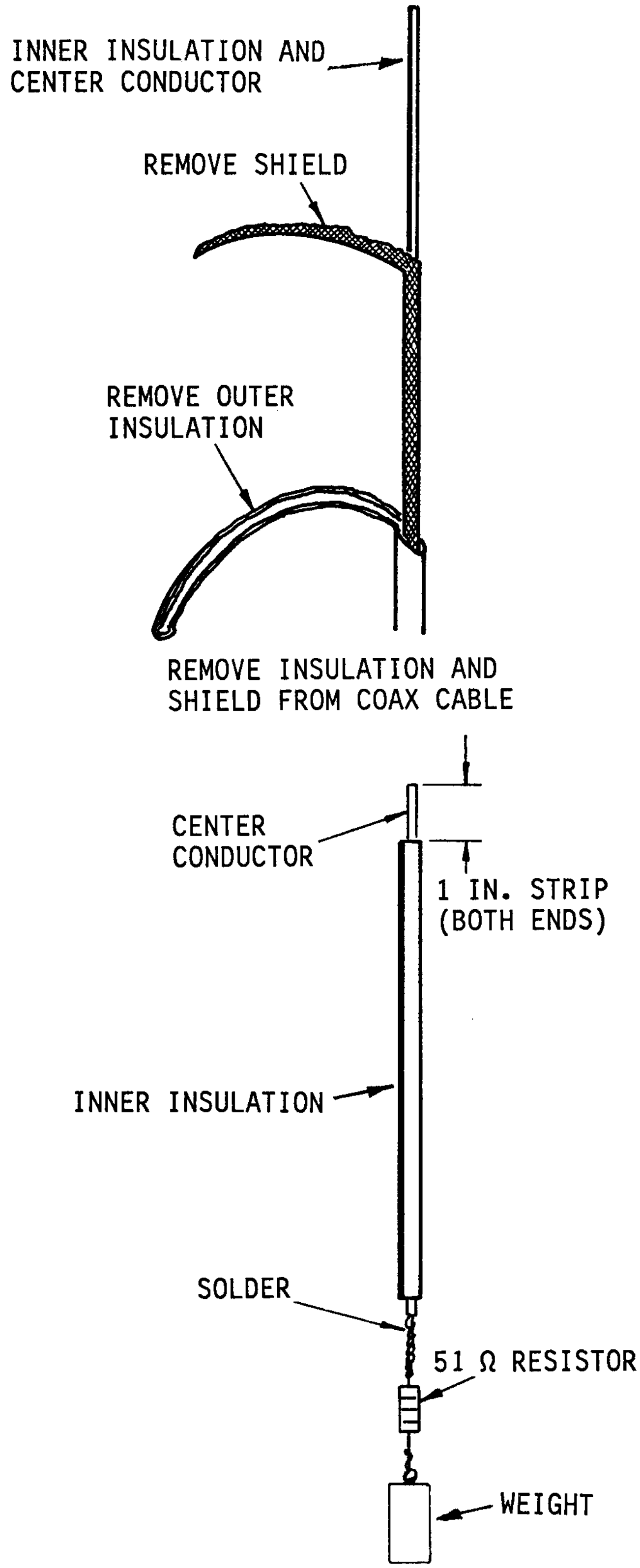



Figure 11-36. Preparation of Coax

4. Next, remove the structural panel on the right-hand side just forward of the tailboom, Figure 11-37.

5. At the tailboom quick disconnect, locate coax cable marked 1 ARC 114-105A and disconnect it.

6. Remove the coax connector and prepare a 4 inch pigtail termination on the end of the coax cable as shown in Figure 11-38.

7. Pass the radiating element of the antenna, from step three, with the resistor end down into the drain hole in the bottom of the tailboom where it joins the fuselage, Figure 11-37.

8. Twist the center conductor from the radiating element of the antenna to the center conductor of the coax. Make a good mechanical joint and insulate with tape.

9. Ground the pigtail from the coax antenna by wrapping and twisting it around the plug where the coax was disconnected.

10. Secure with tape to hold the antenna and coax in place inside the tailboom. Replace the structural panel and secure with screws.

NOTE

Antenna must be at right angle (90°) to aircraft skin to radiate R.F. energy. Do not tape antenna to skin of aircraft.

110 Tape a one to two ounce weight, using tape, below the 51 Ω resistor as shown in Figure 11-36.

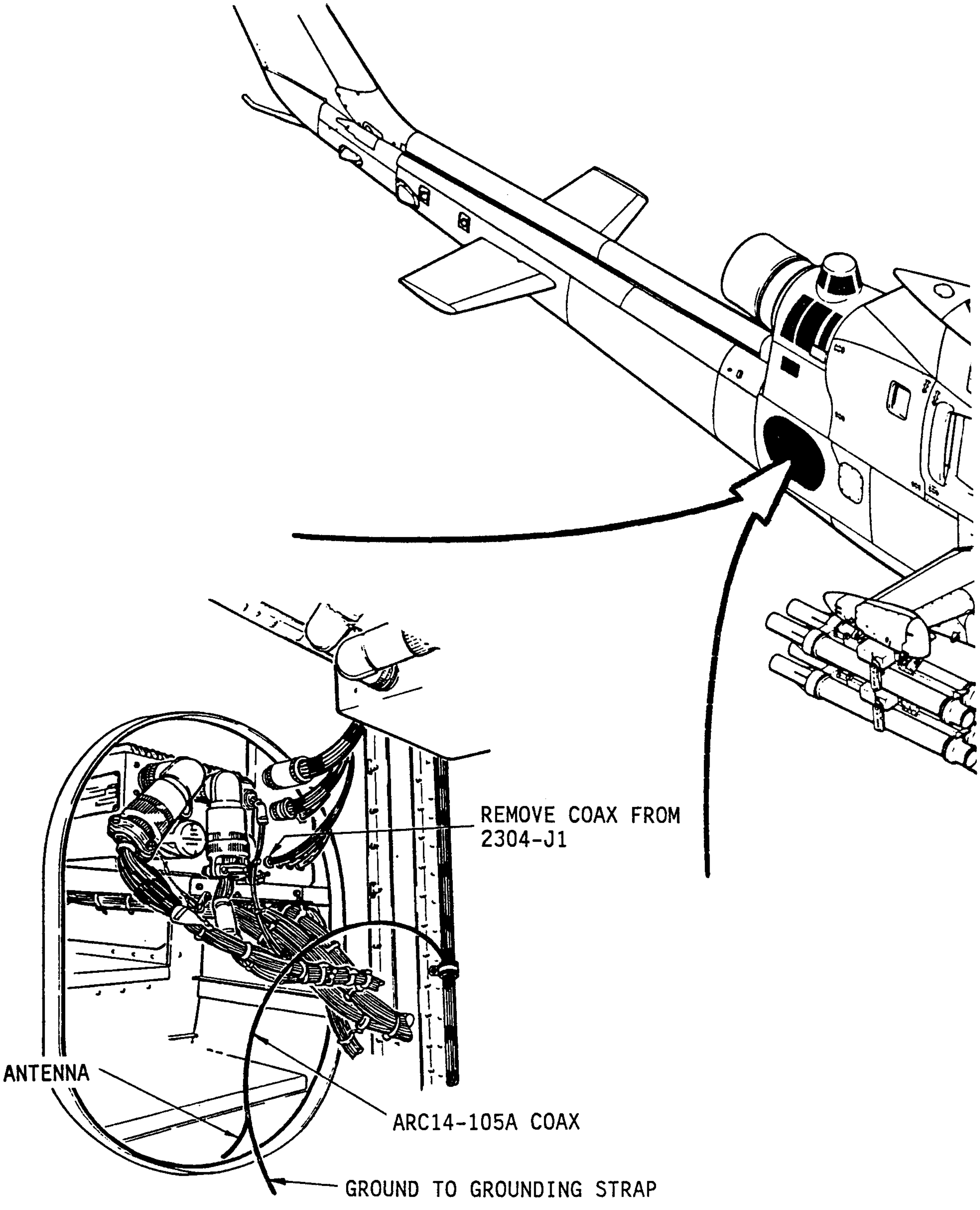



Figure 11-37. Installation of Field Expedient Antenna

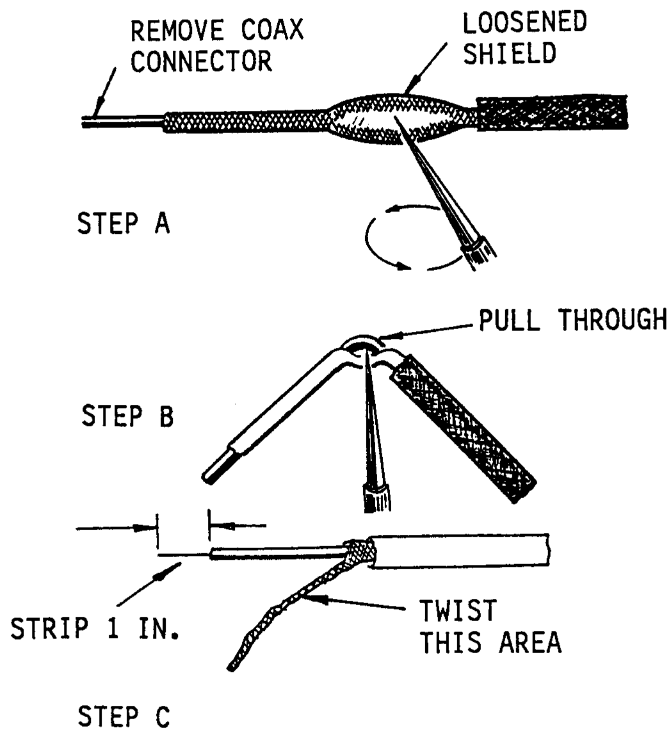



Figure 11-38. Pigtail Termination for Shielded Wire

## Section VIII. ELECTRICAL WIRE INSULATION

11-19. GENERAL. Aircraft wiring may sustain minor damage to the electrical wiring such that splicing repair techniques are not required. The fixes described herein will be the most expedient under minor repair circumstances.

11-20. DAMAGED WIRE INSULATION.

GENERAL INFORMATION: If the wire insulation is damaged but the wire itself is not, repair of the insulation may be accomplished by installing heat shrinkable tape, a transparent sleeve of flexible tubing, and securing with nylon braid or some other means.

CAUTION

Ensure aircraft power is OFF. Disconnect battery before touching wires,

OPTION 1: Apply Heat Shrinkable Reps r Tape.

LIMITATIONS: This is a temporary repair.

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 10 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Heat Shrinkable Tape
- Heat Gun/Heat Source
- Wire Repair Kit (item 14, App. B)

**PROCEDURAL STEPS:**

1. Start wrapping at one end of area to be covered.

2. Overlap each turn about one-third of tape width. Overlap of more than 50 percent or multiple wraps are not recommended. Excess thickness prevents heat transfer to the inner layer. Refer to Figure 11-39.

3. Apply heat to end of last lap to soften the meltable adhesive and press it into position while warm.

4. Heat the tape to shrink it and melt the adhesive layer.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

**OPTION 2:** Apply Insulation Sleeve.

**LIMITATIONS:** This is a temporary repair.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 10 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Insulation Sleeving or Rubber Hose (item 53, App. C)
- Knife
- String or Cable Ties (item 26 or 27, App. C)

**PROCEDURAL STEPS:**

1. Remove damaged insulation and examine to insure conductor strands are not damaged.

2. Prepare a sleeve of flexible tubing one and one-half times the outside diameter of the wire and 2 inches longer than the damaged portion of the insulation.

3. Split lengthwise and wrap one and one-half times around the wire at the damaged section.

4. Tie with string or other suitable material at each end and at 1 inch intervals over the entire length, Figure 11-40.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment /system using standard maintenance procedures.

**OPTION 3:** Apply Tape Insulation.

**LIMITATIONS:** This is a temporary repair.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 5 Minutes Per Wire

**MATERIALS/TOOLS REQUIRED:**
- Tape (item 151 or 153, App. C)
- Knife

**PROCEDURAL STEPS:**

1. Remove damaged insulation and examine to insure center conductor is not damaged.

2. Wrap tape over exposed center conductor of wire. Tape should extend 2 inches beyond the wire insulation at each end of the area to be covered.

3. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

OPTION 4: Apply Potting Compound Insulation.

LIMITATIONS: This is a temporary repair.

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 1-3 Hours Per Wire (depending on which potting compound is used)

MATERIALS/TOOLS REQUIRED:
- Potting Compound (item 85, App.C)
- Tape, Electrical (item 151 or 153, App. C)

Knife

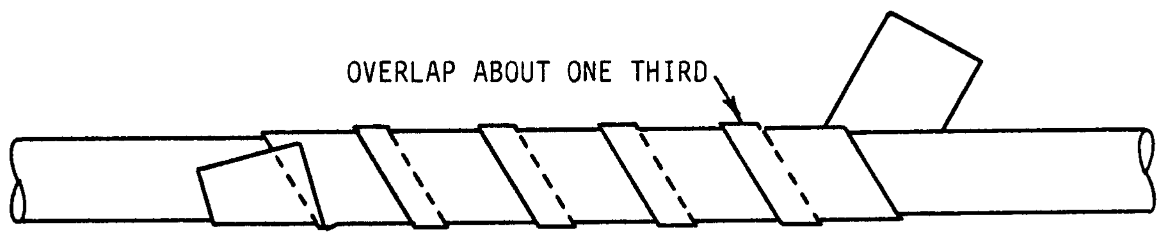
PROCEDURAL STEPS:

1. Remove damaged insulation and examine to insure center conductor is is not damaged.

2. Apply a thin coat of potting compound over the exposed center conductor.

3. Allow time to dry. If compound coating does not seem to be sufficient, apply additional layers as needed.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.




Wrap only tight enough to hold tape in place.
The tape will shrink tightly when heated.

Figure 11-39. Heat Shrinkable Tape

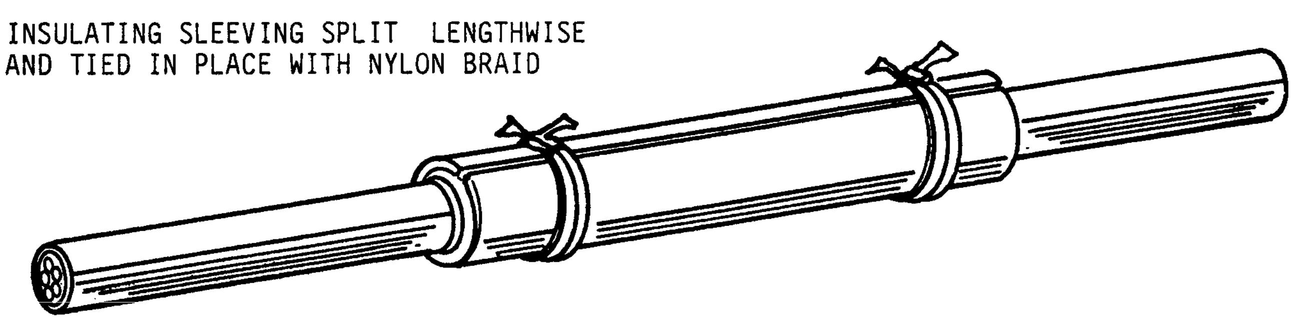



Figure 11-40. Insulation Repair with Sleeving

# CHAPTER 12

# FUEL 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

12-1. SCOPE. This chapter contains the fault assessment and expedient repair procedures for locating and fixing damage to the fuel system. The system is shown pictorially in Figure 12-1.

12-2. ASSESSMENT PROCEDURES. Each fuel system must be carefully evaluated and classified, both in confined areas and in open areas exposed to the airstream, in order to differentiate between leaks which require immediate repair before flight and leaks which do not constitute a flight hazard. The exact location of a leak shall be determined and the leak area examined thoroughly. Refer to Table 12-1 assessment logic.

12-3. REPAIR PROCEDURE INDEX.



## Section II. LINES AND HOSES

12-4. GENERAL.

a. Replacement lines and hoses need not be routed along the path of the original installation. They may be routed along any convenient path as long as they do not interfere with personnel or with operating equipment. Long lines and hoses should be clamped to hard supports at convenient intervals not exceeding two feet.

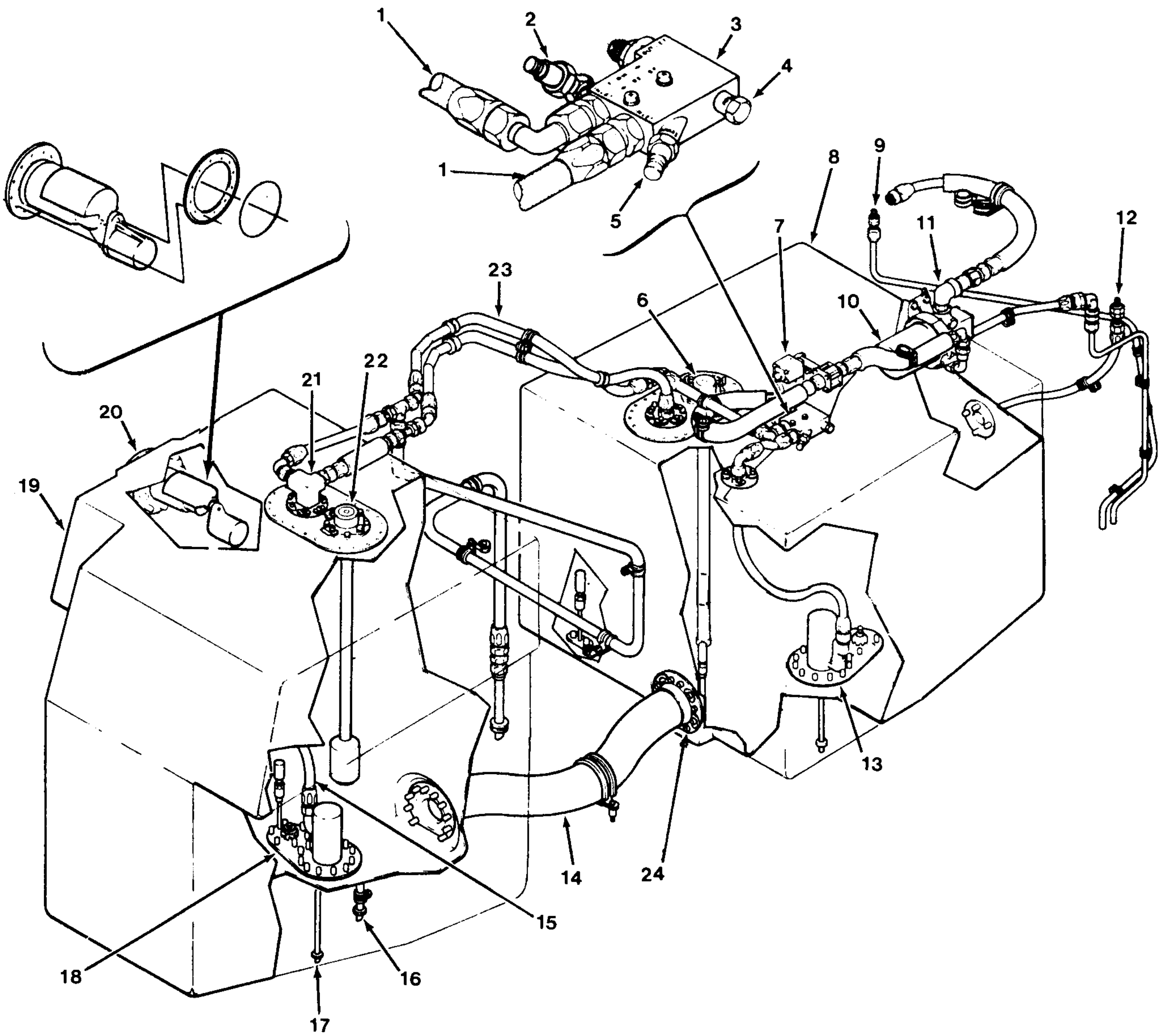
b. Fuel System Metal Tubes and Hoses.

(1) Damaged metal tubes will normally be replaced with hose assemblies from BDAR kits.

(2) If hose assemblies from kits are not available, damage may be cut out and replaced with a small section (refer to repair procedures), or a replacement hose may be manufactured if a long enough hose section and MS fittings are available (refer to repair procedures in Chapter 9).

c. In the event of o-ring damage, refer to Chapter 9, paragraph 9-13. The same criteria that applies to hydraulic o-rings also applies to o-rings in the fuel system.

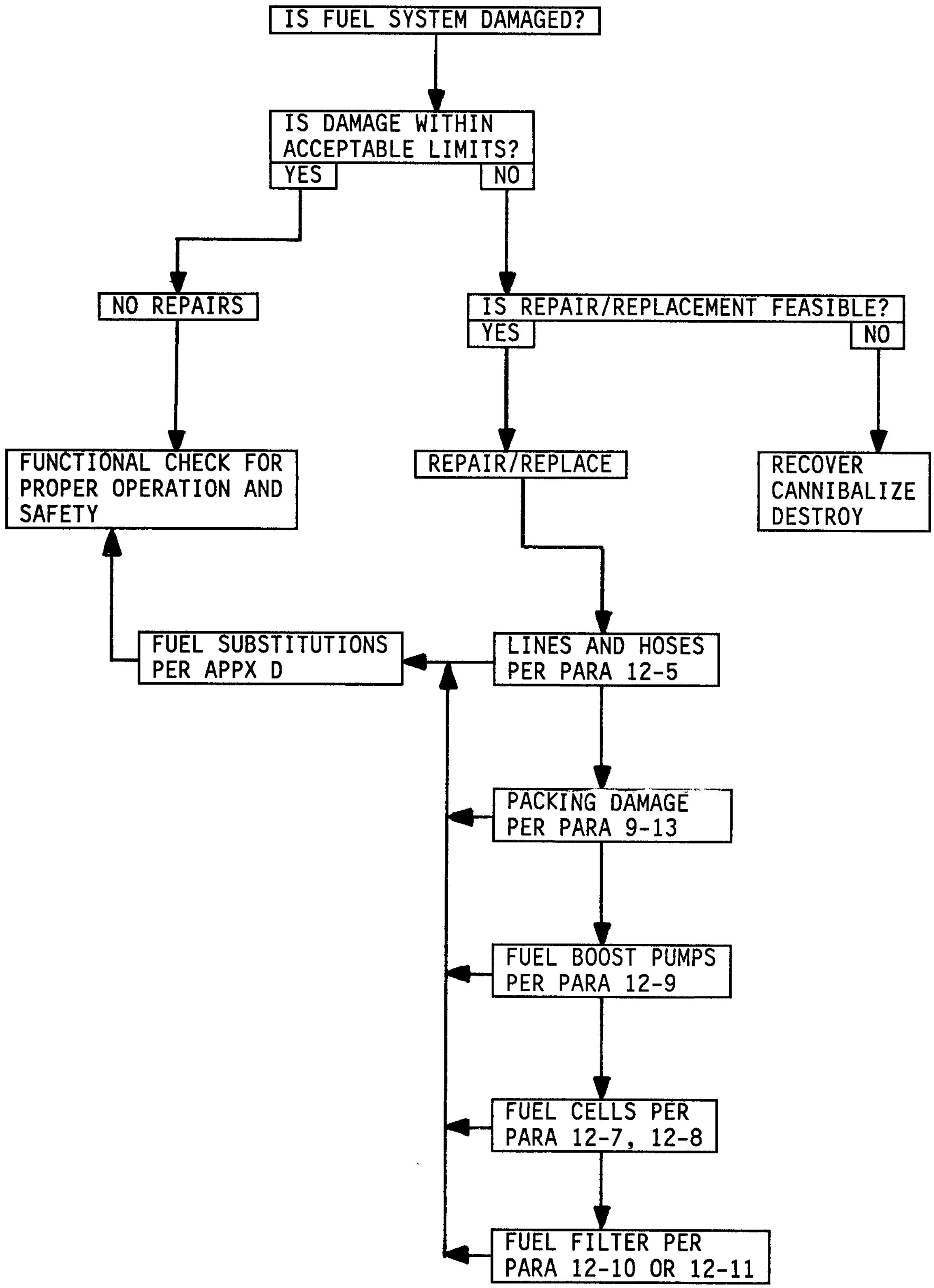
d. If the standard fuel is not available, a substitute fuel must be used. Check Appendix D for a compatible fuel.




1. Hose Assembly
2. Pressure Switch
3. Check Valve Manifold
4. Plug
5. Pressure Switch
6. Fuel Quantity Probe
7. Fuel Shutoff Valve
8. Aft Fuel Cell
9. Engine Drain Coupling
10. Filter
11. Engine Fuel Supply Hose
12. Governor Bleed Coupling
13. Boost Pump
14. Crossover Hose
15. Fuel Hose
16. Drain Valve
17. Seal
18. Boost Pump
19. Forward Fuel Cell
20. Fuel Receiver
21. Fuel Vent Fitting
22. Fuel Quantity Probe
23. Vent Lines
24. Check Valve

Figure 12-1. Fuel System

Table 12-1. Fuel System Assessment Procedure



**WARNING**

- Battle damaged areas should be inspected for unexploded ordnance before attempting repairs. Disposal of unexploded ordnance should be accomplished by qualified personnel.
- Cleaning solvents may be flammable and toxic. Use only in well-ventilated areas. Avoid inhalation of vapors and skin contact. Do not use solvents near open flame or in areas where very high temperatures prevail. Solvent flash point must be less than 100°F.
- When refueling helicopter, the refueling vehicle must be parked a minimum of 20 feet from the helicopter. Before starting the fueling operation, always insert fueling nozzle ground cable of fuel truck into GROUND HERE receptacle. Refer to FM 10-68. When defueling, turn off all electrical switches and disconnect external power from the helicopter. The helicopter must be electrically grounded.
- Fuel line and tank repairs often involve handling of highly inflammable material. Mishandling can result in serious injury or death.
- The helicopter should be electrically grounded when parked to dissipate static electricity. Turn off all power switches before making electrical connections of disconnections.

## 12-5. METAL TUBE AND HOSE LEAKS.

**GENERAL INFORMATION:** This paragraph describes procedures for the expedient repair of low pressure (i.e., fuel lines not hydraulic lines) tubing. New hoses can be manufactured by following the procedures in Chapter 9.

**OPTION 1:** Hose Splice Tubing Repair.

**LIMITATIONS:** Inspect after every flight.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1 Hour

**MATERIALS/TOOLS REQUIRED:**
- String or Wire (item 149 or 61, App. C)
- Sealant or Epoxy (Optional) (items 4 or 123-127, App. C)
- Adhesive (item 5 or 6, App. C)
- Hose
- Two Hose Clamps (items 54-59, App. C)
- Tube Cutter
- Hacksaw
- Tube Cleaner
- Hand File

**PROCEDURAL STEPS:**

1. Cut out damaged area of tubing.

2. Clean and smooth newly cut ends.

3. Make an improvised bead by wrapping string or a soft wire around the tube as shown in Figure 12-2. (If time permits, coat the string or wire with sealant or hardening epoxy and let it dry.)

4. Cut a piece of hose which fits tightly over the tubing and extends 1-1/2 to 2 inches over each end, Figure 12-2 and 12-3.

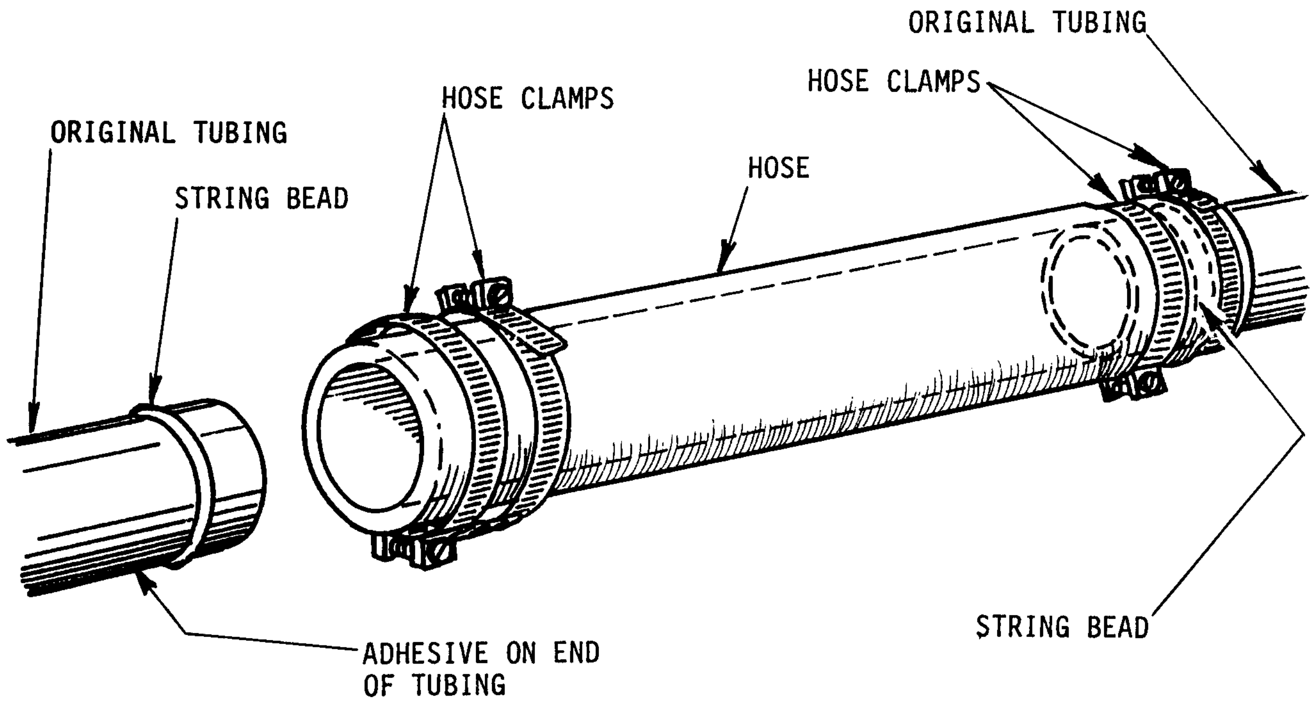



Figure 12-2. Use of String Bead

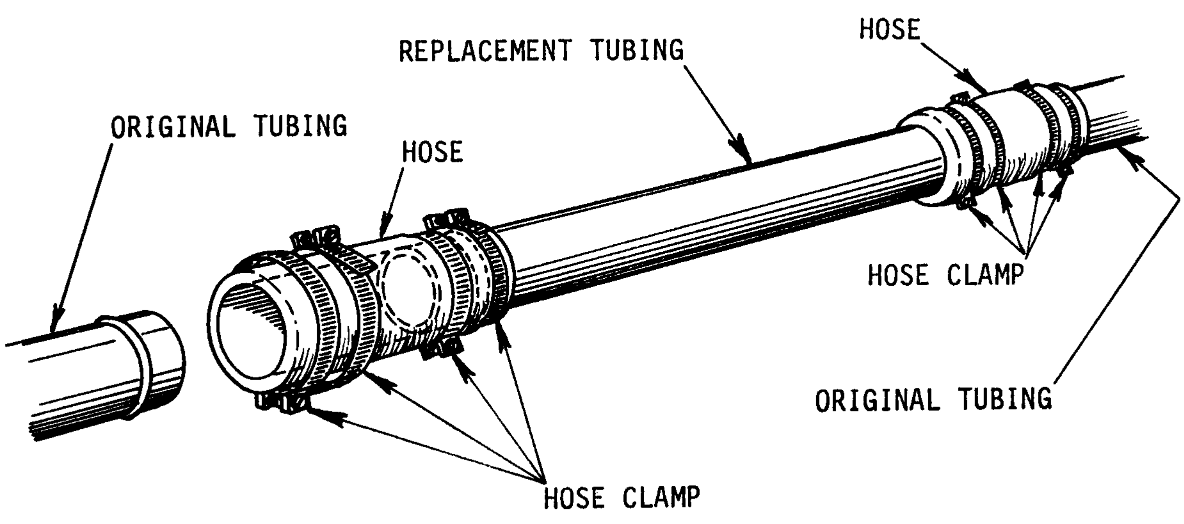



Figure 12-3. Long Replacement Tube Section

5. Slip the hose over both ends of the tube, and secure it with two hose clamps.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

OPTION 2: Patch Metal Tubing.

LIMITATIONS: Inspect after every flight.

PERSONNEL/TIME REQUIRED:
- 1 Soldier
- 1 Hour

MATERIALS/TOOLS REQUIRED:
- Hose or Other Patch Material (item 52 or 116, App. C)
- Sealant (items 123-128,App. C)
- Hose Clamps, Tape, or Wire (items 54-62,153, App. C)

PROCEDURAL STEPS:

1. Use a piece of reinforced hose with an inside diameter equal to the outside diameter of the damaged tube.

2. Split the hose lengthwise.

3. Coat the inside of the tube with sealant.

4. Install the hose over the leak with the split opposite the leak, Figure 12-4.

5. Secure the hose with at least three clamps, the center one directly over the leak.

NOTE

If a rubber hose is not available, use a piece of patch material, rubber (piece of innertube), gasket, or poncho material. If a hose clamp is not available, use tape, lacing wire, or copperware. Check the system fuel level frequently.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

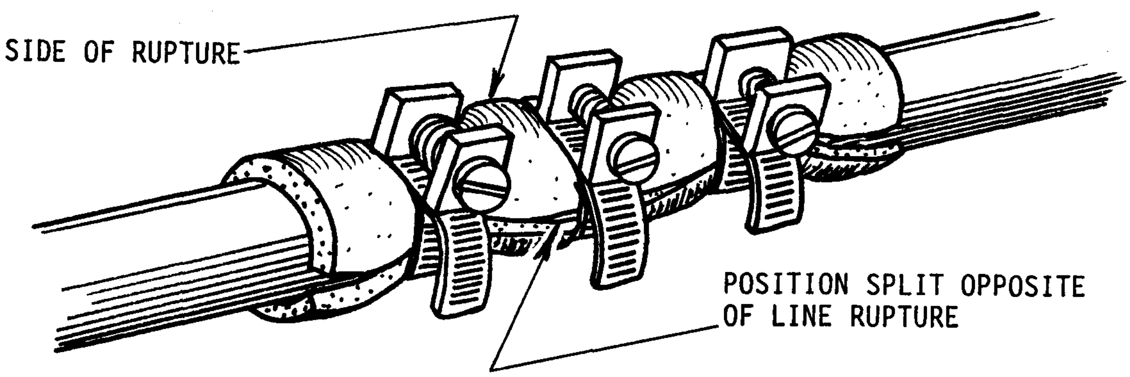



Figure 12-4. Repair of Small Hole in Tube

**OPTION 3:** Manufacture a New Hose. Refer to Chapter 9, repair procedures on installing MS fittings to a hose section.

**OPTION 4:** Replacement of Damaged Hose Section.

**LIMITATIONS:** None.

**PERSONNEL/TIME REQUIRED:**
- 1 soldier
- 30 Minutes

**MATERIAL/TOOLS REQUIRED:**
- Hydraulic Tubing
- Tube Cutter
- Hacksaw
- Hand File
- Safety Wire (items 60-62, App. C)
- Adhesive (items 4-6, App. C)
- Hose Clamps (items 54-59, App. C)
- Tape (items 151-153, App. C)
- String (item 149, App. C)

**PROCEDURAL STEPS:**

1. Cut out the damaged section of the hose. Wrap the hose with tape at the location of intended cuts.

2. Cut each end of the damaged section, take care to make a square cut.

3. Clean loose particles from ends of hose; remove tape.

4. Measure distance between cut ends of damaged hose.

5. Take a piece of tubing with an outside diameter equal to the inside diameter of the hose and cut a length 6 inches longer than the distance measured in step 4, above.

6. Make an improvised bead by wrapping string or safety wire around the tube. (If time permits, coat the string or wire with sealant or hardening epoxy and let it dry.)

7. Position tube inside each end of cut hose, and secure in place with four clamps, Figures 12-5, 12-6.

8. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## Section III. FUEL CELLS

### 12-6. FUEL CELL PATCHING.

**GENERAL INFORMATION:** The fuel cells restrict the catastrophic loss of fuel in survivable crashes. The repairs specified in this section, however, will not necessarily return the cells to their original crash resistant level. Fuel cell damage can be categorized as follows:

a. Non-Repairable:

(1) Damage to tank wall which exceeds 3 inches.

(2) Damage within 2 inches of metal fittings,

b. One-Time or Emergency Flight Capability Repair:

Mechanical Clamp Repair (option 1).

c. 100 Flight Hour Capability Repair:

(1) Adhesive repair (option 2).

(2) Flat panel repair, one plane (option 3).

(3) Two plane repair (option 4).

(4) Three plane repair (option 5).

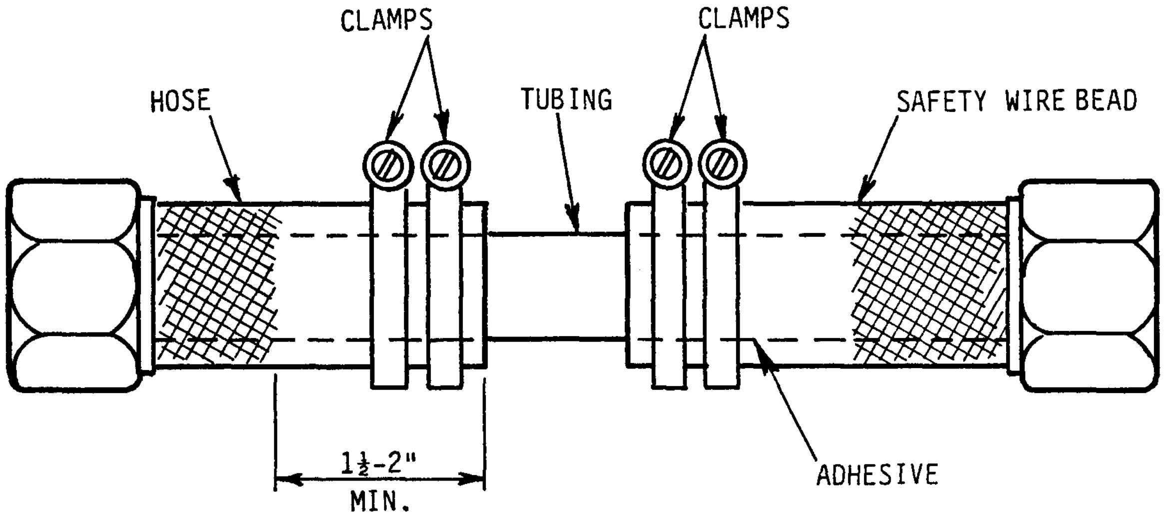



Figure 12-5. Expedient Repair of Damaged Hose

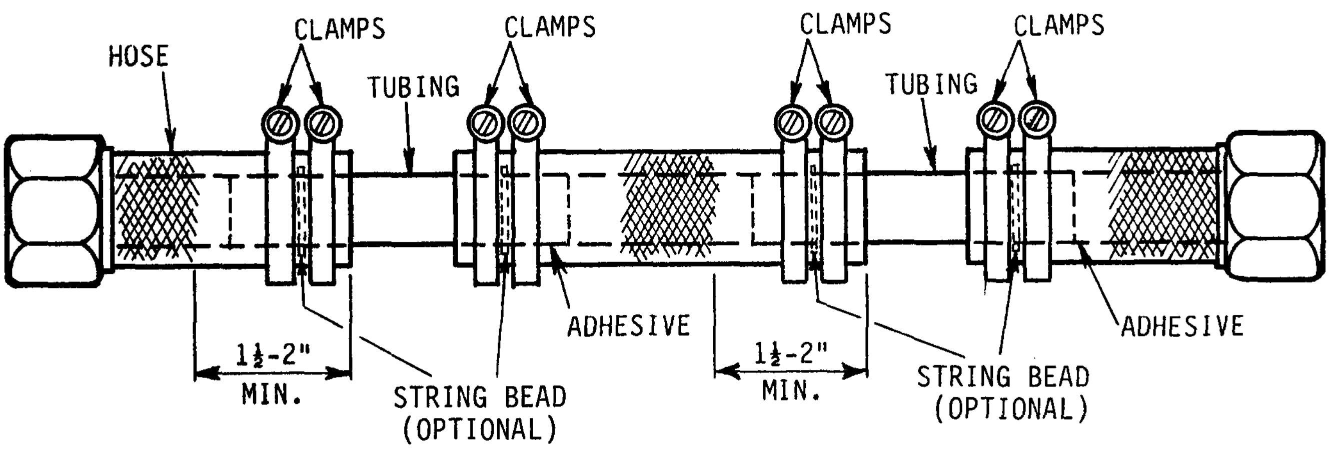



Figure 12-6. Replacement of Damaged Hose Section

**NOTE**

Nonrepairable damage to one fuel cell may be isolated if the other cell is operable or repairable.

**OPTION 1:** Mechanical Clamp Repair.

**LIMITATIONS:** Emergency flight repair.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

**MATERIAL/TOOLS REQUIRED:**
- Fuel Cell Repair Kit (item 5, App. B)
- Sealant (item 125, App. C)

**PROCEDURAL STEPS:**

**CAUTION**

Ground aircraft during defueling and fueling procedures.

1. Defuel aircraft by disconnecting inlet to fuel control and using fuel boost pumps to pump out fuel, Figure 12-7.

2. Locate the damage (i.e., hole or tear) on the cell.

**NOTE**

For holes less than 2 inches across, use the 3 inch clamp. For holes greater than 2 inches across, but less than 3 inches across use the 5 inch clamp. For larger holes consider cell isolation.

3. Use the knife to enlarge the hole 3/4 to 2 inches maximum for a 3 inch clamp and 1 to 3 inches maximum for the 5 inch clamp.

4. Insert the bottom plate of the clamp through the hole and pull up using the cord.

5. Position the plate so the hole is entirely within the gasket area.

6. Slip the top plate over the threaded stud and hand tighten the wing nut. Refer to Figure 12-8.

**CAUTION**

Excessive mechanical tightening of the wing nut can result in failure of the clamp. The wing nut shall be finger tightened and the maximum torque on the wing nut shall not exceed 10 to 12 inch-pounds.

7. Refuel the aircraft.

8. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Adhesive Repair.

**LIMITATIONS:** Inspect after every flight.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Knife
- Solvent (item 7 or 129, App. C)
- Sandpaper (items 118-120, App. C)
- Adhesive (item 5 or 6, App. C)

**PROCEDURAL STEPS:**

1. Defuel the aircraft. Refer to option 1, step 1.

2. Once step 1 (above) has been completed, trim only the outer exposed damage area to provide a reasonably smooth exterior surface. DO NOT ENLARGE HOLE.

3. Abrade and solvent wash the area surrounding the damage using solvent at least 4 inches beyond the damage.

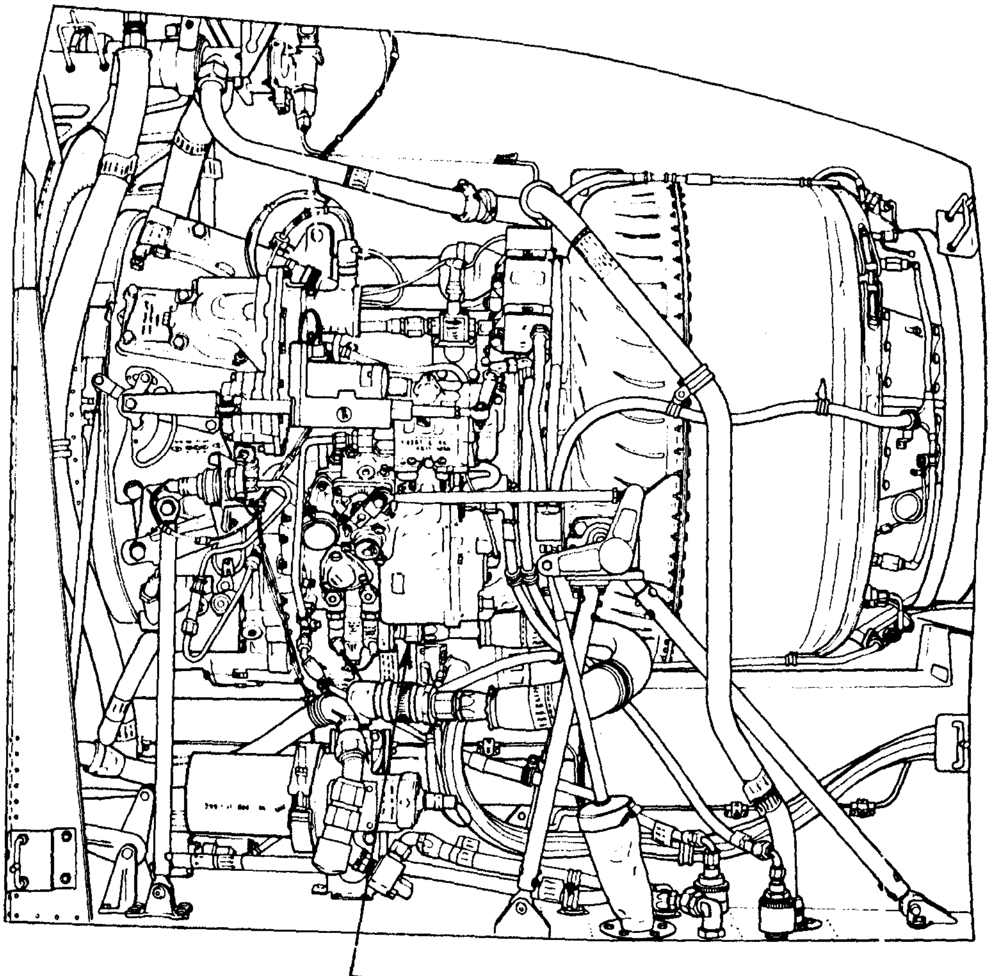



Figure 12-7. Inlet Line to Fuel Control

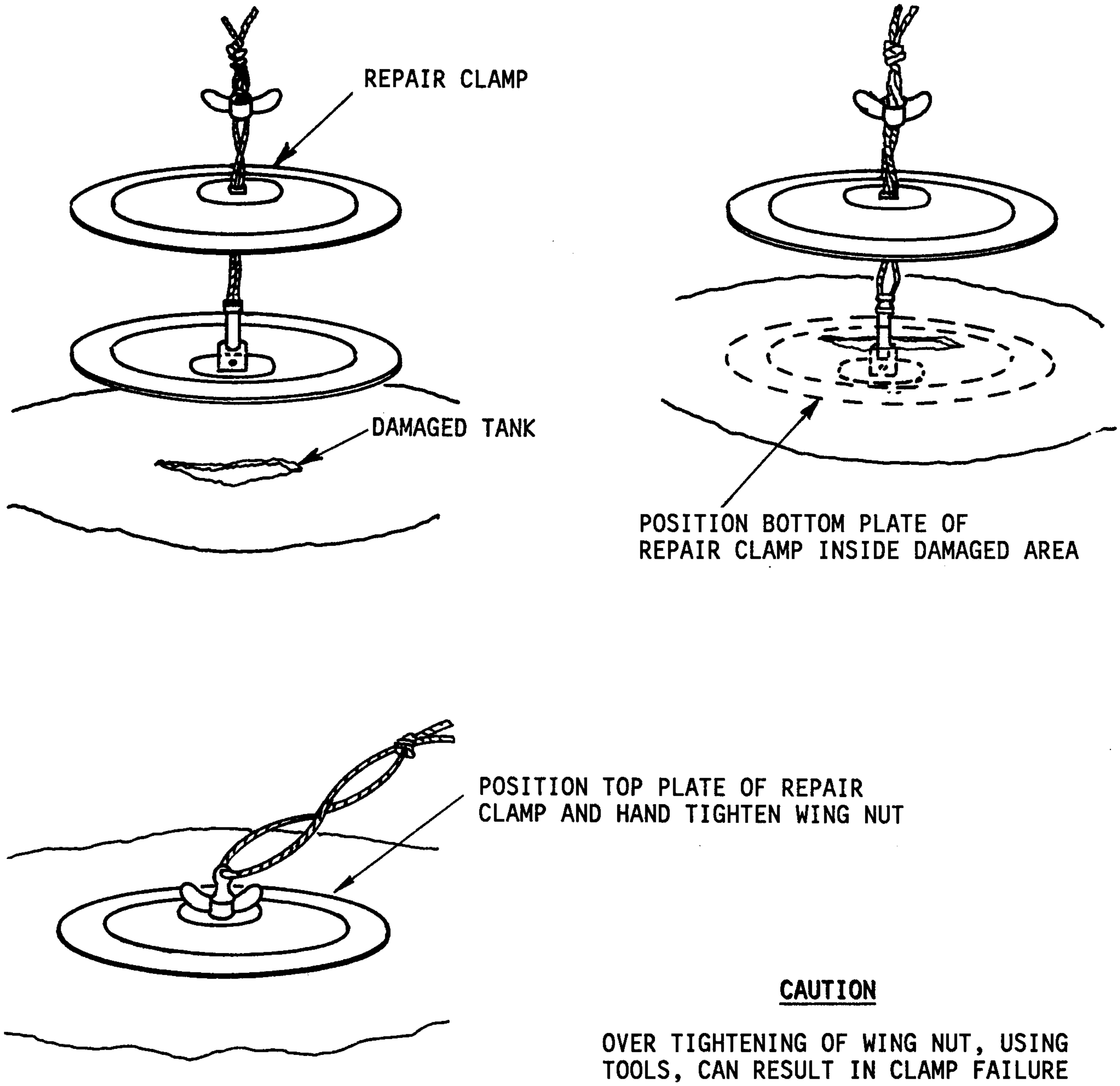



Figure 12-8. Emergency Mechanical Clamp Repair

4. Cut a fabric patch to overlap the damaged area by a minimum of 1 inch all the way around.

5. Soak the patch in solvent. (NOTE: No hole is required in the center of the patch.)

6. Prepare the adhesive.

7. Apply adhesive to the wound opening for at least 1-1/2 inches around the damaged area or enough to accept the patch cut in step 4 (above).

8. Apply and smooth out the applied adhesive and solvent soaked fabric patch to the damaged area.

9. Apply adhesive if required to seal the patch to the tank and smooth out the surface.

CAUTION

The patch will tend to slip when applying additional adhesive and smoothing. Be sure to recenter the patch.

10. Maintain the patch position until the adhesive sufficiently sets. (NOTE: Allow the adhesive to cure before refueling.)

11. Refuel the aircraft.

12. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

OPTION 3: Flat Panel Repair (One

LIMITATIONS: Inspect after every flight.

PERSONNEL/TIME REQUIRED:
1 Soldier
3 Hours

MATERIALS/TOOLS REQUIRED:
- Knife or Scissors
- Solvent (item 7 or 129, Appx C)
- Sandpaper (items 118-120, Appx C)
- Fuel Cell Repair Kit (item 5, Appx B)

PROCEDURAL STEPS:

1. Defuel the aircraft. Refer to option 1, step 1.

2. Once step 1 of this section has been completed, enlarge the wound in the tank to no more than 3 inches in diameter by using a knife or scissors. Remove all frayed fabric and damaged inner lines.

3. Abrade the inner lines or inner surface at least 1/2 inch beyond the enlarged hole, preferably more if conditions permit.

4. Abrade the outer surface to a minimum of 4 inches from the enlarged area. (NOTE: If the fraying fibers are too-numerous, retrim the fiber with scissors.)

5. Clean the abraded areas using towels soaked in solvent.

6. Cut a fabric patch 4 inches in diameter or large enough to extend at least 1 inch beyond the damaged area and add a 1/2 inch hole in the center.

7. Soak the patch in solvent.

8. Prepare the adhesive.

9. Apply adhesive to inner liner using finger to swab cement around the wound.

10. Apply adhesive to concave surface of the rubber plug (this is the surface the cord is attached to). Refer to Figure 12-9 for rubber plug assembly.

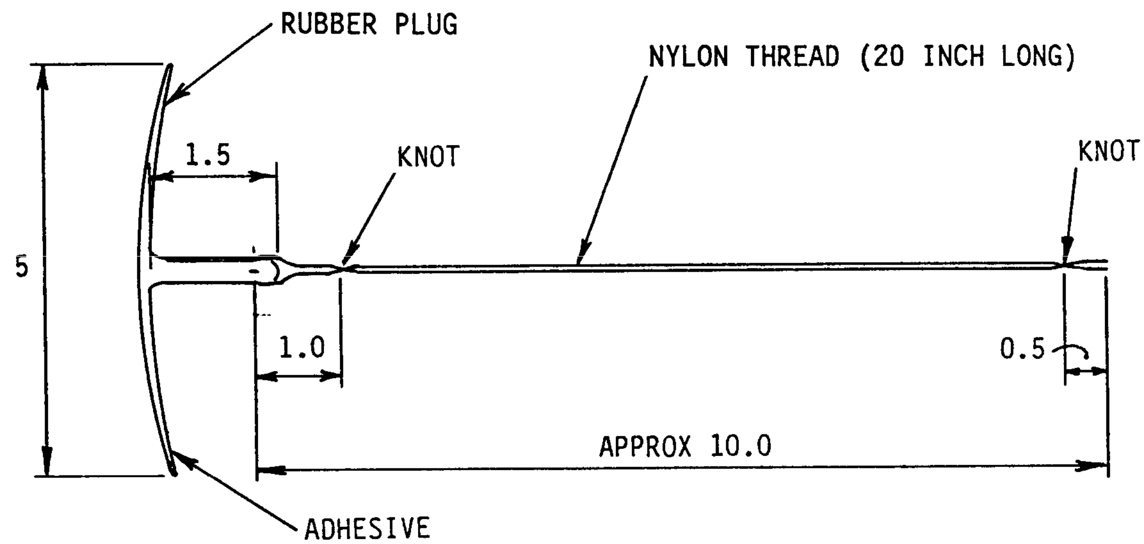



**Figure 12-9. Rubber Repair Plug Assembly**

NOTE

Use adhesive as required, retain some for finishing the outside of the cell repair.

11. Fold the rubber plug and insert it through the hole in the cell. (NOTE: Retain cord to prevent loss of plug in the cell.)

12. Pull the plug into position and rotate it in position to smooth out the adhesive interface.

13. Center the plug on the wound.

14. Apply a layer of adhesive 4 inches in diameter around the wound on the outside and fill in the wound with adhesive (There must be a minimum of a 1/2 inch bond.)

15. Apply the solvent soaked fabric patch to the outside surface by passing the cord through the hole in the patch- and position the patch over the wound.

16. Smooth the patch into the adhesive.

17. Pull the cord and tape to the structure keeping a slight tension.

18. Do not disturb the repair for a minimum of 30 minutes and let cure two hours before refueling.

19. Cut the string and plug stem without distributing the repair.

20. Refuel the aircraft.

21. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/system using standard maintenance procedures.

OPTION 4: Two Plane Repair. Damage to a two plane area will be repaired in the same manner described in OPTION 3 except the hole should not be enlarged to more than 1/2 by 2-1/2 inches.

OPTION 5: Three Plane (Corner) Repair. Damage to a three plane area will be repaired in the same manner as described in OPTION 3 except the hole should not be enlarged to more than 1/2 by 2-1/2 inches and the rubber plug will be cut as shown in Figure 12-10. This will allow the plug to assume the contour of the tank when pulled into place.

## 12-7. AFT FUEL CELL ISOLATION.

GENERAL INFORMATION: If battle damage to the aft fuel cell is too severe to repair, alterations can be made to the system to isolate the damaged aft cell from the fuel system. The forward fuel cell will become the sole fuel reservoir for the aircraft.

OPTION: Isolate Fuel Cell.

LIMITATIONS:

1. The aircraft center of gravity will be changed after the removal of the aft fuel cell. The aircraft will be nose heavy.

CAUTION

Weight and balance consideration: forward cell capacity 143 gallons, located at FS 173.

2. The fuel supply will be one-half of the normal supply which results in less flight time.

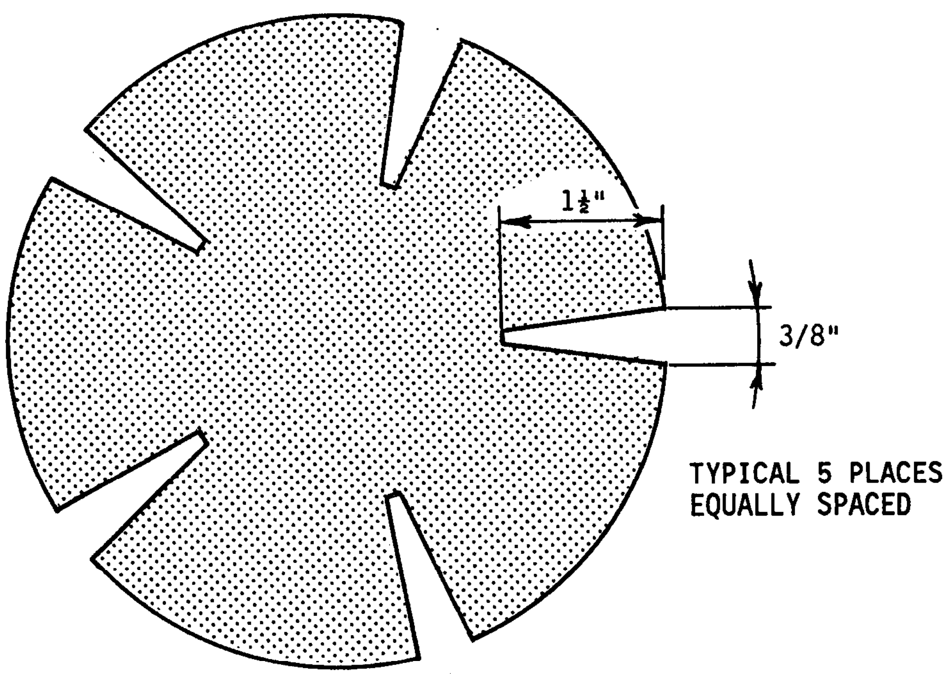



Figure 12-10. Plug Modification for Three Plane (Corner) Repair

3. No more than one-half of the rounds on the 20mm turret gun can be carried with a full forward cell.

**PERSONNEL/TIME REQUIRED:**

- 2 Soldiers
- 3 Hours

**MATERIALS/TOOLS REQUIRED:**

- Knife or Scissors
- Plywood or Sheet Metal (items 136-138, App. C)
- Drill Bit – 1/4 in. and Drill Motor
- Ten 1/4 in. nuts (items 63-70, App. C)
- Ten 1/4 in. washers (item 168 or 169, App. C)
- Ten 1/4 in. bolts
- Sealant (items 123-128, App. C)
- Gasket Material (item 52, App. C)

**PROCEDURAL STEPS:**

1. Defuel the aircraft. Refer to option 1, step 1.

2. Remove the right and left side access panels (1, Figure 12-1 1) to gain access to the crossover line (14, Figure 12-1 ). (Either panel will give access to the crossover line; however, having both panels open will make working easier.)

3. Remove the ten bolts which connect the aft end flange of the crossover line to the aft fuel cell and detach the aft end of the crossover line from the aft cell.

4. Gain access to the damaged aft cell. A damage hole opening on the fuel cell panel may be used as an access port.

5. Cut out a section of the rubber material that the fuel cells are constructed of. Cut the section of fuel cell material to the shape of the crossover line flange use template, Figure 12-12.

6. Drill ten bolt holes on the cutout section as shown on the template. These bolt holes are to match the ten bolt holes on the crossover line flange. This part will be used as a gasket.

7. Obtain a piece of thick sheet metal, plywood, or some other solid plate and cut out two plates to the shape of the cutout made in step 5.

8. Drill ten bolt holes on each of these plates to match those made on the cutout section in step 5.

9. Obtain ten 1/4 inch nuts, washers, and bolts.

10. Place the cell material plate cutout in step 5 and one of the rigid plates cutout in step 7 against the crossover flange to block off the crossover line.

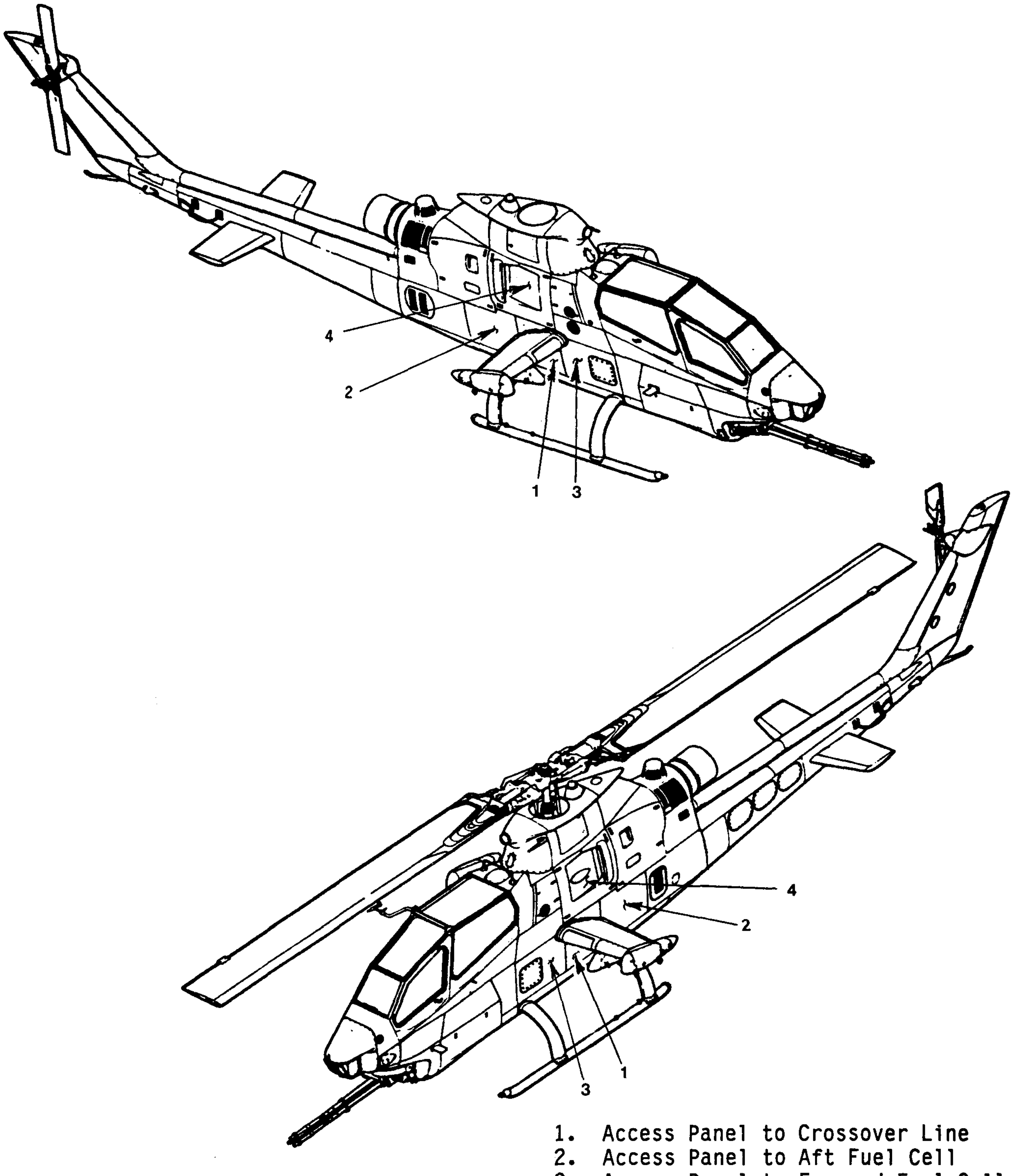
11. Bolt the pieces together using the bolts, washers, and nuts. Refer to Figure 12-13.

