TECHNICAL MANUAL

AVIATION UNIT AND INTERMEDIATE MAINTENANCE

BATTLEFIELD DAMAGE ASSESSMENT AND REPAIR

FOR

ARMY
CH-47D HELICOPTER
(NSN 1520-01-088-3669) (EIC: RCD)

HEADQUARTERS, DEPARTMENT OF THE ARMY
15 APRIL 1997

WARNING

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

Warnings, cautions, and notes are used to emphasize important and critical instructions and are used for the following conditions:

WARNING

An operating procedure or practice, which, if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure or practice, which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE

An operating procedure or condition, which it is essential to highlight.

WARNING

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.

WARNING

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

WARNING

Dynamic components which have experienced sudden stoppage, overtemperature, overtorque, or overspeed shall be evaluated prior to reuse.

WARNING

Substitute or repair hoses must meet system pressure and fluid requirements.

WARNING

Adhesives and materials must be compatible with the system fluid.

WARNING

In all cases, it is preferable to replace the flight control rod rather than repair. Repairs should be made as a last resort for a one-time flight only.

WARNING

The standards contained in this manual are not applicable to CH-47D helicopters with the external stores support system (ESSS) installed.

CAUTION

All damage should be smoothed before detail evaluation is accomplished. Battle-damage should be smoothed when repair is to be deferred. Smoothing is mandatory for certain structures even for a one-time flight deferment.

NOISE

Sound pressure levels in this helicopter during some operating conditions exceed the Surgeon General 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 helicopter during its operation.

ELECTROLYTE

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

TOXIC POISONS

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.

HANDLING HYDRAULIC FLUID (MIL-H-83282)

Prolonged contact with liquid or mist can irritate eyes and skin. After any prolonged contact with skin, immediately wash contacted area with soap and water. If liquid contacts eyes, flush immediately with dear 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.

FIRE EXTINGUISHER

Exposure to high concentrations of monobromotrifluoromethane (CF3BR) 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 frostbite or low temperature bums.

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 dear of hazardous area of all loaded weapons.

FUELING AND DEFUELING

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 grounding chain of fuel truck ground wire into GROUND HERE receptacle located on the right side of the helicopter aft of the cabin area. 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.

RADIOACTIVE MATERIALS

Self-luminous dials and ignition units may contain radioactive materials. h 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 beg and dispose of it as radioactive waste in accordance with AR 755-15 and TM 3-261 (refer TB 43-0108). Repair procedures shall conform to requirements in AR 700-52.

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.

ROTOR BLADES

Personnel will stay dear of rotor blades during operation.

SANDING DUST

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

USE OF WORDS SHALL, SHOULD, AND MAY

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.

TECHNICAL MANUAL
NO. 1-1520-240-BD

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 15 APRIL 1997

AVIATION UNIT AND INTERMEDIATE MAINTENANCE

BATTLEFIELD DAMAGE ASSESSMENT AND REPAIR

FOR

ARMY CH-47D HELICOPTER (NSN 1520-01-088-3669) (EIC: RCD)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes, or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Aviation and Troop Command, ATTN: AMSAT-I-MP, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. You may also submit your recommended changes by E-mail directly to <daf2028@avma27.stl.army.mil>. A reply will be furnished directly to you. Instructions for sending an electronic 2028 may be found at the back of this manual immediately preceding the hard copy 2028.

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CHAPTER 1
GENERAL INFORMATION AND ASSESSMENT

SECTION I. GENERAL

1-1. INTRODUCTION. During the first few days of combat maximum aircraft availability is essential. Aircraft will sustain varying degrees of damage during combat operations. The damage must be assessed and repaired as quickly as possible. Maximum availability must be maintained for further sorties. In addition to the combat damage, aircraft will have higher component failure rates because of increased flying hours and higher stress levels. Aircraft combat maintenance battle-damage repair (ACM/BDR) is an operational concept for maintaining aircraft at a high level of readiness in combat. Peacetime maintenance procedures and methods must be modified to achieve this. One method will be to defer all but the most essential maintenance needed for the next scheduled mission. They will often be flown with nonessential components damaged, inoperative, or missing.

a. Scheduled Maintenance. There are no scheduled maintenance and inspections. However, necessary lubrication, servicing; and operational checks will not be deferred. When conditions permit, the “overflown" inspections will be completed. When expedient repairs are made on the aircraft or repair of damage is deferred, to ensure flight safety or mission accomplishment, it may be necessary to schedule inspections at subsequent flight hour intervals. Scheduled battle damage inspections of this type will not be deferred.

b. Unscheduled Maintenance. Repair of systems and subsystems which are not critical to mission accomplishment, may be deferred unless they might cause further damage. Items may be deferred even if it places operational limitations on the aircraft, as long as the restricted aircraft can accomplish designated missions and can contribute to the battle. Deferment of repairs for a one-time flight to a higher maintenance level, or for self-recovery from a combat area, is highly desirable. This eliminates the need for another aircraft to accomplish the recovery, or the loss of the aircraft if recovery is not available. The maintenance officer or assessor will make the decision based on an analysis of the overall situation and airworthiness of the aircraft.

c. Assessment. Aircraft which have battle damage will be inspected and classified by a damage assessor using a method similar to the medical concept of "triage." Following assessment some aircraft will be returned to service immediately through deferment. Other aircraft will be repaired using approved battle damage repair techniques. Those requiring extensive repair (4 to 24 hours) will be set aside and repaired as manpower and parts become available. Assessors will be trained to identify and assess damage and failed aircraft subsystems. They will learn isolation and repair methods and procedures and serviceability standards.

1-2. PURPOSE. This manual provides information and instructions for assessing and repairing battle damage to the Army CH-47D Chinook helicopter. The purpose of the manual is to assist the damage assessor in identifying and classifying aircraft battle damage, assessing the extent of damage, and determining if repair can be safely deferred. Methods of expedient battle-damage repair are also presented.

1-3. SCOPE. This manual is to be used to assess and repair battle damage to the CH-47D helicopter. It is intended for use by aviation unit maintenance (AVUM) and aviation intermediate maintenance (AVIM) personnel during combat operations, and for training of personnel. The procedures are to be used only during combat operations or during periods of extreme emergency. The commander determines when normal maintenance procedures may be deferred. Repairs are made using interim techniques, off-the-shelf standard hardware (not necessarily aircraft related), and without concern for appearance. As new repair procedures, materials, tools, and equipment become available they will be introduced and incorporated into this manual.

1-4. FORMS. RECORDS. AND RFPORTS.

a. 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.

b. Maintenance of Forms. Instructions for the maintenance of forms, records, and reports are listed in DA PAM 738-751 and TB 1-1500-341-01. When battle-damage repair (BDR) becomes necessary, the procedures in DA PAM 738-751 will apply.

(1) In the Fault Information block of the DA Form 2408-13-1 (See Figure 1-2) or 2408-13-3 (See Figure 1-4), list the fault.

(2) Enter the status symbol in the status block and complete all required parts of the Fault Information block.

(3) Update the status in the System Status block of DA Form 2408-13 (See Figure 1-1) if necessary.

(4) The individual completing the repair will complete all required parts of the Correcting Information block for the fault on the DA Form 2408-13-1 or 2408-13-3.

(5) Status symbols will be cleared per DA PAM 738-751.

(6) After completion of the repair update the current status in the System Status block of the DA Form 2408-13 if necessary.

(7) When DA Form 2408-13-3 is used, this form will become part of the Flight Pack

(8) DA Form 2408-13-2 (See Figure 1-3) will be used to document related maintenance actions needed to repair the fault.

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

(1) In the Correcting Information block for the fault entered on the DA Form 2408-13-1 or 2408-13-3, enter the corrective action taken and complete all required parts of the Correcting Information block

(2) In the next open Fault Information block reenter the fault entry and state that a temporary repair was made for the fault. If the temporary repair limits the capability of the aircraft, use a circled red "X" status symbol. Include the aircraft limitation in the fault entry.

(3) If the status of the temporary repair is a red diagonal "/", the entry may be reentered to the DA Form 2408-14-1 (See Figure 1-6).

(4) If the temporary repair requires an inspection at intervals, list the required inspection on DA Form 2408-18 (See Figure 1-5).

(a) Enter the 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.

(d) Enter when the next inspection is due in block 8.

1-5. QUALITY ASSURANCE AND QUALITY CONTROL. A trained assessor inspects and assesses battle damage and battle damage repairs. Evaluation of damage and recommendations for repairs are based on thorough knowledge of the aircraft. Technical guidance to repairers will be provided as necessary. Ideally, the unit aircraft technical inspectors will be used as BDR assessors. However, combat conditions may require the unit aircraft maintenance officer or the maintenance technician to assume this role. The pilot in command, with crew chief recommendations, may also be required to assess damage in critical situations. Therefore, these personnel must have a thorough knowledge of the aircraft an ACM/BDR.

1-6. BDR TOOLS AND MATERIALS. Battle-damage repair requires simplicity and speed. Authorized tools and materials shall be used where possible. With adequate precautions, AVUM or AVIM manufactured items can be used to expedite repairs. Cosmetic repair of the structure may be accomplished with field expedients such as green tape and nonaircraft materials. BDR techniques are limited only by safety considerations and the experience and skill of the repairman.

DATE _____ NUMBER OF PAGES IN FLIGHT PACK _____

1.. AIRCRAFT SERIAL NUMBER	2. MODEL	3. UIC	4. STATION	5. NAME OF CE/MECH

6 ENGINE HIT READINGS			7. APU HISTORY				8. ROUNDS FIRED AIR-FRAME	9. ENGINE STARTS	
DATE	NO. 1	NO. 2		HOURS	STARTS	HR METER		NO. 1	NO. 2
			CURRENT						
			TODAY						
			TOTAL						

10. SYSTEM STATUS								11. FLIGHT DATA				
ACFT									AIRCRAFT HOURS	LANDINGS		HSF/ CYCLES
										STD	AUTO	
								CURRENT				
ARM								TODAY				
ELECT								TOTAL				
OTHER												

12 SCHEDULED INSPECTION INFORMATION			
a. HOURS OF OPERATION SINCE LAST GENERATION	b. NEXT PHASE/SHEDULED INSP (NO.)	d. HOURS OF OPERATION TO NEXT PHASE/SCHEDULED INSPECTION	e. PMD DUE
	c. NEXT PHASE/SCHEDULED INSP DUE AT		DATE COMPLETED
			PID

13. LOCAL USE

DA FORM 2408-13, OCT 91 **AIRCRAFT STATUS INFORMATION RECORD**

EDITION OF DEC 66 IS OBSOLETE *U.S. GPO: 1992 — 311-630/50175 For use of this form, see DA PAM 738-751; the proponent agency is DCSLOG

Figure 1-1. DA Form 2408-13

1. AIRCRAFT SERIAL NUMBER	2. MODEL	3. DATE	4. PAGE

PART I - FAULT INFORMATION

	STATUS	SYS	DATE	NO.	TIME	PID

FAULT/REMARKS

A/C HRS	WHEN DISC	HOW REC	MAL EFF	WUC

W.O	REQ	OTHER

PART II - CORRECTING INFORMATION

DATE	TIME	HRS

ROUNDS	ACTION CODE	WUC

ACTION

PID	HOURS	PID	HOURS	PID	HOURS

CMH	OMH	FMH	DMH

TIPID	TI MAN-HOURS

	STATUS	SYS	DATE	NO.	TIME	PID

FAULT/REMARKS

A/C HRS	WHEN DISC	HOW REC	MAL EFF	WUC

W.O	REQ	OTHER

DATE	TIME	HRS

ROUNDS	ACTION CODE	WUC

ACTION

PID	HOURS	PID	HOURS	PID	HOURS

CMH	OMH	FMH	DMH

TIPID	TI MAN-HOURS

	STATUS	SYS	DATE	NO.	TIME	PID

FAULT/REMARKS

A/C HRS	WHEN DISC	HOW REC	MAL EFF	WUC

W.O	REQ	OTHER

DATE	TIME	HRS

ROUNDS	ACTION CODE	WUC

ACTION

PID	HOURS	PID	HOURS	PID	HOURS

CMH	OMH	FMH	DMH

TIPID	TI MAN-HOURS

DA FORM 2408-13-1, OCT 91

AIRCRAFT INSPECTION AND MAINTENANCE RECORD

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

Figure 1-2. DA Form 2408-13-1

DATE _____ Page _____

1 STATUS		2. SERIAL NUMBER	3. SYSTEM CODE	4. TIME
		5 FAULT DATE	6. FAULT NUMBER	

7 FAULT _____

# STA	9 FAULT	10. ACTION	11. PID	12. MMH

DA FORM 2408-13-2, NOV 91

RELATED MAINTENANCE ACTIONS RECORD

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

Figure 1-3. DA Form 2408-13-2

Page ____ of ____

AIRCRAFT TECHNICAL INSPECTION WORKSHEET

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

1. ORGANIZATION	2. NOMENCLATURE AND MODEL	3. SERIAL NUMBER	4. TYPE INSPECTION

PART I - FAULT INFORMATION	PART II - CORRECTING INFORMATION
STATUS / SYS / DATE / NO. / TIME / PID	DATE / TIME / HRS
	ROUNDS / ACTION CODE / WUC
FAULT/REMARKS	ACTION
	PID / HOURS / PID / HOURS / PID / HOURS
A/C HRS / WHEN DISC / HOW REC / MAL EFF / WUC	CMH / OMH / FMH / DMH
W.O. / REQ / OTHER	TIPID / TI MAN-HOURS
STATUS / SYS / DATE / NO. / TIME / PID	DATE / TIME / HRS
	ROUNDS / ACTION CODE / WUC
FAULT/REMARKS	ACTION
	PID / HOURS / PID / HOURS / PID / HOURS
A/C HRS / WHEN DISC / HOW REC / MAL EFF / WUC	CMH / OMH / FMH / DMH
W.O. / REQ / OTHER	TIPID / TI MAN-HOURS
STATUS / SYS / DATE / NO. / TIME / PID	DATE / TIME / HRS
	ROUNDS / ACTION CODE / WUC
FAULT/REMARKS	ACTION
	PID / HOURS / PID / HOURS / PID / HOURS
A/C HRS / WHEN DISC / HOW REC / MAL EFF / WUC	CMH / OMH / FMH / DMH
W.O. / REQ / OTHER	TIPID / TI MAN-HOURS
STATUS / SYS / DATE / NO. / TIME / PID	DATE / TIME / HRS
	ROUNDS / ACTION CODE / WUC
FAULT/REMARKS	ACTION
	PID / HOURS / PID / HOURS / PID / HOURS
A/C HRS / WHEN DISC / HOW REC / MAL EFF / WUC	CMH / OMH / FMH / DMH
W.O. / REQ / OTHER	TIPID / TI MAN-HOURS

FOD REMINDER: Check work area for tools and parts after completion of maintenance and inspection

DA FORM 2408-13-3, NOV 91

Figure 1-4. DA Form 2408-13-3

Page _____ of _____

1 NOMENCLATURE	2 MODEL	3 SERIAL NUMBER

4. INSP NO	5. ITEM TO BE INSPECTED	6. REFERENCE	7. FREQUENCY	8. NEXT DUE	9. COMPLETED AT

FREQUENCY LEGEND: H = ACFT HRS D = DAYS M = MONTHS Y = YRS R = ROUNDS C = CYCLES S = STARTS

DA FORM 2408-18, NOV 91

EDITION OF JAN 64 IS OBSOLETE

EQUIPMENT INSPECTION LIST

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

Figure 1-5. DA Form 2408-18

PAGE _____ of _____

1. NOMENCLATURE		2. MODEL	3. SERIAL NUMBER		
4. STATUS SYMBOL	5. FAULT DATA	6. REASON FOR DELAY	7. DATE FROM 2408-13-1	8. APPROVED BY	9. DATE TO 2408-13-1
	a. SYSTEM _____ b. FAULT DATE _____ c. FAULT NO. _____ d. FAULT _____				
	a. SYSTEM _____ b. FAULT DATE _____ c. FAULT NO. _____ d. FAULT _____				
	a. SYSTEM _____ b. FAULT DATE _____ c. FAULT NO. _____ d. FAULT _____				
	a. SYSTEM _____ b. FAULT DATE _____ c. FAULT NO. _____ d. FAULT _____				
	a. SYSTEM _____ b. FAULT DATE _____ c. FAULT NO. _____ d. FAULT _____				

DA FORM 2408-14-1 UNCORRECTED FAULT RECORD AIRCRAFT

Figure 1-6. DA Form 2408-14-1 (Sheet 1 of 2)

4. STATUS SYMBOL	5. FAULT DATA	6. REASON FOR DELAY	7. DATE FROM 2408-13-1	8. APPROVED BY	9. DATE TO 2408-13-1
	a. SYSTEM _____ b. FAULT DATE _____ c. FAULT NO. _____ d. FAULT _____				
	a. SYSTEM _____ b. FAULT DATE _____ c. FAULT NO. _____ d. FAULT _____				
	a. SYSTEM _____ b. FAULT DATE _____ c. FAULT NO. _____ d. FAULT _____				
	a. SYSTEM _____ b. FAULT DATE _____ c. FAULT NO. _____ d. FAULT _____				
	a. SYSTEM _____ b. FAULT DATE _____ c. FAULT NO. _____ d. FAULT _____				

REVERSE OF DA FORM 2408-14-1

Figure 1-6. DA Form 2408-14-1 (Sheet 2 of 2)

1-7. TERMS AND DFFINITIONS. There is a variety of special terms and definitions used with battle-damage assessment and repair. The reader should familiarize himself with the terms in the Glossary before continuing.

NOTE

Many of the illustrations in this manual are in the form of schematics. They are intended to show the principal features of airframe structure and are not always accurate in scale or detail of design. Features of a structure are often enlarged to aid in understanding the instructions given in the manual. The assessor should have no difficulty comparing the illustrations with the airframe structures they represent. However, the assessor is responsible to interpret the illustrations for detail not shown and features not drawn to scale.

SECTION II. BATTLE-DAMAGE ASSESSMENT CONCEPTS

1-8. BATTLE-DAMAGE ASSESSMENT.

a. BDR Assessor. Trained assessors will assess aircraft battle damage. Their training, technical knowledge, and the use of ACM/BDR manuals are the foundation of the ACM/IBDR concept. Assessment is used to determine which aircraft need expedient repair, which can be flown with only minor attention, and which cannot be repaired in time to meet combat requirements. The objective is to return the maximum number of aircraft to a flyable condition. It may be determined that aircraft cannot be made flyable within time and/or manpower constraints. In this case they may be source of repair parts.

b. Personnel Qualifications. Battle-damage assessors must have a minimum aviation skill equivalent to a MOS 66 series technical inspector and appropriate 67 series MOS. Assessors must have successfully completed training in battle-damage assessment. Additional assessors may be aircraft maintenance officers (15T) and technicians (100G and 151A) who have completed the Aircraft Maintenance Officer Course (Phase II). They must also be assigned to aircraft maintenance positions.

1-9. ASSESSOR RESPONSIBILITIES. The assessors' primary responsibilities are to evaluate damage and determine repairs needed to quickly return aircraft to operational service. Resources must not be wasted on aircraft which cannot be repaired within specified time limits. Assessors will determine the requirements for and sequence of repairs. They establish an estimated time to complete repairs by skill. They also coordinate with the maintenance authority to establish an estimated time of availability.

a. AVUM Level. At the level, the assessor may seek assistance from specialist on various aircraft systems. However, the assessor is responsible for the assessment and recommendations given to the maintenance authority. The maintenance authority determines the priority for repairs.

b. Field Recovery Site. At the field recovery site, the assessor evaluates aircraft damage. He also recommends repairs to the maintenance authority. The maintenance authority decides what repairs can be made under the immediate tactical situation.

c. Restrictions. The assessor assist the maintenance authority in determining what restrictions must be placed on the aircraft because of BDR.

d. Repair Priority. When the assessment is complete, the maintenance authority determines the priority in which aircraft will be repaired based on the assessors' reports.

SECTION III. COMBAT THREATS

1-10. THREAT DESCRIPTION. The primary threats confronting Army helicopters in combat include the armor-piercing (AP) and armor-piercing-incendiary (API) projectiles, the high-explosive-incendiary (HEI) projectiles, and several types of ground-to-air and air-to-air missiles. Nuclear, biological, and chemical (NBC) warfare also poses a threat to the successful accomplishment of the aviation mission. In addition to the threats helicopters may encounter in flight, they will be exposed to damage by bombs, mortars, and artillery while on the ground.

1-11. ARMOR-PIERCING AND ARMOR-PIERCING INCENDIARY PROJECTILES. AP and API projectiles will cause most of the damage. These projectiles consist of a hard tough core, designed for maximum penetration The API projectile also has a thermally active filler. The active filler is located in front of the passive core. Upon impact, the core penetrates the outside of the target. This gives the projectile a fire-starting capability if flammable materials are present.

a. Armor-Piercing Projectile. The damage caused by an armor-piercing projectile depends on its mass, velocity, and angle at impact. The primary damage is caused by the penetrator.

b. Armor-Piercing-Incendiary Projectile. API projectiles can cause major damage to an aircraft if the fuel cells are penetrated. Bulging or rupturing of the fuel cell walls and surrounding structures can be caused by hydraulic ram effects. The incendiary mechanism can result in fire and explosions. Intense heat from fires may reduce the temper and strength of surrounding metals.

1-12. HIGH-EXPLOSIVE-INCENDIARY PROJECTILES. HEI projectiles will create much greater repair problems. The HEI projectile consists of a fuse mechanism, explosive charge, tracer element, and an outer casing (Figure 1-7).

a. Fuses. Two types of fuses are used: time-delay and proximity. The time-delay fuse is activated when the projectile strikes a surface, delaying detonation of the charge for varying lengths of time. The proximity or point detonation fuses are activated and detonation occurs upon or just prior to contact with the target. Detonation causes the shell casing to rupture. The projectile breaks into fragments and accelerates them to high velocities. The velocity of the projectile added to the velocity of the fragments caused by the explosive charge focus the fragments into a cone (Figure 1-8). In addition to fragments, the explosive charge produces a shock wave which travels above the speed of sound initially ahead of the accelerating fragments. Structures close to the point of detonation are stressed by the shock wave and overpraises before the fragments impact. The damage mechanisms associated with the point detonation or proximity-fused HEI are basically the same as the time-delayed fused HEI. The exception is that the blast and fragmentation effects occur at the target surface and continue into the interior structure. Overpressure effects are generally less severe because the explosion does not take place inside the fuselage.

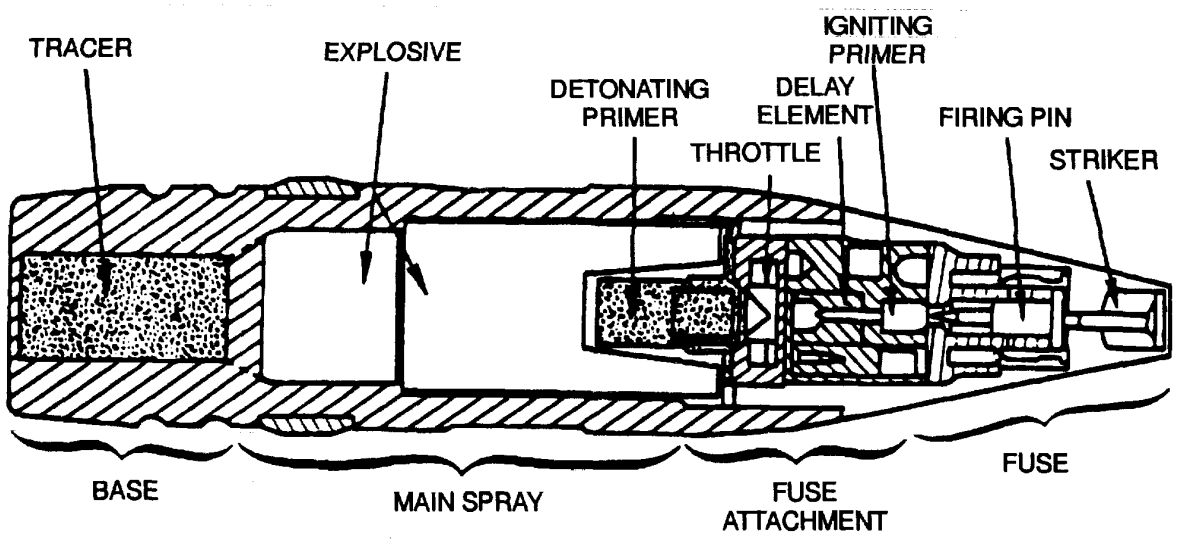
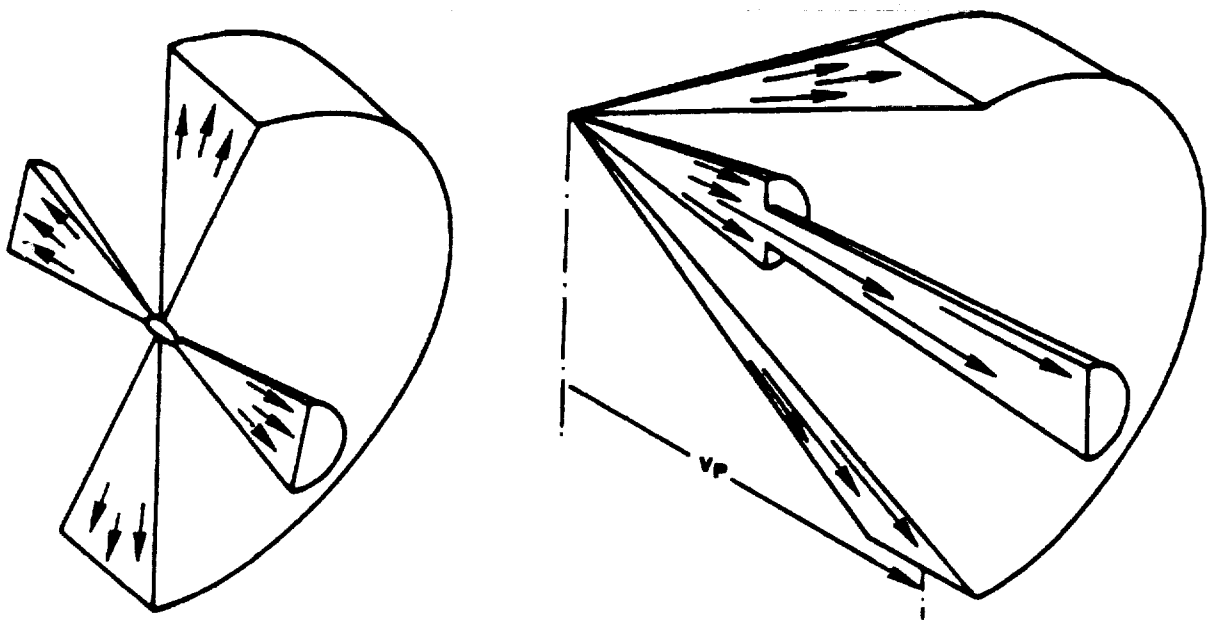


Figure 1-7. Typical HEI Projectile



(A) STATIONARY PROJECTILE (B) PROJECTILE WITH VELOCITY V_P

Figure 1-8. Fragmentation Patterns Associated with a Typical HEI Projectile

b. Effects. The effect of an HEI impact on metal airframe structure depends on the fuse mechanism and the configuration of the structure. For light skin and stringer construction, the delay-fused projectile normally produces a relatively clean penetration on the entry side. In an empty enclosed structure such as a tailcone, exploding fragments penetrate the opposite skin and produce massive damage. Total disintegration occurs in the path of the large, closely-spaced, high-energy fragments directly ahead of the projectile. Flying fragments cause numerous penetrations in the surrounding structure. Shock wave and overpressure effects produce tearing and distortion of the metal. When the HEI projectile strikes major structures such as frames and beams, damage may include the loss of large sections of material and budding and distortion of the structure. In case where the projectile impacts a thin light structure such as a tail fin, complete penetration may occur before the explosion takes place. This will greatly diminish the damage sustained.

1-13. NBC WARFARE The primary countermeasure to the NBC threat must be the ability to continue ACM/BDR while subjected to attack. Flight and ground support personnel, must be constantly aware of the effects the NBC weapons can have on their operations. Personnel must be familiar with detection and decontamination techniques, protective clothing, and equipment. The standard decontaminates and decon procedures currently used with ruin many types of aviation equipment and materials. However, simple common sense measures can be used to avoid becoming contamination. During inspections, battle-damage repair and cannibalization actions maintenance personnel must wear NBC protective clothing and must partially decontaminate work areas and components. Use of JP-4, hot soapy water, or a decontaminate will suffice. No guidelines exist on which decontaminants can be used on specific components.

1-14. THREATS ON THE GROUND. Aircraft on the ground may be exposed to mortars, bombs, and artillery. Direct hits or hits near the aircraft will probably damage the aircraft beyond repair. Damage which can be repaired may occur when a device explodes some distance away, and the aircraft is struck by fragments and blast. Fires may also cause damage.

1-15. STRUCTURE DAMAGE MODES.

a. Projectile Damage. The principal airframe damage modes are defined in Table 1-1. The most frequent damage is caused by ballistic projectiles. The projectiles include solid penetrators such as:

- AP and API rounds.
- Various-size fragments from the HEI threat.
- Larger metal fragments from bombs, missiles, and artillery.

These projectiles travel at high velocity and may have great mass. The kinetic energy allows them to penetrate deeply into airframe structures, causing much damage. Damage caused by these projectiles will be complete penetration in the form of holes and section losses. Ricochets cause spalls and gouges. The stress of the impact may cause cracks. Solid projectiles and fragments may also be imbedded in structures. Petalling is a form of damage caused by projectiles when they penetrate thin skins, causing the metal to tear and deform.

b. Blast and Overpressure Damage. HEI explosive threats pose hazards in addition to projectile damage. The explosive blast may prestress structures causing them to buckle, cripple, and misalign. Separation of joints and loss of mechanical fasteners may also appear. When an explosion occurs within enclosed sections of the airframe, it causes an overpressure which may overstress structures and produce structural deformation.

c. Fire Damage. API and HEI incendiary threats have a fire-starting capability if flammable materials are present. Intense and prolonged heat may weaken and damage structural materials. High temperatures reduce the hardness of metals, reducing their strength and stiffness. Metal may melt under extreme heat. Heat damaged metals may yield and crack under the continued stress of flying.

d. Secondary Damage. All of the damage modes described above are the direct result of combat. When damage to the aircraft causes one or more structural parts to become unserviceable, the remaining parts may be overstressed and damaged as the aircraft continues its flight. This secondary damage may be in the form of cracks, crippling, or buckling and loss or damage to mechanical fasteners. Secondary damage may happen away from the site of the original battle damage. This will depend on how the stress loads are redistributed in the structure when parts are removed or are unserviceable.

SECTION IV. BATTLE-DAMAGE ASSESSMENT

1-16. DAMAGE ASSESSMENT PROCEDURES. In peacetime, flight safety requires restoring damaged structure to its original condition. Consideration is given to strength, corrosion protection, and cosmetic appearance. Repairs are devised by the aircraft engineering authority where expert advice is available and times is not a critical factor. During combat, damage will be quite different, as will the repairs. Time will be of the essence, and the engineering authority and advice will not be available. Sufficient strength to maintain operational flying is the primary concern of the assessment and repair. In some aircraft, extensive damage may require little work; in others the smallest crack could be catastrophic. When a damaged aircraft is flown, it can be assumed that some structural strength is still present. However, this does not necessarily mean that there is sufficient strength remaining to carry out the next sorties as additional weight of fuel and armament must be considered. An assessor must bring together the facts concerning the damage, the role the aircraft has to fulfill, and the repairs necessary for the aircraft to carry out its next sortie. Damage assessment markings are shown in Figure 1-9.

a. Use of Logic Trees. Simplified logic trees are provided in each chapter of this manual to aid the assessor.

b. Figure 1-10 is an example of an overall systematic check logic diagram that the assessor may use during an aircraft battle damage inspection.

DAMAGE ASSESSMENT MARKINGS

MARKINGS	REPRESENTS DAMAGE  MEANINGS
	TO INDICATE DAMAGE HAS BEEN ASSESSED AND EVALUATED: DRAW A CIRCLE AROUND THE DAMAGE.
	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.
	TO INDICATE DAMAGE TO SYSTEMS REQUIRING REPAIRS: DRAW A SERIES OF "CURLEY CUE" LINES ABOUT 1/4 TO 1/2 WAY AROUND THE INITIAL CIRCLE.
	A LARGE CROSS DRAWN THROUGH THE INSTRUCTION MARKINGS INDICATES REPAIRS HAVE BEEN MADE.
	TO INDICATE REPAIR INSTRUCTIONS APPLY TO INTERNAL DAMAGE: DRAW A DASHED CIRCLE AROUND THE REPAIR INSTRUCTIONS. **NOTE** **WRITTEN INSTRUCTIONS WITH NO CIRCLES APPLY TO EXTERNAL DAMAGE.**
	TAG

Figure 1-9. Damage Assessment Markings (Sheet 1 of 3)

WRITTEN INSTRUCTIONS	MEANING
See me- (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 abbreviations 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 limits 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 Sheet 1 of this figure 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.
OK	No repairs required.
Tag	Repair instructions are written on tags tied to individual damaged lines/ components.

Figure 1-9. Damage Assessment Markings (Sheet 2 of 3)

System identification markings are primarily abbreviations of the system.

MARKINGS	MEANING
Sys	Damage to unknown system
Fuel	Fuel
Hyd	Hydraulic
HP	High Pressure
LP	Low Pressure
Elect	Electrical
AV	Avionics
Flt Cont	Flight Control
Fwd Rotor	Forward Rotor Group
Aft Rotor	Aft 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
El	Ejection

NOTE

More than one identification marking may be used to describe the system, ie, HP, Hyd.

Figure 1-9. Damage Assessment Markings (Sheet 3 of 3)

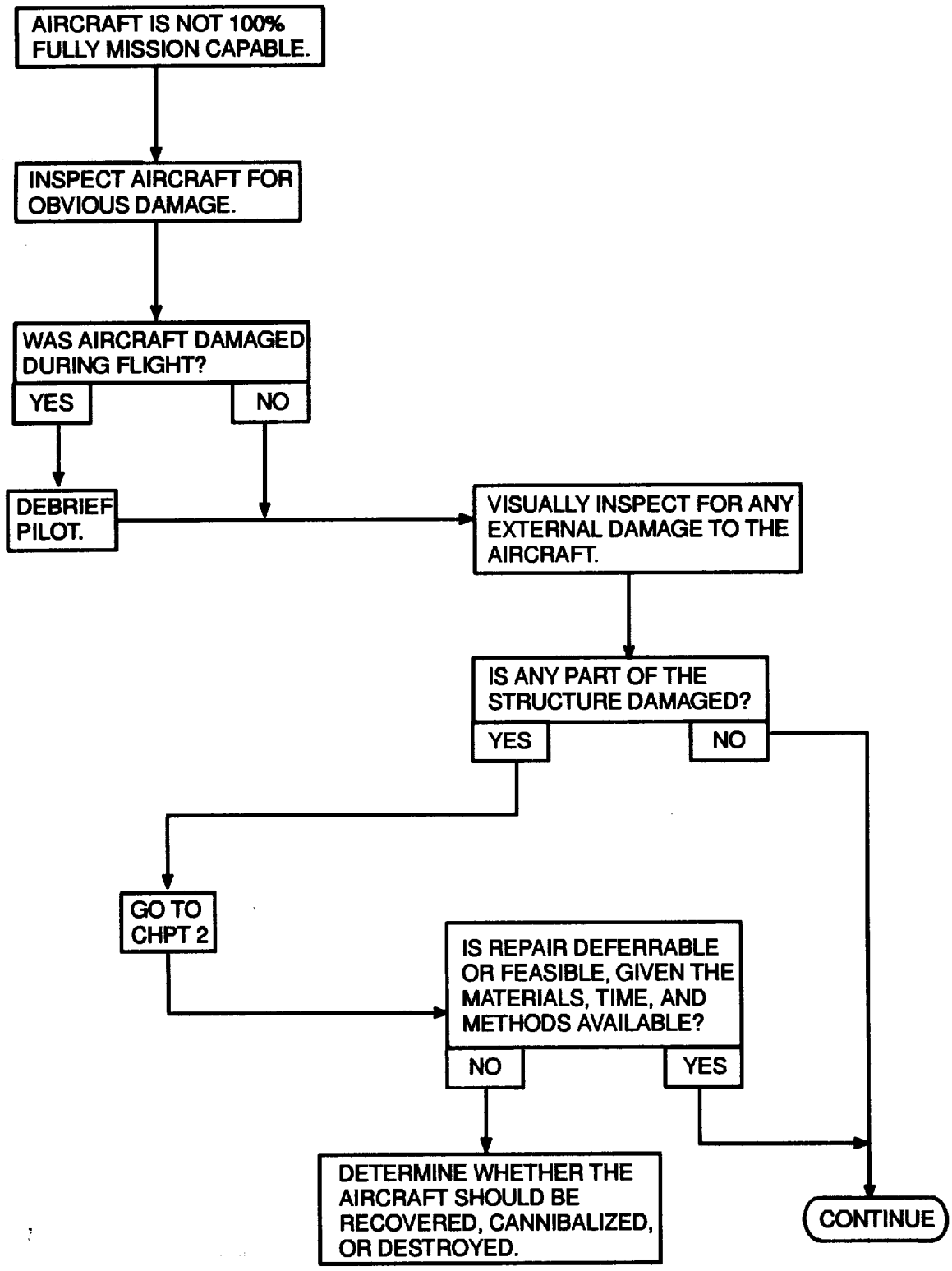


Figure 1-10. General Assessment (Sheet 1 of 7)

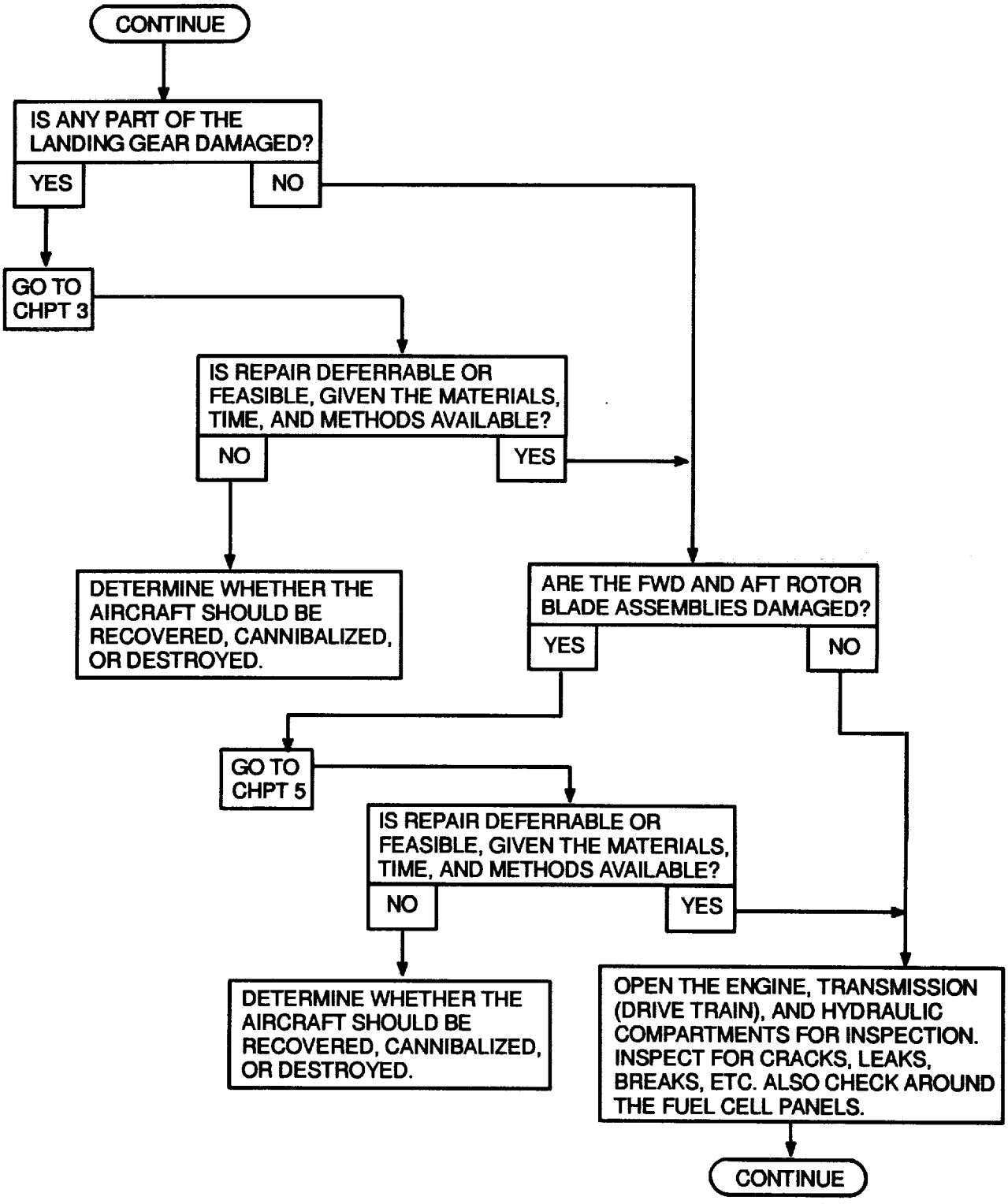


Figure 1-10. General Assessment (Sheet 2 of 7)

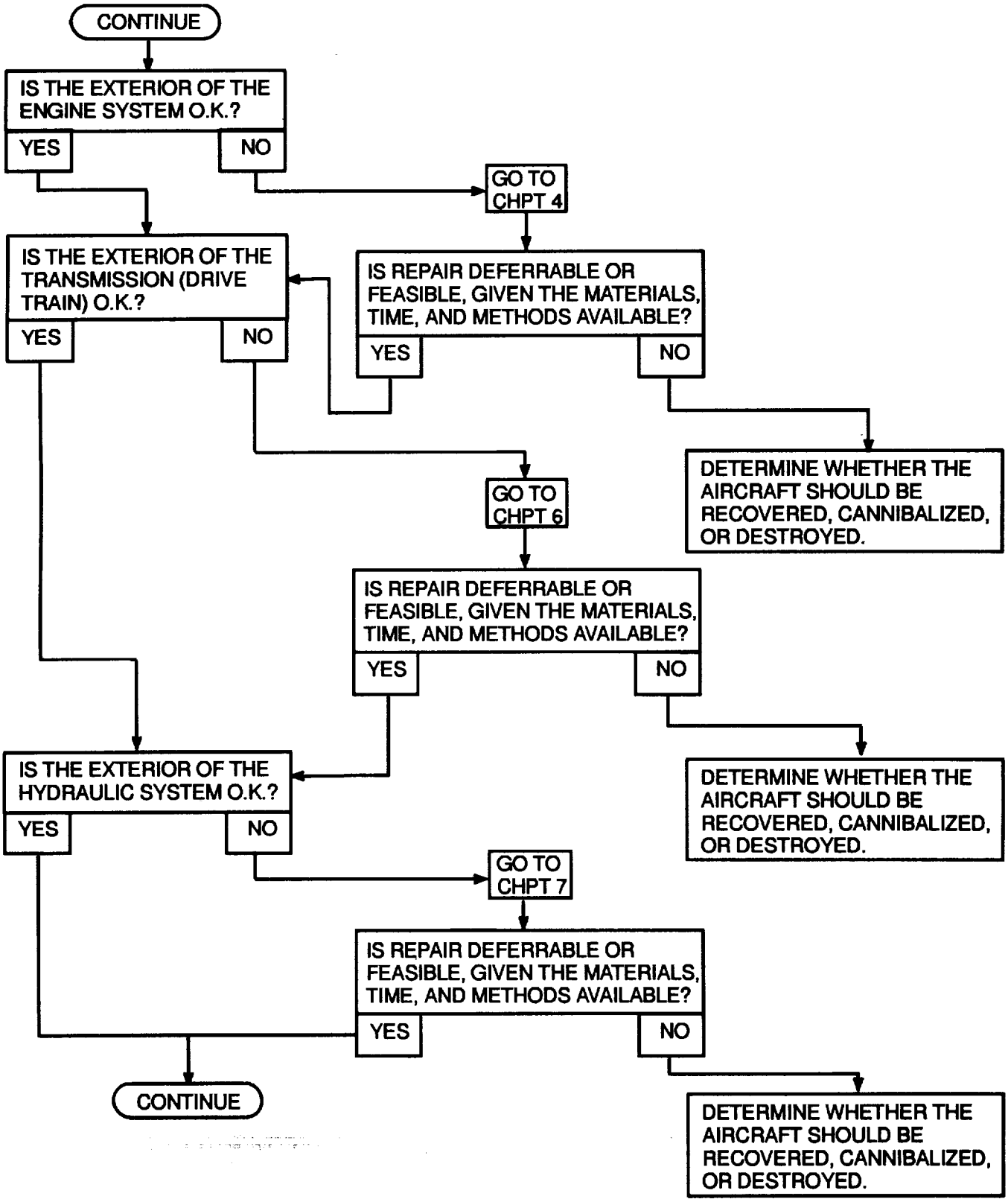


Figure 1-10. General Assessment (Sheet 3 of 7)