12. If available, apply a bead of sealant around the flange assembly and over the bolts.

13. Place the other rigid plate cut out in step 5 against the aft fuel cell opening which is where the crossover line was previously attached.

14. Bolt or seal in place. (This will help to isolate the fuel vapors in the empty fuel compartment and reduce the amount of fuel vapors escaping into the aircraft.)

15. Disconnect and remove the hose assembly (1, Figure 12-14) from the check valve fuel manifold (2).




1. Access Panel to Crossover Line
2. Access Panel to Aft Fuel Cell
3. Access Panel to Forward Fuel Cell
4. Transmission Cowl Assembly Panel

Figure 12-11. Aft Cell Isolation Access Panels

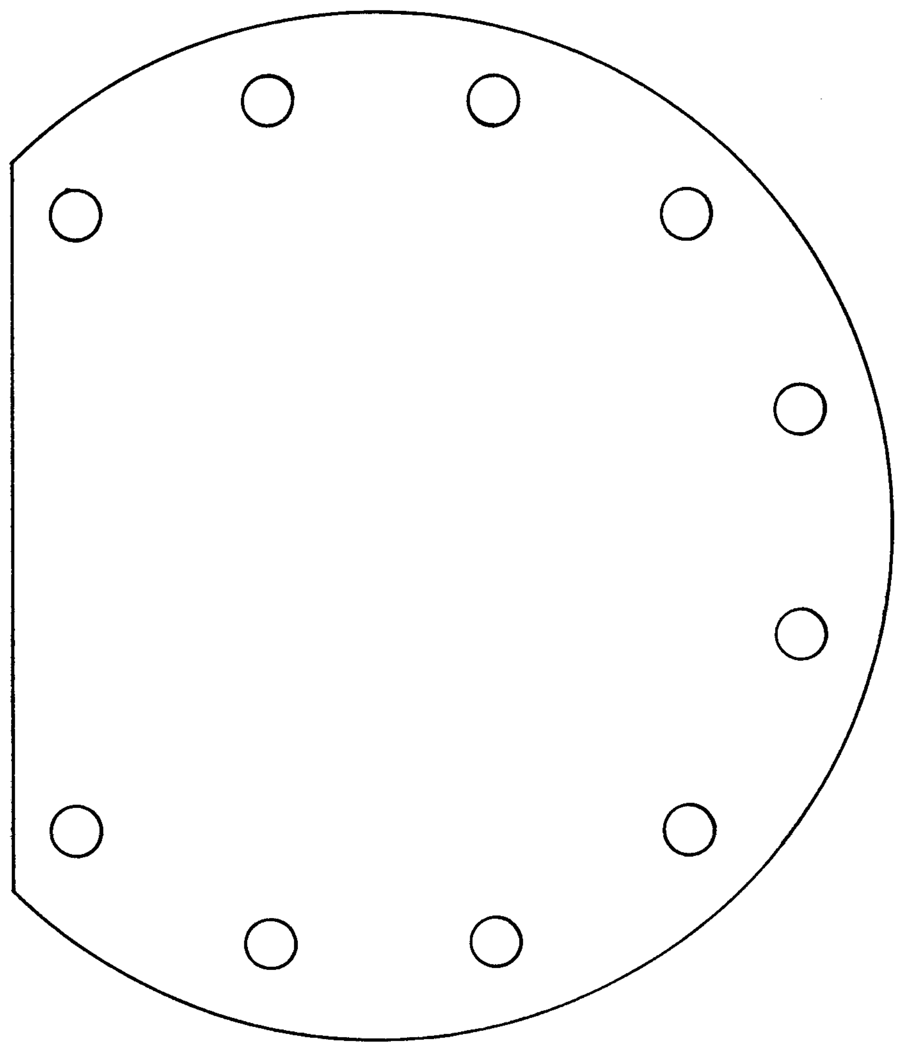
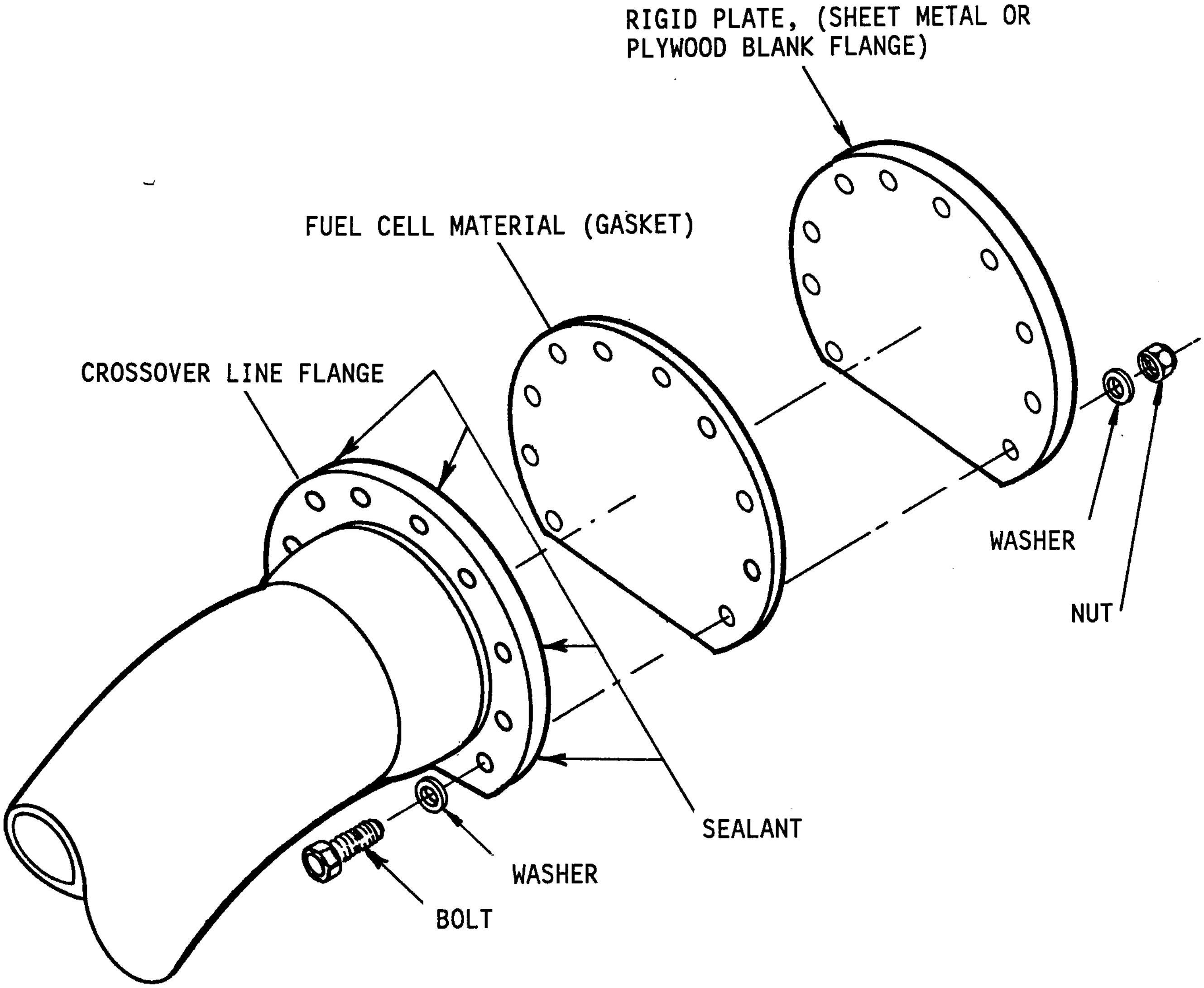


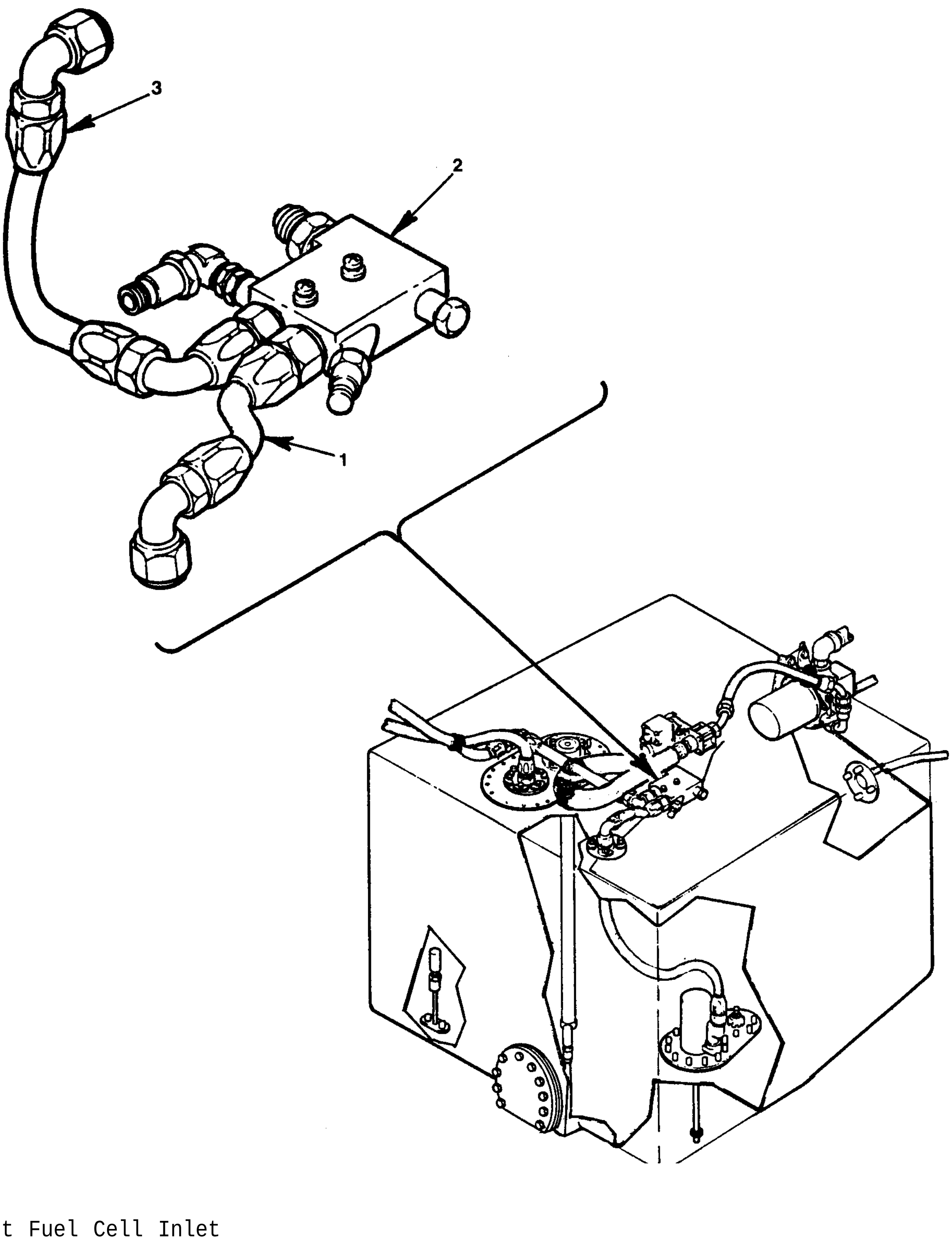
Figure 12-12. Crossover Line Flange Template




NOTE

IF AVAILABLE, APPLY A BEAD OF SEALANT AROUND FLANGE AND OVER BOLTS.

Figure 12-13. Blocked Off Crossover Line




1. Aft Fuel Cell Inlet
2. Fuel Manifold
3. Forward Fuel Cell Inlet

Figure 12-14. Fuel Manifold

16. Disconnect the aft end of the elbow which connects to the fuel cell then disconnect the fitting which attaches to the manifold. The fuel control linkage (not shown) and the pressure switch connections (5, Figure 12-1 ) may need to be removed to allow access.

17. OPTIONAL - Cap off the check valve fuel manifold with a 3/4 inch cap fitting. (The cap fitting is attached where the hose assembly, removed in step 13, previously connected.)

**NOTE**

Turn off circuit breaker for aft fuel boost pump. Aft boost pump light will illuminate when breaker is switched off. Ignore the light or disable segment by removing lamps.

18. Reinstall the panels (1, Figure 12-11) removed in step 2.

19. Refuel the aircraft. Only the forward cell will contain fuel.

20. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**12-8. FORWARD FUEL CELL ISOLATION.**

**GENERAL INFORMATION:** If the battle damage to the forward fuel cell is too severe to repair, alterations can be made to the system to isolate the damaged forward fuel cell from the fuel system. The aft fuel cell will become the sole fuel reservoir for the aircraft.

**OPTION:** Isolate Fuel Cell.

**LIMITATIONS:**

1. The aircraft center of gravity will be changed after the removal of the forward fuel cell. The aircraft will be tail heavy.

**NOTE**

Weight and balance consideration: aft fuel cell capacity 117 gallons, located at FS 230.

2. The fuel supply will be one-half of the normal supply, which results in less flight time.

**PERSONNEL/TIME REQUIRED:**
- 2 Soldiers
- 3 Hours

**MATERIALS/TOOLS REQUIRED:**
- Knife or Scissors
- Plywood or Sheet Metal (items 136-138, App. C)
- Drill Bit - 1/4 in. and Drill Motor
- Ten 1/4 in. Nuts (items 63-70, App. C)
- Ten 1/4 in. Washers (item 168 or 169, App. C)
- Ten 1/4 Bolts (items 8-24, App. C)
- Sealant (items 123-128, App.C)
- Gasket Material (item 52, App.C)

**PROCEDURAL STEPS:**

1. Defuel the aircraft. Refer to option 1, step 1.

2. Remove the right and left side access panels (1, Figure 12-11) to gain access to the crossover line (14, Figure 12-1). (Either panel will give access to the crossover line; however, having both panels open will make working easier.)

3. Remove the ten bolts which connect the aft end flange of the crossover line to the aft fuel cell and detach the aft end of the crossover line from the aft cell. DO NOT discard bolts, they will be used later.

4. Gain access to the damaged forward fuel cell. A damage hole opening on the fuel cell panel may be used as an access port.

5. Cut out a section of the fiberous rubber material that the fuel cells are constructed of. Cut the section of fuel cell material to the shape of the crossover line flange, see template, Figure 12-12.

6. Drill ten bolt holes on the cutout section, as shown on the template. These bolt holes are to match the ten bolt holes on the crossover line flange.

7. Obtain a piece of sheet metal, plywood, or some other solid plate and cut out two plates to the shape of the cutout made in step 5.

8. Drill ten bolt holes on each of these plates to match those made on the cutout section in step 5.

9. Obtain ten 1/4 inch nuts, washers, and bolts (bolts removed in step 3 should be used), and place the cell material plate cutout in step 5 and one of the rigid plates cutout in step 7 against the aft fuel cell flange, which had previously been used to connect with the flange of the crossover line, see Figure 12-15.

10. Bolt the assembly together as shown.

11. If available, apply a bead of sealant around the flange assembly and over the bolts.

12. Place the other rigid plate cutout in step 7 against the fuel cell opening, which is where the crossover line was previously attached and bolt or seal in place. This will help to isolate the fuel vapors in the empty fuel compartment and reduce the amount of fuel vapor escaping into the aircraft.

13. Block off the check valve fuel manifold (2, Figure 12-14) by disconnecting fitting (3).

14. OPTIONAL - Cap off the check valve fuel manifold with a 3/4 inch cap fitting. (The cap fitting is attached where the hose assembly, removed in step 12, previously connected.)

NOTE

Turn off circuit breaker for forward boost pump. Forward boost pump light will illuminate when breaker is switched off. Ignore light.

15. Reinstall the panels (1, Figure 12-11) removed in step 2.

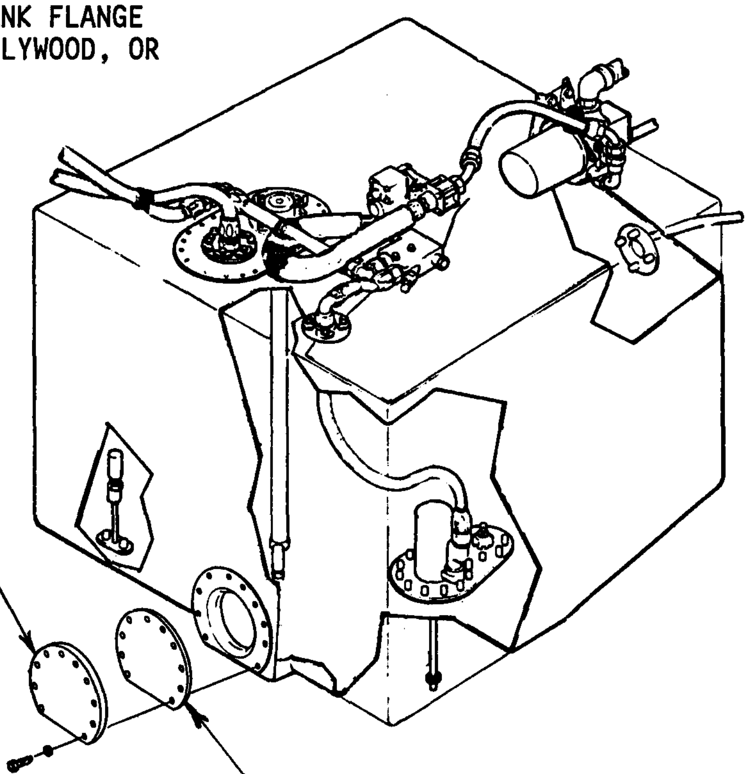
16. Refuel the aft fuel cell by the following procedure:

a. Open the transmission cowl assembly panel (4, Figure 12-11).

b. Remove the floor baffle panel by removing all screws and fasteners which attach to it (Figure 12-16). (The tube assembly going through baffle panel will have to be disconnected as indicated.)

NOTE

Label electrical connectors before removal to assure correct reassembly.




**NOTE**

IF AVAILABLE, APPLY A BEAD OF SEALANT AROUND THE FACE OF THE FLANGE AND OVER THE BOLTS.

Figure 12-15. Blocked Off Fuel Cell

c. Remove the four bolts and the two electrical connectors, which attach the fuel quantity probe (6, Figure 12-1 ) to the aft fuel cell. DO NOT discard probe cap, bolts, or o-ring (1 through 3, Figure 12-17).

d. Remove the fuel quantity probe by gently lifting the probe cap up and out as necessary.

e. Refuel the aircraft by pouring in fuel to the aft cell through the opening provided.

**NOTE**

Close circuit refueling is not possible through this opening.

f. Once the cell has been refueled, replace the probe cap with o-ring attached and reconnect the electrical leads.

16. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## Section IV. FUEL BOOST PUMPS

### 12-9. GENERAL.

a. Each of the two fuel cells has an electrically operated boost pump which feeds fuel into the fuel manifold. The fuel then goes through a shutoff valve and through the engine driven fuel pump.

b. If one or both of the fuel boost pumps becomes inoperable, the engine can still operate on the engine driven pump provided that the boost pump damage is not causing any fuel leakage and that the helicopter not fly above 4600 feet altitude. If the engine driven pump should fail, regardless of whether or not the boost pumps are still functioning, the helicopter is not operable until the engine driven pump is repaired or replaced.

## Section V. FUEL FILTERS

### 12-10. EXTERNAL FUEL FILTER CLOGGED.

The first indication of a clogged or frozen fuel filter will be a failure of the engine to start or degraded performance because of insufficient fuel. Use this procedure if a replacement fuel filter is not available.

**OPTION 1:** Clean Filter.

**LIMITATIONS:** None

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Compressed Air Source
- Common Hand Tools
- Solvent (item 7 or 129, App. C)
- Towels (item 161, App. C)

**PROCEDURAL STEPS:**

1. Open the left engine access panel to gain access to the external fuel filter, Figure 12-18.

2. Remove filter sump bowl, along with filter element (3 and 5, Figure 12-18), from the fuel filter assembly.

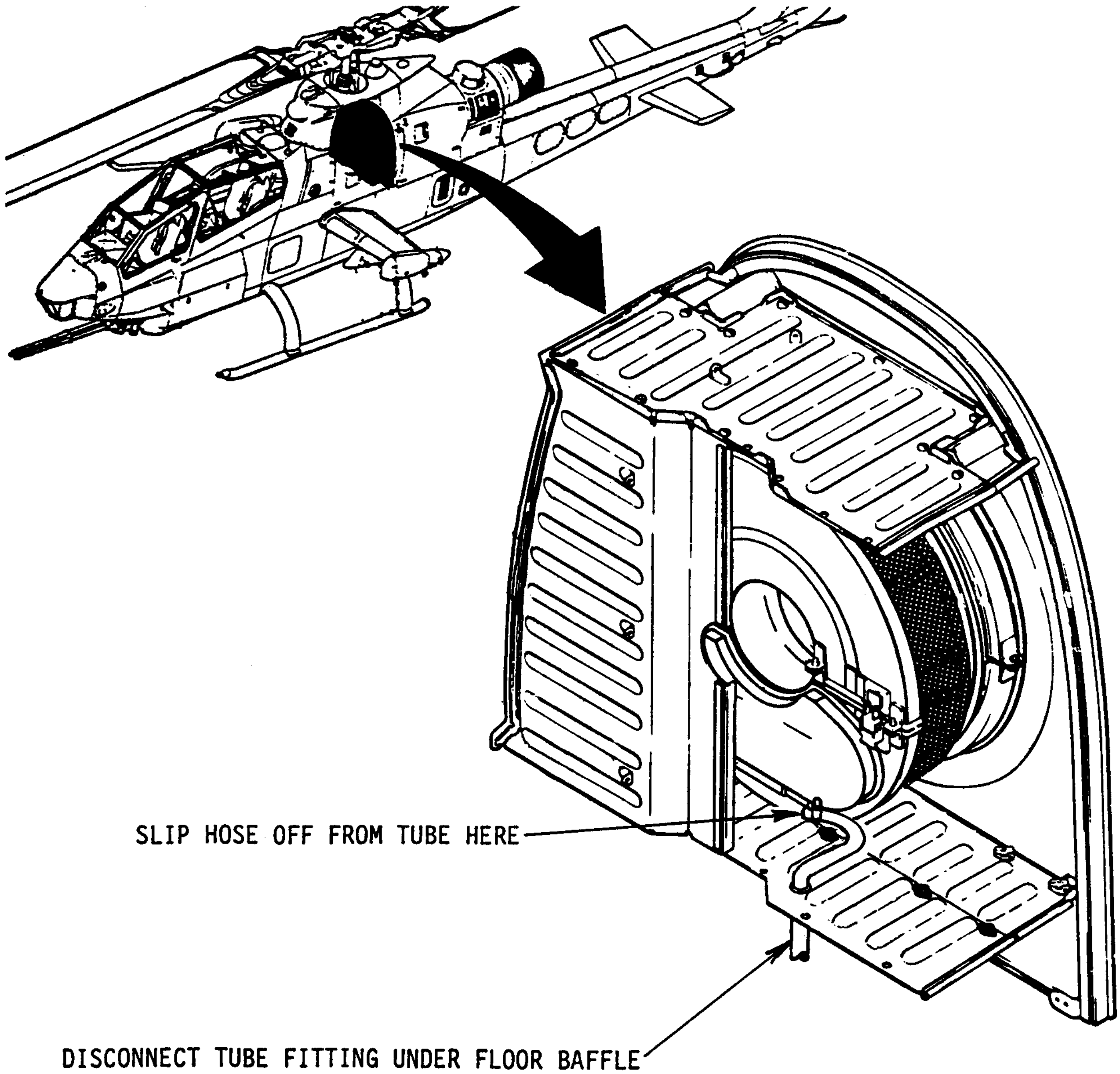
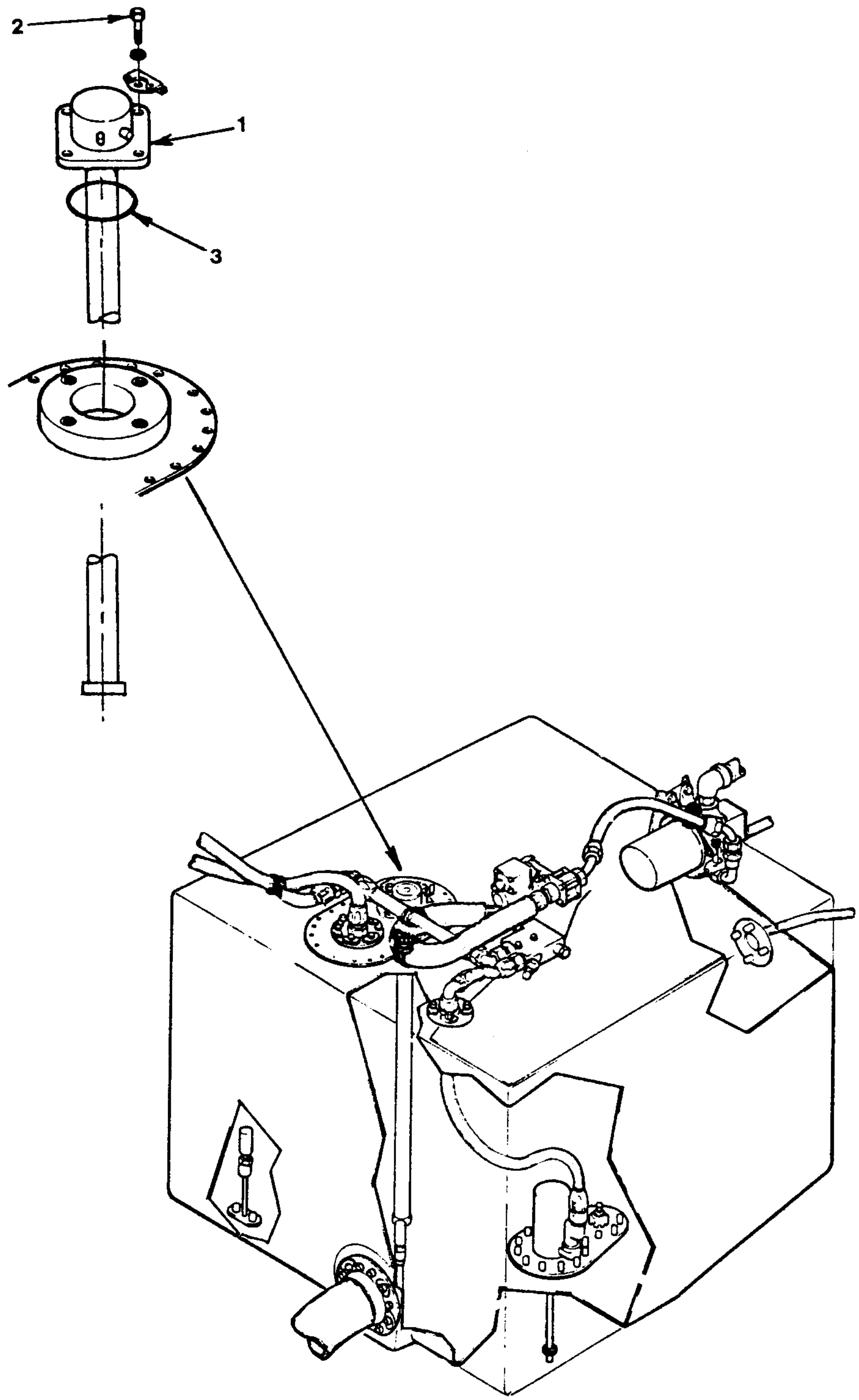



Figure 12-16. Floor Baffle Assembly




1. Probe Cap
2. Bolt
3. O-Ring

Figure 12-17. Fuel Quantity Probe; Fuel Inlet

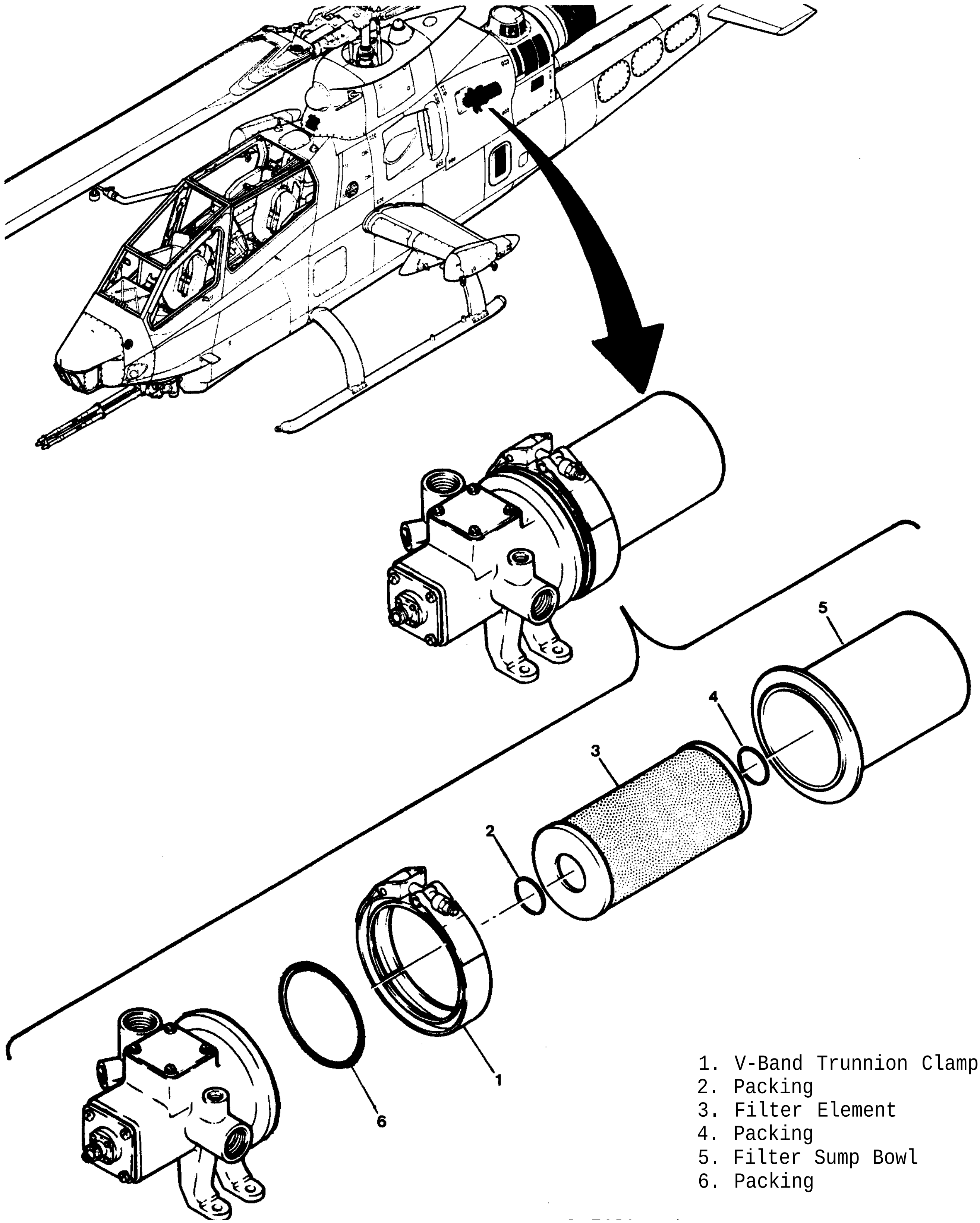



Figure 12-18. External Fuel Filter Assembly

3. Blow dirt out of filter element using compressed air. If frozen, thaw out first then proceed to blow dirt out using compressed air.

4. Place filter element back inside of filter sump bowl and reinstall back onto the filter assembly.

5. Start engine.

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**12-11. FUEL FILTER BYPASS.**

**GENERAL INFORMATION:** If the main filter is bypassed, filtering of fuel will be accomplished by strainers inside the engine fuel control. However, the strainer will clog and require frequent cleaning if the fuel is heavily contaminated.

**OPTION 1:** Bypass Filter.

**LIMITATIONS:** Possible fuel control clogging if filter is by passed.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

**MATERIAL/TOOLS REQUIRED:**
- Common Hand Tools
- Towels (item 161, App. C)

**PROCEDURAL STEPS:**

1. Open the left engine access panel to gain access to external fuel filter, Figure 12-18.

2. Remove filter sump bowl along with filter element (3 and 5, Figure 12-18).

3. Remove filter element from filter sump bowl, and reinstall filter sump bowl without the filter element back into the filter assembly.

4. Start engine.

5. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Ballistic Damage, Bowl Perforated Bypass.

**LIMITATIONS:** Possible fuel control clogging if filter is bypassed.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Common Hand Tools

**PROCEDURAL STEPS:**

1. Open left engine access panel to gain access to external fuel filter, Figure 12-18.

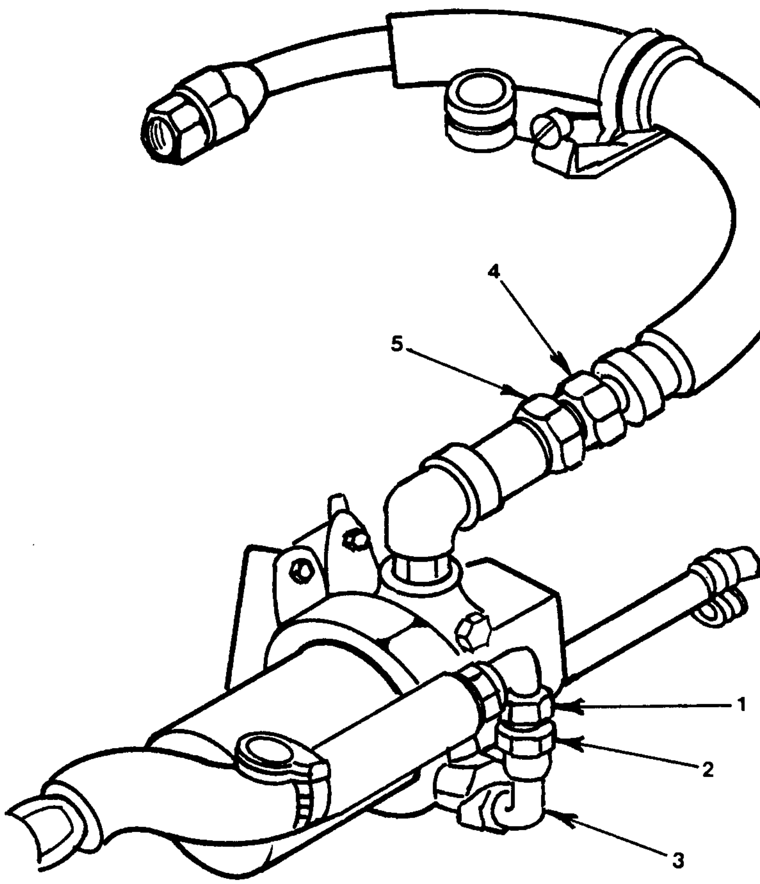
2. Disconnect hose fitting (1, Figure 12-19) from breakaway fitting (2).

3. Loosen and remove the four mounts that attach the filter assembly to the bracket and gently lift upon the filter assembly just enough to provide enough deck clearance to remove the elbow (3) and breakaway fitting (2) from the filter assembly. Do not remove breakaway fitting from elbow.

4. Disconnect hose fitting (4) from coupling assembly (5).

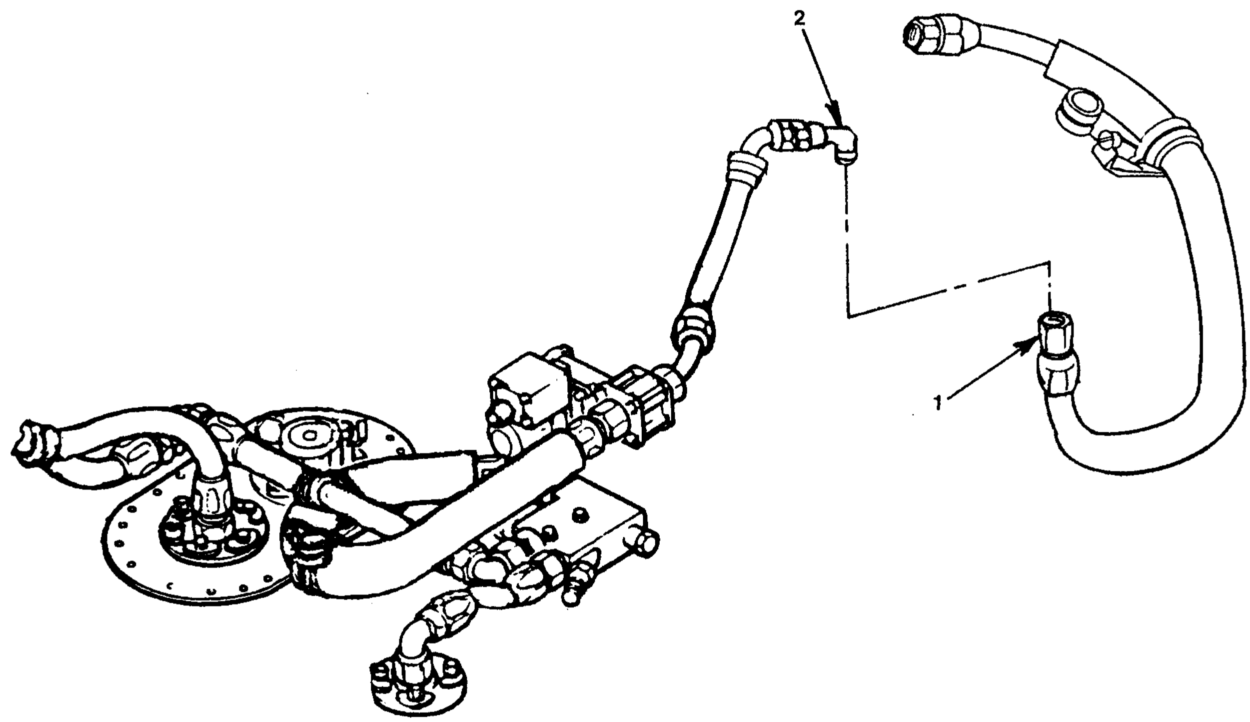
5. Bypass the filter assembly by connecting hose fitting (1, Figure 12-20; also 4, Figure 12-19) to elbow fitting (2, Figure 12-20; also 3, Figure 12-19).

6. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.




1. Hose Fitting
2. Breakaway Fitting
3. Elbow Fitting
4. Hose Fitting
5. Coupling Assembly

Figure 12-19. External Fuel Filter




1. Hose Fitting
2. Elbow Fitting

Figure 12-20. Bypassing External Fuel Filter

# CHAPTER 13

# FLIGHT CONTROLS 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

13-1. SCOPE. This chapter contains the fault assessment and expedient repair procedures for locating and fixing damage to the flight control system. The system is depicted in Figures 13-1 and 13-2.

13-2. ASSESSMENT PROCEDURES. There are various subsystems and assemblies within the flight control system that are vital for combat maneuverability and control, but are not necessarily essential for basic flight capabilities. Refer to Table 13-1 for assessment logic chart.

a. Stability Control and Augmentation System (SCAS). If the entire SCAS or a particular phase of the SCAS is inoperable, it may be bypassed and the aircraft will still be flyable but with the following limitations:

(1) The aircraft speed should not exceed 100 knots.

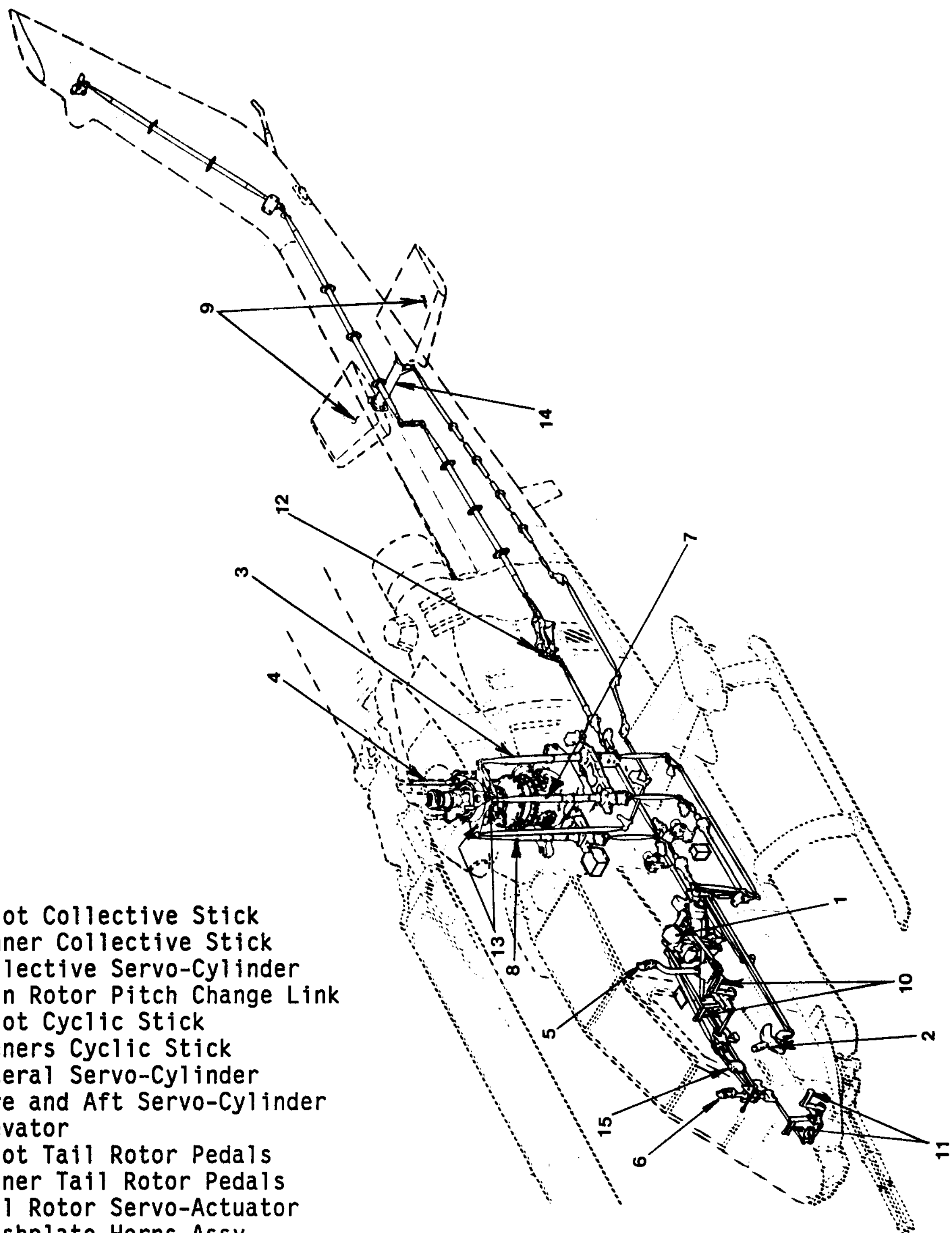
(2) The aircraft armament should not be used.

b. Force Trim System. If the force trim system is malfunctioning, the aircraft is still fully mission capable with no limitation presented.

c. Control Rods. If any control rods, bell-cranks, or linkages connecting gunner controls to pilot controls break or otherwise become inoperable, pilot may assume full control for the particular function which has been damaged, provided that the damaged part does not become jammed in the surrounding aircraft structure. Once the aircraft is on the ground, if no replacement parts are available, damaged control tube may be splice repaired or removed to avoid any possibility of the control tube getting jammed. If the tube is removed, the pilot assumes full control of the function that has been lost to the gunner.

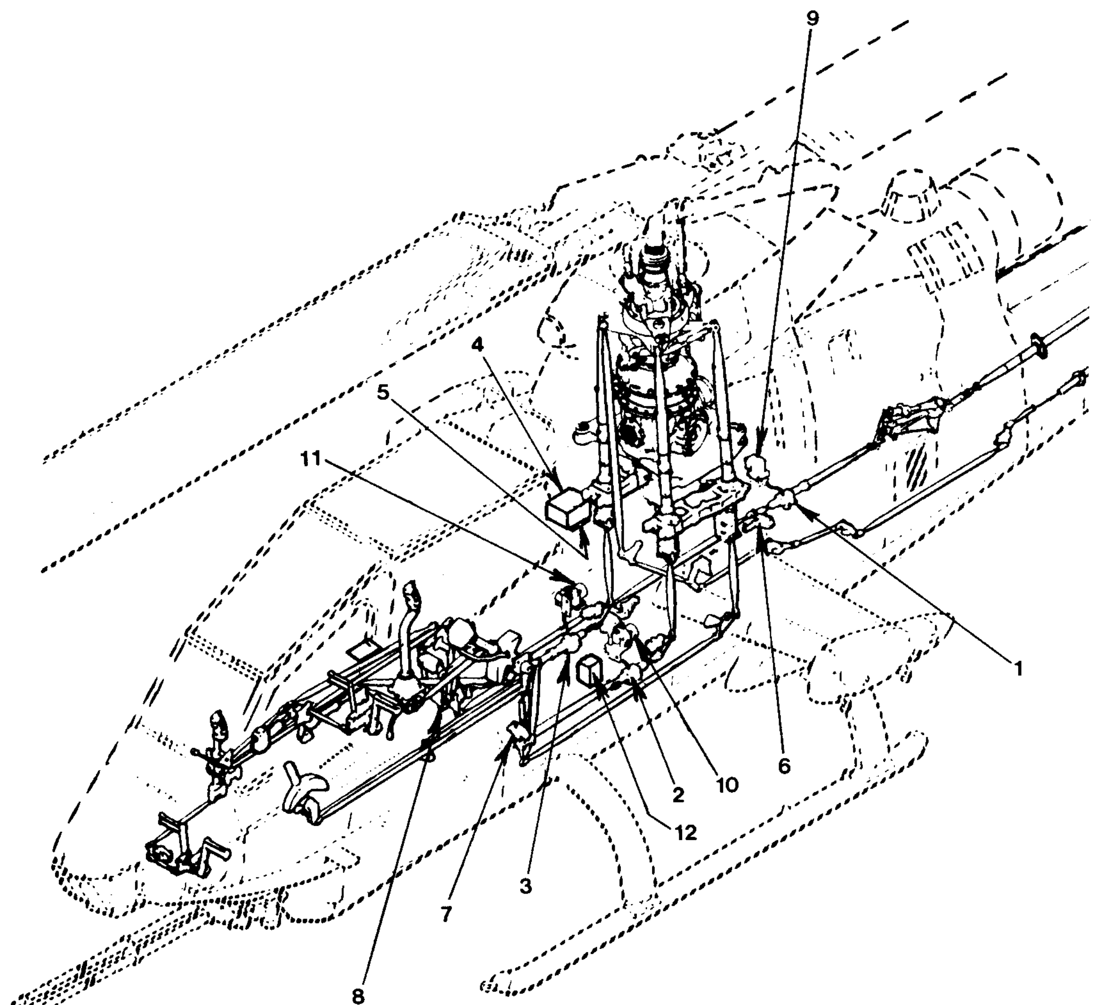
If the Armament Compensator Unit (ACU) is not functioning properly, the aircraft is still flyable; however, the armament is not to be used.

13-3. REPAIR PROCEDURE INDEX.




1. Pilot Collective Stick
2. Gunner Collective Stick
3. Collective Servo-Cylinder
4. Main Rotor Pitch Change Link
5. Pilot Cyclic Stick
6. Gunners Cyclic Stick
7. Lateral Servo-Cylinder
8. Fore and Aft Servo-Cylinder
9. Elevator
10. Pilot Tail Rotor Pedals
11. Gunner Tail Rotor Pedals
12. Tail Rotor Servo-Actuator
13. Swashplate Horns Assy
14. Elevator Horn Assy
15. Force Trim Magnetic Brake

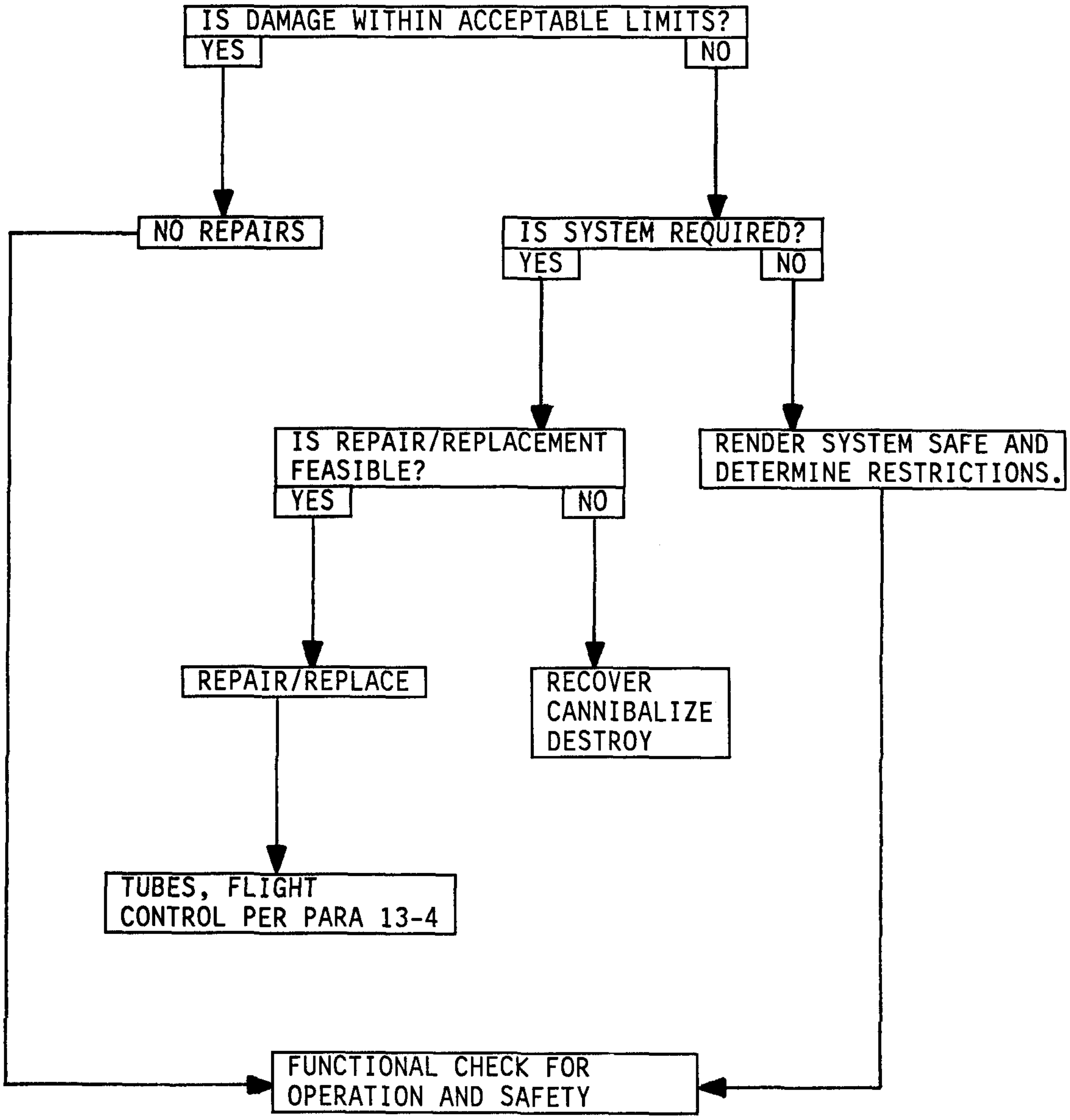
Figure 13-1. Flight Controls




1. Yaw Servo-Actuator
2. Roll Servo-Actuator
3. Pitch Servo-Actuator
4. Sensor Amplifier Unit
5. Three-Axis Rate Sensor
6. Yaw Control Motion Transducer
7. Roll Control Motion Transducer
8. Pitch Control Motion Transducer
9. Yaw Hydraulic Solenoid Valve
10. Roll Hydraulic Solenoid Valve
11. Pitch Hydraulic Solenoid Valve
12. Armament Compensation Unit

Figure 13-2. Stability and Control Augmentation System (SCAS)

Table 13-1. Flight Control System Assessment Procedures



## Section II. FLIGHT CONTROL TUBES

### 13-4. SEVERED OR BENT CONTROL TUBES.

**GENERAL INFORMATION.**

**WARNING**

The standards contained herein allow aircraft to be flown with battle damage substantially in excess of peacetime limits. Under no cirumstances shall this manual be used entirely or in part for peacetime maintenance of the aircraft. Repair of flight control damage requires extreme care and diligence and strict adherence to the instructions and standards contained in this manual.

a. The following repair procedures maybe used to accomplish repairs to flight control tubes. Flight control tubes connect the gunner's and pilot's cyclic, collective, and tail rotor controls to the aft flight control components. See Figure 13-1 for a complete detail of the system and refer to Figures 13-3 through 13-6 for a complete detail on each individual tube, see Table 13-1.

b. Make all necessary repairs on all flight control tubes by splicing. Insure that splice repairs do not cause any interference at bulk-head lighting holes or adjacent components.

**OPTION 1:** Splice Control Tube.

**LIMITATIONS:** Inspect after every flight.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 2 Hours

**MATERIALS/TOOLS REQUIRED:**
- Metal Sleeve
- Angle Stock (items 35-47, App. C)
- Fasteners (items 7-24,63-70, 98-115, App. C)
- Cotter Pins (item 35, App. C)

**PROCEDURAL STEPS:**

1. Measure center to center distance between rod ends or clevis eye bolts before removing damaged control tube. This step will allow repaired tube length to be matched to original, eliminating the need to re-rig flight controls. If damage has completely severed original tube, center to center distance may be determined using Table 13-2.

2. Disconnect and remove damaged control tube from aircraft.

3. Trim damaged area.

4. Using Table 13-2 and Figures 13-3 through 13-6, select a metal splice either inner or outer, whichever is more suitable.

5. Drill at least two bolt/rivet holes on each end of the tube, see Table 13-3. Holes should go through the splicer and the damaged tube and should be positioned in a cross pattern. Refer to Figure 13-7. Make sure that the original center to center, Length b, Table 13-2 is maintained.

6. Reinstall tube after repair is accomplished, and check for binding or interference by manually moving the appropriate controls: cyclic, collective, or pedals.

7. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Fabricate Flight Control Tube.

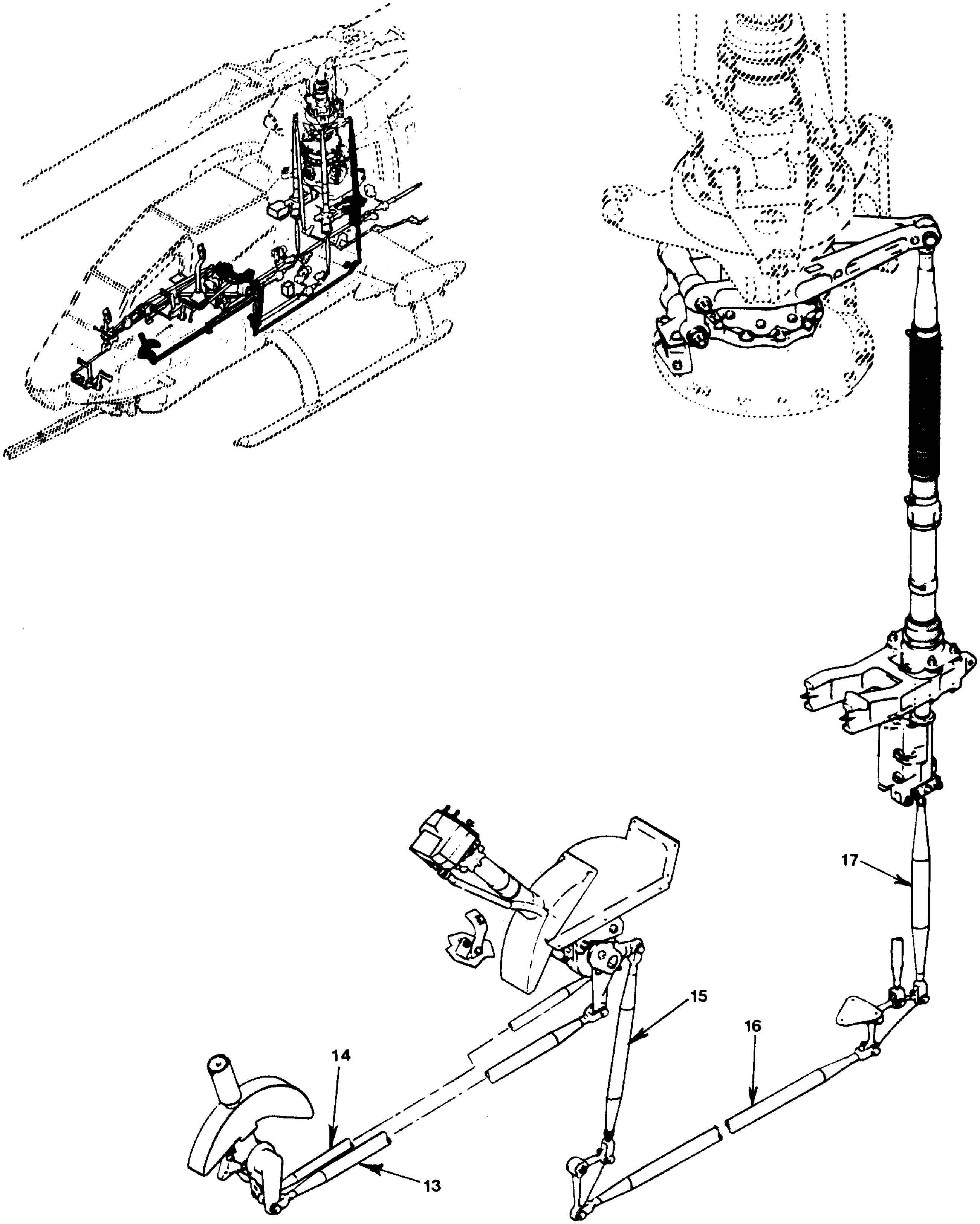



Figure 13-3. Collective Flight Controls

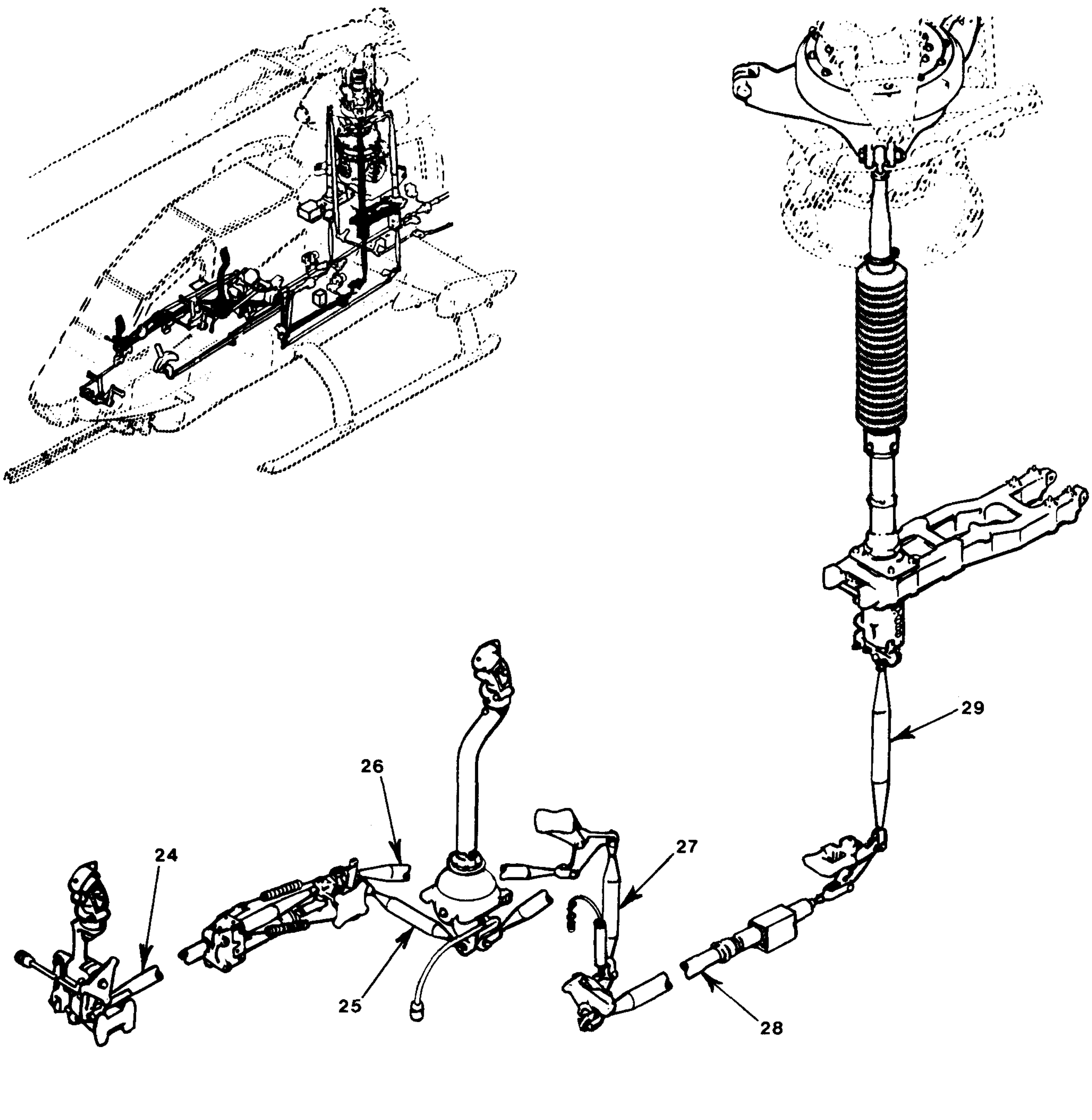



Figure 13-4. Cyclic Lateral Controls

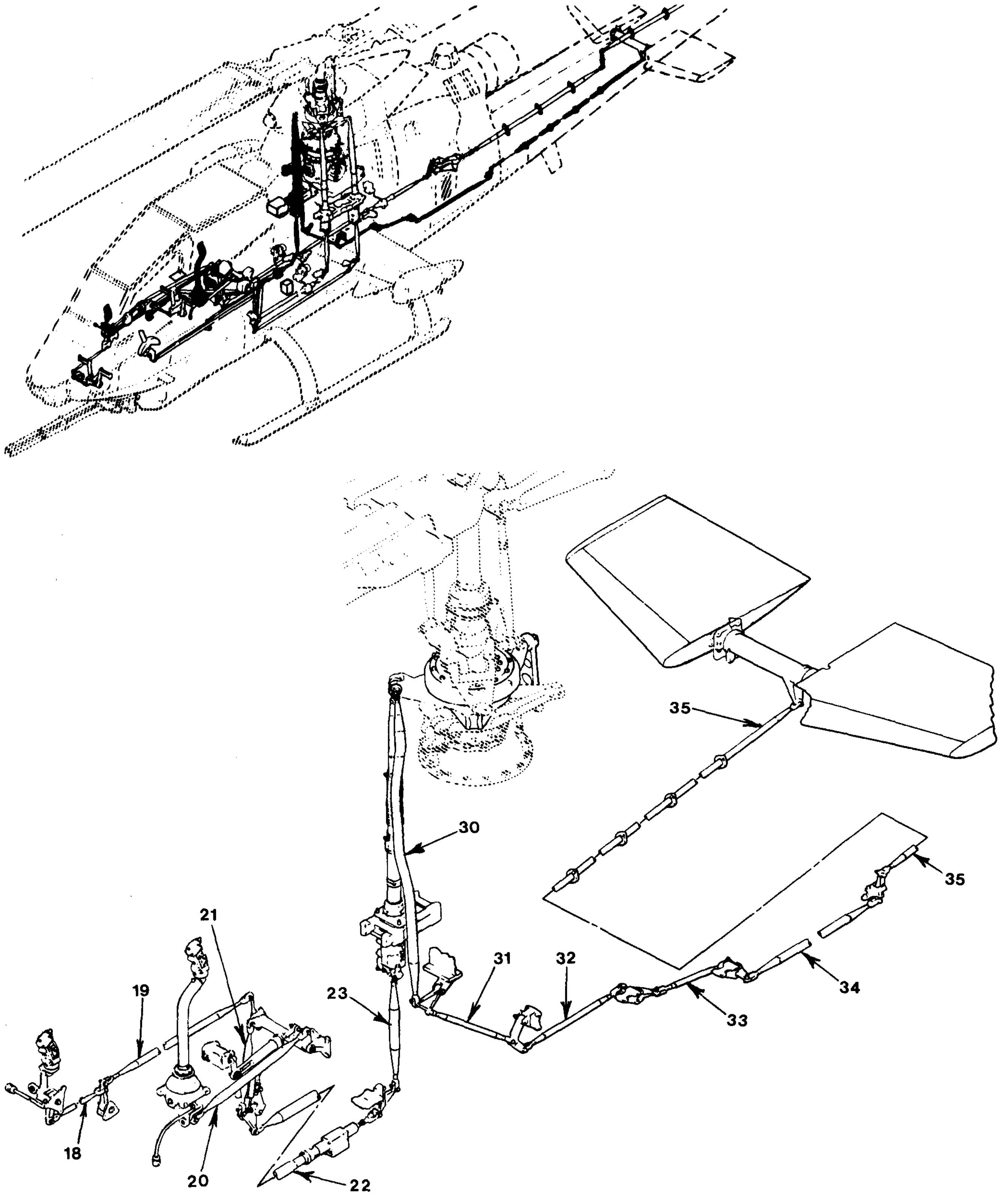



Figure 13-5. Cyclic, Fore and Aft Controls

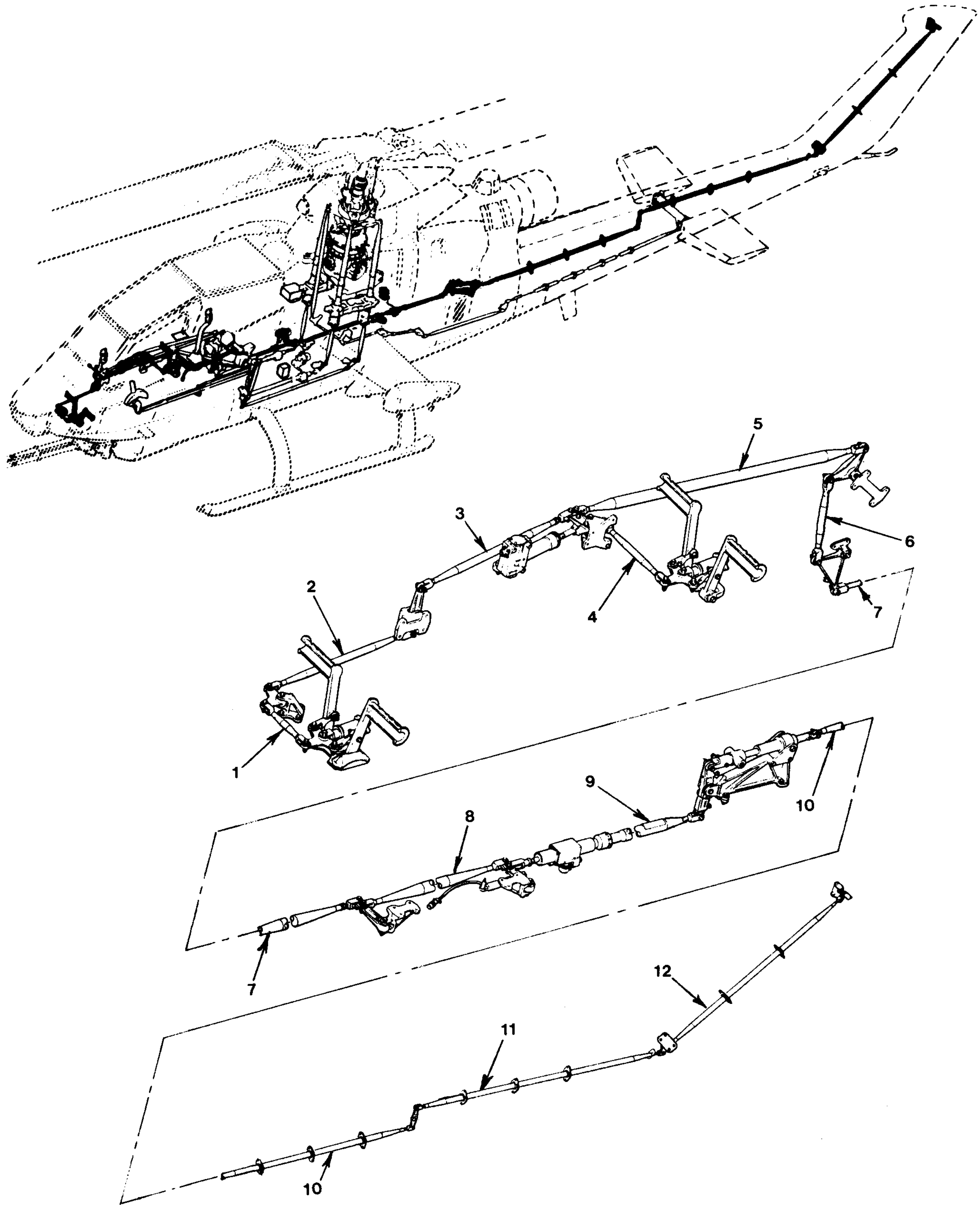
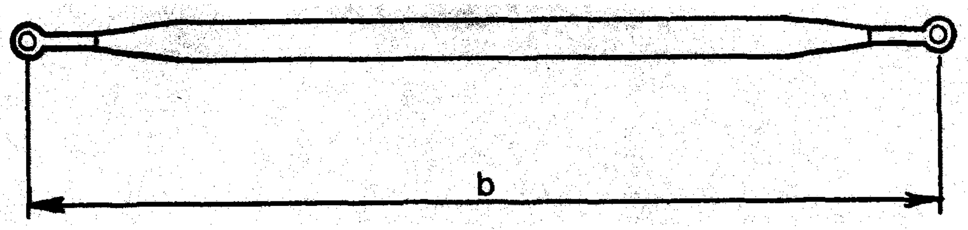



Figure 13-6. Tail Rotor Controls

**Table 13-2. Control Tube Dimensions**
(Refer **to Figures** 13-3 thru 13-6)




| NO. | FIGURE | NSN | SIZE INCHES O.D. | SIZE INCHES I.D. | WALL (IN) | CENTER TO CENTER b | DESIRED SPLICE TUBE SIZE (IN) INSIDE | DESIRED SPLICE TUBE SIZE (IN) OUTSIDE |
|---|---|---|---|---|---|---|---|---|
| 1 | 13-6 | 3040-00-931-8282 | 5/8 | 9/16 | .035 | 8-1/8 | 1/2 | 3/4 |
| 2 | 13-6 | 3040-00-931-8279 | 7/8 | 13/16 | .035 | 22-1/8 | 3/4 | 1 |
| 3 | 13-6 | 3040-00-932-1195 | 718 | 13/16 | .035 | 25-1/8 | 3/4 | 1 |
| 4 | 13-6 | 3040-00-977-2663 | 5/8 | 9/16 | .035 | 12-3/8 | 1/2 | 3/4 |
| 5 | 13-6 | 3040-00-931-8304 | 1-3/8 | 1-5116 | ,035 | 44-3/4 | 1-1/4 | 1-112 |
| 6 | 13-6 | 3040-00-931-8273 | 5/8 | 9116 | .035 | 12-1/16 | 1/2 | 3/4 |
| 7 | 13-6 | 3040-00-932-1194 | 1-3/8 | 1-5/16 | ,035 | 49-3/4 | 1-1/4 | 1-112 |
| 8 | 13-6 | 3040-00-410-6334 | 1-318 | 1-5/16 | .035 | 44-3/4 | 1-114 | 1-112 |
| 9 | 13-6 | 1560-00-446-4478 | 1-3/8 | l-5116 | .035 | 29-1/8 | 1-1/4 | 1-1/2 |
| 10 | 13-6 | 3040-01-031-9151 | 1-1/4 | 1-3/16 | .035 | 86-13/16 | 1-1/8 | 1-318 |
| 11 | 13-6 | 3040-01-031-1200 | 1-1/4 | l-3116 | .035 | 89-9/16 | 1-1/8 | 1-3/8 |
| 12 | 13-6 | 3040-01-031-9152 | 1-3/8 | 1-5/16 | .035 | 67-13/16 | 1-1/4 | 1-112 |
| 13 | 13-3 | 3040-00-931-8274 | 1-3/8 | 1-5/16 | .035 | 63-3/16 | 1-114 | l-112 |
| 14 | 13-3 | 3040-00-878-4915 | 1-3/8 | 1-5/16 | .035 | 64-3/4 | l-314 | l-112 |
| 15 | 13-3 | 3040-00-103-9485 | 1-1/4 | L-3116 | .035 | 22-15/16 | 1-1/8 | l-318 |
| 16 | 13-3 | 3040-00-931-8281 | 1-1/4 | 1-3/16 | .035 | 60-1/16 | 1-1/8 | 1-318 |
| 17 | 13-3 | 3040-00-971-6295 | 1-1/4 | 1-3/16 | .035 | 20-3/8 | 1-1/8 | l-318 |
| 18 | 13-5 | 3040-00-931-8288 | 3/4 | 11116 | .035 | 24-1/2 | 5/8 | 7/8 |

Table 13-2. Control Tube Dimensions (Cont)

| NO. | FIGURE | NSN | SIZE INCHES D.D. | SIZE INCHES I.D. | WALL (IN) | CENTER TO CENTER b | DESIREI SPLICE TUBE SIZE (IN) INSIDE | DESIREI SPLICE TUBE SIZE (IN) OUTSIDE. |
|---|---|---|---|---|---|---|---|---|
| 19 | 13-5 | 1560-00-089-9824 | 1-114 | 1-3116 | .035 | 24-7116 | 1-1/8 | 1-3/8 |
| 20 | 13-5 | 3040-00-089-9825 | 1-1/4 | 1-3/16 | .035 | 23-11/16 | 1-1/8 | 1-318 |
| 21 | 13-5 | 3040-00-877-0102 | 1 | 15/16 | .035 | 12-15/16 | 7/8 | 1-1/8 |
| 22 | 13-5 | 3040-00-446-4436 | 1-3/8 | 1-5116 | .035 | 29-1/8 | 1-1/4 | 1-1/2 |
| 23 | 13-5 | 3040-00-971-6295 | 1-1/4 | 1-3116 | ,035 | 20-3/8 | 1-1/8 | 1-3/8 |
| 24 | 13-4 | 3040-00-931-8292 | 1 | 15/16 | .035 | 39-1/2 | 7/8 | 1-1/8 |
| 25 | 13-4 | 3040-00-931-8291 | 1 | 15116 | .035 | 12 | 7/8 | 1-1/8 |
| 26 | 13-4 | 3040-00-931-8290 | 1-1/4 | 1-3/16 | .035 | 30-9/16 | 1-118 | 1-318 |
| 27 | 13-4 | 3040-00-103-4630 | 5/8 | 9116 | .035 | 14-3/8 | 1/2 | 314' |
| 28 | 13-4 | 3040-00-446-4436 | 1-318 | 1-5/16 | .035 | 29-1/8 | 1-1/4 | 1-1/2 |
| 29 | 13-4 | 3040-00-932-1190 | 1-1/4 | 1-3/16 | .035 | 21-7116 | 1-1/8 | 1-3/8 |
| 30 | 13-5 | 3040-00-877-6573 | 1-1/2 | 1-5/16 | .083 | 58-9/16 | 1-3/8 | 1-5/8 |
| 31 | 13-5 | 3040-00-931-8266 | 3/4 | 11/16 | .035 | 21-9/16 | 5/8 | 7/8 |
| 32 | 13-5 | 3040-00-931-8289 | 3/4 | 11/16 | ,035 | 21-7/16 | 5/8 | 7/8 |
| 33 | 13-5 | 3040-00-931-8276 | 5/8 | 9116 | .035 | 12-9/16 | 1/2 | 3/4 |
| 34 | 13-5 | 3040-00-931-8275 | 1-1/8 | 1-1/16 | .035 | 45-1/4 | 1 | 1-1/4 |
| 35 | 13-6 | 3040-01-028-0016 | 7/8 | 13/16 | .035 | 107-9/16 | 3/4 | 1 |

Table 13-3. Recommended Bolts and Drill Hale Sizes for Splice Repair

| LINK NOMINAL O.D. | MINIMUM BOLT SIZE FOR BOLT | MINIMUM BOLT SIZE DRILL HOLE | MAXIMUM BOLT SIZE FOR BOLT | MAXIMUM BOLT SIZE DRILL HOLE |
|---|---|---|---|---|
| 5/8 | No. 6 | 5/32 | No. 8 | 3/16 |
| 3/4 | 8 | 3/16 | 10 | 7/32 |
| 7/8 | 10 | 7/32 | 1/4 | 9/32 |
| 1 | 10 | 7/32 | 1/4 | 9/32 |
| 1/8 | 10 | 7/32 | 1/4 | 9/32 |
| 1-1/4 | 1/4 | 9/32 | 5/16 | 11/32 |
| 1-3/8 | 1/4 | 9/32 | 5/16 | 11/32 |
| 1-1/2 | 5/16 | 11/32 | 3/8 | 13/32 |

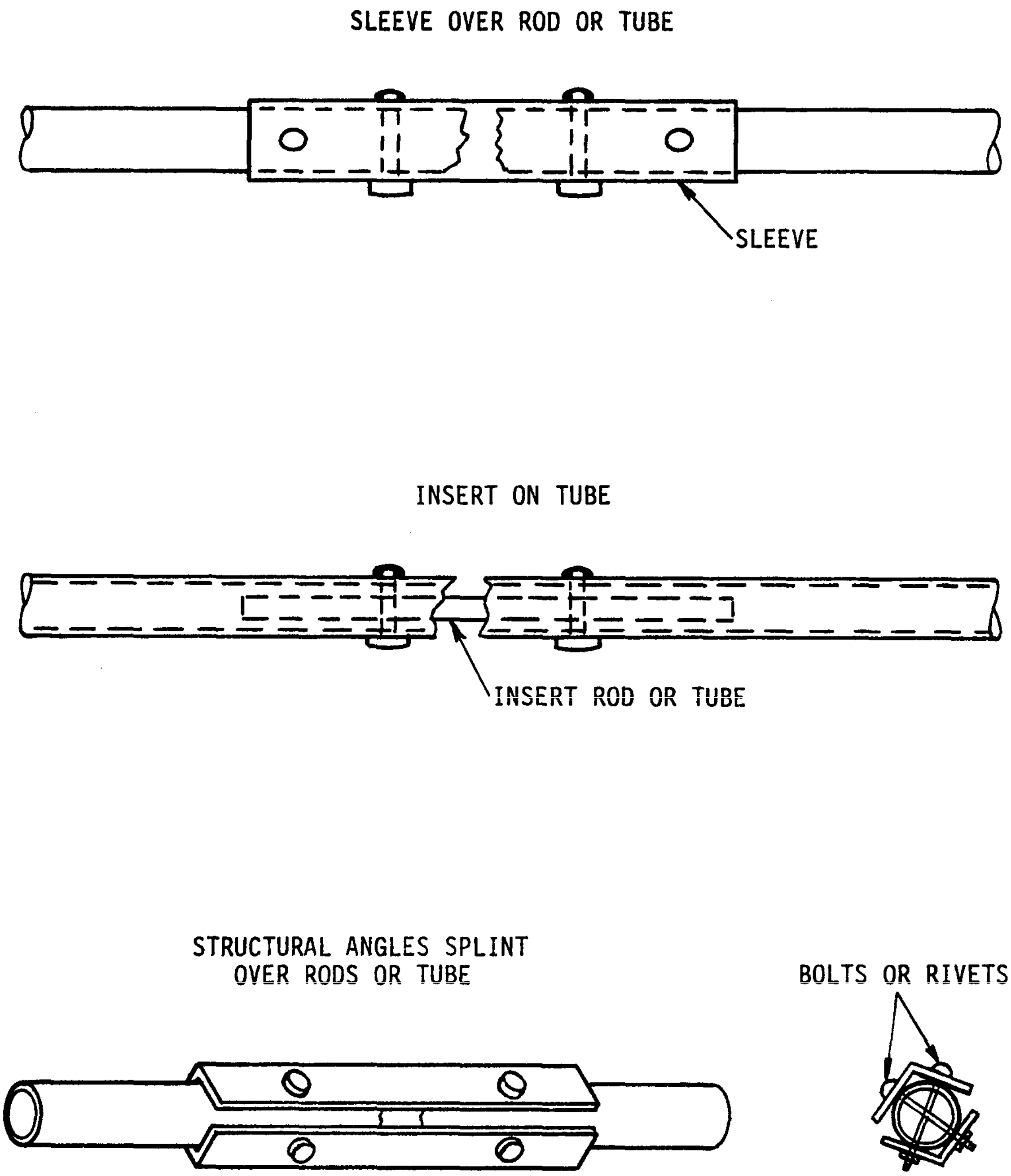



Figure 13-7. Control Tube Splice

**LIMITATIONS:** Inspect after every flight.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 3 Hours

**MATERIAL/TOOLS REQUIRED:**
- Drill and Bit
- Structures repair Kit (ieem 12, App. B)

**PROCEDURAL STEPS:**

1. Put aircraft flight control system into neutral rig.

2. Remove damaged flight control tube, Figure 13-8,

3. On the end that fits into the clevis bolt, mash the tube so that it fits into the arms of the bell crank or clevis. A small amount of clearance between the clevis fork should be allowed, Figure 13-9.

4. Round off the end of the mashed tube, Figure 13-10.

5. Drill a hole through the tube and install the bolt.

6. From Table 13-2, determine the correct distance between holes of the flight tube. Mark this distance.

7. Drill the hole and install the bolt.

8. On the other end where the clevis arms would normally fit, mash the tube only enough to fit over the bearing assembly with some clearance.

9. Round off the end of the tube, Figure 13-11.

10. Drill proper size holes.

11. Install bolts.

12. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

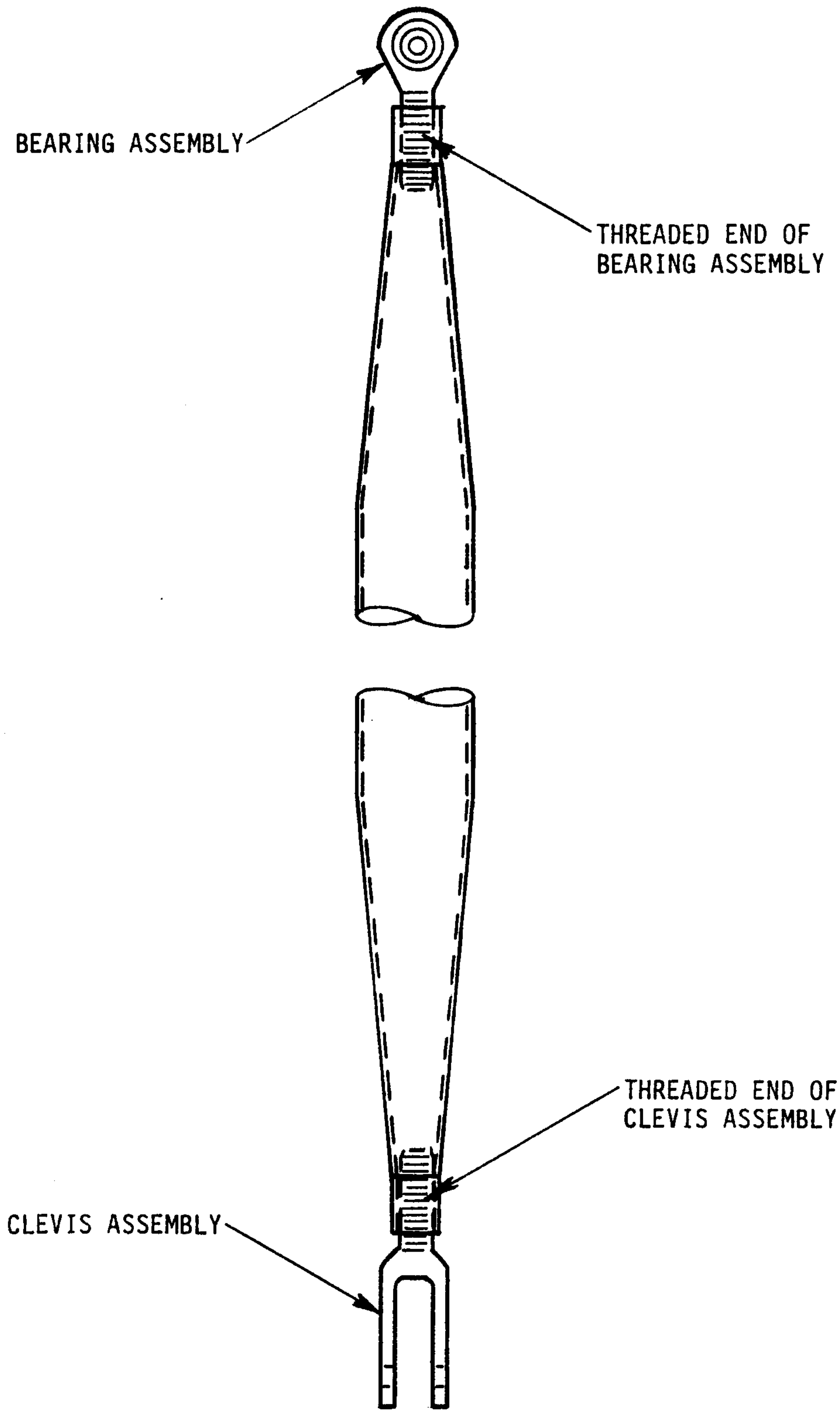



Figure 13-8. Control Rod with Bearing and Clevis Assemblies

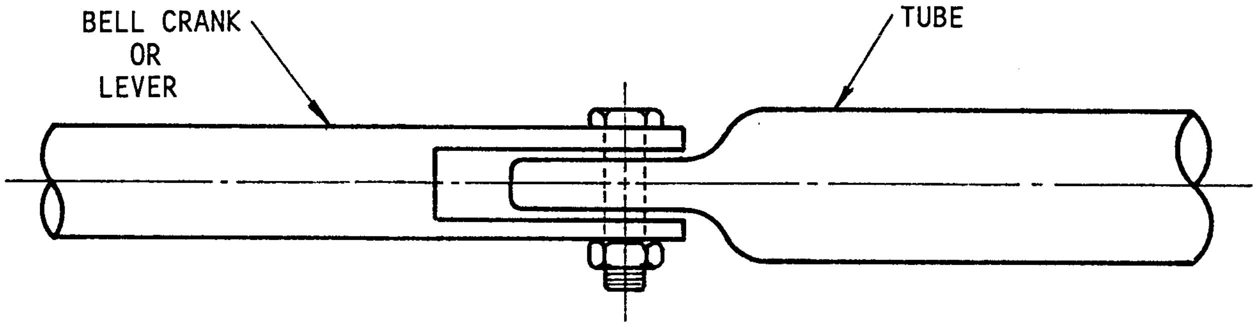



**Figure 13-9. Flattened End of Fabricated Flight Control**

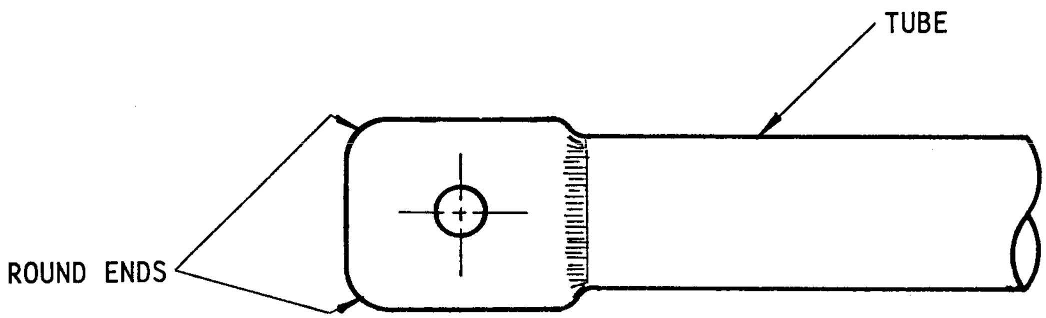



**Figure 13-10. Corner Rounding on Fabricated Flight Control**

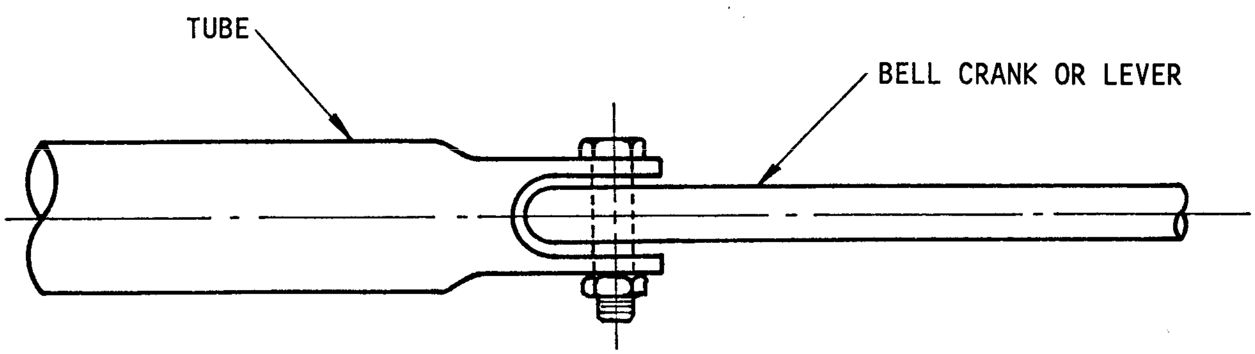



Figure 13-11. Bell Crank or Lever Assembly
Connection of Fabricated Flight Control

# CHAPTER 14

# UTILITY SYSTEMS

| |
|---|
| 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. |

14-1. SCOPE. This chapter describes the fault assessment procedures and references the expedient repairs useful in fixing damages to the utility systems.

14-2. ASSESSMENT PROCEDURES. Assessment procedures are simplified in this chapter. They are contained in Table 14-1 and reference fixes described in other chapters of this manual.

14-3. REPAIR PROCEDURE INDEX.

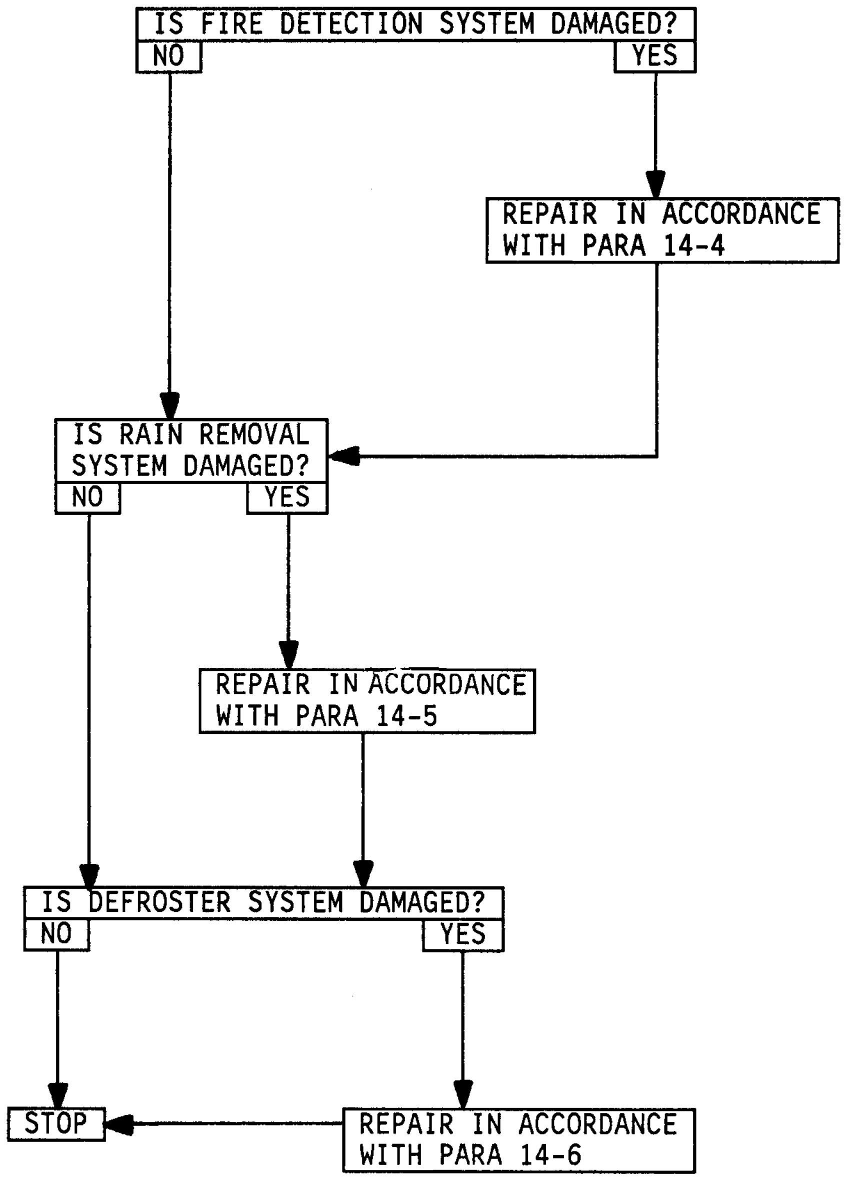


14-4. FIRE DETECTION SYSTEM. The detection system is not vital to the function of the aircraft in reference to its flight capabilities; however, in the event that the fire detection system is inoperative and a fire should occur in the engine compartment, the resulting damage to the aircraft can be catastrophic. Repairs to the system wiring may be accomplished using procedures contained in Chapter 11.

14-5. RAIN REMOVAL SYSTEM. This is a subsystem of the environmental control system. Damage to the system will not impair helicopter operation. Failure of the system during heavy rain may affect full mission capability. If damaged and system is determined unnecessary, defer repair or cap off metal tubing supplying nozzles. If system function is to be restored, refer to Chapter 15 for bleed air line repair. Nozzles may be fabricated from common AN “T” fittings.

14-6. DEFROSTER SYSTEM. This is a subsystem of the environmental control system. Damage to the system will not impair helicopter operation. Failure of the system may affect full mission capability. If system function must be restored, refer to Chapter 15 for bleed air line and duct repair procedures.

**Table 14-1. Utility Systems Assessment Procedures**



# CHAPTER 15

# ENVIRONMENTAL CONTROL 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

15-1. SCOPE. This chapter contains the fault assessment and expedient repair procedures for locating and fixing damage to the environmental control system. The system is depicted in Figure 15-1.

15-2. ASSESSMENT PROCEDURES. The environmental control system is primarily designed for crew comfort, but damage assessment and repair must be based on the possibility of lost engine performance due to leaking bleed air or reduced visibility caused by loss of rain removal or defroster systems operation. Refer to Table 15-1 for assessment logic.

15-3. REPAIR PROCEDURE INDEX.



## Section II. ENVIRONMENTAL CONTROL UNIT (ECU)

15-4. GENERAL. The ECU is the heart of the cooling and heating system. If damage has not occured to the ECU's cooling turbine, the unit can normally be repaired and put back in operation. The cooling turbine operates at high speed and is accordingly very sensitive to damage.

15-5. SURFACE OF ECU DAMAGED.

**WARNING**

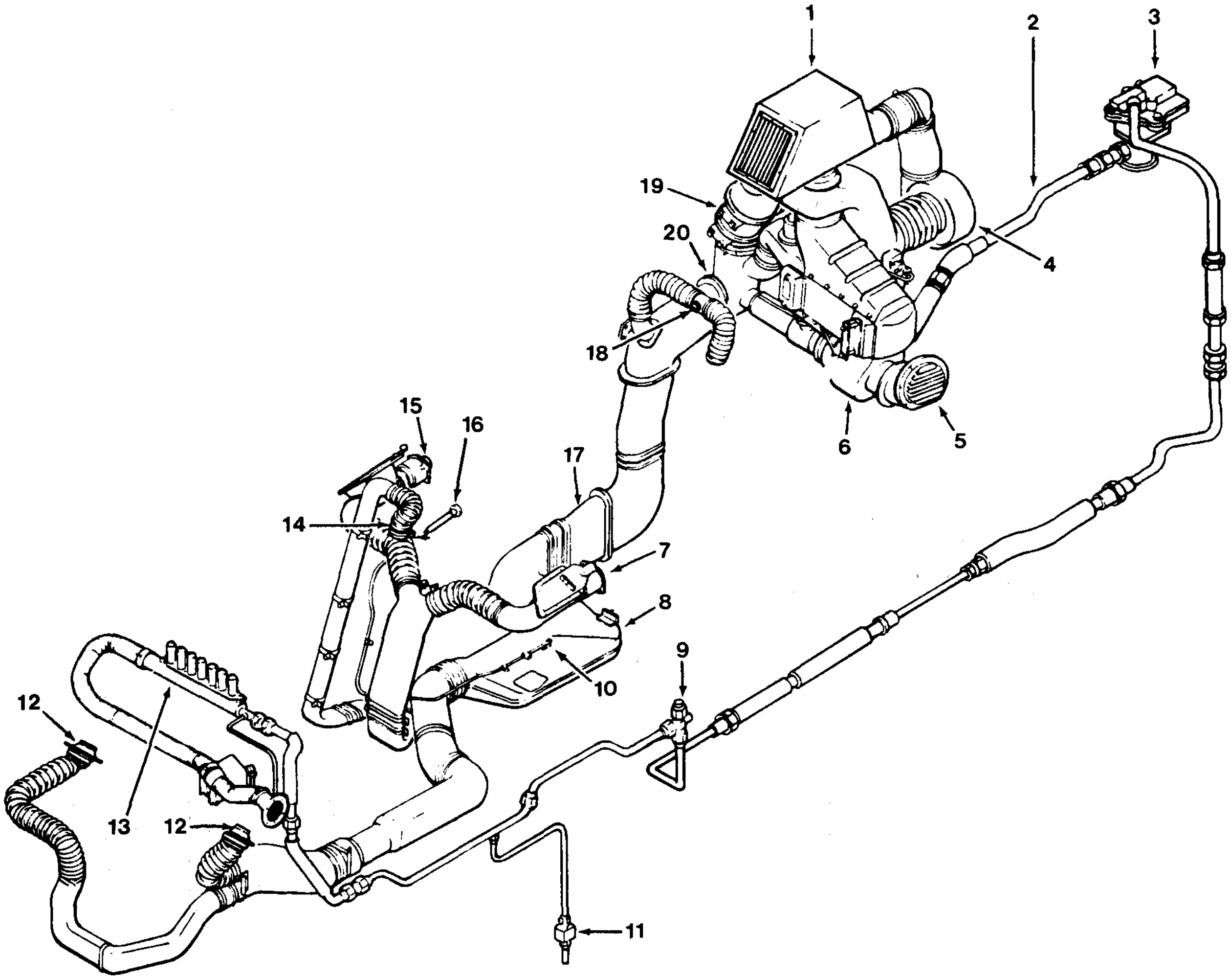
- Adhesives, resins, fillers, and sealants contain toxic substances. Wear protective equipment. Work with adequate ventilation.
- Sanding or reinforced laminated glass produces fine dust that may cause skin and lung irritations. Observe necessary protective measures.

**WARNING**

- Compressed air can blow dust into eyes. Wear eye protection. Do not exceed 30 psig air pressure.
- Cleaning solvents may be flammable and toxic. Use only in well-ventilated areas. Avoid inhalation of vapors and skin contact. Do not use solvents near open flame or in areas where very high temperatures prevail. Solvent flash point must not be less than 100°F.

GENERAL INFORMATION: Some damage, holes, or cracks to the external surface of the ECU housing can be repaired provided no critical internal damage is incurred, Figure 15-2.

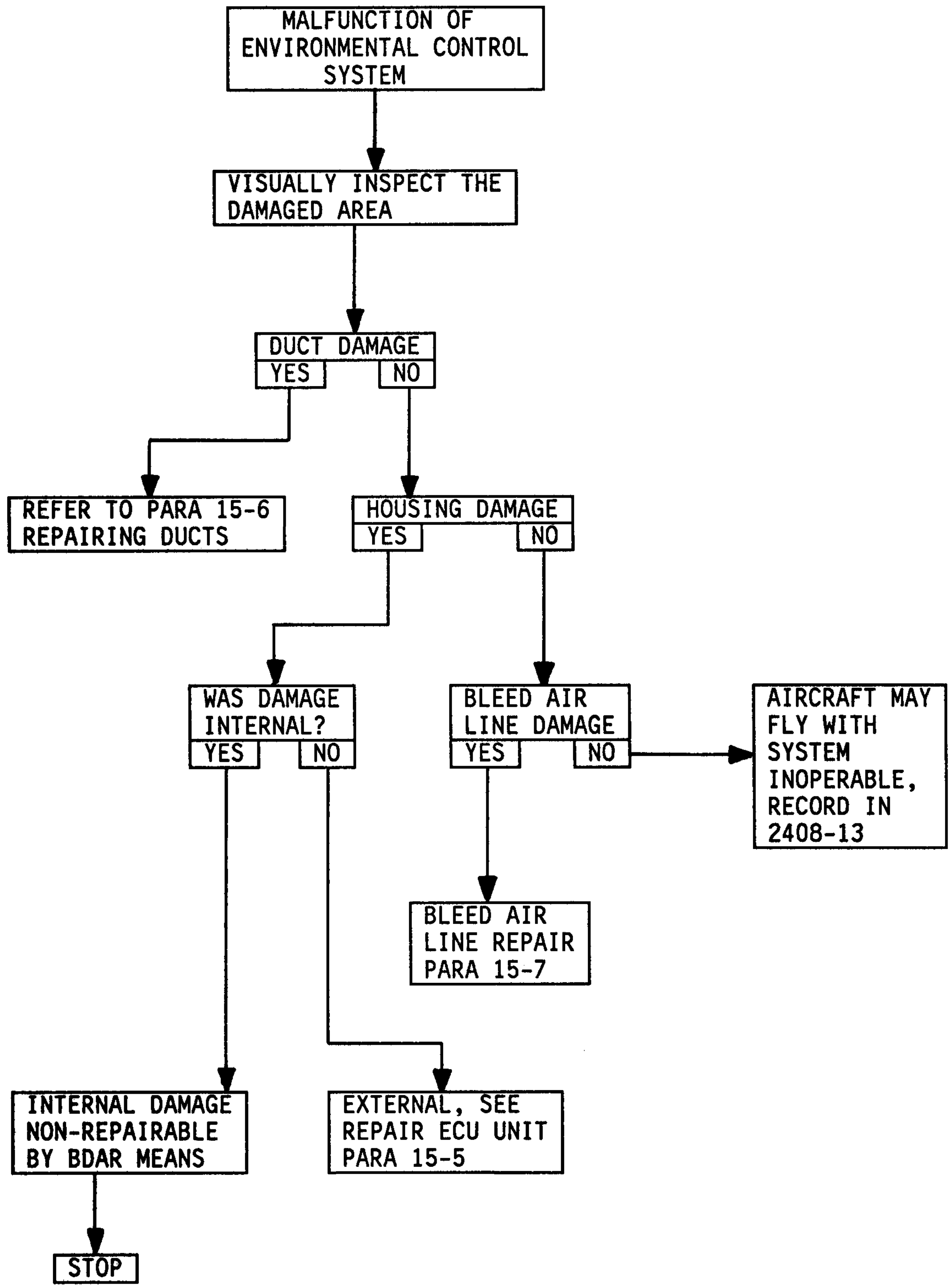
OPTION 1: Plastic Patch Holes or Cracks on ECU Housing.




1. Ram Air Inlet
2. Bleed Air Line
3. Pressure Regulator and Shutoff Valve
4. Blower
5. Ram Air Outlet
6. Environmental Control Unit
7. Defog Outlet
8. Duct
9. Rain Removal Valve
10. Air Control Valve
11. Drain Valve
12. Gunner Air Outlets
13. Rain Removal Manifold
14. Gunner Cushion Air Valve
15. Pilot Air Outlets
16. Heat or Vent Air Pull Control
17. Duct
18. Pilot Cushion Air Valve
19. Vent Air Control Valve
20. Inlet Duct

Figure 15-1. Environmental Control System

**Table 15-1. Environmental Control System Assessment Procedures**



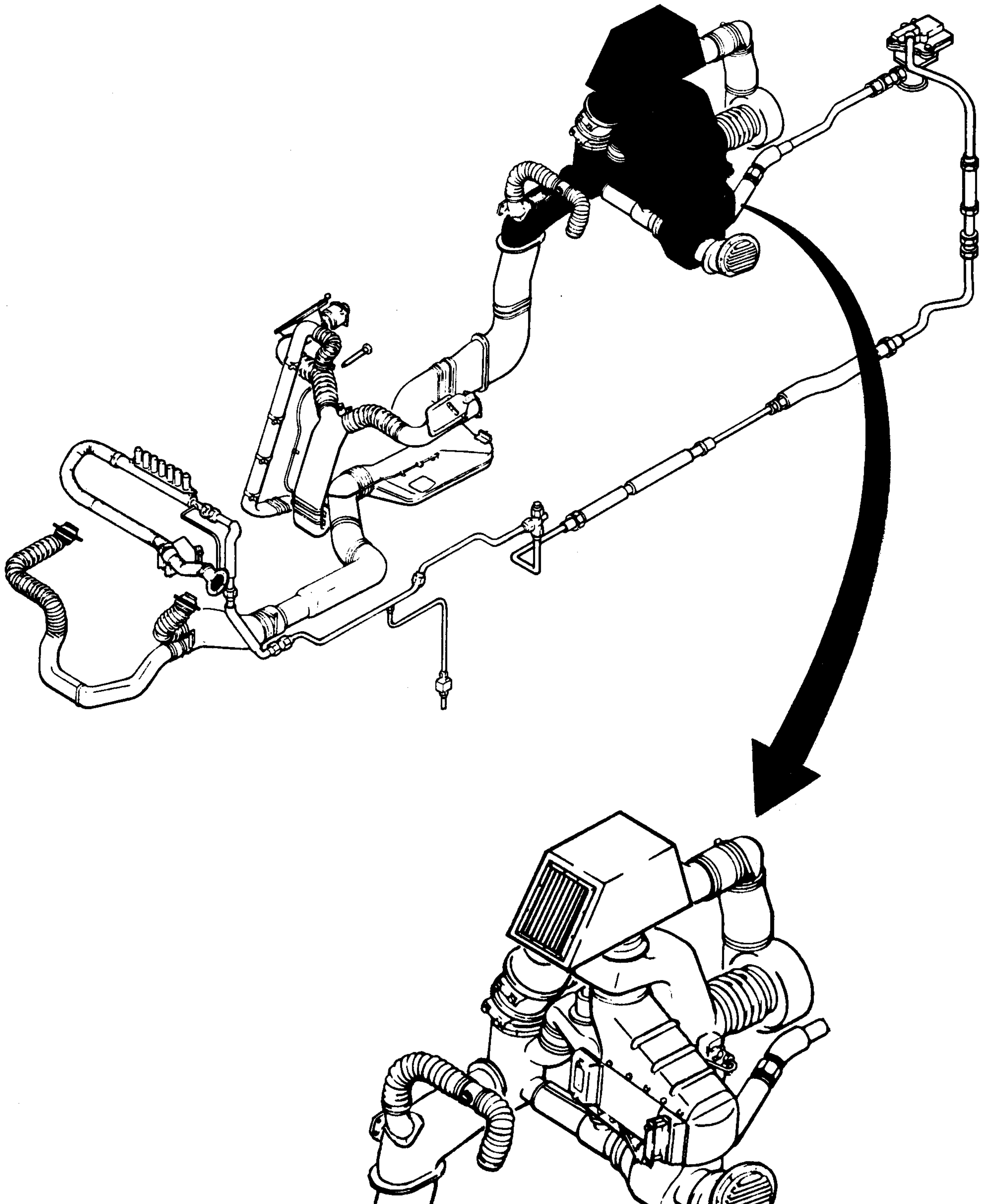


Figure 15-2. ECU Housing

**LIMITATIONS:** Only areas accessible without removing the ECU will be repairable.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 3 Hours

**MATERIAL/TOOLS REQUIRED:**
- Solvent (item 7 or 129, App. C)
- Sandpaper (items 117-121, App. C)
- Repair Material (items 50,51,97, App. C)
- Drill Bit and Drill

**PROCEDURAL STEPS:**

1. Locate hole on housing.

2. Stop drill any cracks which might be extending from hole.

3. Clean surface to be repaired with solvent.

4. Sand surface around hole. Sanded surface should extend at least 1-1/2 inches from the edge of the hole at all points.

5. Cut a piece of patch material that will overlap the hole by 1-1/2 inches at all points.

6. Apply resin to the sanded area around the hole.

7. Press patch over hole.

8. Apply resin over the patch and all around the edge of the patch.

9. Allow time for resin to cure.

10. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Metal Patch Holes or Cracks on ECU Housing.

**LIMITATIONS:** Inspect after every flight.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1 Hour

**MATERIAL/TOOLS REQUIRED:**
- Sheet Metal Patch (item 133, App. C)
- Green or Aluminum Tape
  (item 153 or 150, App. C)

**PROCEDURAL STEPS:**

1. Locate damaged area and remove panels and/or other items as necessary to gain access to the surface to be required.

2. Cut a patch out of sheet stock.

3. Tape into place.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## Section III. DUCTING

### 15-6. DUCTING TORN OR PERFORATED.

**GENERAL INFORMATION:** The ducting maybe repaired using almost any patching material since this is a noncritical area of the helicopter.

**OPTION 1:** Flexible Duct Patch.

**LIMITATIONS:** None.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 15 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Green Tape or Equivalent (item 153 or 150, App. C)

**PROCEDURAL STEPS:**

1. Locate damaged area and remove panels and/or other items as necessary to gain access to the duct to be repaired. Refer to Figure 15-3 for locations of flexible plastic ducts.

2. Wrap tape several turns around duct to cover hole or tear. Tape should extend beyond damaged area 3 to 4 inches in each direction.

**OPTION 2:** Plastic Patch Rigid Duct.

**LIMITATIONS:** None.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1 Hour

**MATERIAL/TOOLS REQUIRED:**
- Sheet Metal Patch (item 133, App. C)
- Sealant (items 123-128, App. C)
- 400 Grit Sandpaper (item 117, App. C)
- Green or Aluminum Tape (item 153 or 150, App. C)
- Solvent (item 7 or 129, App.C)

**PROCEDURAL STEPS:**

1. Locate damaged area and remove panels and/or other items as necessary to gain access to the duct to be repaired. Refer to Figure 15-4 for locations of rigid plastic ducts.

2. Cut a patch out of sheet stock. Patch should extend 1-1/2 inches from the edge of the hole at all points.

3. Stop drill any cracks which might be extending from hole.

4. Sand both the bottom sufface of the patch and the surface area around the hole to be covered by the patch.

5. Clean surface with solvent.

6. Apply sealant to patch and on the surface area that will be covered by the patch.

7. Press patch in place and wrap tape around patch and duct to hold the repair in position.

8. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Metal Patch Rigid Duct.

**LIMITATIONS:** Inspect after every flight.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1 Hour

**MATERIAL/TOOLS REQUIRED:**
- Sheet Metal Patch (item 133, App. C)
- Green or Aluminum Tape (item 153 or 150, App. C)

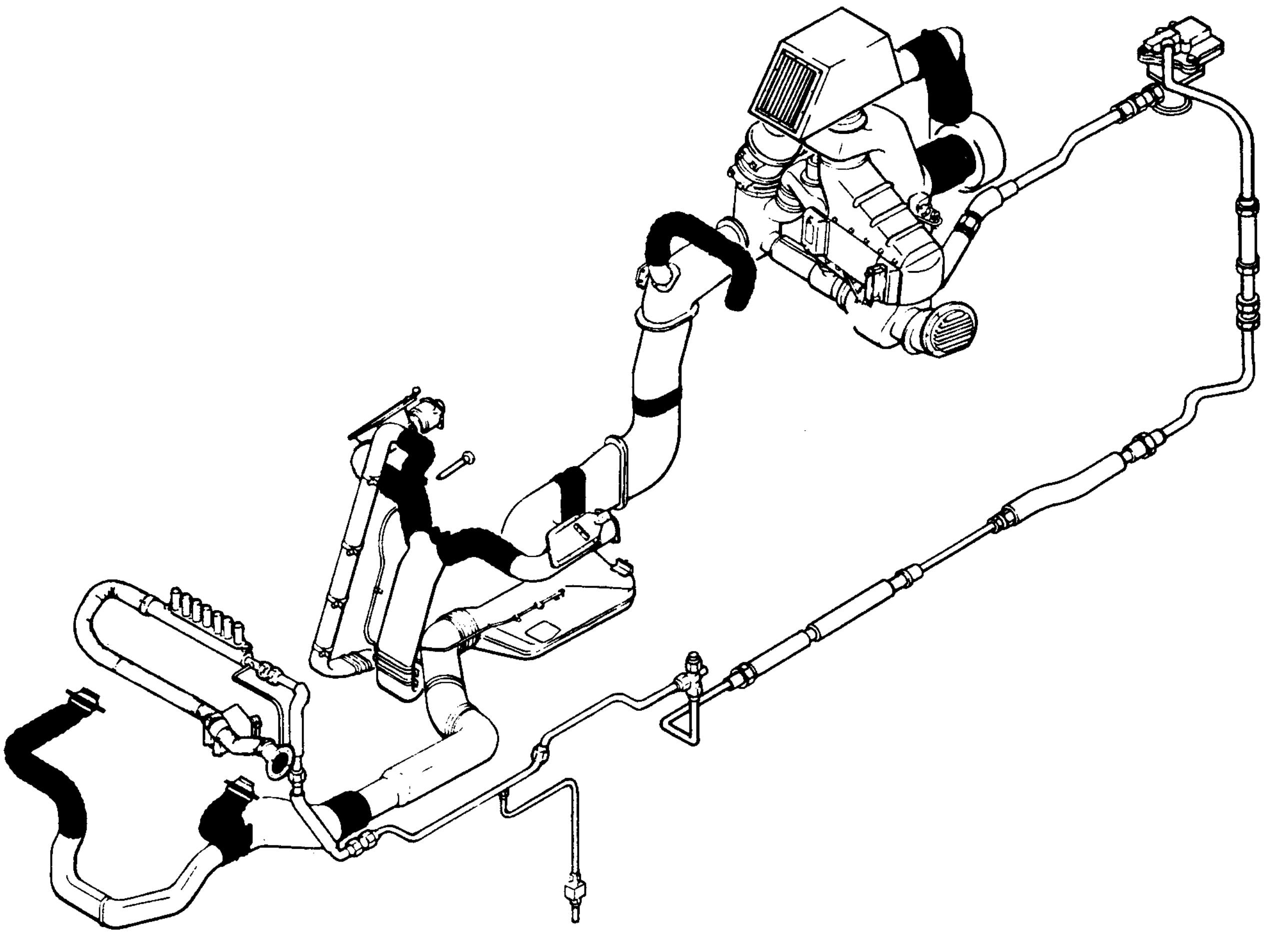


Figure 15-3. Ducts, Flexible Plastic

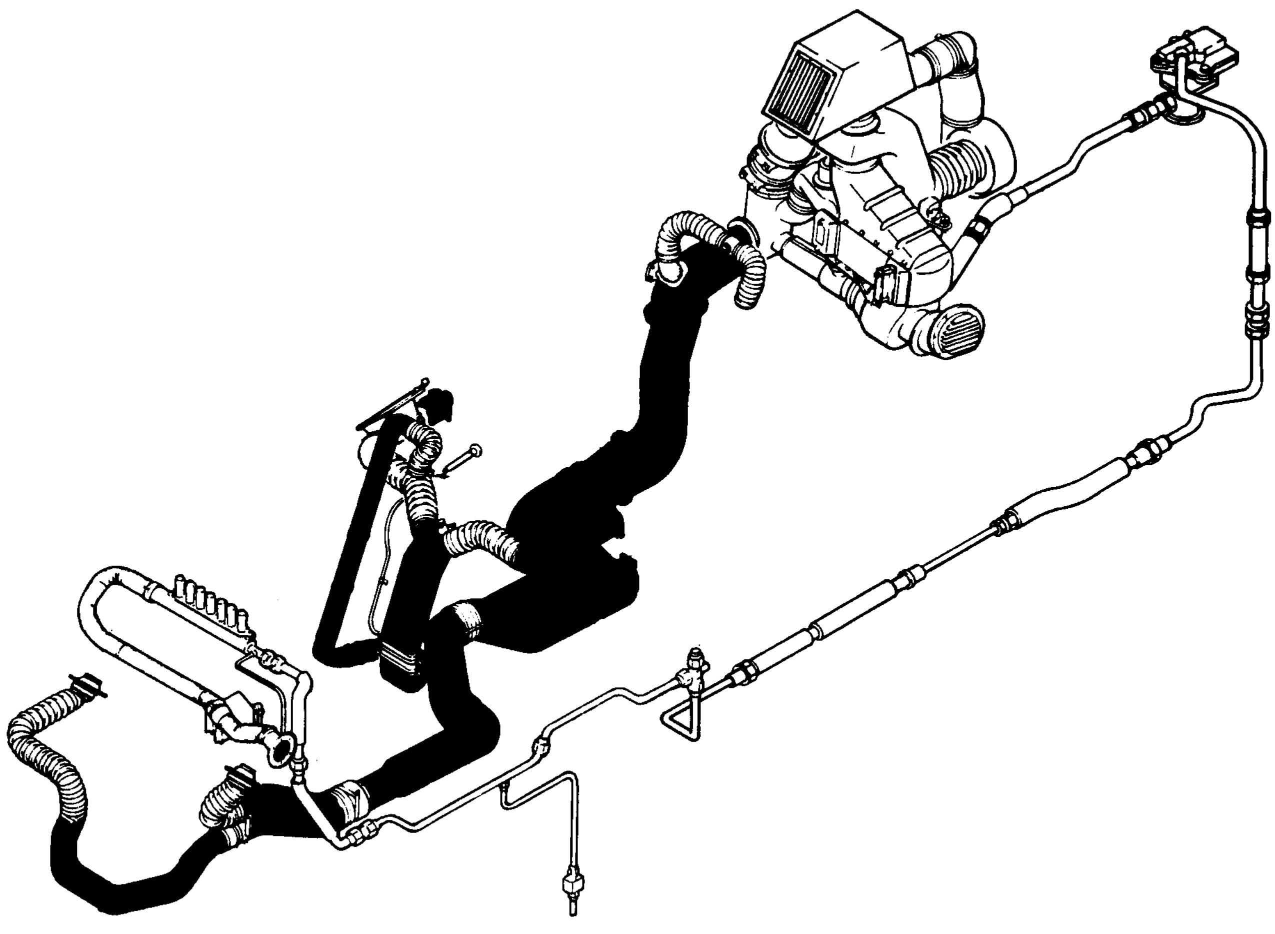


Figure 15-4. Ducts, Rigid Plastic

**PROCEDURAL STEPS:**

1. Locate damaged area and remove panels and/or other items as necessary to gain access to the duct to be repaired. Refer to Figure 15-4 for location of rigid plastic ducts.

2. Cut a patch out of sheet stock.

3. Tape into place.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

## Section IV. BLEED AIR LINES

### 15-7. HOLES IN BLEED AIR LINES.

**GENERAL INFORMATION:** Damage to some bleed air lines routed to the ECU and rain removal system may be repairable. There may be loss of engine torque and/or high engine oil temperature if damage is not repaired, Figure 15-5.

**OPTION:** Line Patching.

**Limitations:** Inspect after every fright.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 1 Hour

**MATERLALS/TOOLS REQUIRED:**
- Sheet Metal Patch (item 133, App. C)
- Sealing Compound (items 123-128, App. C)
- Aluminum Tape (item 150, App. C)
- Clamps or Safety Wire (items 54-62, App.C)

**PROCEDURAL STEPS:**

1. Locate damaged area and remove panels and other items as necessary to gain access to the line to be repaired.

2. Cut patch from sheet metal to cover hole or other damage. Patch should extend approximately 1 inch from the edge of the hole or damage at all points if possible.

3. Apply sealant around the hole area to be covered by the patch.

4. Place patch in position, make sure patch fits the contour of the line.

5. Wrap aluminum tape around the repair. Tape should cover at least 2 inches beyond the edge of repair. (If hose clamps are not available, secure in place with safety wire. Turn pigtail to line.)