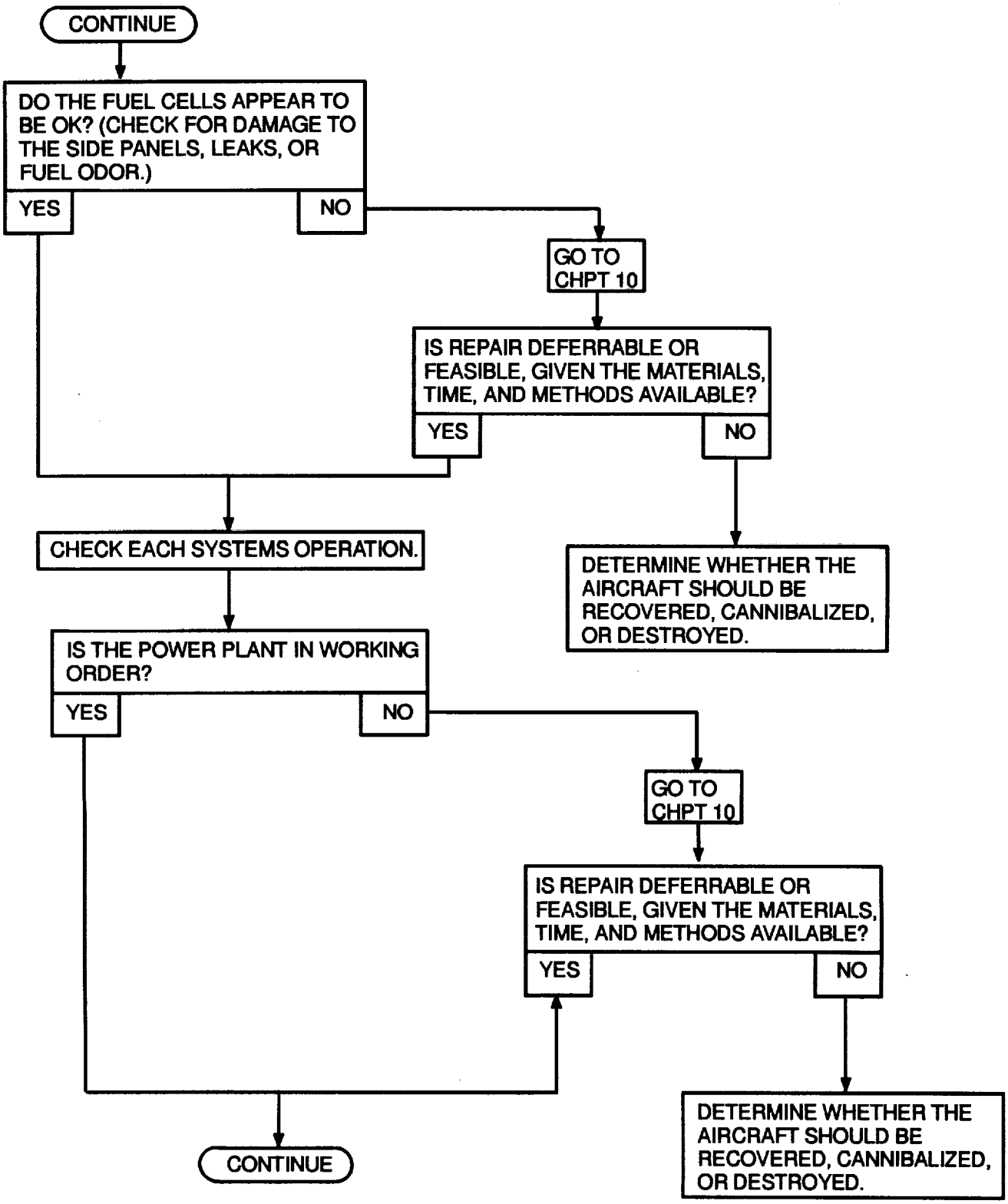


Figure 1-10. General Assessment (Sheet 4 of 7)

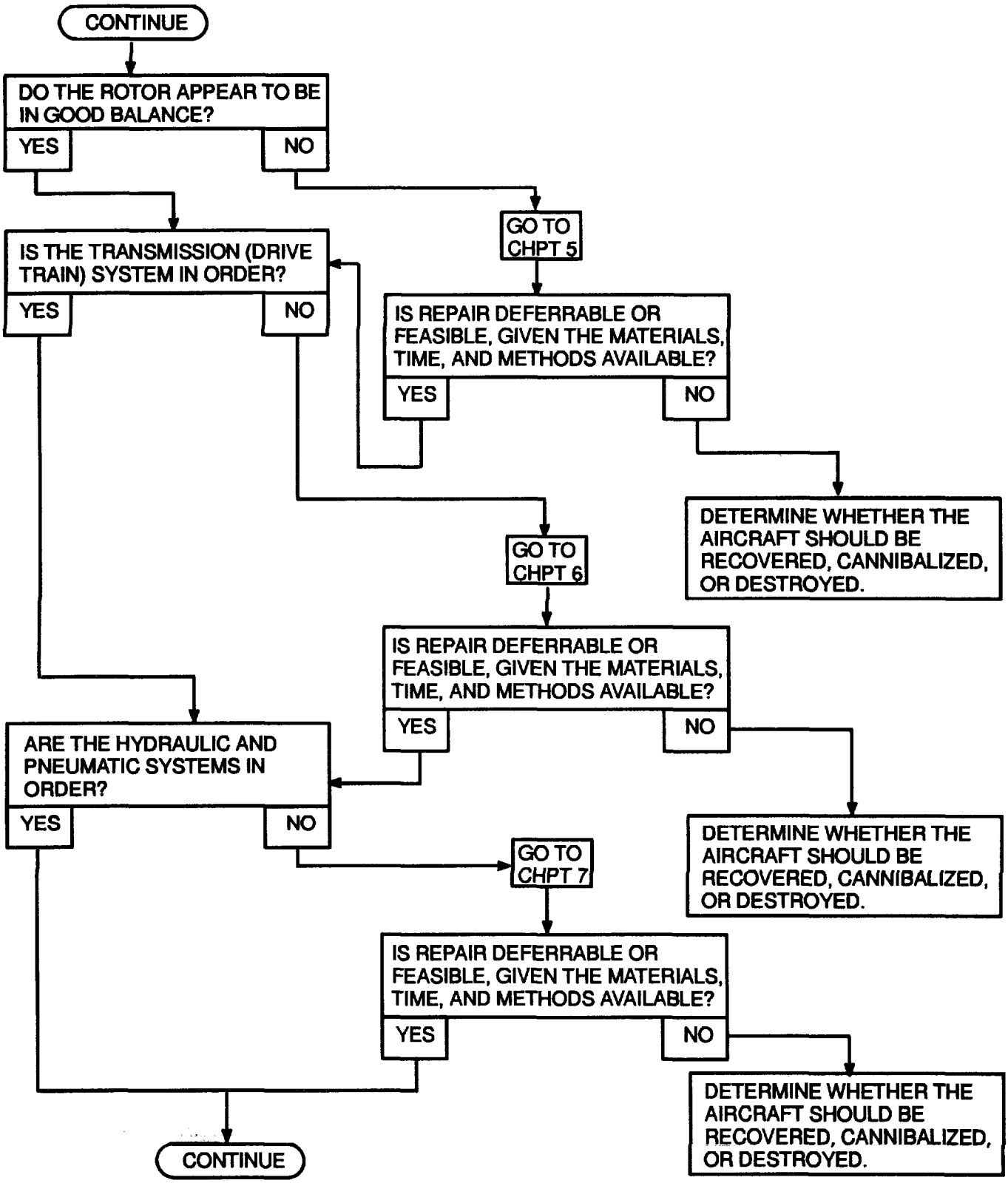


Figure 1-10. General Assessment (Sheet 5 of 7)

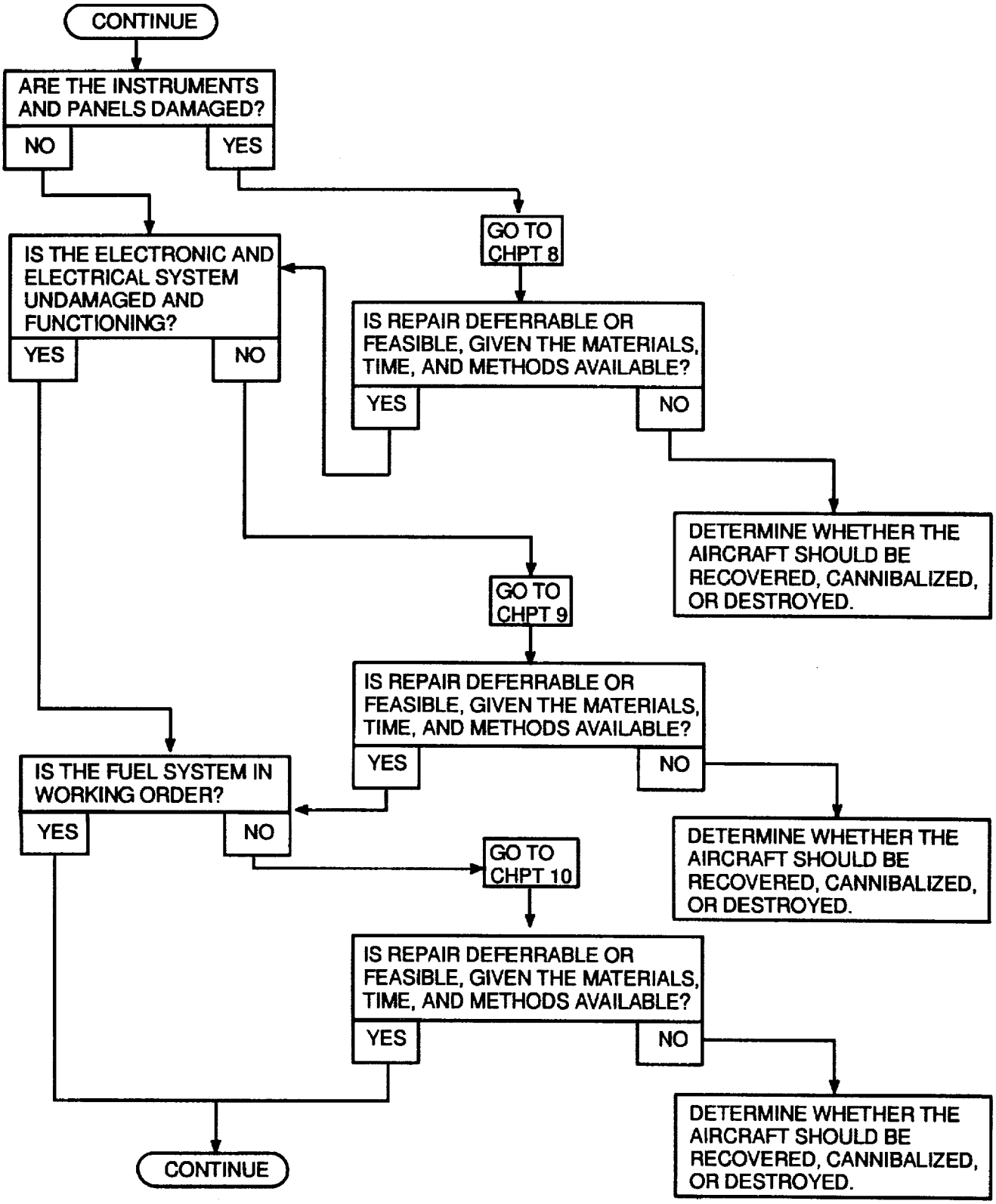


Figure 1-10. General Assessment (Sheet 6 of 7)

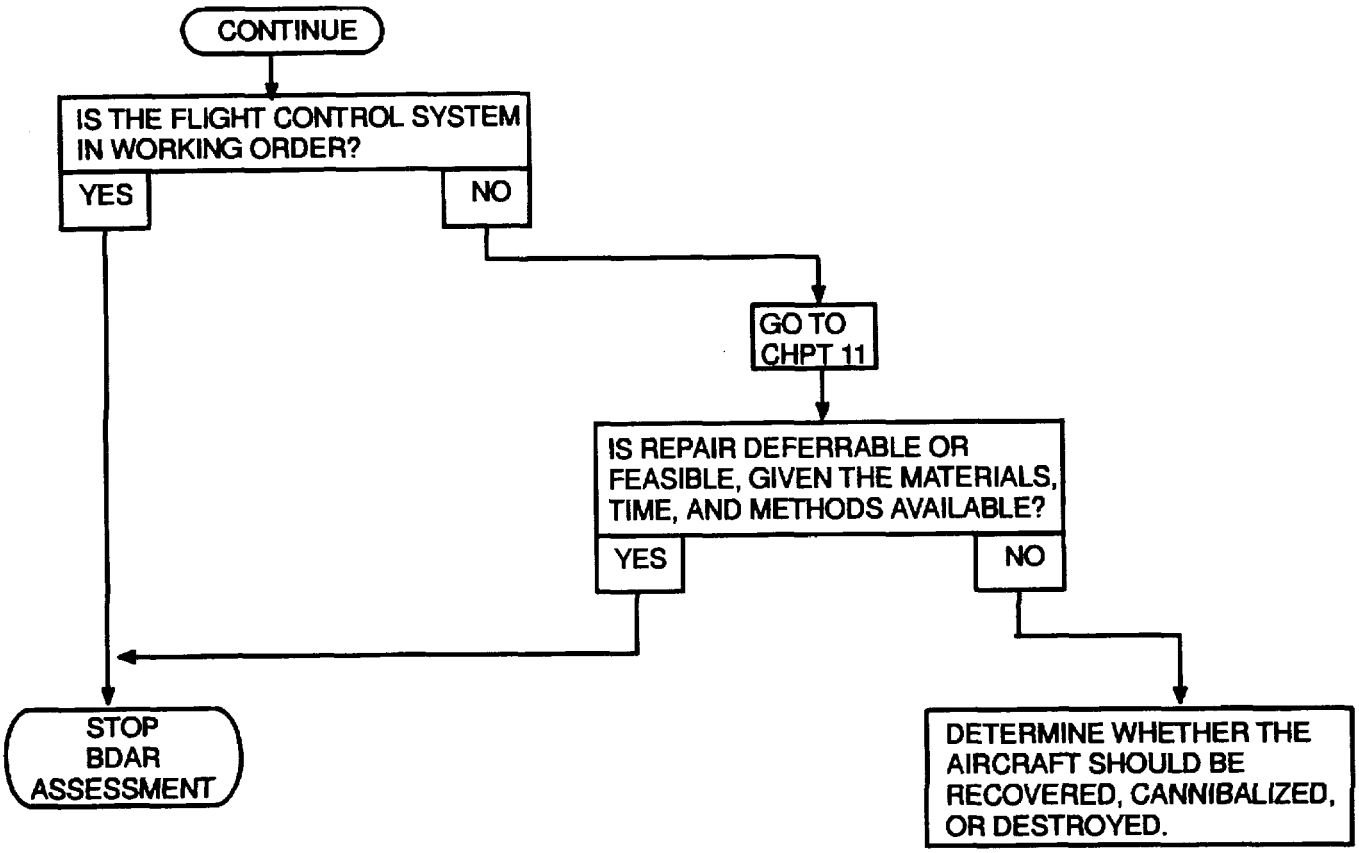


Figure 1-10. General Assessment (Sheet 7 of 7)

Table 1-1. Ballistic Damage Modes

DAMAGE MODE	ALTERNATE DESCRIPTIONS	DEFINITION	TYPES OF MATERIALS AND STRUCTURES AFFECTED
BREAK		GAP OR OPENING IN A WELD OR BONDLINE.	WELDMENTS: BONDED COMPONENTS.
BUCKLE	BEND, KINK, COLLAPSE, CRIPPLE, DISTORTION	DEFORMATION CAUSED BY A COMPRESSIVE OVERLOAD (USUALLY AXIAL) WHICH CAUSES THE MATEIRIAL TO BE PERMANENTLY DISPLACED FROM ITS NATURAL SHAPE OR FORM.	LIGHT, AXIALLY LOADED MEMBERS SUCH AS STIFFENERS AND STRINGERS.
CRACK	FRACTURE	A NARROW BREAK OR FRACTURE IN THE SURFACE OR THROUGH THE MATERIAL.	ALL BRITTLE MATERIALS INCLUDING METALS, COMPOSITES, AND PLASTICS.
CRUSHED	COLLAPSED	DEFORMATION CAUSED BY A COMPRESSIVE OVERLOAD (USUALLY TRANSVERSE) WHICH CAUSES THE MATERIAL TO BE PERMANENTLY DISPLACED FROM ITS NATURAL SHAPE OR FORM.	SANDWICH PANELS AND LIGHT STRUCTURES SUCH AS FAIRINGS.
DEBONDED .		SEPARATION OF AN ADHESIVE BONDLINE	BONDED COMPONENTS SUCH AS SANDWICH PANELS.
DENT		AN INDENTATION OR DEPRESSION WHICH DOES NOT RUPTURE THE MATERIAL.	ALL MATERIALS WHICH YIELD (PLASTICALLY DE- STRESS, ESPECIALLY LIGHT METAL SKINS.
FASTENER DAMAGE		SHEARED, STRIPPED, LOOSE, OR MISSING FASTENERS.	ALL MECHANICALLY ASSEMBLED COMPONENTS.
FRETTING	WEAR SCORING	REMOVAL OR SCORING OF THE SURFACE OF THE MATERIAL CAUSED BY FRICTION FORCES.	ALL MECHANICALLY ASSEMBLED COMPONENTS WHICH EXPERIENCE RELATIVE MOVEMENT BETWEEN FAYING SURFACE.
GOUGE	GROOVE	A GROOVE, CHANNEL, OR CAVITY SCOOPED OR CUT FROM THE SURFACE OF THE MATERIAL.	PRIMARILY THICK, RELATIVELY SOFT MATERIALS SUCH AS CASTINGS.
HOLE	PUNCTURE PENETRATION	AN OPENING OR CAVITY IN OR THROUGH THE MATERIAL.	ALL MATERIALS AND STRUCTURES.

Table 1-1. Ballistic Damage Modes (Continued)

DAMAGE MODE	ALTERNATE DESCRIPTIONS	DEFENITION	TYPES OF MATERIALS AND STRUCTURES AFFECTED
PETALLING		JAGGED MATERIAL AROUND A HOLE THAT IS CURVED BACK FROM THE SURFACE PLANE IN PETAL-LIKE FASHION. (ASSOCIATED WITH PE-NETRATION DAMAGE TO SHEET METAL PANELS.	SHEET METAL PANELS, WEBS, AND BULKHEADS.
SPALL	CHIP	A CHIP OR FRAGMENT REMOVED FROM THE SURFACE OR EDGE OF THE MATERIAL, USUALLY ON THE BACK SURFACE OF A PART THAT HAS BEEN BALLISTICALLY PENE-TRATED.	PRIMARILY THICK METAL COMPONENTS SUCH AS FORGINGS AND CASTINGS.
TEAR	SPLIT	A JAGGED, IRREGULAR SPLIT OR RUPTURE IN THE MATERIAL SKIN PANELS.	PRIMARILY LIGHT METAL COMPONENTS SUCH AS

CHAPTER 2
AIRFRAME

SECTION I. INTRODUCTION

2-1. SCOPE.

a. This chapter contains methods for assessing battlefield damage to the primary structure of the CH-47D 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.

2-2. ASSESSMENT PROCFDURERS. 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 2-1.

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 TM 1-1520-240-BD 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

- **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.**

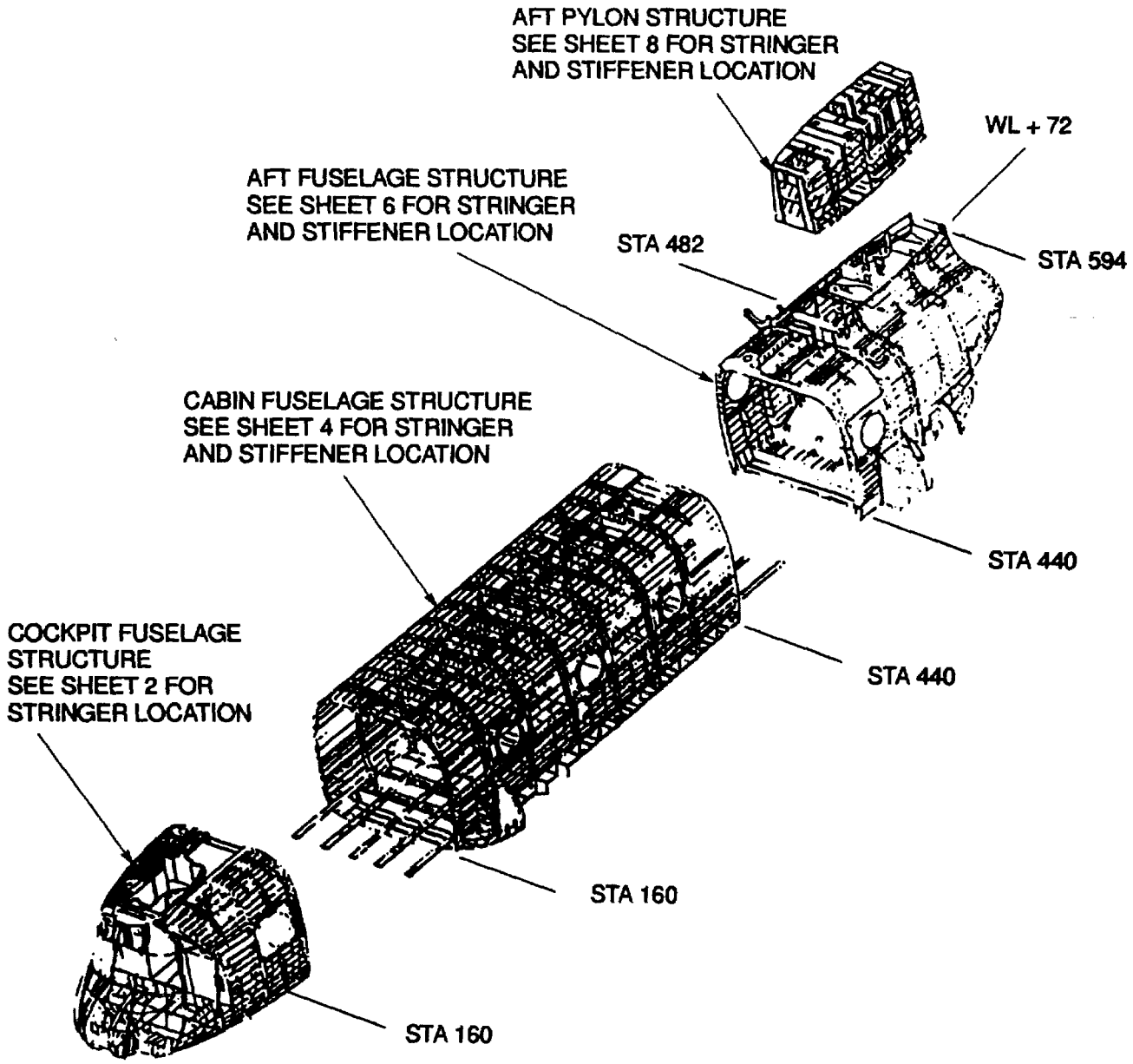


Figure 2-1. Basic Structure

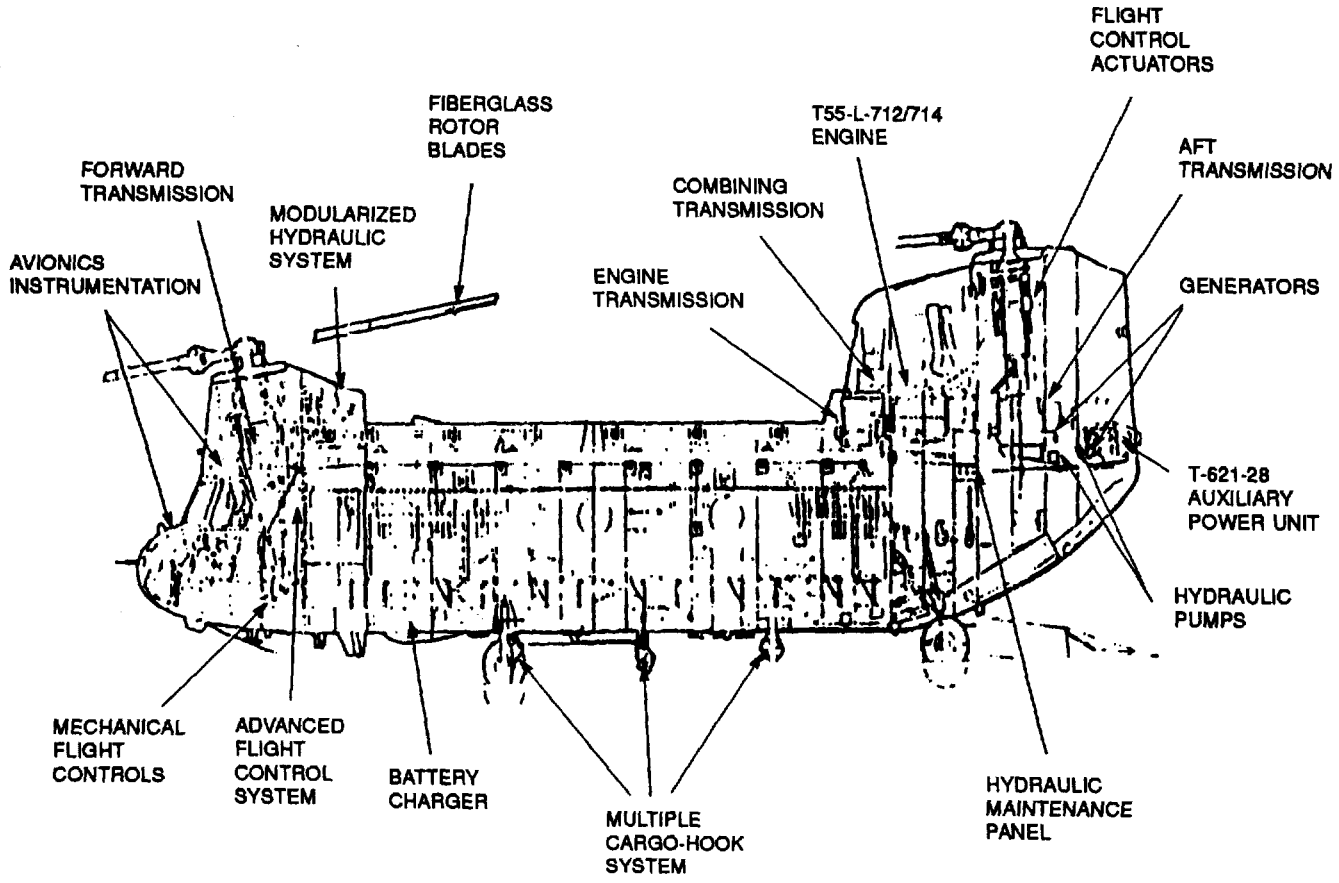


Figure 2-2. Inboard Profile

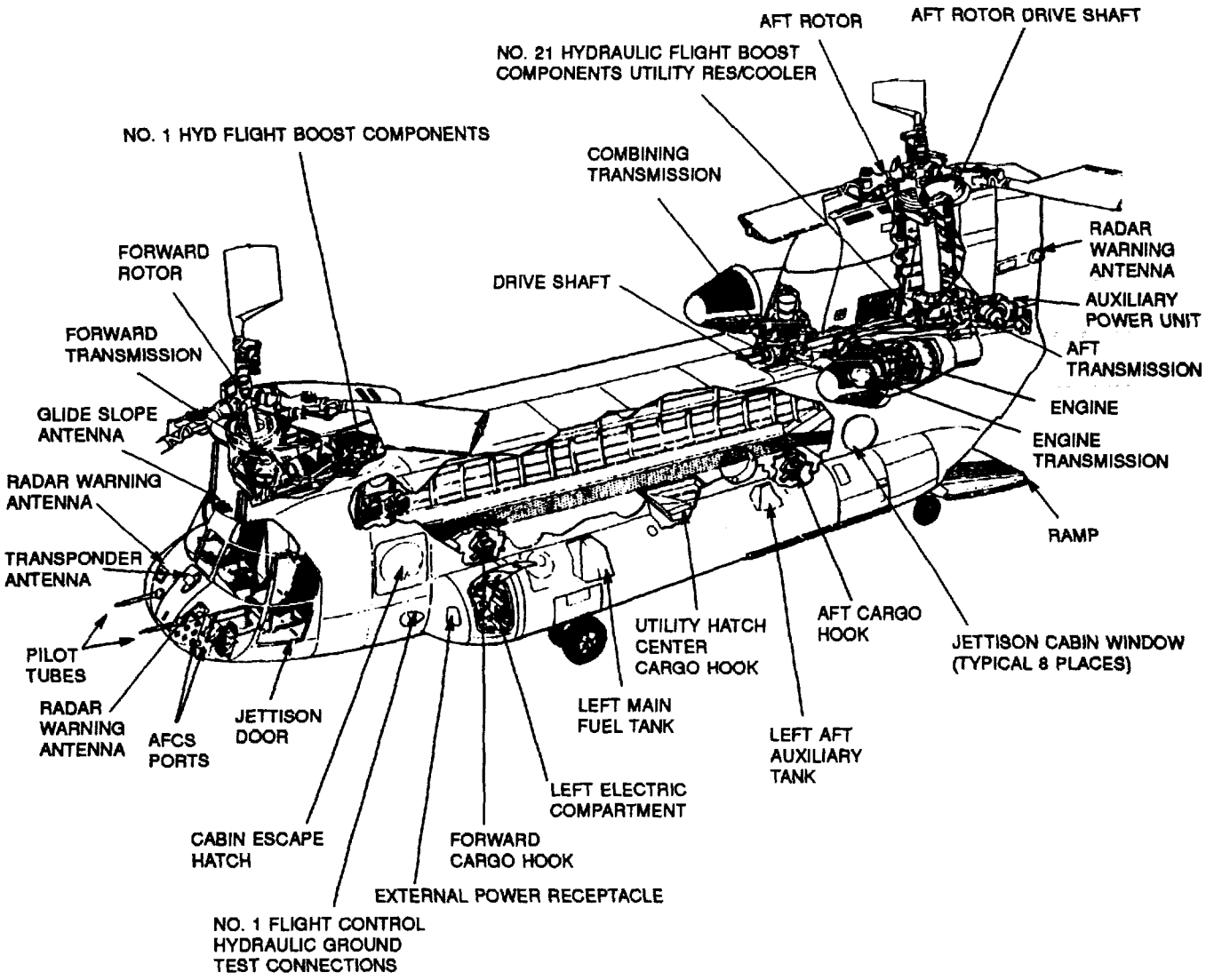


Figure 2-3. General Arrangement

a. Initial Assessment. Refer to Table 2-1. 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.

(2) Inspecting for Cracks.

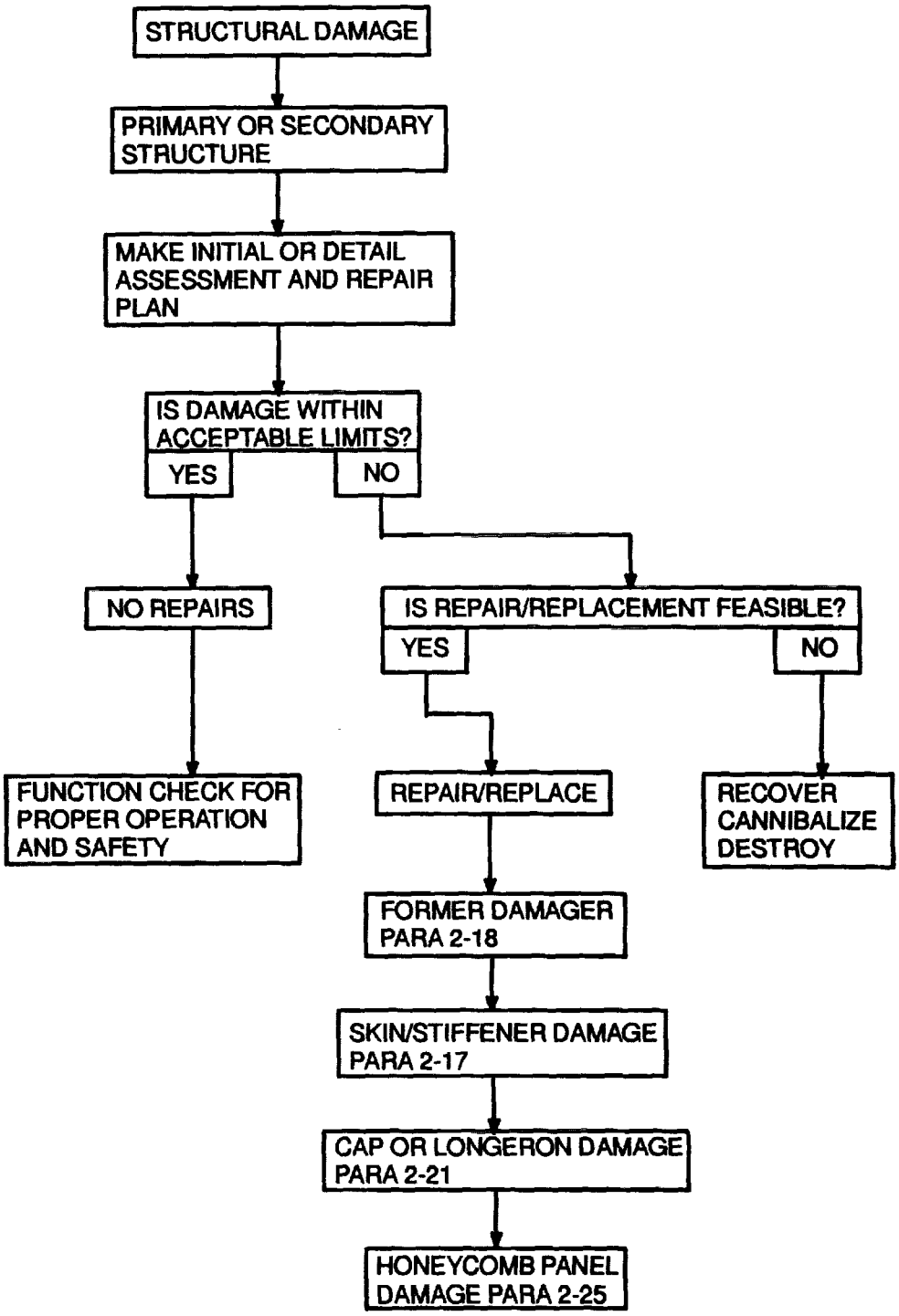
(a) Impact Cracks. Cracks may be caused by projectile impact or penetration. They may also be caused as a direct result of blast pressures. Battle damaged elements carrying reduced loads will place more severe loads on surviving members and may also produce cracks. When cracks are a result of these last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

(b) Projectile Damage Site Cracks. Cracks will primarily be found at the site of the projectile damage. Holes, spalls, and gouges caused by ricochets and embedded particles will often have cracks associated with them. These may be large and visible or hairline microscopic. Small cracks may be as critical as large cracks because then 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 (HIFI) 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.

Table 2-1. Structure Damage Assessment Procedures



(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 and 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 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 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 2-4.

(5) Inspecting for Fire Damage.

(a) Armor Piercing Incendiary (API) and HFI 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 dearly 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.

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	CORRECTIVE ACTION d	INITIAL WHEN CORRECTED e

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

Figure 2-4. DA Form 2404

(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.

(b) Riveted and Bolted Joints. Inspect all riveted and bolted joints near the battle damage. Look for sheared, pulled-through, tom-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 (Figure 2-4).

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

NOTE

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

(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 (Figure 2-4). Determine allowable damage limits. Establish an order of repair on DA Form 2404 (Figure 2-4). 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 2-5.

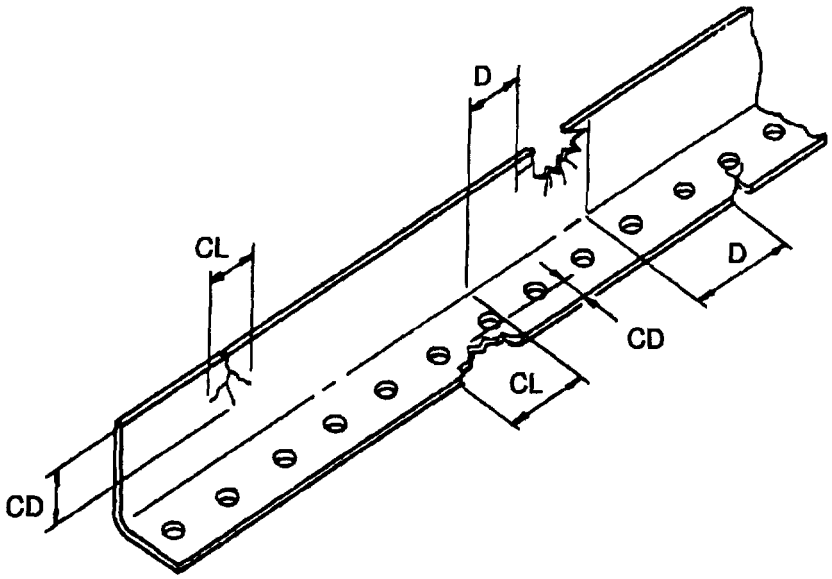


Figure 2-5. Measuring Cap or Longeron Damage

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 (Figure 2-4). 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 2-5. 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 2-6, 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.

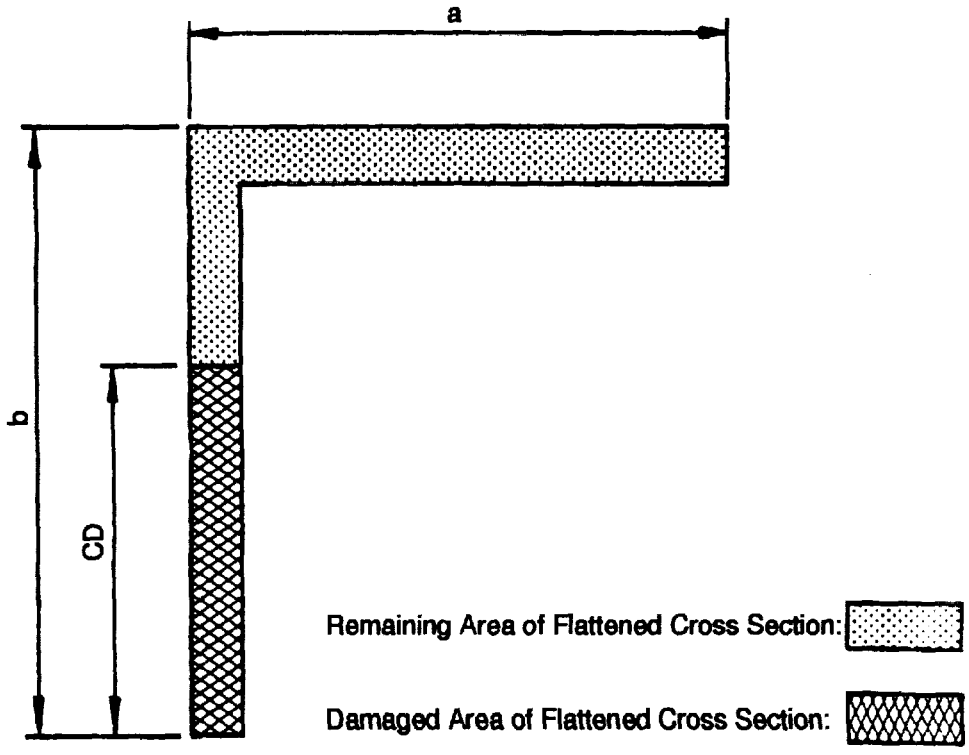


Figure 2-6. Damaged Cross Section

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

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

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

5 Record on DA Form 2404 (Figure 2-4).

(2) Webs, Panels, Floors, and Decks.

(a) Refer to Figures 2-7 and 2-8 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 2-2.

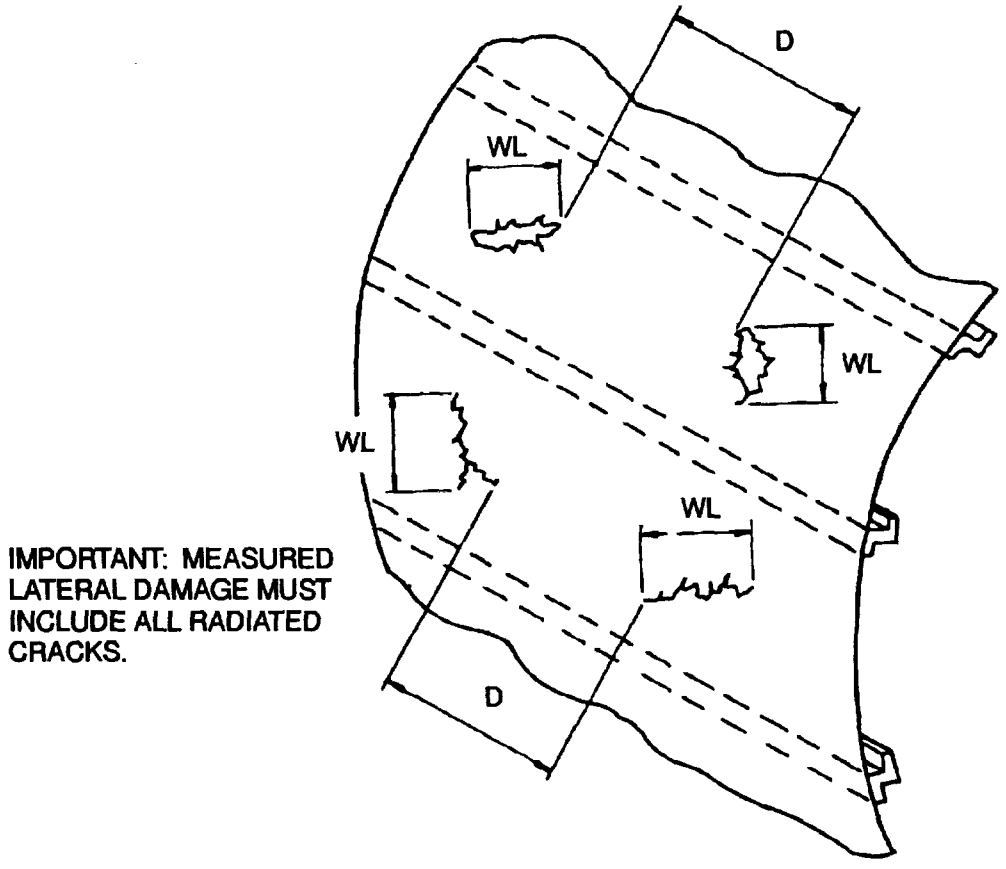


Figure 2-7. Measuring Skin Panel Damage

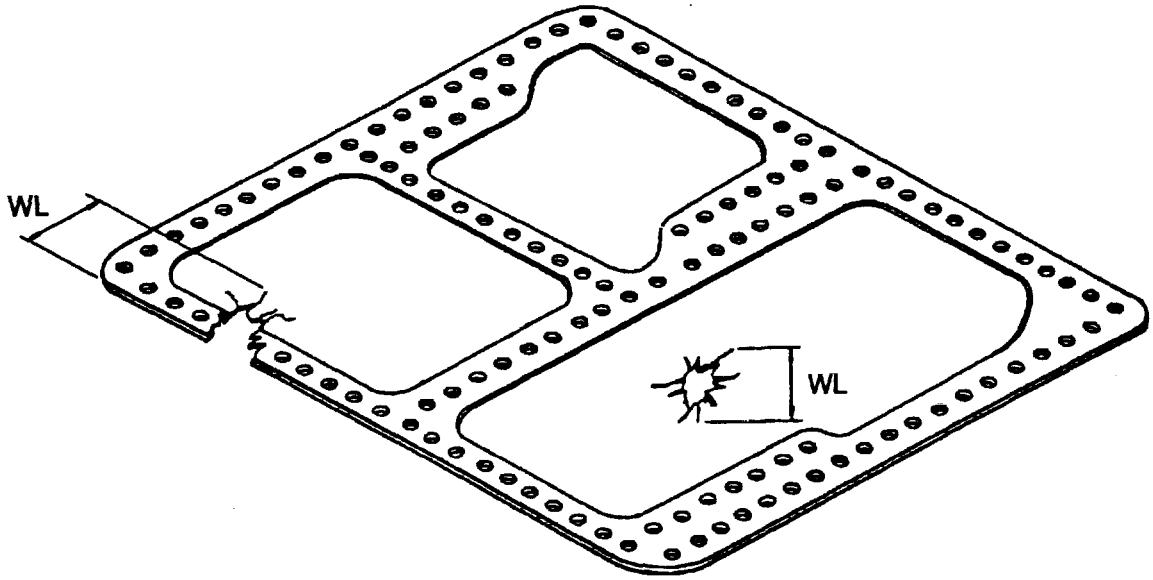


Figure 2-8. Measuring Damage In Floors and Decks

(b) Honeycomb Sandwich Structures. Refer to Figure 2-9 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 Units.

(1) The allowable damage limits corresponding to the damage measurements of paragraph 2-2 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.

(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.

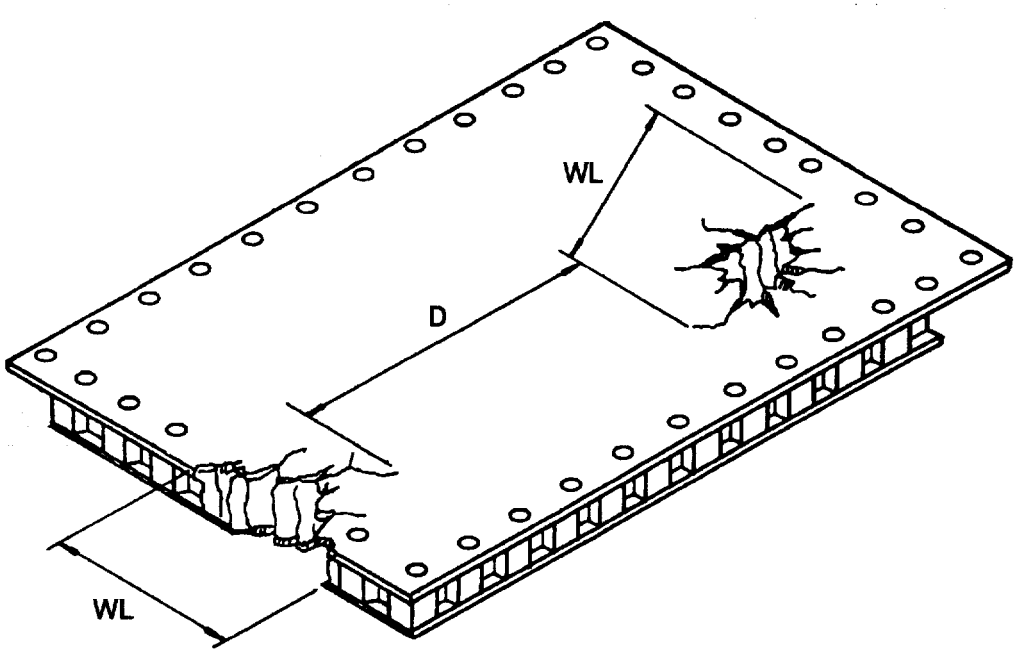


Figure 2-9. Measuring Damage In Honeycomb Panels

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

(a) Condition 1. Aircraft fully flight capable. No flight restrictions; 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.

e. General Damage Assessment.

(1) Damage Measurement.

(a) Reproduce Figures 2-10 through 2-27 as required, and use to mark up damaged areas.

(b) Refer to Figures 2-10 through 2-27 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 2-2.b(9).

(d) Refer to paragraph 2-2.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 (Figure 2-4) and compare them with 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 (Figure 2-4).

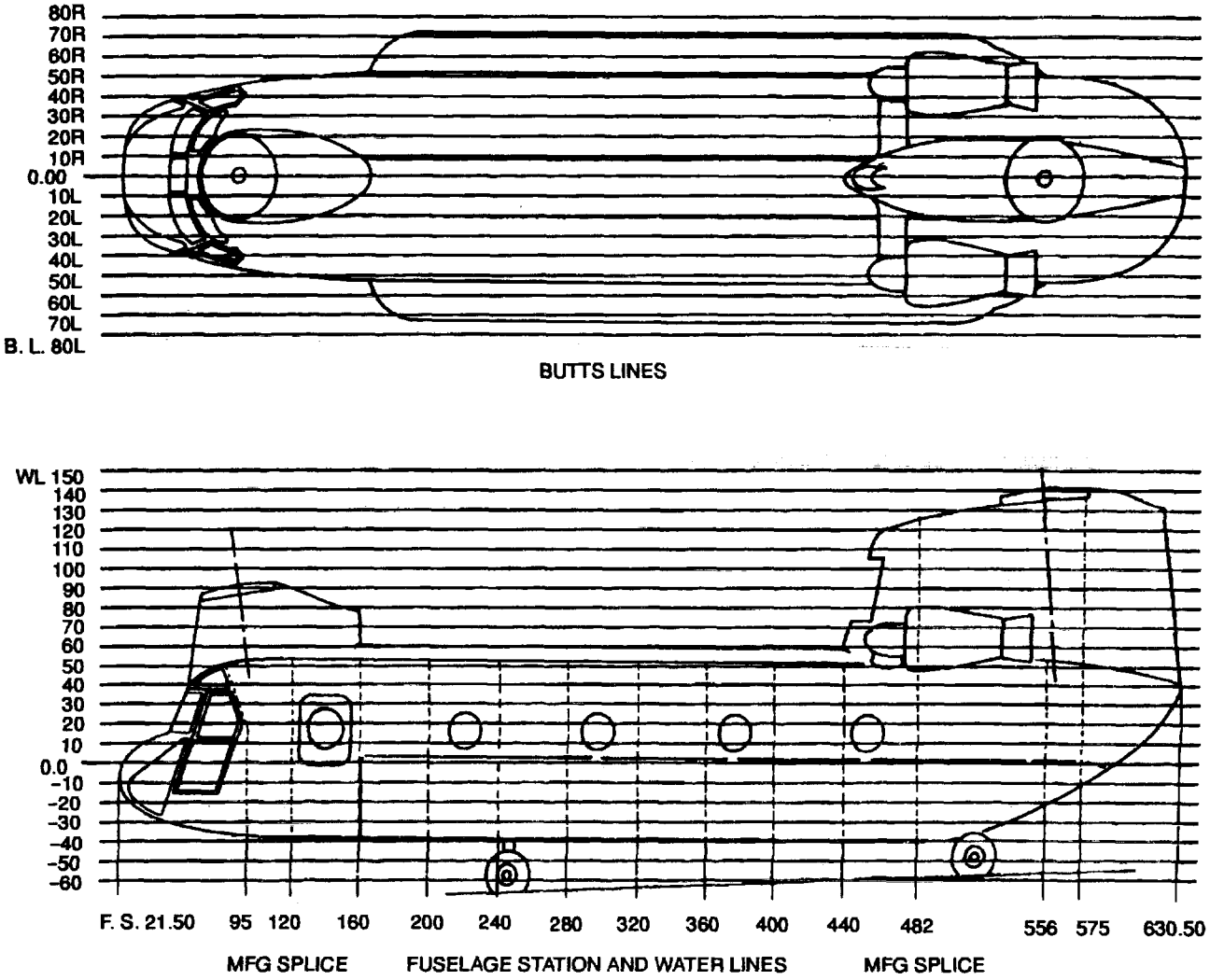


Figure 2-10. Station and Waterlines

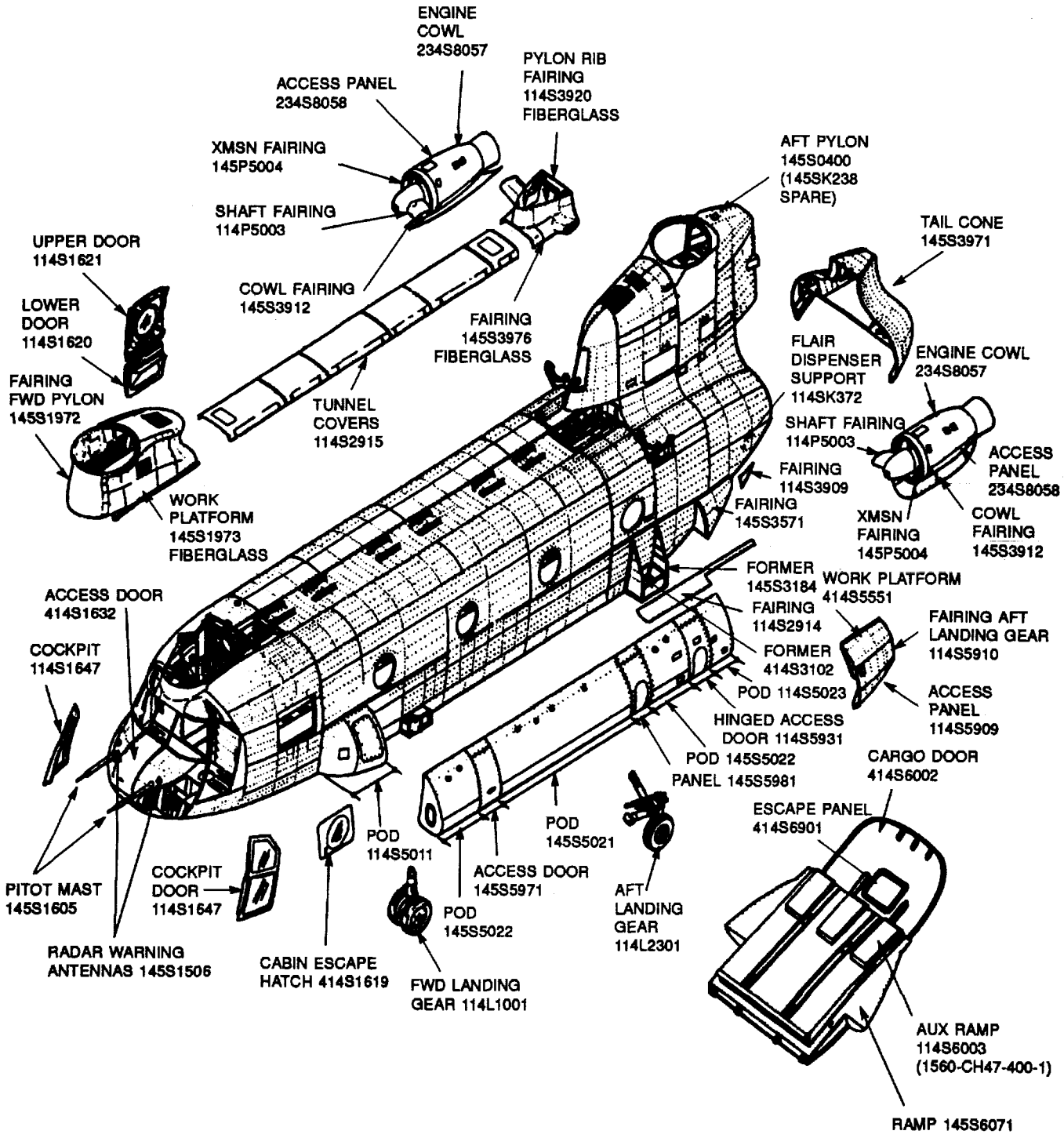


Figure 2-11. Aircraft Breakdown

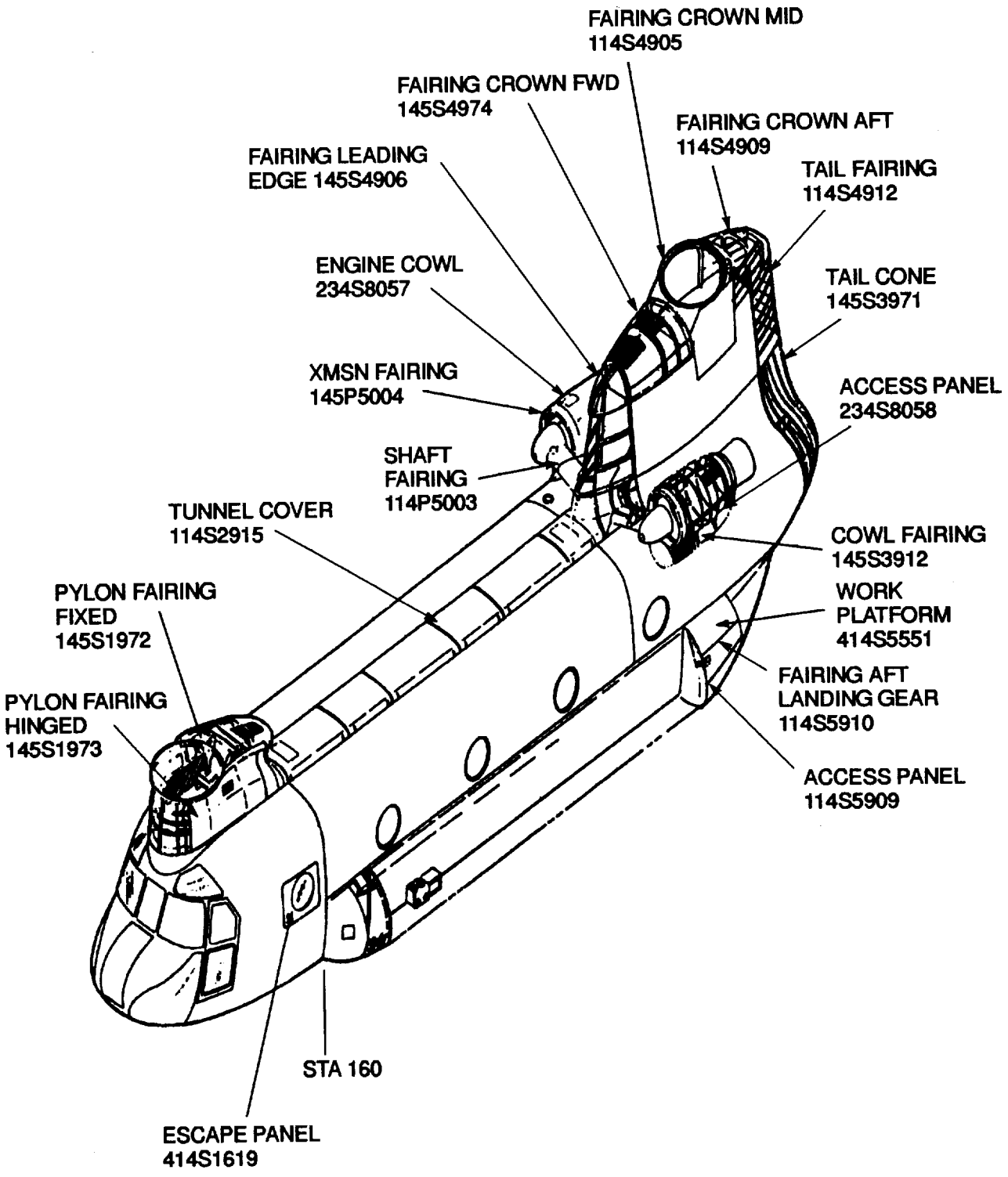


Figure 2-12. Fairing Structure, LH.

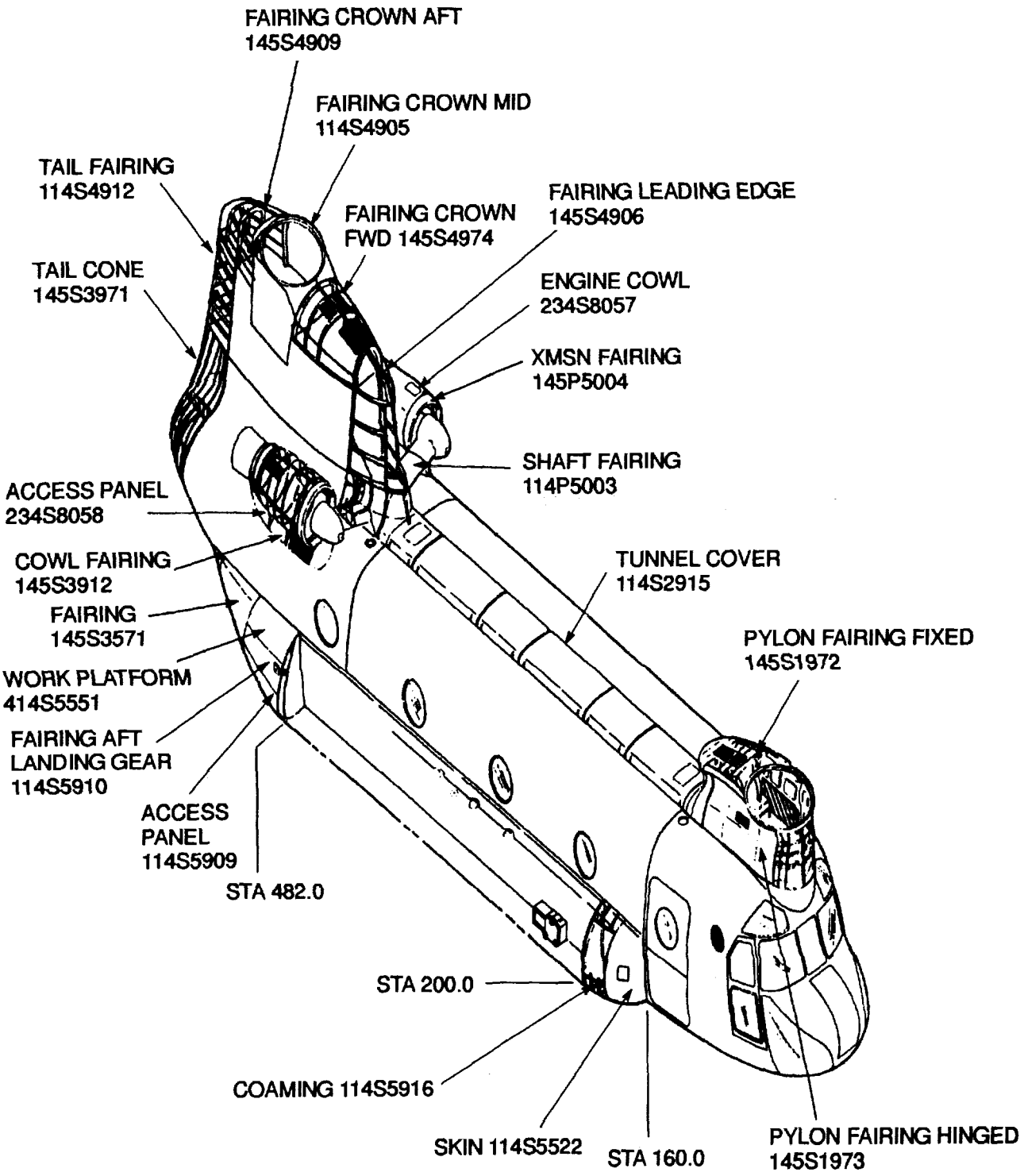


Figure 2-13. Fairing Structure, R. H.

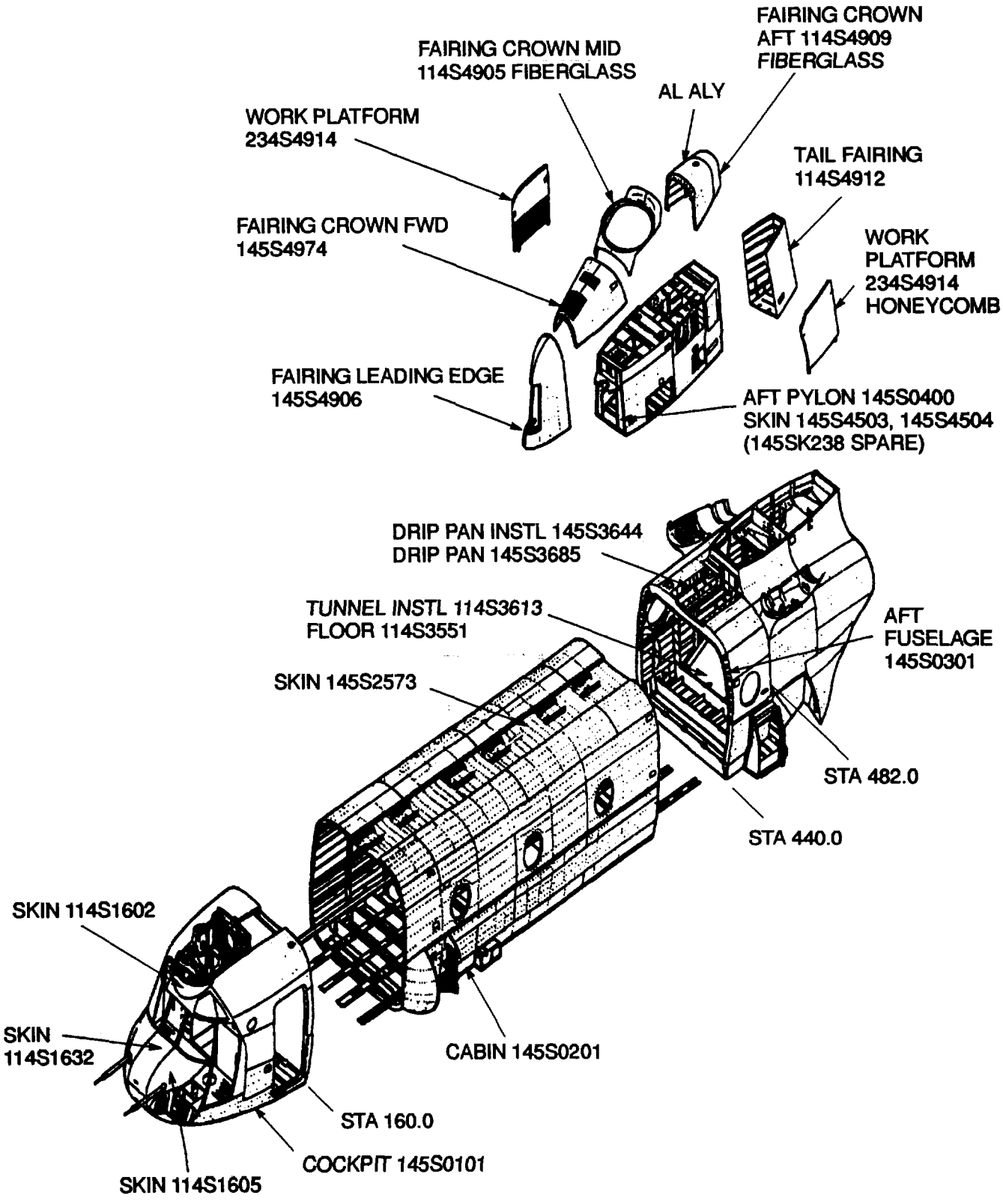


Figure 2-14. Production Breakdown, L. H.

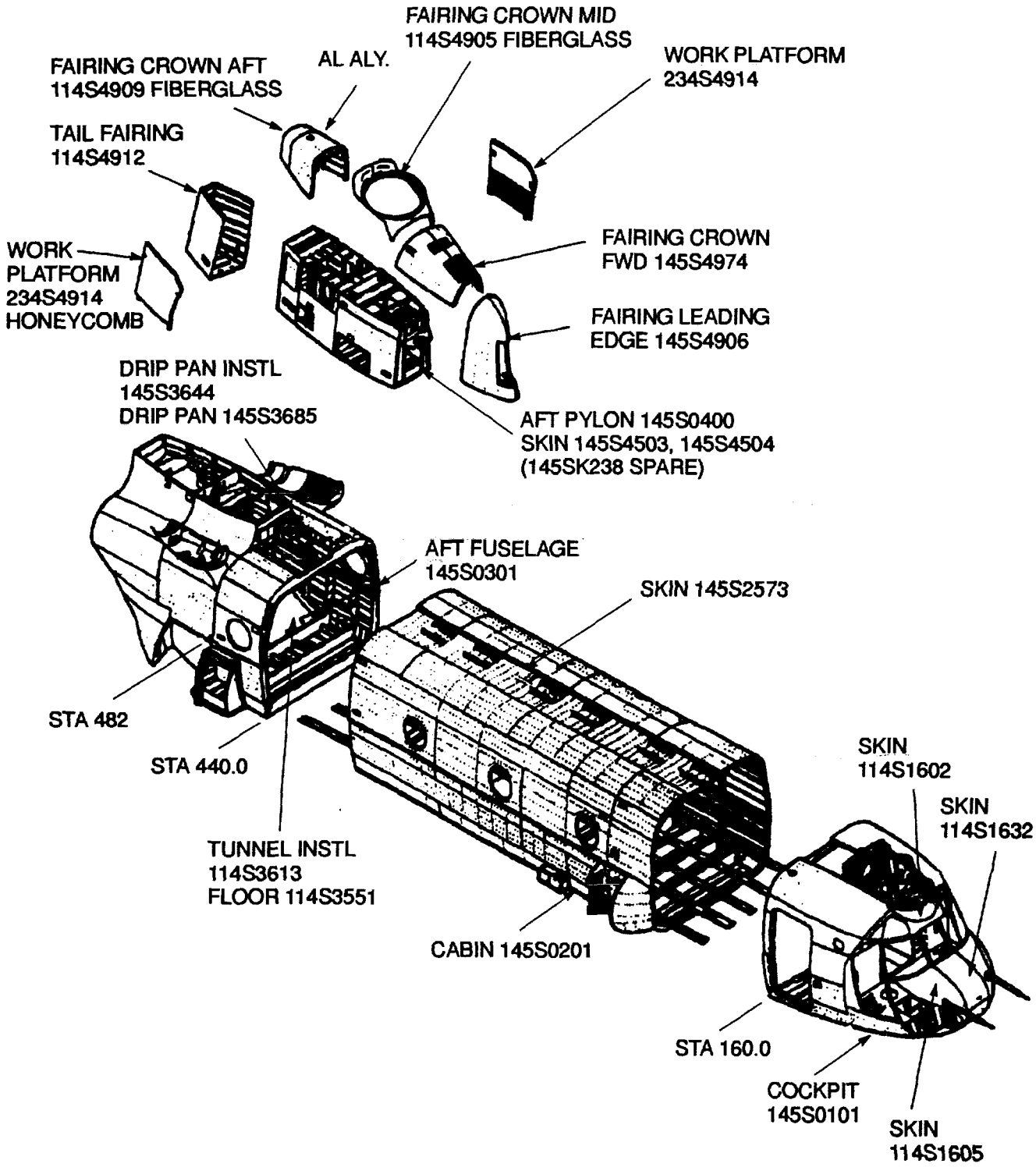


Figure 2-15. Production Breakdown, R. H.

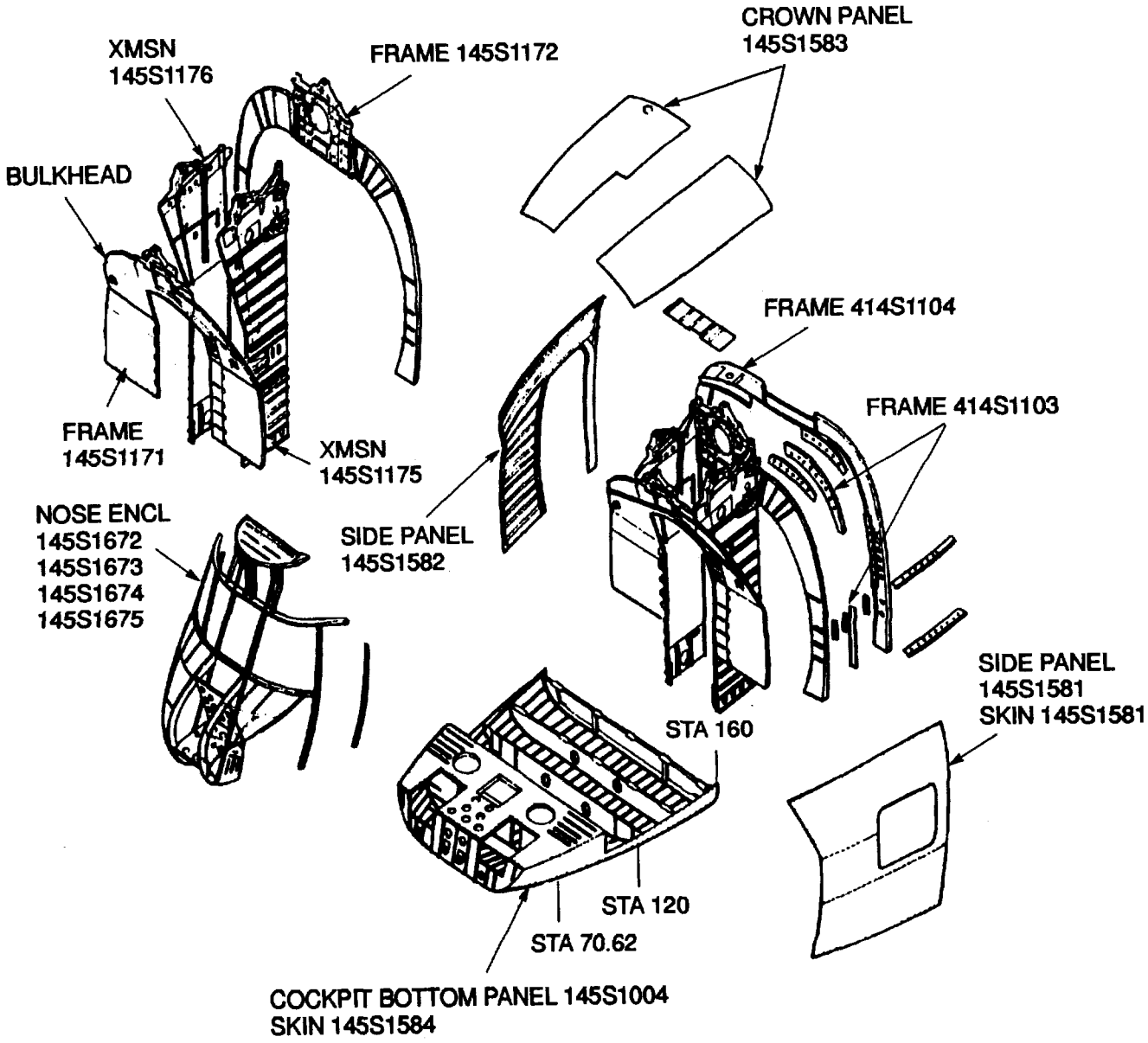


Figure 2-16. Section 41

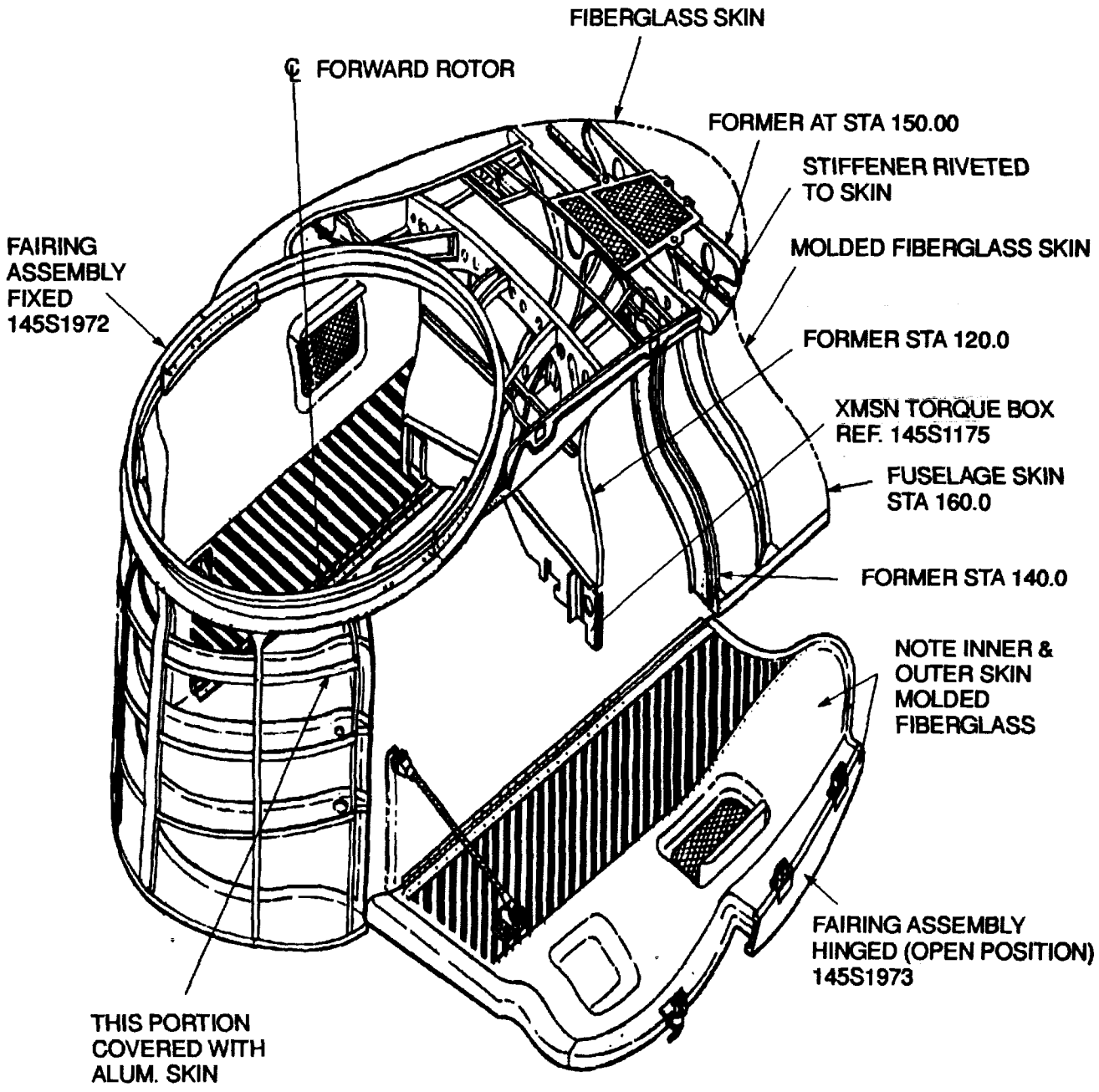


Figure 2-17. Forward Pylon

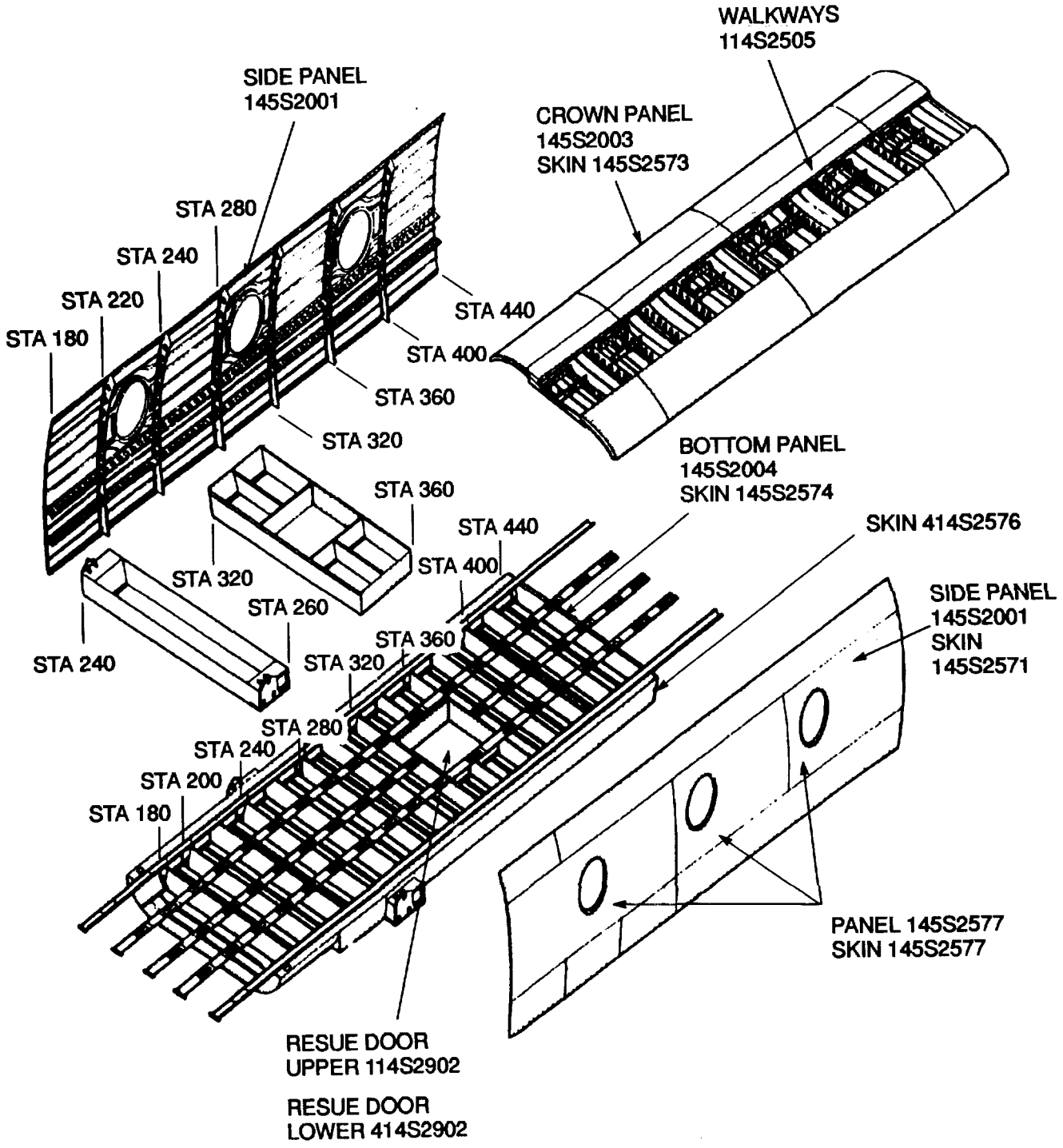


Figure 2-18. Section 43, L. H.

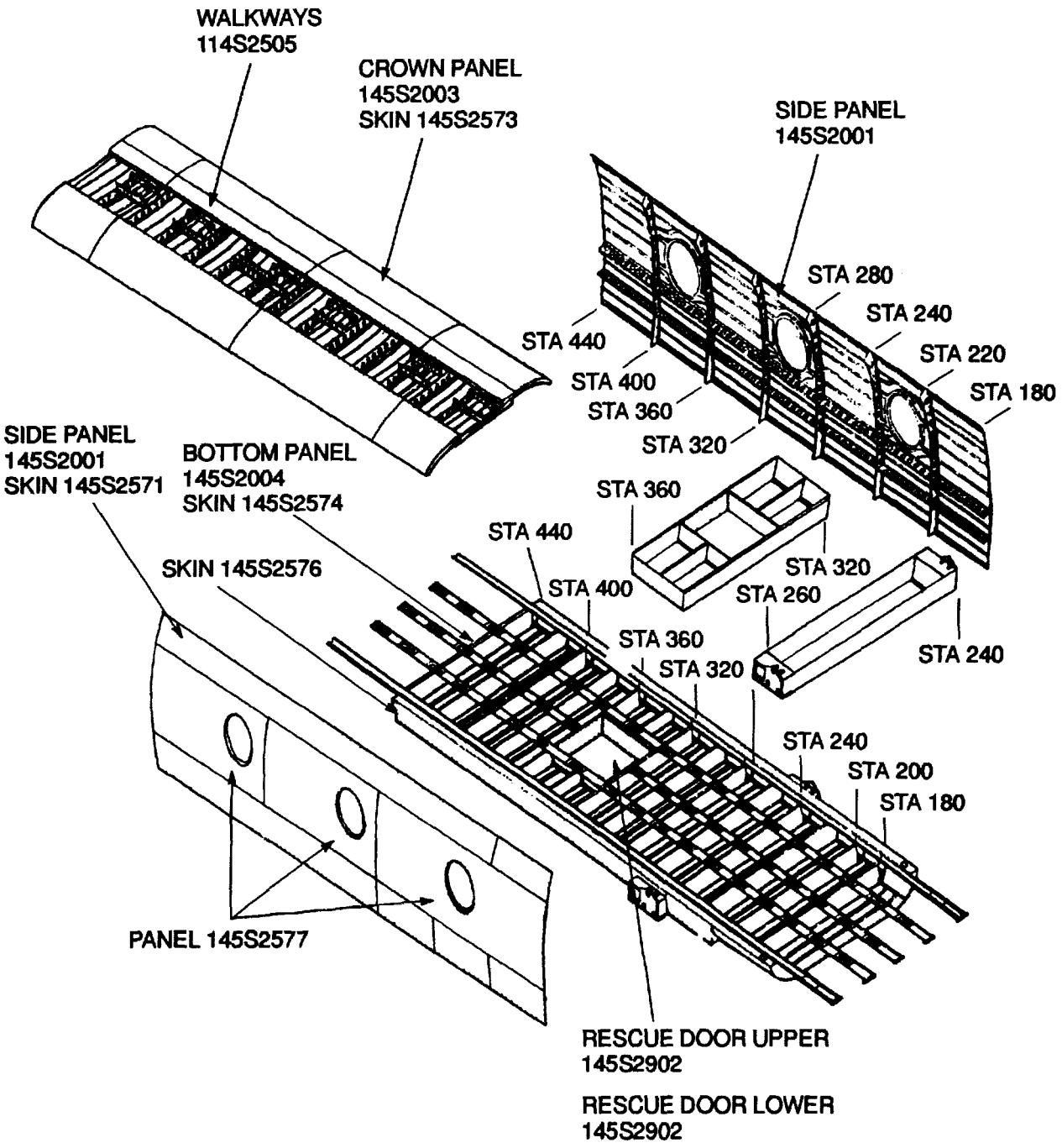


Figure 2-19. Section 43, R. H.