6. Secure metal patch in place using hose clamp. Refer to Figure 15-6.

7. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

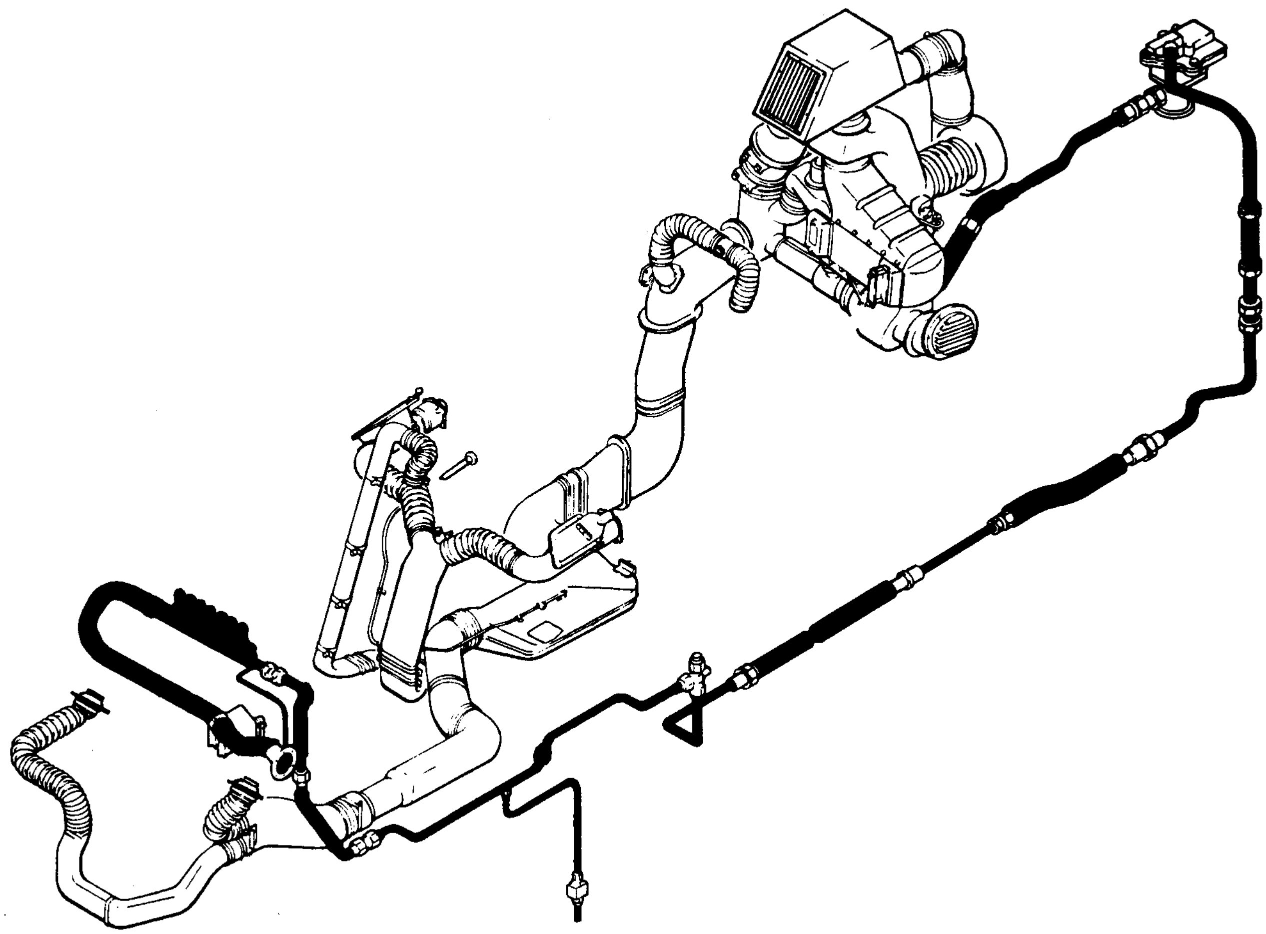
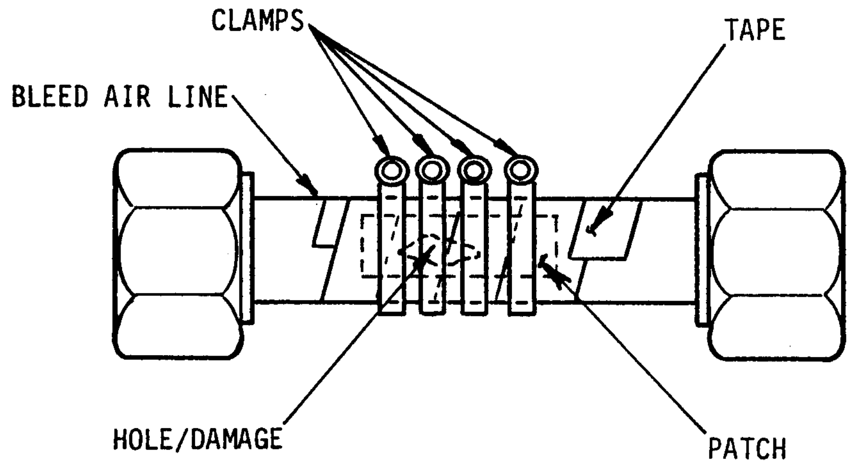
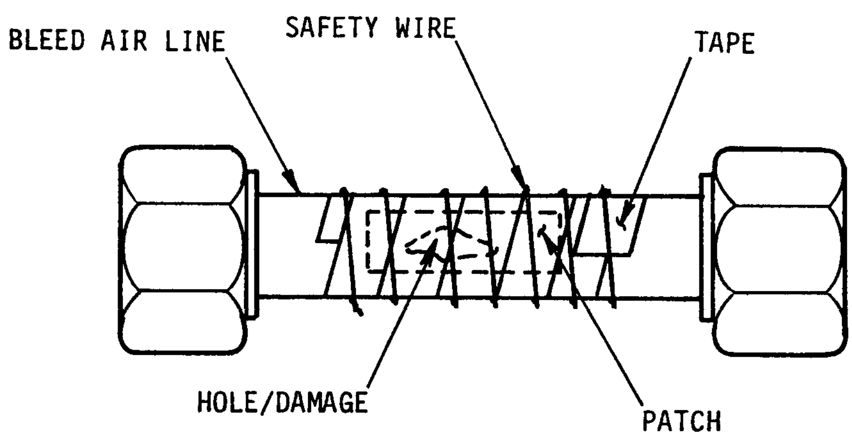


Figure 15-5. Bleed Air Lines




REPAIR USING CLAMPS




REPAIR USING SAFETY WIRE

Figure 15-6. Bleed Line Patch Repair

# CHAPTER 16

# MISSION EQUIPMENT

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

16-1. SCOPE. This chapter contains the fault assessment and expedient repair procedures for locating and fixing damage to the mission equipment. Mission equipment on the attack helicopter consists of the armament systems.

16-2. ASSESSMENT PROCEDURES.

**WARNING**

- Loaded weapons, or weapons being loaded or unloaded, shall be pointed in a direction which offers the least exposure to personnel or property in the event of accidental firing.
- YOU can be blinded if you look into a laser beam when you are not wearing laser safety goggles. Never aim the laser range finder (LRF) at personnel.
- Prior to any helicopter maintenance functions that require external stores be removed, JETTISON cartridge shall be removed. To prevent injury to personnel and damage to equipment, remove jettison cartridges from pylon stores ejection device prior to placing helicopter in a hangar.

**WARNING**

Lifting or moving heavy equipment incorrectly can cause serious injury Do not try to lift or move more than 50 pounds by yourself. Get an assistant. Bend legs while lifting. Do not support heavy weight with your back. Always use assistants during lifting operations. Use guide ropes to move hanging assemblies. Lack of attention or being in an improper position during lifting operations can result in serious injury. Pay close attention to movements of assemblies being lifted. Do not stand under lifted assembly or in a position where you could be pinned against another object. Watch your footing.

a. The armament systems are dependent on the following functional equipment in order to be 100 percent mission capable. Use Table 16-1 to assess vital system functions:

Telescopic Sight Unit (TSU)
Helmet Sight Subsystem (HSS)
Universal Turret Subsystem
Rocket Management Subsystem (RMS)
TOW Missile Subsystem
Air Data Subsystem (ADS) (MC only)
Laser Range Finder (MC only)
Head-Up Display System (HUD) (MC only)
Collective Transducer
Airborne Laser Tracker (ALT) (MC only)
Attitude Reference Gyro
Magnetic Compass Set
Radar Altimeter

Torquemeter
Doppler Navigation System (DNS)
Fire Control Computer (FCC) (MC only)
M73 Reflex Sight (ECAS and PROD only)

b. If the HUD (MC) is nonoperational, the gun and rocket system can still be fired. If the laser rangefinder (if installed) (MC) is also nonoperational, the HUD unit is switched to STAD and a stadiametric reticle is displayed for rocket firing.

c. If the TSU or HSS are nonoperational, the turret gun can be fired by the pilot in the fixed forward mode by maneuvering the helicopter and aiming through the HUD (MC) or the M73 Pilot Reflex Sight (ECAS and PROD).

d. If normal turret subsystem operating power is lost or removed for any reason, the emergency stow control unit will automatically position the Ml 97 (ECAS and MC) gun at the emergency stow position to permit the helicopter to be landed safely. If the gun turret will not return to a position pointed straight ahead with the aircraft, it can be brought back manually (on the ground). To raise or lower the gun manually, release the brake toggle on the end of the elevation drive motor (Figure 16-1 ) and position the gun by hand. To position the gun in azimuth (Figure 16-1), open the panel on the right side of the aircraft nose shroud behind the turret and release the brake toggle on the end of the azimuth drive motor; then, position the gun manually to a straight ahead position.

e. The RMS uses 2.75 inch FFAR as a light antipersonnel/assault weapon. Should one or more launchers be disabled, the subsystem will cause the corresponding launcher on the opposite side of the aircraft fuselage to become inactive in order to maintain inflight stability of the aircraft by equalizing the load of unfired rockets. Thereafter, the subsystem will operate normally with those launchers that remain operable to enable the directed launching of whatever rockets remain.

f. The AH-1 armament system is very complex. It consists of numerous electronic units with interconnecting cabling, optical sighting systems, lasers, and mechanical components. The armament systems do not operate independently but interface with each other, with the helicopter avionics and navigation systems, and with transducers monitoring the engine and flight controls. In most cases, however, the armament system will continue to function when the interface or input from other systems is not functional. Most of the subsystems have a built-in test (BIT) feature which will indicate if there is a malfunction. The following systems have BIT systems:

Air Data System (ADS)
Rocket Management System (RMS)
Helmet Sight System (HSS)
Head-Up Display (HUD).
Fire Control Computer
M65 TOW Guided Missile System
Infrared Countermeasure System
Radar Countermeasure System

g. Assessment of battle damage will also require a visual inspection to determine damage to wiring harnesses, evidence of damage due to fragment penetration, and any damage to the mechanical systems of the TOW launchers, rocket launchers, and the 20mm turret gun with its ammunition feed system.

**16-3. REPAIR PROCEDURE INDEX.**

**Table 16-1. Mission Equipment Assessment Procedures**

| CONTROL COMPONENTS | TURRET | TOW MISSILE | ROCKETS | GUN POD | TARGET ACQUIRED FOR TSU | WING STORES JETTISON | ESSENTIAL |
|---|---|---|---|---|---|---|---|
| Armament Control Panel | P,G | P | P,G | P,G | P | P | YES |
| Rocket Management System (ECAS and MC) | | | P | | | | YES (ROCKET) |
| Rocket Control System (PROD) | | | P | | | | YES (ROCKET) |
| Misc. Control Panel | | | | | | P | NO |
| Wing Stores Jettison Switch | | | | | | P,G | NO |
| Reflex Sight (PROD and ECAS) | P | | P | P | | | NO |
| Helmet Sight | P,G | | | | P,G | | NO |
| Cyclic Switches | P,G | | P,G | P,G | | | YES |
| Head-Up Display (MC) | P | P | P | P | | | NO |
| Telescopic Sight Unit | G | G | | | | | YES (TOW) |
| Left-Hand Grip | G | G | | | | | YES (TOW) |
| Sight Hand Control | G | G | | | G | | YES (TOW) |
| TOW Control Panel | G | G | | | G | | YES (TOW) |
| Acquisition Panel (ECAS and MC) | | | | | G | | NO |

**P-Located in pilot station.**
**G-Located in gunners station.**

## Section II. WIRING

16-4. GENERAL. Due to the highly complex and intergrated design of the wiring, loss of an area of system function may be caused by simple wiring damage. Since most of the mission equipment is electronic, not many battlefield type repairs can be made. Components such as black boxes or control panel equipment containing integrated circuits, circuit cards, and other electronic equipment, which cannot be battlefield repaired, will be replaced if available. Components must be replaced with new parts or with parts cannibalized from other helicopters.

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

16-5. WIRE DAMAGE. Damage to wires, which has not caused any further damage to other units within the mission equipment, may be repaired by the wire repair procedures described in Chapter 11.

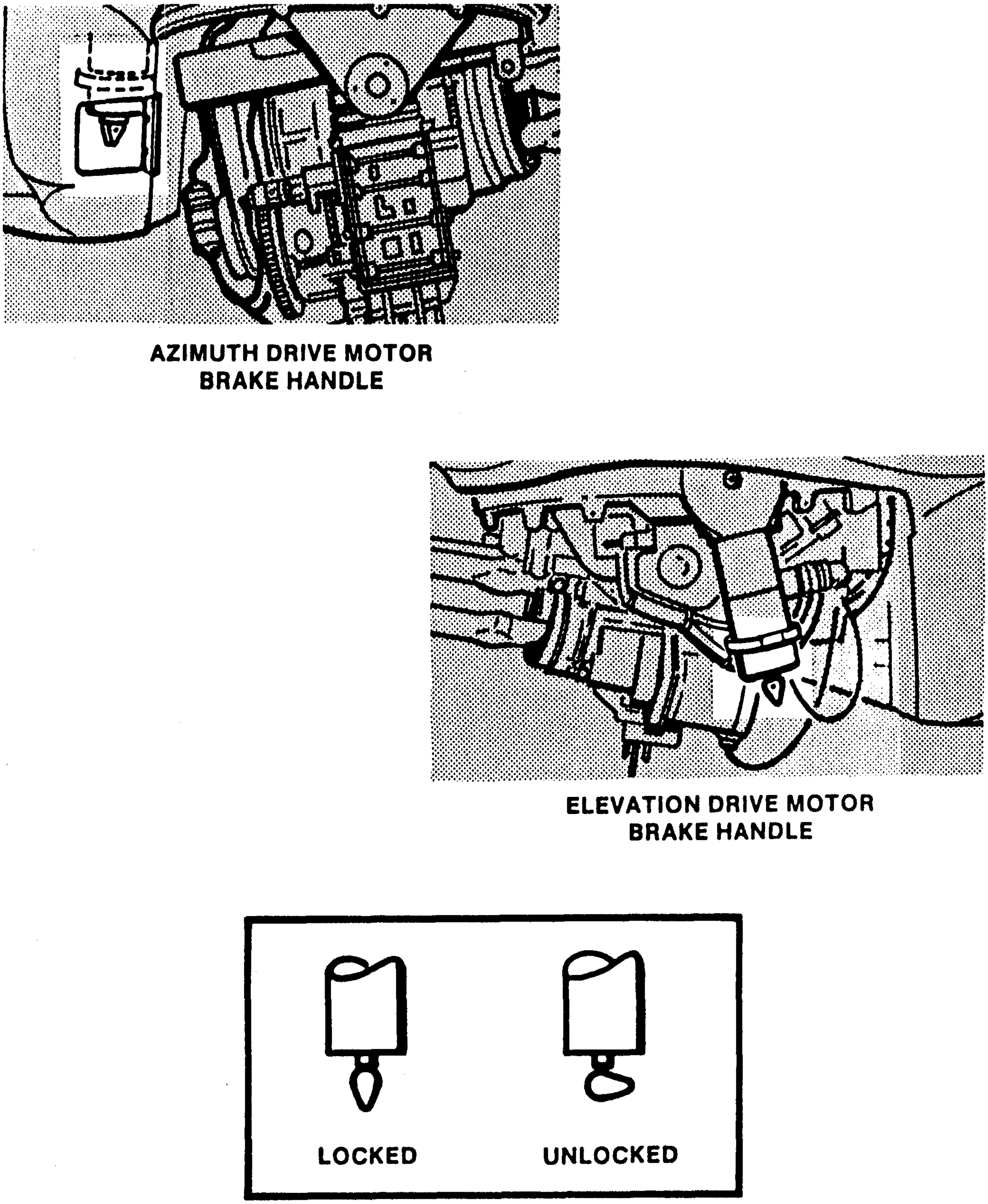



Figure 16-1. Turret Gun Brake Toggle (ECAS and MC)

## Section III. HYDRAULICS

**16-6. GENERAL. The outboard wing stores pylon is equipped with a hydraulically controlled actuator which adjusts the trajectory angle of the TOW or rocket launchers, Figure 16-2.**

**16-7. HYDRAULIC HOSE DAMAGE. In the event that the hydraulic pressure lines which lead to the actuator sustain battle damage, they may be repaired by using procedures in Chapter 9.**

## Section IV. AIR DATA SUBSYSTEM

**16-8. GENERAL.** The air data subsystem may be disabled by leaks in its pneumatic lines.

**16-9. DAMAGED PNEUMATIC LINES.**

**GENERAL INFORMATION:** This procedure is used to repair damaged tubing running from the ADS sensor. Refer to Figure 16-3 for location of pneumatic lines. These are low pressure air lines.

**OPTION 1: Splice Tubing.**

**LIMITATIONS:** None.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Fluid Line Repair Kit (item 4, App. B)
- Sealant (items 123-128, App. C)

**PROCEDURAL STEPS:**

1. Straighten damaged tubing and remove portion of tube that would obstruct air flow.

2. Install a length hose over each end of tube.

3. Secure with hose clamps if available. Due to low pressure levels, tight fitting tubing may not need clamps.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

**OPTION 2:** Tape and Sealant Repair.

**LIMITATIONS:** None.

**PERSONNEL/TIME REQUIRED:**
- 1 Soldier
- 30 Minutes

**MATERIALS/TOOLS REQUIRED:**
- Tape (item 153 or 150, App. C)
- Sealant (items 123-127, App. C)

**PROCEDURAL STEPS:**

1. Straighten damaged tubing and remove obstructions to airflow.

2. Wrap damaged area with tape.

3. Apply sealant over tape to effect an airtight seal.

4. Record BDAR action taken. When mission is complete, as soon as practical, repair the equipment/-system using standard maintenance procedures.

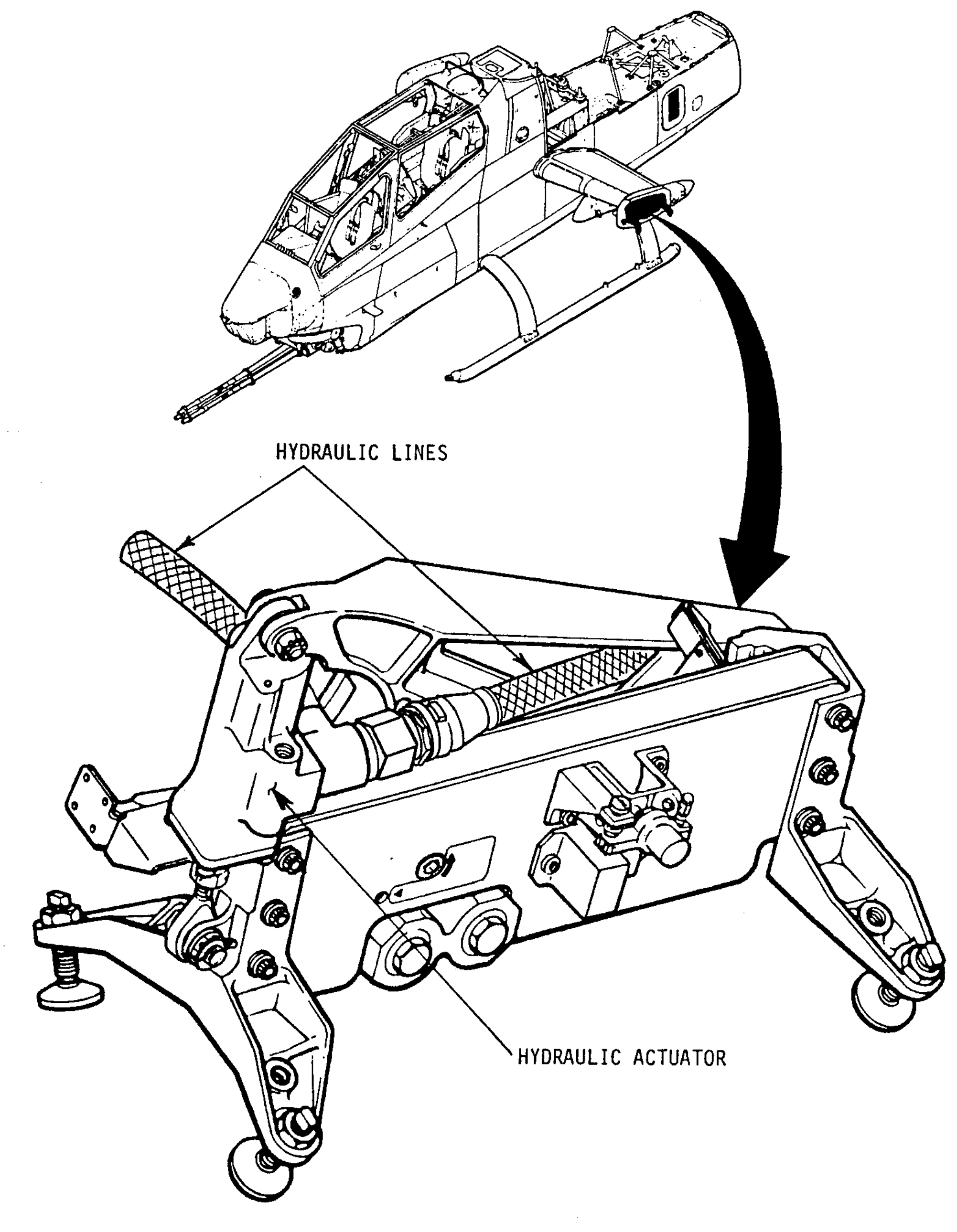
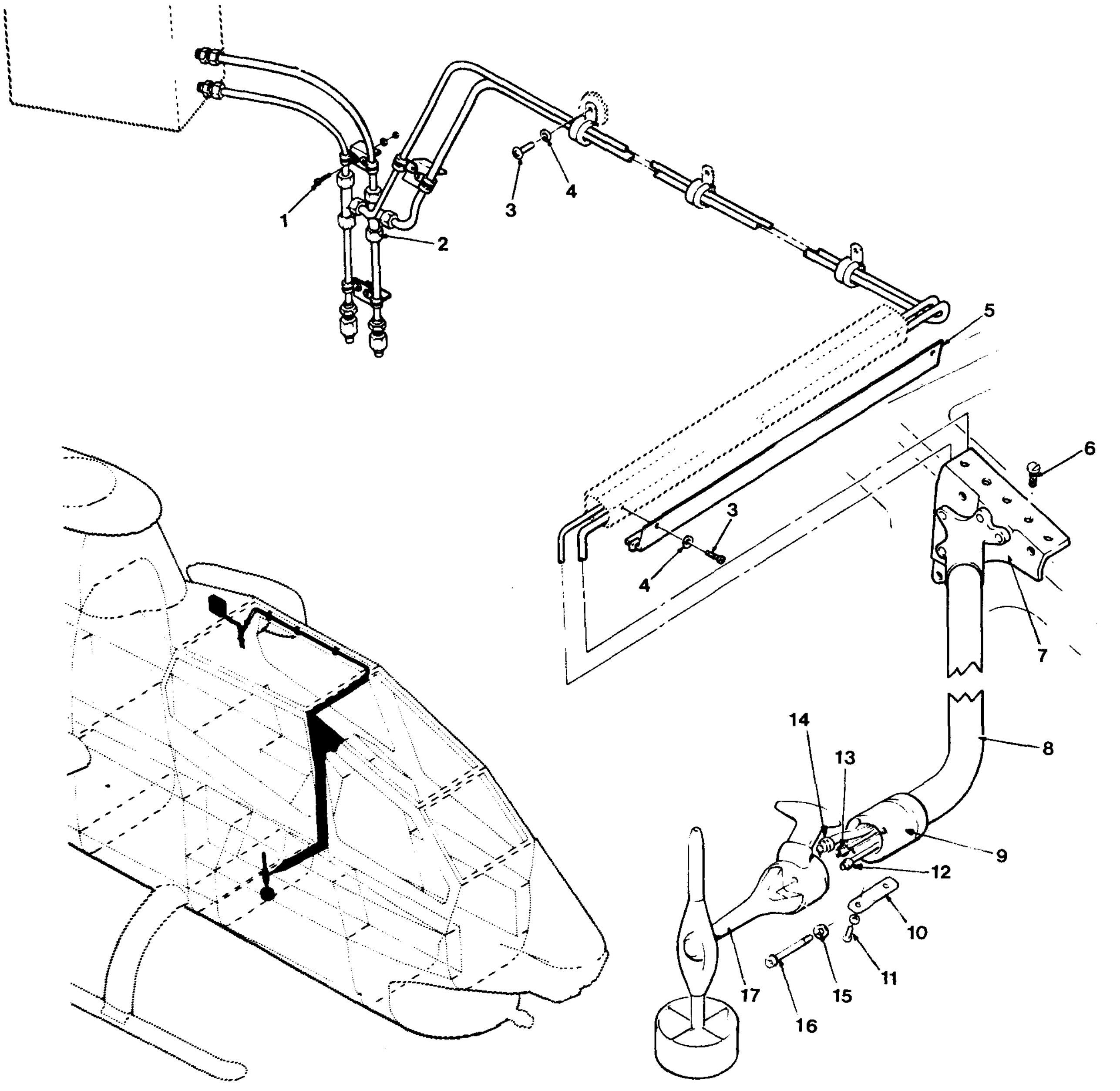



Figure 16-2. Outboard Wing Stores Pylon




| | |
|---|---|
| 1. Pitot Union Tee | 9. Support Assembly |
| 2. Static Union Tee | 10. Grounding Strap |
| 3. Screw | 11. Screw |
| 4. Washer | 12. Pitot Union Connector |
| 5. Canopy Channel Support | 13. Static Union Connector |
| 6. Screw | 14. Electrical Connector 18A2J1 |
| 7. Mounting Bracket | 15. Washer |
| 8. Tube Assembly | 16. Bolt |
| | 17. AADS |

Figure 16-3. ADS Pneumatic Lines

# CHAPTER 17

# EMERGENCY EQUIPMENT

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.

There are no BDAR repairs offered for the emergency equipment.

# 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.**

The following references of the issue in effect are required for use by repair personnel to accomplish the instructions set forth in this TM.

| PUBLICATION NUMBER | TITLE |
|---|---|
| AR95-1 | Army Aviation Flight Regulations |
| AR 385-11 | Ionizing Radiation Protection |
| AR708-1 | Catalog Supply and Management Data |
| DA Form 2028 | Recommend Changes to Publications |
| DA Form 2408-13 | Aircraft Inspection and Maintenance Record |
| DA Form 2408-18 | Equipment Inspection List |
| DA Pam 738-751 | The Army Maintenance Management System (TAMMS) |
| FM 1-500 | Army Aviation Maintenance |
| FM 3-5 | NBC Decontamination |
| FM 10-68 | Aircraft Refueling |
| FM 21-11 | First Aid for Soldiers |
| SF 368 | Quality Deficiency Report |
| TB MED 501 | Occupational and Environmental Health Hearing Conservation |
| TB 43-0108 | Handling, Storage, and Disposal of Army Aircraft Components Containing Radioactive Materials |
| TM 1-1500-328-25 | Aeronautical Equipment Maintenance Management Policies and Procedures |
| TM 3-261 | Handling and Disposal of Unwanted Radioactive Materials |
| TM 55-1500-204-25/1 | General Aircraft Maintenance Manual |
| TM 55-1520-236-23 | Aviation Unit and Intermediate Maintenance Manual: Model AH-1S (PROD), AH-1(ECAS) AH-1S (Modernized Cobra) Helicopters |

# APPENDIX B

# SPECIAL OR 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 special tools and test equipment. Several special tools are contained in the BDAR kits listed on the next page. The kits also contain small quantities of parts and durable supplies not listed in other appendices. Each kit contains its own inventory list and tool usage instructions. There are no fabricated tools associated with this BDAR manual.

## Section II. TOOLS

**B-2. SPECIAL TOOL LISTINGS.** The items listed in this appendix will enhance crew members and mechanics at all levels to accomplish battlefield damage assessment and repairs.

## SPECIAL OR FABRICATED TOOLS

| ITEM NO. | NSN | DESCRIPTION |
|---|---|---|
| 1 | Not Assigned | Composite Structures Repair Kit |
| 2 | 5935-01-161-5883<br>(11851) DMC658 | Connector Repair Kit (Special Tools for Electrical Connector Repair) |
| 3 | 4920-01-266-7535<br>(11851) DMC895 | Emergency Repair Kit (Special and Common Tools for Electrical Repair, including Repair Parts) |
| 4 | 4920-01-266-7534<br>(78286)<br>70700-20900-041 | Fluid Line Repair Kit (Special and Common Tools for Tubing and Hose Repair, Including Repair Parts) |
| 5 | Not Assigned | Fuel Cell Repair Kit |
| 6 | Not Assigned | High Energy Laser Damage Analysis Test Kit |
| 7 | Not Assigned | Optical Component Repair Kit |
| 8 | 5120-00-017-2849<br>(1 0054) 200 | Riveter, Blind, Hand |
| 9 | 5120-00-224-9296<br>(25472) C6000-10-32 | Riveter, Blind, Hand |
| 10 | 5120-00-979-7601<br>(03481 ) C6000-4-40 | Riveter, Blind, Hand |
| 11 | 3540-01-117-7870<br>(19836) 50-T | Sealing Iron, Electric |
| 12 | Not Assigned | Standard Structures Repair Kit |
| 13 | 4920-01-266-7536<br>(78286)<br>70700-20638-041 | Test Equipment Repair Kit (Electrical Test Equipment) |
| 14 | 5935-01-254-1688<br>(06090) MK-0015-1 | Wire Repair Kit (Special Tools Used for Electrical Wiring Repair, Including Repair Parts) |
| 15 | 3455-00-222-3792<br>(72295) F508 | Wing Milling Cuter |
| 16 | 4920-01-035-0319<br>(84955) K747-409-1 | Wing Router, Electric |
| 17 | 4920-01-035-0324<br>(84955) K747-401 -1 | Wing Router Kit |

# APPENDIX C

# EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

**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

**C-1. SCOPE.** This appendix lists expendable supplies and materials needed to make BDAR fixes on the AH-1 attack helicopter. Items are listed alphabetically by the item shown in the description column. These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items) or CTA 8-100.

**C-2. EXPLANATION OF COLUMNS.**

a. Item Nuber. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, item 5, Appendix C").

b. National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

c. Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Commercial and Government Entity Code (CAGEC) in parentheses followed by the part number.

d. Unit of Issue (U/I). Is the abbreviation of the types of units under which material is issued.

APPENDIX ε

## Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

| ITEM NUMBER | NSN | DESCRIPTION | UNIT OF ISSUE |
|---|---|---|---|
| 1 | 8040-01-089-9073 | Adhesive, Epoxy (Blade Repair) (33564) EA9330 | CN |
| 3 | 8040-01-102-2098 | Adhesive, Epoxy (Blade Repair) (33564) EA934NA | CN |
| 4 | 8040-00-944-7292 | Adhesive, Epoxy Metal Set A4 (33564) EA9340 | CN |
| S | 8040-00-165-8614 | Adhesive, General Purpose (81348) MMM-A-121 | TU |
| 6 | 8040-00-941-9984 | Adhesive, Silicone Rubber (80244) MIL-A-46106, Type I | TU |
| 7 | 6810-00-238-81 X 9 | Aliphatic Naphtha (81348) TTN95 | GL |
| 8 | 5306-01-107-1224 | Bolt (80205) NAS1303-4 | HD |
| 9 | 5306-00-680-5285 | Bolt (80205) NAS1303-6 | EA |
| 10 | 5306-00-619-2178 | Bolt (80205) NAS1303-8 | EA |
| 11 | 5306-01-074-2075 | Bolt (80205) NAS1303-10 | HD |
| 12 | 5306-00-807-2958 | Bolt (80205) NAS1304-4H | EA |
| 13 | 5306-00-722-1788 | Bolt (80205) NAS1304-6 | HD |
| 14 | 5306-00-655-7443 | Bolt (80205) NAS1304-8 | BX |
| 15 | 5306-00-616-6471 | Bolt (80205) NAS1304-10 | BX |
| 16 | 5306-00-806-7697 | Bolt (80205) NAS1305-4 | BX |
| 17 | 5306-00-774-8915 | Bolt (80205) NAS1305-6 | BX |
| 18 | 5306-00-582-5723 | Bolt (80205) NAS1305-8 | BX |
| 19 | 5306-00-816-0948 | Bolt (80205) NAS1305-10 | BX |
| 20 | 5306-00-292-8284 | Bolt (88044) AN173H4A | BX |
| 21 | 5306-00-150-9083 | Bolt (88044) AN173H10 | BX |
| Z Z | 5306-00-156-2533 | Bolt (88044) AN173H6A | BX |
| 23 | 5306-00-206-4911 | Bolt (88044) AN173H15A | BX |
| 24 | 5306-00-141-4511 | Bolt (88044) AN173H20A | BX |
| 25 | 7920-00-514-2417 | Brush, Stiff Fiber Bristle (80244) H-B-643 | EA |
| 26 | 5975-00-156-3253 | Cable, Tie, Electrical (81349) MIL-S-23190 | EA |
| 27 | 5975-00-984-6582 | Cable Tie, Electrical (81349) MIL-S-23190 | EA |
| 28 | 5940-00-280-3499 | Cap, Electrical Crimp (96906) MS25274-2 | EA |
| 29 | 5979-00-729-1628 | Cap, Electrical Crimp 14/16 AWG (Blue) (81349) MIL-T-7928 | PG |
| 30 | 8030-00-057-2354 | Chemical Conversion Coating (Alodine) (80244) MIL-C-81706 | GL |
| 31 | 4730-00-289-5909 | Clamp, Hose, 3/8 to 1 in. (70403) MIL-C-11569 | EA |
| 32 | 4730-00-908-3193 | Clamp, Hose, 1-1/16 to 2 in. (01944) MS35842-12 | EA |

APPENDIX C

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST (Cont)

| ITEM NUMBER | NSN | DESCRIPTION | UNIT OF ISSUE |
|---|---|---|---|
| 33 | 8030-00-231-2345 | Corrosion Preventive Compound (80244) MIL-C-16173 | CN |
| 34 | 5310-00-297-3751 | Cotter Pin Assortment (81348) | KT |
| 35 | 9540-00-140-2401 | Extrusion Angle 2X1X0.125 (81348) QQ-A-200/9 | FT |
| 36 | 9540-00-140-2417 | Extrusion Angle 1-1/2Xl 1/2 0.125 (81348) QQ-A-200/11 | FT |
| 37 | 9540-00-145-4524 | Extrusion Angle 1-1/4X3/4 0.063 (81348) QQ-A-200/3 | FT |
| 38 | 9540-00-145-5716 | Extrusion Angle 1-3/4Xl 1/2 0.156 (81348) QQ-A-200/11 | FT |
| 39 | 9540-00-145-7542 | Extrusion Angle 2X1X0.156 (81348) QQ-A-200/11 | FT |
| 40 | 9540-00-145-7543 | Extrusion Angle 2X1 1/2 0.125 (81348) QQ-A-200/3 | FT |
| 41 | 9540-00-230-2338 | Extrusion Angle 1-1/2Xl 1/2 0.188 (81348) QQ-A-200/11 | FT |
| 42 | 9540-00-236-5240 | Extrusion Angle 3X1 1/2 0.250 (81348) QQ-A-200/11 | FT |
| 43 | 9540-00-596-3006 | Extrusion Angle 1-1/2 X 1/4 0.094 (81348) QQ-A-200/11 | FT |
| 44 | 9540-00-854-6554 | Extrusion Angle 2X2 0.250 (81348) QQ-A-200/ | FT |
| 45 | 9540-00-931-7261 | Extrusion Angle 2X2 0.188 (81348) QQ-A-200/3 | FT |
| 46 | 9540-00-933-9650 | Extrusion Angle 1-1/2X1 1/2 0.094 (81348) QQ-A-200/3 | FT |
| 47 | 9540-00-596-3016 | Extrusion, L Angle 2024T-4 0.063 (81348) QQ-A-267 | FT |
| 48 | 9540-00-555-1172 | Extrusion, T Angle 2024T-4 0.063 (81348) QQ-A-200/3 | FT |
| 49 | 5940-00-296-5326 | Ferrul, Electrical, 22-14 Wire Gage size (10 ea) (59730) | EA |
| 50 | 8305-00-530-0109 | Fiberglass Cloth (81349) MIL-C-9084 | RO |
| 51 | 8305-00-530-0111 | Fiberglass Resin (81349) MIL-C-9084 | CN |
| 52 | 5330-00-467-3615 | Gasket, Material 1/32 in. (81348) HH-P-96 | SH |
| 53 | 5970-00-032-0291 | Heat Shrink Sleeve Assortment (61521) DI-295-MS-1 | KT |
| 54 | 4730-00-203-3131 | Hose Clamp (66295) AN737TW57-66 | EA |
| 55 | 4730-00-278-9200 | Hose Clamp (66295) AN737TW22 | EA |

APPENDIX C

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST (Cont)

| ITEM NUMBER | NSN | DESCRIPTION | UNIT OF ISSUE |
|---|---|---|---|
| 56 | 4730-00-279-0065 | Hose Clamp (08484) QS200M1200 | EA |
| 57 | 4730-00-541-7747 | Hose Clamp (66295) AN737TW74-91 | EA |
| 58 | 4730-00-720-0167 | Hose Clamp (88044) AN737TW30 | EA |
| 59 | 4730-00-908-6292 | Hose Clamp (88044) AN737RM98 | EA |
| 60 | 9505-00-596-5101 | Lockwire, Steel 0.020 (81348) QQ-W-423 | RO |
| 61 | 9505-00-293-4208 | Lockwire, Steel 0.032 (81348) QQ-W-423 | RO |
| 62 | 9505-00-331-3275 | Lockwire, Steel 0.041 (81348) QQ-W-423 | RO |
| 63 | 5310-00-297-3751 | Nut Assortment (81348) FFN836 | PG |
| 64 | 5310-00-807-1467 | Nut (80205) NAS1291X3 | BX |
| 65 | 5310-00-807-1469 | Nut (21450) 503443 | BX |
| 66 | 5310-00-807-1474 | Nut (80205) NAS679A3 | BX |
| 67 | 5310-00-807-1475 | Nut (96906) MS21042L4 | BX |
| 68 | 5310-00-680-7105 | Nut, Self-Lock Steel 5/16 (80205) NAS 679C5M | EA |
| 69 | 5310-00-807-1474 | Nut, Self-Lock Steel 3/16 in (80205) NAS679A3 | HD |
| 70 | 5310-00-844-4872 | Nut, Self-Lock Steel 1/4 in (80205) NAS67904 | HD |
| 71 | 5330-00-966-8657 | Packing, Preformed Assortment (51808) MAOK311 | PG |
| 72 | 1615-01-089-0437 | Parts Kit, Rotor (84955) K747-201-119 | EA |
| 73 | 1615-01-041-7060 | Patch Kit (84955) K747-201-1 | EA |
| 74 | 1615-01-041-7061 | Patch Kit (84955) K747-201-3 | EA |
| 75 | 1615-01-041-7062 | Patch Kit (84955) K747-201-5 | EA |
| 76 | 5340-01-161-2806 | Patch Kit, Erosion (84955) K747-204-11 | EA |
| 77 | 1615-01-042-9466 | Patch Kit, Trial Spline (84955) K747-201-113 | EA |
| 78 | 9150-00-250-0926 | Petrolatum, Technical (81349) VV-P-236 | CN |
| 79 | 1615-01-041-7063 | Plug Kit (84955) K747-201-7 | EA |
| 80 | 1615-01-041-7064 | Plug Kit (84955) K747-201-9 | EA |
| 81 | 1615-01-041-7065 | Plug Kit (84955) K747-201-1O1 | EA |
| 82 | 1615-01-041-7067 | Plug Kit (84955) K747-201-1O5 | EA |
| 83 | 1615-01-041-7069 | Plug Kit (84955) K747-201-1O9 | EA |
| 84 | 1515-01-042-9467 | Plug Kit (84955) K747-201-111 | EA |
| 85 | 8030-00-616-7696 | Potting Compound, Electrical (81349) MIL-S-8516 | KT |

APPENDIX C

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST (Cont)

| ITEM NUMBER | NSN | DESCRIPTION | UNIT OF ISSUE |
|---|---|---|---|
| 86 | 8030-00-664-4968 | Putty, Chromate (81349) MIL-P-8116 | RO |
| 87 | 5905-00-901-9520 | Resistor, Fixed Composition 51 ohm (81349) 63A5A68-51O | EA |
| 88 | 1560-01-161-2805 | Repair Kit, Erosion (84955) K747-207 | EA |
| 89 | 1560-01-161-7591 | Repair Kit, Erosion (84955) K747-206 | EA |
| 90 | 1615-01-126-9449 | Repair Kit, Rotor, 3 X 1/4 in. (78286) 70092-15001-016 | EA |
| 91 | 1615-01-126-9450 | Repair Kit, Rotor, 3 X 7/8 in. (78286) 70072-15001-017 | EA |
| 92 | 1615-01-126-9451 | Repair Kit, Rotor, 6 X 1/4 in. (78286) 70072-15001-018 | EA |
| 93 | 1615-01-126-9452 | Repair Kit, Rotor, 6 X 7/8 in. (78286) 70072-15001-020 | EA |
| 94 | 1615-01-128-1748 | Repair Kit, Rotor 3 X 1/4 in. (78286) 70072-15001-015 | EA |
| 95 | 1615-01-128-4408 | Repair Kit, Rotor, 6 X 1/2 in. (78286) 70072-15001-019 | EA |
| 96 | 4920-01-035-0324 | Repair Kit, Rotor (84955) K747-401-1 | EA |
| 97 | 6810-00-995-4804 | Resin Activator (22527) 4573T | KT |
| 98 | 5320-00-006-4912 | Rivet, Blind (92215) RV11OO-4-3 | BX |
| 99 | 5320-00-117-6826 | Rivet, Blind (96906) MS2040AD4-4 | BX |
| 100 | 5320-01-033-8177 | Rivet, Blind, Cherry Max 5-2 (81349) MIL-R-7885/6 | EA |
| 101 | 5320-01-033-8178 | Rivet, Blind, Cherry Max 5-6 (81349) MIL-R-7885/6 | EA |
| 102 | 5320-01-033-8179 | Rivet, Blind (81349) MIL-R-7885/6 | BX |
| 103 | 5320-01-041-6454 | Rivet, Blind (11815) CR3553-5-2 | EA |
| 104 | 5320-01-041-6458 | Rivet, Blind, CR3553-6-6 (96906) MS7885/8-6-6 | EA |
| 105 | 5320-01-042-2891 | Rivet, Blind (7652) CR3553-5-6 | EA |
| 106 | 5320-01-042-8250 | Rivet, Blind (F7652) CR3553-6-4 | EA |
| 107 | 5320-01-042-8893 | Rivet, Blind (F7652) CR3553-6-2 | EA |
| 108 | 5320-01-043-6694 | Rivet, Blind (F7652) CR35553-5-4 | EA |
| 109 | 5320-01-084-9234 | Rivet, Blind, Cherry Max 6-6 (81349) MIL-R-7885/2 | EA |

APPENDIX C

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST (Cont)

| ITEM NUMBER | NSN | DESCRIPTION | UNIT OF ISSUE |
|---|---|---|---|
| 110 | 5320-01-084-9235 | Rivet, Blind (81349) MIL-R-7885/2-6-05 | EA |
| 111 | 5320-01-084-9236 | Rivet, Blind (11815) CR3213-6-11 | EA |
| 112 | 5320-01-135-7319 | Rivet, Blind, Cherry Max 6-3 (81349) MIL-R-7885/2 | EA |
| 113 | 5320-01-136-1782 | Rivet, Blind, Cherry Max 6-4 (81349) MIL-R-7885/2 | EA |
| 114 | 5320-00-408-6073 | Rivet, Pop, Aluminum, 3/16 in. dia., 1/8 in. long (81349) MIL-R-24243 | HD |
| 115 | 5320-00-510-7823 | Rivet, Pop, Aluminum (05693) AAP-4-2 | EA |
| 116 | 9320-00-291-8468 | Rubber Sheet (22337) PF1O056 | SH |
| 117 | 5330-00-224-7201 | Sand Paper 400 Grit (81348) P-P-101 | SH |
| 118 | 5350-00-224-7203 | Sand Paper 320 Grit (81348) P-P-101 | SH |
| 119 | 5350-00-619-9167 | Sand Paper 80 Grit (81348) P-P-101 | |
| 120 | 5350-00-721-8117 | Sand Paper 180 Grit (81348) P-P-101 | SH |
| 121 | 5330-01-060-8212 | Sand Paper 600 Grit (98747) 7530179-50 | SH |
| 122 | 5305-00-206-2036 | Screws, Wood (81348) FF-S-85 | BX |
| 123 | 8030-00-881-5238 | Sealant and Puttying Compound (81349) MI L-S-8516 | KT |
| 124 | 8030-00-935-1083 | Sealant, Asphalt Base (81349) | CN |
| 125 | 8030-00-965-2004 | Sealant, Synthetic Rubber (81349) MIL-S-8802 | KT |
| 126 | 8030-00-656-1426 | Sealing Compound, Gasket Non-Hardening (81349) MIL-S-45180 | PT |
| 127 | 8030-00-723-2746 | Sealing Compound, Pro-Seal 890 (81349) MIL-S-7502 | QT |
| 128 | 8040-00-828-7385 | Silicon Sealant | TU |
| 129 | 6850-00-264-9038 | Solvent, Cleaning, P-D-680 (81348) | GL |
| 130 | 5940-00-500-8723 | Splice, Conductor, Crimp Style, Wire Gage 10 (96906) MS25181-3 | EA |
| 131 | 9515-00-231-8601 | Sheet Metal, 0.032 Stainless (81349) MIL-S-5059 | SH |
| 132 | 9515-00-596-1728 | Sheet Metal, 0.040 Stainless (81349) MIL-S-5059 | SH |
| 133 | 9515-00-995-0731 | Sheet Metal, 0.016 Stainless (81349) MIL-S-5059 | SH |
| 134 | 9535-00-167-2280 | Sheet Metal, 0.040 2024-T3 (81348) QQ-A-250/5 | SH |
| 135 | 9535-00-232-0383 | Sheet Metal, 0.071 2024-T3 (81348) QQ-A-250/5 | SH |

# APPENDIX C

## Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST (Cont)

| ITEM NUMBER | NSN | DESCRIPTION | UNIT OF ISSUE |
|---|---|---|---|
| 136 | 9535-00-232-0405 | Sheet Metal, 0.090 2024-T3 (81348) QQ-A-250/5 | SH |
| 137 | 9535-00-232-0529 | Sheet Metal, 0.063 2024-T3 (81348) QQ-A-250/5 | SH |
| 138 | 9535-00-232-0569 | Sheet Metal, 0.050 2024-T3 (81348) QQ-A-250/5 | SH |
| 139 | 9535-00-232-7540 | Sheet Metal, 0.063 7075-T6 (81348) QQ-A-250/13 | SH |
| 140 | 9535-00-236-7075 | Sheet Metal, 0.125 7075-T6 (81348) QQ-A-250/13 | SH |
| 141 | 9535-00-249-5808 | Sheet Metal, 0.040 7075-T6 (81348) QQ-A-250/13 | SH |
| 142 | 9535-00-249-5809 | Sheet Metal, 0.050 7075-T6 (81348) QQ-A-250/13 | SH |
| 143 | 5305-00-854-6689 | Sheet Metal Screws (96906) MS24617-21 | BX |
| 144 | 5305-00-883-0628 | Sheet Metal Screws (96906) MS24617-21 | BX |
| 145 | 5940-01-079-1375 | Splice, 14/16 AWG Blue (81349) MIL-T-7928/3 | EA |
| 146 | 5940-01-079-1646 | Splice, 24/26 AWG Yellow (81349) MIL-T-7928/3 | EA |
| 147 | 5940-01-079-1647 | Splice, 18/20 AWG Red (81349) MIL-T-7928/5 | EA |
| 148 | 5940-01-079-1936 | Splice, 12/10 AWG Yellow (81349) MIL-T-7928/3 | EA |
| 149 | 4020-00-753-6555 | String (81349) MIL-T-43435 | RO |
| 150 | 7510-00-473-9855 | Tape, Aluminum (81349) MIL-T-23397 | RO |
| 151 | 5970-00-419-4291 | Tape, Electrical (81349) MIL-I-24191 | RO |
| 152 | 7510-00-680-2450 | Tape, Masking (80244) MIL-T-21595 | RO |
| 153 | 7510-00-074-5124 | Tape, Green (58536) A-A-1586 | RO |
| 154 | 5940-00-143-4777 | Terminal, Lug (81349) MIL-T-7928 | BX |
| 155 | 5940-00-115-0776 | Terminal, Lug, 2 AWG 3/8 in. Hole (96906) MS20659-114 | EA |
| 156 | 5940-00-115-4992 | Terminal, Lug, 6 AWG 3/8 in. Hole (96906) MS20659-110 | EA |
| 157 | 5940-00-143-4771 | Terminal, Lug, 10 AWG 18/20 (96906) MS25036-103 | EA |
| 158 | 5940-00-143-4780 | Terminal, Lug, Crimp Style Stud, Size 10, Wire Gage 16-14 (81349) MIL-T-7928 | BX |

APPENDIX C

Section II. -EXPENDABLE SUPPLIES AND MATERIALS LIST (Cont)

| ITEM NUMBER | NSN | DESCRIPTION | UNIT OF ISSUE |
|---|---|---|---|
| 159 | 5940-00-804-9184 | Terminal, Quick Disconnect, Wire Size 14-16 (96906) MS27429-2 | PG |
| 160 | 5940-00-804-9185 | Terminal, Quick Disconnect, Wire Size 18 (96906) MS27429-1 | PG |
| 161 | 8305-00-753-2967 | Towel, Wiping (81348) CCCC46 | BX |
| 162 | 5310-00-275-4290 | Washer Assortment (81349) MIL-W-1085 | PG |
| 163 | 5310-00-167-0765 | Washer, Flat (88044) AN970-3 | BX |
| 164 | 5310-00-167-0766 | Washer, Flat (88044) AN970-4 | BX |
| 165 | 5310-00-167-0801 | Washer,'Flat Steel, 3/16 (88044) AN960C10 | EA |
| 166 | 5310-00-167-0812 | Washer, Flat (88044) AN960C10L | EA |
| 167 | 5310-00-205-8924 | Washer, Flat'(88044) AN960C416L | EA |
| 168 | 5310-00-209-0027 | Washer, Flat Steel, 1/4 (80205) NAS143-4 | EA |
| 169 | 5310-00-883-3049 | Washer, Flat Steel 5/16 (80205) NAS1587-5L | EA |
| 170 | 6145-00-144-0231 | Wire, Electrical, 22 AWG (81349) MIL-W-81044/11 | FT |
| 171 | 6145-00-192-0680 | Wire, Electrical, 14 AWG (81349) MIL-W-81044/2 | FT |
| 172 | 6145-00-578-6595 | Wire, Electrical, 4 AWG (81349) MIL-W-508662 | FT |
| 173 | 6145-00-917-6378 | Wire, Electrica1, 20 Gage (81349) MIL-W-22759/5 | FT |
| 174 | 6145-00-989-3723 | Wire, Electrica1, 1.2 Gage (81349) MIL-W-22759/5 | RO |
| 175 | 6145-00-9.93-5490 | Wire, Electrical, 18 Gage (81349) MIL-W-22759/5 | FT |
| 176 | 6145-01-081-1073 | Wire, Electric-a1, 10 Gage (92607) M22759/5-10-9 | FT |
| 177 | 6145-01-122-3317 | Wire. Electrica1, 2 Gage (81349) MIL-W-22759/3 | FT |
| 178' | 6145-01-203-5399 | Wire, Electrica1, 16 Gage (81349) MIL-W-22759/3 | FT |

# APPENDIX D

# SUBSTITUTE MATERIALS/PART

**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

**D-1. GENERAL.** This appendix lists substitute/-alternate materials and parts. Section II contains prime National stock number (NSN) interchangeability cross-references for spare and repair parts from other models of helicopters. Section III contains O-ring, packing, and gasket substitute information. Section IV contains petroleum, oil, lubricant (POL) substitute, and blending information. Section V contains a substitute table for structural metal alloys.

## Section II. INTERCHANGEABLE PARTS

**D-2. SCOPE.** This section lists and cross-references AH-1 spare and repair parts to other systerns having these same parts.

**D-3. GENERAL.**

a. Parts pertaining to the aircraft mechanical and electrical functions are listed on Table D-1. For cross-reference to aircraft armament parts use Table D-2.

b. All parts which have the same NSN can be used on the AH-1 without making any modification prior to installation.

c. All subcomponents of the major components may be substituted; however, the level of disassembly must be consistent with field tools and skill levels available.

d. These table listings maybe used to cross--reference parts and components provided from cannibalized aircraft.

Table D-1. Spare and Repair Parts

| NOUN/NSN | ARMY HELICOPTERS | | | | | | | | | | NAVY HELICOPTERS | | | | | AIR FORCE HELICOPTERS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRIMARY PART | SUBSTITUTE PART FROM: | | | | | | | | | SUBSTITUTE PART FROM: | | | | | SUBSTITUTE PART FROM: | | |
| | AH1 (MC) (PROD) (ECAS) | UH60 | UH1H | EH1H | AH64 | UH1V | UH1M | OH58 | OH6A | CH47 | AH1T | UH1E | UH1N | UH1K | UH1L | HH1H | UH1F | UH1P |
| BLADE MAIN ROTOR 1615-00-389-1950 | X | | | | | | X | | | | | X | | X | X | | | |
| HUB ASSEMBLY MAIN ROTOR 1615-01-014-6007 | X | | | | | | | | | | | | | | | | | |
| TRANSMISSION ASSY 1615-01-014-6006 | X | | | | | | | | | | | | | | | | | |
| ENGINE 2840-00-621-1860 | X | | | | | | | | | | | | | | | | | |
| SKID TUBE 1630-00-247-0251 | X | | | | | | | | | | | | X | | | | | |
| CROSS TUBE SKID 1620-00-106-0034 | X | | | | | | | | | | X | | | | | | | |
| DRIVESHAFT TAIL ROTOR 1615-01-008-2798 | X | | X | X | | X | X | | | | | X | X | X | X | X | X | X |
| HANGER BEARING TAIL ROTOR 1615-01-021-6150 | X | | X | X | | X | X | | | | | X | | X | X | X | X | X |
| ELEVATOR, SYNC 1560-01-027-3730 | X | | | | | | | | | | | | | | | | | |
| CYLINDER TAIL ROTOR SERVO 1650-00-944-8165 | X | | | | | $Y^1$ | $Y^1$ | | | | | $Y^1$ | | $Y^1$ | $Y^1$ | $Y^1$ | | |
| HYDRAULIC FLUID RESERVOIR 1680-00-872-1154 | X | | | | | | $Y^4$ | | | | | $Y^4$ | | | | | | |
| TURBINE FAN, OIL COOLER 2935-00-543-7296 | X | | X | X | | X | X | | | | | X | | X | X | X | | |
| FUEL PUMP SUBMERGED 2915-00-999-3705 | X | | X | | | | | | | | | | X | | | | | |
| MAST ASSEMBLY 1615-00-179-9165 | X | | | | | | | | | | | | | | | | | |
| BLADE TAIL ROTOR 1615-00-254-2175 | X | | | | | | | | | | | | X | | | X | | |
| STARTER GENERATOR 2925-00-878-1136 | X | | $Y^2$ | $Y^2$ | | $Y^2$ | $Y^2$ | | | | | | | | | $Y^2$ | | |
| SERVO, CYLINDER FLT. CONT. 1650-00-011-9022 | X | | | | | | | | | | | | | | | | | |

NOTE 1: Components marked X are 100% interchangeable and have the same NSN. Components marked Y, $Y^1$, $Y^2$, $Y^3$, and $Y^4$ are 100% interchangeable but have different NSN.

NOTE 2: All subcomponents of the major components may be removed and substituted; however, the level of disassembly must be consistent with the field tools and skill levels available.

NOTE 3: There is no degradation of hardware or aircraft performance created by using substitute parts listed on this table.

Table D-1. Spare and Repair Parts (Cont)

| NOUN/NSN | ARMY HELICOPTERS PRIMARY PART A (MC) H (PROD) 1 (ECAS) | ARMY HELICOPTERS SUBSTITUTE PART FROM: UH60 | UH1H | EH1H | AH64 | UH1V | UH1M | OH58 | OH6A | CH47 | NAVY HELICOPTERS SUBSTITUTE PART FROM: AH1T | UH1E | UH1N | UH1K | UH1L | AIR FORCE HELICOPTERS SUBSTITUTE PART FROM: HH1H | UH1F | UH1P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90° GEARBOX 1615-01-008-7748 | X | | | | | | | | | | | | | | | | | |
| 42° GEARBOX 1615-01-015-0584 | X | | | | | | | | | | | | | | | | | |
| MODULE HYDRAULIC 1650-01-059-6006 | X | | | | | | $Y^3$ | | | | | $Y^3$ | | $Y^3$ | $Y^3$ | | | |
| PUMP HYDRAULIC 4320-00-176-1261 | X | | | | | | X | | | | | X | | X | X | | | |
| IGNITER EXCITER 2925-00-064-9435 | X | | X | | | | | X | | X | | | | | | | | |
| LINEAR ACTUATOR 2995-00-990-3163 | X | | X | X | | X | X | | | | | X | | X | X | X | | |
| LOCK-OUT VALVE 1650-00-839-7078 | X | | | | | | | | | | | | | | | | | |
| OIL TANK 1560-00-973-1754 | X | | | | | | X | | | | | X | | | | | X | |
| OIL COOLER ENGINE 2935-00-177-8331 | X | | | | | | | | | | | | | | | | | |
| CONNECT LINK DROOP 1615-00-835-1457 | X | | | | | | | | | | | | | | | | | |
| CONNECT LINK DROOP 3040-00-835-1430 | X | | X | | | | | | | | | | | | | | | |
| CONNECT LINK DROOP 3040-00-928-3418 | X | | X | | | | | | | | | | | | | | | |
| CONNECT LINK DROOP 3040-00-835-1428 | X | | X | | | | | | | | | | | | | | | |
| XMSN FILTER ASSY 1615-00-796-5004 | X | | X | | | | X | | | | | X | | | | | X | |
| XMSN OIL COOLER 2935-00-877-1113 | X | | | | | | | | | | | | | | | | | |
| FUEL MANIFOLD 2915-00-003-5503 | X | | | | | | | | | | | | | | | | | |
| FUEL CUT-OFF VALVE 4810-00-758-2845 | X | | | | | | X | | | | | X | | | | | X | |
| FUEL FILTER ASSY 2915-00-003-5904 | X | | X | | | | | | | | | X | | X | | X | | |
| FORCE GRADIENT 1560-00-888-7348 | X | | X | X | | X | X | | | | | X | | | | X | X | X |
| CONNECTING LINK 3040-00-977-2663 | X | | | | | | | | | | | | | | | | | |
| CONNECTING LINK 3040-00-931-8304 | X | | | | | | | | | | | | | | | | | |
| CONNECTING LINK 3040-00-932-1194 | X | | | | | | | | | | | | | | | | | |

NOTE 1: Components marked X are 100% interchangeable and have the same NSN. Components marked Y, $Y^1$, $Y^2$, $Y^3$, and $Y^4$ are 100% interchangeable but have different NSN.

NOTE 2: All subcomponents of the major components may be removed and substituted; however, the level of disassembly must be consistent with the field tools and skill levels available.

NOTE 3: There is no degradation of hardware or aircraft performance created by using substitute parts listed on this table.

Table D-1. Spare and Repair Parts (Cont)

| | ARMY HELICOPTERS | | | | | | | | | | NAVY HELICOPTERS | | | | | AIR FORCE HELICOPTERS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRIMARY PART | SUBSTITUTE PART FROM: | | | | | | | | | SUBSTITUTE PART FROM: | | | | | SUBSTITUTE PART FROM: | | |
| NOUN/NSN | AH1 (MC) (PROD) (ECAS) | UH60 | UH1H | EH1H | AH64 | UH1V | UH1M | OH58 | OH6A | CH47 | AH1T | UH1E | UH1N | UH1K | UH1L | HH1H | UH1F | UH1P |
| CONNECTING LINK 3040-00-410-6334 | X | | | | | | | | | | | | | | | | | |
| CONNECTING LINK 1560-00-446-4478 | X | | | | | | | | | | | | | | | | | |
| CONNECTING LINK 3040-01-031-9151 | X | | | | | | | | | | | | | | | | | |
| CONNECTING LINK 3040-01-031-9152 | X | | | | | | | | | | | | | | | | | |
| CONNECTING LINK 3040-01-031-1200 | X | | | | | | | | | | | | | | | | | |
| CONNECTING LINK 3040-00-876-4915 | X | | | | | | | | | | | | | | | | | |
| CONNECTING LINK 3040-00-931-8274 | X | | | | | | | | | | X | | X | | | | | |
| CONNECTING LINK 3040-00-103-9485 | X | | | | | | | | | | X | | | | | | X | X |
| CONNECTING LINK 3040-00-931-8281 | X | | | | | | | | | | | | | | | | | |
| CONNECTING LINK 3040-00-971-6295 | X | | | | | | | | | | | | | | | | | |
| MAGNETIC BRAKE 1680-00-909-8098 | X | | | | | | | X | | | | X | X | | | X | | |
| FORCE GRADIENT 1680-00-919-2369 | X | | | | | | | | | | | | X | | | | | |
| TUBE CYCLIC CONTROL 1560-00-089-9824 | X | | | | | | | | | | | | | | | | | |
| TUBE CYCLIC CONTROL 3040-00-089-9825 | X | | | | | | | | | | | | | | | | | |
| MAGNETIC BRAKE 1680-00-909-8716 | X | | X | X | | X | X | X | | | X | X | X | X | X | X | X | X |
| CONNECTING LINK 3040-00-877-6573 | X | | X | | | | | | | | | | | | | | | |
| CONNECTING LINK 3040-00-931-8286 | X | | | | | | | | | | | | | | | | | |
| CONNECTING LINK 3040-00-931-8289 | X | | | | | | | | | | | | | | | | | |
| CONNECTING LINK 3040-00-931-8276 | X | | | | | | | | | | | | | | | | | |
| CONNECTING LINK 3040-00-931-8275 | X | | | | | | | | | | X | | | | | | | |
| CONNECTING LINK 5340-00-927-7401 | X | | | | | | | | | | | | | | | | | |

NOTE 1: Components marked X are 100% interchangeable and have the same NSN. Components marked Y, $Y^1$, $Y^2$, $Y^3$, and $Y^4$ are 100% interchangeable but have different NSN.

NOTE 2: All subcomponents of the major components may be removed and substituted; however, the level of disassembly must be consistent with the field tools and skill levels available.

NOTE 3: There is no degradation of hardware or aircraft performance created by using substitute parts listed on this table.