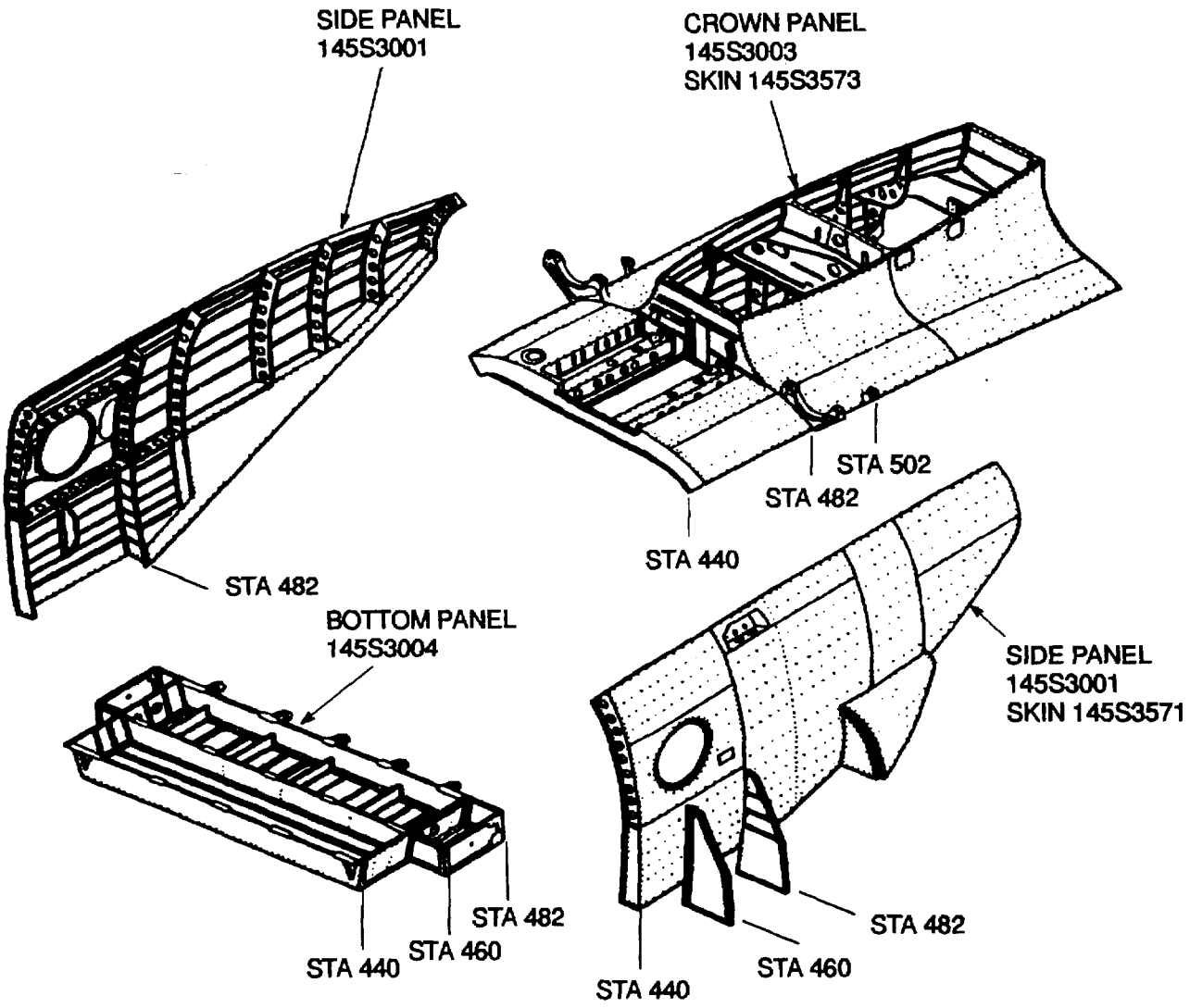


Figure 2-20. Section 46, L. H.

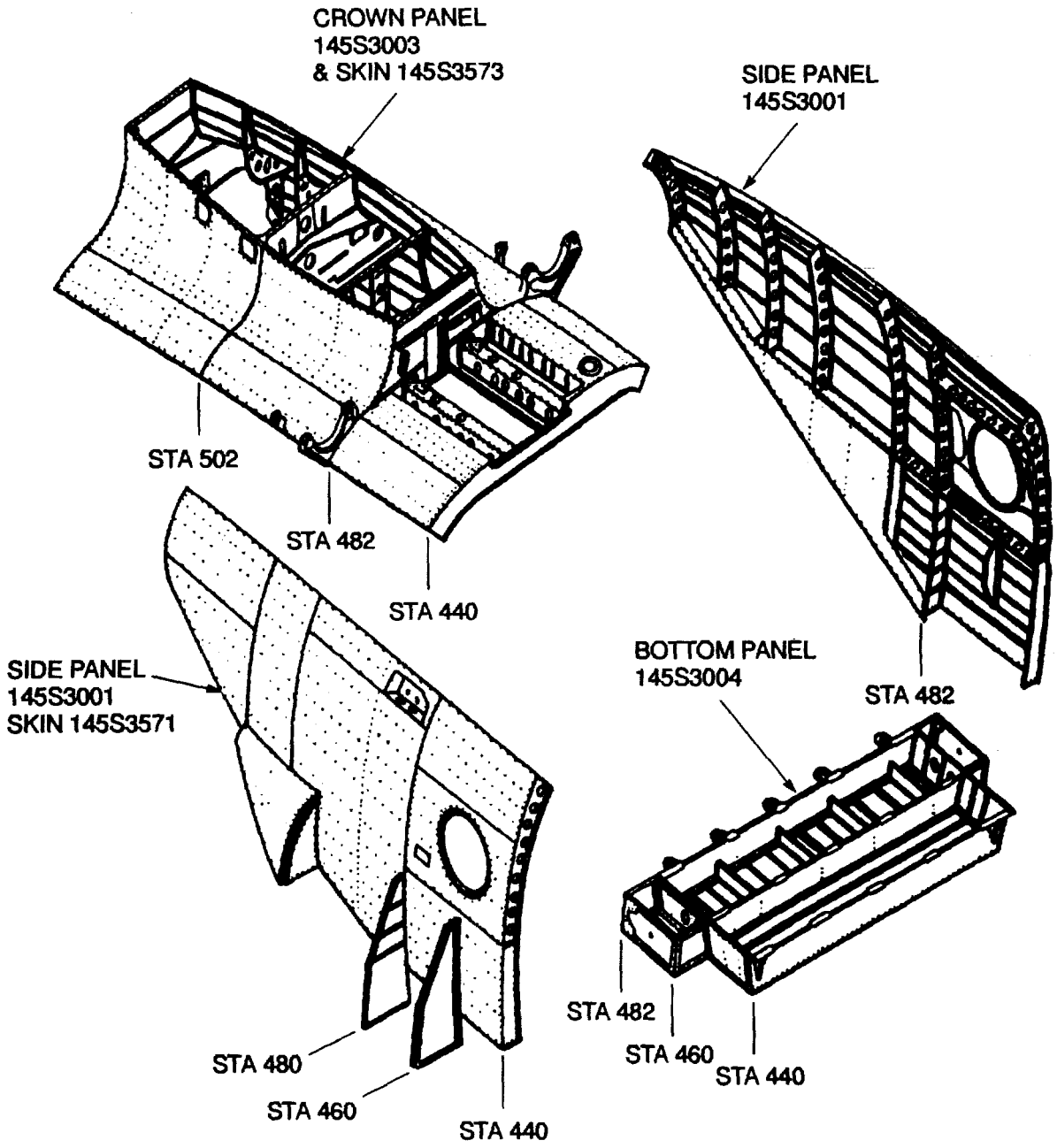


Figure 2-21. Section 46, R. H.

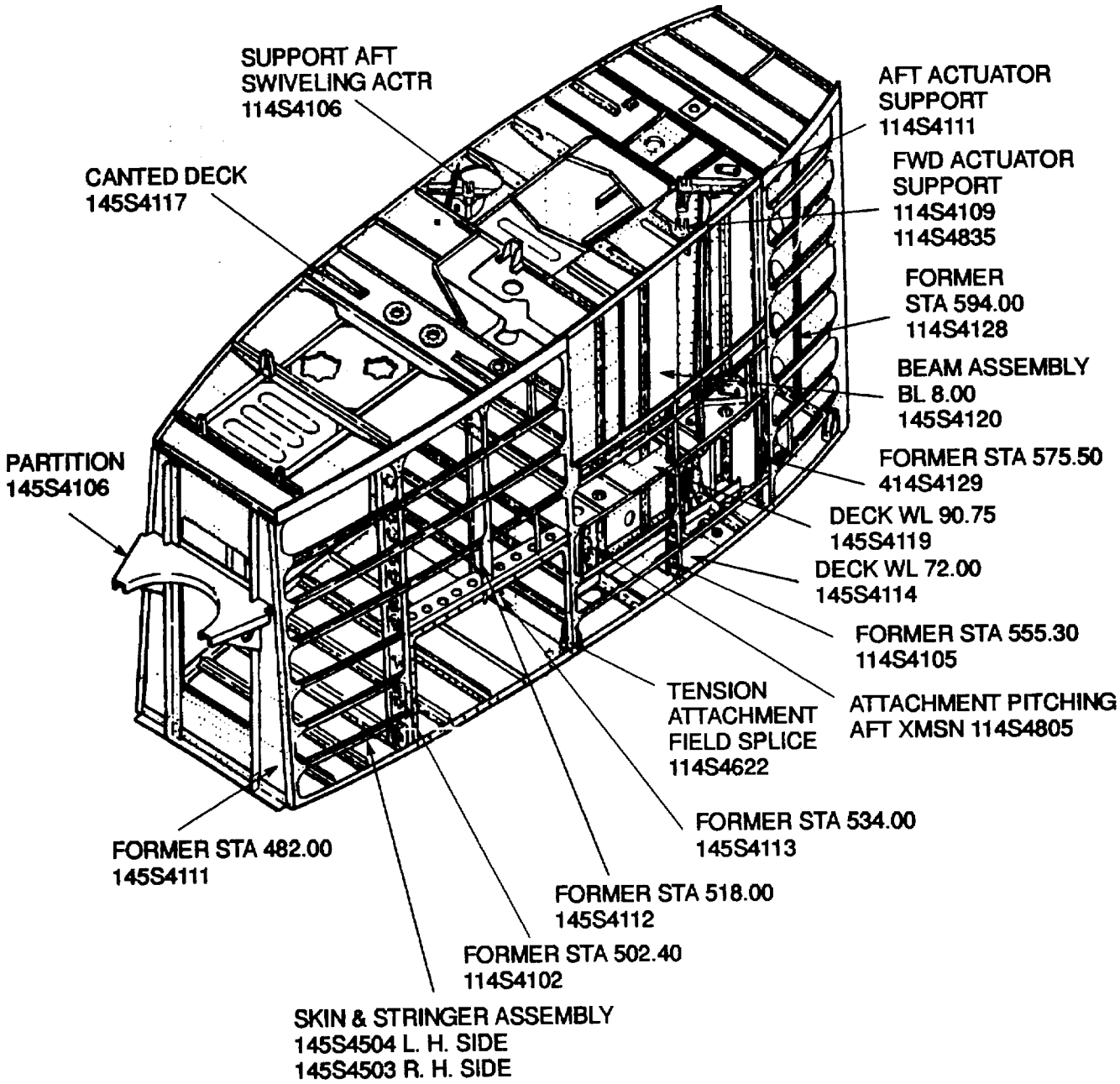


Figure 2-22. Aft Pylon, L. H.

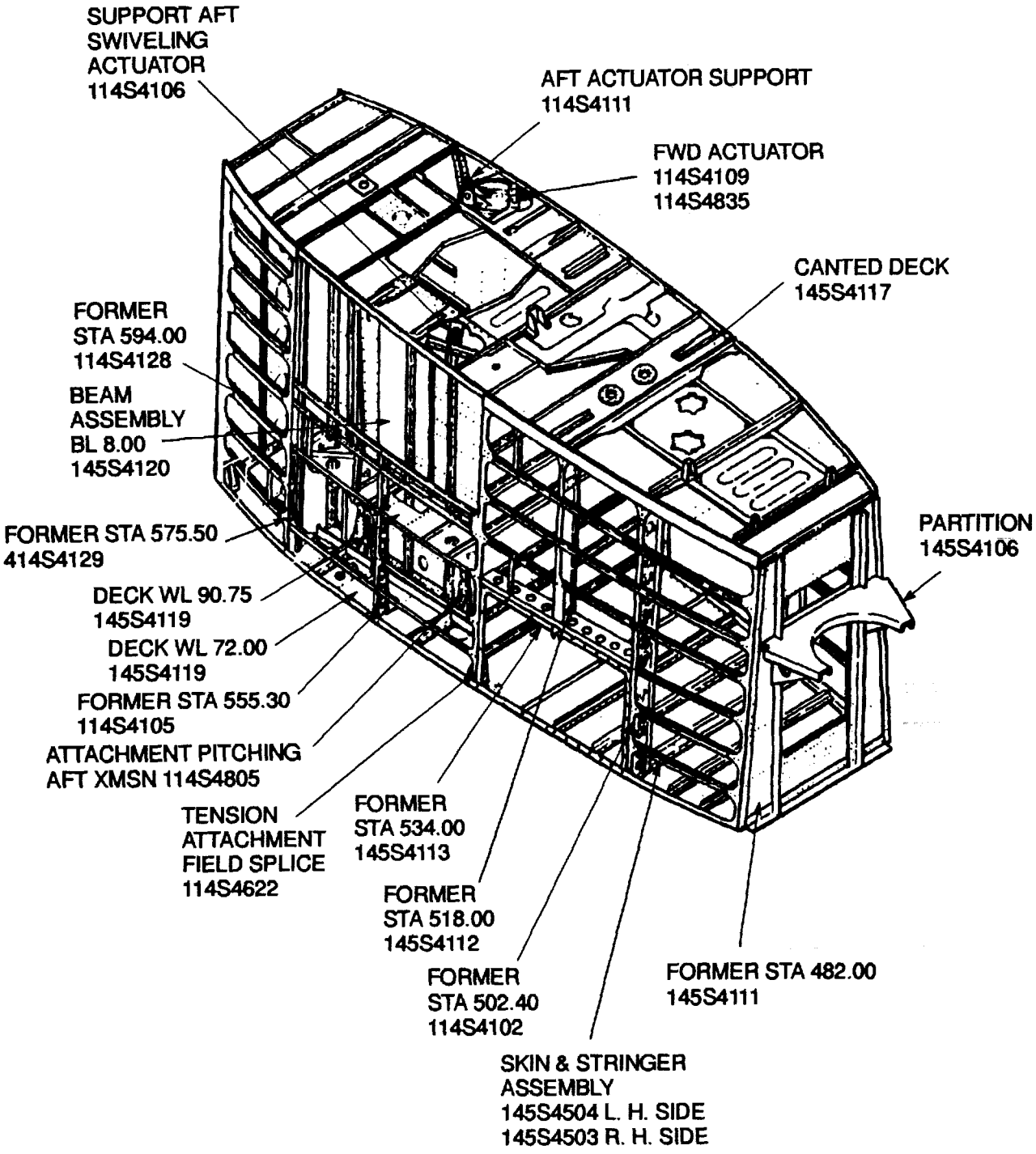


Figure 2-23. Aft Pylon, R. H.

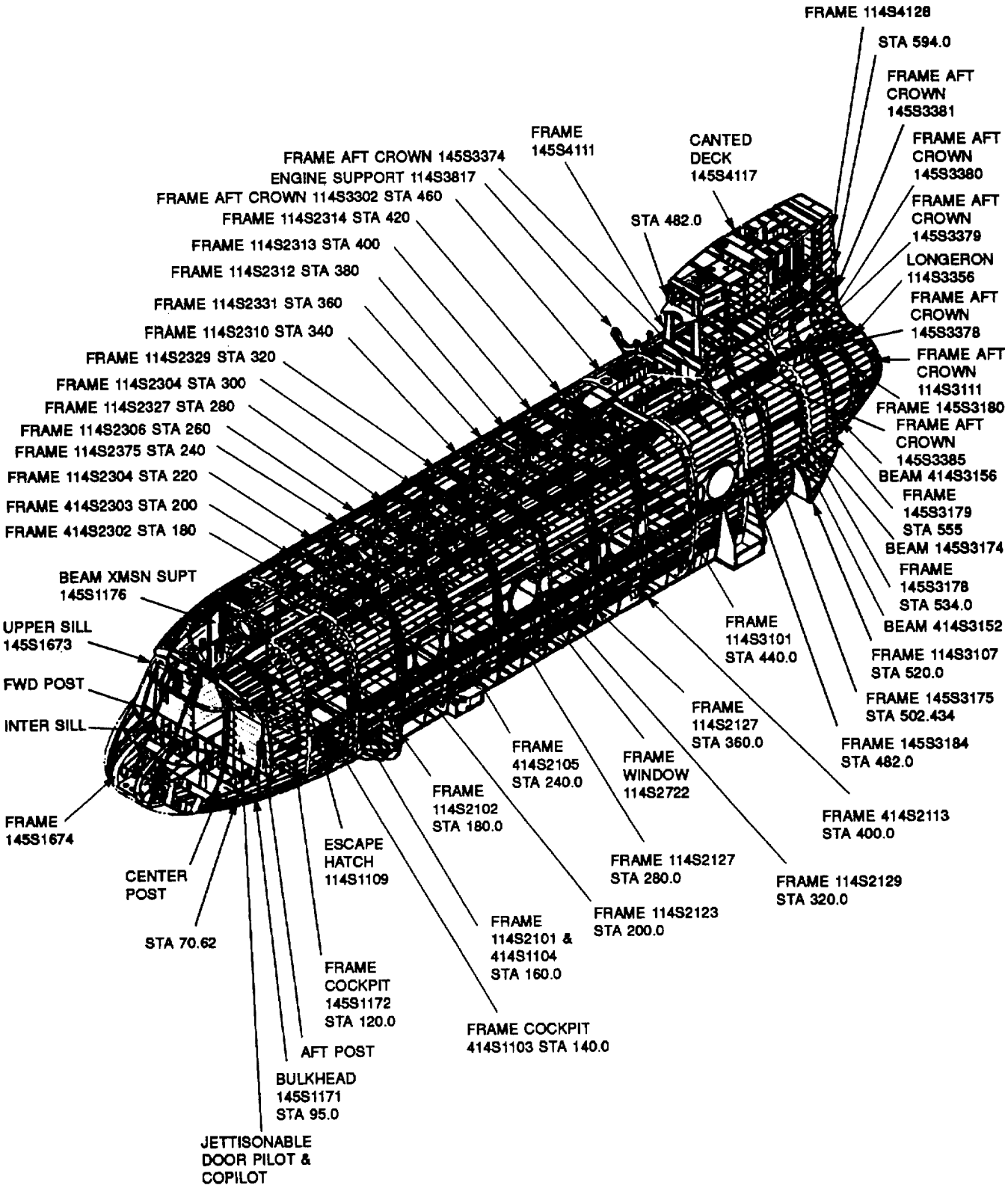


Figure 2-24. Basic Structure, L. H.

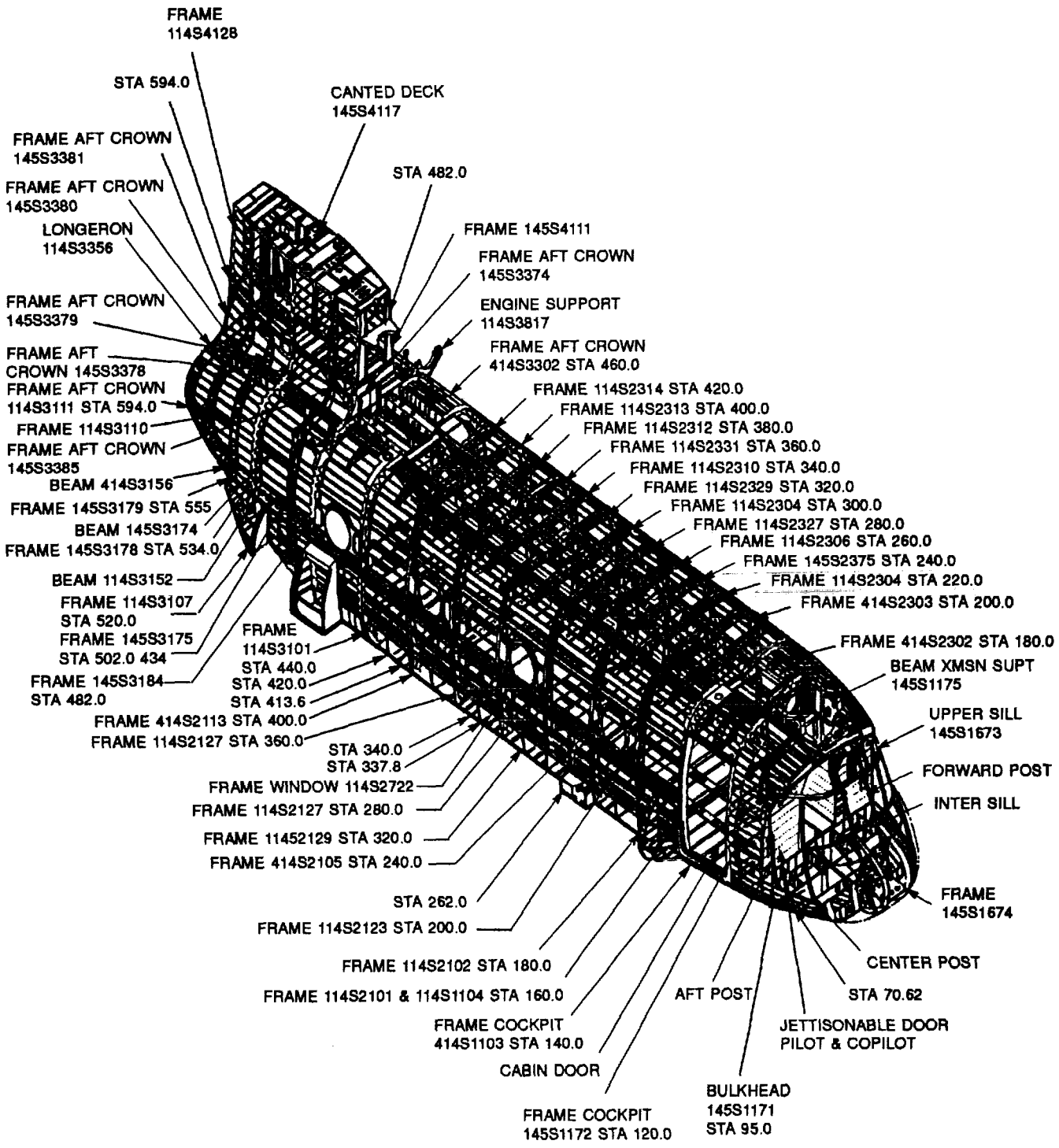


Figure 2-25. Basic Structure, R. H.

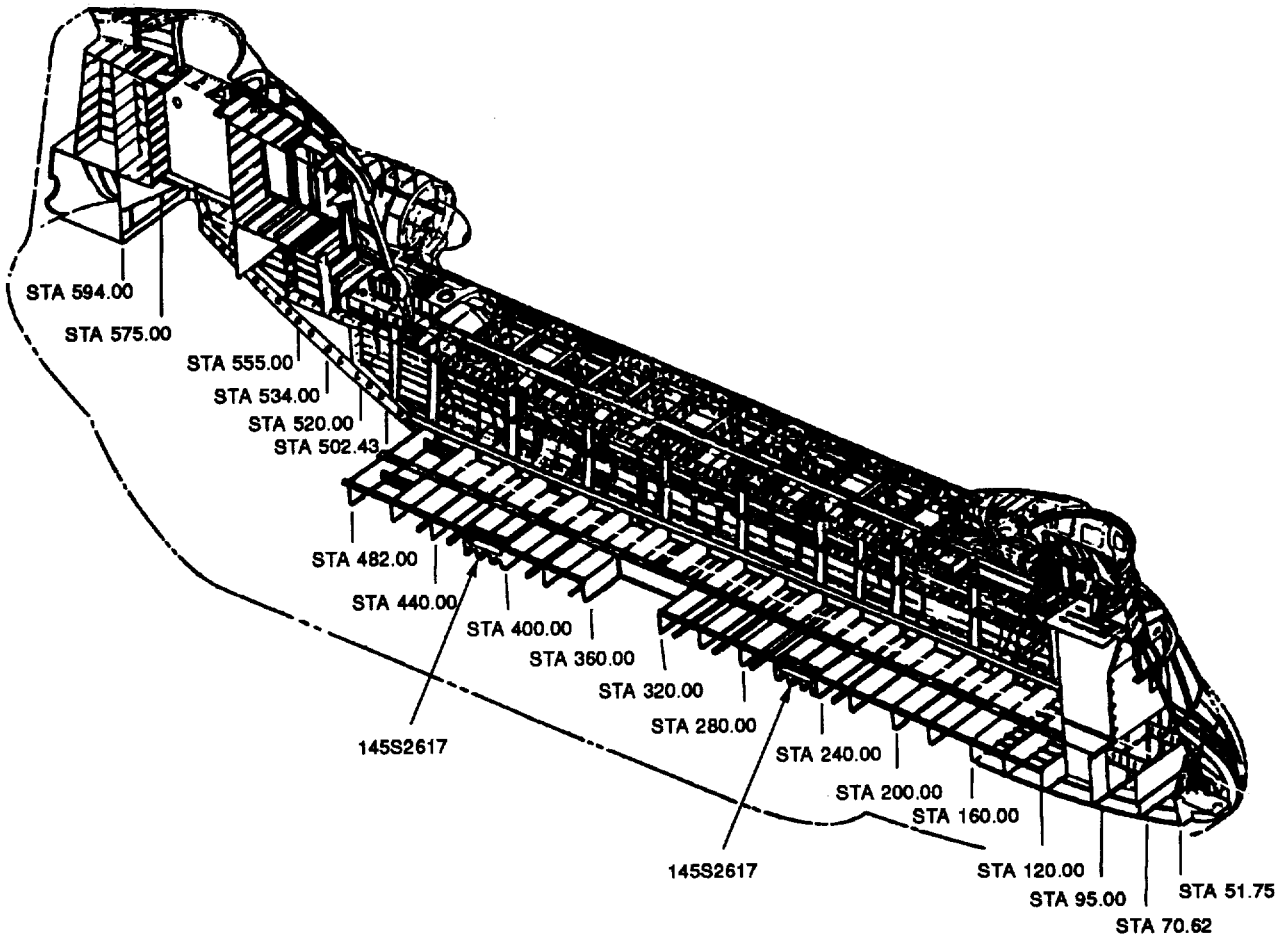


Figure 2-26. Centerline, R. H.

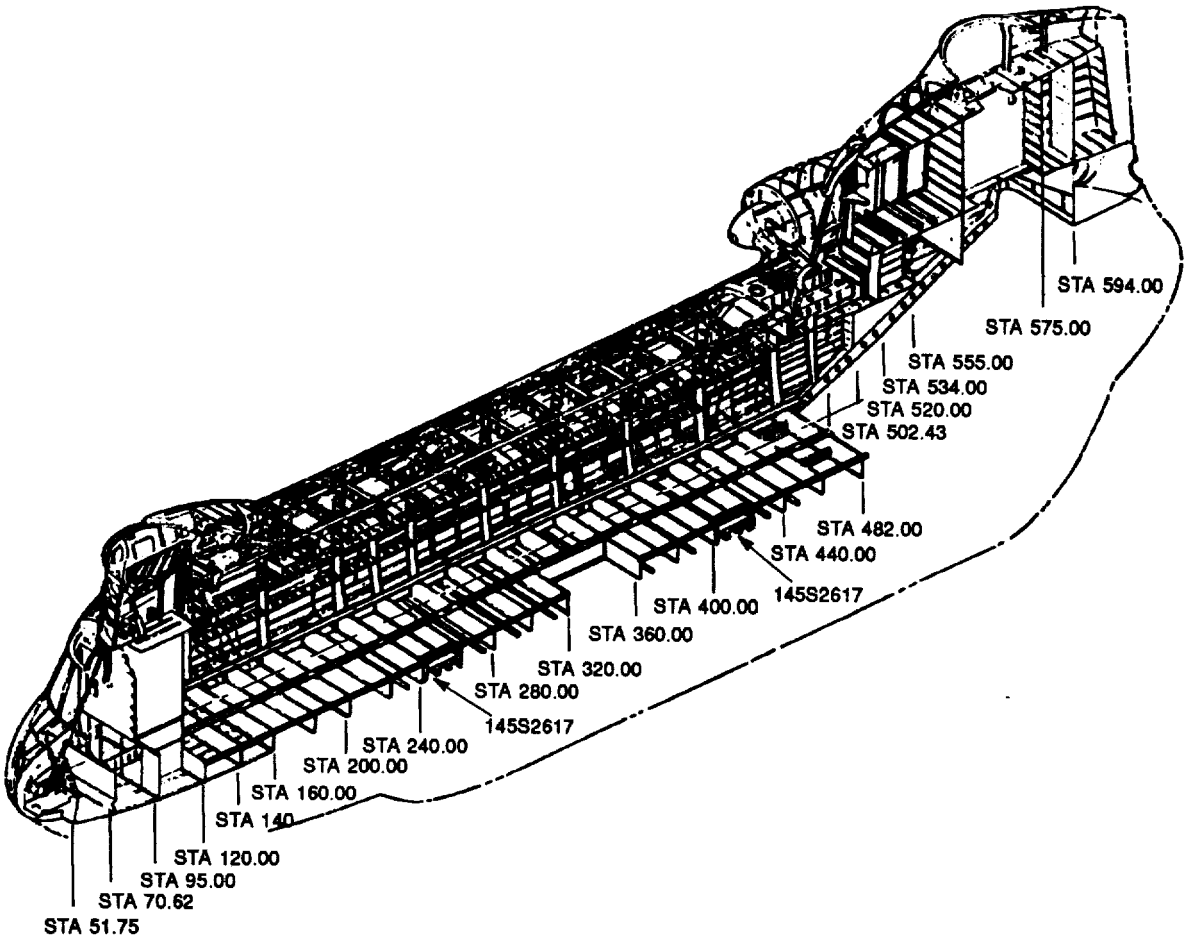


Figure 2-27. Centerline, L. H.

2-3. **AIRFRAME**. The airframe structure consists of two parts the primary structure and the secondary structure. Both are made mostly of high-strength aluminum alloy. (See Figure 2-28).

a. Primary Structure. The primary structure is the skeleton framework that gives the helicopter its shape. Stringers and longerons extend fore and aft. They are supported by frames and bulkheads that extend across the width of the fuselage. Formers and beams are used where needed to support loads such as power-plants, transmissions, and landing gear.

b. Secondary Structure. (Figure 2-29). The secondary structure is made up of aluminum panels that are riveted to the primary structure. The panels are stressed to help provide strength and stiffness to the helicopter. Other panels protect and provide aerodynamic fairings over components. The airframe is built in four sections cockpit, cabin fuselage, aft fuselage, and pylon. The cockpit is spliced to the cabin fuselage at station 160. The aft fuselage is spliced to the cabin fuselage at station 440. The pylon is attached to the aft fuselage at water line 72. The cockpit and fuselage sections cannot be separated. The pylon can be removed if needed to transport the helicopter.

c. Cockpit. (Figure 2-30). The cockpit section contains controls and the fully adjustable pilot's and copilot's seats. The forward transmission is mounted at the top of the section; covered by a fiberglass fairing. A hinged work platform is built into each side of the fairing. Three self-tuning dynamic absorbers are installed in the cockpit section. One is in the nose and two are below the cockpit floor, under the seats. The absorbers automatically adjust themselves to lower vibration in the helicopter throughout its normal operating range. The section contains three doors. A jettisonable door is next to each seat. The main entrance door is at the aft right side of the section. There are three windshields in the cockpit pilot's, copilot's, and center. Each consists of three layers. The middle layer of all windshields is plastic. Inboard and outboard layers are either glass or plastic. The pilot's and copilot's windshield can be heated electrically for anti-icing or defogging. The center windshield can be heated for defogging only. Each windshield has a temperature sensing element to provide automatic temperature control.

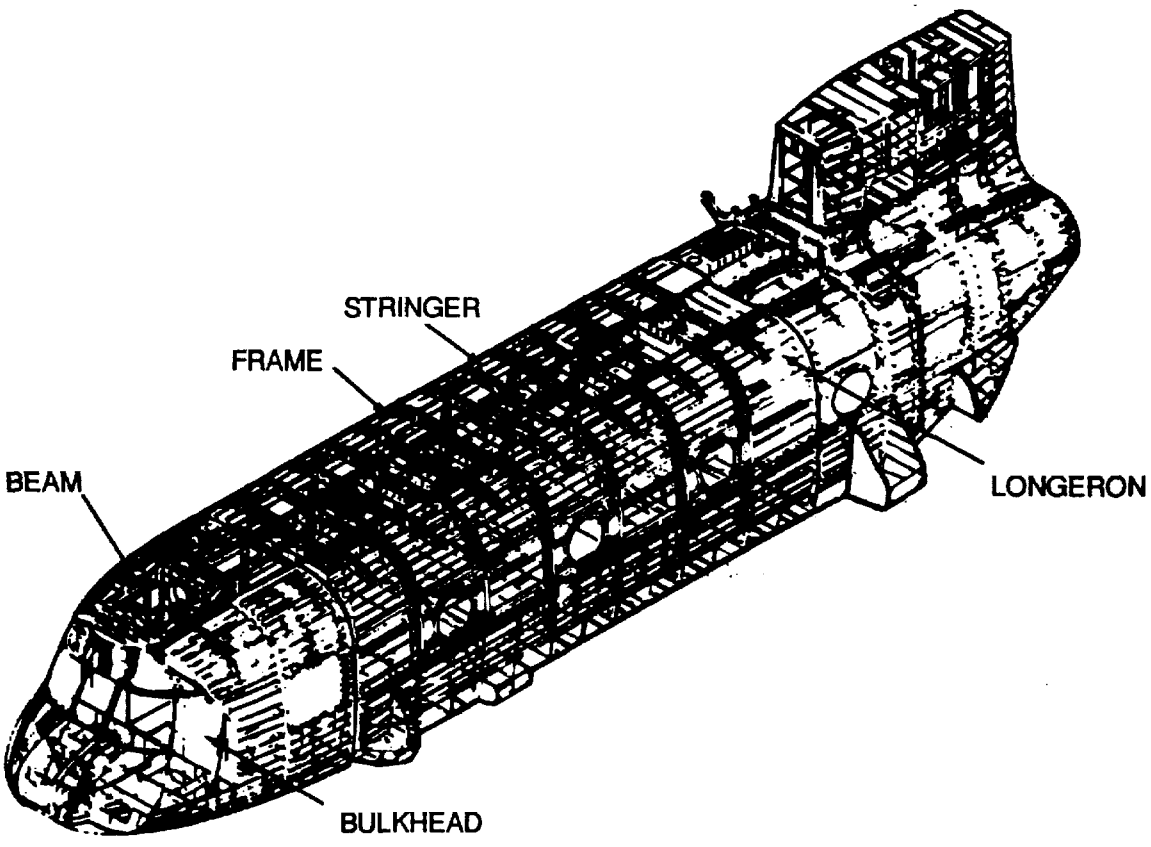


Figure 2-28. Airframe

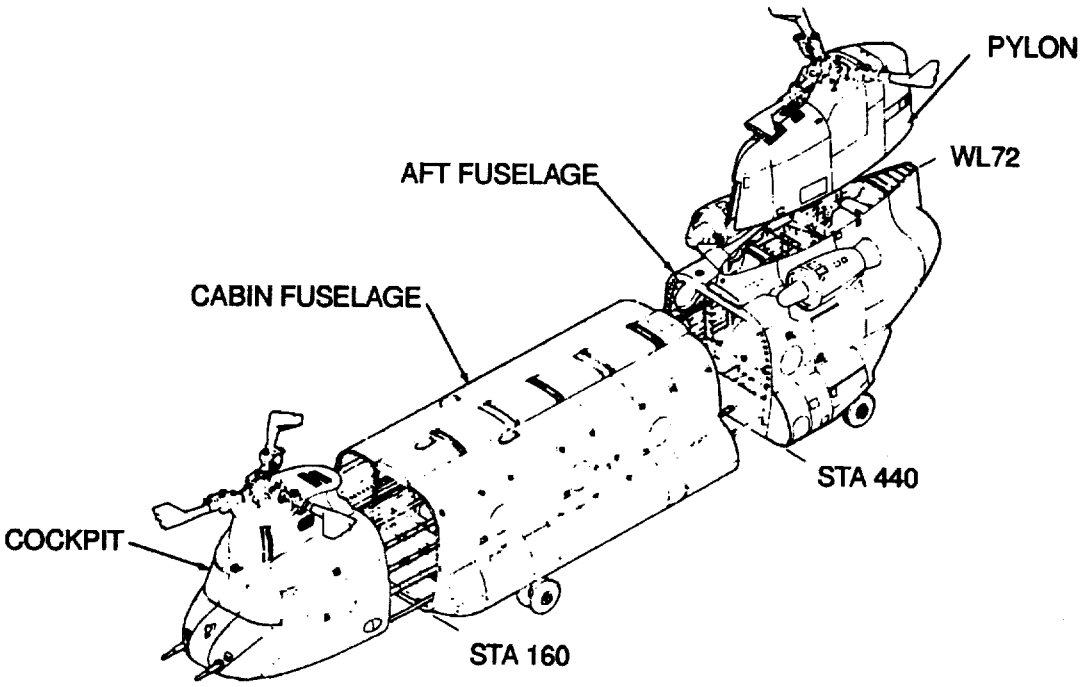


Figure 2-29. Secondary Structure

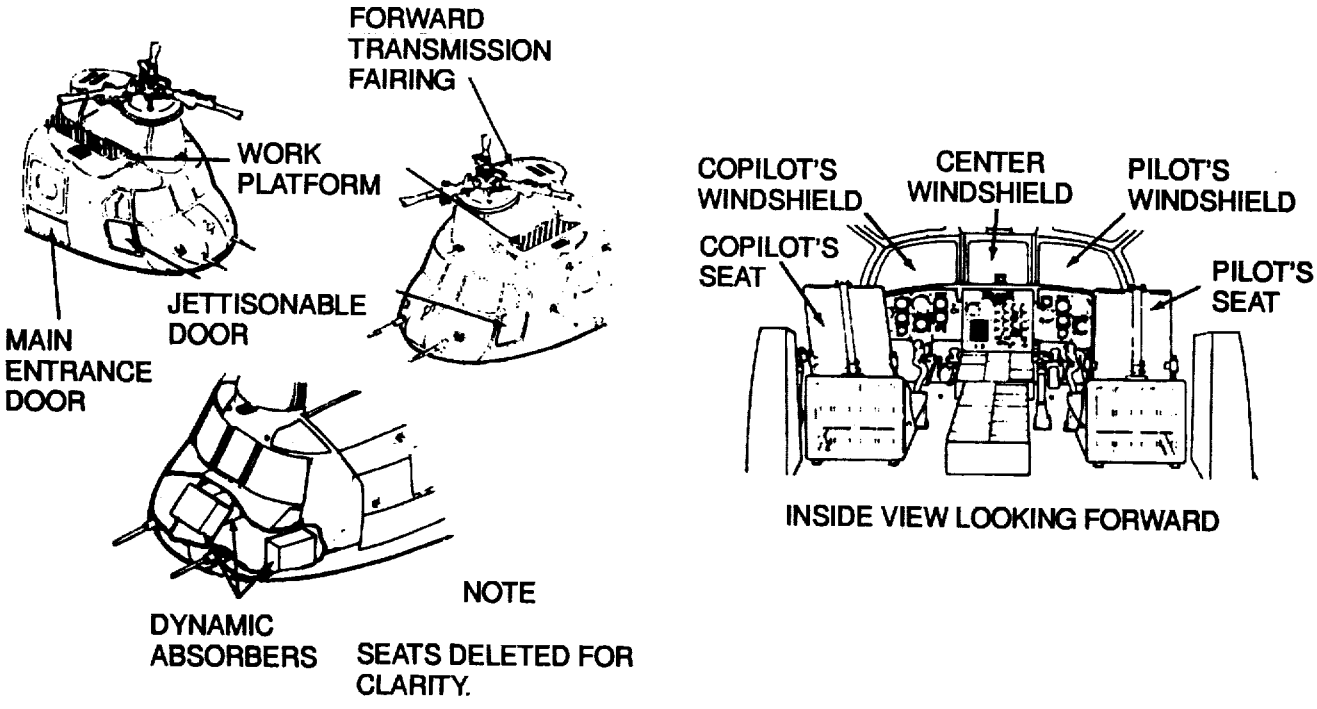


Figure 2-30. Cockpit

d. Cabin Fuselage. (Figure 2-31). The cabin section provides the major carrying capacity of the helicopter. It can be fitted to carry troops, litters, cargo, or any combination of the three. The cabin floor consists of 12 removable panels set between five tiedown beams. The panels are made of riveted sections of magnesium alloy. Center panels are covered with non-skid material. Tiedown rings are installed in the tiedown beams. The rings have a capacity of 5,000 or 10,000 pounds. A rescue hatch door of sandwich honeycomb construction is in the center of the floor. It hinges open for access to an external cargo hook and a movable hatch in the lower skin. A tunnel along the top of the cabin section houses drive shafting and flight controls. The tunnel consists of six honeycomb covers that hinge open for access to components. A walkway at the right of the tunnel runs the length of the cabin. Detachable pods on each side of the fuselage section contain the fuel tanks. The forward end of each pod contains components of the electronic and electrical systems. A hinged panel in each pod provides access to the forward landing gear.

e. Aft Fuselage and Pylon. (Figure 2-32). The aft fuselage and pylon sections together contain the aft transmission and the apu. The engines are mounted inside nacelles at the base of the pylon on each side of the fuselage. A hydraulically operated cargo loading ramp is at the aft end of the fuselage section. It includes a ramp, a jettisonable cargo door, and three auxiliary loading ramps. Three removable floor panels are set into the cargo ramp. Two 5,000 pound tiedown fittings are at each side of the ramp. The cargo door retracts inside the ramp when the ramp is lowered and extends when the ramp is raised. A jettisonable door hatch is in the center of the cargo door. The three auxiliary ramps are hinged at the aft edge of the ramp. In use, they are rotated from their stowed position on the ramp to bridge the gap from the ramp to the ground. The center auxiliary ramp can be used as a work platform for maintenance on the apu. Pods along the lower edge of each side of the aft fuselage form an extension of the cabin fuselage pods. They contain access panels to the aft landing gear and fold-out work platforms for engine maintenance. The pylon houses the aft rotor shaft and the combining transmission. The leading edge of the pylon is hinged on each side. It opens at the centerline for access to the combining transmission. A work platform opens to provide access to the rotor shaft. The pylon is attached to the aft fuselage at water line 72. It can be removed if needed to transport the helicopter.