Table D-1. Spare and Repair Parts (Cont)

| NOUN/NSN | ARMY HELICOPTERS | | | | | | | | | | NAVY HELICOPTERS | | | | | AIR FORCE HELICOPTERS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRIMARY PART | SUBSTITUTE PART FROM: | | | | | | | | | SUBSTITUTE PART FROM: | | | | | SUBSTITUTE PART FROM: | | |
| | AH1 (MC) (PROD) (ECAS) | UH60 | UH1H | EH1H | AH64 | UH1V | UH1M | OH58 | OH6A | CH47 | AH1T | UH1E | UH1N | UH1K | UH1L | HH1H | UH1F | UH1P |
| INDICATING PANEL 1680-01-034-1080 | X | | | | | | | | | | | | | | | | | |
| AIRSPEED INDICATOR 6610-00-809-5515 | X | | | | | | | | | | | | | | | | | |
| PRESSURE ALTIMETER 6610-00-935-4323 | X | | X | | | | | X | | X | | | | | | | | |
| ATTITUDE INDICATOR 6610-00-128-7614 | X | | X | | | | | | | | | | | | | | | |
| COURSE INDICATOR 5826-00-505-3094 | X | | X | | | | | X | | | | | | | | | | X |
| CAUTION LIGHT 6340-00-155-7847 | X | | | | | | | | | | | | | | | | | |
| TORQUE INDICATOR 6620-01-028-0504 | X | | | | | | | | | | | | | | | | | |
| SYMBOL INDICATOR 6610-01-028-4647 | X | | | | | | | | | | | | | | | | | |
| TACHOMETER INDICATOR 6620-00-969-3772 | X | | | | | | | | | | | | | | | | | |
| TEMP., ENGINE, OIL INDICATOR 6685-00-557-0370 | X | | X | | | | | | | X | | X | | | | | | |
| PRESSURE ENGINE OIL INDICATOR 6620-00-179-1886 | X | | X | | | | | | | | | X | | X | | | | |
| PRESSURE, DIAL, GAGE 6620-00-974-6490 | X | | X | | | | | | | | | | | | | | | |
| PRESSURE ALTIMETER 6620-00-514-5334 | X | | X | | | | | | | | | X | | | | | | |
| PRESSURE ALTIMETER 6610-00-179-5242 | X | | | | | | | X | | | | | | | | | | |
| PRESSURE ALTIMETER 6610-00-179-5254 | X | | X | | | | | X | | | | | | | | | | |
| ATTITUDE INDICATOR 6610-00-128-7614 | X | | X | | | | | | | | | | | | | | | |
| VERTICAL SPEED INDICATOR 6610-00-935-4278 | X | | | | | | | X | | | | | | | | | | |
| AIRCRAFT MECHANICAL CLOCK 6645-00-084-1424 | X | | | | | | | X | | X | | | X | | | | | |

NOTE 1: Components marked X are 100% interchangeable and have the same NSN. Components marked Y, $Y^1$, $Y^2$, $Y^3$, and $Y^4$ are 100% interchangeable but have different NSN.

NOTE 2: All subcomponents of the major components may be removed and substituted; however, the level of disassembly must be consistent with the field tools and skill levels available.

NOTE 3: There is no degradation of hardware or aircraft performance created by using substitute parts listed on this table.

Table D-1. Spare and Repair Parts (Cont)

| | ARMY HELICOPTERS | | | | | | | | | | NAVY HELICOPTERS | | | | | AIR FORCE HELICOPTERS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRIMARY PART | SUBSTITUTE PART FROM: | | | | | | | | | SUBSTITUTE PART FROM: | | | | | SUBSTITUTE PART FROM: | | |
| NOUN/NSN | AH1 (MC) (PROD) (ECAS) | UH60 | UH1H | EH1H | AH64 | UH1V | UH1M | OH58 | OH6A | CH47 | AH1T | UH1E | UH1N | UH1K | UH1L | HH1H | UH1F | UH1P |
| TURN AND SLIP INDICATOR 6610-00-169-1489 | X | | X | | | | | | | | | | X | | | | | |
| TURN AND SLIP INDICATOR 6610-00-339-1254 | X | | | | | | | | | | | | X | | | | | |
| LIGHT CAUTION INDICATOR 6610-00-134-0851 | X | | | | | | | | | | | | | | | | | |
| MULTIMETER 6625-00-929-5793 | X | | X | | | | | | | | | | | | | | | |
| TORQUEMETER INDICATOR 6620-01-029-6706 | X | | | | | | | | | | | | | | | | | |
| TEMPERATURE INDICATOR 6620-01-025-8229 | X | | X | | | | | | | | | | | | | | | |
| ELECTRICAL INDICATOR 6620-01-065-3742 | X | | X | | | | | | | | | | | | | | | |
| AIRSPEED INDICATOR 1680-01-036-3909 | X | | | | | | | | | | | | | | | | | |
| PRESSURE ALTIMETER 6610-00-110-3368 | X | | X | | | | | X | | X | | | | | | | | |
| ATTITUDE INDICATOR 6610-01-029-6702 | X | | | | | | | X | | | | | | | | | | |
| VERTICAL INDICATOR 6610-01-029-6703 | X | | | | | | | X | | | | | | | | | | |
| MASTER CAUTION FIRE 1680-01-036-3909 | X | | | | | | | | | | | | | | | | | |
| PRESSURE ALTIMETER 6610-00-110-3368 | X | | | | | | | | | | | | | | | | | |
| ATTITUDE INDICATOR 6610-01-029-6702 | X | | | | | | | | | | | | | | | | | |
| VERTICAL INDICATOR 6610-01-029-6703 | X | | | | | | | | | | | | | | | | | |
| MASTER CAUTION FIRE 1680-01-036-3909 | X | | | | | | | | | | | | | | | | | |
| OIL TEMPERATURE INDICATOR 6695-01-028-1092 | X | | | | | | | | | | | | | | | | | |
| INDICATING PANEL 1680-01-070-7603 | X | | | | | | | | | | | | | | | | | |

NOTE 1: Components marked X are 100% interchangeable and have the same NSN. Components marked Y, $Y^1$, $Y^2$, $Y^3$, and $Y^4$ are 100% interchangeable but have different NSN.

NOTE 2: All subcomponents of the major components may be removed and substituted; however, the level of disassembly must be consistent with the field tools and skill levels available.

NOTE 3: There is no degradation of hardware or aircraft performance created by using substitute parts listed on this table.

Table D-1. Spare and Repair Parts (Cont)

| | ARMY HELICOPTERS | | | | | | | | | | NAVY HELICOPTERS | | | | | AIR FORCE HELICOPTERS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRIMARY PART | SUBSTITUTE PART FROM: | | | | | | | | | SUBSTITUTE PART FROM: | | | | | SUBSTITUTE PART FROM: | | |
| NOUN/NSN | AH1 (MC) (PROD) (ECAS) | UH60 | UH1H | EH1H | AH64 | UH1V | UH1M | OH58 | OH6A | CH47 | AH1T | UH1E | UH1N | UH1K | UH1L | HH1H | UH1F | UH1P |
| LIQUID INDICATOR 6680-01-028-8420 | X | | | | | | | | | | | | | | | | | |
| INDICATING PANEL 1680-01-070-7602 | X | | | | | | | | | | | | | | | | | |
| FIRE INDICATOR 6340-00-759-0710 | X | | X | | | | | | | | | X | X | | | | | |
| OIL TEMPERATURE INDICATOR 6695-01-028-1091 | X | | | | | | | | | | | | | | | | | |
| VOLTMETER INDICATOR 6625-01-033-8745 | X | | | | | | | X | | | | | | | | | | |
| AIRSPEED INDICATOR 6610-01-030-7226 | X | | | | | | | | | | | | | | | X | | |
| ELECTRICAL INDICATOR 6620-01-029-6704 | X | | | | | | | | | | | | | | | | | |
| ELECTRICAL INDICATOR 6620-01-029-6705 | X | | | | | | | | | | | | | | | | | |
| PRESSURE INDICATOR 6620-00-179-1886 | X | | | | | | X | | | | | X | | X | | X | | |
| TEMPERATURE INDICATOR 6685-00-557-5910 | X | | | | | | | | | | | | | | | | | |
| DUAL TACHOMETER INDICATOR 6680-00-841-0302 | X | | X | | | | | | | | | | | | | | | |
| DUAL TACHOMETER INDICATOR 6680-00-737-6608 | X | | | | | | X | | | | | | | | | | | |
| DUAL TACHOMETER INDICATOR 6680-00-907-3380 | X | | | | | | | | | | | | | | | | | |
| DUAL TACHOMETER INDICATOR 6680-00-932-5133 | X | | | | | | X | | | | | X | | X | | | | |
| AIRCRAFT MECHANICAL CLOCK 6645-00-076-3050 | X | | | | | | | X | | | X | | X | X | | | | |
| CN-1497/A 6615-01-031-7270 | X | | | | | | | | | | | | | | | | | |
| TRANSPONDER 5895-00-160-2198 | X | | X | | | | X | X | | | | | X | | | | | |

NOTE 1: Components marked X are 100% interchangeable and have the same NSN. Components marked Y, $Y^1$, $Y^2$, $Y^3$, and $Y^4$ are 100% interchangeable but have different NSN.

NOTE 2: All subcomponents of the major components may be removed and substituted; however, the level of disassembly must be consistent with the field tools and skill levels available.

NOTE 3: There is no degradation of hardware or aircraft performance created by using substitute parts listed on this table.

Table D-1. Spare and Repair Parts (Cont)

| NOUN/NSN | ARMY HELICOPTERS PRIMARY PART A H 1 (MC) (PROD) (ECAS) | ARMY HELICOPTERS SUBSTITUTE PART FROM: U H 6 0 | U H 1 H | E H 1 H | A H 6 4 | U H 1 V | U H 1 M | O H 5 8 | O H 6 A | C H 4 7 | NAVY HELICOPTERS SUBSTITUTE PART FROM: A H 1 T | U H 1 E | U H 1 N | U H 1 K | U H 1 L | AIR FORCE HELICOPTERS SUBSTITUTE PART FROM: H H 1 H | U H 1 F | U H 1 P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MOUNT 5895-00-063-9498 | X | | X | | | | X | X | | | | X | X | | | | | |
| CONTROL 5895-00-089-4403 | X | | X | | | | X | X | | | | X | X | | | | | |
| TEST SET 5895-00-471-3174 | X | | | | | | | | | | | | X | | | | | |
| MOUNT 5895-00-919-9513 | X | | X | | | | X | X | | | | X | X | | | | | |
| ANTENNA 5895-00-935-4975 | X | | X | | | | X | X | | | | | X | X | | | | |
| MOUNT 5975-00-935-9582 | X | | X | | | | X | X | | | | | X | | | | | |
| IFF COMPUTER 5810-00-061-3386 | X | | | | | | | | | | | | | | | | | |
| ICS 5895-00-895-4175 | X | X | X | | | | X | X | X | | | | X | | | | | |
| UHF RADIO SET 5821-00-138-7990 | X | | X | | | | | X | | X | | | | | | | | |
| AM-4859A/ARN-89 5826-00-001-4074 | X | X | X | | X | | | X | X | X | | | X | | | | | |
| LOOP ANTENNA 5826-00-001-4077 | X | X | | | X | | | X | X | X | | | X | | | | | |
| CONTROL 5826-00-001-4076 | X | X | | | X | | | X | X | X | | | X | | | | | |
| RECEIVER 5826-01-021-3288 | X | X | | | X | | | X | X | X | | | X | | | | | |
| SENSE ANTENNA 5826-01-085-3010 | X | X | | | X | | | X | X | X | | | | | | | | |
| COMPENSATOR 6605-00-487-4773 | X | | X | | | | X | X | | X | | | X | | | | | X |
| DIRECTIONAL GYRO 6615-00-167-9757 | X | | X | | | | X | X | | | | | X | | | | | |
| COMPASS TRANSMITTER 6605-00-531-2992 | X | | X | | | | | X | | X | | | X | | | | | X |
| CONTROL COMPASS 6605-00-140-1732 | X | | | | | | | | | X | | | X | | | | | |
| ID-2103A 6610-01-029-7542 | X | | | | | | | | | | | | | | | | | |
| ID-2104/A 6610-01-029-7544 | X | | | | | | | | | | | | | | | | | |

NOTE 1: Components marked X are 100% interchangeable and have the same NSN. Components marked Y, $Y^1$, $Y^2$, $Y^3$, and $Y^4$ are 100% interchangeable but have different NSN.

NOTE 2: All subcomponents of the major components may be removed and substituted; however, the level of disassembly must be consistent with the field tools and skill levels available.

NOTE 3: There is no degradation of hardware or aircraft performance created by using substitute parts listed on this table.

Table D-1. Spare and Repair Parts (Cont)

| NOUN/NSN | ARMY HELICOPTERS | | | | | | | | | | NAVY HELICOPTERS | | | | | AIR FORCE HELICOPTERS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRIMARY PART | SUBSTITUTE PART FROM: | | | | | | | | | SUBSTITUTE PART FROM: | | | | | SUBSTITUTE PART FROM: | | |
| | AH1 (MC) (PROD) (ECAS) | UH60 | UH1H | EH1H | AH64 | UH1V | UH1M | OH58 | OH6A | CH47 | AH1T | UH1E | UH1N | UH1K | UH1L | HH1H | UH1F | UH1P |
| AN/ARC-114 5821-00-935-5071 | | | X | X | | | X | X | X | | X | | X | | | | | |
| AN/ARC-114(A) 5821-00-165-2970 | X | | X | | | | | X | | | | | X | | | | | |
| RADIO SET AN/ARC-115 5821-00-935-5072 | X | | X | | | | X | X | X | X | | | X | | | | | |
| RADIO SET AN/ARC-115A 5821-01-057-4037 | X | | X | | | | X | X | X | X | | | | | | | | |
| RT-1354/ARC-186(V) 5821-01-092-4907 | X | | X | | X | | | | | X | | | | | | X | X | X |
| ANTENNA 5985-00-892-0895 | X | | X | | | | X | X | | X | | | X | | | | X | |
| ANTENNA 5895-00-686-7626 | | | X | | | | | X | | | | | | | | | | |
| ANTENNA 5985-00-106-0906 | X | | X | | | | | X | | | X | X | X | | | | X | |
| BATTERY 6140-01-068-8572 | X | | | | | | | X | | | | | | | | | | |
| INVERTER 5841-01-140-0941 | X | | | | | | | | | | X | | | | | | | |
| AS-2595/APN-194 5841-01-181-0330 | X | | | | | | | | | | | | | | | | | |
| ANTENNA 5985-01-031-7155 | X | | | | | | | | | | | | | | | | | |
| ATTITUDE INDICATOR 6610-00-419-3154 | X | | | | | | | | | | | | | | | | | |
| ELEC INDICATOR 6620-01-065-3740 | X | | | | | | | X | | | | | | | | | | |
| PP-7274()/A 6125-00-148-8342 | X | | | | | | | | | | X | | | | | | | |

NOTE 1: Components marked X are 100% interchangeable and have the same NSN. Components marked Y, $Y^1$, $Y^2$, $Y^3$, and $Y^4$ are 100% interchangeable but have different NSN.

NOTE 2: All subcomponents of the major components may be removed and substituted; however, the level of disassembly must be consistent with the field tools and skill levels available.

NOTE 3: There is no degradation of hardware or aircraft performance created by using substitute parts listed on this table.

Table D-2. Armament Parts

| NOUN/NSN | ARMY HELICOPTERS | | | | | | | | | | NAVY HELICOPTERS | | | | | AIR FORCE HELICOPTERS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRIMARY PART | SUBSTITUTE PART FROM: | | | | | | | | | SUBSTITUTE PART FROM: | | | | | SUBSTITUTE PART FROM: | | |
| | AH1 (MC) (PROD) (ECAS) | UH60 | UH1H | EH1H | AH64 | UH1V | UH1M | OH58 | OH6A | CH47 | AH1T | UH1E | UH1N | UH1K | UH1L | HH1H | UH1F | UH1P |
| 40MM MAGAZINE ASSEMBLY 1010-00-826-5308 | | | | | | | X | | | | | | | | | | | |
| QUICK RELEASE PIN 5340-00-935-8804 | | | | | | | | | | | | | | | | | | |
| FEED TRAY ASSEMBLY 1010-00-082-0145 | | | | | | | | | | | | | | | | | | |
| GUN 20MM M197 1005-00-369-9015 | X | | | | | | | | | | X | | | | | | | |
| FEED SYSTEM AMMO BOX 1005-01-056-8368 | X | | | | | | | | | | | | | | | | | |
| TOW MISSILE LAUNCHER 1440-00-626-8285 | | | | | | | | | | | | | | | | | | |
| 7-62 FLEX AMMO CHUTE 1005-01-027-4217 | | | | | | | | | | | | | | | | | | |
| M158 A1 LAUNCHER 1055-00-805-0689 | X | | | | | | | | | | | | | | | | | |
| M200 LAUNCHER 1055-00-168-6164 | X | | | | | | | | | | | | | | | | | |
| M260 LAUNCHER 1055-01-070-9113 | X | | | | | | | | | | | | | | | | | |
| M261 LAUNCHER 1055-01-071-0064 | X | | | | | | | | | | | | | | | | | |
| MACHINE GUN 762MM 1005-00-903-0751 | | | | | | | | | | | | | | | | | | |
| 40MM GRENADE LAUNCHER 1010-00-781-9953 | | | | | | | | | | | | | | | | | | |

NOTE 1: Components marked X are 100% interchangeable and have the same NSN. Components marked Y, $Y^1$, $Y^2$, $Y^3$, and $Y^4$ are 100% interchangeable but have different NSN.

NOTE 2: All subcomponents of the major components may be removed and substituted; however, the level of disassembly must be consistent with the field tools and skill levels available.

NOTE 3: There is no degradation of hardware or aircraft performance created by using substitute parts listed on this table.

## Section III. O-RING, PACKINGS, AND GASKETS

D-4. SCOPE. This section lists and cross-references packings and o-rings in the military part number series to commercial or other military series.

D-5. GENERAL. Use of substitute or alternate packings may limit the operational life of the packing when exposed to higher temperatures or fluids not in its range. The degradation process will not occur rapidly enough to affect the helicopter mission except in instances where low temperature packings or seals are used in high temperature applications on the engine or bleed air system.

Table D-3. Packings Reference and Temperature Guides Chart

| PRIMARY PART NO. SERIES | MILITARY SPECIFICATION | PARKER COMPOUND | BASE POLYMER | TEMP GUIDE CONT SERV | DURO-METER | SERVICE |
|---|---|---|---|---|---|---|
| AN6227B<br>AN67230B | MIL-P-5516<br>Class B | PS-01-30-5 | NITRILE (BUNA N) | -65°F to +180°F | 70 | Air Force and Navy hydraulic fluid MIL-H-5606, MIL-H-83282 |
| MS28775 | MIL-P-25732 | N304-7 | NITRILE (BUNA N) | -65°F to +250°F | 70 | |
| MS29512<br>MS29513<br>2-, 3- | MIL-P-5315 | N602-7 | NITRILE (BUNA N) | -65°F to +180°F | 60 | Air Force & Navy aircraft fuel JP-4, JP-5 |
| MS29561<br>NAS617 | MIL-R-7362<br>Comp.A, Type 1 | 47-071 | NITRILE (BUNA N) | -65°F to +250°F | 70 | Synthetic lubricants MIL-L-7808 |
| AN6290<br>MS28778<br>2-, 3- | MIL-P-5510 | N507-9 | NITRILE (BUNA N) | -65°F to +180°F | 90 | Hydrualic oil, MIL-H-5606 MIL-H-83282 |
| NAS1593<br>NAS1595 | MIL-R-25897<br>CL 1 | 77-545 | Fluoro-1 Elastomer | -20°F to +400°F | 70 | High temperature, fluid resistant. |
| NAS1594<br>NAS1596 | MIL-R-25897<br>CL 2 | V-377-9 | Fluoro-1 Elastomer | -20°F to +400°F | 90 | High temperature, fluid resistant. |

| ALTERNATE, SUBSTITUTE PART NO. | COMMERCIAL DESIGNATION ASTMID735-58T | PARKER COMPOUND | BASE POLYMER | TEMP GUIDE CONT SERV | DURO-METER | SERVICE AND SPECIFICATIONS |
|---|---|---|---|---|---|---|
| 2-, 3- | SC720BCE1 E3 F2 | C147-7 | NEOPRENE | -65°F to +300°F | 70 | Freon 12, weather & salt water resistant. AMS3209 |
| 2-, 3- | SC712BE1 E3 F2 | C526-7 | NEOPRENE | -65°F to +300°F | 70 | General purpose industrial Neoprene. AMS3209 |
| 2-, 3- | R810 B F2 | F515-8 | ETHYLENE PROPYLENE | -65°F to +300°F | 80 | Skydrol, Cellulube, & other phosphate esters, steam, water, air, dilute acids & alkalis. |

Table D-3. Packings Reference and Temperature Guides Chart (Cont)

| ALTERNATE, SUBSTITUTE PART NO. | COMMERCIAL DESIGNATION ASTMID735-58T | PARKER COMPOUND | BASE POLYMER | TEMP GUIDE CONT SERV | DURO-METER | SERVICE AND SPECIFICATIONS |
|---|---|---|---|---|---|---|
| 2-, 3- | SB620 B E1 E3 F1 | N525-6 | NITRILE (BUNA N) | -40°F to +250°F | 60 | Mineral oil & hydraulic fluid, water, steam, coolants, pneumatic service. |
| MS9021 MS9020 2-, 3- | SB712BE1 F2 | N506-7 | NITRILE (BUNA N) | -65°F to +225°F | 65 | Petroleum base fuel & low temperature resistance. AMS7271 |
| 2-, 3- | SB715BE1 E3 F2 | N103-7 | NITRILE (BUNA N) | -65°F to +225°F | 70 | Commercial gasoline, mineral oils & hydraulic fluids, pneumatic service. |
| 2-, 3- | SB715BE1 E3 F1 | N109-7 | NITRILE (BUNA N) | -30°F to +250°F | 70 | Mineral oil & hydraulic fluids, alkalies, gasolines, diesel oils, pneumatics. |
| AN1239XX AN1240XX 2-, 3- | SB715B E1 E3 F2 | N179-7 | NITRILE (BUNA N) | -40°F to +250°F | 70 | Petroleum base fuel resistant. AMS7270 |
| AN1238XX AN1239XX 2-, 3- | SB720B E1 F2 | N180-7 | NITRILE (BUNA N) | -20°F to +250°F | 70 | Petroleum base lubricating oil resistant. AMS7274 |
| 2-, 3- | SB715E1 E3 F1 | N214-7 | NITRILE (BUNA N) | -40°F to +250°F | 70 | Listed by Underwriter Laboratories for fuels, oils, and gasolines. |
| 2-, 3- | SB715BE1 E3 F1 | N219-7 | NITRILE (BUNA N) | -40°F to +250°F | 70 | Mineral oils & hydraulic fluids, gasolines, pneumatics, SAE 120R Class 1, UL Listed. |

Table D-3. Packings Reference and Temperature Guides Chart (Cont)

| ALTERNATE, SUBSTITUTE PART NO. | COMMERCIAL DESIGNATION ASTMID735-58T | PARKER COMPOUND | BASE POLYMER | TEMP GUIDE CONT SERV | DURO-METER | SERVICE AND SPECIFICATIONS |
|---|---|---|---|---|---|---|
| 2-, 3- | SB710 B E1 E3 F1 | N398-7 | NITRILE (BUNA N) | -40°F to +250°F | 70 | Water service. Low swell, extremely stable. Oil resistance. |
| 2-, 3- | SB820B E1 E3 F1 | N256-8 | NITRILE (BUNA N) | -20°F to +225°F | 80 | For rotary seals. Do not use with stainless steel. |
| 2-, 3- | SB815BE1 E3 F1 | N532-8 | NITRILE (BUNA N) | -20°F to +250°F | 80 | Mineral oils & hydraulic fluids, gasoline, pneumatics. |
| 2-, 3- | SB915B E1 E3 | N183-9 | NITRILE (BUNA N) | -30°F to +250°F | 90 | Mineral oil & hydraulics fluid, pneumatics. High extrusion resistance. |
| 2-, 3- | SB915B E1 E3 | N552-9 | NITRILE (BUNA N) | -30°F to +250°F | 90 | Mineral oil & hydraulic fluids pneumatics. |
| 2-, 3- | TA-605B E1 E3 F2 | S418-6 | SILICONE | -80°F to +450°F | 60 | Air & gases. Static seal only. AMS3303 |
| 2-, 3- | TA705B E1 E3 LF2 | S417-7 | SILICONE | -80°F to +450°F | 70 | Air & gases. Static seal only. |
| MS9068 2-, 3- | TA-705BE1 E3 F2 | S604-7 | SILICONE | -80°F to +450°F | 70 | Air & gases. Static seal only. AMS3304 |
| 2-, 3- | None | 77-545 | Fluoro-1 Elastomer | -20°F to +400°F | 70 | High temperature oils, aromatic solvents, chemical service. AMS7278 |
| 2-, 3- | None | V377-9 | Fluoro-1 Elastomer | -20°F to +400°F | 90 | High temperature oils, aromatic solvents, chemical service. AMS7278 |

## Section IV. PETROLEUM, OIL, AND LUBRICANT (POL)

**D-6. SCOPE.** This appendix lists various types of substitute fuels, lubricants, and hydraulic fluids which can be used on the AH-1 attack helicopter. Contained in this appendix is general information concerning types, uses, and effects of such POL substitutes.

**D-7. GENERAL.**

a. Some substitute products are made up of chemical ingredients which are not compatible with products used on an AH-1 aircraft. Some fuels, oils, and hydraulic fluids can have an adverse effect on systems and components compatible with the AH-1 systems; therefore, it is advisable to properly identify the product by specification number and name for cross-reference with primary and expedient products available.

b. National stock numbers are used in conjunction with specification numbers to distinguish them from foreign products. The identification of (NATO) product numbers relate directly to U.S. Military Specification Numbers and thus are considered direct replacements.

c. In some situations, POL substitute products of friendly or enemy nations can be used; however, CAUTION should be exercised due to the possibility of sabotage. If there is no other alternative but to use enemy products, check for signs of contamination, discoloration, smell, and thickness.

d. Once a product under consideration is identified, as described above, it will fall in one of three categories. These categories are defined as follows:

(1) Primary products. These are basic products for which the system was designed. The system will function without limitation.

(2) Alternate product. These are products that closely match the primary product and may result in some reduced performance with no effect on system durability. There are no limitations on duration of use.

(3) Emergency/expedient products. These are products that can be used for only short periods of time. These products are to be used as a last resort. These products will cause poor performance or system damage after prolonged use,

**CAUTION**

The helicopter shall not be flown when emergency fuel has been used for a total cumulative time of 50 hours unless a hot section inspection is performed.

e. Table D-4 lists some possible U.S. fuels, in proper priority, that may be used. Table D-5 lists primary or standard fuel sources and alternate fuel sources for various foreign countries. Table D-6 lists some commercial fuel sources that may be substituted for the primary or standard JP-4.

f. Substitute fuels, which cannot be used alone on the AH-1, can be blended with a primary fuel and can then be utilized for engine operation.

(1) When using substitute fuels, it is preferable to premix the fuels in a container for better blending before pouring into tank. This method of mixing the primary fuel with a substitute fuel insures that the fuels mix completely. The best expedient fueling method is to add both fuels at the same time from two separate fuel lines. Table D-7 lists alternate and expedient fuel blends.

(2) There is no special limitation on the use of Army standard fuel or alternate fuel. When using an emergency fuel, a fuel mixture which contains over 10 percent leaded gasoline is considered to be all leaded fuel. When using an emergency fuel, an entry on the faults and remarks column of DA Form 2408-13, Inspection Record, should be made. The entry should annotate the type of fuel, additives, and duration of operation.

(3) Fuels having the same NATO code number are interchangeable, and fuels conforming to ASTM-D-l 655 specification may be used when standard fuel, MIL-T-5624 JP4, is not available.

g. The lubricants and hydraulic fluids used in the AH-1 systems and components must have a compatible base composition, as well as good additive level. The purpose of lubricants and hydraulic fluids is to reduce wear, support bearing loads, and provide cooling; their chemical composition must be compatible. In addition to lubricating, hydraulic fluids must transmit power and motion. If two incompatible hydraulic fluids are mixed, there is a tendency of a gel substance forming within the system. Some lubricants will not withstand AH-1 temperatures or loads for extended periods of time. These type of lubricants do not contain the necessary base properties for withstanding long term use, therefore they are recommended only as a last resort. Expedient lubricants can cause one of three problems:

(1) They may not allow proper efficient operations because of improper viscosity.

(2) They may allow an increase in wear because of improper viscosity.

(3) They may cause seals to swell or create deposits because of improper composition.

h. Table D-8 lists the primary lubricants and hydraulic fluids for use as alternate and expedients on the AH-1 helicopter.

**CAUTION**

- Lubricating oil MIL-L-23699 shall not be used in ambient temperatures below minus 32°C/25°F.
- It is not advisable to mix MIL-L-7808 and MIL-L-23699 oils, except during an emergency. If oils are mixed, the system should be flushed within six hours. Hydraulic oils MIL-L-83282 and MIL-L-5606 should not be mixed except during an emergency. When these oils are mixed with each other or any other oil, a DA Form 2408-13 entry is required.

**Table D-4. Substitute U.S. Fuels**

| PRIMARY FUEL | ALTERNATE FUEL | EXPEDIENT FUEL | MILITARY SPECIFI-CATION | COMMERCIAL SPECIFICATION |
|---|---|---|---|---|
| Aviation Tur-bine: MIL-T-5624(JP4) NATO-F-40 | | | X | |
| | MIL-T-5624(JP-5) NATO-F-44 | | X | |
| | Aviation Turbine: ASTM-D-1655 (Jet B) | | | X |
| | Aviation Turbine: MIL-T-83133 (JP-8) NATO-F-34 | | X | |
| | Aviation Turbine: ASTM-D-1655 (Jet A-1) | | X | |
| | | Kerosene: ASTM-D-3699 | | X |
| | | Kerosene: NATO-F-5B | X | |
| | | MIL-G-5572 (Any AVGAS) NATO-F-12, F-18, F-22 | X | |

Table D-5. Substitute Foreign Fuels

| Source | Primary or Standard Fuel | Alternate Fuels | |
|---|---|---|---|
| U.S. Military Fuel<br>NATO Code No. | JP-4(MIL-T-5624) | JP-5(MIL-T-5624) | JP-8(MIL-T-83133) |
| FOREIGN FUEL | NATO F-40 | NATO-44 | NATO-34 |
| PRODUCT DESCRIPTION | TURBINE FUEL,<br>AVIATION TYPE:<br>Wide cut type<br>+(S-748) | TURBINE FUEL,<br>AVIATION:<br>High Flash Type | TURBINE FUEL,<br>AVIATION:<br>Kerosene Type<br>+(S-748) |
| BELGIUM | BA-PF-2B AMD.2<br>a/AF | BA-PF-6<br>n/AF | BA-PF-7 (AF) |
| CANADA | 3-GP-22F n/AF | 3-GP-24h n/(AF) | |
| DENMARK | MIL-T-5624<br>Grade JP-4 a/AF | | D.Eng.RD.2453<br>Iss.3Amd.2 n/a/(AF) |
| FRANCE | AIR 3407/B AF | | AIR 3405/C n/a/AF |
| FEDERAL REPUBLIC OF GERMANY | TL 9130-006 Iss.4<br>n/a/AF | TL 9130-007 Iss.4<br>n/(AF) | |
| GREECE | MIL-T-5624<br>Grade JP-4 n/AF | | |
| ITALY | AA-M-C.142p<br>n/a/AF | AA-M-C.143b<br>n/(AF) | AA-M-C.141d<br>Amd.1 (AF) |
| LUXUMBOURG | | | |
| NETHERLANDS | MIL-T-5624<br>Grade JP-4 a/AF | D.Eng.RD.2498<br>Iss.6Amd.2 n/(AF) | D.Eng.RD.2453<br>Iss.3Amd.2 a/AF |
| NORWAY | MIL-T-5624<br>Grade JP-4 AF | | |
| PORTUGAL | MIL-T-5624<br>Grade JP-4 AF | | AIR 3405/C AF |
| TURKEY | MIL-T-5624<br>Grade JP-4 a/AF | | |
| UNITED KINGDOM | D.Eng.RD.2454<br>Iss.3Amd.2 n/a/AF | D.Eng.RD.2498<br>Iss.6Amd.2 n/a/(AF) | D.Eng.RD.2453<br>Iss.3Amd.2 a/AF |
| UNITED STATES | MIL-T-5624<br>Grade JP-4 n/a/AF | MIL-T-5624<br>Grade JP-5 n/(AF) | MIL-T-83133<br>JP-8 |
| USSR | GOST 1842-52<br>GOST 10227-62<br>T-1, TS-1 | | GOST 9145-59 |

Table D-6. Substitute Commercial Fuels

| SOURCE | PRIMARY OR STANDARD FUEL | ALTERNATE FUELS | |
|---|---|---|---|
| U.S. MILITARY FUEL NATO CODE NO. | JP-4(MIL-T-5624) F-40 | JP-5(MIL-T-2624) F-44 | JP-8(MIL-T-83133) F-34 |
| COMMERCIAL FUEL (ASTM-D-1655) | JET B | JET A | JET A-1 |
| American Oil Co. | American JP-4 | American Type A | |
| Atlantic Richfield Richfield Div | Arcojet B | Arcojet A Richfield A | Arcojet A-1 Richfield A-1 |
| B.P. Trading | B.P.A.T.G | | B.P.A.T.K. |
| Caltex Petroleum Corp. | Caltex Jet B | | Caltex Jet A-1 |
| City Service Co. | | CITCO A | |
| Continental Oil Co. | Conoco JP-4 | Conoco Jet-50 | Conoco Jet-60 |
| Exxon Co. U.S.A. | Exxon Turbo Fuel B | Exxon A | Exxon A-1 |
| Gulf Oil | Gulf Jet B | Gulf Jet A | Gulf Jet A-1 |
| Mobil Oil | Mobil Jet B | Mobil Jet A | Mobil Jet A-1 |
| Phillips Petroleum | Philjet JP-4 | Philjet A-50 | |
| Shell Oil | Aeroshell JP-4 | Aeroshell 640 | Aeroshell 650 |
| Sinclair | | Superjet A | Superjet A-1 |
| Standard Oil Co. | | Jet A Kerosene | Jet A-1 Kerosene |
| Chevron | Chevron B | Chevron A-50 | Chevron A-1 |
| Texaco | Texaco Avjet B | Avjet A | Avjet A-1 |
| Union Oil | Union JP-4 | 76 Turbine Fuel | |

Table D-7. Alternate and Expedient Fuel Blends

| BASE FUEL | EXTENDER (50% MAXIMUM) |
|---|---|
| NOTE<br>Fuel may be extended on an alternate basis with the following blends up to a half and half mixture. | |
| Any Primary Fuel | Any Alternate Fuel |
| Any Primary Fuel | Any Alternate Fuel |
| Any Primary or Alternate Fuel | MIL-F-815 Distillate |
| Any Primary or Alternate Fuel | NATO-F-76 Navy Distillate |
| Any Alternate or Primary Fuel | Dry Cleaning Solution: P-D-680 (Type I and II) |
| | Dry Cleaning Solution: AMSTM-D-484 (K, I, II, III, IV) |
| | Petroleum Spirits: ASTM-D-235 (I, II, III, IV) |

CAUTION

The helicopter shall not be flown when emergency fuel has been used for a total cumulative time of 50 hours.

**Table D-8. Substitute Lubricants and Hydraulic Fluids**

| AH-1 | PRIMARY SOURCE | | ALTERNATIVE SOURCE | | EXPEDIENT SOURCE | |
|---|---|---|---|---|---|---|
| LUBRICATION POINT | MILITARY SPECIFICATION OR PROPRIETARY PRODUCT | NATO CODE | U.S. OR NATO EQUIVALENT | SOVIET EQUIVALENT | U.S. OR (NATO EQUIV.) | NOTES |
| Engine Oil, Auxilary Power Unit, Transmission Oil, 42° Gear Box Oil, 90° Gear Box Oil. | MIL-L-23699 (for use in ambient temperatures above -25°F/-32°C). | O-156 | MIL-L-27502 | GOST-13076-6767<br>GR: VNIINP-50-1-4F | MIL-L-46167<br>(O-183) | MIL-L-46167 lack high thermal stability degrades gradually and much sooner than MIL-L-23699 or MIL-L-7808 |
| | MIL-L-7808 (for use in ambient temperatures below -25°F/-32°C). | O-148 | PQ Turbine Oil 8365<br>RM-184<br>ARM-201A ENCO Turbo Oil 2389<br><br>Aeroshell Turbine Oil 500<br>Aeroshell Turbine Oil 550<br>Chevron Jet Engine Oil 5<br>Stauffer 6924 Jet II<br>SATO 7377-7730. TL-8090 Turbo Oil 2380 (WS-6000)<br>Castro 205 | NRTV-38-1-164-65<br>Gr: TSNIL-36/IK (for use in ambient termperatures below -25°F/-32°C). | | |

Table D-8. Substitute Lubricants and Hydraulic Fluid (Cont)

| AH-1 | PRIMARY SOURCE | | ALTERNATIVE SOURCE | | EXPEDIENT SOURCE | |
|---|---|---|---|---|---|---|
| LUBRICATION POINT | MILITARY SPECIFICATION OR PROPRIETARY PRODUCT | NATO CODE | U.S. OR NATO EQUIVALENT | SOVIET EQUIVALENT | U.S. OR (NATO EQUIV.) | NOTES |
| Hydraulic System Nos. 1 and 2 | MIL-H-83282 (for use in ambient temperatures above -40°F/-40°C). | H-537 | MIL-H-6083 (C-635) (for use in ambient temperatures above -40°F/-40°C). | GOST-15819 -70 RMTS | MIL-L-46167 (O-183) | MIL-L-46167 lack thermal stability. Will degrade much sooner than the standard sources that are normally used. |
| | MIL-H-5606 (for use in ambient temperatures below -40°F/-40°C). | H-515 | MIL-H-46170 (for use in ambient temperatures below -40°F/-40°C). | | | |
| | | | Hydraulic Fluid (Petroleum Base) MIL-H-6083 MIL-H-5606B, MIL-L-2104 (OE/HDO-10), MIL-L-46167(OEA), MIL-L-2104 (OE/HDO-30) (FRH) MIL-H-46170, AMD1 | | Silicone MIL-B-46176<br>Dexron II, SAE10 Motor Oil SAE30 Motor | |
| Flexible Couplings, Main and Tail Rotor Drive Shafts, Swash Plate Assy. Pylon Controls | Syntech Grease 3913-G1<br>MIL-G-81322 | G-395 | MIL-G-25537 | GOST-5573 -67 ST, NK-50 | | |

## Section V. STRUCTURAL METAL ALLOYS

D-8. SCOPE. This section lists and cross-references substitute structural metal alloys.

D-9. GENERAL. Due to the short term of use, weight and dissimilar metal corrosion considerations can be overlooked during BDAR structural repairs. Metal selection should be based only on strength requirements. Refer to Table D-9 and use the following steps to locate substitute metal alloy types:

a. Locate the material to be replaced on the line in the left-hand column.

b. Locate the substitute material in the vertical columns.

c. To obtain the minimum thickness of the substitute material, multiply the thickness of the material to be replaced by the factor shown at the intersection of the line and column found in step A & B, substitute standard gage equal to this thickness or nearest standard gage.

# Table D-9. Metal Substitution Chart

| MATERIAL TO BE REPLACED | ULTIMATE TENSILE STRENGTH PSI | 2024 | | | 1025 | 7075 T6 | | 4130 8630 STEEL | | TITANIUM | | | | STAINLESS STEEL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T3&4 CLAD | T4 EXTRUDED | T6 BARE | STEEL | CLAD | EXTRUDED | 90 KSI | 125 KSI | 99% | 8 Mn | 6AL -4V | 6Al-6V-2Sn | 1/4 301 | 1/2 302 | 321 347 |
| 6061-T6 EXTRUDED | 38,000 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| AZ31A-H MAGNESIUM | 39,000 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 6061-T6 CLAD | 42,000 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 2024-T4 EXTRUDED | 57,000 | 1.0 | 1.0 | 1.0 | 1.04 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 2024-T4 CLAD | 58,000 | 1.0 | 1.02 | 1.0 | 1.05 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 2024-T3 CLAD | 60,000 | 1.04 | 1.05 | 1.0 | 1.09 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 2024-T6 BARE | 62,000 | 1.07 | 1.09 | 1.0 | 1.13 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 2024-T81 CLAD | 64,000 | 1.1 | 1.12 | 1.03 | 1.16 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 2024-T88 CLAD | 70,000 | 1.21 | 1.23 | 1.13 | 1.25 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 7075-T6 CLAD | 72,000 | 1.24 | 1.27 | 1.16 | 1.31 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 7075-T6 BARE | 78,000 | 1.35 | 1.37 | 1.26 | 1.42 | 1.09 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 7075-T6 EXTRUDED | 78,000 | 1.35 | 1.37 | 1.26 | 1.42 | 1.09 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 7178-T6 BARE | 84,000 | 1.45 | 1.48 | 1.36 | 1.53 | 1.17 | 1.08 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 7178-T6 EXTRUDED | 84,000 | 1.45 | 1.48 | 1.36 | 1.53 | 1.17 | 1.08 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| TITANIUM 99Z | 80,000 | 1.38 | 1.40 | 1.29 | 1.45 | 1.11 | 1.02 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| TYPE 321 & 347 CRES | 100,000 | 1.72 | 1.75 | 1.61 | 1.82 | 1.38 | 1.28 | 1.11 | 1.0 | 1.25 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| TITANIUM-8Mn | 120,000 | 2.06 | 2.1 | 1.93 | 2.18 | 1.66 | 1.53 | 1.33 | 1.0 | 1.50 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.20 |
| TYPE 301 STAINLESS | 125,000 | 2.15 | 2.19 | 2.09 | 2.27 | 1.73 | 1.60 | 1.38 | 1.0 | 1.56 | 1.04 | 1.0 | 1.0 | 1.0 | 1.0 | 1.25 |
| TITANIUM 6AL-4V | 134,000 | 2.31 | 2.35 | 2.16 | 2.43 | 1.86 | 1.71 | 1.48 | 1.07 | 1.67 | 1.12 | 1.0 | 1.0 | 1.07 | 1.0 | 1.34 |
| TITANIUM 4AL-4Mn | 140,000 | 2.41 | 2.45 | 2.25 | 2.55 | 1.94 | 1.79 | 1.55 | 1.12 | 1.75 | 1.16 | 1.04 | 1.00 | 1.12 | 1.0 | 1.40 |
| TYPE 301 STAINLESS | 150,000 | 2.58 | 2.63 | 2.42 | 2.73 | 2.08 | 1.92 | 1.66 | 1.20 | 1.88 | 1.25 | 1.11 | 1.0 | 1.2 | 1.0 | 1.50 |
| TITANIUM 6A1-6V-2Sn | 155,000 | 2.67 | 2.71 | 2.5 | 2.81 | 2.15 | 1.98 | 1.72 | 1.24 | 1.93 | 1.29 | 1.15 | 1.0 | 1.24 | 1.03 | 1.55 |

# APPENDIX E

## BDAR FIXES AUTHORIZED FOR TRAINING

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.

NOTE

- The procedures listed below are authorized for sustainment training. They do not permanently alter aircraft or components. These procedures duplicate those highlighted in each system's chapter, Repair Procedure Index, surrounded by a box.

- All BDAR fixes contained in this manual are trainable if scrap or beyond economical repair (BER) components are available for practice repair and such training is approved by the unit commander. Many of the other procedures not listed in this appendix will permanently alter or damage the equipment.

| REPAIR PROCEDURE | PARA NO. |
|---|---|
| POWER PLANT INSTALLATION | |
| Low Oil Pressure, Defective Indicator/Transmitter. . . | 6-5 |
| Fuel Filter Clogged. . . . . . . . . . . . . . . . . . . | 6-6 |
| ROTOR | |
| Lateral Vibrations . . . . . . . . . . . . . . . . . . | 7-6 |
| DRIVE TRAIN SYSTEM | |
| Oil Pressure Switch Leak... . . . . . . . . . . . . . . | 8-5 |
| Oil Pressure Transmitter Leak. . . . . . . . . . . . . | 8-6 |
| Oil Filter Leak. . . . . . . . . . . . . . . . . . . . . | 8-7 |
| Sump Outlet Hose Leak. . . . . . . . . . . . . . . . . | 8-8 |
| HYDRAULIC SYSTEM | |
| Lock-Out Valve Stuck Closed . . . . . . . . . . . . . | 9-9 |
| No. 1 Hydraulic System Pump Inoperative. . . . . . . . | 9-11 |
| No. 2 Hydraulic System Pump Inoperative. . . . . . . . | 9-12 |

BDAR FIXES AUTHORIZED FOR TRAINING (Cont)

# APPENDIX F

# AVIONICS CONFIGURATIONS

**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

**F-1. SCOPE.** This appendix lists and depicts the major components, cable routes, and wiring terminations pertaining to the AH-1 series helicopter avionics. This information is furnished as an aid to expedient repair techniques described in Chapter 11.

**F-2. GENERAL.** The actual configurations may vary depending on particular requirements or changes incorporated through modification work order (MWO) action and special purpose alterations. The Figures F-1 thru F-16 show typical location of avionics and their associated components in relation to the helicopter and lists the component part number. Each figure also has a table associated with the avionics system which contains a complete wire listing to be used as an aid in rapid wire splicing. This includes the wire number, type (shielded, not shielded, or pair twisted with shield), end connectors and the pin numbers on each connector.

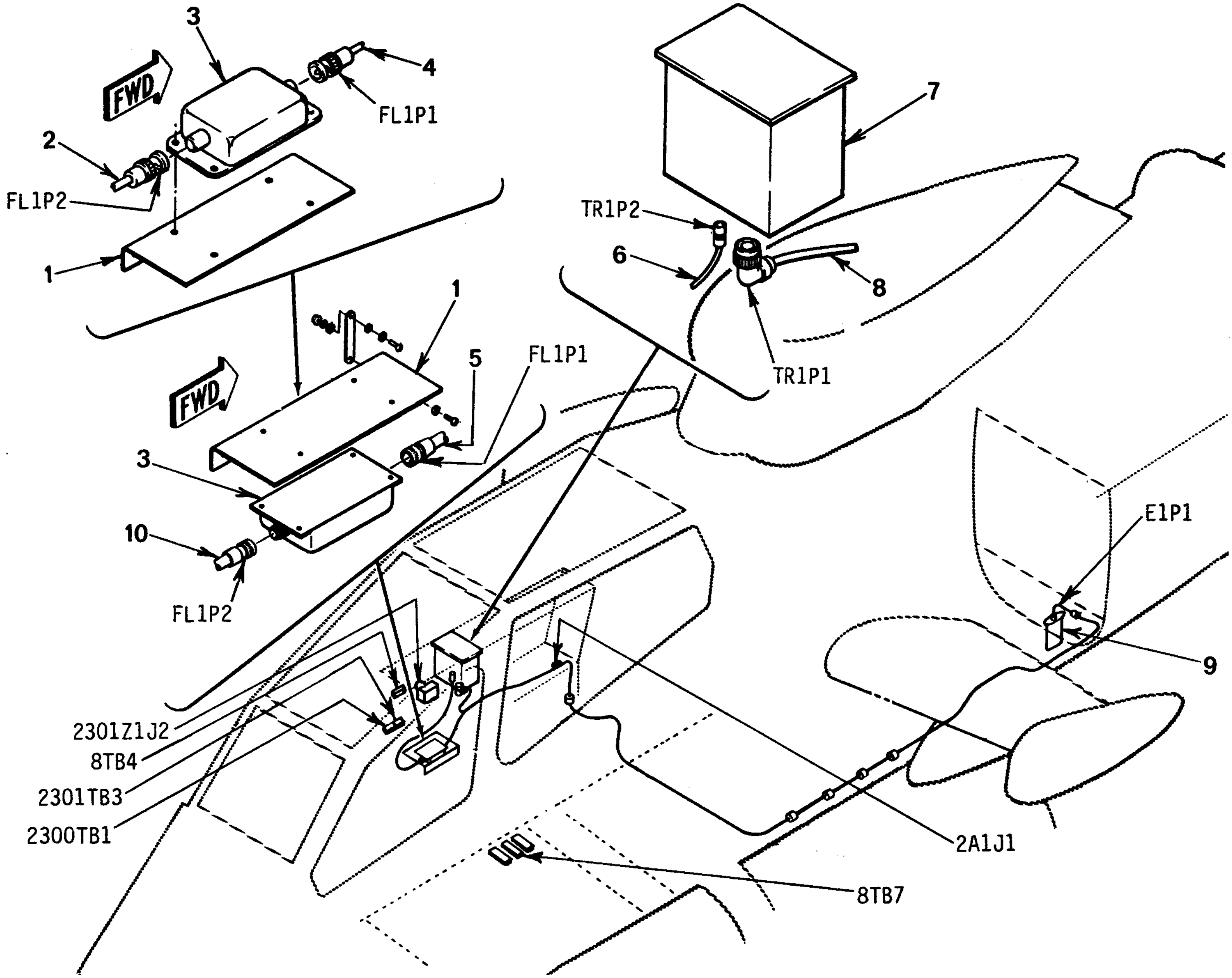



Figure F-1. UHF Command Communication System AN/ARC-1160 or AN/ARC-164 (Sheet 1 of 2)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | 209-975-132-5 | Bracket, Mounting |
| 2 | 209-077-097-107 | Cable Assembly, Spec Pr USBL EFF 78-23093 and subsequent. |
| 3 | HFP40-01T | Filter, High Pass |
| 4 | 209-077-097-105 | Cable Assembly, Spec PR USBL EFF 77-23093 and subsequent |
| 5 | 209-077-043-5 | Cable Assembly, Special Purpose USBL EFF 76-22567 thru 77-23092. |
| 6 | 209-077-043-5 | Cable Assembly, Coax USBL EFF 76-2256 thru 77-23092 |
| | 209-077-097-105 | --Cable Assembly, Special Purpose USBL EFF 77-23093 and subsequent. |
| 7 | AN/ARC-116 | Radio set USBL EFF 76-22567 thru 77-23092 |
| | RT-1167/ARC-164(V) | Receiver-Transmitter USBL 78-23093 and subsequent. |
| 8 | 209-077-043-3 | Cable Assembly, ARC 116 USBL EFF 76-22567 thru 77-23092. |
| 9 | AT-256AfARC | Antenna |
| 10 | 209-077-043-7 | Cable Assembly, UHF Antenna USBL EFF 76-22567 thru 77-23092. |

Figure F-1. UHF Command Communication System AN/ARC-116() or AN/ARC-164 (Sheet 2 of 2)

**Table F-1. UHF AN/ARC-116(), Wire Chart**

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARC116-2A22 | NO/S | TR1P1 | B | TR1P1 | V |
| ARC116-3A20 | NO/S | TR1P1 | C | 8TB7 | D2 |
| ARC116-4B20 | NO/S | TR1P1 | D | 2A1J1 | U |
| ARC116-5A20 | NO/S | TR1P1 | E | 2300TB1 | C5 |
| ARC116-10A22WHT | PR/S | TR1P1 | K | 2301Z1J2 | D6 |
| ARC116-10A22BLU | PR/S | TR1P1 | L | 2301Z1J2 | B6 |
| ARC116-14A20 | NO/S | TR1P1 | P | 2300TB1 | D5 |
| ARC116-27A22 | SHIELD | TR1P1 | D | 2301TB3 | C4 |
| ARC116-28A22 | SHIELD | TR1P1 | E | 2300TB1 | H1 |
| ARC116-31-A22 | NO/S | TR1P1 | H | 2301Z1J2 | A3 |
| ARC116-101A | COAX | TR1P2 | | FL1P2 | |
| ARC116-101B | COAX | FL1P2 | | E1P1 | |

**Table F-2. UHF AN/ARC-164(), Wire Chart**

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARC164-2A22 | NO/S | TR1P1 | B | TR1P1 | V |
| ARC164-3A20 | NO/S | TR1P1 | C | 8TB4 | D2 |
| ARC164-4B20 | NO/S | TR1P1 | D | 2A1J1 | U |
| ARC164-5A20 | NO/S | TR1P1 | E | 2300TB1 | C5 |
| ARC164-10A22WHT | PR/S | TR1P1 | K | 2301Z1J2 | D6 |
| ARC164-10A22BLU | PR/S | TR1P1 | L | 2301Z1J2 | B6 |
| ARC164-14A20 | NO/S | TR1P1 | P | 2300TB1 | D5 |
| ARC164-27A22 | SHIELD | TR1P1 | D | 2300TB3 | C4 |
| ARC164-28A22 | SHIELD | TR1P1 | E | 2300TB1 | H1 |
| ARC164-31-A22 | NO/S | TR1P1 | H | 2301Z1J2 | A3 |
| ARC164-101A | COAX | TR1P2 | | FL1P1 | |
| ARC164-101B | COAX | FL1P2 | | E1P1 | |

1 Underlined Pin Numbers Denote Lower Case

2 Denotes: NO/S--No Shield
PR/S--Pair Twisted, W/Shield

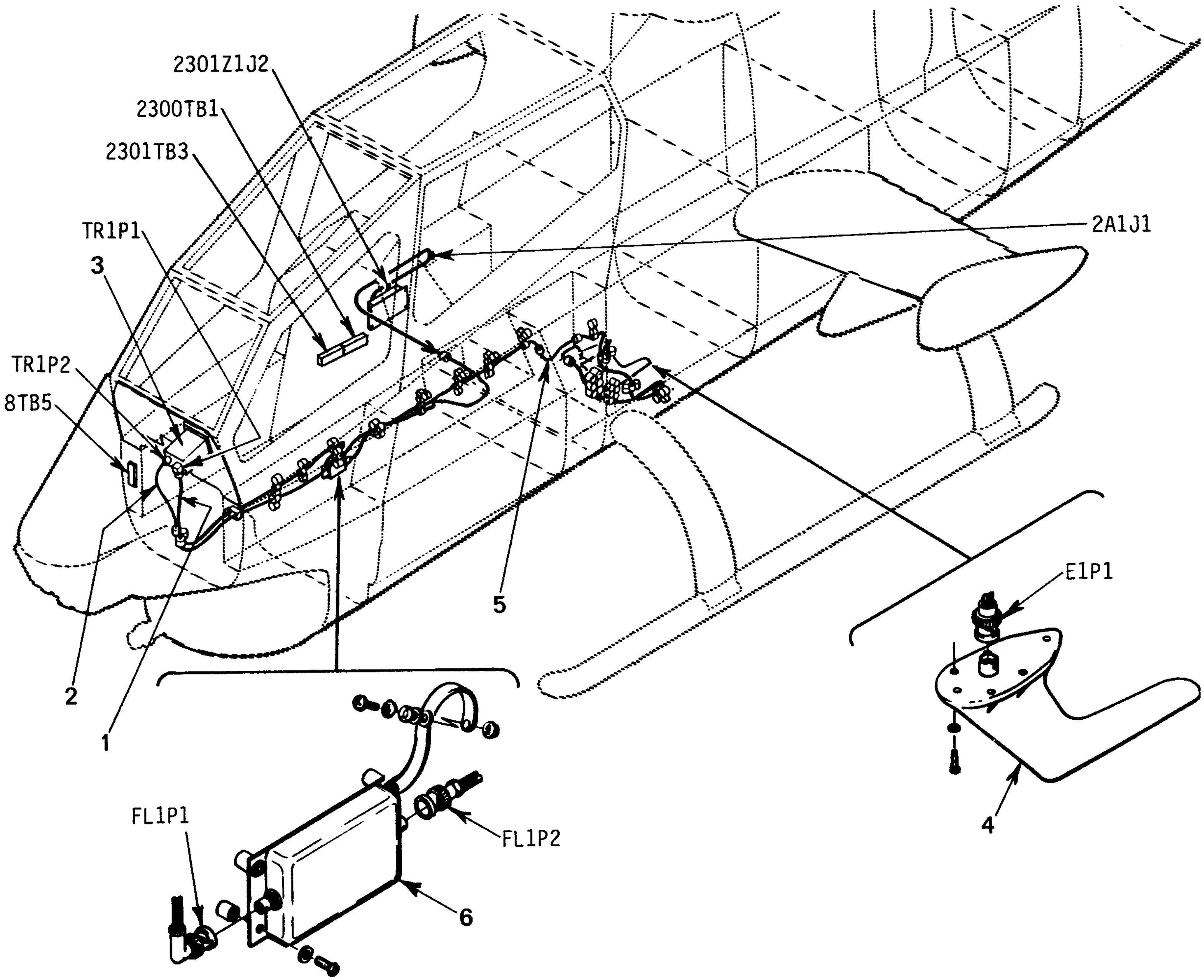



Figure F-2. VHF Command Communication System
AN/ARC-115 (Sheet 1 of 2)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | 209-077-044-3 | Cable Assembly, Coaxial |
| 2 | 209-077-044-5 | Cable Assembly, Coaxial |
| 3 | AN/ARC-115A | Radio Set |
| 4 | AS-3204/ARC | Antenna |
| 5 | 209-077-044-7 | Cable Assembly, VHF Antenna |
| 6 | BPF 40-03P | Filter, Band Pass |

**Figure F-2. VHF Command Communication System AN/ARC-115 (Sheet 2 of 2)**

**Table F-3. VHF AN/ARC-115(), Wire Chart**

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARC115-2A22 | NO/S | TR1P1 | B | TR1P1 | V |
| ARC115-3A20 | NO/S | TR1P1 | C | 8TB5 | K5* |
| ARC115-4B20 | NO/S | TR1P1 | D | 2A1J1 | CC |
| ARC115-5A20 | NO/S | TR1P1 | E | 2300TB1 | H4 |
| ARC115-10A22WHT | PR/S | TR1P1 | K | 2301Z1J2 | D5 |
| ARC115-10A22BLU | PR/S | TR1P1 | L | 2301Z1J2 | D6 |
| ARC115-14A20 | NO/S | TR1P1 | P | 2300TB1 | G4 |
| ARC115-27A22 | SHIELD | TR1P1 | D | 2301TB3 | A2 |
| ARC115-28A22 | SHIELD | TR1P1 | E | 2300TB1 | H2 |
| ARC115-31A22 | NO/S | TR1P1 | H | 2301Z1J2 | A2 |
| ARC115-101A | COAX | TR1P2 | | FL1P1 | |
| ARC115-102A | COAX | FL1P2 | | E1P1 | |

1 Underlined Pin Numbers Denote Lower Case

2 Denotes: NO/S--No Shield
PR/S--Pair, Twisted W/Shield

*Was 8TB4-E3
Now 8TB5-K5 (AH-1S 24001 ANS SUBQ) PROD & ECAS
Is 8TB4-A2 on (MC)

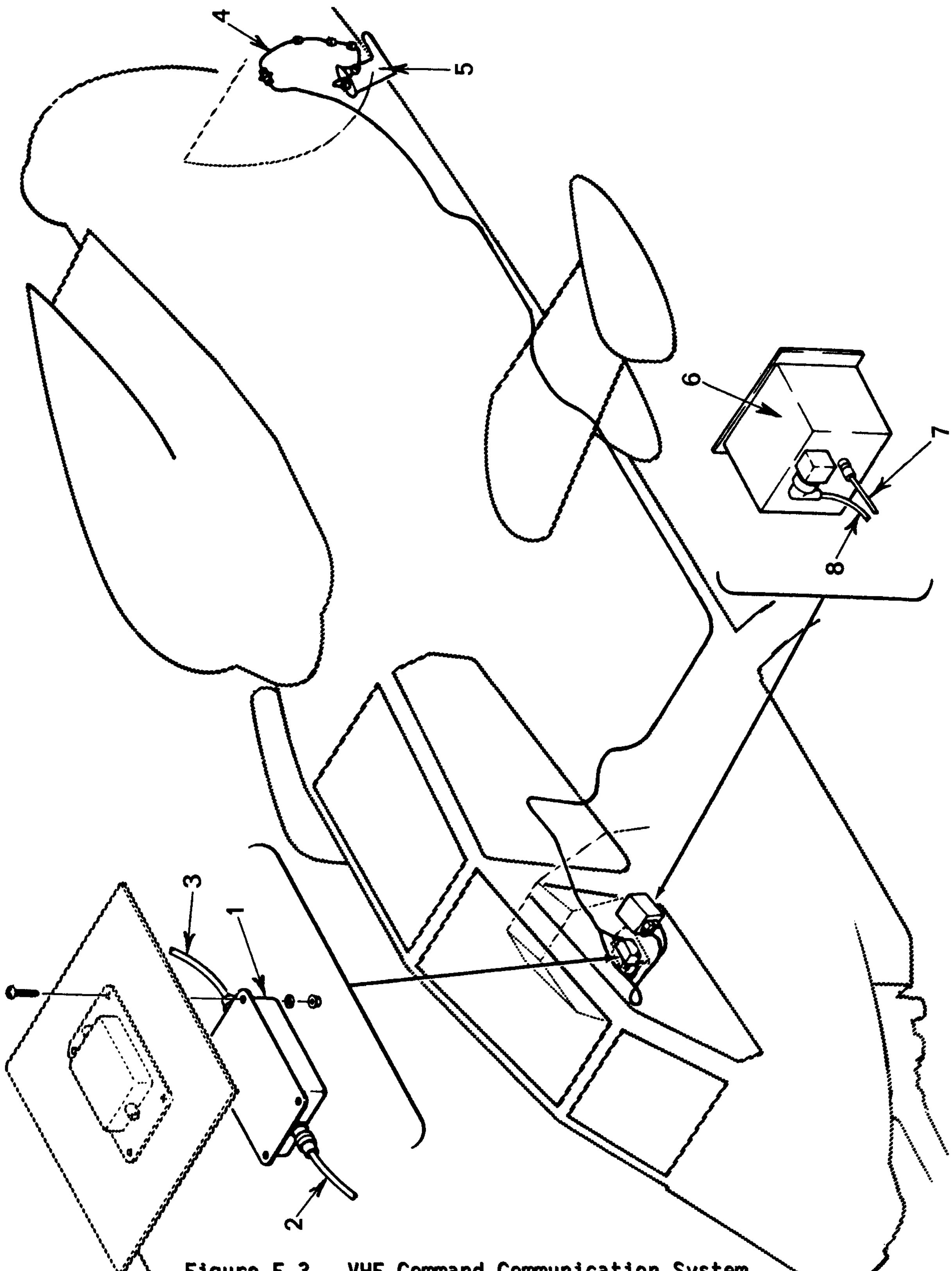



Figure F-3. VHF Command Communication System AN/ARC-115 or AN/ARC-186 (Sheet 1 of 2)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | BPF 40-03P | Filter, Band Pass |
| 2 | 209-077-096-105 | Cable Assembly, Special Purpose |
| 3 | 209-077-096-107 | Cable Assembly, Special Purpose |
| 4 | 209-077-096-109 | Cable Assembly, ARC-115 |
| 5 | VFS 10-90-6 | Antenna UBL EFF 78-23093 thru 78-23125, 79-23253 |
| | AS-3204/ARC | Antenna USBL EFF 79-23187 thru 79-23252 |
| 6 | AN/ARC-115 | Radio Set Direct Replacement: AN/ARC-186 |
| | AN/ARC-186 | Radio Set Direct Replacement: AN/ARC-115 |
| 7 | 209-077-096-105 | Cable Assembly, Special Purpose |
| 8 | 209-077-096-103 | Cable Assembly, Special Purpose |

Figure F-3. VHF Command Communication System
AN/ARC-115 or AN/ARC-186 (Sheet 2 of 2)

Table F-4. VHF Command Communication System
AN/ARC-115 or AN/ARC-186 Wire Chart

NOTE

See wire chart, Table F-3. AN/ARC-186 uses same wiring harness and connectors.

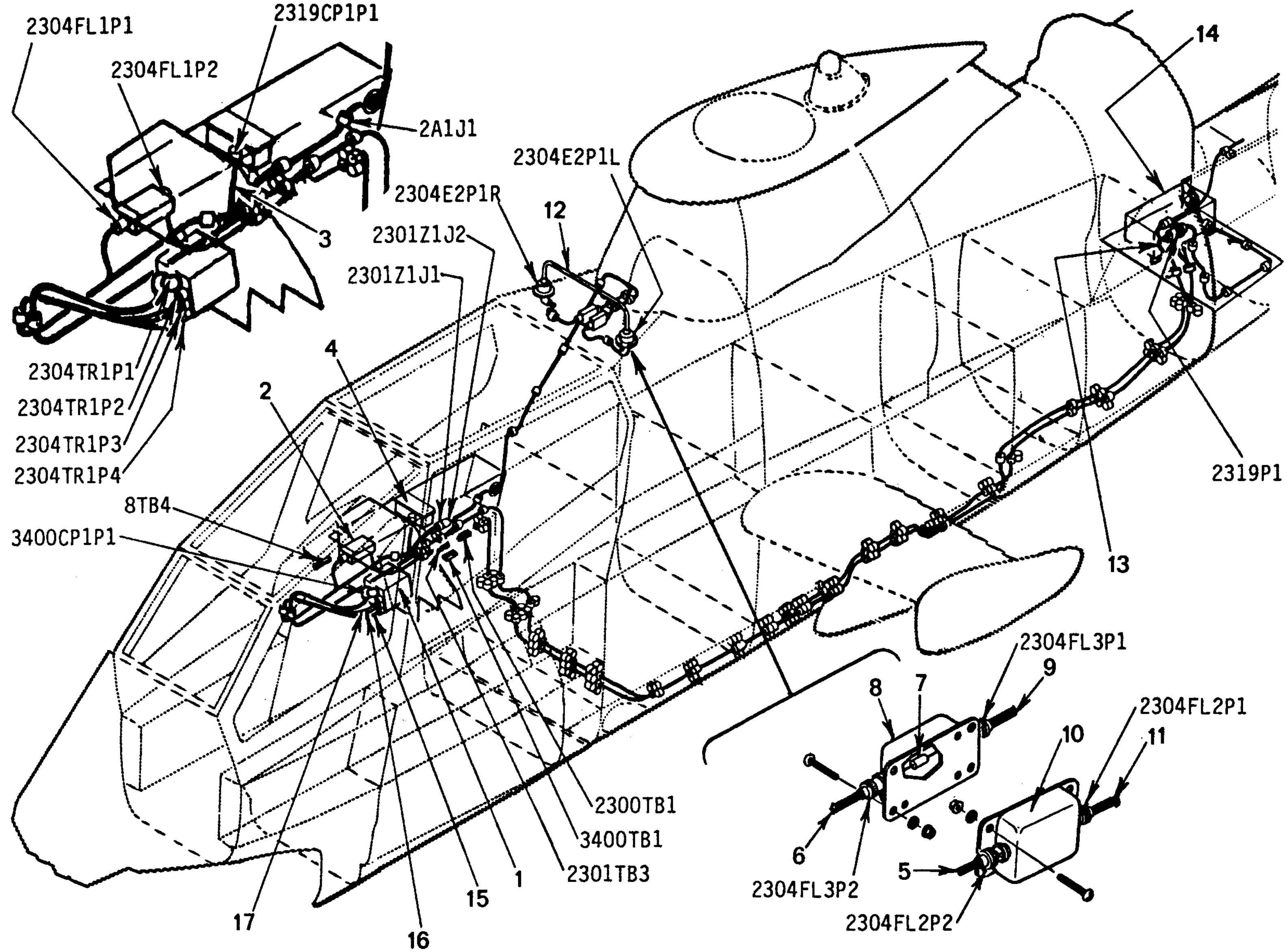



Figure F-4. FM Liaison Communication System AN/ARC-114 (Sheet 1 of 3)

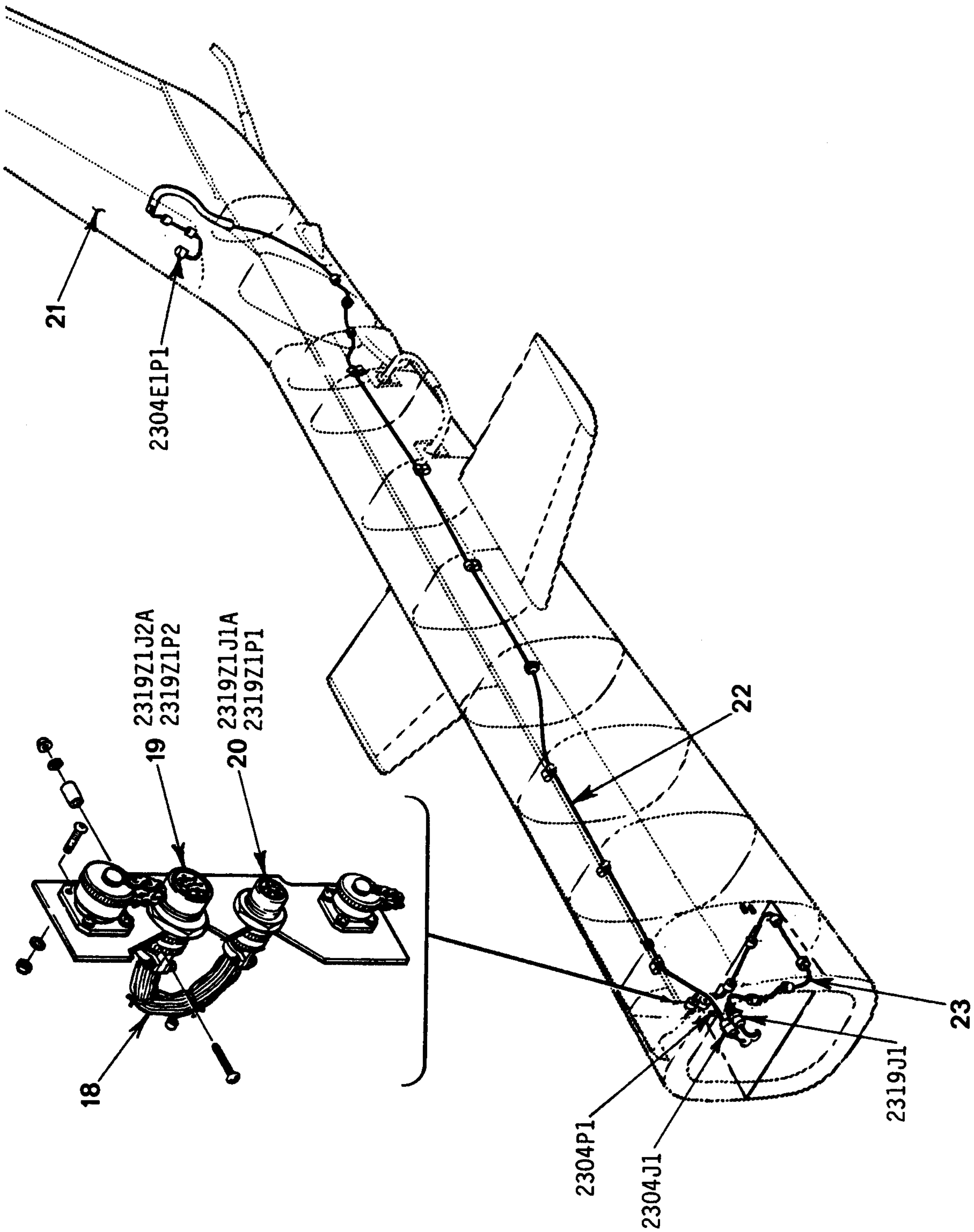



Figure F-4. FM Liaison Communication System AN/ARC-114 (Sheet 2 of 3)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | AN/ARC-114A | Radio Set |
| 2 | LPF 40-02B | Filter, Low Pass |
| 3 | 209-077-042-3 | Cable Assembly, ARC-114 |
| 4 | 8157-ARC | Control, Indicator |
| 5 | 209-077-042-21 | Cable Assembly, Homing |
| 6 | 209-077-042-25 | Cable Assembly, Homing |
| 7 | M39014/05-2219 | Capacitor, Fixed, Cer |
| 8 | 209-077-062-1 | Filter Assembly, Avionics |
| 9 | 209-077-042-23 | Cable Assembly, Homing |
| 10 | 209-077-062-1 | Filter Assembly, Avionics |
| 11 | 209-077-042-19 | Cable Assembly, Homing |
| 12 | AS-3205/ARC | Antenna, F.M. Homing |
| 13 | 209-077-042-15 | Cable Assembly, ARC-114 |
| 14 | TSEC/KY-28 | Communications, Security |
| 15 | 209-077-042-19 | Cable Assembly, Homing |
| 16 | 209-077-042-23 | Cable Assembly, Homing |
| 17 | 209-077-042-9 | Cable Assembly, ARC-114 |
| 18 | 209-077-042-13 | Cable Assembly, ARC-114 |
| 19 | MS3474L16-26PW | Connector Receptacle |
| 20 | MS3474L12-1OP | Connector Receptacle |
| 21 | 209-077-202-3 | Antenna |
| 22 | 209-077-042-27 | Cable Assembly, ARC-114 |
| 23 | 209-077-042-11 | Cable Assembly |

Figure F-4. FM Liaison Communication System AN/ARC-l14 (Sheet 3 of 3)

Table F-5. FM AN/ARC-114(), Wire Chart (with KY-28) PROD & ECAS

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARC114-1A22 | NO/S | 3400CP1P1 | I | 2304TR1P1 | A |
| ARC114-2A22 | SHIELD | 3400CP1P1 | $\overline{F}$ | 2304TR1P1 | B |
| ARC114-3A22 | NO/S | 2304TR1P1 | $\overline{C}$ | 8TB4 | A2 |
| ARC114-4B20 | NO/S | 2A1J1 | K | 2304TR1P1 | D |
| ARC114-5A20 | NO/S | 2304TR1P1 | $\overline{E}$ | 2300TB1 | C3 |
| ARC114-6A22 | NO/S | 3400TB1 | D3 | 2304TR1P1 | R |
| ARC114-6E22 | NO/S | 3400CP1P1 | H | 3400TB1 | B5 |
| ARC114-9A22 | SHIELD | 2319P1 | $\overline{J}$ | 2304TR1P1 | J |
| ARC114-9B22 | SHIELD | 2319J1 | J | 2319Z1P2 | P |
| ARC114-10A22 | SHIELD | 2319P1 | K | 2304TR1P1 | K |
| ARC114-10B22 | SHIELD | 2319J1 | K | 2319Z1P2 | V |
| ARC114-11A22 | SHIELD | 2319P1 | R | 2304TR1P1 | L |
| ARC114-11B22 | SHIELD | 2319J1 | R | 2319Z1P1 | H |
| ARC114-11C22 | NO/S | 2319Z1J1A | H | SPLICE CAP | |
| ARC114-14A20 | NO/S | 2304TR1P1 | P | 2300TB1 | D3 |
| ARC114-18A22BLU | PR/S | 3400CP1P1 | D | 2304TR1P1 | T |
| ARC114-18A22WHT | PR/S | 3400CP1P1 | $\overline{E}$ | 2304TR1P1 | U |
| ARC114-19A22 | SHIELD | 3400CP1P1 | $\overline{G}$ | 2304TR1P1 | V |
| ARC114-26A22 | SHIELD | 2319P1 | $\overline{M}$ | 2304TR1P1 | C |
| ARC114-26B22 | SHIELD | 2319J1 | M | 2319Z1P2 | $\overline{D}$ |
| ARC114-27A22 | SHIELD | 2301Z1J1 | C2 | 2304TR1P1 | D |
| ARC114-28A22 | SHIELD | 2319P1 | S | 2304TR1P1 | E |
| ARC114-28B22 | SHIELD | 2319P1 | S | 2319Z1P1 | $\overline{K}$ |
| ARC114-28C22 | NO/S | 2319Z1J1A | K | SPLICE CAP | |
| ARC114-29A22 | SHIELD | 2319P1 | B | 2304TR1P1 | F |
| ARC114-29B22 | SHIELD | 2319J1 | B | 2319Z1P2 | $\overline{C}$ |
| ARC114-30A22 | NO/S | 2319P1 | H | 2304TR1P1 | $\overline{G}$ |
| ARC114-30B22 | NO/S | 2319J1 | H | 2319Z1P2 | $\overline{W}$ |
| ARC114-31A22 | NO/S | 2301TB3 | K1 | 2304TR1P1 | H |
| ARC114-31B22 | NO/S | 2319P1 | N | 2301TB3 | $\overline{J}$1 |
| ARC114-31C22 | NO/S | 2319J1 | N | 2319Z1P2 | M |
| ARC114-32A22 | SHIELD | 2319P1 | A | 2304TR1P1 | J |
| ARC114-32B22 | SHIELD | 2319J1 | A | 2319Z1P2 | $\overline{B}$ |
| ARC114-34A22 | NO/S | 2304TR1P1 | A | SPLICE CAP | |
| ARC114-35A22 | NO/S | 2319J1 | $\overline{P}$ | SPLICE CAP | |
| ARC114-35B22 | NO/S | 2319Z1P2 | E | SPLICE CAP | |
| ARC114-51A20N | NO/S | 2319P1 | U | LOCAL GND | |
| ARC114-51B20 | NO/S | 2319J1 | U | 2319Z1P1 | J |
| ARC114-51C22 | NO/S | 2319Z1J1A | J | SPLICE CAP | |
| ARC114-52A22 | SHIELD | 2319P1 | T | 2301Z1J1 | B1 |
| ARC114-52B22 | SHIELD | 2319J1 | T | 2319Z1P1 | F |
| ARC114-52C22 | SHIELD | 2319Z1J2A | G | 2319Z1J1A | F |
| ARC114-53A20N | NO/S | 2319P1 | W | LOCAL GND | |
| ARC114-53B22 | NO/S | 2319Z1P1 | E | SPLICE CAP | |
| ARC114-53C22 | NO/S | 2319J1 | W | SPLICE CAP | |
| ARC114-53D22 | NO/S | 2319P1 | P | SPLICE CAP | |
| ARC114-53E22 | NO/S | 2319Z1J1A | E | SPLICE CAP | |
| ARC114-54A22 | SHIELD | 2319P1 | V | 2301TB3 | F1 |
| ARC114-54B22 | SHIELD | 2319J1 | V | 2319Z1P1 | A |

**Table F-5. FM AN/ARC-114(), Wire Chart (with KY-28) PROD & ECAS (Cont)**

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARC114-54C22 | SHIELD | 2319Z1J2A | V | 2319Z1J1A | A |
| ARC114-60A22 | NO/S | 2301Z1J1 | C1 | 2300TB1 | J1 |
| ARC114-61A22 | SHIELD | 2319P1 | L | 2301Z1J1 | B2 |
| ARC114-61B22 | SHIELD | 2319J1 | L | 2319Z1P2 | G2 |
| ARC114-101A | COAX | 2304TR1P2 | | 2304FL1P1 | |
| ARC114-102A | COAX | 2304TR1P4 | | 2304FL3P1 | |
| ARC114-103A | COAX | 2304TR1P3 | | 2304FL2P1 | |
| ARC114-104A | COAX | 2304FL1P2 | | 2304P1 | |
| ARC114-105A | COAX | 2304J1 | | 2304E1P1 | |
| ARC114-106A | COAX | 2304FL2P2 | | 2304E2P1L | |
| ARC114-107A | COAX | 2304FL3P2 | | 2304E2P1R | |
| KY28-2A20 | NO/S | 2319P1 | E | 2319CP1P1 | B |
| KY28-2B20 | NO/S | 2319J1 | E | 2319Z1P2 | J |
| KY28-3A20 | NO/S | 2319P1 | X | 2319CP1P1 | F |
| KY28-4A20 | NO/S | 2319P1 | F | 2319CP1P1 | D |
| KY28-4B20 | NO/S | SPLICE | | 2319J1 | F |
| KY28-4C20 | NO/S | SPLICE | | 2319Z1P2 | S |
| KY28-4D20 | NO/S | SPLICE | | 2319Z1P2 | R |
| KY28-5A20 | NO/S | 2319P1 | G | 2319CP1P1 | C |
| KY28-5B20 | NO/S | 2319J1 | G | 2319Z1P2 | H |
| KY28-6A20 | NO/S | 2319P1 | L | 2319CP1P1 | J |
| KY28-6B20 | NO/S | 2319J1 | C | 2319Z1P2 | Z |
| KY28-7A20 | NO/S | 2319P1 | D | 2319CP1P1 | K |
| KY28-7B20 | NO/S | 2319J1 | D | 2319Z1P2 | Y |
| KY28-8B20 | NO/S | 2A1J1 | BB | 2319CP1P1 | A |
| KY28-8D20 | NO/S | 2A1J1 | M | 2301Z1J2 | A1 |
| KY28-9A20 | NO/S | 2300TB1 | A3 | 2319CP1P1 | E |
| KY28-17A20 | NO/S | 8TB4 | J2 | 2319CP1P1 | H |
| KY28-3B20 | NO/S | 2319J1 | X | 2319Z1P2 | K |

1 Underlined Pin Numbers Denote Lower Case

2 Denotes: NO/S--No Shield

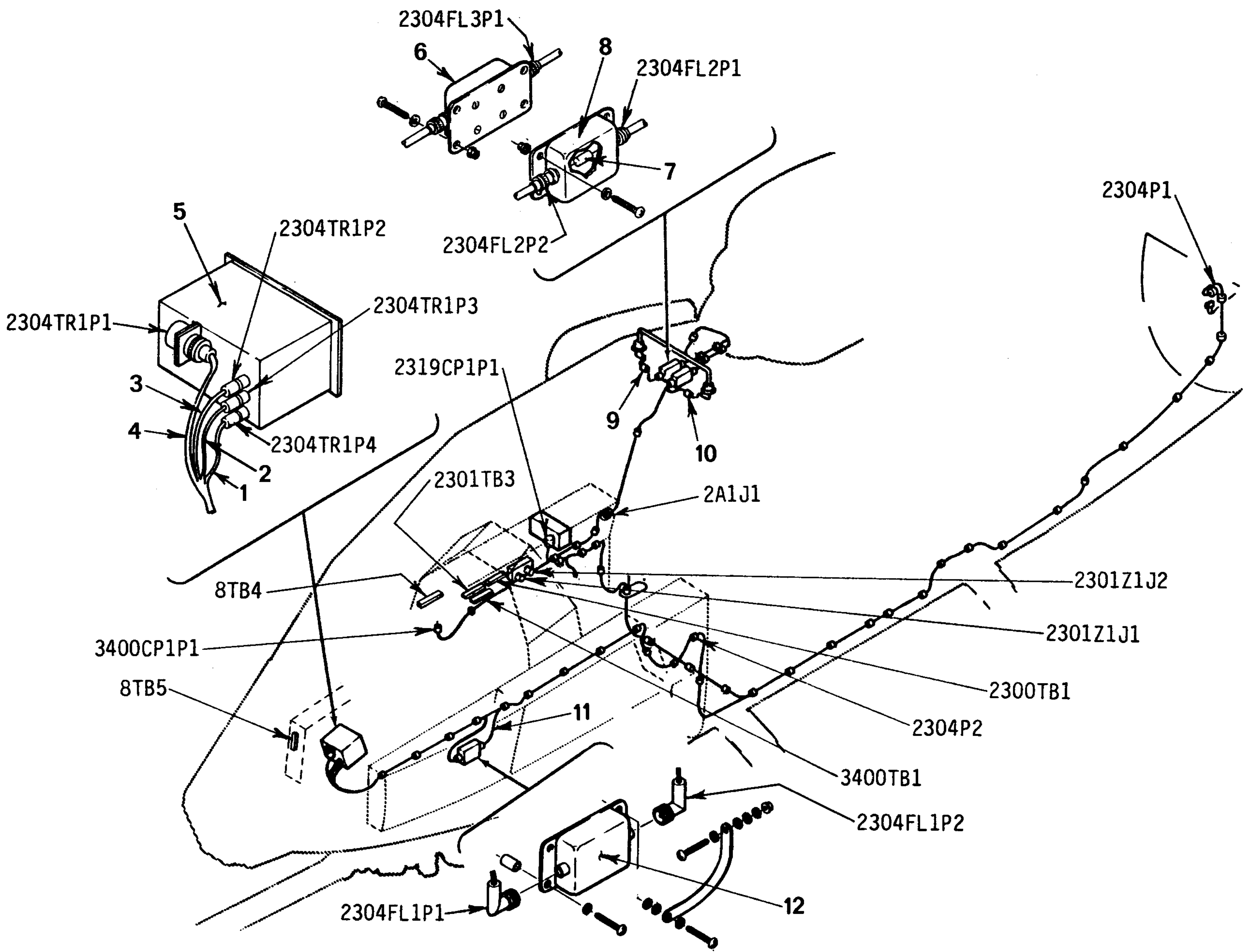



Figure F-5. FM Liaison Communication System AN/ARC-114A (Sheet 1 of 3)

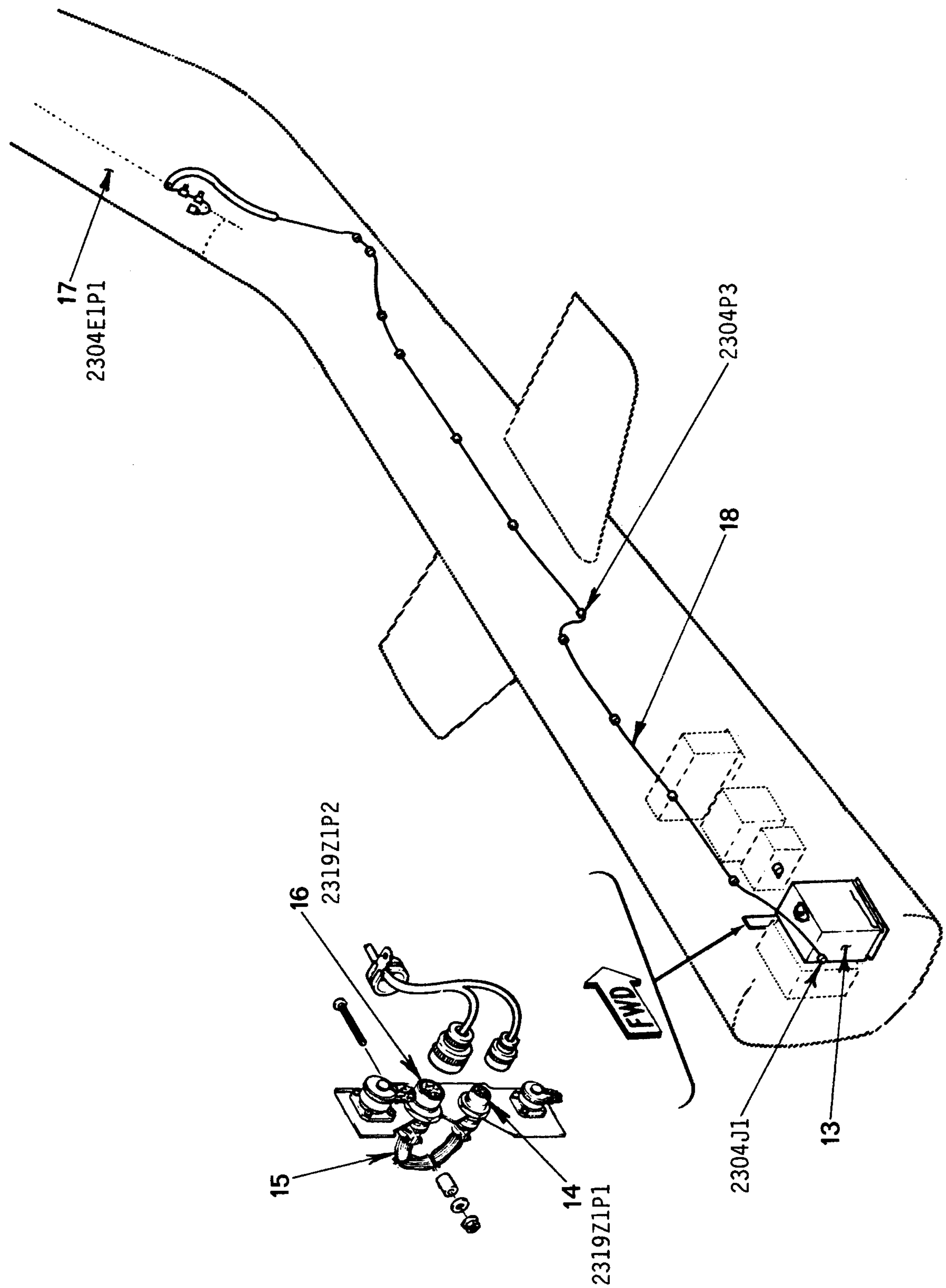



Figure F-5. FM Liaison Communication System AN/ARC-114A (Sheet 2 of 3)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | 209-077-093-107 | Cable Assembly, Coaxial |
| 2 | 209-077-093-105 | Cable Assembly, Coaxial |
| 3 | 209-077-093-109 | Cable Assembly, Coaxial |
| 4 | 209-077-093-117 | Cable Assembly, Coaxial |
| 5 | AN/ARC-114A | Radio Set |
| 6 | 209-077-062-1 | Filter Assembly, Avionics |
| 7 | M39014/05-2219 | Capacitor Fixed Cer |
| 8 | 209-077-062-1 | Filter Assembly, Avionics |
| 9 | 209-077-042-25 | Cable Assembly, Homing |
| 10 | 209-077-042-21 | Cable Assembly, Homing |
| 11 | 209-077-093-111 | Cable Assembly, Coaxial |
| 12 | LPF 40-02B | Filter, Low Pass |
| 13 | TSEC/KY-28 | Communication Security |
| 14 | MS3474L12-1OP | Connector, Receptacle |
| 15 | 209-077-042-13 | Cable Assembly, ARC-114A |
| 16 | MS3474L16-26PW | Connector, Receptacle |
| 17 | . . . | Antenna |
| 18 | 209-077-093-113 | Cable Assembly, ARC-114 |

Figure F-5. FM Liaison Communication System AN/ARC-l14A (Sheet 3 of 3)

**Table F-6. FM AN/ARC-114(), Wire Chart (with KY-28) MC**

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARC114-1A22 | NO/S | 3400CP1P1 | $\underline{I}$ | 2304TR1P1 | A |
| ARC114-2A22 | SHIELD | 3400CP1 | $\underline{F}$ | 2304TR1P1 | B |
| ARC114-3A22 | NO/S | 2304TR1P1 | C | 8TB5 | K5 |
| ARC114-4B20 | NO/S | 2A1J1 | $\underline{K}$ | 2304TR1P1 | D |
| ARC114-5A20 | NO/S | 2304TR1P1 | E | 2300TB1 | C3 |
| ARC114-6A22 | NO/S | 3400TB1 | D3 | 2304TR1P1 | R |
| ARC114-6E22 | NO/S | 3400CP1P1 | $\underline{H}$ | 3400TB1 | B5 |
| ARC114-9A22 | SHIELD | 2319Z1P2 | P | 2304TR1P1 | J |
| ARC114-10A22 | SHIELD | 2319Z1P2 | V | 2304TR1P1 | K |
| ARC114-11A22 | SHIELD | 2319Z1P1 | H | 2304TR1P1 | L |
| ARC114-14A20 | NO/S | 2304TR1P1 | P | 2300TB1 | D3 |
| ARC114-18A22BLU | PR/S | 3400CP1P1 | $\underline{D}$ | 2304TR1P1 | T |
| ARC114-18A22WHT | PR/S | 3400CP1P1 | $\underline{E}$ | 2304TR1P1 | U |
| ARC114-19A22 | SHIELD | 3400CP1P1 | $\underline{G}$ | 2304TR1P1 | V |
| ARC114-26A22 | SHIELD | 2319Z1P2 | D | 2304TR1P1 | $\underline{C}$ |
| ARC114-27A22 | SHIELD | 2301Z1J1 | C2 | 2304TR1P1 | $\underline{D}$ |
| ARC114-28A22 | SHIELD | 2319Z1P1 | K | 2304TR1P1 | $\underline{E}$ |
| ARC114-29A22 | SHIELD | 2319Z1P2 | $\underline{C}$ | 2304TR1P1 | $\underline{F}$ |
| ARC114-30A22 | NO/S | 2319Z1P2 | W | 2304TR1P1 | $\underline{G}$ |
| ARC114-31A22 | NO/S | 2301TB3 | K1 | 2304TR1P1 | $\underline{H}$ |
| ARC114-31B22 | NO/S | 2319Z1P2 | M | 2301TB3 | $\underline{J1}$ |
| ARC114-32A22 | SHIELD | 2319Z1P2 | $\underline{B}$ | 2304TR1P1 | $\underline{J}$ |
| ARC114-34A22 | NO/S | 2304TR1P1 | $\underline{A}$ | SPLICE CAP | |
| ARC114-51A20N | NO/S | 2319Z1P1 | J | LOCAL GND | |
| ARC114-52A22 | SHIELD | 2319Z1P1 | F | 2301Z1J1 | B1 |
| ARC114-52A22 | SHIELD | 2319Z1P1 | A | 2301TB3 | F1 |
| ARC114-60A22 | NO/S | 2301Z1J1 | C1 | 2300TB1 | J1 |
| ARC114-61A22 | SHIELD | 2319Z1P2 | G | 2301Z1J1 | B2 |
| ARC114-101A | COAX | 2304TR1P2 | | 2304FL1P1 | |
| ARC114-102A | COAX | 2304TR1P4 | | 2304FL3P1 | |
| ARC114-103A | COAX | 2304TR1P3 | | 2304FL2P1 | |
| ARC114-104A | COAX | 2304FL1P2 | | 2304P1 | |
| ARC114-105A | COAX | 2304J1 | | 2304P1 | |
| ARC114-101A | COAX* | 2304TR1P2 | | 2304FL1P1 | |
| ARC114-102A | COAX* | 2304TR1P4 | | 2304FL3P1 | |
| ARC114-103A | COAX* | 2304TR1P3 | | 2304FL2P1 | |
| ARC114-104A | COAX* | 2304FL1P2 | | 2304P2 | |
| ARC114-105A | COAX* | 2304P2 | | 2304P1 | |
| ARC114-106A | COAX* | 2304J1 | | 2304P3 | |
| ARC114-107A | COAX* | 2304P3 | | 2304E1P1 | |

**Table F-6. FM AN/ARC-114(), Wire Chart (with KY-28) MC (Cont)**

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| KY28-2A20 | NO/S | 2319Z1P2 | J | 2319CP1P1 | B |
| KY28-3A20 | NO/S | 2319Z1P2 | K | 2319CP1P1 | F |
| KY28-4A20 | NO/S | SPLICE | | 2319CP1P1 | D |
| KY28-4B20 | NO/S | SPLICE | | 2319Z1P2 | S |
| KY28-4C20 | NO/S | SPLICE | | 2319Z1P2 | R |
| KY28-5A20 | NO/S | 2319Z1P2 | H | 2319CP1P1 | C |
| KY28-6A20 | NO/S | 2319Z1P2 | Z | 2319CP1P1 | J |
| KY28-7A20 | NO/S | 2319Z1P2 | Y | 2319CP1P1 | K |
| KY28-8B20 | NO/S | 2A1J1 | BB | 2319CP1P1 | A |
| KY28-8D20 | NO/S | 2A1J1 | M | 2301Z1J2 | A1 |
| KY28-9A20 | NO/S | 2300TB1 | A3 | 2319CP1P1 | E |
| KY28-17A20 | NO/S | 8TB4 | J2 | 2319CP1P1 | H |

1 Underlined Pin Numbers Denote Lower Case

2 Denotes: NO/S--No Shield
PR/S--Pair, Twisted, W/Shield

*Denotes Coax Cable Per RG-223()/U

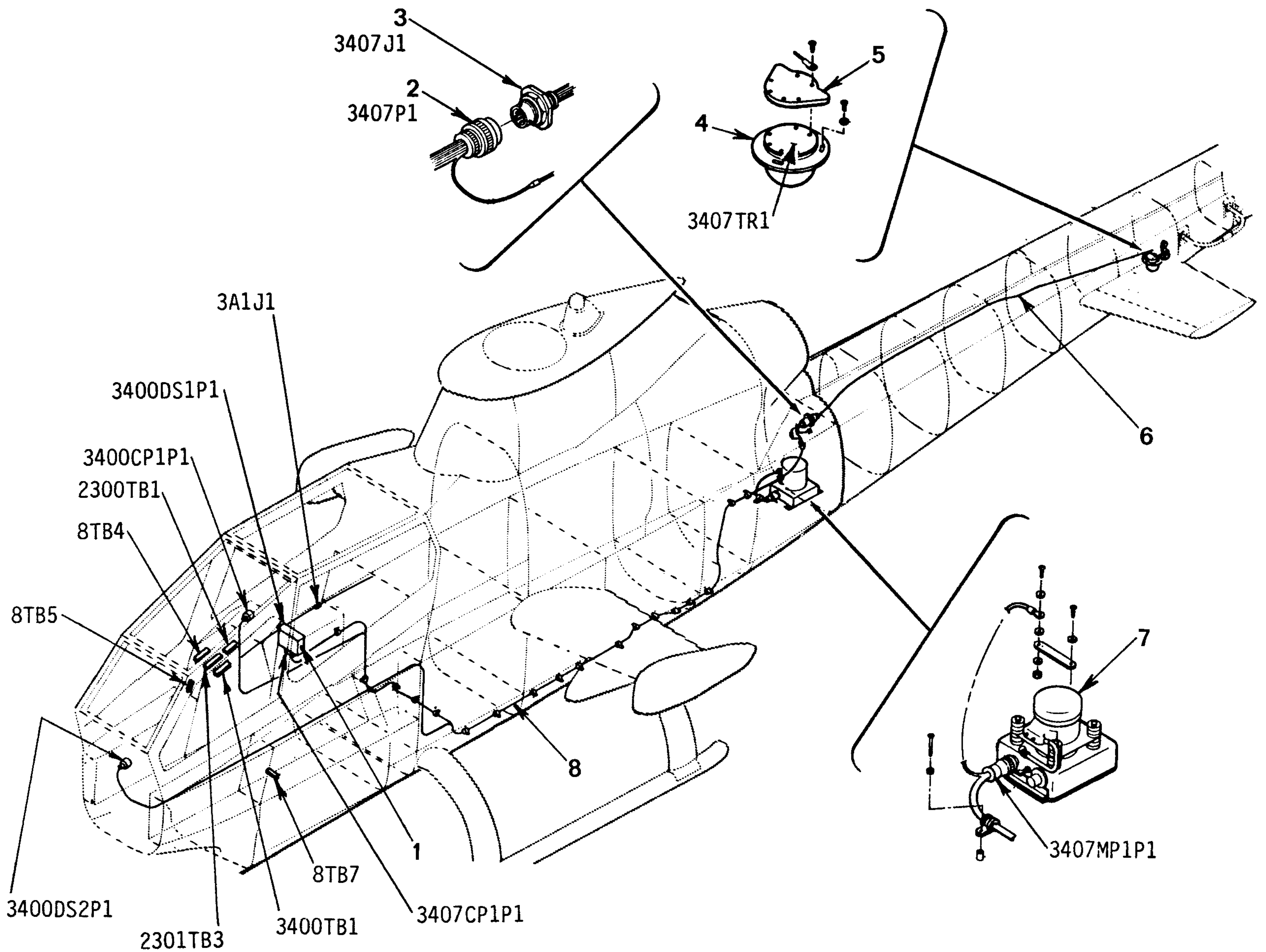



Figure F-6. Gyromagnetic Compass System AN/ASN-43 (Sheet 1 of 2)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | C-6347()/ASN-43 | Controller, Compass |
| 2 | MS3476L10-6S | Connector, Plug Elec |
| 3 | MS3474L10-6P | Connector, Receptacle |
| 4 | T-611A/ASN | Transmitter, Induction |
| 5 | CN-405/ASN | Compensator, Transmitter |
| 6 | 209-077-048-5 | Cable Assembly ASN-43, USBL EFF 76-22567 thru 77-23092. |
| | 209-077-095-105 | Cable Assembly ASN-43, USBL EFF 78-23093 and subsequent. |
| 7 | CN-998B/ASN-43 | Gyroscope, Displacement |
| 8 | 209-077-048-3 | Cable Assembly, Branch USBL EFF 76-22567 thru 77-23092 |
| | 209-077-095-103 | Cable Assembly, Branch USBL EFF 78-23093 and subsequent. |

Figure F-6. Gyromagnetic Compass System AN/ASN-43 (Sheet 2 of 2)

Table F-7. AN/ASN-43, Wire Chart

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ANS43-1B20 | NO/S | 3A1J1 | X | 3400TB1 | F3 |
| ANS43-1C20 | NO/S | 3400TB1 | $\overline{G}$3 | SPLICE | |
| ANS43-1D20 | NO/S | SPLICE | | 3407MP1P1 | C |
| ANS43-1E22 | NO/S | 3400TB1 | H3 | 3400DS1P1 | 65 |
| ANS43-2A22WHT | TWT/S | 3400TB1 | A1 | 3407CP1P1 | M |
| ANS43-2B22WHT | TWT/S | 3400TB1 | B1 | 3400DS1P1 | 13 |
| ANS43-2A22BLU | TWT/S | 3400TB1 | F1 | 3407CP1P1 | N |
| ANS43-2B22BLU | TWT/S | 3400TB1 | G1 | 3400DS1P1 | 14 |
| ANS43-2A22ORN | TWT/S | 3400TB1 | A2 | 3407CP1P1 | L |
| ANS43-2B22ORN | TWT/S | 3400TB1 | B2 | 3400DS1P1 | 15 |
| ANS43-19B20 | NO/S | 3400TB1 | J5 | 3407CP1P1 | T |
| ANS43-6A20 | NO/S | 3407MP1P1 | R | SPLICE | |
| ANS43-7A20N | NO/S | 3407MP1P1 | S | GND | |
| ANS43-19C22 | NO/S | 3400TB1 | K5 | 3400DS1P1 | 16 |
| ANS43-8A22 | SHIELD | 3407MP1P1 | T | 3407MP1P1 | V |
| ANS43-9A22 | NO/S | 3407MP1P1 | B | 3407MP1P1 | U |
| ANS43-10A22WHT | TWT/S | 3407MP1P1 | W | 3407CP1P1 | E |
| ANS43-10A22BLU | TWT/S | 3407MP1P1 | X | 3407CP1P1 | F |
| ANS43-10A22ORN | TWT/S | 3407MP1P1 | Y | 3407CP1P1 | D |
| ANS43-13A22WHT | TWT/S | 3407MP1P1 | H | 3407CP1P1 | J |
| ANS43-13A22BLU | TWT/S | 3407MP1P1 | J | 3407CP1P1 | K |
| ANS43-13A22ORN | TWT/S | 3407MP1P1 | G | 3407CP1P1 | H |
| ANS43-16A22 | NO/S | 3407MP1P1 | A | 3407CP1P1 | P |
| ANS43-17A22 | NO/S | 3407MP1P1 | $\overline{B}$ | 3407CP1P1 | R |
| ANS43-18A20 | NO/S | 3407MP1P1 | $\overline{E}$ | 3407CP1P1 | S |
| ANS43-19A20 | NO/S | 3407MP1P1 | P | 3400TB1 | D5 |
| ANS43-20A22WHT | TWT/S | 3407TR1 | B | 3407J1 | B |
| ANS43-20B22WHT | TWT/S | 3407P1 | B | 3407CP1P1 | B |
| ANS43-20A22BLU | TWT/S | 3407TR1 | C | 3407J1 | C |
| ANS43-20B22BLU | TWT/S | 3407P1 | C | 3407P1 | C |
| ANS43-20A22ORN | TWT/S | 3407TR1 | A | 3407J1 | A |
| ANS43-20B22ORN | TWT/S | 3407P1 | A | 3407CP1P1 | A |
| ANS43-23A20 | NO/S | 3407MP1P1 | M | 3407P1 | E |
| ANS43-23B20 | NO/S | 3407J1 | E | 3407TR1 | E |
| ANS43-24A20 | NO/S | 8TB7 | H3 | 3407CP1P1 | U |
| ANS43-25A20 | NO/S | 2300TB1 | J3 | 3407CP1P1 | V |
| ANS43-26A20N | NO/S | 3407MP1P1 | Z | GND | |
| ANS43-27A20 | NO/S | 3400TB1 | A4 | 3407CP1P1 | W |

Table F-7. AN/ASN-43, Wire Chart (Cont)

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ANS43-28A20 | NO/S | 3407TR1 | D | 3407J1 | D |
| ANS43-28B20N | NO/S | 3407P1 | D | GND | |
| ANS43-29A20N | NO/S | 3407MP1P1 | A | GND | |
| ANS43-30A20N | NO/S | 3407MP1P1 | D | GND | |
| ANS43-31A20 | NO/S | 8TB5 | K2 | 3400DS2P1 | H |
| ANS43-32A20 | NO/S | 8TB5 | K4 | 3400DS2P1 | K |
| *ANS4 3 -33B20 | NO/S | 3A1J1 | V | 3400TB1 | F5 |
| *ANS4 3 -33C20 | NO/S | 3400TB1 | G5 | 3400DS2P1 | V |
| *ANS4 3 -33D22 | NO/S | 3400TB1 | H5 | 3400DS1P1 | 68 |
| *ANS4 3 -34A20 | NO/S | 3400TB1 | B4 | 3400DS2P1 | D |
| *ANS4 3 -35A22 | NO/S | 3400TB1 | D4 | 3400DS1P1 | 64 |
| *ANS4 3 -35B22 | NO/S | 3400TB1 | H4 | 3400DS1P1 | 69 |
| *ANS4 3 -37A22WHT | TWT/S | 3400DS1P1 | 70 | 3400DS2P1 | B |
| *ANS4 3 -37A22BLU | TWT/S | 3400DS1P1 | 71 | 3400DS2P1 | C |
| *ANS4 3 -37A22ORN | TWT/S | 3400DS1P1 | 72 | 3400DS2P1 | E |
| *ANS43-38A22 | NO/S | 3400TB1 | J4 | 3400DS1P1 | 83 |
| **ASN43-24A20 | NO/S | 8TB4 | H3 | 3407CP1P1 | U |

1 Underlined Pin Numbers Denote Lower Case

2 Denotes: NO/S--No Shield
PR/S--Pair Twisted, W/Shield

*Wires Not Used On (MC)AH-1

**Denotes Difference In Wiring For (MC) AH-1

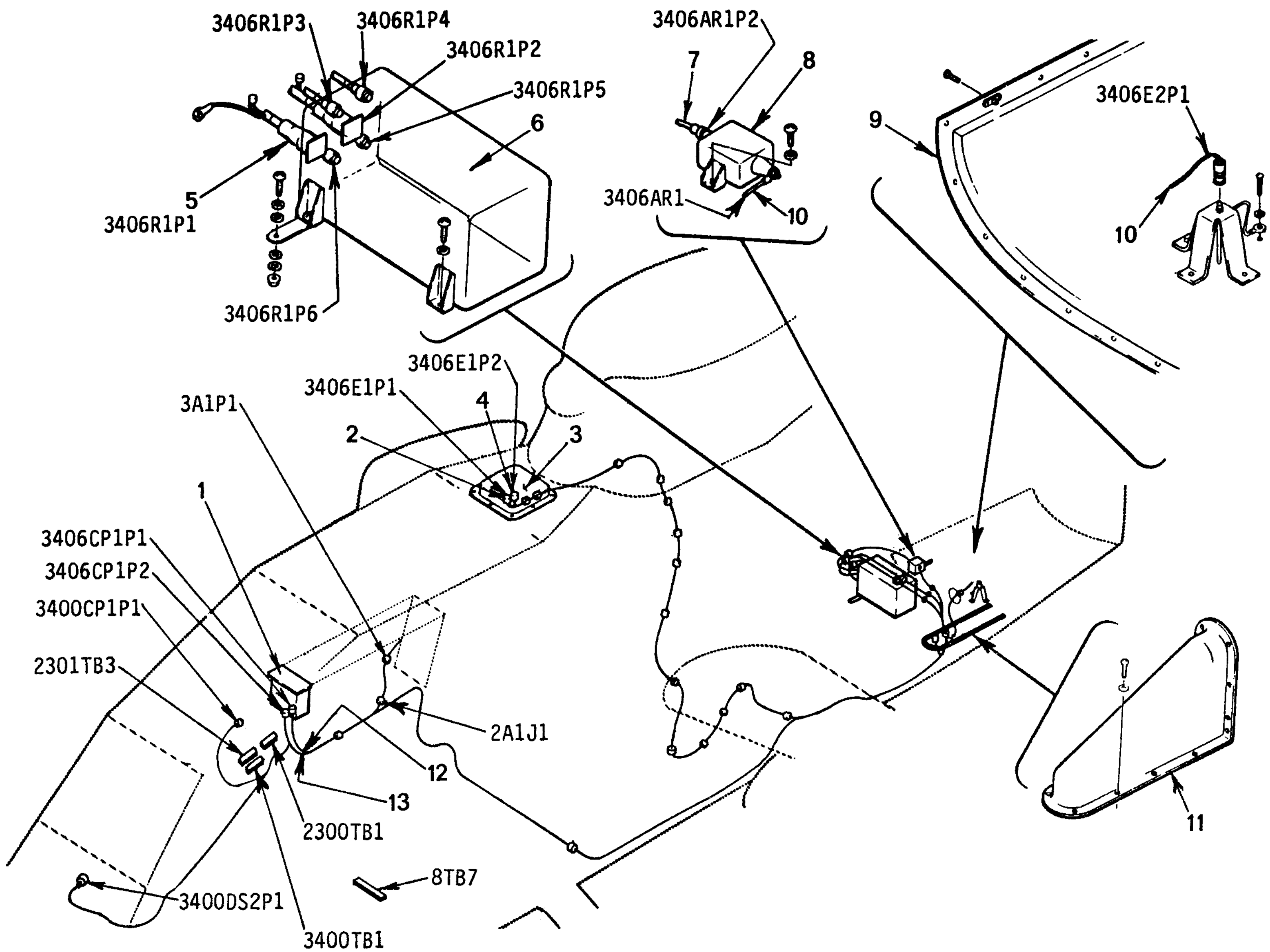



Figure F-7. Automatic Direction Finder AN/ARN-89B (Sheet 1 of 2)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | 7392A/ARN-89 | Control, Radio Set |
| 2 | 9-077-041-13 | Cable Assembly, Loop Antenna |
| 3 | -2108A/ARN-89 | Antenna |
| 4 | 9-077-041-15 | Cable Assembly, Loop Antenna |
| 5 | 9-077-041-5 | Cable Assembly, ADF |
| 6 | 1496A/ARN-89 | Receiver, Radio |
| 7 | 9-077-041-9 | Cable Assembly, Spec Pr USBL EFF 76-22567 thru 77-22762. |
| | 9-077-041-19 | Cable Assembly, Spec Pr USBL EFF 77-22763 and subsequent. |
| 8 | -4859A/ARN-89 | Amplifier, Impedance |
| 9 | 9-030-133-7 | Sense Antenna Panel |
| 10 | 9-077-041-11 | Cable Assembly, Spec Pr USBL EFF 76-22567 thru 77-22762 |
| | 9-077-041-21 | Cable Assembly, Spec Pr USBL EFF 77-22763 and subsequent. |
| 11 | 9-075-108-101 | Cover, Instl Wiring, USBL EFF 78-23093 and subsequent. |
| 12 | 9-077-041-17 | Cable Assembly, ADF |
| 13 | 9-077-041-7 | Cable Assembly, ADF |

Figure F-7. Automatic Direction Finder AN/ARN-89B (Sheet 2 of 2)

Table F-8. AN/ARN-89B, Wire Chart, ADF

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARN89-1A22 | SHIELD | 3406R1P1 | A | 2301TB3 | D5 |
| ARN89-2A22 | SHIELD | 3406R1P1 | B | 2300TB1 | B2 |
| ARN89-3A20N | NO/S | 3406R1P1 | C | LOCAL GND | |
| ARN89-6B22 | SHIELD | 3A1P1 | T | 3400TB1 | B3 |
| ARN89-6C22 | SHIELD | 3400TB1 | A3 | 3406R1P1 | H |
| ARN89-6D22 | SHIELD | 3400TB1 | C3 | 3400DS2P1 | M |
| ARN89-8A20N | NO/S | 3406R1P1 | D | LOCAL GND | |
| ARN89-9A22 | NO/S | 3406R1P1 | J | 3400TB1 | J9 |
| ARN89-9B22 | NO/S | 3400DS2P1 | L | 3400TB1 | D9 |
| ARN89-9C22 | NO/S | 3400CP1P1 | C | 3400TB1 | E9 |
| ARN89-10A22 | NO/S | 3406R1P1 | K | 3400TB1 | A9 |
| ARN89-10B22 | NO/S | 3400DS2P1 | P | 3400TB1 | B9 |
| ARN89-10C22 | NO/S | 3400CP1P1 | B | 3400TB1 | C9 |
| ARN89-11B20 | NO/S | 3400CP1P1 | L | 2A1J1 | HH |
| ARN89-12A22 | NO/S | 3406R1P1 | M | 8TB7 | H2 |
| ARN89-13A20 | NO/S | 3406R1P1 | N | 3406R1P1 (SHIELD) | |
| ARN89-15A22 | NO/S | 3406R1P1 | R | 3400TB1 | F9 |
| ARN89-15B22 | NO/S | 3400DS2P1 | N | 3400TB1 | H9 |
| ARN89-15C22 | NO/S | 3406CP1P1 | A | 3400TB1 | G9 |
| ARN89-16A20 | SHIELD | 3406CP1P1 | C | 3406R1P2 | C |
| ARN89-17A22 | SHIELD | 3406CP1P1 | G | 3406R1P2 | G |
| ARN89-18A22 | SHIELD | 3406CP1P1 | L | 3406R1P2 | S |
| ARN89-19A22 | SHIELD | 3406CP1P1 | S | 3406R1P2 | S |
| ARN89-20A20 | SHIELD | 3406CP1P1 | B | 3406R1P2 | B |
| ARN89-21A20 | NO/S | 3406CP1P1 | T | 3406CP1P1 (SHIELDS) | |
| ARN89-21B20 | NO/S | 3406R1P2 (SHIELD) | | 3406R1P2 | T |
| ARN89-22A22 | SHIELD | 3406CP1P1 | D | 3406R1P2 | D |
| ARN89-23A22 | SHIELD | 3406CP1P1 | E | 3406R1P2 | E |
| ARN89-24A22 | SHIELD | 3406CP1P1 | M | 3406R1P2 | M |
| ARN89-25A22 | SHIELD | 3406CP1P1 | F | 3406R1P2 | F |
| ARN89-26A22 | SHIELD | 3406CP1P1 | P | 3406R1P2 | P |
| ARN89-27A20 | SHIELD | 3406CP1P1 | A | 3406R1P2 | A |
| 3 ARN89-2A22 | SHIELD | 3406R1P1 | B | 2301TB3 | C5 |
| ARN89-101A | COAX | 3406CP1P2 | | 3406R1P3 | |
| ARN89-102A | COAX | 3406AR1P2 | | 3406R1P6 | |

Table F-8. AN/ARN-89B, Wire Chart, ADF (Cont)

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARN89-103A | COAX | 3406E1P2 | | 3406R1P5 | |
| ARN89-104A | COAX | 3406E1P1 | | 3406P1P4 | |
| ARN89-105A16 | SHIELD | 3406E2P1 | | 3406AR1 | ANT |
| ARN89-105A16 | NO/S | 3406E2P1 | | 3406AR1 | ANT |
| 3 ARN89-105A | COAX | 3406E2P1 | | 3406AR1 | |
| 3 ARN89-102A | COAX | 3406AR1P2 | | 3406R1P6 | |

1 Underlined Pin Numbers Denote Lower Case

2 Denotes: NO/S--No Shield
PR/S--Pair Twisted, W/Shield

3 Wires Vary Between AH-1 Models

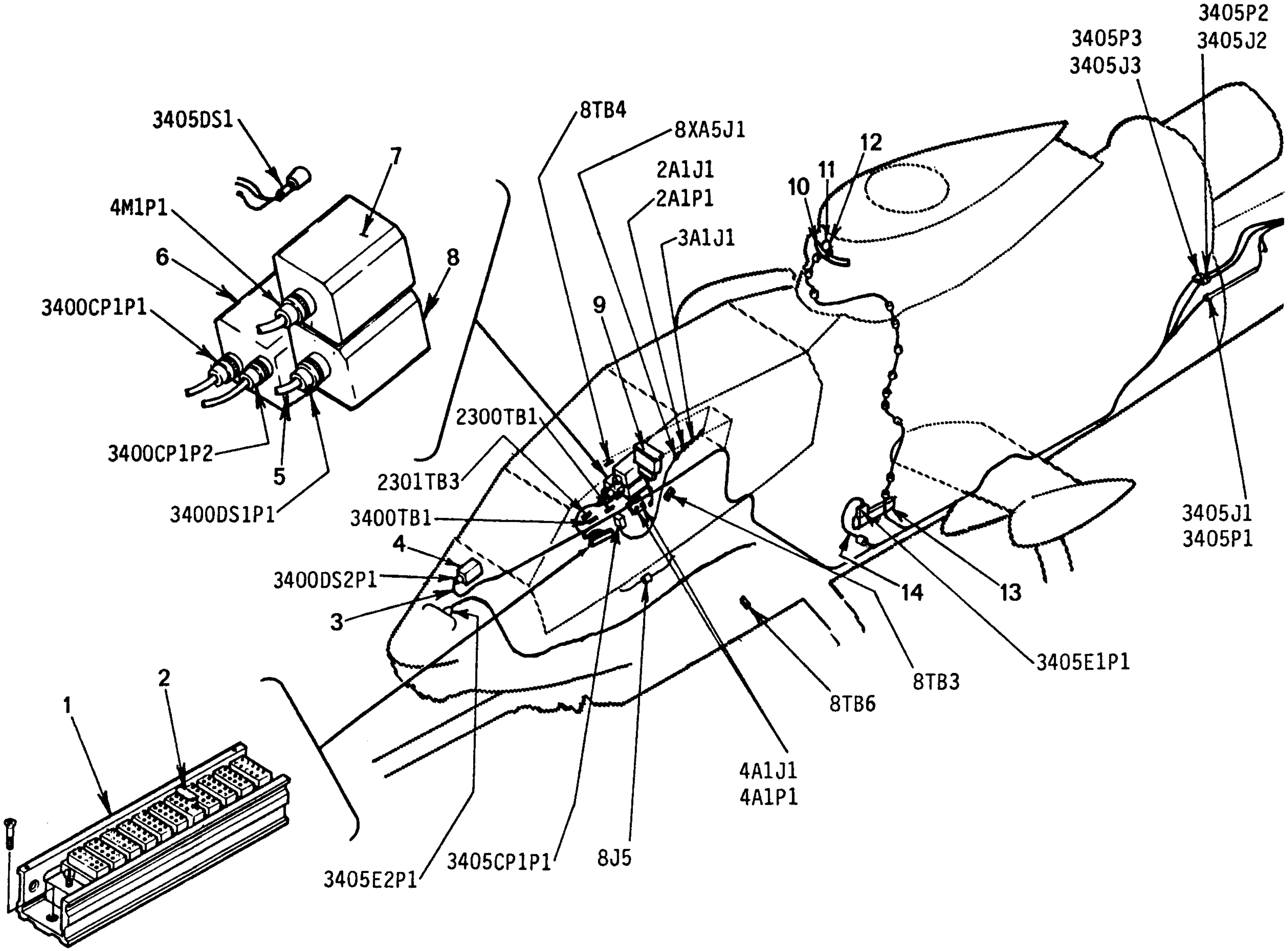



Figure F-8. VOR/MB/GS Receiving Set Radio AN/ARN-123(V)3 (Sheet 1 of 3)

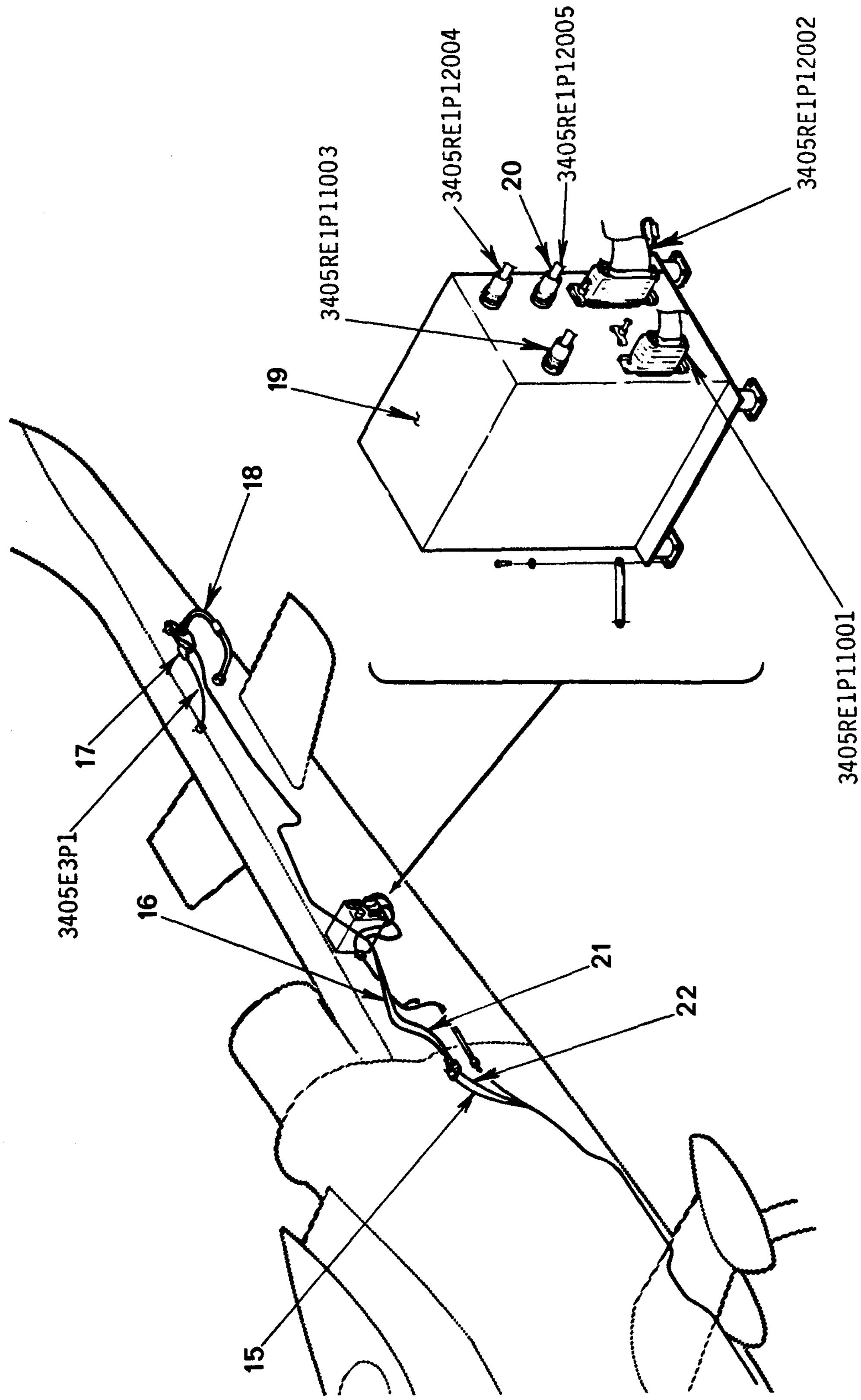



Figure F-8. VOR/MB/GS Recieving Set Radio AN/ARN-123(V)3 (Sheet 2 of 3)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | 30-015-13 | Track, Terminal |
| 2 | CR07G333JS | Resistor Fixed, Comp |
| 3 | 09-077-094-119 | Cable Assembly, VOR GLID |
| 4 | D-2105/A | Indicator, Radio-Magnetic |
| 5 | 09-077-094-119 | Cable Assembly, VOR GLID |
| 6 | 09-077-081-5 | Control, Navigation Select |
| 7 | D-2404/A | Indicator, Attitude |
| 8 | D-3103/A | Indicator, Horizontal |
| 9 | -10048/ARN-123(V) | Control, Receiver |
| 10 | S-3188/ARN | Antenna |
| 11 | 209-077-094-113 | Cable Assembly, GS Antenna |
| 12 | M39012/16-0004 | Connector Plug, Elec |
| 13 | AT-640/ARN | Antenna |
| 14 | 209-077-094-111 | Cable Assembly, MB Antenna |
| 15 | 209-077-094-111 | Cable Assembly, MB Antenna |
| 16 | 209-077-094-107 | Cable Assembly, ARN-123 |
| 17 | 5995-00-858-6552 | Spider, Coax Assembly (05211) |
| 18 | AS-1304 ( )/ARN | Antenna |
| 19 | R-2023/ARN-123(V) | Receiver, Radio |
| 20 | 209-077-094-109 | Cable Assembly, ARN-123 |
| 21 | 209-077-094-105 | Cable Assembly, ARN-123 |
| 22 | 209-077-094-113 | Cable Assembly, GS Antenna |

Figure F-8. VOR/MB/GS Receiving Set Radio AN/ARC-123(V)3 (Sheet 3 of 3)