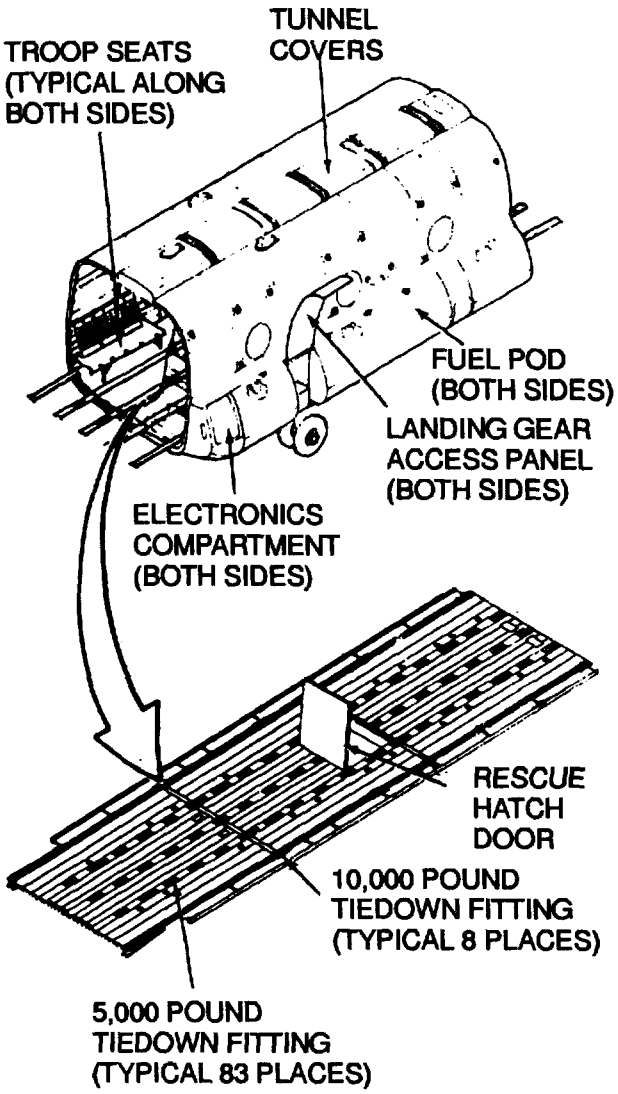


Figure 2-31. Cabin Fuselage

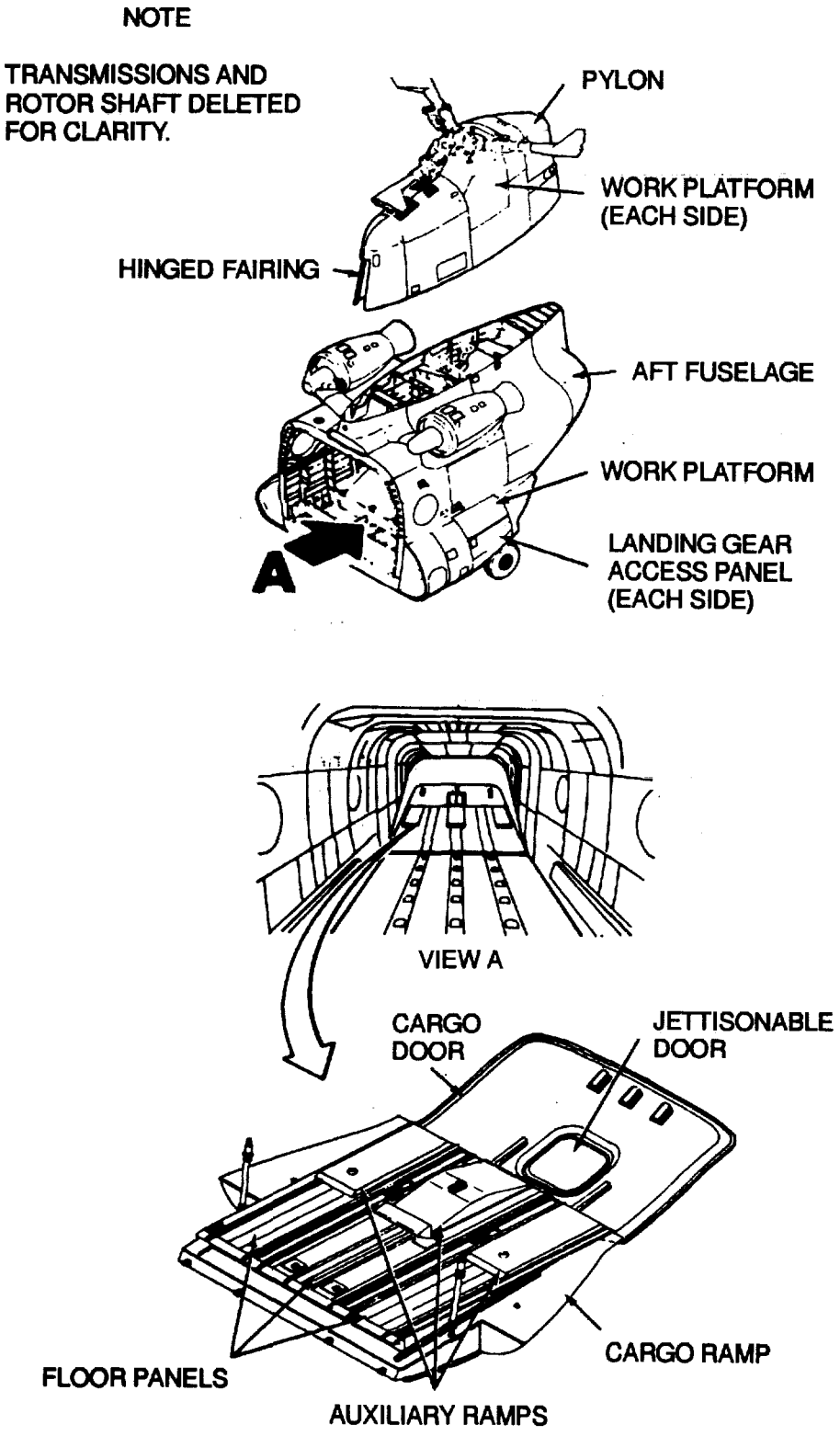


Figure 2-32. Aft Fuselage and Pylon

SECTION II. GENERAL STRUCTURAL REPAIRS

2-4. RIVETS. Refer to TM 1-1500-204-23 Series for riveting procedures and identification. Additional information on rivets, including alloy selection, row distance, and pitch, as may be necessary to accomplish repairs is shown. Acceptable rivet inspection criteria is as follows:

a. The head of a flush rivet should be flush with the surface with no significant deviation above or below this level. The rivet should be centered in the countersink to provide continuous contact around the head of the rivet.

b. The head of a protruding head rivet should provide continuous contact with the surface; that is, there should be no significant head tit relative to the surface.

c. The tails of both of the above rivets should provide continuous circumferential contact between the tail and the local surface.

d. There should be no damage to the rivet or local surface such as that resulting from bucking bar slippage.

e. A truly loose rivet will be moveable by hand and should be replaced.

2-5. SUBSTITUTE AN BOLTS FOR AN RIVETS .
Substitute AN bolts for AN rivets as follows:

a. When rivets left out on assembly cannot be installed.

b. Where edge distance is less than 1 1/2 times diameter of rivet.

NOTE
Minimum edge distance of two times diameter of rivet is preferred.

c. Replacement sizes are as follows:

RIVET ALLOY AND DIA	BOLT SIZE
AD4, 5, 6	AN3 or AN23
AD8	AN4DD or AN24
AD10	AN5DD or AN25
AD12	AN6DD or AN26

2-6. INSTALLATION OF AN BOLTS FOR AN RIVETS.

a. Drill rivet hole to size as follows:

RIVET ALLOY AND DIA	BOLT SIZE	HOLE DIA (INCHES)
AD4, 5, 6	AN3 or AN23	0.191 to 0.197
AD8	AN4DD or AN24	0.250 to 0.257
AD10	AN5DD or AN25	0.3125 to 0.3195
AD12	AN6DD or AN26	0.375 to 0.382

b. Install washers AN960 and nuts MS20364 as required.

c. Nuts MS20365 can replace nuts MS20364.

2-7. SUBSTITUTE HUCK, HI-LOK, OR NAS BOLTS .
Substitute HUCK, HI-LOK or NAS bolts as follows:

HUCK PART NO.	HI-LOK PART NO.	NAS PART NO.	HOLE DIA (INCHES)
R3001-5	HL18-5	NAS1465	0.161 to 0.164
R3001-6	HL18-6	NAS1466	0.185 to 0.188
R3001 -8	HL18-81	NAS1468	0.242 to 0.246
R3001-10	HL18-10	NAS1470	0.307 to 0.310
R3002-5	HL21-5	-	0.161 to 0.164
R3002-6	HL21-6	NAS1956	0.185 to 0.188
R3002-8	HL21 -8	NAS1458	0.242 to 0.246
R3002-10	HL21-10	NAS1460	0.307 to 0.310

NOTE

- **Dash numbers for all bolts are the same.**
- **Hole sizes apply to high-shear requirements.**
- **Hole sizes do not apply to fasteners of splices installed at sta 160.219 and 439.71.**

2-8. SUBSTITUTE JO-BOLTS OR V-BOLTS.

JO-BOLT PART NO.	V-BOLT PART NO.	HOLE DIA (INCHES)
WP 164	BA5A*H	0.164 to 0.168
WP 200	BA6A*H	0.199 to 0.203
WP 260	BA8A*H	0.261 to 0.265
WP 312	BA1OA*H	0.313 to 0.317
WF164	BA5A*F	0.164 to 0.168
WF200	BA6A*F	0.199 to 0.203
WF260	BA8A*F	0.261 to 0.265
WF312	BA1OA*F	0.313 to 0.317

NOTE

- **JO-BOLTS numbers refer to its diameter.**
- **The asterisk (*) is the position for the length dash number.**
- **These fasteners are used mainly in blind installations.**

2-9. SUBSTITUTE STANDARD BOLTS FOR HUCK BOLTS.

a. Bolts or screws can be substituted for HUCK bolts as follows:

(1) Use standard bolts or screws only when HUCK bolts or similar fasteners are not available.

(2) Hole diameter must allow thread through without force, but bolt shank must be push fit

b. When bolts replace HUCK bolts under shear forces, use NAS1103, NAS1303, NAS464, NAS624 or Hi-lok HL-18 bolts.

c. When bolts replace HUCK bolts under tension forces, use NAS624 bolts.

d. When replacing 3/16-inch diameter (under tension forces) HUCK bolts, use NAS1303 bolts.

e. For emergencies, any steel bolt or screw of tensile strength 125.000 psi and nominal hole diameter may be used. This fastener must be replaced within 25 flight hours.

RIVET SELECTION AND SPACING WHEN REPAIRING ALUMINUM ALLOY PARTS

GAGE OF THICKEST PIECE	TYPE OF REPAIR RIVET		PITCH		ROW DISTANCE
	STANDARD	BLIND	MINIMUM	MAXIMUM	
0.020	* 3	**4	0.375	0.500	0.437
0.025	* 4	**5	0.500	0.625	0.500
0.032	* 4	**5	0.562	0.687	0.500
0.040	* 5	**6	0.687	0.812	0.625
0.051	* 5	**6	0.687	0.750	0.562
0.064	*** 6	**6	0.812	1.062	0.625
0.072	*** 6	**6	0.750	1.062	0.687
0.081	*** 6	**6	0.625	0.937	0.687
0.091	*** 6	**6	0.625	0.750	0.687
0.102	10	**6	1.562	1.812	0.875
0.250	10	-	1.187	1.375	0.875

* MS20470AD or MS20426AD.
** MS20600AD or MS20601AD.
*** MS20470DD or MS20426DD AN hex head bolt or steel lockbolts (HUCK MFG. CO).

RIVET SELECTION AND SPACING WHEN REPAIRING CORROSION-RESISTANT STEEL PARTS

GAGE OF THICKEST PIECE	TYPE OF REPAIR RIVET		PITCH		ROW DISTANCE
	STANDARD	BLIND	MINIMUM	MAXIMUM	
0.025	* 4	**5	0.562	0.687	0.500
0.030	* 4	**5	0.437	0.562	0.500
0.036	* 5	**6	0.750	0.875	0.625
0.042	* 5	**6	0.687	0.812	0.625
0.042	* 6	**6	0.875	1.00	0.687
0.060	* 6	**6	0.812	1.062	0.687

* MS20615M or MS20427M.
** MS20600M or MS20601M.

RIVET SELECTION AND SPACING WHEN REPAIRING MAGNESIUM ALLOY PARTS

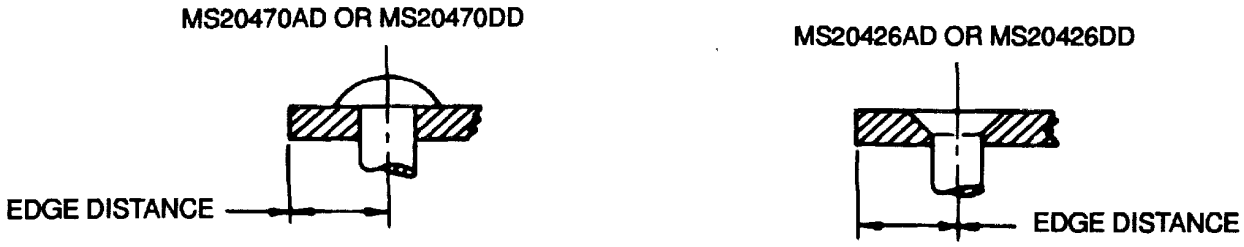
GAGE OF THICKEST PIECE	TYPE OF REPAIR RIVET		PITCH		ROW DISTANCE
	STANDARD	BLIND	MINIMUM	MAXIMUM	
0.020	* 3	**4	0.375	0.500	0.437
0.025	* 4	**5	0.500	0.625	0.500
0.032	* 4	**5	0.562	0.687	0.500

* MS20470B or MS20426B.
** MS20600B or MS20601B.

NOTES: A. ALL DIMENSIONS ARE SHOWN IN INCHES UNLESS OTHERWISE NOTED.
B. WHEN INSTALLING FLUSH-TYPE RIVETS, MATERIAL MUST BE DIMPLE COUNTERSUNK IF 0.063 OR THINNER, AND MACHINE COUNTERSUNK IF THICKER THAN 0.063.
C. MAINTAIN 2D EDGE DISTANCE WHEN INSTALLING ALL RIVETS. SEE SHEET 2 OF THIS FIGURE FOR MINIMUM ACCEPTABLE EDGE DISTANCE.

Figure 2-33. Rivet Spacing, Selection, and Acceptability Limits (Sheet 1 of 6)

MINIMUM ACCEPTABLE RIVET EDGE DISTANCES FOR ALUMINUM ALLOY RIVETS



MINIMUM RIVET EDGE DISTANCES

	NON FLUSH-TYPE RIVETS				FLUSH-TYPE RIVETS			
SHEET THICKNESS	3	4	5	6	3	4	5	6
0.020	0.156	0.218	0.265	--	0.187	0.281	0.328	--
0.025	0.156	0.218	0.265	0.328	0.187	0.281	0.328	0.390
0.032	0.140	0.218	0.265	0.328	0.171	0.281	0.328	0.390
0.040	0.125	0.187	0.234	0.328	0.156	0.250	0.328	0.390
0.051	0.109	0.156	0.203	0.312	0.140	0.218	0.296	0.375
*0.064	--	0.140	0.187	0.265	--	0.203	0.265	0.328
*0.072	--	0.140	0.171	0.250	--	0.203	0.250	0.312
*0.081	--	0.125	--	0.234	--	--	0.234	0.296
*0.102	--	--	--	0.203	--	--	--	0.265

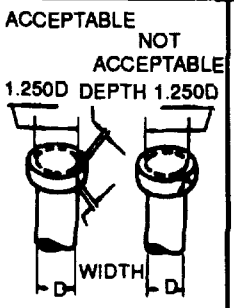
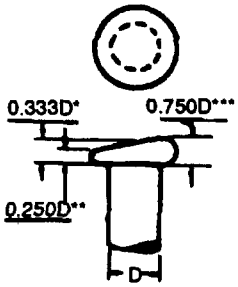
RIVETS DIAMETER IN 32ND INCREMENTS.
* USE MS20470DD OR MS20426DD RIVETS.

NOTES

A. ALL DIMENSIONS ARE IN INCHES.
B. MINIMUM EDGE DISTANCES SHOWN ARE APPLICABLE ONLY TO ROWS OF RIVETS CONTAINING THREE OR MORE RIVETS, AND FURTHER LIMITED TO A MAXIMUM OF 30 PERCENT OF TOTAL RIVETS IN A ROW

Figure 2-33. Rivet Spacing, Selection, and Acceptability Limits (Sheet 2 of 6)

ACCEPTABILITY LIMITS

RIVET DIA IN 32NDS	DIMENSIONS OF SHOP HEAD						CRACKED HEADS	COCKED (BEVELED) HEADS	
	NOMINAL DIAMETER 1.5D	NOMINAL HEIGHT 0.5D	MINIMUM DIAMETER 1.333D	MAXIMUM HEIGHT 0.666D	MAXIMUM DIAMETER 1.666D	MINIMUM HEIGHT 0.333D		MINIMUM **	MAXIMUM ***
	COND 1		COND 2		COND 3		COND 4	COND 5	
3	0.141	0.047	0.122	0.062	0.157	0.031	REFER TO NOTE D.	0.023	0.070
4	0.188	0.063	0.163	0.083	0.208	0.042		0.031	0.094
5	0.234	0.078	0.203	0.104	0.260	0.052		0.039	0.117
6	0.281	0.094	0.245	0.125	0.312	0.063		0.047	0.141
8	0.375	0.125	0.325	0.167	0.416	0.083		0.063	0.188
10	0.469	0.156	0.406	0.208	0.520	0.104		0.078	0.235
12	0.562	0.188	0.487	0.250	0.625	0.125		0.094	0.281
LIMITING DEFECT									
REMARKS			RIVETS NOT CONFORMING TO THE ABOVE LIMITATIONS CAN BE RESTRUCK ON SHOP HEAD IF HEAD THICKNESS PERMITS. REFER TO NOTE B.				REFER TO NOTE D.	MEAN HEIGHT CANNOT BE LESS THAN 0.333D.	

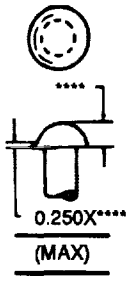
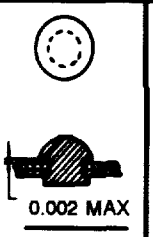
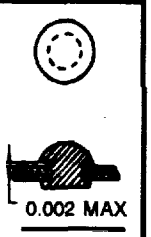
* MEAN HEIGHT OF SHOP HEAD.
** HEIGHT OF SHOP HEAD AT THINNEST PART.
*** HEIGHT OF SHOP HEAD AT THICKEST PART.

NOTES

A. ALL DIMENSIONS ARE IN INCHES.
B. DO NOT RESTRIKE TYPE DD RIVETS AFTER INITIAL DRIVING.
C. THE LIMITS SHOWN ARE THE MINIMUM ALLOWABLE AND SHALL NOT BE APPLIED TO DYNAMICALLY BALANCED COMPONENTS.
D. SEE SHEET 6 OF THIS FIGURE FOR CLARIFICATION OF CRACKED HEADS AND APPLICABLE ACCEPTABLE LIMITS.

Figure 2-33. Rivet Spacing, Selection, and Acceptability Limits (Sheet 3 of 6)

ACCEPTABILITY LIMITS

COND	CONCENTRIC STEPPED OR TRUNCATED CONICAL HEAD	FLATTENED HEAD	OFFSET HEAD	CONCENTRIC WINGED HEAD	CUT HEAD	STEPPED HEAD	INCOMPLETELY DRIVEN (OPEN) HEAD	OPEN HEAD (TILTED)
	COND 6	COND 7	COND 8	COND 9	COND 10	COND 11	COND 12	COND 13
LIMITING DEFECT								
REMARKS	CAN BE USED FOR SHOP HEAD AND RIVET DIA. 0.1875 AND GREATER	THE USE OF A FLAT SET IS PERMITTED ON THE MANUFACTURED HEAD	THE HEAD CAN BE TANGENT TO THE SHANK. NOT ACCEPTABLE IF THE HOLE SHOWS OR FOR USE IN SECTION OF INTEGRAL TANKS	NOT ACCEPTABLE. PROBABLY CAUSED BY THE USE OF A SMALL RIVET SET	MAX. DEPTH IS 1/4 HEAD HEIGHT	STEPPED PART OF HEAD TO BE NOT LESS THAN ALLOWABLE MINIMUM HEAD THICKNESS. NOT NECESSARY TO CHIP OR FILE THE HIGH PART	NOT ACCEPTABLE IF RIVET IS LOOSE OF IF A 0.002 FEELER GAGE CAN BE INSERTED TO SHANK. RIVET CAN BE RESTRUCK TO REDUCE CLEARANCE NOT ACCEPTABLE. FOR USE IN SECTIONS OF INTEGRAL TANKS. REFER TO NOTE B.	

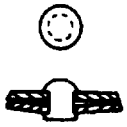
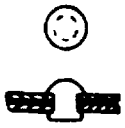
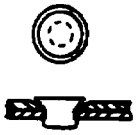
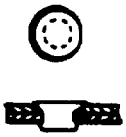
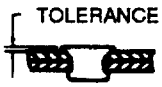
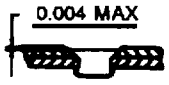
HEIGHT OF MANUFACTURED HEAD.

NOTES

A. ALL DIMENSIONS ARE IN INCHES.
B. DO NOT RESTRIKE TYPE DD RIVETS

Figure 2-33. Rivet Spacing, Selection, and Acceptability Limits (Sheet 4 of 6)

ACCEPTABILITY LIMITS

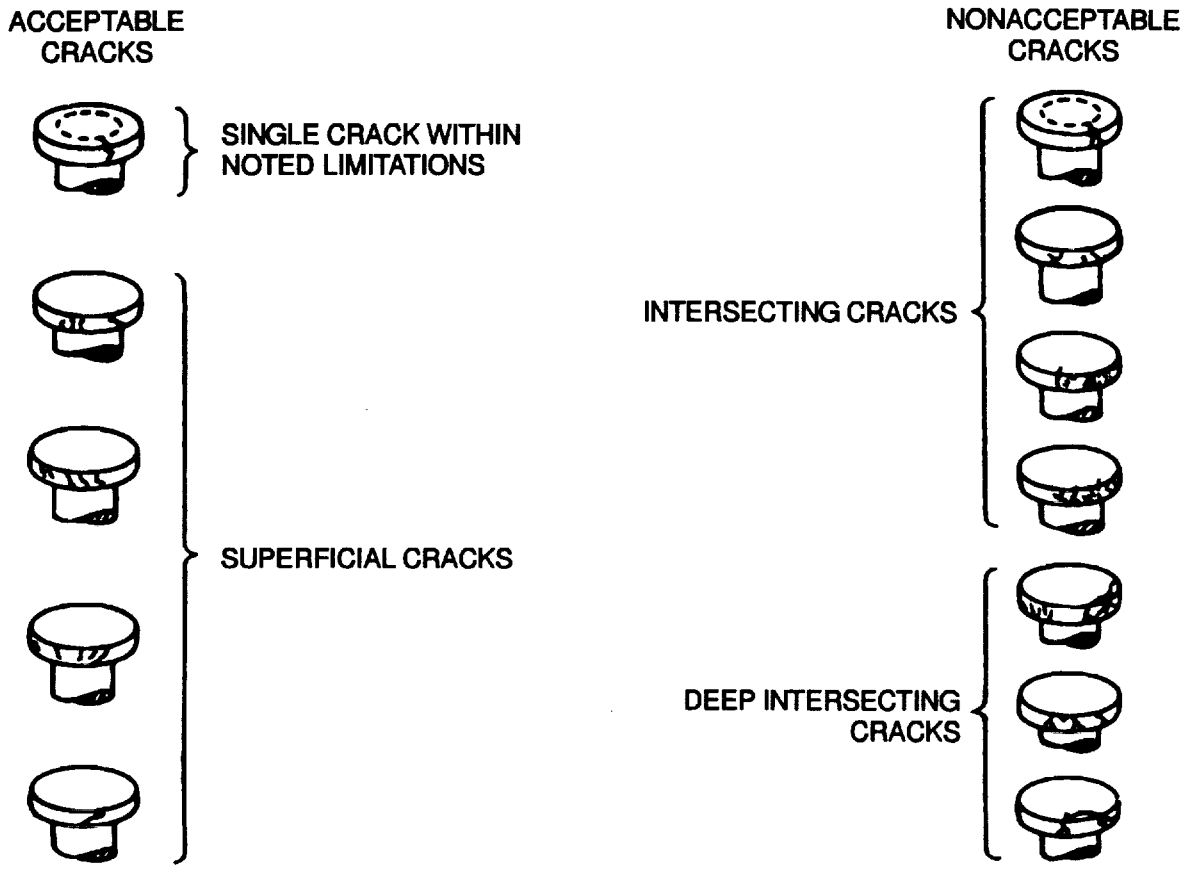
CONDITION	SWELLED RIVET (SHEET BUCKLED AT RIVET)		OPEN	PARTIALLY OPEN	PROJECTING HEAD	DEPRESSED HEAD
	INTERNAL GAP	OPEN GAP	COUNTERSUNK RIVET	COUNTERSUNK RIVET	COUNTERSUNK RIVET	COUNTERSUNK OR DIMPLED RIVET
	COND 14	COND 15	COND 16	COND 17	COND 18	COND 19
LIMITING DEFECT						
REMARKS	ACCEPTABLE IF CASE IS ISOLATED. LIMITED TO NOT MORE THAN THREE NONCONSECUTIVE RIVETS IN A ROW OF TEN RIVETS.	RESTRIKE IF A 0.003 FEELER GAGE CAN BE INSERTED TO SHANK. IF THIS DOES NOT CORRECT, REMOVE RIVET AND CLEAN OUT CHIPS. MAX EDGE GAP 0.015. OPEN GAP NOT ACCEPTABLE IN INTEGRAL TANK SECTIONS. REFER TO NOTE B.	NOT ACCEPTABLE. IF SKIN THICKNESS PERMITS, REMOVE RIVET AND RECOUNTERSINK FOR NEXT LARGER DIAMETER. IF APPROVED EQUIPMENT IS AVAILABLE, THE SHOP HEAD CAN BE FORMED IN THE COUNTERSINK AND ANY PROJECTION SHAVED FLUSH.		TYPICAL MAXIMUM TOLERANCE IS 0.004. SPECIFIC TOLERANCES ARE DEPENDENT UPON LOCATIONS.	REPLACE RIVET IF HEAD IS MORE THAN 0.004, BELOW SURFACE. IF MACHINE COUNTERSUNK AND SKIN THICKNESS PERMITS, REPLACE WITH NEXT LARGER DIAMETER RIVET. FORM SHOP HEAD OF REPLACEMENT RIVETS IN THE COUNTERSINK.

NOTES

A. ALL DIMENSIONS ARE IN INCHES.
B. DO NOT RESTRIKE TYPE DD RIVETS

Figure 2-33. Rivet Spacing, Selection, and Acceptability Limits (Sheet 5 of 6)

ACCEPTABILITY LIMITS



NOTES

A. ALL DIMENSIONS ARE IN INCHES.
B. CRACKED HEADS ARE ACCEPTABLE UNDER THE FOLLOWING CONDITIONS:
   1. DEPTH OF CRACK LESS THAN 1/8 THE SHANK DIAMETER.
   2. WIDTH OF CRACK LESS THAN 1/16 THE SHANK DIAMETER.
   3. LENGTH OF CRACK CONFINED TO AN AREA ON THE HEAD WITHIN A CIRCLE HAVING A MINIMUM DIAMETER OF 1 1/4 TIMES THE SHANK DIAMETER.
   4. CRACKS SHOULD NOT INTERSECT TO FORM A POTENTIAL CAUSE FOR THE LOSS OF A PORTION OF THE HEAD.

Figure 2-33. Rivet Spacing, Selection, and Acceptability Limits (Sheet 6 of 6)

2-10. REPLACE OR SUBSTITUTE BOLTS FOR SCREWS.

a. AN standard hex head or clevis bolts can replace or substitute screws AN525.

b. No AN standard hex head or clevis bolts can be replaced or substituted by screws.

c. Aluminum alloy bolts must not replace or substitute steel screws.

2-11. BOLT HOLE STANDARDS.

a. Before replacing fitting installed with bolts, check holes in fitting and structure for oversize or oval.

b. Bolts 0.0625-inches larger in diameter than original bolts can be used. Only one oversize bolt is allowed for each fitting.

c. Edge distance and hole sizes must be as follows on Table 2-2.

2-12. USE OF NUTS. WASHERS, OR COTTER PIN.

a. Use nut and bolt as follows:

(1) Both nut and bolt are same material.

(2) When damaged, replace with same size, material, and hardness as original nut or bolt

b Use aluminum alloy washers under aluminum alloy nuts and bolts.

c. Use aluminum alloy washers under steel nut on bolt heads, attaching aluminum parts when not under tension forces, or a controlled torque is not required.

d. Use cadmium plated steel washers under steel nuts or bolt heads attaching steel parts.

e. Use cadmium plated steel washers under steel nuts or bolt heads, attaching aluminum alloy parts when bolt is under tension forces, or a controlled torque is required.

f. Steel spring washers may be used a second time if replacements are not available.

g. Cotter pin must not be used a second time.

SECTION III. MAINTENANCE AND REPAIR PROCEDURES

2-13. ADHESIVE BONDING.

a. General. Subsequent paragraphs contain procedures for the mixing and application of bonding agents. These procedures should be used only when referenced in this manual. For non-critical applications the procedures may be used without specific reference. To obtain optimum benefit from the information and tables, select the proper adhesive as follows:

(1) Determine the type of the material to be bonded. Cross reference trade names to the type of material.

(2) Determine the appropriate adhesive systems by matching materials in Table 2-3. An adhesive system may include more than one type of adhesive, since several adhesives may be identical in physical properties and use.

(3) Determine which adhesive system is most suitable. Table 2-4 lists the criteria for each system.

(4) Select the adhesive. Table 2-5 lists the adhesive system numbers and the corresponding acceptable adhesives. Refer to the task number given in the column APPLICATION AND CURE for the acceptable method of bonding.

b. Criteria for Application of Adhesive Systems. This information is applicable to all adhesives and must be strictly adhered to.

(1) If the adhesive or individual components of adhesive have been stored under refrigeration allow adhesive or components to reach 70° F (21.1 °C), prior to blending or use.

Table 2-2. Information on Bolts and Screws

DESCRIPTION	STANDARD PART NUMBER	SIZE AND DIAMETER		HOLE SIZE FIT I LOOSE DRILL		HOLE SIZE FIT II CLOSE DRILL		HOLE SIZE FIT III REAM		HOLES SIZE FIT IV REAM (SPECIAL)		MINIMUM SPACING	MINIMUM EDGE DISTANCE*
Washer Head Screws	AN525-10	10-32	0.190	0.201	-0.000 +0.006	0.191	-0.000 +0.006	0.190	-0.0005 +0.0005		-	11/16	3/8
	AN525-416	114-28	0.250	0.261	-0.000 +0.007	0.250	-0.000 +0.007	0.250	-0.0005 +0.0005		-	3/4	1/2
Countersunk Head Screws	NAS213	10-32	0.189	0.2031	-0.002 +0.004	0.191	-0.02 +0.006		-		-	11/6	3/8
	NAS-214	1/4-28	0.249	0.2656	-0.002 +0.005	0.250	-0.000 +0.007		-		-	3/4	1/2
	NAS8215	516-24	0.3115	0.3281	-0.002 +0.005	0.3175	-0.000 +0.007		-		-	-	-
	NAS216	3/824	0.3740	0.3906	-0.002 +0.005	0.375	-0.000 +0.007		-		-	-	-
Hex Head Bolts	AN3	10-32	0.189	0.201	-.000 +0.006	0.191	-0.000 +0.006	0.190	-0.005 +0.0005		-	11/16	3/8
	AN4	114-28	0.249	0.261	-0.000 +0.007	0.250	-0.000 +0.007	0.250	-0.0005 +0.0005		-	3/4	1/2
	AN5	5116-24	0.312	0.323	-0.000 +0.007	0.3125	-0.000 +0.007	0.3125	-0.0005 +0.0005		-	-	-
	AN6	3/124	0.374	0.386	-0.000 +0.007	0.375	-0.000 +0.007	0.375	-0.0005 +0.0005		-	-	-
	AN7	7/16-20	0.437	0.4531	-0.000 +0.000	0.4375	-0.000 +0.007	0.4375	-0.0005 +0.0005		-	-	-
	AN8	112-20	0.449	0.5156	-0.000 +0.008	0.500	-0.000 +0.008	0.500	-0.005 +0.0005		-	-	-
	AN9	9/16-18	0.562	0.5781	-0.000 +0.006	0.5625	-0.000 +0.008	0.5625	-0.0005 +0.0005		-	-	-
	AN10	56-18	0.624	0.6406	-0.000 +0.008	0.625	-0.000 +0.008	0.625	-0.0005 +0.0005		-	-	-
	AN12	3W4-16	0.749	0.7656	-0.000 +0.010	0.750	-0.000 +0.010	0.750	-0.0005 +0.0005		-	-	-
Clevis Head Bolts	AN23	10-32	0.186	0.199	-0.000 +0.006	0.189	-0.000 +0.006	0.1875	-0.0010 +0.0005	0.1865	-0.0000 +0.0005	11/16	3/8
	AN24	114-28	0.248	0.257	-0.000 +0.007	0.250	-0.000 +0.007	0.250	-0.0015 +.0.0005	0.2485	-0.0000 +0.0005	3/4	1/2
	AN25	5116-24	0.311	0.323	-0.000 +0.007	0.3125	-0.000 +0.007	0.3125	-0.0010 +0.0005	0.3115	-0.0000 +0.0005	-	-
	AN26	38B	0.373	0.386	-0.000 +0.007	0.375	-0.000 +0.007	0.375	-0.0015 +0.0005	0.3735	-0.0000 +0.0005	-	-

*Minimum edge distance applies only to sheet construction.

FIT I	Used to attach brackets and accessories, or where several bob attach sheet or plate material.
FIT II	Used In primary structure where several bolts are used in a rigid joint.
FIT III	Used where one or two bolts are subject to reversible loads, vibration, or both.
FIT IV	Used where minimum clearance is to be maintained and units subjected to shear loads.

Table 2-3. Adhesive System Selection

	ACRYLICS	CELLULOSIC	CORK	FELT	FABRICS	GLASS CERAMICS	LEATHER	MELAMINE	METALS: ALUMINUM AND STEEL	METALS:BRASS AND COPPER	NYLON	PAPER, CARDBOARD	PHENOLICS	POLYCARBONATE	POLYESTERS AND EPOXY LAMINATES	POLYSTYRENE A-B-5	POLYURETHANE FOAM	POLYVINYLCHLORIDE— FLEXIBLE	POLYVINYLCHLORIDE—RIGID	RUBBER: BUNA-N	RUBBER: BUTYL	RUBBER: FLUOROSILICONE	RUBBER: NEOPRENE	RUBBER: POLYURETHANE	RUBBER: SILICONE	RUBBER: VISON	TEFLON	WOOD
ACRYLICS	13																										
CELLULOSIC	2	1																									
CORK	2	1	1.2.5																								
FELT	2	1	1.5	1.5	1																						
FABRICS	2	1	1.2.5	1.2.5																							
GLASS CERAMICS	2	1	1.2.5	1.2.5	1.5	1.5.9																					
LEATHER	2	1	1.2.5	1.2.5	1.5	1.2.5	1.2																				
MELAMINE	2	1	1.5.9	1.5	1.5	5.9	1.5.9	5.9																			
METALS: ALUMINUM AND STEEL	2.5	1	1.5.9	1.5	1.5	1.5.9	1.2.5	1.5.9	1.5.9																		
METALS: BRASS AND COPPER	2	1	1	1.2	1	1.2	1.2	1.2	1.2	1																	
NYLON	2	1.2	1	1.2.5	1.5	1.5.9	1.2.5	1.5	1.5	1	5																
PAPER, CARDBOARD	2	1.2	1.2	1.2	1	1.2	1.2	1.2	1.2	1.2	1.2	1.2															
PHENOLICS	2	1	1.2.5	1.5	1.5	1.5.9	1.5	1.5	1.5	1.2	1.5	1.2	1.5.9														
POLYCARBONATE	2							3	3	3			3	3													
POLYESTERS AND EPOXY LAMINATES	2	1	1.5	1.5	1.5	1.5	1.5	5.10	1.5	1	1.5	1.2.5	5	3	5.9.12												
POLYSTYRENE A-B-5	2	1	1.5	1.5	1.5	1.2.5	1.2.5	1.2.5	1.2.5	1.2	1.2.5	2	1.2.5		1.2.5	1.5											
POLYURETHANE FOAM	2	1.2	1.2	1.2	1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2		1.2	1.2	1.2										
POLYVINYLCHLORIDE — FLEXIBLE	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1									
POLYVINYLCHLORIDE — RIGID		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								
RUBBER: BUNA-N	2	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1			1							
RUBBER: BUTYL	11	1	1	1	1	1	1	1	1	1	1	1	1		1	1					1						
RUBBER: FLUOROSILICONE								6	6	6			6		6							6					
RUBBER: NEOPRENE	11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						1		1		
RUBBER: POLYURETHANE								3	3	3			3	3	3			3	3					3	3		
RUBBER: SILICONE	8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8		7.8	7.8	7									7.8	
RUBBER: VISON								4	4	4			4		4												4
TEFLON	2	1	1.5	1.2.5	1	1.5.9	1.2	5.9	1.5.9	1	3		1.5.9		5.9	1.5	1.2	1	1	1	1		1		7.8		1.5.9
WOOD	2	1	1.2.5	1.2.5	1.5	1.5	1.2.5	1.2.5	1.5.9	1.2	1.5	2	5.9		5	1.5	1.2	1.5	1.5	1	1		1		7.8		5	5

Table 2-4. Adhesive System Criteria

ADHESIVE SYSTEM NO.	NO. OF COMPO-NENTS	PHYSICAL PROPERTIES	POT LIFE AT 21.1 °C (70^0F)	FLASH POINT	SHELF LIFE	STORAGE TEMPERATURE
1	1	A tough, flexible contact adhesive with good peel strength. Good resistance to fuel, oil, and water	N/A	30° F (-1.2°C)	9 months	Below 80° F (26.7°C)
2	1	A flexible water resistant contact cement. Poor resistance to fuel and oil	N/A	54°F (12.2oC)	9 months	40° to 80°F (4.5° to 26.7°C)
3	2	Cures to a tough flexible rubber; resistant to oil	40 to 60 minutes	-	12 months	40° to 80°F (4.5° to 26.7°C)
4	2	Cures to a tough flexible rubber; resistant to fuel and oil	24 hours	50°F (10°C) for primer	12 months for adhesive 90 days for primer	Below 80°F (26.7°C)
5	4	A rigid epoxy adhesive, high in tensile and shear strength. Resistant to fuel and oil; fair resistance to water	2 hours	Part AB: 395°F (201.8°C) Part CD: 468°F (242° C)	2 years	Below 80° F (26.7°C)
6	1	Cures to a flexible rubber; resistant to fuel and oil	30 minutes	50° F (10° C) for primer	8 months for adhesive 12 months for primer	Below 70°F (21.1 °C)
7	2	A water resistant contact adhesive. Cures to a resilient film with very low bond strength. Poor resistance to fuel and oil	2 to 4 hours	60° to 90°F (15.6° to 32.2°C)	6 months for adhesive and catalyst 12 months for primer	Below 75°F (23.9°C)

Table 2-4. Adhesive System Criteria

ADHESIVE SYSTEM NO.	NO. OF COMPO-NENTS	PHYSICAL PROPERTIES	POT LIFE AT 21.1 °C (70^{0}F)	FLASH POINT	SHELF LIFE	STORAGE TEMPERATURE
8	1	Cures to a rubbery solid. Excellent peel strength and good insulating properties. Resistant to water and ozone. Poor resistance to oil and no resistance to fuel	5 to 10	50°F (10°C) for primer	8 months for adhesive 12 months for primer	Below 80° F (26.7°C)
9	2	A rigid adhesive high in tensile and shear strength, but low in peel strength. Good resistance to fuel and oil but poor resistance to water and salt spray	1 hour	150°F (66°C)	2 years	Below 80°F (26.7°C)
10	2	A tough flexible adhesive, resistant to water, fuel and oil. Poor resistance to salt spray	30 minutes	150°F (66°C)	6 months	Below 80°F (26.7°C)
11 SEE NOTE	2	Cures to a tough, flexible rubber with good peel strength. Resistant to fuel, water, and salt spray	1/2 hr for B-1/2 1 hr for B-1 2 hr for B-2 4 hr for B-4 8 hr for B-8	800F (26.7°C)	6 months	400 to 80 F (4.5° to 26.7°C)
12	2	A rigid adhesive high in shear and tensile strength	20 to 30 minutes	395°F (201.8°C)	2 years	Below 80°F (26.7°C)
13	3	A rigid adhesive which will not craze acrylics	10 minutes	-	1 year	Below 75° F (23.9°C)

NOTE

The acceptable adhesives under this system are available in a choice of pot lives. For example, B-1/2 indicates a pot life of 30 minutes, B-1 a pot life of 1 hour, etc.

NOTE

High temperatures and humidity shorten pot life of adhesives, low temperatures will lengthen it.

(2) No addition or omission of ingredients, or deviation from mixing or blending procedures is permitted.

(3) Thinning of adhesives is not permitted unless specifically allowed in the procedure.

(4) All multiple-part adhesives must be blended by weight, within 2-1/2 percent.

(5) All multiple-part adhesives must be blended in dean, metal, glass, polyethylene, or Teflon containers only.

c. Preparation of Bonding Surfaces. Unless otherwise specified, all bonding surfaces except thermoplastic, phenolic, and melamine, must be thoroughly cleaned using dean cloths moistened with methyl-ethyl-ketone. Thermoplastic, phenolic, and melamine must be lightly sanded to remove the glass and then cleaned with aliphatic naphtha.

d. Application of Adhesive System No. 1.

WARNING

The adhesives under this system are toxic and flammable. Work in well-ventilated areas away from flame.

(1) (Refer to Table 2-5 for the list of acceptable adhesives.) Clean the faying surfaces using methyl-ethyl-ketone.

(2) Thoroughly stir adhesive in its own container using a spatula.

NOTE

If adhesive is to be applied by spraying, it may be thinned with methyl-ethyl-ketone.

(3) Brush or spray one coat of the adhesive on each faying surface.

NOTE

On porous surfaces such as textiles and wood, two coats must be applied. The first coat must seal the surface and be completely dry before application of the second coat.

(4) Allow adhesive to dry until tacky, then join surfaces. Apply sufficient pressure to ensure solid contact.

e. Application of Adhesive System No. 3.

WARNING

The adhesives under this system are toxic. Work only in well-ventilated areas.

NOTE

The pot life is 40 minutes for adhesive (item 39, Table 2-5) and 45 minutes for adhesive (item 40, Table 2-5).

(1) (Refer to Table 2-5 for list of acceptable adhesives.) Clean faying surfaces using naphtha.

(2) Stir individual components in their own container then blend them as follows:

(a) If adhesive (item 39, Table 2-5) is being used, blend 100 parts, by weight, of part A with 34 parts, by weight, of part B.

(b) If adhesive (item 40, Table 2-5) is being used, blend 100 parts, by weight, of part A with 40 parts, by weight, of part B.

(3) Apply a coat of primer J (item 116, Table 2-5) to all surfaces except brass or neoprene. Use primer H (item 115, Table 2-5) for brass or neoprene surfaces. Allow primer to dry for 30 to 40 minutes.

NOTE

Primer is not required on polycarbonate plastic surfaces.

(4) Apply the adhesive to both faying surfaces using a brush or a spatula.

(5) Join coated surfaces and apply light pressure.

(6) Allow adhesive (item 39, Table 2-5) to cure for 3 days at 70°F (21 °C). Adhesive (item 40, Table 2-5) cures in 2 days at same temperature.

Table 2-5. Acceptable Adhesives

MANUFACTURER'S DESIGNATION	ITEM NO.	ADHESIVE SYSTEM NO.
1	52	Pro-Seal 590M
	51	M6249
2	50	EC-1128
	38	Tereco No. 68
3	39	Uralane 5716, Parts A and B
	115	Primer H
	116	Primer J
	40	Uralane 8089, Parts A and B
	115	Primer H
	116	Primer J
4	35	PR1710
	117	PR1711 Primer
5	17	Component A: Epon 828 Component B: Epon 812 Component C: Versamid 115 Component D: Versamid 125
	27	Component A: EC-2216 Part A Component B: EC-2216 Part B
	18	Component AB: Hysol 4405 Component CD: Hysol 3538
	20	Component AB: Sa Co 2862 (Component 1) Component CD: Sa Co 28621 (Component 2)
	23	Component AB: 522 Component CD: 542
	21	Component AB: XS-1173625A Component CD: XS-1173625B
	22	Component AB: 183-C-417 Component CD: 183-C-418
	19	Component AB: J1170-1 Component CD: E-18-1
6		37 Q-2-0046
	118	RTV-1200 Primer
7	32	A-4000 Silicone Adhesive
	32	A-4000 Catalyst
	111	A-4014 Primer
8	42	92-018
	118	RTV-1200 Primer
9	31	Epon 901
	45	B-1 Catalyst (Option 1)
	46	B-3 Catalyst (Option 2)

Table 2-5. Acceptable Adhesives - Continued

MANUFACTURER'S DESIGNATION	ITEM NO.	ADHESIVE SYSTEM NO.
	24	190-H-1 Resin 191-C-21 Catalyst
	25	190-H-1 Resin 190-B-10 Catalyst
10	34	Pro-Seal 501
11	26	EC-1239
	33	Pro-Seal 719
	36	PR9021
12	17	Epon 828
	81	Curing Agent DTA
13	53	PS-18 Cement
	48	PS-18 Catalyst
	121	PS-18 Promoter

f. Application of Adhesive System No. 4.

WARNING

The adhesives under this system are toxic and flammable. Work only in well-ventilated areas away from flame.

(1) Refer to Table 2-5 for list of acceptable adhesives. Clean all faying surfaces with methyl-ethyl-ketone.

(2) Brush one uniform coat of primer (item 35, Table 2-5) on all faying surfaces, except rubber surfaces. Allow the primer to dry for 30 to 60 minutes.

(3) Thoroughly blend 20 parts, by weight, of the adhesive base with 1 part, by weight, of accelerator.

NOTE

The pot life of blended adhesive is 24 hours.

(4) Bond rubber to surfaces other than rubber as follows:

(a) Brush one uniform coat of blended adhesive on rubber surface. Allow it to dry for 30 to 60 minutes.

NOTE

- **Both adhesives may be cured in 3 hours by maintaining a temperature of 150 F (66°C).**
- **For best results the adhesive should be 0.002 to 0.003 inch thick.**

(b) Brush a second coat on one of the surfaces and allow it to dry until tacky.

(c) Join coated surfaces with sufficient pressure to ensure solid contact.

(d) Allow adhesive to cure under pressure for 16 hours at 700F (21.1 °C) before handling.

NOTE

Complete cure is achieved after 7 days at 70°F (21.1°C, or in 16 hours at 70°F (21.1 °C), followed by 1 hourat2000F (930C).

(5) Bond rubber to rubber as follows: Brush one uniform coat of the blended adhesive, on both faying surfaces and allow it to dry for 30 to 60 minutes.

g. Application of Adhesive System No. 5.

WARNING

The adhesives under this system are toxic and may produce skin irritation. Work only in well-ventilated areas and avoid bodily contact with the adhesives.

(1) (Refer to Table 2-5 for list of acceptable adhesives). Clean faying surfaces, using methyl-ethyl-ketone.

(2) If adhesive (item 27, Table 2-5) is used, blend 100 parts, by weight, of part B with 140 parts, by weight, of part A.

(3) If adhesive (item 118, Table 2-5) is used, thoroughly blend equal parts of components A and B to form component AB. Thoroughly blend equal parts of components C and D to form component CD. Thoroughly blend equal parts of the combined components AB and CD.

(4) If adhesives (items 16, 18, 21, 19, 20, or 17, Table 2-5) are used, thoroughly blend equal parts of components AB and CD.

(5) Apply a thin uniform coat of blended adhesive to faying surfaces.

(6) Assemble parts and apply sufficient pressure to ensure solid contact.

(7) Remove excess adhesive, using methyl-ethyl-ketone.

(8) Allow adhesive to cure in accordance with one of the following cure cycles.

(a) 30 to 60 minutes 200°F (93^0C).
(b) 2 hours at 170°F (77°C).
(c) 8 hours at 120°F (490C).
(d) 11 hours at 104°F (40°C).
(e) 24 hours at 70 0F (21° C).

h. Application of Adhesive System No. 6.

WARNING

The adhesives under this system are toxic and flammable. Work only in well-ventilated areas away from flame.

(1) (Refer to Table 2-5 for list of acceptable adhesives.) Clean faying surfaces using methyl-ethyl-ketone.

(2) Brush two coats of primer (item 118, Table 2-5) on all surfaces, other than rubber. Allow 45 minutes drying time after each coat.

(3) Brush a uniform coat of adhesive (item 37, Table 2-5) on both faying surfaces, and immediately join coated surfaces.

NOTE

Exposure to air for more than a few minutes will cause adhesive surface to dry, resulting in a poor bond.

(4) Apply sufficient pressure to ensure solid contact but not enough to cause excessive adhesive squeeze out.

NOTE

A bond line thickness of 0.015 inch will give best results.

(5) Allow adhesive to cure for a minimum of 24 hours 70° to 800F (21.1 ° to 26.7°C).

NOTE

Complete bond strength is achieved after approximately 3 days.

i. Application of Adhesive System No. 7.

WARNING

All procedures should be performed in a well ventilated area and away from open flame as the adhesives contain toxic and flammable materials. Hydrogen is generated by catalyzed adhesive during cure. Therefore, all containers of material should be vented to avoid pressure buildup.

(1) (Refer to Table 2-5 for list of acceptable adhesives.) Clean all faying surfaces using methyl-ethyl-ketone.

(2) Brush or spray a thin coat of primer (item 111, Table 2-5) on all bonding surfaces, except silicone rubber.

(3) Allow primer to dry for 30 minutes.

(4) Prepare required amount of adhesive (item 32, Table 2-5) by adding 16 drops of catalyst (item 32, Table 2-5) to 1/2 ounce of adhesive. Stir adhesive constantly while adding catalyst.

NOTE

The pot life of catalyzed adhesive is 2 to 4 hours.

(5) Brush a uniform coat of catalyzed adhesive on all faying surfaces. Allow adhesive to air dry approximately 30 minutes or until tacky.

(6) To ensure solid contact and removal of entrapped air, join faying surfaces with moderate pressure.

(7) Remove pressure and cure adhesive bond for 24 hours at 70°F (21°C). Maximum bond strength is achieved in 4 to 7 days.

j. Application of Adhesive System No. 8.

WARNING

The adhesives under this system are toxic and flammable. Work only in well-ventilated areas away from flame.

(1) (Refer to Table 2-5 for list of acceptable adhesives.) Clean all faying surfaces using methyl-ethyl-ketone.

(2) Brush or spray a liberal coat of primer (item 118, Table 2-5) on all bonding surfaces except silicone rubber.

(3) Allow primer to dry for at least 30 minutes.

(4) Apply a uniform layer of adhesive to both surfaces; immediately join surfaces.

(5) Apply sufficient pressure to ensure solid contact but not enough to cause excessive squeeze out.

NOTE

A bond line thickness of at least 0.015 inch will give best results.

(6) Allow adhesive to cure under contact pressure for 24 hours at 60 to 70° F (21 ° to 27 C). Maximum strength is achieved after approximately 3 days.

k. Application of Adhesive System No. 9 (Option 1).

WARNING

The adhesives under this system may produce skin irritation. Avoid bodily contact with the adhesives.

NOTE

The acceptable adhesives given in Table 2-5 for this adhesive system replace adhesives Epon VI and Epon VIII (items 28 and 29, Appendix C). Existing stocks of these replaced adhesives may be used until depleted.

(1) (Refer to Table 2-5 for list of acceptable adhesives.) Clean faying surfaces using methyl-ethyl-ketone.

(2) Thoroughly blend 100 parts, by weight, of base with 16.5 parts, by weight, of catalyst.

(3) Apply thin coat of adhesive to both faying surfaces, using a spatula.

(4) Join parts, applying sufficient pressure to ensure solid contact.

NOTE

A continuous bead of adhesive squeeze out indicates solid contact (5) Remove excess adhesive using methyl-ethyl-ketone.

(6) Allow adhesive to cure for 12 hours at 70°F (21 °C), for 2 hours at 125°F (52°C), or 1 hour at 200°F (93^{0}C).

l. Application of Adhesive System No. 9 (Option 2).

WARNING

The adhesives under this system may produce skin irritation. Avoid bodily contact with the adhesives.

(1) (Refer to Table 2-5 for list of acceptable adhesives.) Clean faying surfaces using methyl-ethyl-ketone.

(2) Thoroughly blend 100 parts, by weight, of base with 10.9 parts by weight, of catalyst NOTE Thorough blending is extremely important. A 50-gram batch of adhesive will usually require at least 6 minutes of constant, vigorous stirring.

(3) Apply a thin coat of blended adhesive to both faying surfaces.

(4) Join parts, applying sufficient pressure to ensure solid contact.

NOTE

A continuous bead of adhesive squeeze out indicates solid contact.

(5) Remove excess adhesive using methyl-ethyl-ketone.

(6) Cure adhesive for 30 minutes at 240°F (116°C), then increase temperature to 350°F (117°C) and allow adhesive to cure for 1-1/2 hours.

m. Application of Adhesive System No. 10.

WARNING

The adhesives under this system are toxic. Work only in well-ventilated areas.

(1) (Refer to Table 2-5 for list of acceptable adhesives.) Clean all faying surfaces using methyl-ethyl-ketone.

(2) Thoroughly mix each component in its own container.

(3) Thoroughly blend 30 parts, by weight, of accelerator with 100 parts, by weight, of base.

(4) Apply a uniform coat of blended adhesive to both faying surfaces.

(5) Join parts, applying sufficient pressure to ensure solid contact.

(6) Remove adhesive squeeze out using methyl-ethyl-ketone.

(7) Allow the adhesive to cure for 12 hours at 70°F (21 °C). Full cure is attained after 48 hours.

n. Application of Adhesive System No. 11.

WARNING

The adhesives under this system are toxic and flammable. Work only in well-ventilated areas away from flame.

(1) (Refer to Table 2-5 for list of acceptable adhesives.) Clean all faying surfaces, using methyl-ethyl-ketone.

(2) Thoroughly blend base with activator in accordance with instructions on container.

(3) Apply a thin uniform coat of adhesive to both faying surfaces.

(4) Assemble parts immediately, apply sufficient pressure to ensure solid contact.

(5) Allow adhesive to cure at 70°F (21°C) for one of the following periods of time, depending upon class of adhesive used;

(a) Class B-1/2 - 16 hours
(b) Class B-1 - 36 hours
(c) Class B-2 - 48 hours
(d) Class B-4 - 60 hours

NOTE

The above cure times are for handling only. Full cure is not achieved for 7 days or more.

o. Application of Adhesive System No. 1P.

WARNING

The adhesives under this system are toxic. Work only in well-ventilated area.

(1) (Refer to Table 2-5 for list of acceptable adhesives.) Clean faying surfaces using naphtha. Roughen area slightly with abrasive paper (item 39, Appendix C).

(2) Place 9 parts, by weight, of curing agent (item 81, Appendix C) and 100 parts, by weight, of adhesive (item 17, Table 2-5) into a dean container and mix thoroughly.

(3) Brush one coat of adhesive on each ply of repair part.

(4) Assemble plies while still wet, on a Teflon sheet.

(5) Brush final coat of adhesive on assembled plies.

(6) Place assembled plies, with Teflon sheet exposed, on area to be repaired.

(7) Remove entrapped air by working a roller across the patch.

(8) Apply a slight pressure to repaired area with wooden blocks and C-clamps.

(9) Allow repaired area to cure 4 hours at 70°F (21°C) or use head lamps and cure area at 1500 to 170°F (66° to 77°C) for 1 hour. Remove blocks, clamps, and Teflon sheet.

p. Application of Adhesive System No. 13.

WARNING

The adhesives under this system are toxic and may be irritating to the skin. Work only in well-ventilated areas and avoid bodily contact with adhesives.

(1) (Refer to Table 2-5 for list of acceptable adhesives.) Roughen faying surfaces to be bonded, using abrasive paper (item 9, Appendix C).

(2) Clean faying surfaces using aliphatic naphtha. Refer to paragraph 2-13c.

(3) Allow area to dry thoroughly prior to applying cement.

(4) Apply masking tape (item 145, Appendix C) to adjacent areas.

(5) Place 4 fluid ounces of cement resin into a dean earthenware container.

(6) Add one capsule (2.4 grams) of catalyst (item 48, Table 2-5) to cement resin and stir resin until capsule is completely dissolved.

NOTE

This mixture can be kept usable for a period not to exceed 24 hours by refrigeration at 40°F (4°C) or lower.

(7) Place 5-cubic-centimeters of promoter (Item 121, Table 2-5) into a dean container.

WARNING

Do not mix promoter directly with catalyst as a violent reaction will result. The cement contains chemicals which may irritate the skin. If contact with skin is made, wash the area immediately with isopropyl alcohol (item 93, Appendix C) and flush with soap (item 140, Appendix C) and water. All operations should be performed in a well-ventilated room as vapors may be toxic.

(8) Add promoter to mixture of cement resin and catalyst, and stir ingredients thoroughly.

NOTE

The pot life of adhesive mixture with promoter added is approximately 10 minutes.

(9) Brush on a thin, uniform coat of cement on both faying surfaces.

(10) Join coated surfaces immediately. Hold them together gently for 15 to 30 seconds before applying pressure.

(11) Apply equally distributed pressure with clamps.

(12) Scrape excess cement onto masked area.

(13) Allow assembly to set for 2 hours.

(14) Remove clamps. Allow assembly to cure for 2 hours at a minimum of 70°F (21°C).

(15) For final cure, allow assembly to set for 4 hours at 148°F (64°C).

2-14. APPLICATION OF TAPES. Subsequent paragraphs contain information on the various tapes used on the structure and component parts.

a. Application of Antichafing Tape. This tape is used if a smooth, nonabrasive surface is desired over rivet heads and seams.

CAUTION

Exposure of antichafing tape to sunlight for 4 hours will destroy its adhesive qualifies. Storage of unused tape should be in a cool dark area.

(1) Remove all burrs, rough and sharp edges, and loose primer in area to be taped.

(2) Using an air blast, brush or dry cloth, remove loose metal clips, dust, and primer scale.

(3) Using a cloth moistened with naphtha, wipe all surfaces to be taped.

NOTE

Solvent may be substituted for naphtha. The solvent must be wiped dry and not allowed to evaporate on surfaces.

(4) Repeat step c. at least two times or until the surfaces are clean.

(5) Cut a length of tape as follows:

(a) if protrusions are less than 1/4-inch high, the tape should be cut to extend 1 to 2 inches each side of protrusion.

(b) If protrusions are higher than 1/4-inch, the tape should be cut to extend 1-1/2 to 2 inches each side of protrusion.

NOTE

Lengths of tape should be cut to allow protective paper line to extend beyond cut edge.
This will make it easier to remove tape. Continuous lengths of tape should be used whenever possible.

(6) Remove liner from tape. The activator may have a harmful effect on some materials. Therefore, precautionary measures should be taken to prevent activator or items dampened with activator from contacting other materials.

(7) Pour a sufficient amount of activator (item 16, Appendix C) into a pan.

(8) Use a wooden applicator to apply activator with a wiping motion. Apply activator to adhesive side of tape.

(9) Apply activated tape to cleaned surfaces by starting tape at one end and pressing it down firmly. Smooth tape down with a wooden scraper and work tape from center to edge with sufficient pressure to eliminate air pockets and wrinkles and to ensure good adhesion.

NOTE

All edges must be firmly bonded to surface. Small blisters and voids must be kept to a minimum. Voids around rivet and screw heads are permissible.

b. Removal of Antichafing Tape. Rejected or improperly applied tape should be removed as follows:

WARNING

Methyl-ethyl-ketone is toxic. Work in a well ventilated area. Avoid inhaling fumes and prolonged contact with the skin. Wash thoroughly after using. Wear protective clothing.

(1) Saturate tape with methyl-ethyl-ketone. Allow a few minutes for tape to soak. Then, carefully peel tape from surface.

(2) Apply new tape. Refer to paragraph 2-14a.

c. Application of Velcro Tape. This procedure is used for the application of precoated adhesive-backed or uncoated Velcro hook and pile tape. This fastener is used for attachment and repair of sound-proofing blankets and coverings.

(1) Clean surface to which tape is to be applied. Use cloths soaked with solvent (item 144, Appendix C). Wipe surface with dry cloths before solvent evaporates.

(2) Apply masking tape (item 145, Appendix C) around surface to be covered.

NOTE

For best results surface should be bare of prime-coat.

(3) Brush a coat of adhesive (item 41, Appendix C) on masked surface and tape.

NOTE

The shelf life of adhesive and tape is 6 months when stored at 60° to 80° F (16° to 27°C).

(4) Press tape in place within 5 minutes of adhesive application, but not sooner than 1 minute.

(5) If tape is too long, insert a piece of wood between tape and coated surface. Trim tape with a sharp knife.

NOTE

Tape must be applied to fabrics by stitching with nylon thread in accordance with Fed. Std. 751.

(6) Check for acceptable bonding by gently pulling edges of tape with fingernail.

NOTE

Small voids around rivet and screw heads are permissible.

2-15. APPLICATION OF FILLERS. Refer to TM 55-1520-240-23.

2-16. TYPICAL REPAIRS. Subsequent text contains procedures for, and referenced illustrations show examples of oilcan repair, material substitution, repairs for skin and web, formed parts, extruded parts, attachment holes, eliminating gaps and leveling installations, spotwelded parts, canvas and webbing, aluminum tubing, rubber seals, hinges, and restoring transparent plastics. In most cases, these procedures and examples are referenced from specific repair paragraphs and figures throughout the manual. They are to be used as a guide when making repairs. If the procedures and examples are not referenced, they can be used within limitations noted.

a. Oilcan Repair. Loose skins, skins having unacceptable oilcans, and trapped skin should be repaired as directed in subsequent paragraphs. Repair to the body skin below waterline 0 must be sealed watertight.

(1) Trapped skin, evidenced by an outward or inward bulge between attaching hardware and caused by improper repair techniques is not acceptable. Correct this condition by removing attaching hardware as required allowing skin to shift, and installing next larger size fasteners.

(2) Loose skins and skins having unacceptable oilcan should be repaired using stiffeners with the following exceptions:

(a) Stiffeners are not permitted within area on bottom of cabin fuselage section between lower longer-ons and sta 160 and 482.

(b) Stiffeners are not permitted externally on the helicopter.

(c) Stiffeners are not permitted in areas where they will interfere with installation and function or operation of any component.

(3) Determine locations where a minimum number of stiffeners will correct oilcanning or loose skin.

(4) Add stiffeners as required. Stiffeners must be attached at each end to primary structure, such as longeron to longeron or frame to frame. The method of attachment should eliminate discrepancy without transferring it to another area. Comply with following methods:

(a) Stiffeners must be next heavier thickness than skin to which they are attached and are to be formed from 2024-T3 cad aluminum alloy. Stiffeners exceeding 30 inches in length must be made from Alcoa 33372 or equivalent extrusions.

(b) If attaching clips are used, make from 2024-T2 dad aluminum alloy. They must be same thickness as stiffener to which they are attached.

(c) Install rivets MS20470AD4 at approximately 3/4-inch pitch for attachment of stiffeners, not thicker than 0.040 inch.

(d) Install rivets MS20470AD5 at approximately 7/8-inch pitch for attachment of stiffeners thicker than 0.040 inch.

(e) Seal and refinish stiffeners and clips to match adjacent structure.

CAUTION

Substitution of materials can create a corrosion hazard. If the substitute material is different than original part (as when a 7075-T6 aluminum extrusion is reinforced with a 4130 steel strap), failure to insulate metals from direct contact with each other will permit electrolytic corrosion to attack repaired area. Insulation of dissimilar metals, is extremely important.

b. Material Substitution. If repair cannot be made from the same material as original part, select a substitute material. Refer to Table 2-6 for a list of substitute materials and an example of how to use this table. When material for a non-load-bearing part, such as a filler, is not available in thickness required, build up to desired thickness with two or more pieces. Substitutions of this type are not permitted-for loadbearing parts, such as reinforcements and insertions.

2-17. SKIN AND WEB REPAIRS. (See Figure 2-34.) Subsequent paragraphs contain procedures and limitations for coin patch repair for skins, backing plate repair for webs. (See TM 1-1500-204-23 for rivet type and spacing.) Maintain a minimum clearance of 5/8 inch between cutouts and edge of replacements, unless otherwise noted. Insulate dissimilar metals.

a. Coin Patch Repair for Skins. This repair is for dents, punctures, tears, and small cracks that can be cut out from 1/2 inch to 1 1/2-inch diameter. No more than two patches are permitted for each skin panel. Panels, not less than 15 by 50 inches, between longer longerons and sta 160 and 482, may contain a maximum of four patches. All patches must clear adjacent structural members by 1/8 inch and be sealed.

(1) Cut out damage and make a coin patch of same material and thickness as skin. The patch should have a diameter 5/16 inch less than cutout.

(2) Make a circular backing plate three times diameter of coin patch and from same material but in next heavier thickness.

(3) Smooth edges of cutout, coin patch, and backing plate with a file.

(4) Center coin patch on backing plate and drill rivet holes through coin patch and backing plate.

NOTE

The size and number of rivet holes are determined by size of rivet to be used. In most cases rivets MS20470AD3 can by used.

(5) Install and set rivets.

(6) Spray or brush a thin coat of primer (item 113, Appendix C) on all surfaces of coin patch. Allow primer to dry.

(7) Insert coin patch in cutout from inside skin. Drill rivet holes through backing plate and skin.

NOTE

Use rivets MS20470AD4, for 0.025-inch thick skin, and rivets MS20470AD5, for skin 0.03 inch or thicker. Rivet pitch should be approximately 3/4 inch.

(8) Remove coin patch from cutout after establishing a rivet pattern and seal faying surfaces of cutout and coin patch.

(9) If damage is less than 1/2 inch and larger than 3/16 inch and located over an undamaged frame or stiffener, repair damage by omitting backing plate. Rivet coin patch to frame or stiffener.

(10) Install and set rivets.

NOTE

Repair magnesium skin as directed in preceding steps, providing dissimilar metals are insulated. Use rivets MS20470B.

b. Backing Plate Repair for Webs. This repair is intended for damage occurring in webs, such as holes, tears or sharp dents that can be cut out. It must be repaired within an area not to exceed 1-1/2-inch diameter. When repaired, it must clear adjacent structure by 1/8 inch. Not more than two repairs are permitted in any web.

(1) Remove damage by cutting or drilling. The diameter of cutout should not be less than 3/16 inch.

(2) Smooth edges of cutout with a file.

(3) If damage can be removed by drilling, drill a 3/16-inch-diameter hole or smaller. Insert a rivet MS20470-AD and install a washer AN960D of a size to fit shank of rivet. Set rivet.

(4) If diameter of cutout is larger than 3/16 inch, make a circular backing plate from same material as web, in next heavier thickness.

NOTE

The backing plate must be large enough to cover cutout and overlap web a minimum of four times diameter of rivet. If backing plate cannot be circular, all comers must have a minimum radius of 1/4 inch.

(5) Smooth edges of backing plate with a file.

(6) Center backing plate over cutout. Drill a rivet pattern having a pitch of 1/2 to 3/4 inch. The number of rivet holes will be determined by size of backing plate. Maintain a pattern that will allow a minimum edge distance of two-times diameter of rivet. Use rivets MS20470AD4, for webs not thicker than 0.025 inch. Use rivets MS20470AD5, for webs 0.03 inch or thicker. Use monel rivets for corrosion-resistant steel webs.

(7) Apply a thin even coat of primer (item 113, Appendix C) to faying surfaces of backing plate and web. Allow primer to dry.

(8) Assemble backing plate to web by installing and setting rivets.

Table 2-6. Substitute Materials

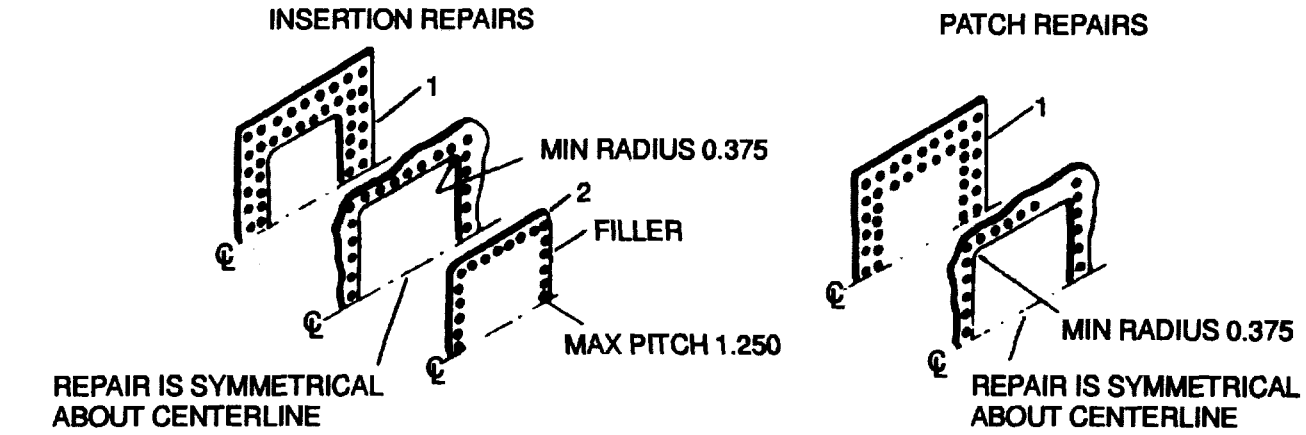
ORIGINAL MATERIAL	FACTORS TO DETERMINE THICKNESS OR ALUMINUM SUBSTITUTE MATERIAL										
	2014 T6	2024 T3	2024 T36	2024 T36*	2024 T81*	2024 T86*	5052 H32	5052 H34	5052 H36 H38	6061 T6	7075 T6
ALUMINUM											
2024-T3*/T4*	1.00	1.00	1.00	1.00	1.00	1.00	1.85	1.71	1.54	1.53	1.00
2024-T4	↕	↕	↕	↕	↕	↕	2.00	1.82	1.67	1.63	↕
5052-H34	↕	↕	↕	↕	↕	↕	1.20	1.00	1.00	1.00	↕
6061-T6	1.00	1.00	1.00	1.00	1.00	1.00	1.75	1.46	1.46	1.00	1.00
7075-T6	1.20	1.81	1.37	1.46	1.23	1.15	3.35	2.79	2.79	1.92	1.09
7075-T6*	1.13	1.68	1.27	1.35	1.13	1.13	3.10	2.58	2.58	1.77	1.00
7178-T6	1.31	1.97	1.49	1.81	1.51	1.20	3.65	3.04	3.18	2.08	1.18
7178-T6*	1.20	1.81	1.37	1.46	1.38	1.15	3.35	2.80	2.91	1.91	1.08
MAGNESIUM											
AZ31B1-H24	1.00	1.00	1.00	1.00	1.00	1.00	1.10	1.00	1.00	1.00	1.00
HK31-H24	1.00	1.00	1.00	1.00	1.00	1.00	1.26	1.15	1.00	1.00	1.00

	FACTORS TO DETERMINE THICKNESS OF STEEL SUBSTITUTE MATERIAL								
	17-7 TH1050	301, 302 321, 347 ANL	301, 302 1/4H	301 1/2H	301 3/4H	301 H	4130 N	4130 UTS 125	4130 UTS 150
ALUMINUM									
2024-T3*/T4*	1.00	1.06	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2024-T4	↕	1.00	↕	↕	↕	↕	↕	↕	↕
5052-H34	↕	1.00	↕	↕	↕	↕	↕	↕	↕
6061-T6	↕	1.00	1.00	1.00	↕	↕	↕	↕	↕
7075-T6	↕	1.91	1.56	1.16	↕	↕	↕	↕	↕
7075-T6*	↕	1.77	1.44	1.07	↕	↕	↕	↕	↕
7178-T6	↕	2.09	1.70	1.26	↕	↕	↕	↕	↕
7178-T6*	↕	1.91	1.56	1.16	↕	↕	↕	↕	↕
MAGNESIUM									
AZ31B1-H24	↕	1.00	1.00	1.00	↕	↕	↕	↕	↕
HK31-H24	↕	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
STEEL									
I7-7 TH1050	↕	4.62	3.77	2.80	2.14	1.91	2.32	1.57	1.39
301, 302 ANL	↕	1.00	1.00	1.00	1.00	1.00	1.07	1.00	1.00
301, 302 1/4H	↕	1.67	1.00	1.00	↕	↕	1.78	1.29	1.14
301 1/2H	↕	2.00	1.35	1.00	↕	↕	2.14	1.55	1.37
301 3/4H	1.00	2.34	1.77	1.31	1.00	↕	2.50	1.80	1.60
301H	1.03	2.47	1.98	1.47	1.12	↕	2.64	1.91	1.69
321 ANL, 347	1.00	1.00	1.00	1.00	1.00	↕	1.00	1.00	1.00
1020, 1025	↕	1.03	1.00	1.00	1.00	↕	1.00	↕	↕
4130 N	↕	2.00	1.63	1.21	1.00	1.00	1.00	↕	↕
4130 UTS 125	↕	3.23	2.63	1.95	1.49	1.33	1.62	1.00	↕
4130 UTS 150	1.00	4.29	3.37	2.50	1.91	1.11	2.07	1.28	1.00

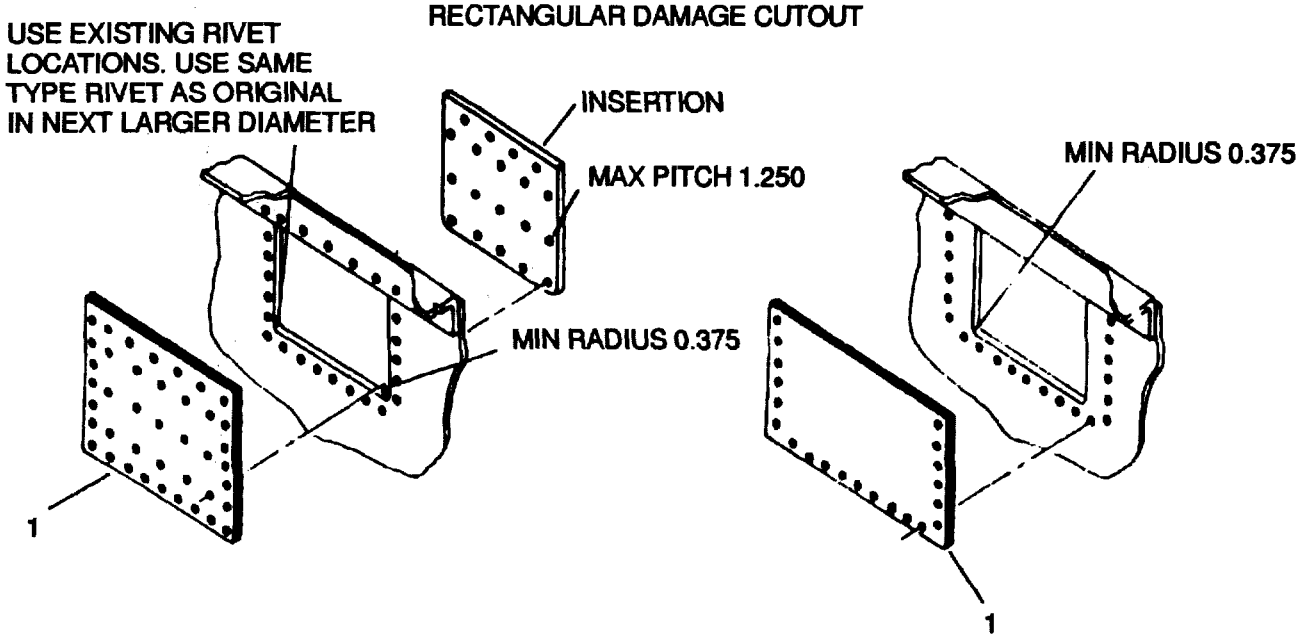
*ALCLAD, ALL OTHER ALUMINUM ALLOYS LISTED ARE BARE SHEET

To determine thickness of substitute material, multiply thickness that would be required if original material were used, by the substitution factor. Example: If repair should be made from 0.040-inch thick 7075-T6 clad aluminum alloy and only 2024-T3 clad is available, the substitution factor (found by reading across the 7075-T6 clad line under Original Material to the 2024-T3 clad column under Substitute to Material) is 1.68. Therefore, 0.040 x 1.68 = 0.06720. Use 0.071-inch thick 2024-T3 clad aluminum alloy.

LIGHTLY STRESSED REPAIRS



RECTANGULAR DAMAGE CUTOUT



DAMAGE NEAR EXISTING STRUCTURE

REPAIR PARTS

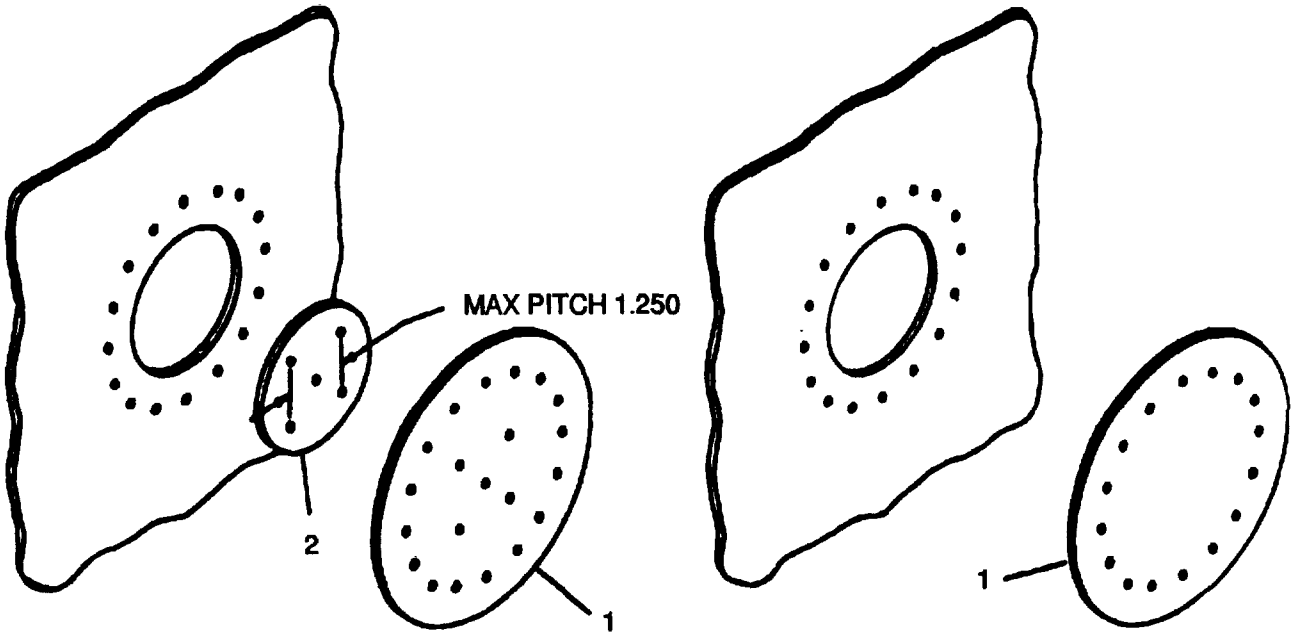
1. REINFORCEMENT. SEE APPLICABLE FIGURE FOR REPAIR MATERIAL AND THICKNESS. USE SAME MATERIAL AND THICKNESS AS ORIGINAL IF SPECIFIC REPAIR FIGURE DOES NOT EXIST.
2. REPLACEMENT. USE SAME MATERIAL AND THICKNESS AS ORIGINAL. SEE APPLICABLE FIGURE FOR ORIGINAL.

NOTE

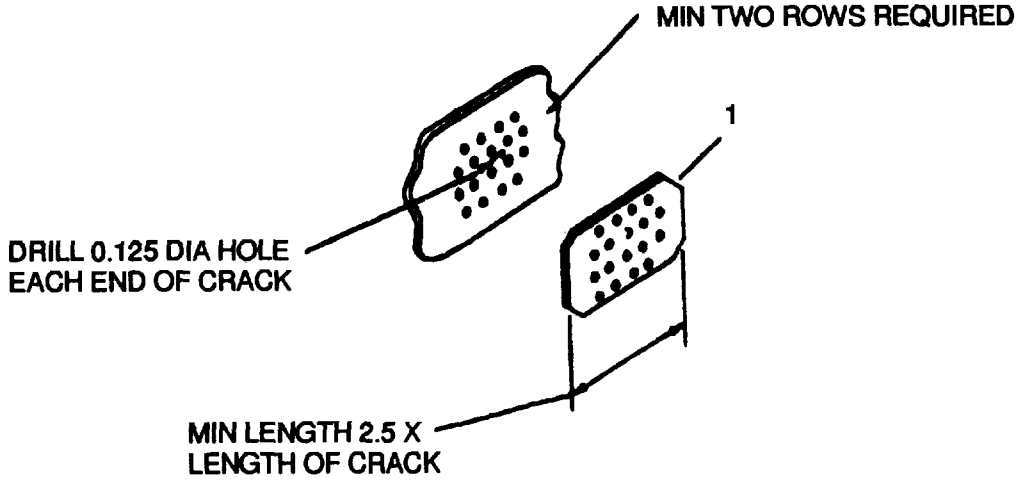
ALL DIMENSIONS ARE IN INCHES

Figure 2-34. Skin and Web Repairs (Sheet 1 of 9)

LIGHTLY STRESSED REPAIRS



CIRCULAR DAMAGE CUTOUT



CRACK

REPAIR PARTS

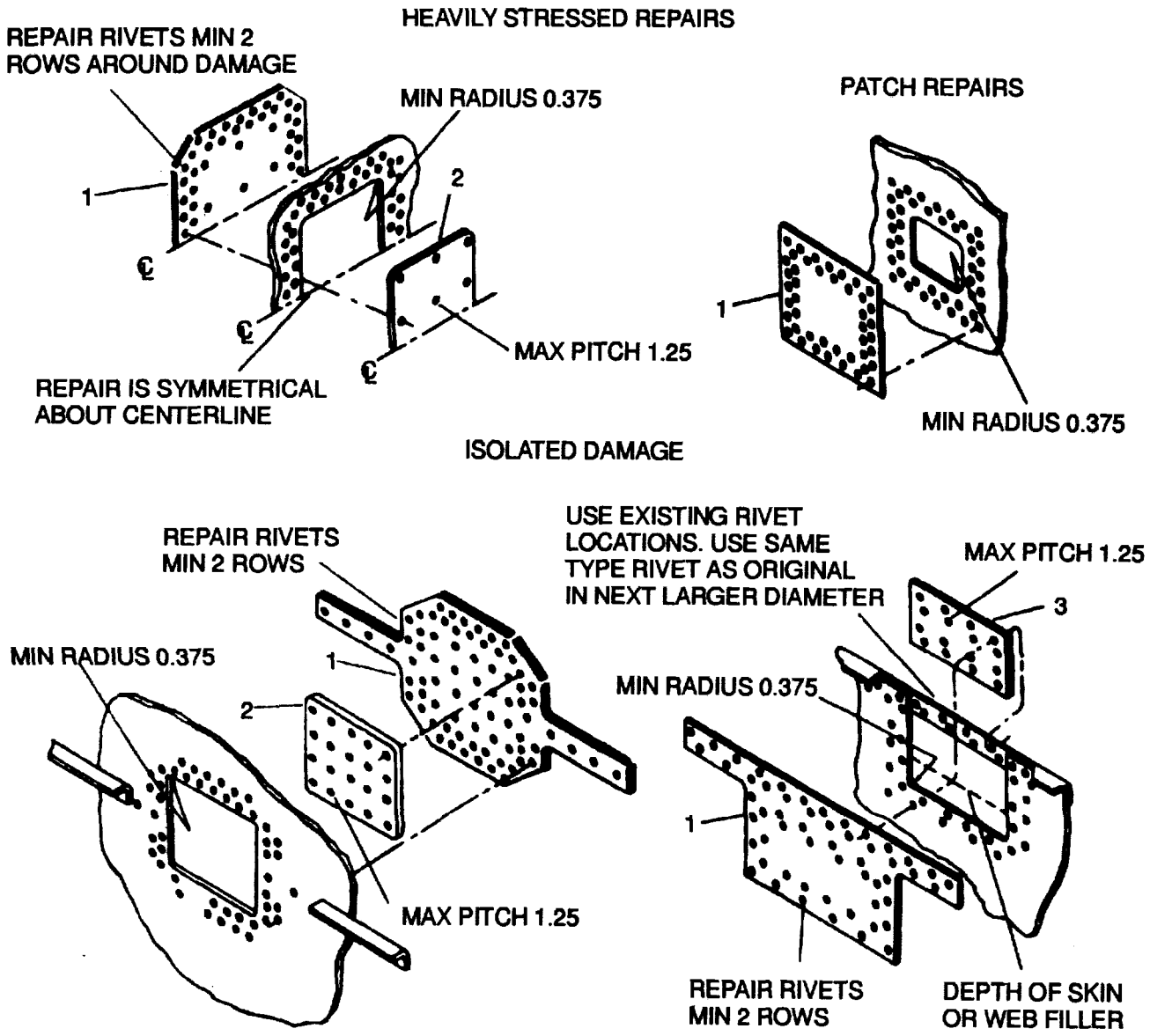
1. REINFORCEMENT. SEE APPLICABLE FIGURE FOR REPAIR MATERIAL AND THICKNESS. USE SAME MATERIAL AND THICKNESS AS ORIGINAL IF SPECIFIC REPAIR FIGURE DOES NOT EXIST.