**Table F-9. AN/ARN-123(V)3, Wire Chart (MC)**

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARN123-1B20 | NO/S | 2A1J1 | X | 3405CP1P1 | 6 |
| ARN123-2A22 | NO/S | 3405RE1P11001 | 14 | 3405CP1P1 | 22 |
| ARN123-3A22 | NO/S | 3405RE1P11001 | 2 | 3405CP1P1 | 23 |
| ARN123-4A22 | NO/S | 3405RE1P11001 | 15 | 3405CP1P1 | 24 |
| ARN123-5A22 | NO/S | 3405RE1P11001 | 1 | 3405CP1P1 | 25 |
| ARN123-6A22 | NO/S | 3405RE1P11001 | 8 | 3405CP1P1 | 26 |
| ARN123-7A22 | NO/S | 3405RE1P11001 | 3 | 3405CP1P1 | 30 |
| ARN123-8A22 | NO/S | 3405RE1P11001 | 4 | 3405CP1P1 | 31 |
| ARN123-9A22 | NO/S | 3405RE1P11001 | 5 | 3405CP1P1 | 32 |
| ARN123-10A22 | NO/S | 3405RE1P11001 | 6 | 3405CP1P1 | 33 |
| ARN123-11A22 | NO/S | 3405RE1P11001 | 7 | 3405CP1P1 | 29 |
| ARN123-12A22 | NO/S | 3405RE1P11001 | 9 | 3405CP1P1 | 28 |
| ARN123-13A22 | NO/S | 3405RE1P11001 | 21 | 3405CP1P1 | 27 |
| ARN123-14A22 | NO/S | SPLICE | | 3405CP1P1 | 15 |
| ARN123-15A22 | NO/S | 3405RE1P12002 | 21 | 3405CP1P1 | 8 |
| ARN123-16A22 | NO/S | 3405RE1P12002 | 22 | 3405CP1P1 | 16 |
| ARN123-17A22 | NO/S | 3405RE1P12002 | 5 | 3405CP1P1 | 12 |
| ARN123-18A22 | NO/S | 3405RE1P12002 | 26 | 3405CP1P1 | 14 |
| ARN123-19D22 | NO/S | SPLICE | | 8J5 | 7 |
| ARN123-1D22 | NO/S | 3400CP1P1 | K | 2A1J1 | X |
| ARN123-20A20WHT | TWT/S | 3405RE1P11001 | 12 | 3400TB1 | G6 |
| ARN123-20A20BLU | TWT/S | 3405RE1P11001 | 13 | 3400TB1 | C6 |
| ARN123-20A20ORN | TWT/S | 3405RE1P11001 | 25 | 3400TB1 | K6 |
| ARN123-21A22 | NO/S | 3405RE1P11001 | 19 | 3400TB1 | F7 |
| ARN123-22A22 | NO/S | 3405RE1P11001 | 24 | 3400TB1 | J7 |
| ARN123-23A22 | NO/S | 3405RE1P11001 | 11 | 3400TB1 | A7 |
| ARN123-24A22 | NO/S | 3405RE1P11001 | 20 | 3400TB1 | F8 |
| ARN123-26A22 | NO/S | 3405RE1P12002 | 37 | 3400CP1P1 | T |
| ARN123-27A22 | NO/S | 3405RE1P12002 | 29 | 3400CP1P1 | X |
| ARN123-69A22 | NO/S | 3400CP1P1 | L | 8TB4 | E3 |
| ARN123-29A22 | NO/S | 3405RE1P12002 | 12 | 3400TB1 | J8 |
| ARN123-30A22 | NO/S | 3405RE1P12002 | 30 | 3400TB1 | A8 |
| ARN123-31A22 | NO/S | 3405RE1P12002 | 31 | 3400DS1P1 | 60 |
| ARN123-32A22 | NO/S | 3405RE1P12002 | 14 | 3400DS1P1 | 59 |
| ARN123-33A22WHT | TWT/S | 3405RE1P12002 | 9 | 3400DS1P1 | 36 |
| ARN123-33A22BLU | TWT/S | 3405RE1P12002 | 32 | 3400DS1P1 | 37 |
| ARN123-33A22ORN | TWT/S | 3405RE1P12002 | 23 | 3400DS1P1 | 35 |
| ARN123-35A22WHT | PR/S | 3405RE1P12002 | 8 | 3400DS1P1 | 38 |
| ARN123-35A22BLU | PR/S | 3405RE1P12002 | 33 | 3400DS1P1 | 39 |
| ARN123-36A22WHT | PR/S | 3405RE1P12002 | 36 | 3400DS1P1 | 40 |
| ARN123-36A22BLU | PR/S | 3405RE1P12002 | 34 | 3400DS1P1 | 41 |
| ARN123-37A22 | SHIELD | 3405CP1P1 | 2 | 2301TB3 | C7 |
| ARN123-38A22WHT | PR/S | 3405RE1P12002 | 15 | 3405CP1P1 | 3 |

Table F-9. AN/ARN-123(V)3, Wire Chart (MC) (Cont)

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARN123-38A22BLU | PR/S | 3405RE1P12002 | 11 | SPLICE | |
| ARN123-39A22WHT | PR/S | 3405RE1P12002 | 4 | 3405CP1P1 | 19 |
| ARN123-39A22BLU | PR/S | 3405RE1P12002 | 2 | SPLICE | |
| ARN123-40A20WHT | TWT/S | 3405RE1P12002 | 7 | 3400TB1 | D1 |
| ARN123-40A20BLU | TWT/S | 3405RE1P12002 | 6 | 3400TB1 | J1 |
| ARN123-40A20ORN | TWT/S | 3405RE1P12002 | 10 | 3400TB1 | D2 |
| ARN123-41B20WHT | PR/S | 3405RE1P12002 | 18 | 3A1J1 | W |
| ARN123-41B20N-BLU | PR/S | 3405RE1P12002 | 19 | LOCAL GND | |
| ARN123-38B22 | NO/S | 3405CP1P1 | 1 | SPLICE | |
| ARN123-39B22 | NO/S | 3405CP1P1 | 17 | SPLICE | |
| ARN123-45A22 | NO/S | SPLICE | | 2300TB1 | C2 |
| ARN123-46A22 | NO/S | SPLICE | | 2300TP1 | D2 |
| ARN123-47B22 | NO/S | 3405CP1P1 | 13 | 4A1J1 | J |
| ARN123-48A22 | SHIELD | 3405CP1P1 | 18 | 2301TB3 | D9 |
| ARN123-50A22WHT | TWT/S | 3400DS1P1 | 32 | 3400CP1P2 | U |
| ARN123-50A22BLU | TWT/S | 3400DS1P1 | 33 | 3400CP1P2 | V |
| ARN123-50A22ORN | TWT/S | 3400DS1P1 | 34 | 3400CP1P2 | W |
| ARN123-59A22WHT | PR/S | 3400DS1P1 | 19 | 3400CP1P2 | F |
| ARN123-59A22BLU | PR/S | 3400DS1P1 | 20 | 3400CP1P2 | G |
| ARN123-60A22WHT | PR/S | 3400DS1P1 | 24 | 3400CP1P2 | H |
| ARN123-60A22BLU | PR/S | 3400DS1P1 | 25 | 3400CP1P2 | J |
| ARN123-61A22 | NO/S | 3400DS1P1 | 9 | 3400CP1P2 | D |
| ARN123-62A22 | NO/S | 3400DS1P1 | 10 | 3400CP1P2 | E |
| ARN123-63A22 | NO/S | 3400DS1P1 | 81 | 3400CP1P2 | B |
| ARN123-64A22 | NO/S | 3400DS1P1 | 80 | 3400CP1P2 | C |
| ARN123-65A22 | NO/S | 3400DS1P1 | 56 | 3400CP1P2 | X |
| ARN123-53A20H | NO/S | 3400TB1 | K2 | LOCAL GND | |
| ARN123-54A20N | NO/S | 3405CP1P1 | 10 | LOCAL GND | |
| ARN123-14B22 | NO/S | SPLICE | | 3405RE1P11001 | 10 |
| ARN123-14C22 | NO/S | SPLICE | | 3405RE1P12002 | 17 |
| ARN123-19A22 | NO/S | SPLICE | | 3405RE1P12002 | 1 |
| ARN123-19B22 | NO/S | SPLICE | | 3405RE1P12002 | 20 |
| ARN123-19C22 | NO/S | SPLICE | | 3405RE1P12002 | 25 |
| ARN123-56A20N | NO/S | SHIELD | | 3405RE1P12002 | SHELL |
| ARN123-56B20N | NO/S | SHIELD | | 3405RE1P12002 | SHELL |
| ARN123-70A22 | NO/S | 3400CP1P1 | J | 3400TB1 | G4 |
| ARN123-57A22 | NO/S | 4A1J1 | I | 8J5 | 4B |
| ARN123-73A22 | NO/S | 4M1P1 | M | 3400CP1P2 | K |
| ARN123-21B22 | NO/S | 3400TB1 | W7 | 3400CP1P1 | B |
| ARN123-74A22 | NO/S | 3400CP1P2 | L | 4M1P1 | N |
| ARN123-22B22 | NO/S | 3400TB1 | E7 | 3400CP1P1 | S |
| ARN123-75A22 | NO/S | 3400CP1P2 | M | 4M1P1 | V |
| ARN123-23B22 | NO/S | 3400TB1 | C7 | 3400CP1P1 | Y |

Table F-9. AN/ARN-123(V)3, Wire Chart (MC) (Cont)

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARN123-76A22 | NO/S | 3400CP1P2 | N | 4M1P1 | W |
| ARN123-24B22 | NO/S | 3400TB1 | H8 | 3400CP1P1 | E |
| ARN123-71A22 | NO/S | 3400CP1P2 | H | 4M1P1 | T |
| ARN123-29B22 | NO/S | 3400TB1 | E8 | 3400CP1P1 | P |
| ARN123-72A22 | NO/S | 3400CP1P2 | J | 4M1P1 | U |
| ARN123-30B22 | NO/S | 3400TB1 | C8 | 3400CP1P1 | Q |
| ARN123-6A20N-GND | NO/S | 3400TB1 | F4 | LOCAL GND | |
| ARN123-7A20N-GND | NO/S | 3400TB1 | K4 | LOCAL GND | |
| ARN123-58A22 | NO/S | 3405CP1P1 | 21 | 8TB4 | 13 |
| ARN123-51A20N | NO/S | LOCAL GND | | 3405RE1P12002 | 28 |
| ARN123-52A20N | NO/S | LOCAL GND | | 3405RE1P12002 | 35 |
| ARN123-78A22 | NO/S | 3400DS1P1 | 62 | 8TB3 | H2 |
| ARN123-79A22 | NO/S | 3400DS1P1 | 63 | 8TB6 | C4 |
| ARN123-66A22 | NO/S | 3400DS1P1 | 55 | 3400CP1P2 | Y |
| ARN123-67A22 | NO/S | 3400DS1P1 | 8 | 3400CP1P2 | Z |
| ARN123-68A22 | NO/S | 3400DS1P1 | 7 | 3400CP1P2 | A |
| ARN123-41E20 | NO/S | 3A1J1 | N | 3400DS2P1 | S |
| ARN123-20C22WHT | TWT/S | 3400TB1 | 6F | 3400CP1P1 | K |
| ARN123-20C22BLU | TWT/S | 3400TB1 | B6 | 3400CP1P1 | M |
| ARN123-20C22ORN | TWT/S | 3400TB1 | D6 | 3400CP1P1 | N |
| ARN123-20D22WHT | TWT/S | 3400TB1 | H6 | 3400DS2P1 | T |
| ARN123-20D22BLU | TWT/S | 3400TB1 | A6 | 3400DS2P1 | U |
| ARN123-20D22ORN | TWT/S | 3400TB1 | J6 | 3400DS2P1 | R |
| ARN123-20E22 | NO/S | 3400TB1 | E6 | 3400TB1 | E4 |
| ARN123-42A | COAX | 3405E2P1 | | 3405P2 | |
| ARN123-42B | COAX | 3405AJ2 | | 3405RE1P11003 | |
| ARN123-43A | COAX | 3505E1P1 | | 3405P3 | |
| ARN123-43B | COAX | 3405J3 | | 3405RE1P12004 | |
| ARN123-44A | COAX | 3405RE1P12005 | | 3405E3P1 | |

Table F-9. AN/ARN-123(V)3, Wire Chart (P)(E) (Cont)

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARN123-1B20 | NO/S | 2A1P1 | $\underline{X}$ | 3405CP1P1 | 6 |
| ARN123-2A22 | NO/S | 3405P1 | PP | 3405CP1P1 | 22 |
| ARN123-3A22 | NO/S | 3405P1 | JJ | 3405CP1P1 | 23 |
| ARN123-4A22 | NO/S | 3405P1 | KK | 3405CP1P1 | 24 |
| ARN123-5A22 | NO/S | 3405P1 | LL | 3405CP1P1 | 25 |
| ARN123-6A22 | NO/S | 3405P1 | MM | 3405CP1P1 | 26 |
| ARN123-7A22 | NO/S | 3405P1 | NN | 3405CP1P1 | 30 |
| ARN123-8A22 | NO/S | 3405P1 | HH | 3405CP1P1 | 31 |
| ARN123-9A22 | NO/S | 3405P1 | GG | 3405CP1P1 | 32 |
| ARN123-10A22 | NO/S | 3405P1 | $\underline{W}$ | 3405CP1P1 | 33 |
| ARN123-11A22 | NO/S | 3405P1 | $\underline{X}$ | 3405CP1P1 | 29 |
| ARN123-12A22 | NO/S | 3405P1 | $\underline{Y}$ | 3405CP1P1 | 28 |
| ARN123-13A22 | NO/S | 3405P1 | $\underline{Z}$ | 3405CP1P1 | 27 |
| ARN123-14A22 | NO/S | 3405P1 | BB | 3405CP1P1 | 15 |
| ARN123-15A20 | NO/S | 3405P1 | $\underline{G}$ | 3405CP1P1 | 8 |
| ARN123-16B22 | NO/S | 3405P1 | $\underline{H}$ | 3405CP1P1 | 16 |
| ARN123-17B22 | NO/S | 3405P1 | $\underline{I}$ | 3405CP1P1 | 12 |
| ARN123-18B22 | NO/S | 3405P1 | $\underline{J}$ | 3405CP1P1 | 14 |
| ARN123-19E22 | NO/S | 3405P1 | $\underline{K}$ | 8XA5J1 | 43 |
| ARN123-1D22 | NO/S | 3400CP1P1 | $\underline{K}$ | 2A1P1 | X |
| ARN123-20B20WHT | TWT/S | 3405P1 | T | 3400TB1 | G6 |
| ARN123-20B20BLU | TWT/S | 3405P1 | U | 3400TB1 | C6 |
| ARN123-20B20ORN | TWT/S | 3405P1 | V | 3400TB1 | K6 |
| ARN123-21B22 | NO/S | 3405P1 | FF | 3400TB1 | F7 |
| ARN123-22B22 | NO/S | 3405P1 | EE | 3400TB1 | J7 |
| ARN123-23B22 | NO/S | 3405P1 | DD | 3400TB1 | A7 |
| ARN123-24B22 | NO/S | 3405P1 | AA | 3400TB1 | F8 |
| ARN123-25B22 | NO/S | 3405P1 | N | SPLICE | |
| ARN123-26B22 | NO/S | 3405P1 | CC | 3400CP1P1 | $\underline{T}$ |
| ARN123-27B22 | NO/S | 3405P1 | $\underline{V}$ | 3400CP1P1 | X |
| ARN123-69A22 | NO/S | 3400CP1P1 | $\underline{L}$ | 8TB4 | E3 |
| ARN123-29B22 | NO/S | 3405P1 | $\underline{C}$ | 3400TB1 | A8 |
| ARN123-30B22 | NO/S | 3405P1 | $\underline{D}$ | 3400TB1 | J8 |
| ARN123-31B22 | NO/S | 3405P1 | $\underline{E}$ | 3400DS1P1 | 60 |
| ARN123-32B22 | NO/S | 3405P1 | $\underline{F}$ | 3400DS1P1 | 59 |
| ARN123-33A22WHT | PR/S | 3405P1 | A | 3400DS1P1 | 36 |
| ARN123-33A22BLU | PR/S | 3405P1 | B | SPLICE | |
| ARN123-34A22WHT | PR/S | 3405P1 | D | 3400DS1P1 | 35 |
| ARN123-34A22BLU | PR/S | 3405P1 | C | SPLICE | |
| ARN123-35A22WHT | PR/S | 3405P1 | E | 3400DS1P1 | 38 |
| ARN123-35A22BLU | PR/S | 3405P1 | F | 3400DS1P1 | 39 |
| ARN123-36A22WHT | PR/S | 3405P1 | G | 3400DS1P1 | 41 |
| ARN123-36A22BLU | PR/S | 3405P1 | H | 3400DS1P1 | 40 |

Table F-9. AN/ARN-123(V)3, Wire Chart (P)(E) (Cont)

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARN123-37A22 | SHIELD | 3405CP1P1 | 2 | 2301TB3 | C7 |
| ARN123-38B22WHT | PR/S | 3405J1 | J | 3405CP1P1 | 3 |
| ARN123-38B22BLU | PR/S | 3405J1 | K | SPLICE | |
| ARN123-39B22WHT | PR/S | 3405J1 | L | 3405CP1P1 | 19 |
| ARN123-39B22BLU | PR/S | 3405J1 | M | SPLICE | |
| ARN123-40B20WHT | PR/S | 3405J1 | $\underline{M}$ | 3400TB1 | D1 |
| ARN123-40B20BLU | PR/S | 3405J1 | $\underline{N}$ | 3400TB1 | J1 |
| ARN123-40B20ORN | TWT/S | 3405J1 | $\underline{P}$ | 3400TB1 | D2 |
| ARN123-41B20WHT | TWT/S | 3405J1 | $\underline{Q}$ | 3A1J1 | $\underline{W}$ |
| ARN123-41B20N-BLU | TWT/S | 3405P1 | $\underline{R}$ | LOCAL GND | |
| ARN123-38C22 | NO/S | 3405CP1P1 | 1 | SPLICE | |
| ARN123-39C22 | NO/S | 3405CP1P1 | 17 | SPLICE | |
| ARN123-45A22 | NO/S | SPLICE | | 2300TB1 | C2 |
| ARN123-46A22 | NO/S | SPLICE | | 2300TB1 | D2 |
| ARN123-47B22 | NO/S | 3405CP1P1 | 13 | 4A1J1 | $\underline{J}$ |
| ARN123-48A22 | SHIELD | 3405CP1P1 | 18 | 2301TB3 | D9 |
| ARN123-50A22WHT | TWT/S | 3400DS1P1 | 32 | 3400CP1P2 | U |
| ARN123-50A22BLU | TWT/S | 3400DS1P1 | 33 | 3400CP1P2 | V |
| ARN123-50A22ORN | TWT/S | 3400DS1P1 | 34 | 3400CP1P2 | W |
| ARN123-59A22WHT | PR/S | 3400DS1P1 | 19 | 3400CP1P2 | $\underline{F}$ |
| ARN123-59A22BLU | PR/S | 3400DS1P1 | 20 | 3400CP1P2 | $\underline{G}$ |
| ARN123-60A22WHT | PR/S | 3400DS1P1 | 24 | 3400CP1P2 | $\underline{H}$ |
| ARN123-60A22BLU | PR/S | 3400DS1P1 | 25 | 3400CP1P2 | $\underline{J}$ |
| ARN123-61A22 | NO/S | 3400DS1P1 | 9 | 3400CP1P2 | $\underline{D}$ |
| ARN123-62A22 | NO/S | 3400DS1P1 | 10 | 3400CP1P2 | $\underline{E}$ |
| ARN123-63A22 | NO/S | 3400DS1P1 | 81 | 3400CP1P2 | $\underline{B}$ |
| ARN123-64A22 | NO/S | 3400DS1P1 | 80 | 3400CP1P2 | $\underline{C}$ |
| ARN123-65A22 | NO/S | 3400DS1P1 | 56 | 3400CP1P2 | X |
| ARN123-53A20N | NO/S | 3400TB1 | K2 | LOCAL GND | |
| ARN123-54A20N | NO/S | 3405CP1P1 | 10 | LOCAL GND | |
| ARN123-2B22 | NO/S | 3405J1 | PP | 3405RE1P11001 | 14 |
| ARN123-3B22 | NO/S | 3405J1 | JJ | 3405RE1P11001 | 2 |
| ARN123-4B22 | NO/S | 3405J1 | KK | 3405RE1P11001 | 15 |
| ARN123-5B22 | NO/S | 3405J1 | LL | 3405RE1P11001 | 1 |
| ARN123-6B22 | NO/S | 3405J1 | MM | 3405RE1P11001 | 8 |
| ARN123-7B22 | NO/S | 3405J1 | NN | 3405RE1P11001 | 3 |
| ARN123-8B22 | NO/S | 3405J1 | HH | 3405RE1P11001 | 4 |
| ARN123-9B22 | NO/S | 3405J1 | GG | 3405RE1P11001 | 5 |
| ARN123-10B22 | NO/S | 3405J1 | $\underline{W}$ | 3405RE1P11001 | 6 |
| ARN123-11B22 | NO/S | 3405J1 | $\underline{X}$ | 3405RE1P11001 | 7 |
| ARN123-12B22 | NO/S | 3405J1 | $\underline{Y}$ | 3405RE1P11001 | 9 |
| ARN123-13B22 | NO/S | 3405J1 | $\underline{Z}$ | 3405RE1P11001 | 21 |
| ARN123-14B22 | NO/S | 3405J1 | BB | SPLICE | |
| ARN123-14C22 | NO/S | SPLICE | | 3405RE1P11001 | 10 |
| ARN123-14D22 | NO/S | SPLICE | | 3405RE1P12002 | 17 |

Table F-9. AN/ARN-123(V)3, Wire Chart (P)(E) (Cont)

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ARN123-15B20 | NO/S | 3405J1 | G | 3405RE1P12002 | 21 |
| ARN123-16A22 | NO/S | 3405J1 | H | 3405RE1P12002 | 22 |
| ARN123-17A22 | NO/S | 3405J1 | T | 3405RE1P12002 | 5 |
| ARN123-18A22 | NO/S | 3405J1 | J | 3405RE1P12002 | 26 |
| ARN123-19A22 | NO/S | SPLICE | | 3405RE1P12002 | 1 |
| ARN123-19B22 | NO/S | SPLICE | | 3405RE1P12002 | 20 |
| ARN123-19C22 | NO/S | SPLICE | | 3405RE1P12002 | 25 |
| ARN123-19D22 | NO/S | 3405J1 | K | SPLICE | |
| ARN123-20A20WHT | TWT/S | 3405J1 | T | 3405RE1P11001 | 12 |
| ARN123-20A20BLU | TWT/S | 3405J1 | U | 3405RE1P11001 | 13 |
| ARN123-20A20ORN | TWT/S | 3405J1 | V | 3405RE1P11001 | 25 |
| ARN123-21A22 | NO/S | 3405J1 | FF | 3405RE1P11001 | 19 |
| ARN123-22A22 | NO/S | 3405J1 | EE | 3405RE1P11001 | 24 |
| ARN123-23A22 | NO/S | 3405J1 | DD | 3405RE1P11001 | 11 |
| ARN123-24A22 | NO/S | 3405J1 | AA | 3405RE1P11001 | 20 |
| ARN123-25A22 | NO/S | 3405J1 | N | SPLICE CAP | |
| ARN123-27A22 | NO/S | 3405J1 | V | 3405RE1P12002 | 29 |
| ARN123-29A22 | NO/S | 3405J1 | C | 3405RE1P12002 | 12 |
| ARN123-30A22 | NO/S | 3405J1 | D | 3405RE1P12002 | 30 |
| ARN123-31A22 | NO/S | 3405J1 | E | 3405RE1P12002 | 31 |
| ARN123-32A22 | NO/S | 3405J1 | F | 3405RE1P12002 | 14 |
| ARN123-33B22WHT | PR/S | 3405J1 | A | 3405RE1P12002 | 9 |
| ARN123-33B22BLU | PR/S | 3405J1 | B | SPLICE | |
| ARN123-33C22 | NO/S | SPLICE | | 3405RE1P12002 | |
| ARN123-56A20N | NO/S | SHIELDS | | 3405RE1P12002 | |
| ARN123-56B20N | NO/S | SHIELDS | | 3405RE1P12002 | |
| ARN123-26A22 | NO/S | 3405J1 | CC | 3405RE1P12002 | 37 |
| ARN123-19E22 | NO/S | 3405P1 | K | 8J5 | 7 |
| ARN123-57A22 | NO/S | 4A1J1 | I | 8J5 | 48 |
| ARN123-70A22 | NO/S | 3400CP1P1 | J | 3400TB1 | G4 |
| ARN123-57A22 | NO/S | 4A1J1 | I | 8XA5J1 | 46 |
| ARN123-73A22 | NO/S | 4M1P1 | M | 3400CP1P2 | K |
| ARN123-21C22 | NO/S | 3400TB1 | H7 | 3400CP1P1 | R |
| ARN123-74A22 | NO/S | 3400CP1P2 | L | 4M1P1 | N |
| ARN123-22C22 | NO/S | 3400TB1 | E7 | 3400CP1P1 | S |
| ARN123-75A22 | NO/S | 3400CP1P2 | M | 4M1P1 | V |
| ARN123-23C22 | NO/S | 3400TB1 | C7 | 3400CP1P1 | Y |
| ARN123-76A22 | NO/S | 3400CP1P2 | N | 4M1P1 | W |
| ARN123-24C22 | NO/S | 3400TB1 | H8 | 3400C1P1 | Z |
| ARN123-71A22 | NO/S | 3400CP1P2 | H | 4M1P1 | T |
| ARN123-29C22 | NO/S | 3400TB1 | E8 | 3400C1P1 | P |
| ARN123-72A22 | NO/S | 3400CP1P2 | J | 4M1P1 | U |
| ARN123-30C22 | NO/S | 3400TB1 | C8 | 3400CP1P1 | Q |
| GND-6A20N | NO/S | 3400TB1 | F4 | LOCAL GND | |

**Table F-9. AN/ARN-123(V)3, Wire Chart (P)(E) (Cont)**

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| GND-7A20N | NO/S | 3400TB1 | K4 | LOCAL GND | |
| ARN123-58A22 | NO/S | 3405C1P1 | 21 | 8TB4 | J3 |
| ARN123-34B22WHT | PR/S | 3405J1 | D | 3405RE1P12002 | 23 |
| ARN123-34B22BLU | PR/S | 3405J1 | C | SPLICE | |
| ARN123-35B22WHT | PR/S | 3405J1 | E | 3405RE1P12002 | 8 |
| ARN123-35B22BLU | PR/S | 3405J1 | F | 3405RE1P12002 | 33 |
| ARN123-36B22WHT | PR/S | 3405J1 | G | 3405RE1P12002 | 36 |
| ARN123-36B22BLU | PR/S | 3405J1 | H | 3405RE1P12002 | 34 |
| ARN123-38A22WHT | PR/S | 3405J1 | J | 3405RE1P12002 | 15 |
| ARN123-38A22BLU | PR/S | 3405J1 | K | 3405RE1P12002 | 11 |
| ARN123-39A22WHT | PR/S | 3405J1 | L | 3405RE1P12002 | 4 |
| ARN123-39A22BLU | PR/S | 3405J1 | M | 3405RE1P12002 | 2 |
| ARN123-40A20WHT | TWT/S | 3405J1 | $\underline{M}$ | 3405RE1P12002 | 7 |
| ARN123-40A20BLU | TWT/S | 3405J1 | $\underline{N}$ | 3405RE1P12002 | 6 |
| ARN123-40A20ORN | TWT/S | 3405J1 | $\underline{P}$ | 3405RE1P12002 | 10 |
| ARN123-41C20WHT | PR/S | 3405J1 | $\underline{Q}$ | 3405RE1P12002 | 18 |
| ARN123-41C20BLU | PR/S | 3405J1 | $\underline{R}$ | 3405RE1P12002 | 19 |
| ARN123-51A20N | NO/S | LOCAL GND | | 3405RE1P12002 | 28 |
| ARN123-52A20N | NO/S | LOCAL GND | | 3405RE1P12002 | 35 |
| ARN123-77A22 | NO/S | SPLICE | | 3400DS1P1 | 37 |
| ARN123-78A22 | NO/S | 3400DS1P1 | 62 | 8TB3 | H2 |
| ARN123-47A22 | PR/S | 4A1P1 | $\underline{J}$ | 3405DS1 | 1 |
| ARN123-49A22N | NO/S | LOCAL GND | | 3405DS1 | 3 |
| ARN123-57B22 | PR/S | 4A1P1 | $\underline{I}$ | 3405DS1 | 2 |
| ARN123-79A22 | NO/S | 3400DS1P1 | 63 | 8TB6 | C4 |
| ARN123-66A22 | NO/S | 3400DS1P1 | 55 | 3400CP1P2 | Y |
| ARN123-67A22 | NO/S | 3400DS1P1 | 8 | 3400CP1P2 | Z |
| ARN123-68A22 | NO/S | 3400DS1P1 | 7 | 3400CP1P2 | A |
| ARN123-41E20 | NO/S | 3A1J1 | $\underline{N}$ | 3400DS2P1 | S |
| ARN123-20C22WHT | TWT/S | 3400TB1 | F6 | 3400CP1P1 | $\underline{K}$ |
| ARN123-20C22BLU | TWT/S | 3400TB1 | B6 | 3400CP1P1 | $\underline{M}$ |
| ARN123-20C22ORN | TWT/S | 3400TB1 | D6 | 3400CP1P1 | $\underline{N}$ |
| ARN123-20D22WHT | TWT/S | 3400TB1 | H6 | 3400DS2P1 | T |
| ARN123-20D22BLU | TWT/S | 3400TB1 | A6 | 3400DS2P1 | U |
| ARN123-20D22ORN | TWT/S | 3400TB1 | J6 | 3400DS2P1 | R |
| ARN123-20E22 | NO/S | 3400TB1 | E6 | 3400TB1 | E4 |
| ARN123-42A | COAX | 3405E2P1 | | 3405P2 | |
| ARN123-42B | COAX | 3405J2 | | 3405RE1P11003 | |
| ARN123-43A | COAX | 3405E1P1 | | 3405P3 | |
| ARN123-43B | COAX | 3405J3 | | 3405RE1P12004 | |
| ARN123-44A | COAX | 3405E2P1 | | 3405RE1P12005 | |

1 Underlined Pin Numbers Denote Lower Case

2 Denotes: NO/S--No Shield
PR/S--Pair. Twisted. W/Shield

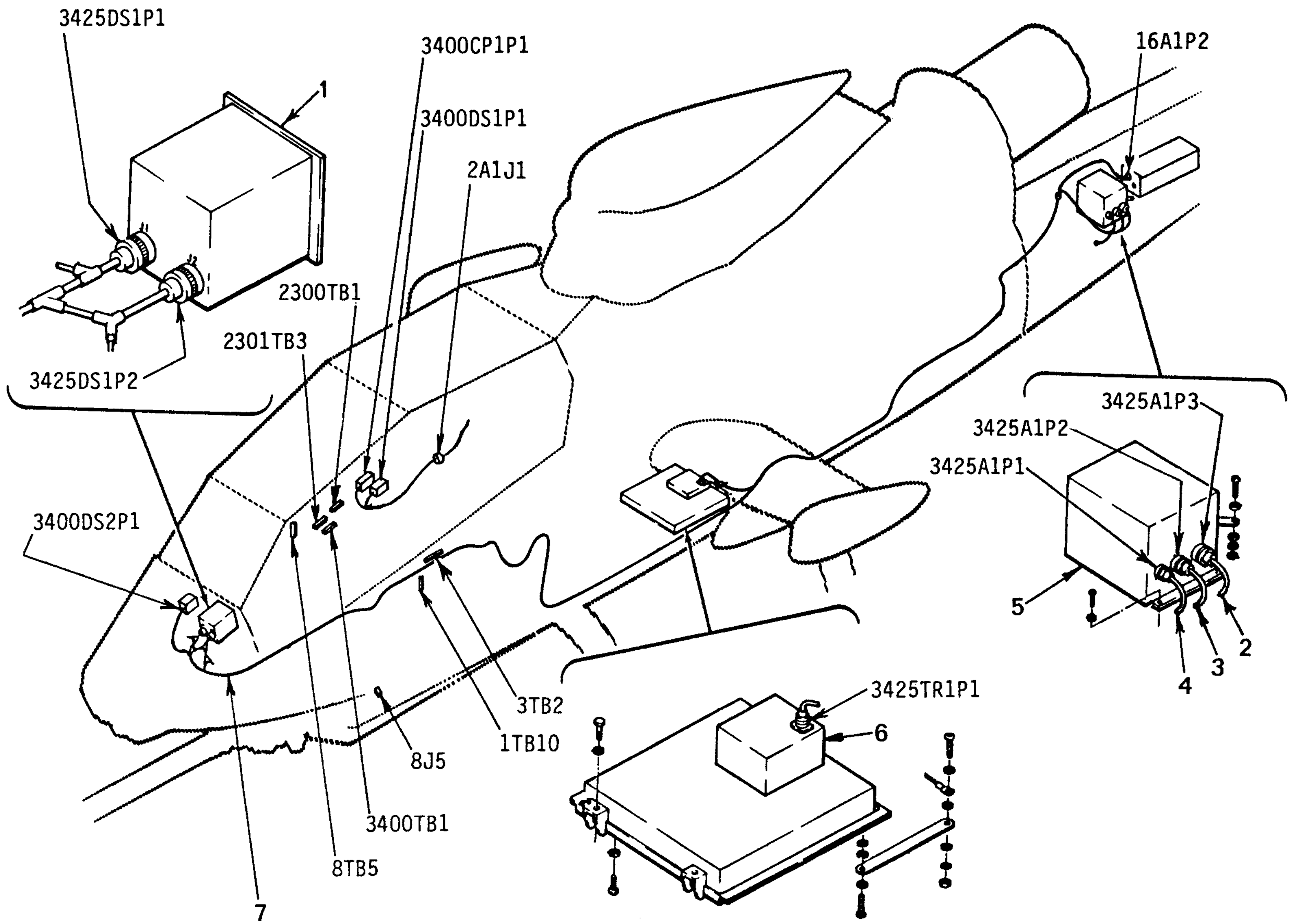



Figure F-9. Doppler Navigation System AN/ASN-128(MC) (Sheet 1 of 2)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | CP-1252/ASN-128 | Computer, Display Unit |
| 2 | 209-077-091-117 | Cable Assy, Spec Purpose |
| 3 | 209-077-091-115 | Cable Assy, ASN-128 |
| 4 | 209-077-091-119 | Cable Assy, ASN-128 |
| 5 | CV-3338()/ASN-128 | Converter, Signal Data |
| 6 | RT-1193()/ASN-128 | Receiver, Transmitter |
| 7 | 209-077-091-117 | Cable Assy, Spec Purpose |

Figure F-9. Doppler Navigation System AN/ASN-128 (MC) (Sheet 2 of 2)

Table F-10. AN/ASN-128, Wire Chart

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ASN128-7A22WHT | TWT/S | 3425A1P1 | J | 1TB10 | D2 |
| ASN128-7A22BLU | TWT/S | 3425A1P1 | G | 1TB10 | J1 |
| ASN128-7A22ORN | TWT/S | 3425A1P1 | H | 1TB10 | D1 |
| ASN128-12A20N | NO/S | 3425A1P1 | P | GND | |
| ASN128-14A22WHT | PR/S | 3400DS1P1 | 68 | 3TB2 | K2 |
| ASN128-14A22BLU | PR/S | 3400DS1P1 | 69 | 3TB2 | K3 |
| ASN128-14B22WHT | PR/S | 3400DS2P1 | V | 3TB2 | J2 |
| ASN128-14B22BLU | PR/S | 3400DS2P1 | D | 3TB2 | J3 |
| ASN128-14C22WHT | PR/S | 3425A1P1 | T | 3TB2 | G2 |
| ASN128-14C22BLU | PR/S | 3425A1P1 | U | 3TB2 | G3 |
| ASN128-16B16 | SHIELD | 3425A1P1 | W | 2A1J1 | AA |
| ASN128-19A16N | NO/S | 3425A1P1 | Z | GND | |
| ASN128-1A22WHT | TWT/S | 3400DS1P1 | 70 | 3400TB1 | A10 |
| ASN128-1A22BLU | TWT/S | 3400DS1P1 | 71 | 3400TB1 | F10 |
| ASN128-1A22ORN | TWT/S | 3400DS1P1 | 72 | 3400TB1 | F11 |
| ASN128-1B22WHT | TWT/S | 3400DS2P1 | B | 3400TB1 | B10 |
| ASN128-1B22BLU | TWT/S | 3400DS2P1 | C | 3400TB1 | G10 |
| ASN128-1B22ORN | TWT/S | 3400DS2P1 | E | 3400TB1 | G11 |
| ASN128-1C22WHT | TWT/S | 3425A1P1 | C | 3400TB1 | C10 |
| ASN128-1C22BLU | TWT/S | 3425A1P1 | A | 3400TB1 | H10 |
| ASN128-1C22ORN | TWT/S | 3425A1P1 | B | 3400TB1 | H11 |
| ASN128-106A20N | NO/S | SHIELDS | | GND | |
| ASN128-107A20 | NO/S | SHIELDS | | GND | |
| ASN128-1E20N | NO/S | 3400TB1 | J11 | GND | |
| ASN128-4A22WHT | TWT/S | 3425A1P1 | F | 1TB10 | J3 |
| ASN128-4A22BLU | TWT/S | 3425A1P1 | D | 1TB10 | D3 |
| ASN128-4A22ORN | TWT/S | 3425A1P1 | E | 1TB10 | J2 |
| ASN128-51B20 | SHIELD | 2A1J1 | Z | 3425DS1P1 | C |
| ASN128-52A20 | SHIELD | 2300TB1 | G5 | 3425DS1P1 | D |
| ASN128-74A20WHT | PR/S | 8TB5 | H2 | 3425DS1P1 | K |
| ASN128-74A20BLU | PR/S | 8TB5 | H4 | 3425DS1P1 | M |
| ASN128-76A22WHT | PR/S | 3425DS1P2 | 52 | SPLICE | |
| ASN128-76A22BLU | PR/S | 3425DS1P2 | 53 | SPLICE | |
| ASN128-76B22WHT | PR/S | SPLICE | | 16A1P2 | 20 |
| ASN128-76B22BLU | PR/S | SPLICE | | 16A1P2 | 44 |
| ASN128-76C22WHT | PR/S | SPLICE | | 3400DS1P1 | 47 |
| ASN128-76C22BLU | PR/S | SPLICE | | 3400DS1P1 | 46 |
| ASN128-78A22 | SHIELD | 8J5 | 4 | 3425DS1P1 | J |
| ASN128-79A22 | SHIELD | 3425DS1P2 | 19 | 2300TB1 | E7 |
| ASN128-100A22 | NO/S | 3400DS1P1 | 44 | 3400CP1P1 | H |
| ASN128-101A22 | NO/S | 3400DS1P1 | 49 | 3400CP1P1 | E |
| ASN128-102A22 | NO/S | 3400DS1P1 | 50 | SPLICE | |
| ASN128-102B22 | NO/S | SPLICE | | 3400CP1P1 | M |
| ASN128-102C22 | NO/S | SPLICE | | 3400CP1P1 | J |
| ASN128-103A22WHT | PR/S | 3400DS1P1 | 53 | 3400CP1P1 | B |
| ASN128-103A22BLU | PR/S | 3400DS1P1 | 54 | 3400CP1P1 | A |
| ASN128-104A22WHT | PR/S | 3400DS1P1 | 42 | 3400CP1P1 | D |
| ASN128-104A22BLU | PR/S | 3400DS1P1 | 43 | 3400CP1P1 | C |

Table F-10. AN/ASN-128, Wire Chart (Cont)

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ASN128-105A20 | NO/S | 3425A1P3 | V | 3425A1P3 | W |
| WHT/YEL/GRN-22 | S/CABLE | SPLICE | | 3425DS1P2 | 64 |
| WHT/YEL/BLU-22 | S/CABLE | SPLICE | | 3425DS1P2 | 37 |
| WHT/YEL/VIO-22 | S/CABLE | SPLICE | | 3425DS1P2 | 38 |
| WHT/YEL/GRA-22 | S/CABLE | SPLICE | | 3425DS1P2 | 36 |
| WHT/BLK/BRN/GRN-22 | S/CABLE | SPLICE | | 3425DS1P2 | 65 |
| WHT/BLK/BRN/BLU-22 | S/CABLE | SPLICE | | 3425DS1P2 | 66 |
| WHT-22 | PR/S | SPLICE | | 3425DS1P2 | 59 |
| BLU-22 | PR/S | SPLICE | | 3425DS1P2 | 60 |
| WHT/BLK/BRN/VIO-22 | S/CABLE | SPLICE | | 3425DS1P2 | 43 |
| WHT/BLK/BRN/GRA-22 | S/CABLE | SPLICE | | 3425DS1P2 | 44 |
| WHT/BLK/RED/ORN-22 | S/CABLE | SPLICE | | 3425DS1P2 | 21 |
| WHT/ORN/GRN | S/CABLE | 3425A1P3 | A | 3425DS1P1 | E |
| WHT/ORN/BLU | S/CABLE | 3425A1P3 | B | 3425DS1P1 | F |
| WHT/ORN/VIO | S/CABLE | 3425A1P3 | C | 3425DS1P1 | G |
| WHT/ORN/GRA | S/CABLE | 3425A1P3 | D | 3425DS1P1 | H |
| WHT/YEL/GRN | S/CABLE | 3425A1P3 | E | SPLICE | |
| WHT/YEL/BLU | S/CABLE | 3425A1P3 | F | SPLICE | |
| WHT/YEL/VIO | S/CABLE | 3425A1P3 | H | SPLICE | |
| WHT/YEL/GRA | S/CABLE | 3425A1P3 | J | SPLICE | |
| WHT/GRN/BLU | S/CABLE | 3425A1P3 | K | 3425DS1P1 | N |
| WHT/GRN/VIO | S/CABLE | 3425A1P3 | L | 3425DS1P1 | P |
| WHT/GRN/GRA | S/CABLE | 3425A1P3 | M | 3425DS1P1 | R |
| WHT/BLU/VIO | S/CABLE | 3425A1P3 | N | 3425DS1P1 | S |
| WHT/BLU/GRA | S/CABLE | 3425A1P3 | T | 3425DS1P1 | A |
| WHT/VIO/GRA | S/CABLE | 3425A1P3 | Z | 3425DS1P1 | B |
| WHT/BLK/BRN/YEL | S/CABLE | 3425A1P3 | S | 3425DS1P1 | L |
| WHT/BLK/BRN/GRN | S/CABLE | 3425A1P3 | R | SPLICE | |
| WHT/BLK/BRN/BLU | S/CABLE | 3425A1P3 | $\underline{D}$ | SPLICE | |
| WHT/BLK/BRN/RED | S/CABLE | 3425A1P3 | X | SPLICE | |
| WHT/BLK/BRN/ORN | S/CABLE | 3425A1P3 | Y | SPLICE | |
| WHT/BLK/BRN/VIO | S/CABLE | 3425A1P3 | $\underline{C}$ | SPLICE | |
| WHT/BLK/BRN/GRA | S/CABLE | 3425A1P3 | $\underline{B}$ | SPLICE | |
| WHT/BLK/BRN/ORN | S/CABLE | 3425A1P3 | $\underline{F}$ | SPLICE | |
| WHT/YEL | PR/S | 3425TR1P1 | 34 | 3425A1P2 | C |
| WHT/GRN | PR/S | 3425TR1P1 | 35 | 3425A1P2 | D |
| WHT/BLU | PR/S | 3425TR1P1 | 36 | 3425A1P2 | $\underline{D}$ |
| WHT/VIO | PR/S | 3425TR1P1 | 37 | 3425A1P2 | $\underline{E}$ |
| WHT/GRA | PR/S | 3425TR1P1 | 30 | 3425A1P2 | $\underline{B}$ |
| WHT/BLK/BRN | PR/S | 3425TR1P1 | 31 | 3425A1P2 | $\underline{C}$ |
| WHT/BLK | PR/S | 3425TR1P1 | 23 | 3425A1P2 | X |
| WHT/BRN | PR/S | 3425TR1P1 | 17 | 3425A1P2 | Y |
| WHT/RED | PR/S | 3425TR1P1 | 19 | 3425A1P2 | Z |
| WHT/ORN | PR/S | 3425TR1P1 | 20 | 3425A1P2 | $\underline{A}$ |
| WHT/BLK/RED | S/CABLE | 3425TR1P1 | 10 | 3425A1P2 | F |
| WHT/BLK/ORN | S/CABLE | 3425TR1P1 | 25 | 3425A1P2 | G |
| WHT/BLK/YEL | S/CABLE | 3425TR1P1 | 5 | 3425A1P2 | H |
| WHT/BLK/GRN | S/CABLE | 3425TR1P1 | 1 | 3425A1P2 | J |
| WHT/BLK/BLU | S/CABLE | 3425TR1P1 | 16 | 3425A1P2 | K |

**Table F-10. AN/ASN-128, Wire Chart (Cont)**

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| WHT/BLK/VIO | S/CABLE | 3425TR1P1 | 15 | 3425A1P2 | L |
| WHT/BLK/GRA | S/CABLE | 3425TR1P1 | 18 | 3425A1P2 | M |
| WHT/BRN/RED | S/CABLE | 3425TR1P1 | 11 | 3425A1P2 | N |
| WHT/BRN/ORN | S/CABLE | 3425TR1P1 | 24 | 3425A1P2 | P |
| WHT/BRN/YEL | S/CABLE | 3425TR1P1 | 21 | 3425A1P2 | R |
| WHT/BRN/GRN | S/CABLE | 3425TR1P1 | 22 | 3425A1P2 | S |
| WHT/BRN/BLU | S/CABLE | 3425TR1P1 | 12 | 3425A1P2 | G |
| WHT/BRN/VIO | S/CABLE | 3425TR1P1 | 13 | 3425A1P2 | H |
| WHT/BRN/GRA | S/CABLE | 3425TR1P1 | 2 | 3425A1P2 | I |
| WHT/RED/ORN | S/CABLE | 3425TR1P1 | 3 | 3425A1P2 | J |
| WHT/RED/YEL | S/CABLE | 3425TR1P1 | 4 | 3425A1P2 | K |
| WHT/RED/GRN | S/CABLE | 3425TR1P1 | 6 | 3425A1P2 | M |
| WHT/RED/BLU | S/CABLE | 3425TR1P1 | 7 | 3425A1P2 | N |
| WHT/RED/VIO | S/CABLE | 3425TR1P1 | 8 | 3425A1P2 | P |
| WHT/RED/GRA | S/CABLE | 3425TR1P1 | 9 | 3425A1P2 | Q |
| WHT/ORN/YEL | S/CABLE | 3425TR1P1 | 14 | 3425A1P2 | R |

1 Underlined Pin Numbers Denote Lower Case

2 Denotes: NO/S--No Shield
PR/S--Pair. Twisted, W/Shield
TWT/S--Three Wire Twisted, W/Shield
S/CABLE--Shielded Cable/Multi-Pair

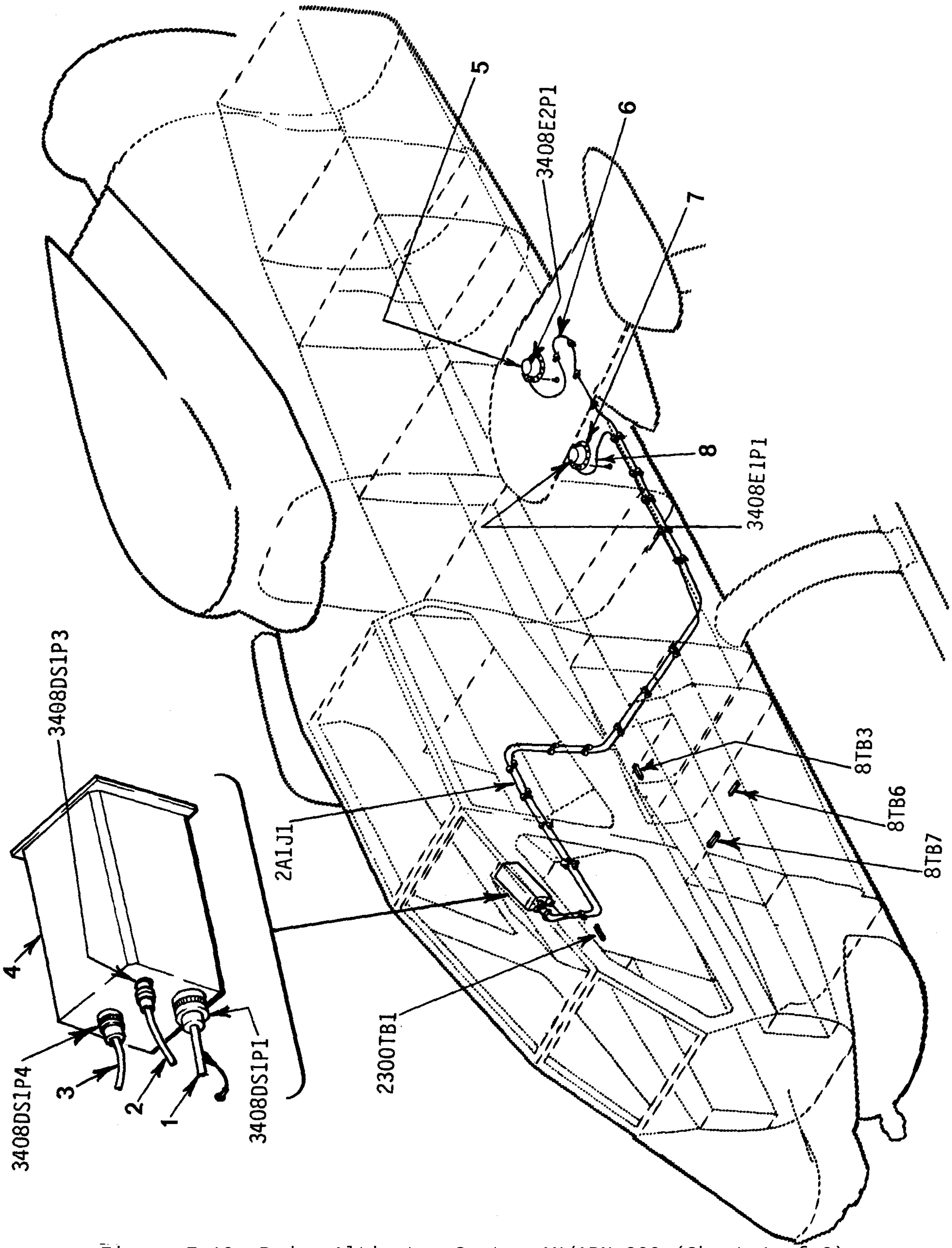



Figure F-10. Radar Altimeter System AN/APN-209 (Sheet 1 of 2)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | 209-077-051-3 | Cable Assy, Spec Pur |
| 2 | 209-077-051-5 | Cable Assy, APN-209 USBL EFF 76-22567 Thru 77-23092 |
| | 209-077-051-103 | Cable Assy, APN-209 USBL EFF 78-23093 and Subq. |
| 3 | 209-077-051-7 | Cable Assy, APN-209 USBL EFF 76-22567 thru 77-23092 |
| | 209-077-051-105 | Cable Assy, APN-209 USBL EFF 78-23093 and Subq. |
| 4 | RT-1115/APN-209 | Receiver-Transmitter |
| 5 | AS-2595/APN-194V | Antenna |
| 6 | 209-077-051-5 | Cable Assy, APN-209 USBL EFF 76-22567 thru 77-23092 |
| | 209-077-051-103 | Cable Assy, APN-209 USBL EFF 78-23093 and Subq. |
| 7 | AS-2595/APN-194V | Antenna |
| 8 | 209-077-051-7 | Cable Assy, APN-209 USBL EFF 76-22567 thru 77-23092 |
| | 209-077-051-105 | Cable Assy, APN-209 USBL EFF 78-23093 and Subq. |

Figure F-10. Radar Altimeter System AN/APN-209 (Sheet 2 of 2)

Table F-11. AN/APN-209, Wire Chart

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| APN209-1B22 | NO SHIELD | 3408DS1P1 | 7 | 8TB7 | C1 |
| APN209-6A22 | NO SHIELD | 3408DS1P1 | 4 | 2300TB1 | F7 |
| APN209-7B22 | NO SHIELD | 3408DS1P1 | 9 | 2A1J1 | KK |
| APN209-8A22 | NO SHIELD | 3408DS1P1 | 3 | 2300TB1 | G7 |
| APN209-23A22 | NO SHIELD | 3408DS1P1 | 5 | 8TB3 | B3 |
| APN209-24A22 | NO SHIELD | 3408DS1P1 | 10 | 8TB6 | E3 |
| APN209-1-22 | NO SHIELD | 3408DS1P1 | 1 | STOW | |
| APN209-2-22 | NO SHIELD | 3408DS1P1 | 2 | STOW | |
| APN209-6-22 | NO SHIELD | 3408DS1P1 | 6 | STOW | |
| APN209-8-22 | NO SHIELD | 3408DS1P1 | 8 | STOW | |
| APN209-11-22 | NO SHIELD | 3408DS1P1 | 11 | STOW | |
| APN209-12-22 | NO SHIELD | 3408DS1P1 | 12 | STOW | |
| APN209-13-22 | NO SHIELD | 3408DS1P1 | 13 | STOW | |
| APN209-21A | COAX | 3408DS1P3 | | 3408E2P1 | |
| APN209-22A | COAX | 3408DS1P4 | | 3408E1P1 | |

1 Underlined Pin Numbers Denote Lower Case.

2 Denotes: NO/S--No Shield

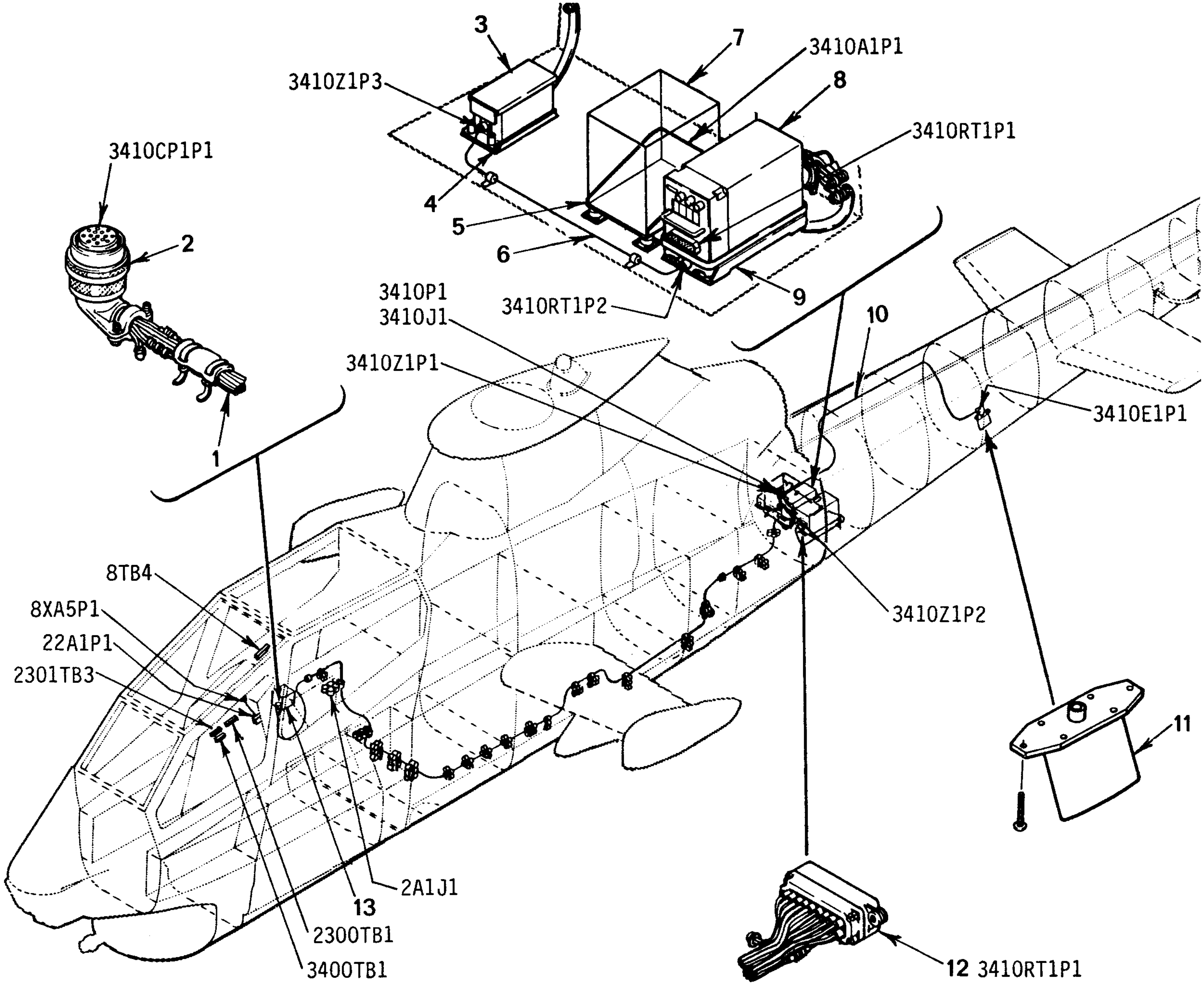



Figure F-11. IFF System AN/APX-72 (Sheet 1 of 2)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | 209-077-045-3 | Cable Assembly, APX-72 USBL EFF 76-22567 thru 77-22762 |
| | 209-077-045-103 | Cable Assembly, APX-72 USBL EFF 77-22763 thru 77-23092 |
| 2 | M83723-75R2255N | Connector Plug, Elec |
| 3 | TS-1843( )/APX | Test Set, Transponder |
| 4 | MT-3513/APX | Mount, Receiver |
| 5 | MT-3949A/U | Mounting Base, Elec |
| 6 | 209-077-045-7 | Cable Assembly, APX-72 |
| 7 | KIT-lA/TSEC | Transponder Computer |
| 8 | RT-859 A/APX-72 | Receiver-Transmitter |
| 9 | MT-3809/APX-72 | Mount, Transponder |
| 10 | 209-077-045-9 | Cable Assembly, APX-72 |
| 11 | AT-884 ( )/APX-44 | Antenna |
| 12 | DPJM-59C1O-34SA | Connector, Body Rece |
| 13 | C-6280 (P)/APX | Control, Transponder |

Figure F-11. IFF System AN/APX-72 (Sheet 2 of 2)

Table F-12. AN/APX-72, Wire Chart

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| APX72-705A22 | NO/S | 2300TB1 | B4 | SPLICE | |
| APX72-705B22 | NO/S | SPLICE | | SPLICE | |
| APX72-705C22 | NO/S | SPLICE | | SPLICE | |
| APX72-705D22 | NO/S | 3410CP1P1 | 34 | 2300TB1 | J4 |
| APX72-705E22 | NO/S | 3410CP1P1 | 31 | SPLICE | |
| APX72-705F20N | NO/S | 3410A1P1 | 34 | GND | |
| APX72-705G20N | NO/S | 3410Z1P1 | 2 | GND | |
| APX72-705H20N | NO/S | 3410RT1P1 | 3 | GND | |
| APX72-705J20N | NO/S | SPLICE | | GND | |
| APX72-705K22 | NO/S | SPLICE | | SPLICE | |
| APX72-705L22 | NO/S | SPLICE | | SPLICE | |
| APX72-706B20 | SHIELD | 2A1J1 | Q | 3410P1 | N |
| APX72-706D20 | NO/S | 2A1J1 | R | 22A1P1 | Z |
| APX72-706F20 | SHIELD | 3410J1 | N | 3410RT1P1 | 2 |
| APX72-707A22 | SHIELD | 3410CP1P1 | 24 | 3410P1 | B |
| APX72-707B22 | SHIELD | 3410J1 | B | 3410RT1P1 | 4 |
| APX72-712A22 | SHIELD | 3410CP1P1 | 2 | 3410P1 | C |
| APX72-712B22 | SHIELD | 3410J1 | C | 3410RT1P1 | 21 |
| APX72-714A22 | SHIELD | 3410CP1P1 | 11 | 3410P1 | D |
| APX72-714B22 | SHIELD | 3410J1 | D | 3410RT1P1 | 20 |
| APX72-716A22 | SHIELD | 3410CP1P1 | 5 | 3410P1 | E |
| APX72-716B22 | SHIELD | 3410J1 | E | 3410RT1P1 | 19 |
| APX72-717A22 | SHIELD | 3410CP1P1 | 6 | 3410P1 | DD |
| APX72-717B22 | SHIELD | 3410J1 | DD | 3410RT1P1 | 18 |
| APX72-719A22 | SHIELD | 3410CP1P1 | 8 | 3410P1 | F |
| APX72-719B22 | SHIELD | 3410J1 | F | 3410RT1P1 | 16 |
| APX72-720A22 | SHIELD | 3410CP1P1 | 9 | 3410P1 | CC |
| APX72-720B22 | SHIELD | 3410J1 | CC | 3410RT1P1 | 15 |
| APX72-721A22 | SHIELD | 3410CP1P1 | 10 | 3410P1 | EE |
| APX72-721B22 | SHIELD | 3410J1 | EE | 3410RT1P1 | 14 |
| APX72-736A20 | NO/S | 3410CP1P1 | 53 | 2301TB1 | C4 |
| APX72-743A20 | NO/S | 3410A1P1 | 31 | 3410RT1P1 | 6 |
| APX72-747B20 | NO/S | 2A1J1 | S | 3410P1 | M |
| APX72-747C20 | NO/S | 3410J1 | M | 3410Z1P1 | 1 |
| APX72-754A22 | SHIELD | 3410CP1P1 | 26 | 3410P1 | P |
| APX72-754B22 | SHIELD | 3410J1 | P | 3410RT1P1 | 40 |
| APX72-755A22 | SHIELD | 3410CP1P1 | 27 | 3410P1 | R |
| APX72-755B22 | SHIELD | 3410J1 | R | 3410RT1P1 | 39 |
| APX72-756A22 | SHIELD | 3410CP1P1 | 28 | 3410P1 | S |
| APX72-756B22 | SHIELD | 3410J1 | S | 3410RT1P1 | 38 |
| APX72-757A22 | SHIELD | 3410CP1P1 | 29 | 3410P1 | T |
| APX72-757B22 | SHIELD | 3410J1 | T | 3410RT1P1 | 37 |
| APX72-758A22 | SHIELD | 3410CP1P1 | 30 | 3410P1 | U |
| APX72-758B22 | SHIELD | 3410J1 | U | 3410RT1P1 | 36 |
| APX72-761A22 | SHIELD | 3410CP1P1 | 32 | 3410P1 | V |
| APX72-761B22 | SHIELD | 3410J1 | V | 3410RT1P1 | 29 |
| APX72-762A22 | SHIELD | 3410CP1P1 | 33 | 3410P1 | W |
| APX72-762B22 | SHIELD | 3410J1 | W | 3410RT1P1 | 28 |