2. REPLACEMENT. USE SAME MATERIAL AND THICKNESS AS ORIGINAL. SEE APPLICABLE FIGURE FOR ORIGINAL.

NOTE

ALL DIMENSIONS ARE IN INCHES

Figure 2-34. Skin and Web Repairs (Sheet 2 of 9)



REPAIR PARTS

1. REINFORCEMENT. SEE APPLICABLE FIGURE FOR REPAIR MATERIAL AND THICKNESS. SEE SHEET 6 OF THIS FIGURE IF A SPECIFIC REPAIR FIGURE DOES NOT EXIST.
2. REPLACEMENT. USE SAME MATERIAL AND THICKNESS AS ORIGINAL. SEE APPLICABLE FIGURE FOR ORIGINAL.
3. FILLER. USE SAME MATERIAL AND THICKNESS AS ORIGINAL. SEE APPLICABLE FIGURE FOR ORIGINAL.

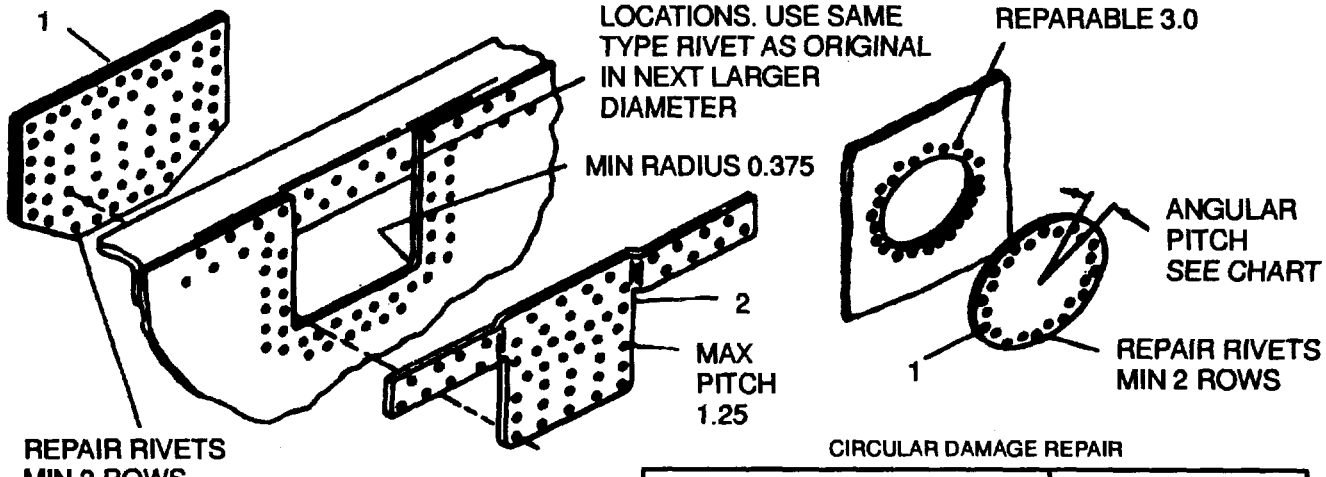
NOTES

A. ALL DIMENSIONS ARE IN INCHES
B. A STRAP PATCH, SHOWN ON SHEET 5 OF THIS FIGURE, CAN BE USED AS AN ALTERNATE FOR THE TABS SHOWN ON REINFORCEMENTS (1)

Figure 2-34. Skin and Web Repairs (Sheet 3 of 9)

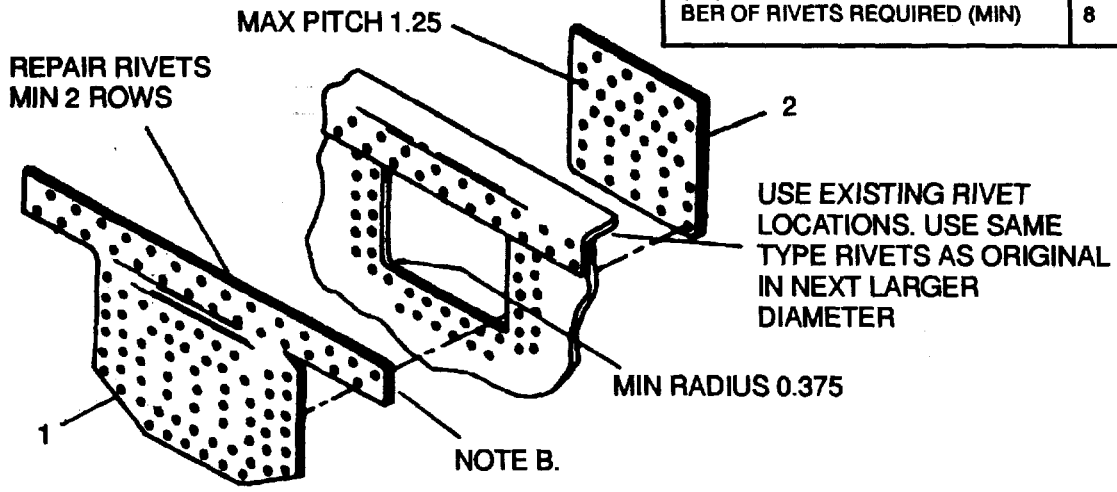
HEAVILY-STRESSED SKIN REPAIRS

INSERTION REPAIRS



CIRCULAR DAMAGE REPAIR

DESIGNATION	HOLE DIAMETER		
	1.0	2.0	3.0
OD OF CIRCULAR REINFORCEMENT	2.50	5.0	7.50
DIAMETER OF OUTER RIVET CIRCLE	1.750	4.0	6.50
DIAMETER OF INNER RIVET CIRCLE	-	3.0	4.0
(AP) ANGULAR RIVET PITCH	45°	22°30'	15°
NUMBER OF RIVETS REQUIRED (MIN)	8	16	24



DAMAGE NEAR ADJACENT MEMBER

REPAIR PARTS

1. REINFORCEMENT. SEE APPLICABLE FIGURE FOR REPAIR MATERIAL AND THICKNESS. SEE SHEET 6 OF THIS FIGURE IF A SPECIFIC REPAIR FIGURE DOES NOT EXIST.
2. REPLACEMENT. USE SAME MATERIAL AND THICKNESS AS ORIGINAL. SEE APPLICABLE FIGURE FOR ORIGINAL.

NOTES

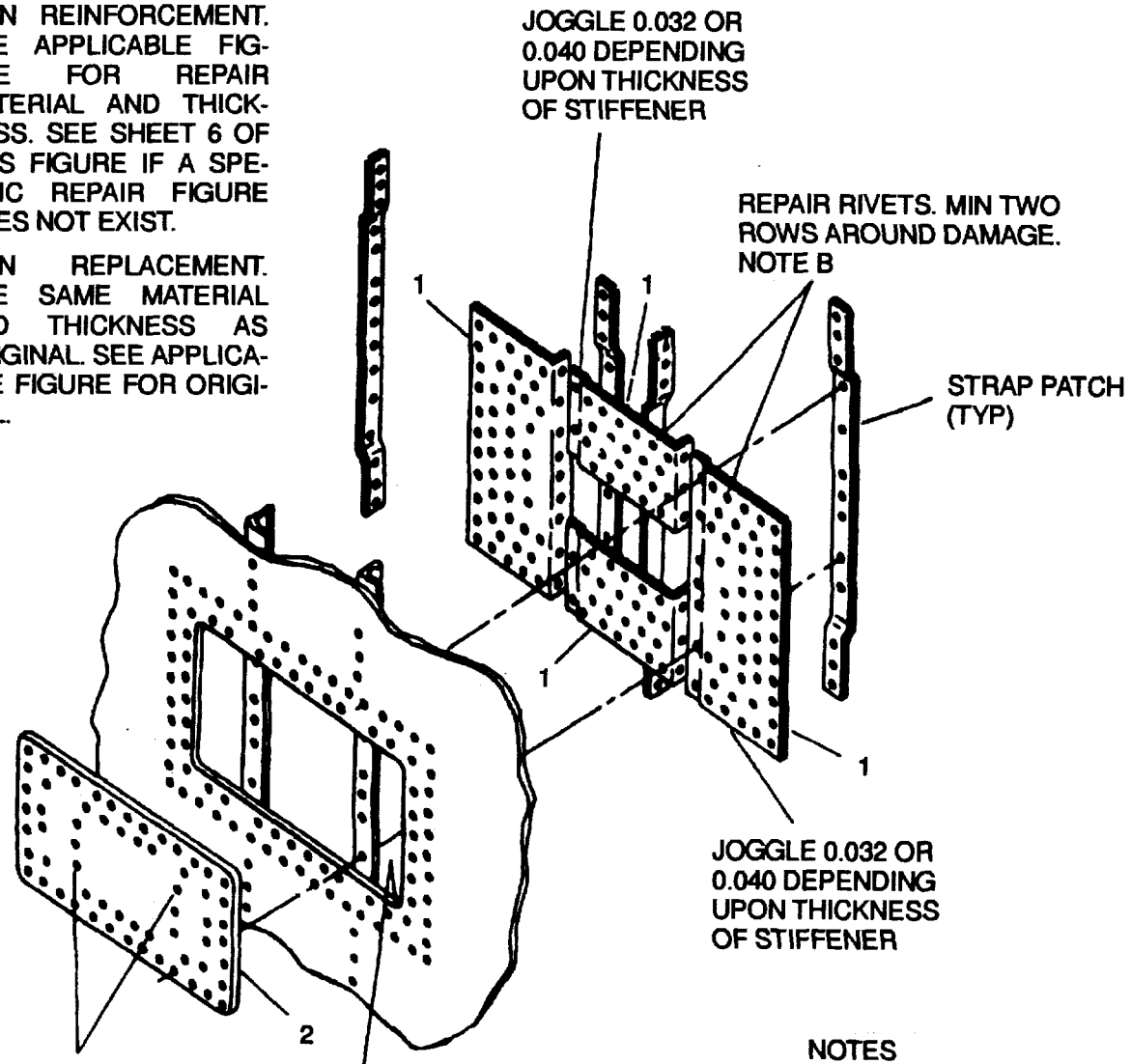
A. ALL DIMENSIONS ARE IN INCHES
B. A STRAP PATCH, SHOWN ON SHEET 5 OF THIS FIGURE, CAN BE USED AS AN ALTERNATE FOR THE TABS SHOWN ON REINFORCEMENTS (1)

Figure 2-34. Skin and Web Repairs (Sheet 4 of 9)

INSERTION SKIN REPAIR ACROSS STIFFENERS

REPAIR PARTS

1. SKIN REINFORCEMENT. SEE APPLICABLE FIGURE FOR REPAIR MATERIAL AND THICKNESS. SEE SHEET 6 OF THIS FIGURE IF A SPECIFIC REPAIR FIGURE DOES NOT EXIST.
2. SKIN REPLACEMENT. USE SAME MATERIAL AND THICKNESS AS ORIGINAL. SEE APPLICABLE FIGURE FOR ORIGINAL.



NOTES

A. ALL DIMENSIONS ARE IN INCHES.

B. WHERE DAMAGED AREA CROSSES A STIFFENER OR STRINGER, WIDEN THE REINFORCEMENT TO FORM TABS, OR ADD A STRAP PATCH, AS SHOWN. PICK UP A TOTAL OF FIVE RIVETS EACH SIDE FOR SINGLE-ROW PATTERNS, EIGHT RIVETS EACH SIDE FOR MULTIPLE-ROW PATTERNS.

Figure 2-34. Skin and Web Repairs (Sheet 5 of 9)

REINFORCEMENT SELECTION

2024-T3 AND T4 REPAIR WITH 2024-T3, AND 7075-T6 REPAIR WITH 7075-T6

ORIGINAL THICKNESS	REINFORCEMENT THICKNESS
0.012	0.016
0.016	0.020
0.020	0.025
0.025	0.032
0.032	0.040
0.040	0.050
0.050	0.050
0.063	0.063
0.071	0.071
0.080	0.081
0.090	0.090
0.100	0.100
0.125	0.125

7075-T6 REPAIR WITH 2024-T3

ORIGINAL THICKNESS	REINFORCEMENT THICKNESS
0.012	0.020
0.016	0.025
0.020	0.032
0.025	0.040
0.032	0.050
0.040	0.063
0.050	0.071
0.063	0.080
0.071	0.090
0.080	0.100
0.090	0.125
0.100	0.160
0.125	0.160

301 AND 302 REPAIR WITH SAME MATERIAL

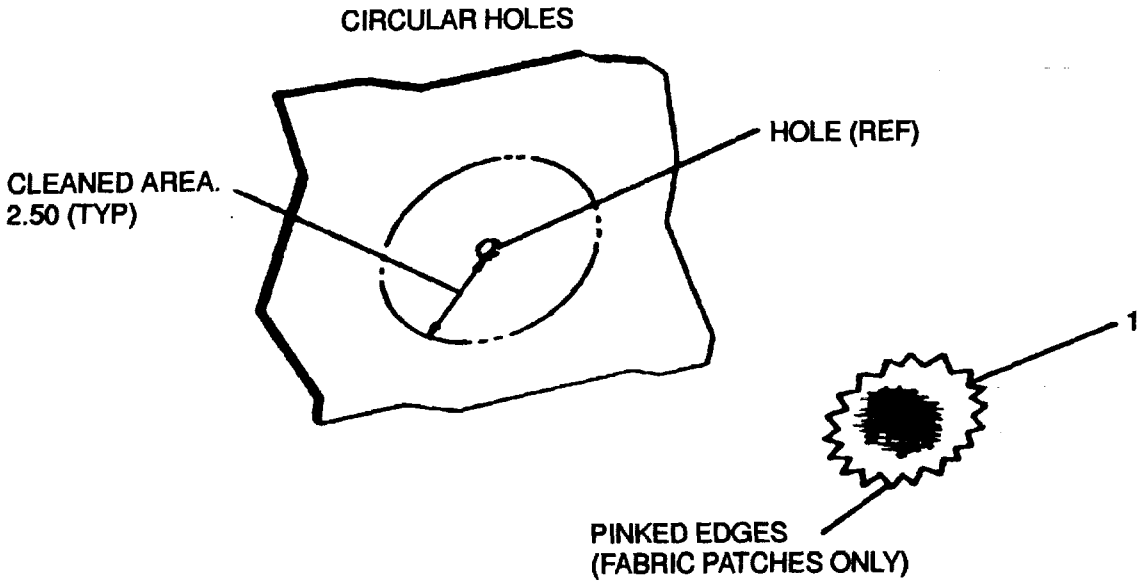
ORIGINAL THICKNESS	REINFORCEMENT THICKNESS
0.012	0.016
0.016	0.020
0.020	0.025
0.025	0.032
0.032	0.036
0.036	0.040
0.040	0.040

NOTES

A. ALL DIMENSIONS ARE IN INCHES

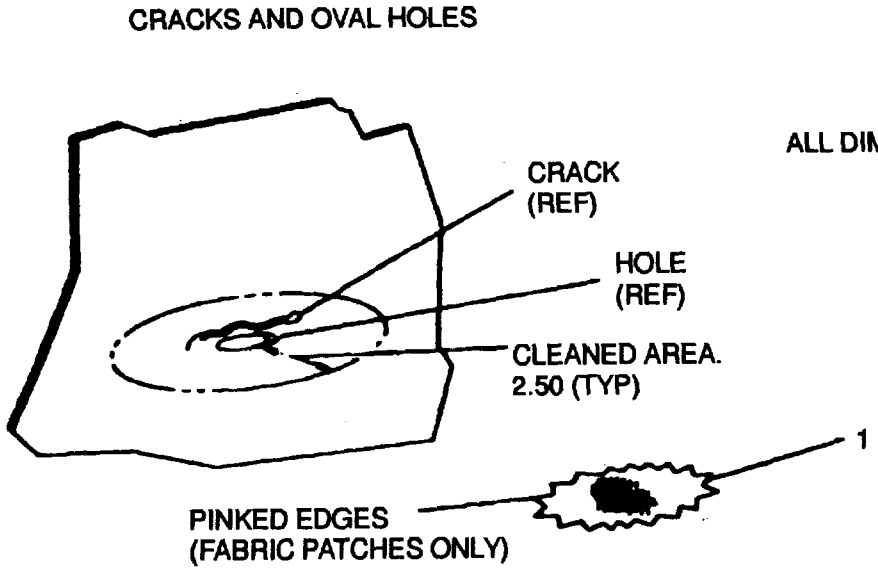
B. THESE CHARTS MAY BE USED TO SELECT A REINFORCEMENT WHEN A SPECIFIC REPAIR FIGURE, DENOTING A SPECIFIC REPAIR MATERIAL, DOES NOT EXIST FOR A PARTICULAR PART.

Figure 2-34. Skin and Web Repairs (Sheet 6 of 9)



REPAIR PARTS

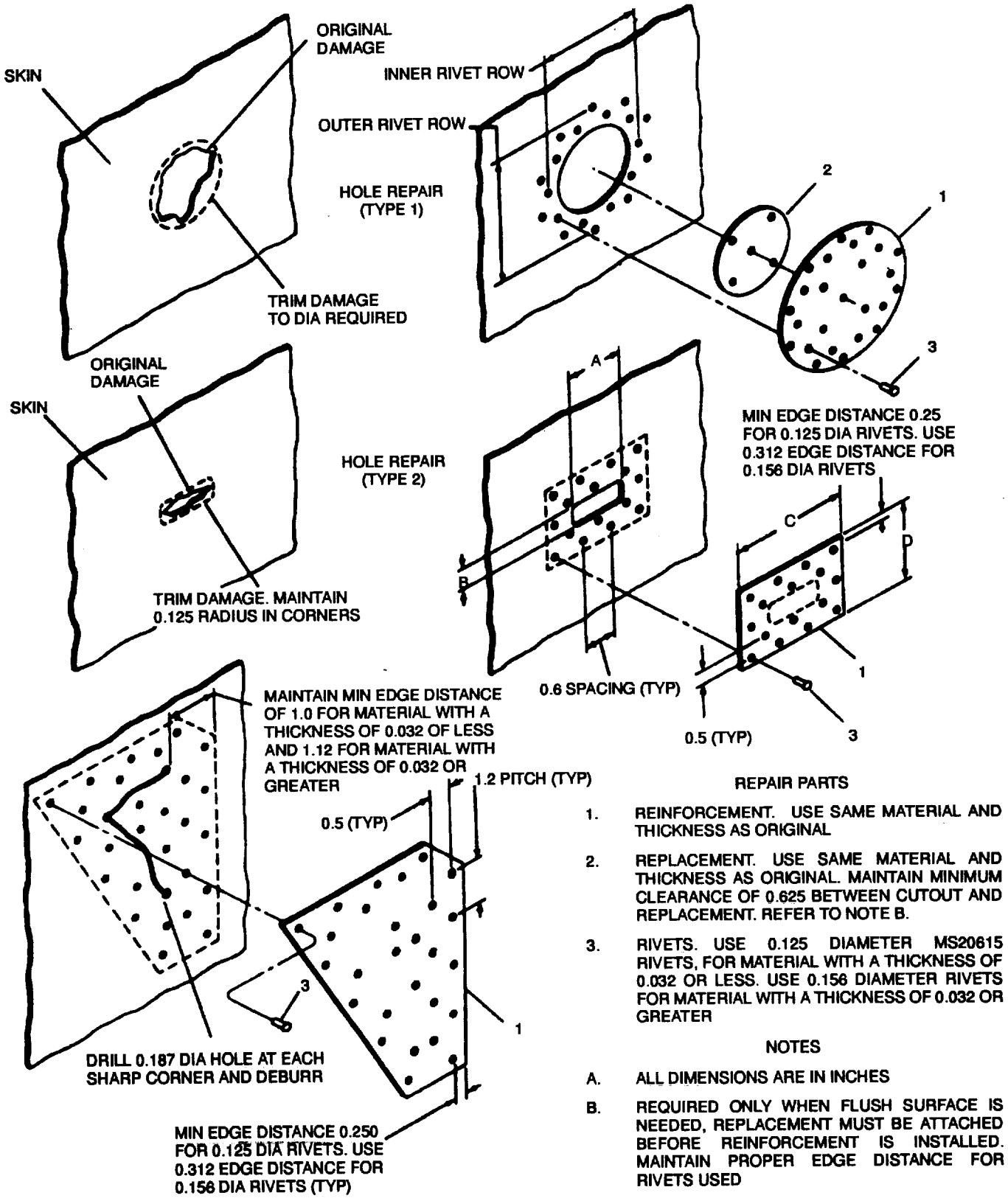
1. PATCH, COTTON CLOTH (ITEM 57, APPENDIX C) OR TAPE (ITEM 131, APPENDIX C)



NOTE

ALL DIMENSIONS ARE IN INCHES

Figure 2-34. Skin and Web Repairs (Sheet 7 of 9)



REPAIR PARTS

1. REINFORCEMENT. USE SAME MATERIAL AND THICKNESS AS ORIGINAL
2. REPLACEMENT. USE SAME MATERIAL AND THICKNESS AS ORIGINAL. MAINTAIN MINIMUM CLEARANCE OF 0.625 BETWEEN CUTOUT AND REPLACEMENT. REFER TO NOTE B.
3. RIVETS. USE 0.125 DIAMETER MS20615 RIVETS, FOR MATERIAL WITH A THICKNESS OF 0.032 OR LESS. USE 0.156 DIAMETER RIVETS FOR MATERIAL WITH A THICKNESS OF 0.032 OR GREATER

NOTES

A. ALL DIMENSIONS ARE IN INCHES

B. REQUIRED ONLY WHEN FLUSH SURFACE IS NEEDED, REPLACEMENT MUST BE ATTACHED BEFORE REINFORCEMENT IS INSTALLED. MAINTAIN PROPER EDGE DISTANCE FOR RIVETS USED

Figure 2-34. Skin and Web Repairs (Sheet 8 of 9)

CRITERIA FOR HOLE REPAIR (TYPE 1)

REPLACEMENT (2) DIAMETER	RIVET ROW DIAMETER*		PATCH (1) DIAMETER
	INNER**	OUTER	
- -	0.87 / 0.87	1.25 / 1.37	1.75 / 1.87
- -	0.75 / 0.995	1.375 / 1.495	1.875 / 1.995
0.50	1.0 / 1.12	1.5 / 1.62	2.0 / 2.12
0.625	1.125 / 1.245	1.625 / 1.745	2.125 / 2.245
0.75	1.25 / 1.37	1.75 / 1.87	2.25 / 2.37
0.875	1.375 / 1.495	1.875 / 1.995	2.375 / 2.495
1.0	1.5 / 1.62	2.0 / 2.12	2.5 / 2.62
1.25	1.75 / 1.87	2.25 / 2.37	2.75 / 2.87
1.50	2.0 / 2.12	2.5 / 2.62	3.0 / 3.12
1.75	2.25 / 2.37	2.75 / 2.87	3.25 / 3.37

* DIMENSIONS ABOVE DIAGONAL LINE ARE FOR MATERIAL THICKNESS LESS THAN 0.04, THOSE BELOW ARE FOR MATERIAL THICKNESS GREATER THAN 0.032

** MAINTAIN 0.6 PITCH AND STAGGER OUTER ROW BETWEEN INNER ROW

NOTES

A. ALL DIMENSIONS ARE IN INCHES

B. DETERMINE PATCH DIMENSIONS D AND C FOR HOLE REPAIR (TYPE 2) AS FOLLOWS:

1. D = B +1.0, IF MATERIAL THICKNESS IS LESS THAN 0.04

2. D = B +1.62, IF MATERIAL THICKNESS IS GREATER THAN 0.032

3. C = A +1.12, IF MATERIAL THICKNESS IS LESS THAN 0.04

4. C = A +1.12, IF MATERIAL THICKNESS IS GREATER THAN 0.032

Figure 2-34. Skin and Web Repairs (Sheet 9 of 9)

2-18. FORMED PARTS REPAIRS. Repair formed parts as shown in Figure 2-35. See TM 1-1500-204-23 for rivet selection and spacing. Insulate dissimilar metals.

2-19. STRINGERS. Refer to TM 55-1520-240-23.

2-20. FORMERS. Refer to TM 55-1520-240-23.

2-21. LONGERONS. Refer to TM 55-1520-240-23.

REINFORCEMENT SELECTION

ALUMINUM AND STEEL

ORIGINAL MATERIAL 2024-T4 OR 7075-T6	2024-T3 REINFORCEMENT FOR 2024-T4	2024-T3 REINFORCEMENT FOR 7075-T6	7075-T6 REINFORCEMENT FOR 7075-T6	4130 REINFORCEMENT FOR 2024-T4 OR 7075-T6
0.020	0.025	0.032	0.025	0.025
0.025	0.032	0.040	0.032	0.032
0.032	0.040	0.050	0.040	0.036
0.040	0.050	0.063	0.050	0.050
0.050	0.063	0.080	0.063	0.063
0.063	0.063	0.100	0.071	0.071
0.071	0.071	0.125	0.080	0.080
0.080	0.080	0.125	0.090	0.090
0.090	0.090	0.160	0.100	0.100
0.100	0.100	0.160	0.125	0.112
0.125	0.125	0.160	0.160	0.125

CORROSION RESISTANT STEEL

ORIGINAL MATERIAL	REINFORCEMENT*
301 ANL	301 ANL, 1/4H, 1/2H, 3/4H, H, 302 ANL, 17-7PH ANL, 180KSI
301 1/4H	301 1/4H, 1/2H, 3/4H. H, 17-7PH ANL, 180KSI
301 1/2H	301 1/2H. 3/4H, H, 17-7PH 180KSI
301 3/4H	301 3/4H, H
301 H	301 H
302 ANL	301 1/4H, 1/2H, 3/4H, H, 302 ANL, 17-7PH ANL, 18KSI
17-7 ANL	17-7PH ANL, 180KSI
17-7 180KSI	17-7PH 180KSI

*REINFORCEMENT MATERIAL THICKNESS TO BE SAME AS ORIGINAL

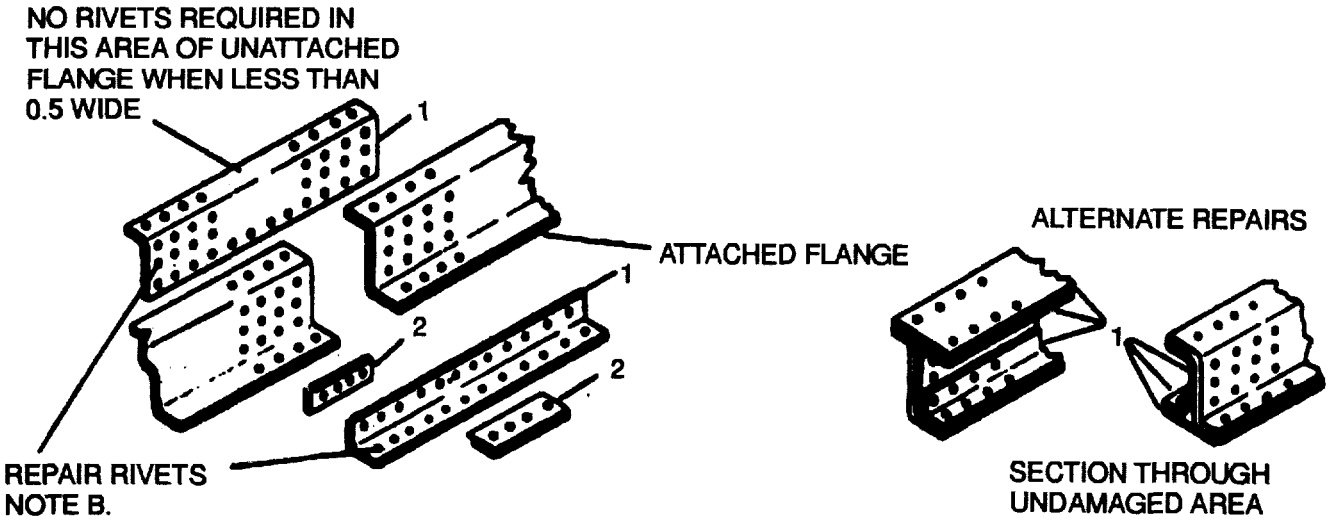
NOTES

A. ALL DIMENSIONS ARE IN INCHES

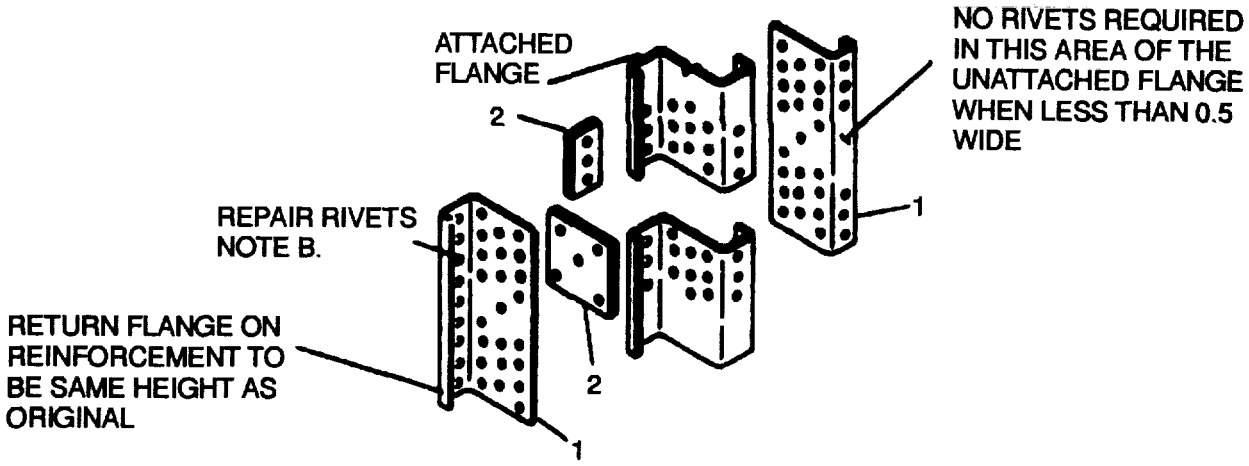
B. THIS CHART MAY BE USED TO SELECT A REINFORCEMENT, WHEN A SPECIFIC REPAIR FIGURE, DENOTING A SPECIFIC REPAIR MATERIAL DOES NOT EXIST FOR A PARTICULAR PART.

Figure 2-35. Formed Parts Repairs (Sheet 1 of 6)

REPAIRS FOR DAMAGED ZEE SECTIONS



REPAIRS FOR DAMAGED Z-SECTIONS HAVING RETURN FLANGES



REPAIR PARTS

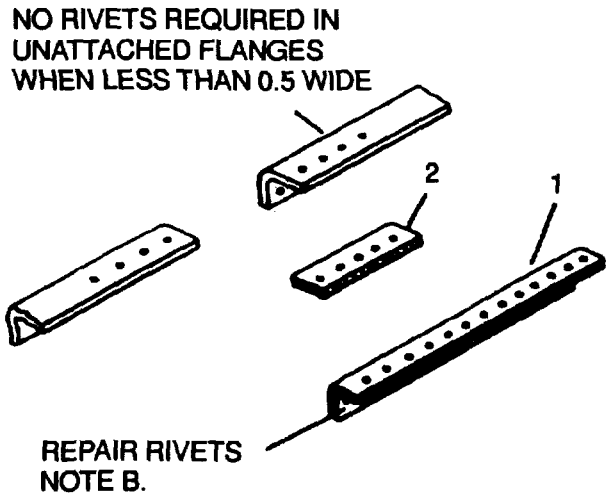
1. REINFORCEMENT. SEE APPLICABLE FIGURE FOR REPAIR MATERIAL AND THICKNESS. SEE SHEET 6 OF THIS FIGURE IF A SPECIFIC REPAIR FIGURE DOES NOT EXIST.
2. FILLER. USE SAME MATERIAL AND THICKNESS AS ORIGINAL. SEE APPLICABLE FIGURE FOR ORIGINAL.

NOTES

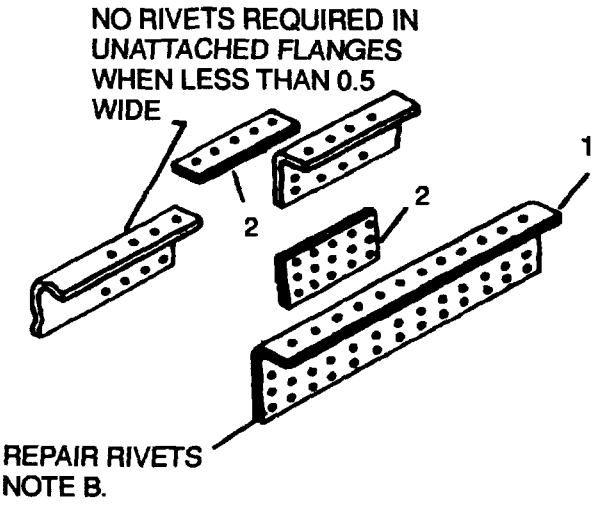
A. ALL DIMENSIONS ARE IN INCHES.
B. THE MINIMUM OF RIVETS IN EACH ROW EACH SIDE OF DAMAGE IS: FOUR IN 2024 AND SIX IN 7075 AND CORROSION RESISTANT STEEL.

Figure 2-35. Formed Parts Repairs (Sheet 2 of 6)

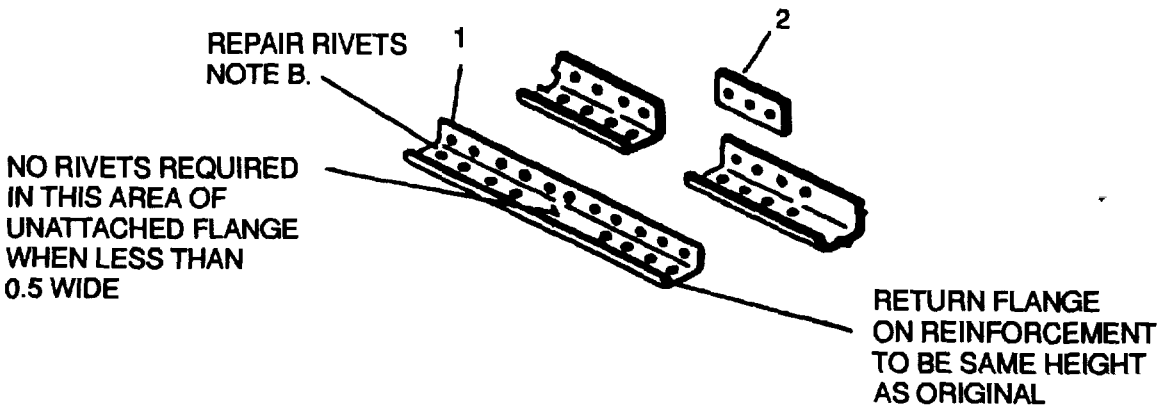
REPAIR FOR DAMAGED ANGLES
LESS THAN 1.5 WIDE



REPAIR FOR DAMAGED ANGLES
GREATER THAN 1.5 WIDE



REPAIR FOR DAMAGED ANGLES HAVING RETURN FLANGES



REPAIR PARTS

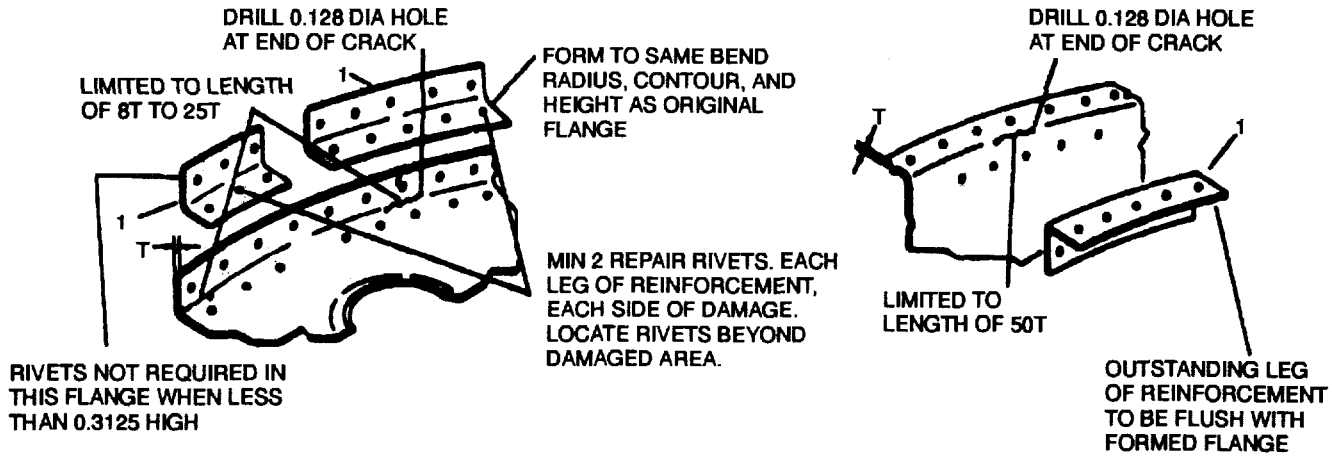
1. REINFORCEMENT. SEE APPLICABLE FIGURE FOR REPAIR MATERIAL AND THICKNESS. SEE SHEET 6 OF THIS FIGURE IF A SPECIFIC REPAIR FIGURE DOES NOT EXIST.
2. FILLER. USE SAME MATERIAL AND THICKNESS AS ORIGINAL. SEE APPLICABLE FIGURE FOR ORIGINAL.

NOTES

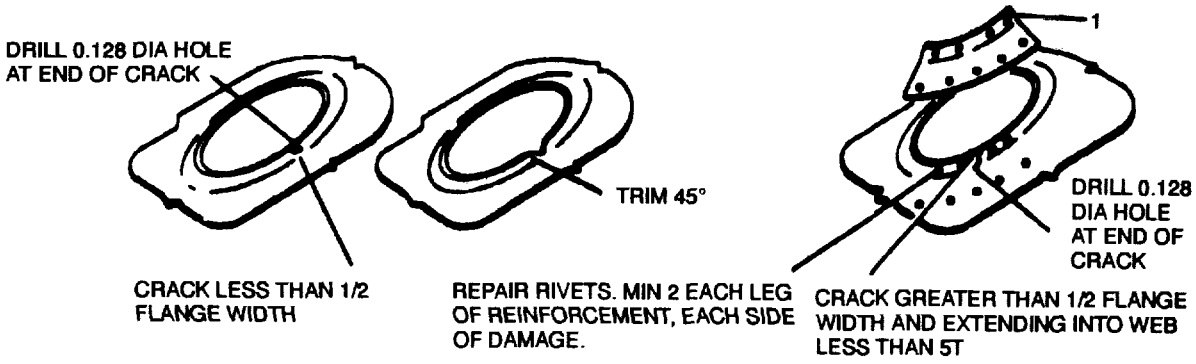
A. ALL DIMENSIONS ARE IN INCHES.
B. THE MINIMUM OF RIVETS IN EACH ROW EACH SIDE OF DAMAGE IS: FOUR IN 2024 AND SIX IN 7075 AND CORROSION RESISTANT STEEL.

Figure 2-35. Formed Parts Repairs (Sheet 3 of 6)

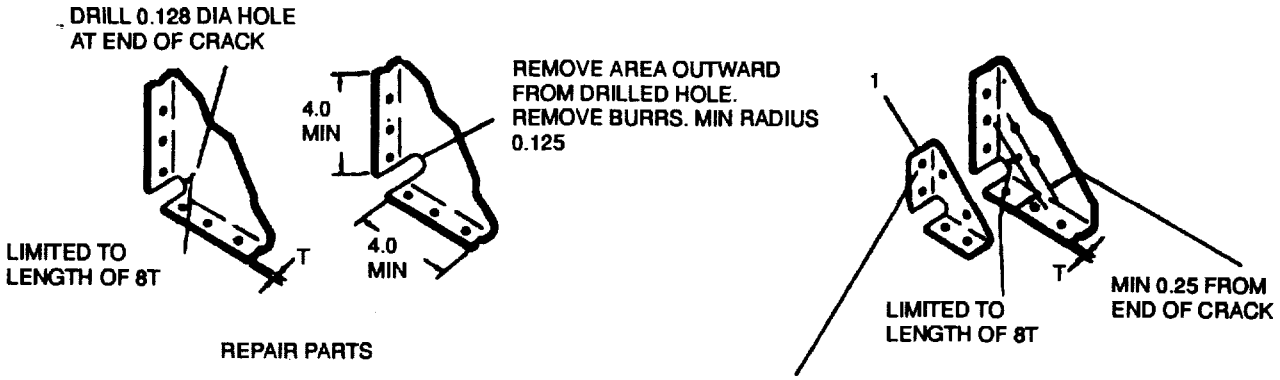
REPAIRS FOR BEND CRACKS IN SINGLE FORMED FLANGE



REPAIRS FOR CRACKS IN STANDARD STRAIGHT FLANGED LIGHTENING HOLES



REPAIRS FOR CORNER CRACKS IN DOUBLE FORMED FLANGE



REPAIR PARTS

1. REINFORCEMENT. REFER TO APPLICABLE FIGURE FOR REPAIR MATERIAL AND THICKNESS. SEE SHEET 6 OF THIS FIGURE IF A SPECIFIC REPAIR FIGURE DOES NOT EXIST.