Table F-12. AN/APX-72, Wire Chart (Cont)

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| APX72-763A22 | SHIELD | 3410CP1P1 | 35 | 3410P1 | X |
| APX72-763B22 | SHIELD | 3410J1 | X | 3410RT1P1 | 27 |
| APX72-764A22 | SHIELD | 3410CP1P1 | 36 | 3410P1 | Y |
| APX72-764B22 | SHIELD | 3410J1 | Y | 3410RT1P1 | 26 |
| APX72-765A22 | SHIELD | 3410CP1P1 | 37 | 3410P1 | Z |
| APX72-765B22 | SHIELD | 3410J1 | Z | 3410RT1P1 | 25 |
| APX72-766A22 | SHIELD | 3410CP1P1 | 38 | 3410P1 | A |
| APX72-766B22 | SHIELD | 3410J1 | A | 3410RT1P1 | 24 |
| APX72-768A22 | NO/S | 3410CP1P1 | 12 | 8TB4 | G2 |
| APX72-802A20 | NO/S | 3410A1P1 | 28 | 3410RT1P1 | 53 |
| APX72-802B20 | NO/S | 3410J1 | N | 3410A1P1 | 30 |
| APX72-802C20 | NO/S | 8XA5P1 | 49 | 3410P1 | N |
| APX72-803A22 | SHIELD | 3410J1 | G | 3410RT1P1 | 9 |
| APX72-803B22 | SHIELD | 2301TB3 | B8 | 3410P1 | G |
| APX72-804A22 | SHIELD | 3410J1 | I | 3410RT1P1 | 10 |
| APX72-804B22 | SHIELD | 2300TB1 | E1 | 3410P1 | I |
| APX72-806A22 | NO/S | STOW | | 3410P1 | A |
| APX72-806B22 | NO/S | 3410J1 | A | 3410RT1P1 | 8 |
| APX72-807A22 | NO/S | STOW | | 3410P1 | B |
| APX72-807B22 | NO/S | 3410J1 | B | 3410RT1P1 | 54 |
| APX72-808A22 | NO/S | STOW | | 3410P1 | C |
| APX72-808B22 | NO/S | 3410J1 | C | 3410RT1P1 | 55 |
| APX72-809A22 | NO/S | STOW | | 3410P1 | D |
| APX72-809B22 | NO/S | 3410J1 | D | 3410RT1P1 | 17 |
| APX72-810A22 | NO/S | STOW | | 3410P1 | E |
| APX72-810B22 | NO/S | 3410J1 | E | 3410RT1P1 | 23 |
| APX72-811A22 | NO/S | STOW | | 3410P1 | F |
| APX72-811B22 | NO/S | 3410J1 | F | 3410RT1P1 | 30 |
| APX72-812A22 | NO/S | STOW | | 3410P1 | G |
| APX72-812B22 | NO/S | 3410J1 | G | 3410RT1P1 | 31 |
| APX72-813A22 | NO/S | STOW | | 3410P1 | H |
| APX72-813B22 | NO/S | 3410J1 | H | 3410RT1P1 | 32 |
| APX72-814A22 | NO/S | STOW | | 3410P1 | J |
| APX72-814B22 | NO/S | 3410J1 | J | 3410RT1P1 | 35 |
| APX72-815A22 | NO/S | STOW | | 3410P1 | K |
| APX72-815B22 | NO/S | 3410J1 | K | 3410RT1P1 | 41 |
| APX72-816A22 | NO/S | STOW | | 3410P1 | L |
| APX72-816B22 | NO/S | 3410J1 | L | 3410RT1P1 | 42 |
| APX72-817A22 | SHIELD | 3410CP1P1 | 4 | 3410P1 | FF |
| APX72-817B22 | SHIELD | 3410J1 | FF | 3410RT1P1 | 59 |
| APX72-818A22 | SHIELD | 3410CP1P1 | 15 | 3410P1 | GG |
| APX72-818B22 | SHIELD | 3410J1 | GG | 3410RT1P1 | 43 |
| APX72-819A22 | SHIELD | 3410CP1P1 | 16 | 3410P1 | HH |
| APX72-819B22 | SHIELD | 3410J1 | HH | 3410RT1P1 | 44 |
| APX72-820A22 | SHIELD | 3410CP1P1 | 17 | 3410P1 | JJ |
| APX72-820B22 | SHIELD | 3410J1 | JJ | 3410RT1P1 | 50 |
| APX72-821A22 | SHIELD | 3410CP1P1 | 18 | 3410P1 | KK |
| APX72-821B22 | SHIELD | 3410J1 | KK | 3410RT1P1 | 56 |

Table F-12. AN/APX-72, Wire Chart (Cont)

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| APX72-822A22 | SHIELD | 3410CP1P1 | 19 | 3410P1 | LL |
| APX72-822B22 | SHIELD | 3410J1 | LL | 3410RT1P1 | 57 |
| APX72-823A22 | SHIELD | 3410CP1P1 | 20 | 3410P1 | MM |
| APX72-823B22 | SHIELD | 3410J1 | MM | 3410RT1P1 | 58 |
| APX72-824A22 | SHIELD | 3410CP1P1 | 25 | 3410P1 | BB |
| APX72-824B22 | SHIELD | 3410J1 | BB | 3410RT1P1 | 22 |
| APX72-825A22 | SHIELD | 3410CP1P1 | 42 | 3410P1 | NN |
| APX72-825B22 | SHIELD | 3410J1 | NN | 3410RT1P1 | 34 |
| APX72-826A22 | SHIELD | 3410CP1P1 | 55 | 3410P1 | PP |
| APX72-826B22 | SHIELD | 3410J1 | PP | 3410RT1P1 | 51 |
| APX72-832A22 | NO/S | 3410A1P1 | 17 | 3410P1 | 52 |
| APX72-833B22 | NO/S | 3410RT1P1 | 49 | 3410RT1P1 | 49 |
| APX72-834B20 | NO/S | 3410CP1P1 | 51 | 2A1J1 | T |
| APX72-836A22 | NO/S | 3410CP1P1 | 45 | 3410P1 | V |
| APX72-836B22 | NO/S | 3410J1 | V | 3410Z1P1 | 3 |
| APX72-837A22 | NO/S | 3410CP1P1 | 40 | 3410P1 | W |
| APX72-837B22 | NO/S | 3410J1 | W | 3410Z1P1 | 4 |
| APX72-838A22 | NO/S | 3410CP1P1 | 41 | 3410P1 | X |
| APX72-838B22 | NO/S | 3410J1 | X | 3410Z1P1 | 5 |
| APX72-839A22 | NO/S | 3410CP1P1 | 43 | 3410P1 | Y |
| APX72-839B22 | NO/S | 3410J1 | Y | 3410Z1P1 | 6 |
| APX72-840A22 | NO/S | 3410CP1P1 | 44 | 3410P1 | Z |
| APX72-840B22 | NO/S | 3410J1 | Z | 3410Z1P1 | 7 |
| APX72-841A22 | NO/S | 3410CP1P1 | 46 | 3410P1 | AA |
| APX72-841B22 | NO/S | 3410J1 | AA | 3410Z1P1 | 8 |
| APX72-842A22 | NO/S | 22A1P1 | C | 3400TB1 | D4 |
| APX72-847A22 | NO/S | 3410A1P1 | 32 | 3410J1 | K |
| APX72-847B22 | NO/S | 3410P1 | K | 22A1P1 | B |
| APX72-848A22 | NO/S | 3410CP1P1 | 1 | 3410P1 | Q |
| APX72-848B22 | NO/S | 3410J1 | Q | 3410A1P1 | 37 |
| APX72-849A22 | SHIELD | 3410CP1P1 | 3 | 34101P1 | R |
| APX72-849B22 | NO/S | 3410J1 | R | 3410A1P1 | 19 |
| APX72-851A22 | NO/S | 3410CP1P1 | 22 | 3410P1 | S |
| APX72-851B22 | NO/S | 3410J1 | S | 3410A1P1 | 33 |
| APX72-852A22 | NO/S | 3410CP1P1 | 23 | 3410P1 | T |
| APX72-852B22 | NO/S | 3410J1 | T | 3410A1P1 | 14 |
| APX72-855A22 | NO/S | 3410CP1P1 | 48 | 3410P1 | U |
| APX72-855B22 | NO/S | 3410J1 | U | 3410A1P1 | 9 |
| APX72-865A22 | NO/S | 3410Z1P1 | 9 | 3410Z1P1 | 10 |
| APX72-867A22 | NO/S | 22A1P1 | A | 8XA5P1 | 52 |
| APX72-701A | COAX | 3410RT1P2 | | 3410Z1P3 | |
| APX72-828A | COAX | 3410A1P1 | 2 | 3410RT1P1 | 45 |
| APX72-829A | COAX | 3410A1P1 | 3 | 3410RT1P1 | 46 |
| APX72-830A | COAX | 3410A1P1 | 1 | 3410RT1P1 | 47 |
| APX72-831A | COAX | 3410A1P1 | 4 | 3410RT1P1 | 48 |
| APX72-844A | COAX | 3410Z1P2 | | 3410E1P1 | |

1 Underlined Pin Numbers Denote Lower Case

2 Denotes: NO/S--No Shield

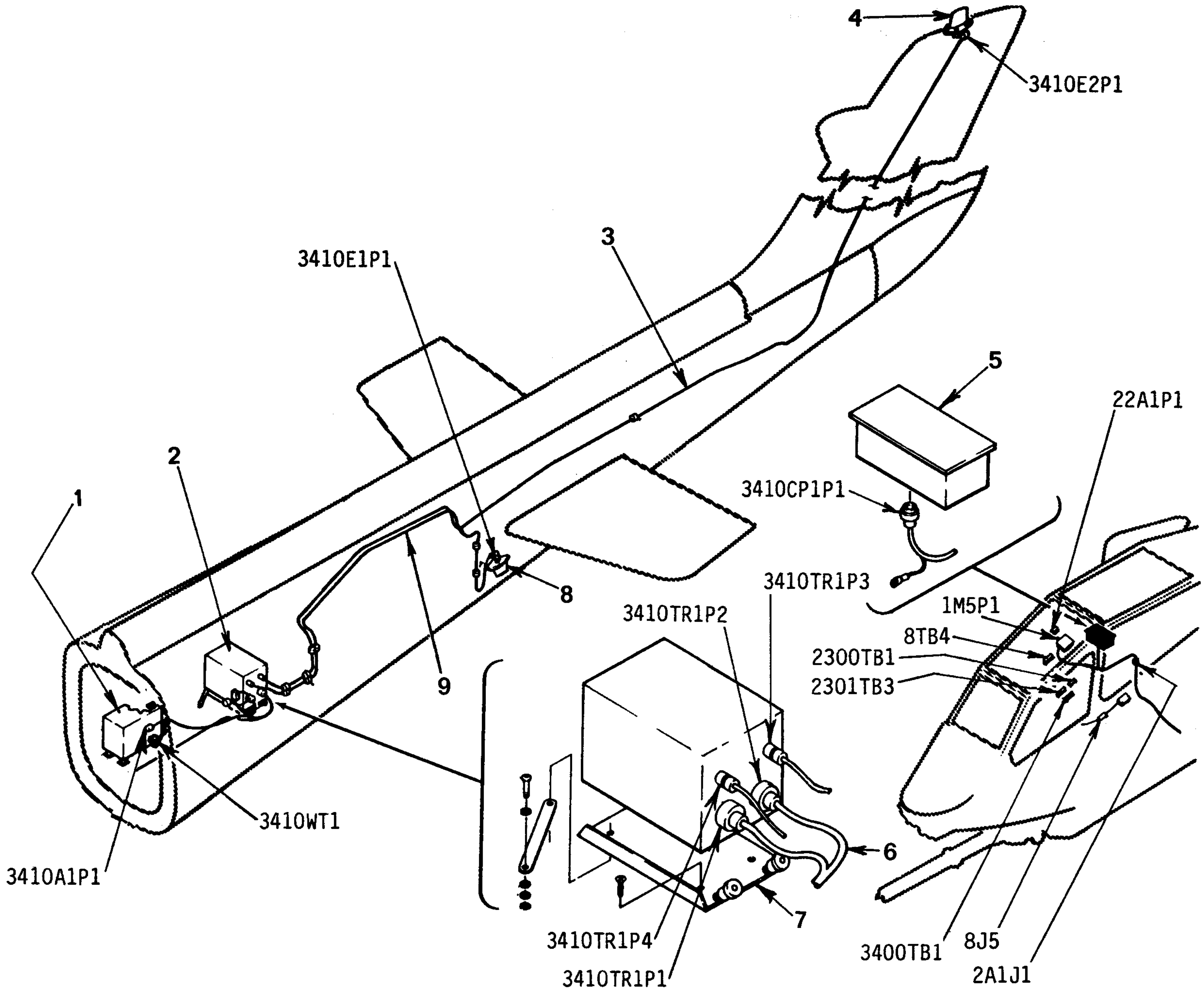



Figure F-12. IFF System AN/APX-100(V) (Sheet 1 of 2)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | KIT-lA/TSEC | Transponder Computer |
| 2 | RT-1157()/APX-100 | Receiver-Transmitter |
| 3 | 209-077-090-107 | Cable Assy., APX-1OO |
| 4 | AT-741B/A | Antenna |
| 5 | C-10533/APX-100 | Control, Transponder |
| 6 | 209-077-090-111 | Cable Assy., Branch |
| 7 | MT-4811/APX-100 | Mounting Base, Elect. |
| 8 | AT-884( )/APX-100 | Antenna |
| 9 | 209-077-090-109 | Cable Assy., APX-1OO |

Figure F-12. IFF System AN/APX-100(V) (Sheet 2 of 2)

**Table F-13. AN/APX-100, Wire Chart**

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| APX100-5003A22 | NO/S | 3410TR1P1 | 31 | 1M5P1 | K |
| APX100-5004A22 | NO/S | 3410TR1P1 | 32 | 1M5P1 | J |
| APX100-5005A22 | NO/S | 3410TR1P1 | 33 | 1M5P1 | H |
| APX100-5006A22 | NO/S | 3410TR1P1 | 6 | 1M5P1 | G |
| APX100-5007A22 | NO/S | 3410TR1P1 | 7 | 1M5P1 | F |
| APX100-5008A22 | NO/S | 3410TR1P1 | 30 | 1M5P1 | E |
| APX100-5009A22 | NO/S | 3410TR1P1 | 1 | 1M5P1 | D |
| APX100-5010A22 | NO/S | 3410TR1P1 | 2 | 1M5P1 | C |
| APX100-5011A22 | NO/S | 3410TR1P1 | 3 | 1M5P1 | B |
| APX100-5013A22 | NO/S | 3410TR1P1 | 5 | 1M5P1 | L |
| APX100-5021A22BLU | PR/S | 3410TR1P1 | 78 | 2300TB1 | E1 |
| APX100-5021A22WHT | PR/S | 3410TR1P1 | 79 | 2301TB3 | D8 |
| APX100-5022B22 | NO/S | 2A1J1 | S | 3401TR1P1 | 24 |
| APX100-5025A20 | NO/S | 3410A1P1 | 34 | 3410WT1 | D |
| APX100-5030A22 | NO/S | 3410A1P1 | 28 | 3410TR1P2 | 26 |
| APX100-5031A22 | NO/S | 3410A1P1 | 17 | 3410TR1P1 | 69 |
| APX100-5033A22 | NO/S | 3410A1P1 | 31 | 3410RT1P1 | 25 |
| APX100-5034A22 | NO/S | 3410CP1P1 | 48 | 3410A1P1 | 9 |
| APX100-5035A22 | NO/S | 3410CP1P1 | 23 | 3410A1P1 | 14 |
| APX100-5036A22 | NO/S | 3410CP1P1 | 22 | 3410A1P1 | 33 |
| APX100-5037A22 | NO/S | 3410CP1P1 | 1 | 3410A1P1 | 37 |
| APX100-5038A22 | NO/S | 3410CP1P1 | 3 | 3410A1P1 | 19 |
| APX100-5039A22 | NO/S | 3410A1P1 | 32 | 22A1P1 | B |
| APX100-5041A22 | NO/S | 3410AP1P1 | 30 | 8J5 | 46 |
| APX100-5043A22 | NO/S | 3410CP1P1 | 25 | 3410TR1P1 | 68 |
| APX100-5044A22 | NO/S | 3410CP1P1 | 9 | 3410TR1P1 | 67 |
| APX100-5045A22 | NO/S | 3410CP1P1 | 6 | 3410TR1P1 | 66 |
| APX100-5046A22 | NO/S | 3410CP1P1 | 4 | 3410TR1P1 | 65 |
| APX100-5047A22 | NO/S | 3410CP1P1 | 24 | 3410TR1P1 | 64 |
| APX100-5048A22 | NO/S | 3410CP1P1 | 11 | 3410TR1P1 | 23 |
| APX100-5049A22 | NO/S | 3410CP1P1 | 55 | 3410TR1P1 | 70 |
| APX100-5050A22 | NO/S | 3410CP1P1 | 66 | 3410TR1P1 | 63 |
| APX100-5051A22 | NO/S | 3410CP1P1 | 42 | 3410TR1P1 | 36 |
| APX100-5052A22 | NO/S | 3410CP1P1 | 26 | 3410TR1P1 | 46 |
| APX100-5053A22 | NO/S | 3410CP1P1 | 27 | 3410TR1P1 | 47 |
| APX100-5054A22 | NO/S | 3410CP1P1 | 28 | 3410TR1P1 | 48 |
| APX100-5055A22 | NO/S | 3410CP1P1 | 29 | 3410TR1P1 | 49 |
| APX100-5056A22 | NO/S | 3410CP1P1 | 30 | 3410TR1P1 | 50 |
| APX100-5057A22 | NO/S | 3410CP1P1 | 32 | 3410TR1P1 | 51 |
| APX100-5058A22 | NO/S | 3410CP1P1 | 33 | 3410TR1P1 | 52 |
| APX100-5059A22 | NO/S | 3410CP1P1 | 35 | 3410TR1P1 | 53 |
| APX100-5060A22 | NO/S | 3410CP1P1 | 36 | 3410TR1P1 | 16 |
| APX100-5061A22 | NO/S | 3410CP1P1 | 37 | 3410TR1P1 | 17 |
| APX100-5062A22 | NO/S | 3410CP1P1 | 38 | 3410TR1P1 | 18 |
| APX100-5063A22 | NO/S | 3410CP1P1 | 15 | 3410TR1P1 | 19 |
| APX100-5064A22 | NO/S | 3410CP1P1 | 16 | 3410TR1P1 | 41 |
| APX100-5065A22 | NO/S | 3410CP1P1 | 17 | 3410TR1P1 | 42 |
| APX100-5066A22 | NO/S | 3410CP1P1 | 18 | 3410TR1P1 | 43 |

Table F-13. AN/APX-100, Wire Chart (Cont)

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| APX100-5067A22 | NO/S | 3410CP1P1 | 19 | 3410TR1P1 | 44 |
| APX100-5068A22 | NO/S | 3410CP1P1 | 20 | 3410TR1P1 | 45 |
| APX100-5069C22 | NO/S | 2A1J1 | R | 3410CP1P1 | 51 |
| APX100-5069D22 | NO/S | 2A1J1 | Q | 22A1P1 | Z |
| APX100-5071A22 | NO/S | 3410CP1P1 | 50 | 8TB4 | G2 |
| APX100-5073A22 | NO/S | 3410CP1P1 | 54 | 2300TB1 | J4 |
| APX100-5074A22 | NO/S | 3410CP1P1 | 2 | 3410TR1P1 | 72 |
| APX100-5075A22 | NO/S | 3410CP1P1 | 8 | 3410TR1P1 | 74 |
| APX100-5076A22 | NO/S | 3410CP1P1 | 62 | 3410TR1P1 | 9 |
| APX100-5077A22 | NO/S | 3410CP1P1 | 63 | 3410TR1P1 | 8 |
| APX100-5078A22 | NO/S | 3410CP1P1 | 5 | 3410TR1P1 | 71 |
| APX100-5079A22 | NO/S | 3410CP1P1 | 40 | 3410TR1P1 | 60 |
| APX100-5080A22 | NO/S | 3410CP1P1 | 41 | 3410TR1P1 | 59 |
| APX100-5081A22 | NO/S | 3410CP1P1 | 43 | 3410TR1P1 | 58 |
| APX100-5082A22 | NO/S | 3410CP1P1 | 44 | 3410TR1P1 | 57 |
| APX100-5083A22 | NO/S | 3410CP1P1 | 64 | 3410TR1P1 | 61 |
| APX100-5084A22 | NO/S | 3410CP1P1 | 46 | 3410TR1P1 | 75 |
| APX100-5085A22 | NO/S | 3410CP1P1 | 60 | 3410TR1P1 | 37 |
| APX100-5086A22N | NO/S | 3410CP1P1 | 53 | GND | |
| APX100-5089A22 | NO/S | 3410CP1P1 | 56 | 3410TR1P1 | 15 |
| APX100-5090A22 | NO/S | 3410CP1P1 | 57 | 3410TR1P1 | 38 |
| APX100-5091A22 | NO/S | 3410CP1P1 | 58 | 3410TR1P1 | 39 |
| APX100-5092A22 | NO/S | 3410WT1 | A | 3410TR1P1 | 21 |
| APX100-5093A22 | NO/S | 3410TR1P1 | 22 | 3410WT1 | B |
| APX100-5094A22 | NO/S | 3410TR1P1 | 27 | 3410WT1 | E |
| APX100-5095A22 | NO/S | 3410TR1P1 | 35 | 3410WT1 | F |
| APX100-5096A22 | NO/S | 3410TR1P1 | 55 | 3410WT1 | C |
| APX100-5096B20N | NO/S | 3410WT1 | K | GND | |
| APX100-100A20N | NO/S | 1MP5 | A | GND | |
| APX100-101A22 | NO/S | 22A1P1 | A | 8J5 | 34 |
| APX100-102A20 | NO/S | 22A1P1 | C | 2300T3 | D4 |
| APX100-5026A | SHIELD | 3410A1P1 | 4 | 3410TR1P2 | B |
| APX100-5027A | SHIELD | 3410A1P1 | 2 | 3410TR1P2 | 26 |
| APX100-5028A | SHIELD | 3410A1P1 | 3 | 3410TR1P2 | 69 |
| APX100-5029A | SHIELD | 3410A1P1 | 1 | 3410TR1P2 | 25 |
| APX100-5087A | COAX | 3410TR1P4 | | 3410E2P1 | |
| APX100-5088A | COAX | 3410TR1P3 | | 3410E1P1 | |

1 Underlined Pin Numbers Denote Lower Case

2 Denotes: NO/S--No Shield
PR/S--Pair, Twisted, W/Shield

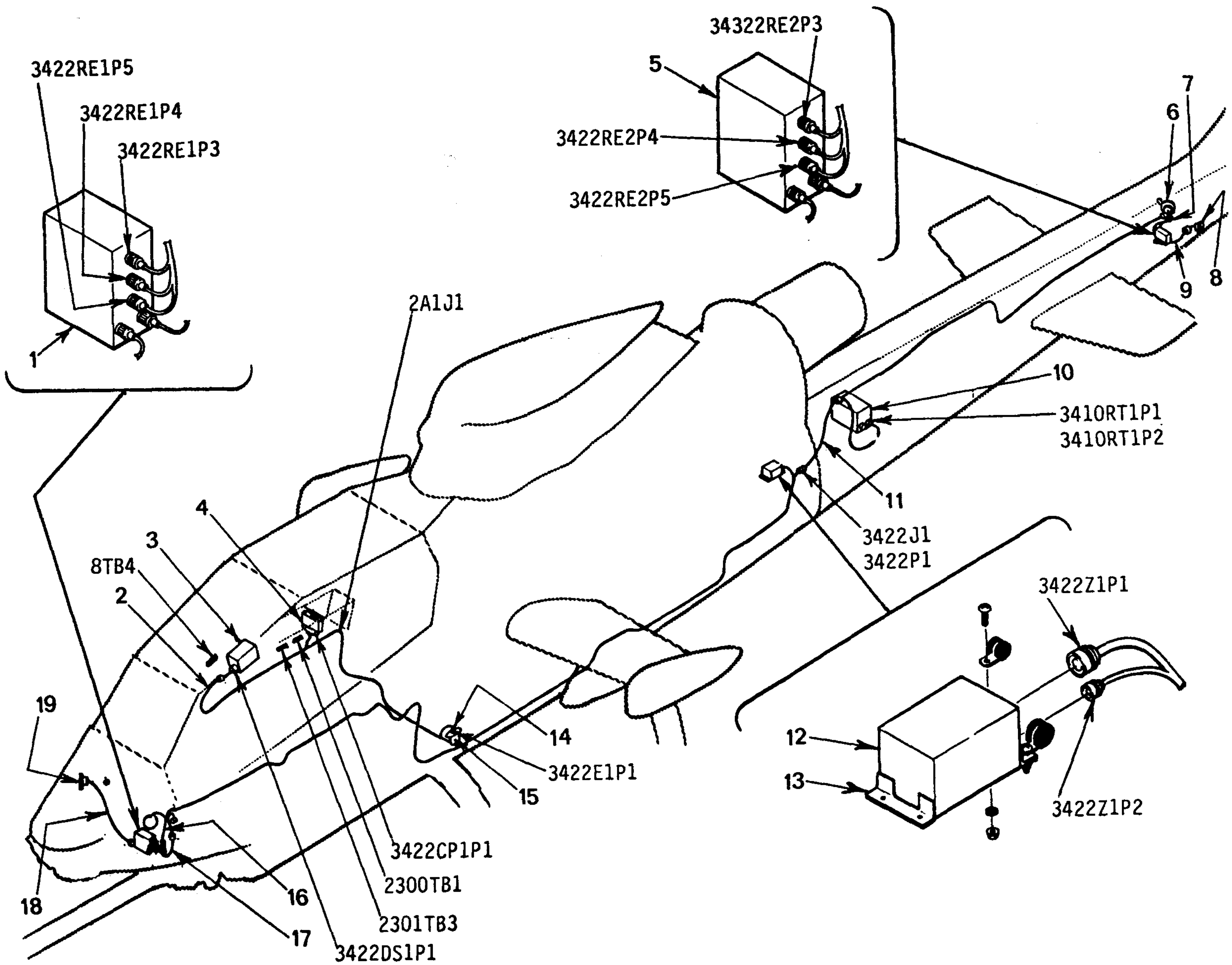



Figure F-13. Radar Warning System AN/APR-39(V)1 (Sheet 1 of 2)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | R-1838()/APR-39 | Receiver, Radar |
| 2 | 209-077-050-3 | Cable Assy., APR-39, USBL EFF 76-22567 thru 77-23092 |
| | 209-077-050-105 | Cable Assy., APR-39, USBL EFF 78-23093 and subsequent |
| 3 | IP-1150()/APR-39 | Indicator, Radar Signal |
| 4 | C-9326 APR-39V | Control, Detecting Signal |
| 5 | R-f.838()/APR-39 | Receiver, Radar |
| 6 | 1538-8252-1 | Cable Assy., Radio |
| 7 | AS-2891/APR-39(V) | Antenna, Right Spiral |
| 8 | AS-2892/APR-39(V) | Antenna, Left Spiral |
| 9 | 1538-8252-3 | -Cable Assy., Radio |
| 10 | RT-1157()/APX-10 | MOD AH-1S |
| | RT-859()/APX-72 | PROD, ECAS, AH-IS |
| 11 | 209-077-050-15 | Cable Assy., APR-39, USBL EFF 76-22567 thru 77-23092 |
| | 209-077-a50-101 | Cable Assy., APR-39, USBL EFF 77-23093 and subsequent |
| 12 | CM-440/APR-39(V) | Comparator |
| 13 | 209-077-053-l | Bracket, Support |
| 14 | 209-077-050-5 | Cable Assy., Blade Antenna |
| 15 | AS-2890/APR-39(V) | Antenna |
| 16 | AS-2891/APR-39(V) | Antenna, Right Spiral |
| 17 | 1538-8252-5 | Cable Assy., Radio |
| 18 | 1538-8252-7 | Cable Assy., Radio |
| 19 | AS-2892/APR-39(V) | Antenna, Left Spiral , |

Figure F-13. Radar Warning System AN/APR-39(V)l (Sheet 2 of 2)

**Table F-14. AN/APR-39, Wire Chart**

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| APR39-1A | COAX | 3422RE1P3 | | 3422Z1P1 | 8 |
| APR39-2A | COAX | 3422J1 | A | 3422RE2P3 | |
| APR39-3A | COAX | 3422J1 | B | 3422RE2P4 | |
| APR39-4A | COAX | 3422RE1P4 | | 3422Z1P1 | 9 |
| APR39-25A22 | NO/S | 3422DS1P1 | 8 | 3422CP1P1 | 8 |
| APR39-30A22BLU | PR/S | 3422CP1P1 | 22 | 2301TB3 | J6 |
| APR39-30A22WHT | PR/S | 3422CP1P1 | 14 | 2301TB3 | A6 |
| APR39-9A | COAX | 3422Z1P2 | | 3422E1P1 | |
| APR39-11A22 | NO/S | 3422DS1P1 | 1 | 3422Z1P1 | 1 |
| APR39-12A22 | NO/S | 3422DS1P1 | 2 | 3422Z1P1 | 2 |
| APR39-13A22 | NO/S | 3422DS1P1 | 3 | 3422Z1P1 | 3 |
| APR39-14A22 | NO/S | 3422DS1P1 | 4 | 3422Z1P1 | 4 |
| APR39-15A | COAX | 3422DS1P1 | 5 | 3422Z1P1 | 5 |
| APR39-16A22 | NO/S | 3422DS1P1 | 10 | 2300TB1 | 45 |
| APR39-17A | COAX | 3422RE1P5 | | 3422Z1P1 | 7 |
| APR39-18A22 | NO/S | 3422CP1P1 | 2 | 3422Z1P1 | 12 |
| APR39-19A22 | NO/S | 3422CP1P1 | 3 | 3422Z1P1 | 13 |
| APR39-20A22 | NO/S | 3422CP1P1 | 4 | 3422Z1P1 | 14 |
| APR39-21A22 | NO/S | 3422CP1P1 | 5 | 3422Z1P1 | 15 |
| APR39-22A22 | NO/S | 3422Z1P1 | 16 | 2300TB1 | B7 |
| APR39-23A | COAX | 3422J1 | C | 3422RE2P5 | |
| APR39-24A22 | NO/S | 3422DS1P1 | 7 | | |
| APR39-25A22 | NO/S | 3422DS1P1 | 8 | | |
| APR39-26A22 | NO/S | 3422DS1P1 | 9 | | |
| APR39-27A22 | NO/S | 3422CP1P1 | 10 | 2300TB1 | J5 |
| APR39-28B22 | NO/S | 3422CP1P1 | 12 | 2A1J1 | H |
| APR39-29A22 | NO/S | 3422CP1P1 | 13 | 8TB4 | K3 |
| APR39-30A22 | NO/S | 3422CP1P1 | 14 | 2301TB3 | A6 |
| APR39-2B | COAX | 3422P1 | A | 3422Z1P1 | 18 |
| APR39-3B | COAX | 3422P1 | B | 3422Z1P1 | 19 |
| APR39-23B | COAX | 3422P1 | C | 3422Z1P1 | 17 |
| APR39-31A | COAX | 3422J1 | D | 3410RT1P1 | 11 |
| APR39-31B | COAX | 3422P1 | D | 3422Z1P1 | 22 |
| APR39-40A22 | NO/S | 3422Z1P1 | 20 | SPLICE CAP | |
| APR39-31A | COAX | 3422Z1P1 | 22 | 3410TR1P2 | E |
| APR39-2A | COAX | 3422J1 | A | 3422RE2P3 | |
| APR39-3A | COAX | 3422J1 | B | 3422RE2P4 | |
| APR39-23A | COAX | 3422J1 | C | 3422RE2P5 | |

1 Underlined Pin Numbers Denote Lower Case

2 Denotes: NO/S--No Shield
PR/S--Pair, Twisted, W/Shield

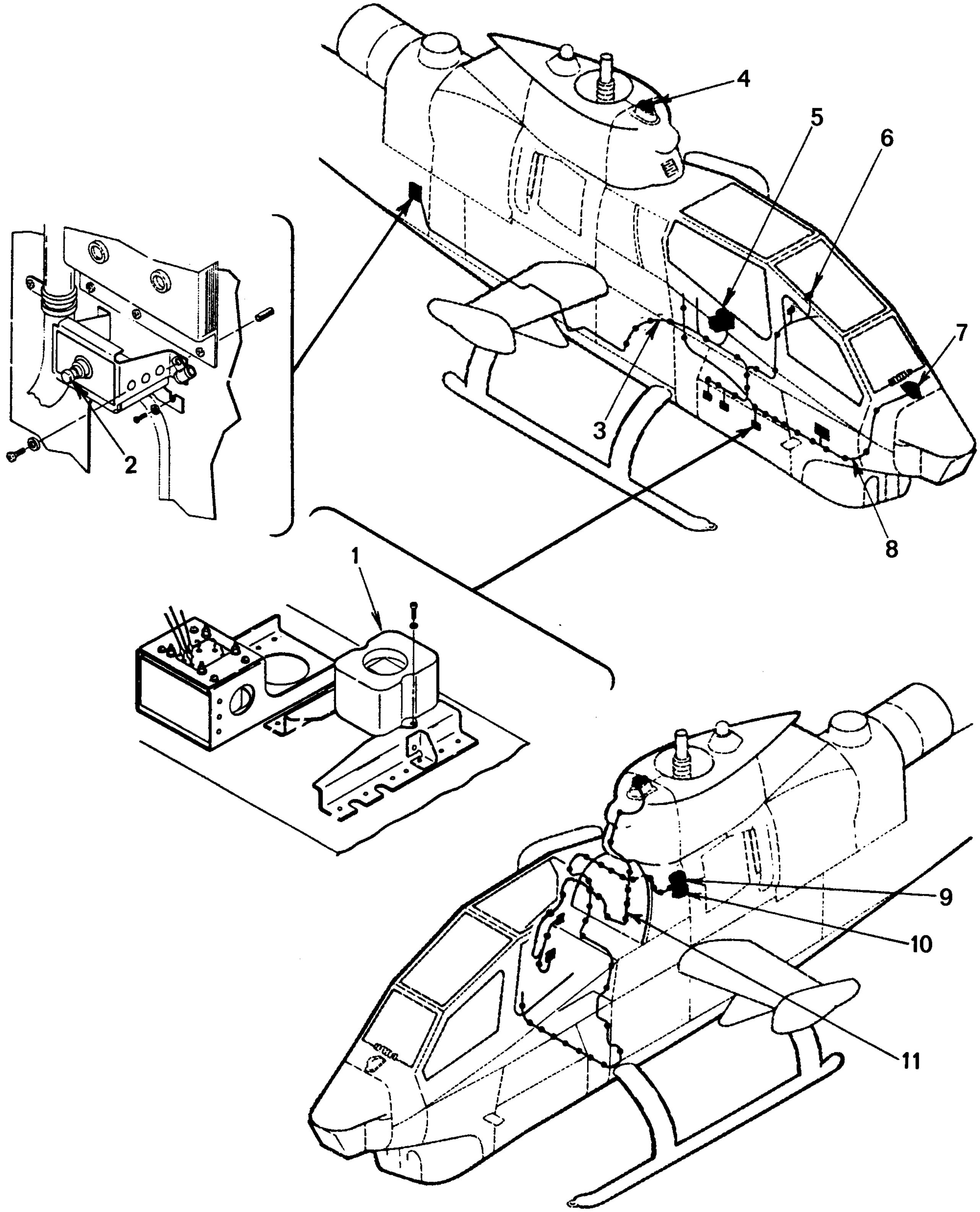



Figure F-14. Countermeasures Set AN/ALQ-136 (MC) (Sheet 1 of 2)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | MS24140-D1 | Relay, Electromagnetic |
| 2 | 6TC14-2 | Circuit Breaker |
| 3 | DSK-9-01752-501 | Wire Harness Assy. |
| 4 | AS-3007/ALQ-136(V) | Antenna Assy. |
| 5 | C-9576/ALQ-136 | Control Unit |
| 6 | 10620 AEL2-7 | Indicator, Light, PB 19544 |
| 7 | AS-307/ALQ-136(V) | Antenna Assy. |
| 8 | CSK-9-01926 | Cable Assy, Coax, XMT. |
| 9 | 020372 | Fan, Vanaxial |
| 10 | RT-1149/ALQ-136 | Receiver, Transmitter |
| 11 | CSK-9-01927 | Cable Assy., Coax RCV. |

Figure F-14. Countermeasures Set AN/ALQ-136 (MC) (Sheet 2 of 2)

Table F-15. AN/ALQ-136 Wire Chart

NOTE

Information is classified.

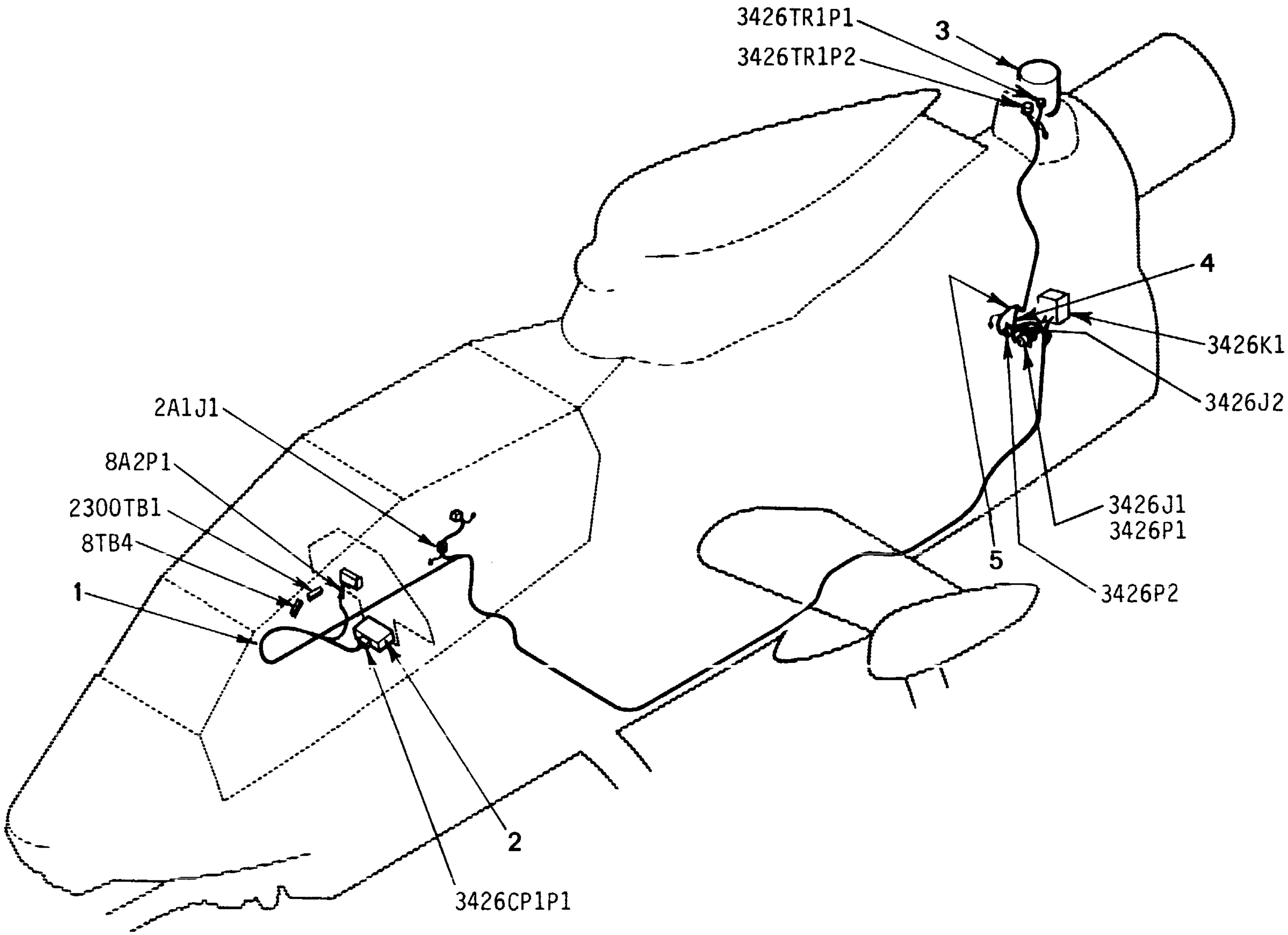



Figure F-15. Countermeasures Set AN/ALQ-144(V) (NC) (Sheet 1 of 2)

| DRAWING DESIGNATION | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | 209-077-092-109 | Cable Assembly, Branch |
| 2 | C-10280/ALQ-144V | Control, Countermeasures |
| 3 | T-1360(V)2/ALQ | Transmitter, Counter, I.R. |
| 4 | 209-077-092-113 | Cable Assembly |
| 5 | 209-077-092-111 | Cable Assembly, I.R. Jammer |

Figure F-15. Countermeasures Set AN/ALQ-144(V) (MC) (Sheet 2 of 2)

Table F-16. AN/ALQ-144, Wire Chart

| WIRE NUMBER | TYPE 2 | END 1 | PIN 1 | END 2 | PIN 1 |
|---|---|---|---|---|---|
| ALQ144-1A22 | NO/S | 3426CP1P1 | 20 | 3426J2 | A |
| ALQ144-1B20 | NO/S | 3426TR1P2 | C | 3426P2 | A |
| ALQ144-2A22 | NO/S | 3426CP1P1 | 21 | 3426J2 | B |
| ALQ144-2B20 | NO/S | 3426TR1P2 | D | 3426P2 | B |
| ALQ144-3A22 | NO/S | 3426CP1P1 | 17 | 3426J2 | C |
| ALQ144-3B20 | NO/S | 3426TR1P2 | T | 3426P2 | C |
| ALQ144-4A22 | NO/S | 3426CP1P1 | 18 | 3426J2 | D |
| ALQ144-4B20 | NO/S | 3426TR1P2 | V | 3426P2 | D |
| ALQ144-5A22 | NO/S | 3426CP1P1 | 19 | 3426J2 | E |
| ALQ144-5B20 | NO/S | 3426TR1P2 | S | 3426P2 | E |
| ALQ144-6A20 | NO/S | 3426CP1P1 | 22 | 2300TB1 | B4 |
| ALQ144-7B20 | NO/S | 3426CP1P1 | 24 | 2A1J1 | I |
| ALQ144-8A22 | NO/S | 3426CP1P1 | 25 | 8TB4 | H12 |
| ALQ144-9A22 | NO/S | 3426CP1P1 | 13 | 8A2P1 | B |
| ALQ144-10A20 | NO/S | 3426CP1P1 | 23 | 2300TB1 | C4 |
| ALQ144-11A6 | NO/S | 3426K1 | A2 | 3426J1 | A |
| ALQ144-11B6 | NO/S | 3426TR1P1 | A | 3426P1 | A |
| ALQ144-12A6 | NO/S | 3426TR1P1 | C | 3426P1 | C |
| ALQ144-12B6N | NO/S | GND | | 3426J1 | C |
| ALQ144-13B22 | NO/S | 3426K1 | 3 | 2A1J1 | Y |
| ALQ144-14B22N | NO/S | GND | | 2A1J1 | GG |
| ALQ144-15A20N | NO/S | 3426K1 | 5A | GND | |
| ALQ144-16A12 | NO/S | 3426K1 | A2 | 3426P1 | B |
| ALQ144-16B12 | NO/S | 3426TR1P1 | B | 3426J1 | B |
| D-12 | NO/S | 3426TR1P1 | D | CAP | |
| E-12 | NO/S | 3426TR1P1 | E | CAP | |

1 Underlined Pin Numbers Denote Lower Case

2 Denotes: NO/S--No Shield

# GLOSSARY

NOTE

- The terms and acronyms listed herein are defined in relation to BDAR, and accordingly may not be used in the same manner in other manuals.
- Additional definitions of terms, markings, and acronyms used during BDAR assessment procedures will be found under chapter 1, paragraph 1-10, Tagging and Identifying BDAR Repairs.

| | |
|---|---|
| ABRASION | Roughened surface, varying from light to severe. |
| ALLOWANCE | A prescribed difference between the maximum condition of mating parts. The minimum clearance or maximum interference between such parts. |
| API | Armor piercing incendary armament round. |
| ASSEMBLY | A group of two or more physically connected and related parts, capable of disassembly, and when combined with other assemblies and parts, creates a component. |
| ASSEMBLY CLEARANCE | The actual fit between two or more mating parts with respect to the amount of clearance or interference between them. |
| ASSESSMENT | A procedure to rapidly determine what is damaged, whether it is repairable, what assets are required, who can perform the repair, and where the repair can made. |
| ASSOCIATED PARTS | A group of parts which could contain one or more unrelated parts of a subassembly, one or more subassemblies, and attaching hardware. |
| AXIAL | Related to an axis. Describes the linear distance a shaft or gear moves. |
| BATTLEFIELD DAMAGE | Any incident such as combat damage, random failures, operator errors, accidents, and wear-out failures which occur on the battlefield and which prevent the equipment/end item from accomplishing its mission. |
| BEAM | A primary structural element designed to carry heavy loads by resisting bending in one direction. Usually constructed with a channel, tee, or “I” cross section. |
| BEND | Any change in an intended configuration. |
| BORE | Inside measurement of the interior diameter of a hole or tube. Also used to describe the hole itself. |

GLOSSARY (Cont)

| | |
|---|---|
| BOWED | Curved or gradual deviation from original line or plane. |
| BOX BEAM | A primary structural element designed to carry heavy loads by resisting bending in at least two directions characterized by a square or rectangular hollow cross section. |
| BRAID | Machine woven wire strands. |
| BREAK | Separation of a part or substance from itself. |
| BRIDGING | Jumping or bypassing of a part or component. |
| BRINELLED | Circular indentations on bearing surfaces. |
| BULKHEAD | The primary vertical structural element. Often called frames or walls. |
| BUCKLE | Wrinkle or crease damage to sheet metal structural elements. |
| BURN | Loss of metal resulting from overheating. |
| BURNISHING | The smoothing of a metal surface by mechanical action without loss of material. Generally found on plain bearing surfaces. Surface discoloration is sometimes present around outer edges of a burnished area. |
| BURR | A rough edge or sharp projection. |
| CANNIBALIZATION | The removal of needed parts or assemblies from other aircraft, equipment, or from non-essential systems on the helicopter undergoing repair. |
| CAP | A continuous structural element (angle, tee, or channel shape) fastened to the top and bottom of a beam or web. |
| CATASTROPHIC | A sudden and disastrous event caused by equipment failure which endangers human life. |
| CHAFED | Functional wear. A rubbing action between two parts having relative motion. |
| CHECK | An examination for verifying. |
| CHIPPING | Breaking away of small metallic particles. |
| CHORDLINE | An imaginary line running perpendicular to the leading or trailing edge of a rotor blade. |

GLOSSARY (Cont)

| | |
|---|---|
| CLOCKWISE | A circular motion in the direction the hands of a clock rotate when viewed from the front. |
| COATING, PROTECTIVE | An external surface treatment, such as paint, anodizing, electroplating or chemical film, used to delay the effects of corrosive or atmospheric elements upon metals. |
| COMBAT CAPABLE | The ability of the helicopter to perform the MINIMUM combat mission assignments. |
| COMBAT EMERGENCY CAPABLE | The ability of the helicopter to perform LIMITED specific tactical mission assignments. |
| COMPONENT | A group of physically connected assemblies or parts. |
| CONSUMABLE ITEMS | Parts or materials which are consumed by usage or which have a one-time usage in depot maintenance activity. |
| CORE | The inner layer of material used to construct honeycomb structural panels. |
| CORROSION | Surface chemical action which results in surface discoloration, a layer of oxide, rust, or removal of surface metal. |
| COUNTER-CLOCKWISE | The direction opposite to the direction the hands of a clock rotate, when viewed from the front. |
| CRACK | A break in some type of material. |
| CRIPPLE | Damage to a load carrying structural member which would cause degradation of the helicopters full mission capability. |
| CRITERIA | Standards or rules used to judge. |
| DATA | A group of facts. |
| DECONTAMINATION | To make an item safe for unprotected personnel by removing, neutralizing, or destroying any harmful substance. A function of Nuclear, Biological, and Chemical (NBC) Warfare. |
| DENT | Indentation in metal surface produced by an object striking with force. |
| DISASSEMBLY | The operations necessary to reduce an assembly to its separate components and parts. |

GLOSSARY (Cont)

| | |
|---|---|
| DISTORTION | A change from an original shape. |
| EROSION | Wearing away of metal. |
| EVACUATION | A combat service support function which involves the movement of recovered helicopters from a main supply route, maintenance collection point, or maintenance activity to higher categories of maintenance. |
| EXPEDIENT | A rapid and often non-standard method of repairing an item (repair technique). |
| FAILURE MODE | The specific cause of failure, relating to categories such as cracks, corrosion, ballistic impact, etc. |
| FATIGUE FAILURE | Sharp indentations, cracks, tool marks, or inclusions that result in progressive yielding of one or more local areas of material. |
| FIX | Any rapid action that returns a damaged part or assembly to full or an acceptably degraded operating condition (repair technique). |
| FLANGE | A broad ridge or pair of ridges projecting from the edge of a structural element, providing additional strength or a place for attachment. |
| FLAKING | Loose particles of metal or evidence of separation of a surface covering material. |
| FLUORESCENT PENETRANT | A test for locating cracks and fissures in non-magnetic material, making use of radiation properties of fluorescent particles when exposed to ultraviolet light. |
| FORMER | A curved structural element which gives the fuselage its even aerodynamic shape. Normally longerons and stringers are attached and the skin is fitted tightly over all these elements. |
| FRACTURE | Separation of a part or piece of material from itself. |
| FRAYING | Loose or raveled threads and fibers. |
| FULLY MISSION CAPABLE (FMC) | The ability of the helicopter to perform ALL its combat mission assignments. |
| FUNCTIONAL GROUP | Major helicopter subsystems identified in and corresponding to functional groups in TM 55-1520-236-23. |
| FUSELAGE | The central main body of the helicopter. |

GLOSSARY (Cont)

| | |
|---|---|
| GALLING | Aggravated condition of wear, generally caused by a rubbing action with little or no lubrication. |
| GAP | Clearance between faying surfaces, measurement of which is used to determine thickness of shims. |
| GOUGING | Removal of surface metal because of mechanical contact with foreign material. |
| HEAT DISCOLORATION | A change in color or appearance of a part, caused by excessive temperature. |
| HEI | High explosive incendiary armament round. |
| HOUSING | A frame support or cover, used to hold parts of machinery in place. Also used as a protective cover. |
| INDENTATION | A cavity with smooth bottom or sides, which can occur on rolling contact surfaces. |
| INSPECTION | A critical examination of parts to determine their usefulness or condition. |
| INTERFACE | The joining point of two flat surfaces. |
| JURY-RIGGING | A rapid non-standard method of repairing an item (repair technique). |
| LIMIT | An established point or boundary, in time, speed, or space, beyond which something may not go or is not permitted to go. |
| LOAD PATH | The route taken by a mechanical force traveling through an airframe structure. |
| LONGERON | A principle longitudinal (fore and aft), structural element (angle or tee shape) continuous across several points of support. |
| LRU | Line replaceable unit (electronic circuit board). |
| MAINTENANCE COLLECTION POINT | A point operated by AVIM units for the collection of equipment for repair. |
| MAINTENANCE SUPPORT TEAM (MST: | A team consisting of AVUM and AVIM mechanics and technical specialist who are trained in assessing battle damage in addition to their routine speciality. |

GLOSSARY (Cont)

| | |
|---|---|
| MAINTENANCE TEAM (MT) | A team consisting of organizational mechanics who may be trained in assessing-battle damage and field repair Procedures. |
| MISSION FUNCTION COMBAT CAPABLE (MFCC) | The ability of the helicopter to perform the MINIMUM combat mission assignments. |
| MODIFICATION | An alteration and/or integral change affecting the configuration of equipment or its respective parts, components, subassemblies, or assemblies. |
| NATIONAL STOCK NUMBER (NSN) | The assigned identifying number for an item of supply, consisting of the four-digit Federal Supply Class (FSC), and the nine-digit National Stock Identification Number (NIIN). |
| NICK | A local break or notch in the edge of material. |
| OPERATION | Performance of a practical, functional action. |
| OPTION | A specific BDAR repair technique often non-standard in nature. |
| OVERHAUL | The process of repairing or adjusting a machine to restore, improve, or lengthen its useful life. |
| PEELING | A breaking away of surface finishes such as coatings or platings, or flaking of large pieces of such material. |
| PIGTAIL | A group of electrical wire strands twisted together. |
| PITTING | Small holes or indentations, generally caused by rust, corrosion, high compressive stresses, or metal-to-metal pounding. |
| PRACTICE | A repeated or customary action. |
| PRIMARY STRUCTURE | The major structural load carrying elements of an airframe without which helicopter flight safety would be compromised. |
| PROCEDURE | A particular course of action. |
| PROCESS | A series of actions conducive to an end. |
| PYLON | The box shaped structural area surrounding the helicopter main transmission. This area carries several primary structural loads. |

GLOSSARY (Cont)

| | |
|---|---|
| REASSEMBLY | The assembling and aligning of all subassemblies and parts into a complete assembly to affect a serviceable item of equipment. |
| RECOVERY | The retrival of immobile, inoperative, or abandoned helicopters from the battlefield or immediate vicinity and its movement to a maintenance collection point, main supply route, or a maintenance activity for disposition, repair, or evacuation. |
| REMOVE | To move by lifting, pulling or pushing. |
| REPAIR | To restore a defective part, component, subassembly, or assembly to a usable condition in accordance with the instructions contained in this manual. |
| REPLACE | To supply an equivalent for. |
| REWORK | To work over again. |
| RUPTURE | The breaking of an airframe structural element or skin due to overstress/hostile fire. |
| SCORING | Very deep scratches caused by foreign particles between surfaces that are moving, or between one moving and one stationary surface. Scores follow the travel direction of the part. |
| SCRATCHING | Narrow, shallow lines resulting from movement of foreign particles across a surface. |
| SECONDARY STRUCTURE | The non-flight safety structural elements of an airframe. |
| SELF-RECOVERY | The ability of the helicopter to fly at reduced airspeed and altitude from the battlefield or immediate vicinity to a maintenance collection point, the main supply route, or maintenance activity for disposition, repair or evacuation. |
| SEMIMONOCOQUE | A structural design which relies on strength of the skin to carry a large portion of the load. The skin is normally reinforced by longerons and vertical bulkheads (walls), but has no diagonal bracing, leaving the interior basicly hollow. |
| SERVICING | The lubrication, treating, cleaning, or preservation necessary to maintain the equipment and other respective parts in serviceable condition. |
| SKIN | The aerodynamic exterior covering of the helicopter. |

GLOSSARY (Cont)

| | |
|---|---|
| SPALLING | Chipped or flaked surface caused by the breaking away of the hardened metal and separation of the case from the core. |
| SPANWISE | The location of a point or direction of movement parallel to the leading or trailing edge of a rotor blade. |
| SPAR | A primary structural element designed to carry weight and resist bending loads in wings and rotor blades. Spars typically extend the full length of the wing, and taper down to a smaller cross section toward the tip of the wing. |
| STIFFENER | A longitudinal (fore and aft) structural element use in semimonocoque design which stiffens the skin. Often called a stringer. |
| STOP HOLE | A hole intentionally drilled at the end of a crack, or saw cut which normally will prevent further propagation of the crack. |
| STRINGER | A longitudinal (fore and aft) structural element used in semimonocoque design which stiffens the skin. Often called a stiffener. |
| TEST | As used herein, the checking or operation of equipment to determine that the unit functions properly within the limits set forth in this manual. |
| TOLERANCE | The difference between two limiting sizes as a means of specifying the degree of accuracy. |
| TOXIC | A poisonous substance. |
| TWIST | The damage of a structural element by turning or torque forces causing permanent deformation. |
| VISCOSITY | The property of a fluid that tends to resist the force trying to make it flow such as gravity or applied pressure. |
| WARPAGE | The bending or twisting damage causing a structural element to weaken and permanently loose its original shape. |
| WEB | The sheet metal membrain connecting the upper and lower flanges of a beam or spar. Provides overall rigidity to the airframe structure. |
| WHIP | The tendency of a bent shaft to rotate away from its original center as the shaft RPM is increased, thus causing severe vibration. |

# INDEX

INDEX (Cont)

INDEX (Cont)

INDEX (Cont)

INDEX (Cont)

**By Order of the Secretary of the Army:**

**CARLE.VUONO**
*General, United States Army*
*Chief of Staff*

**Official:**

**THOMAS F. SIKORA**
*Brigadier General, United States Army*
*The Adjutant General*

DISTRIBUTION :
To be distributed in accordance with DA Form 12-31, AVUM and AVIM Maintenance requirements for AH-lP/E/F Helicopter, Attack.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1991 554-122/21092

FILL IN YOUR UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

______________________________

______________________________

OFFICIAL BUSINESS

TEAR ALONG PERFORATED LINE

Commander
US Army Aviation Systems Command
ATTN: AMSAV-MC
4300 Goodfellow Boulevard
St. Louis, MO 63120-1798

**RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS**


**SOMETHING WRONG WITH THIS PUBLICATION?**

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

| PUBLICATION NUMBER | PUBLICATION DATE | PUBLICATION TITLE |
|---|---|---|
| TM 55-1520-244-BD | 26 Nov 90 | Operators, AVUM and AVIM Maint Battlefield Damage Assessment and Repair for Hel Attack |

BE EXACT. PIN-POINT WHERE IT IS

| PAGE NO | PARA-GRAPH | FIGURE NO | TABLE NO | IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT: |
|---|---|---|---|---|
| | | | | |

| PRINTED NAME GRADE OR TITLE AND TELEPHONE NUMBER | SIGN HERE |
|---|---|
| | |

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS

TEAR ALONG PERFORATED LINE

FILL IN YOUR
UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

Commander
US Army Aviation Systems Command
ATTN: AMSAV-MC
4300 Goodfellow Boulevard
St. Louis, MO 63120-1798

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS


SOMETHING WRONG WITH THIS PUBLICATION?

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

| PUBLICATION NUMBER | PUBLICATION DATE | PUBLICATION TITLE |
|---|---|---|
| TM 55-1520-244-BD | 26 Nov 90 | Operators, AVUM and AVIM Maint Battlefield Damage Assessment and Repair for Hel Attack |

BE EXACT. PIN-POINT WHERE IT IS

| PAGE NO | PARA-GRAPH | FIGURE NO | TABLE NO | IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT: |
|---|---|---|---|---|
| | | | | |

PRINTED NAME GRADE OR TITLE AND TELEPHONE NUMBER

SIGN HERE

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS

TEAR ALONG PERFORATED LINE

FILL IN YOUR UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

Commander
US Army Aviation Systems Command
ATTN: AMSAV-MC
4300 Goodfellow Boulevard
St. Louis, MO 63120-1798

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

THEN. . JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT. FOLD IT AND DROP IT IN THE MAIL!

SOMETHING WRONG WITH THIS PUBLICATION?

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

| PUBLICATION NUMBER | PUBLICATION DATE | PUBLICATION TITLE |
|---|---|---|
| TM 55-1520-244-BD | 26 Nov 90 | Operators, AVUM and AVIM Maint Battlefield Damage Assessment and Repair for Hel Attack |

BE EXACT. PIN-POINT WHERE IT IS

| PAGE NO | PARA-GRAPH | FIGURE NO | TABLE NO | IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT: |
|---|---|---|---|---|
| | | | | |

| PRINTED NAME GRADE OR TITLE AND TELEPHONE NUMBER | SIGN HERE |
|---|---|
| | |

DA FORM 1 JUL 79 2028-2 PREVIOUS EDITIONS ARE OBSOLETE

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS

TEAR ALONG PERFORATED LINE

FILL IN YOUR UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

Commander
US Army Aviation Systems Command
ATTN: AMSAV-MC
4300 Goodfellow Boulevard
St. Louis, MO 63120-1798

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS


**SOMETHING WRONG WITH THIS PUBLICATION?**

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

| PUBLICATION NUMBER | PUBLICATION DATE | PUBLICATION TITLE |
|---|---|---|
| TM 55-1520-244-BD | 26 Nov 90 | Operators, AVUM and AVIM Maint Battlefield Damage Assessment and Repair for Hel Attack |

| BE EXACT. PIN-POINT WHERE IT IS | | | | IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT: |
|---|---|---|---|---|
| PAGE NO | PARA-GRAPH | FIGURE NO | TABLE NO | |
| | | | | |

| PRINTED NAME GRADE OR TITLE AND TELEPHONE NUMBER | SIGN HERE |
|---|---|
| | |

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS

TEAR ALONG PERFORATED LINE

FILL IN YOUR UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

Commander
US Army Aviation Systems Command
ATTN: AMSAV-MC
4300 Goodfellow Boulevard
St. Louis, MO 63120-1798

**RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS**


**SOMETHING WRONG WITH THIS PUBLICATION?**

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

| PUBLICATION NUMBER | PUBLICATION DATE | PUBLICATION TITLE |
|---|---|---|
| TM 55-1520-244-BD | 26 Nov 90 | Operators, AVUM and AVIM Maint Battlefield Damage Assessment and Repair for Hel Attack |

BE EXACT. PIN-POINT WHERE IT IS

| PAGE NO | PARA-GRAPH | FIGURE NO | TABLE NO | IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT: |
|---|---|---|---|---|
| | | | | |

PRINTED NAME GRADE OR TITLE AND TELEPHONE NUMBER

SIGN HERE

DA FORM 1 JUL 79 **2028-2**

PREVIOUS EDITIONS ARE OBSOLETE

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS

FILL IN YOUR
UNIT'S ADDRESS

FOLD BACK

TEAR ALONG PERFORATED LINE

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

Commander
US Army Aviation Systems Command
ATTN: AMSAV-MC
4300 Goodfellow Boulevard
St. Louis, MO 63120-1798

# 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 |

PIN: 064982-000