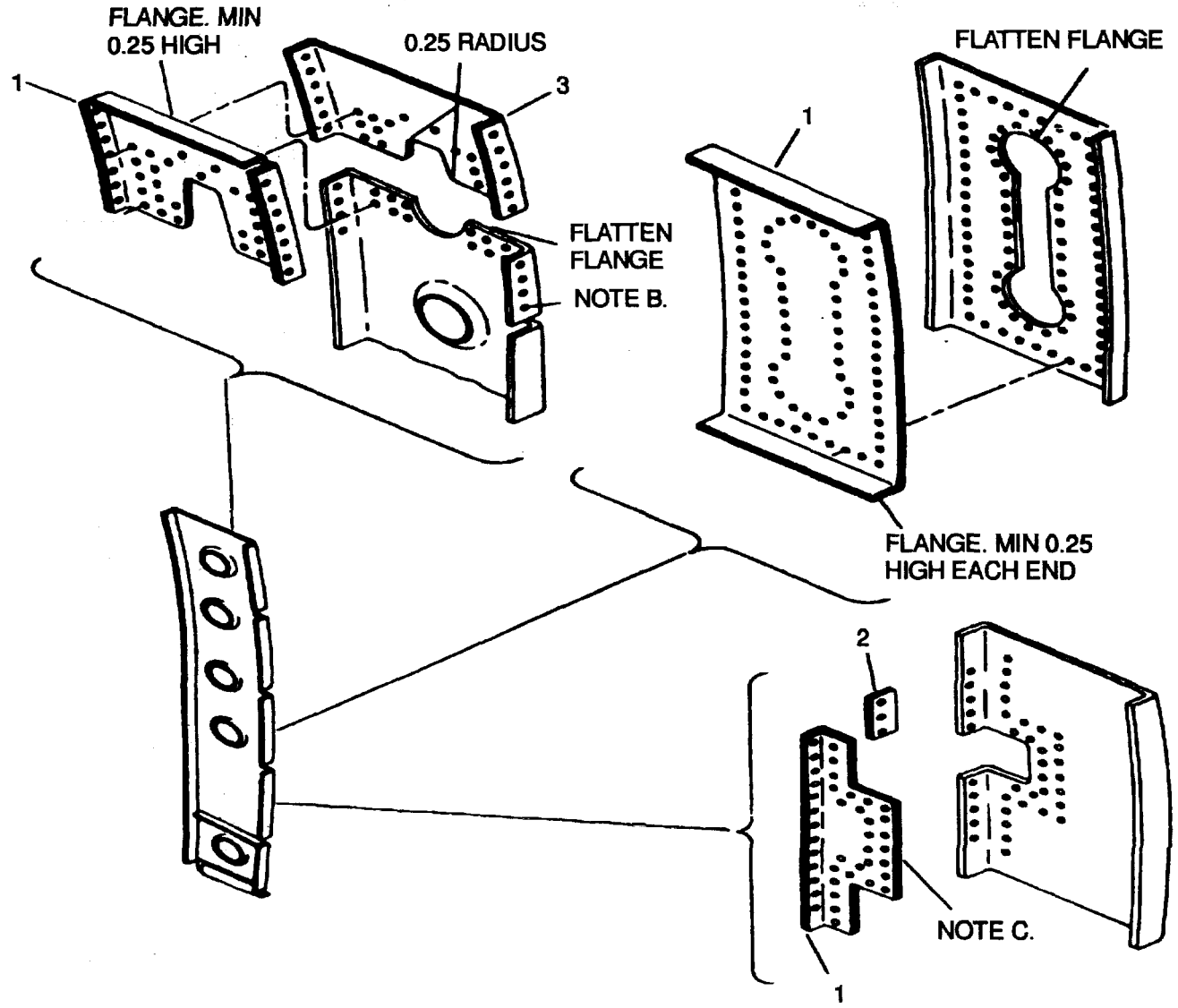
MIN 6 RIVETS. USE EXISTING RIVET LOCATIONS. USE SAME TYPE RIVET AS ORIGINAL IN NEXT LARGER DIAMETER.

NOTE

ALL DIMENSIONS ARE IN INCHES.

Figure 2-35. Formed Parts Repairs (Sheet 4 of 6)

FRAMES



REPAIR PARTS

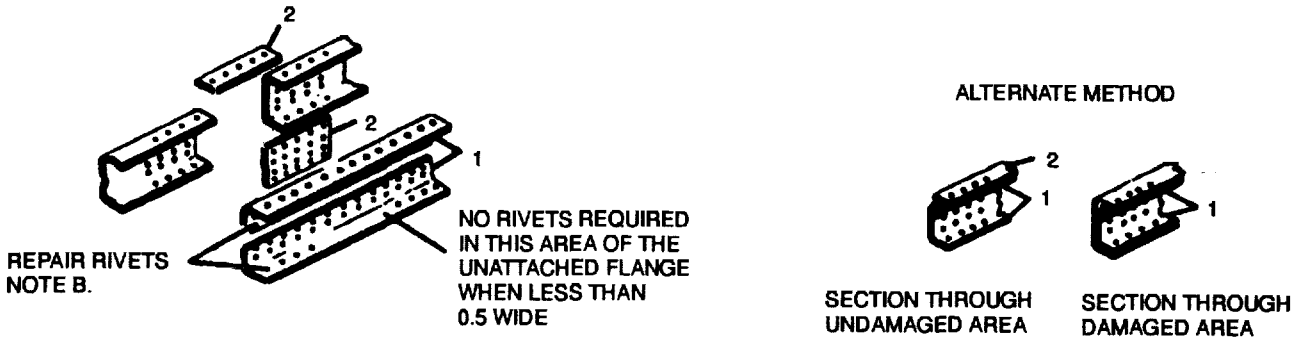
1. REINFORCEMENT. SEE APPLICABLE FIGURE FOR REPAIR MATERIAL AND THICKNESS. SEE SHEET 6 OF THIS FIGURE IF A SPECIFIC REPAIR FIGURE DOES NOT EXIST.
2. FILLER. USE SAME MATERIAL AND THICKNESS AS ORIGINAL. SEE APPLICABLE FIGURE FOR ORIGINAL.
3. REPLACEMENT. USE SAME MATERIAL AND THICKNESS AS ORIGINAL. SEE APPLICABLE FIGURE FOR ORIGINAL

NOTES

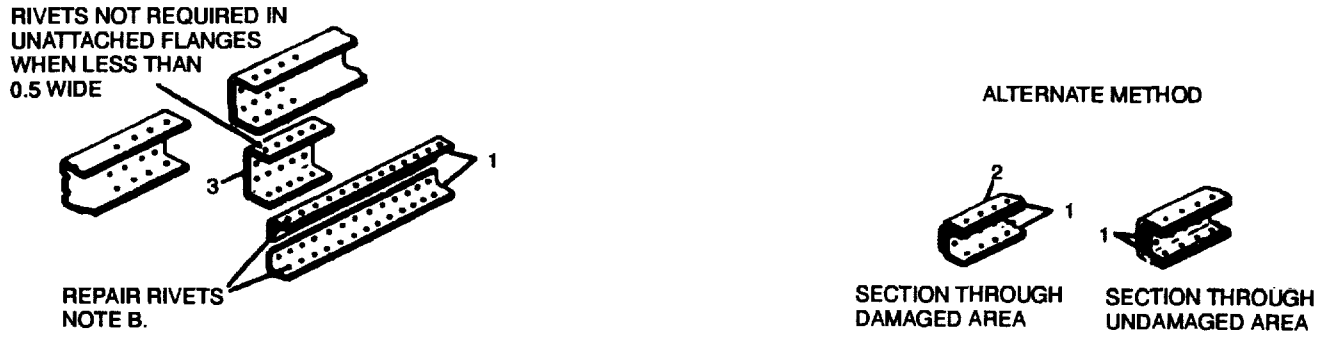
A. ALL DIMENSIONS ARE IN INCHES.
B. USE ORIGINAL RIVET LOCATIONS AND SAME TYPE RIVET IN NEXT LARGER DIAMETER, OR SUBSTITUTE BLIND RIVETS IN ORIGINAL LOCATIONS
C. USE EXISTING RIVET LOCATIONS, A MINIMUM OF TWO ROWS IN EACH WEB, AND A MINIMUM OF FIVE RIVETS EACH SIDE OF DAMAGE IN FLANGE AREA

Figure 2-35. Formed Parts Repairs (Sheet 5 of 6)

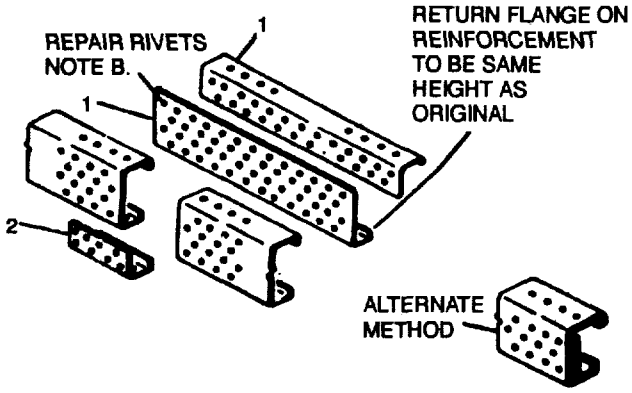
REPAIRS FOR DAMAGED CHANNELS HAVING A WEB GREATER THAN 1.5 WIDE



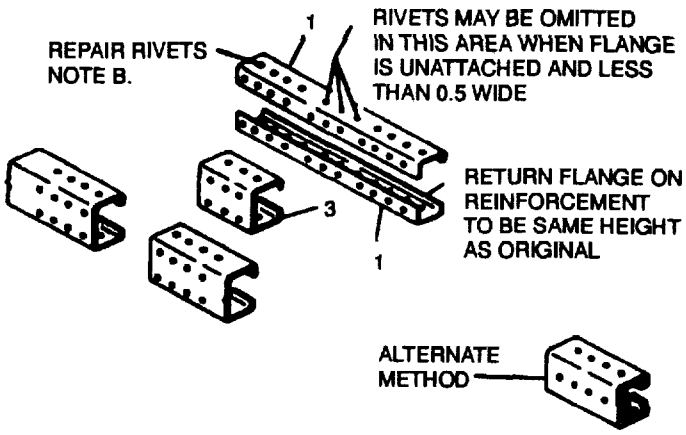
REPAIRS FOR DAMAGED CHANNELS HAVING A WEB LESS THAN 1.5 WIDE



REPAIRS FOR DAMAGED CHANNELS HAVING RETURN FLANGES AND A WEB GREATER THAN 1.5 WIDE



REPAIRS FOR DAMAGED CHANNELS HAVING RETURN FLANGES AND A WEB GREATER THAN 1.5 WIDE



REPAIR PARTS

1. REINFORCEMENT. SEE APPLICABLE FIGURE FOR REPAIR MATERIAL AND THICKNESS. SEE SHEET 6 OF THIS FIGURE IF A SPECIFIC REPAIR FIGURE DOES NOT EXIST.
2. FILLER. USE SAME MATERIAL AND THICKNESS AS ORIGINAL. SEE APPLICABLE FIGURE FOR ORIGINAL.
3. REPLACEMENT. USE SAME MATERIAL AND THICKNESS AS ORIGINAL. SEE APPLICABLE FIGURE FOR ORIGINAL

NOTES

A. ALL DIMENSIONS ARE IN INCHES.

B. THE MINIMUM OF RIVETS IN EACH ROW EACH SIDE OF DAMAGE IS: FOUR IN 2024 AND SIX IN 7075 AND CORROSION RESISTANCE STEEL

Figure 2-35. Formed Parts Repairs (Sheet 6 of 6)

2-22. BEAMS. The beams include one beam on the crown panel and three beams on each side panel. The CH-47D has 13 beams on the bottom panel. The beam on the crown panel extends from sta 320 to 340 on the cl of the fuselage. The beams on each side panel are those at wl plus 29.0 and minus 16. Those beams at wl plus 29 extend from sta 160 to 440 and support the troop seat backrests and litter poles. The beams at wl 0 extends the same distance. The beams at wl 16 extend from sta 140 to 482 and support the troop seats. The beams on the bottom panel are the cargo tiedown adapter beams, forward landing gear support beams, rescue hoist cutout watertight beams, and the partial beams in the forward part of the cabin fuselage structure assembly. Also the CH-47D has a forward and an aft cargo hook beam. The cargo tiedown adapter beams are at bl 0, sta 120 to 320 and 320 to 486, bl 20, each side of the fuselage; and bl 44, each side of the fuselage. The forward landing gear support beams are between sta 240 and 260 each side of the fuselage. The rescue hoist cutout watertight beams extend from sta 300 to 380, each side of the cutout. The partial beams are between sta 160 and 200, at bl 45.4, each side of the fuselage. The beams on the bottom panel are sealed for watertightness.

a. Negligible Damage. Damage to fittings is limited to nicks and scratches whose depth, after burnishing, does not exceed 10 percent of the thickness of the fitting. Burnished areas must dear radii, holes, and fasteners, a minimum of 3/4 inch. Refer to TM 55-1520-240-23 for wear tolerances on support fitting 114S2834 and the cargo hook beam track 114S5063.

b. Reparable Damage. Refer to TM 55-1520-240-23.

2-23. STIFFENERS. The skin stiffeners are located on the bottom panel and the bottom side panel. The transverse stiffeners on the bottom panel, except those encompassing the rescue hatch cutout, extend the full width of the panel (hinge to hinge) and are formed Zee-sections of 7075-T6 dad aluminum alloy. The longitudinal and transverse stiffeners on the bottom panel, reinforcing the area of the rescue hatch cutout, are extruded sections of 7075-T6 aluminum alloy. The longitudinal stiffeners on the bottom panel are section of Alcoa 83264 or AND10136-2006. The transverse stiffeners are sections of Alcoa 83264 or 55794. The stiffeners on the bottom side panels are sections of AND10134-1005, AND10134-1003, Alcoa 67580, or 22477.

Reparable. Refer to TM 55-1520-240-23.

2-24. FLOORING. Refer to TM 55-1520-240-23.

2-25. TUNNEL COVER (SANDWICH HONEYCOMB TYPE). Refer to TM 55-1520-240-23.

2-26. POD INSTALLATION CABIN FUSELAGE STRUCTURE ASSEMBLY. Refer to TM 55-1520-240-23.

2-27. BATTERY SHELF. Refer to TM 55-1520-240-23.

2-28. DOORS AND ACCESS PANELS. Refer to TM 55-1520-240-23.

2-29. REPAIR OF NOMEX/FIBERGLASS: FUEL PODS.

a. All core depressions greater than 3 square inches in surface area and/or deeper than 0.10 inch shall be considered to be a puncture and be repaired according to the detailed procedures given in TM 55-1520-240-23.

b. Honeycomb repairs; single skin repair, single skin and core repair, double skin and core repair surlock insert repair, delamination repair and skin puncture repairs are detailed (along with list of materials, process, preparation and techniques) for nomex/fiberglass fuel pod repairs in TM 55-1520-240-23.

c. Accomplish repairs per TM 55-1520-240-23.

d. Inspect repair for voids. None are permitted.

e. Prime and repaint pod as necessary.

2-30. AFT FUSELAGE STRUCTURE ASSEMBLY. Refer to TM 55-1520-240-23.

2-31. SKIN. Refer to TM 55-1520-240-23.

2-32. STRINGERS. Refer to TM 55-1520-240-23.

2-33. FORMERS. Refer to TM 55-1520-240-23.

2-34. FORMER-STATION 534. Refer to TM 55-1520-240-23.

2-35. TAILCONE AUXILIARY POWER UNIT ENCLOSURE. Refer to TM 55-1520-240-23.

CHAPTER 3
LANDING GEAR

SECTION I. GENERAL

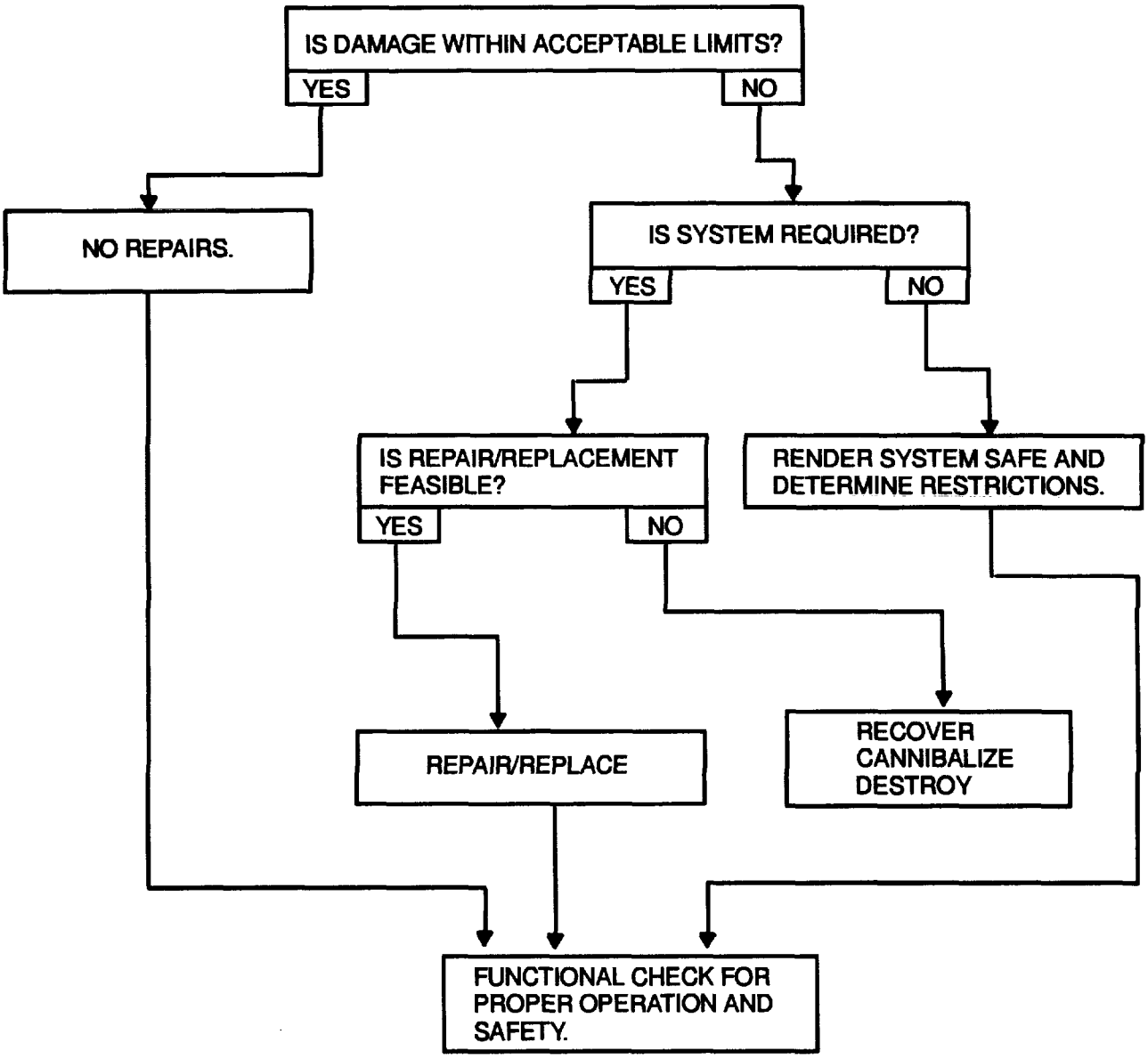


Figure 3-1. Landing Gar Assessment Logic

3-1. LANDING GEAR REPAIRS. Structural components of wheeled landing gear systems consists of highly stressed steel forgings and machined parts. Repair of battle damage to these components is limited. Also, the condition of the landing gear is important to the dynamic stability of the aircraft on the ground. The only authorized repairs are for minor damage.

3-2. ACCFSSORIES Repair landing gear system accessories as follows:

a. Hydraulic Tubing. Hydraulic tubing and hose repairs can be found in Chapter 7.

b. Wiring. Wiring repairs can be found in Chapter 9.

c. Sheet Metal. Repair sheet metal parts such as strut fairings using procedures in Chapter 2. An alternative is to simply remove the damaged parts.

CHAPTER 4
POWERPLANT

SECTION I. GENERAL

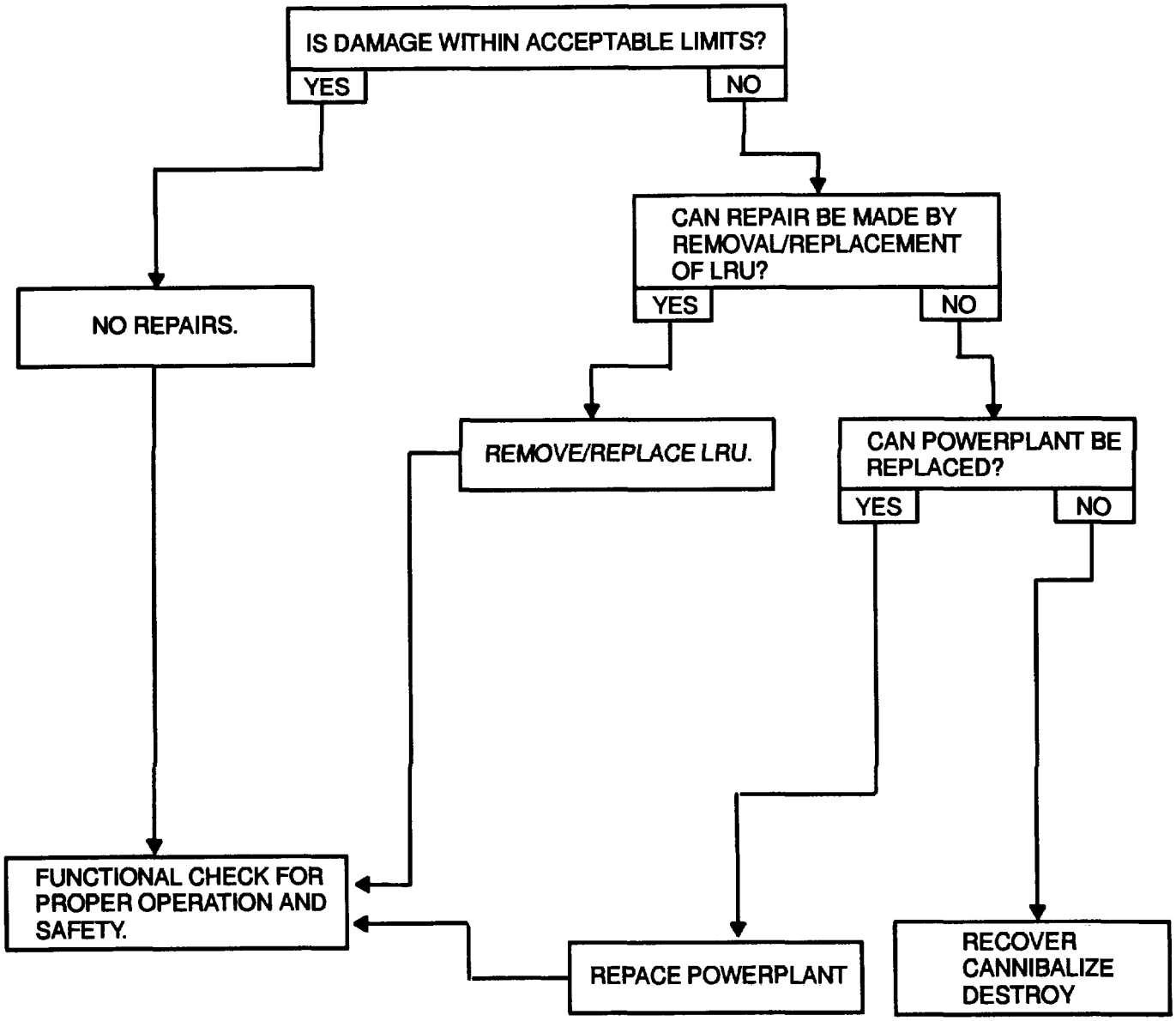


Figure 4-1. Powerplant Assessment Logic

4-1. BATTLE DAMAGE. Damage to the basic power plants will most likely require an engine change, especially if the engine has internal damage. The technical manual for specific engines contains damage limitations and minimal acceptable performance standards. The engine manual will also be used to determine continued engine serviceability.

4-2. LINE REPLACEMENT UNITS. Modular designed engines have quick line replaceable units (LRUs). Remove and replace as required using the engine manual.

4-3. ENGINE COMPONENTS ACCESSORIES AND WIRING. Repair damage to quick engine change (QEC) components and/or accessories as follows:

a. Accessories. Repair or replace accessories such as fuel controls, alternators, or pumps as applicable.

b. Sheet Metal Parts. Use the procedure given in Chapter 2 to repair sheet metal parts such as cowling, and cold or hot air ducting.

c. Wiring. Wiring repairs can be found in Chapter 9.

4-4. SINGLE ENGINE OPERATIONS. Mission requirements will dictate the possibility of flights with less than all engines.

CHAPTER 5
ROTOR SYSTEM

SECTION I. GENERAL

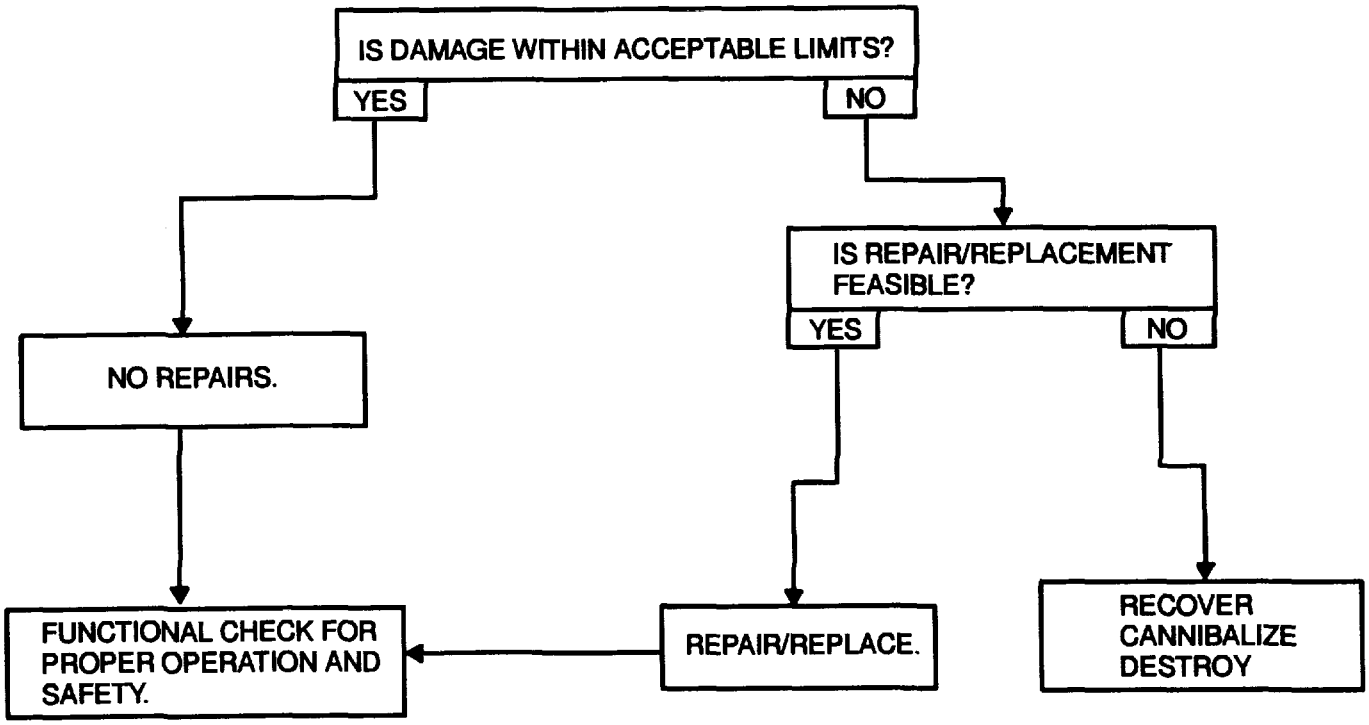


Figure 5-1. Rotor System Assessment Logic

ROTARY-WING COMPONENTS. Refer to TM 55-1520-240-23.

CHAPTER 6
POWERTRAIN SYSTEM

SECTION I. GENERAL

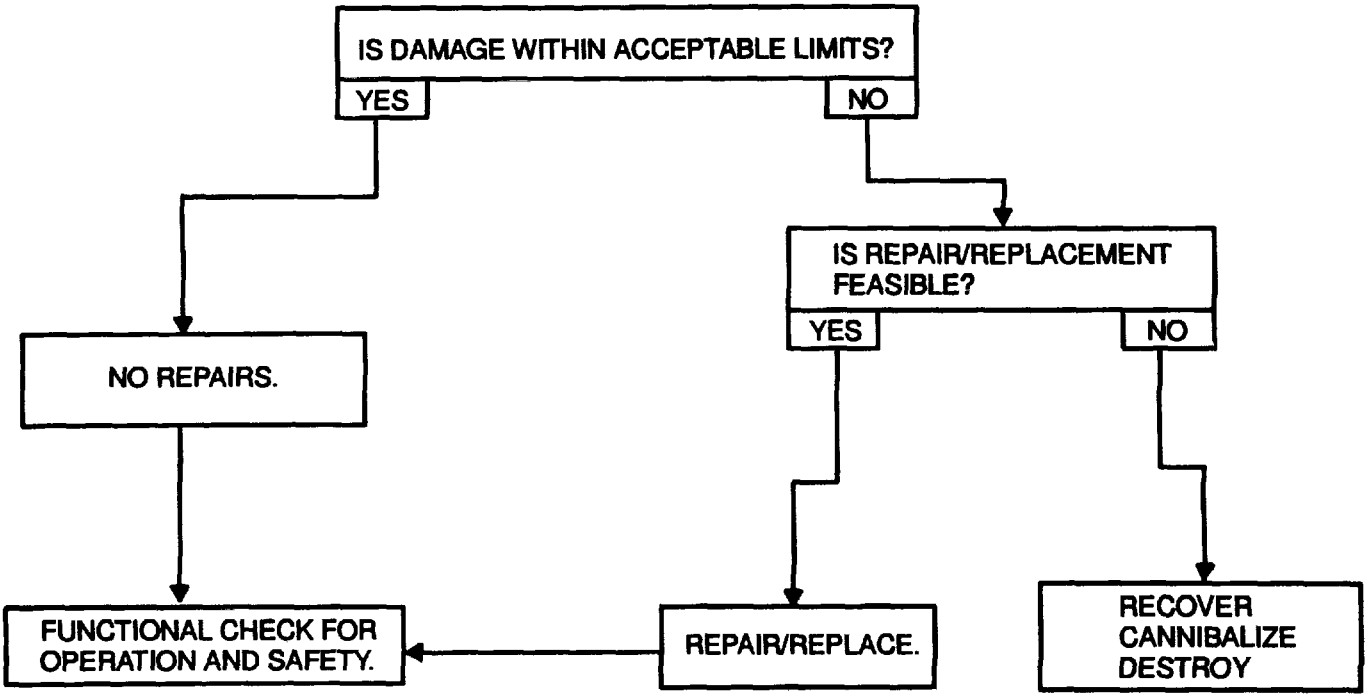


Figure 6-1. Powertrain Assessment Logic

6-1. **POWERTRAIN COMPONENTS** Battle damaged to the basic powertrain (transmission, gear boxes, and drive shafts) will most likely require a component change. This is especially true if internal damage has occurred.

6-2. **GEARBOX DAMAGE**

6-3. **GENERAL INFORMATION**. if a bullet strikes the gear box and exits, and the gears do not jam or bind and there is no loss or lubricant, repair may be deferred.

6-4. **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 jam.

6-5. **PERSONNEL TIME REQUIRED**. One Person Required

6-6. **OPTION 1**. Sealant Repair (Refer to paragraph 2-13).

6-7. OPTION 2. Tape Repair.

a. Material/Tools Required:

Solvent
Tape, Army Green or Equivalent
Rubber for patch

b. Procedural Steps:

(1) Clean damaged area with solvent.

(2) Close bullet hole with a rubber patch, 34 inch larger than hole, and secure with tape.

(3) Inspect after every fight.

(4) Record BDAR action taken. When mission s completed or as soon as feasible, replace gearbox.

6-8. TRANSMISSION ROTOR DRIVE SHAFT. Refer to TM 55-1520-240-23.

CHAPTER 7
PNEUDRAULICS

SECTION I. GENERAL

7-1. INTRODUCTION This chapter provides procedures for assessing battle damage, deferring damage, and repairing pneudraulic system. This primary emphasis Is on providing the assessor with guidance to perform the assessment process. Simplified logic trees (See Figure 7-1) and related illustrations also aid the assessor.

SECTION II. DAMAGE ASSESSMENT

7-2. DAMAGE ASSESMENT PROCEEDURE

a. Assessment. Inspect and evaluate all pneudraulic hoses, tubing, fittings, and line supports in the entire damaged area before beginning repair. The inspection may reveal damaged hoses and hoses with broken wire braling. Tubing that is dented, scratched, or nicked might also be found. The inspection may also reveal damaged line supports or evidence of fire damage (Figure 7-1).

b. Damaged Arm, Damaged and suspected damage areas should be cleaned before inspection. Fluid residue will make it difficult to determine which components are actually damaged. Do not use abrasives for cleaning.

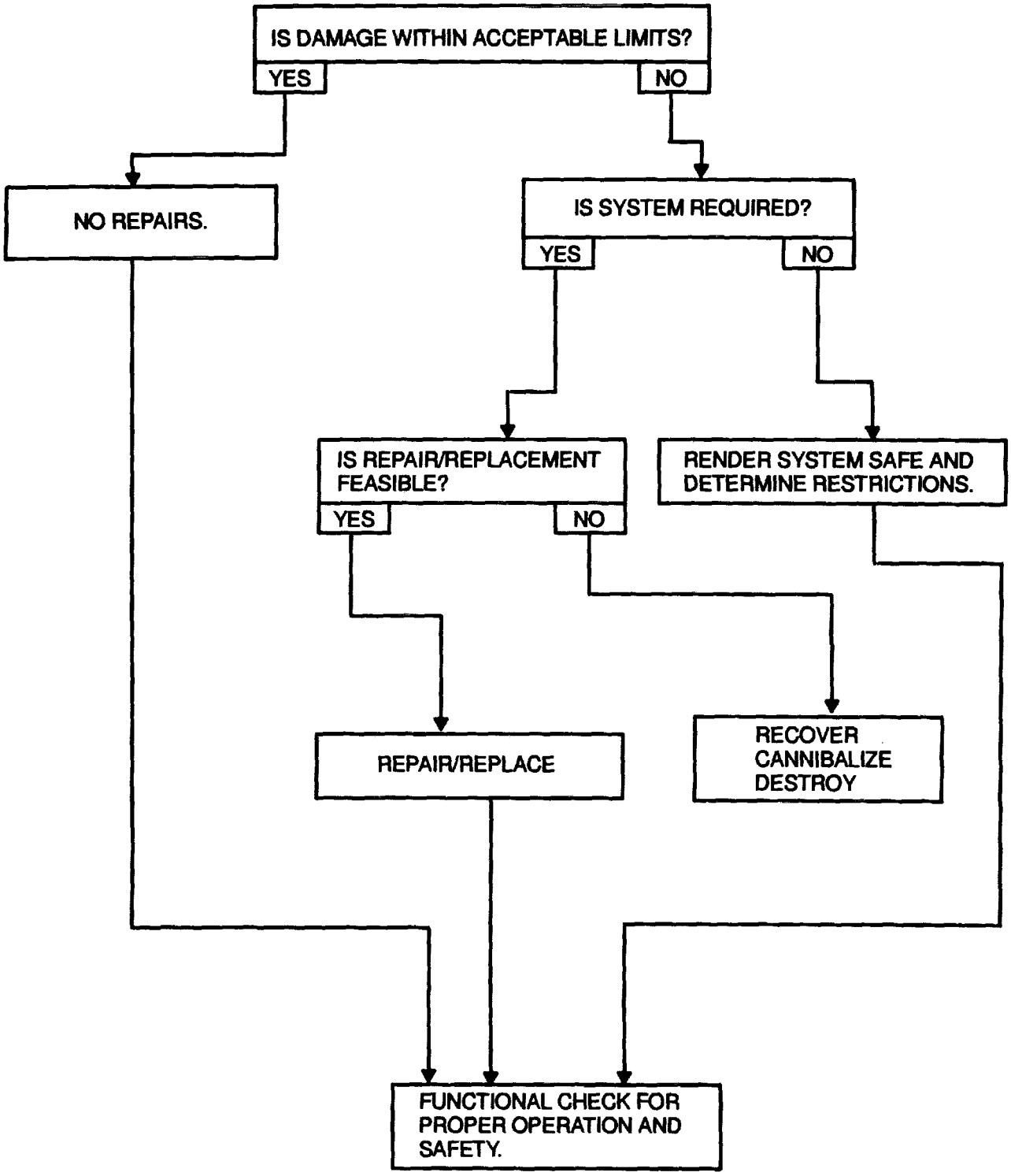


Figure 7-1. Pneudraulics Assessment Logic

SECTION III. BATTLE-DAMAGE REPAIRS

7-3. DEFERMENT. Scheduled maintenance as indicated in the applicable aircraft manual may be deferred. Unscheduled maintenance, such as the repair of systems and subsystems which are not critical to mission accomplishment, may be deferred if safety of flight is not significantly degraded. The commander may defer combat maintenance and battle-damage repair, even if doing so places operational limitations on the aircraft.

7-4. GENERAL The purpose of pneudraulic system BDR is to restore serviceability to only those systems required to perform the mission. The type mission to be flown will determine the system required. Pneudraulic system damage will normally be reported by the pilot or be self-evident. However, a full assessment of all damage is essential before repair decisions are made. Repair to nonessential systems should only be attempted when down time will not be increased. These procedures are intended to provide guidance and suggest approaches to making essential repairs in a timely manner.

a. Expedient Repairs. Standard repair methods should be used if facilities, equipment, materials, and experienced personnel are available. In most cases, standard repair methods take less time than nonstandard repair methods. Some of the expedient repairs are temporary, while others are permanent. However, it should be remembered that the objective of BDR is to return the aircraft to the flight line by the speediest means possible so that it is capable of additional sorties.

b. Non-detailed Instructions. Uncertainties in the battle-damage repair environment make it impossible to give specific repair procedures for all situations involving pneudraulic system damage. The best repair method will depend on the availability of facilities, spares, and the operational or tactical environment Ultimately, the best method will depend on the experience and ingenuity of the BDR technicians. The repair techniques discussed in this manual do not include detailed procedures. Therefore, the use of sound judgment and experience in the selection and application of repairs is of paramount importance. Although these repairs will restore essential systems to a serviceable condition, they are intended to serve as a checklist of ideas. The repairs are neither exhaustive nor mandatory.

7-5. COMPONENT DAMAGE. Component damage such as hydraulic valves, will be repaired by replacement. Serviceable items will be obtained through normal sources or cannibalization. However, internal repairs will be attempted when replacement parts are not available and technical ability is accessible. Nonessential components will be isolated at the component or downstream past the damaged area. Leaving existing damaged tubing installed and routing a replacement hose from the first undamaged "B" nut, can save time. The procedure is permissible providing existing tubing does not interfere with other operations. Secure replacement hose where it will not be damage during system operation.

WARNING

Substitute or repair hoses must meet system pressure and fluid requirements.

7-6. PNEUDRAULIC SYSTEM. When only one pressure source is required, other damaged systems maybe isolated. The type mission required will determine what systems can be eliminated. The technician and assessor will evaluate these situations.

CAUTION

Take care to prevent hydraulic liquid locks whenever a component has one system disconnected or isolated. A bypass hose will have to be installed to direct pressure from inlet port to outlet port. In some cases ports will have to be left open.

7-7. BDR TUBING AND HOSE REPAIR TECHNIQUES. Of all battle damage incurred by aircraft pneudraulic systems, the most probable will be tubing and hose installation damage. BDR to hose and tubing installation can be accomplished in many different ways. When repairs must be made, the most important items are system pressures, tools and repair materials. Most aircraft have a combination of both tubing and hose installations of both AN (flared), MS (flareless), and permaswage manufacture. Replacement with original equipment is desirable but not essential, providing materials are available and down time will not be increased.

7-8. TUBING REPAIRS.

a. Manufacture. Manufacture as per sample or template and replace damaged assembly. This can be accomplished using AN flared assemblies with MS flareless installation or MS flareless assemblies with AN flared type installation providing appropriate AN to MS unions are available.

b. Replace. Replace damaged tubing with high pressure hose assemblies. This also can be accomplished using AN flared assemblies with MS flareless installation and vise-versa, providing appropriate AN to MS unions are available. Use hydraulic repair kit when applicable.

c. Repair Using Union Fitting. Repair damaged area using a union fitting. Bulkhead fittings can be used where slightly larger repairs are necessary. AN or MS unions may be used providing tubing is prepared appropriately.

d. Repair Using Union And Tube. Repair the damaged area using union and tubing when the damaged area exceeds the use of one union alone. AN and MS plumbing may be used providing tubing is prepared appropriately (Figure 7-2).

CAUTION

- **An MS flareless sleeve cannot adequately bite into hard surfaced, thin wall 21-6-9 (301) stainless steel tubing. This combination is unreliable and undesirable.**

- **After tubing has been cut, all efforts should be made to flush any residue from tube end. Rush with any available fluid. If end connections are inaccessible, momentary activation of the system will suffice.**

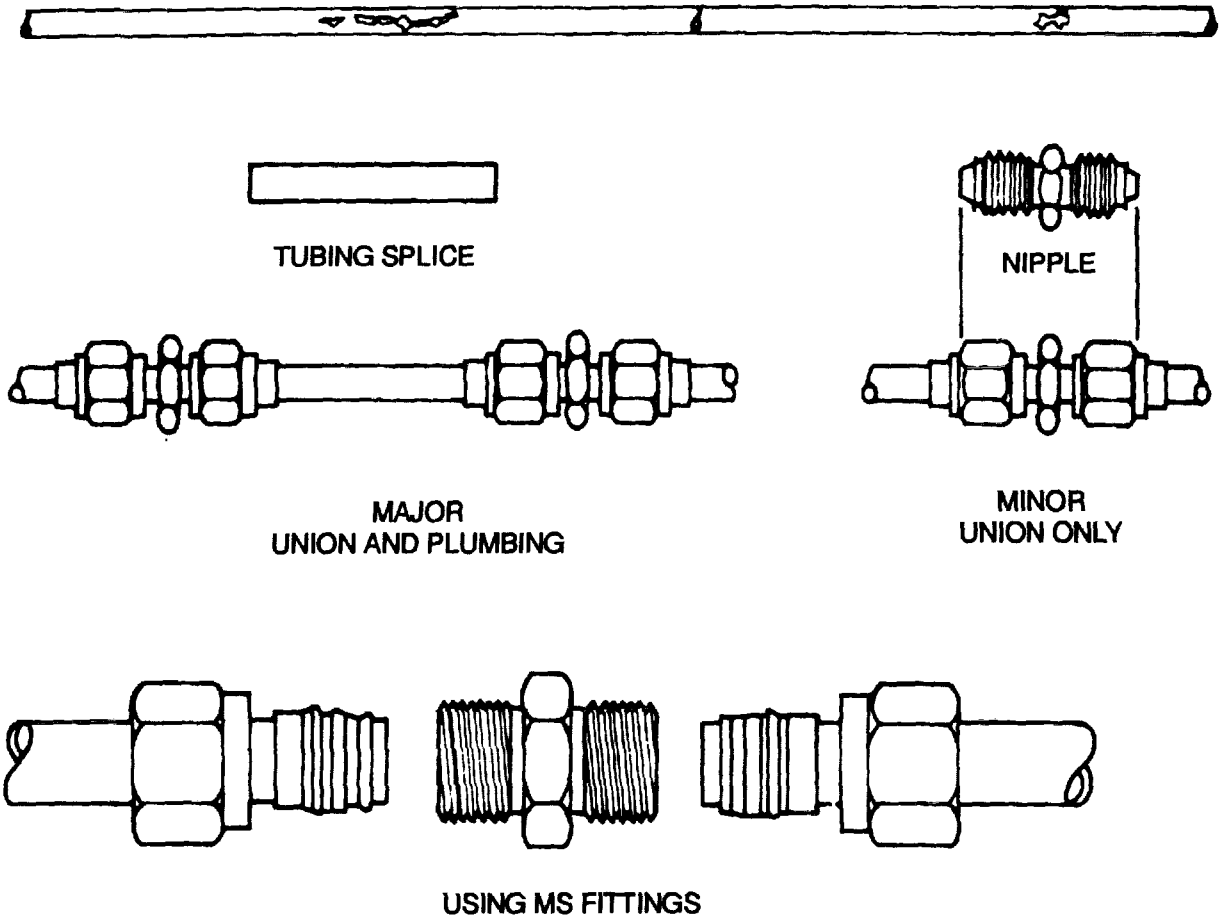


Figure 7-2. Tubing Repair (Union)

7-9. REPAIR OF METAL TUBE LINES. Minor dents and scratches in tubing may be repaired. Scratches or nicks no deeper than 20% of the tubing wall thickness, that are not in the heel of a bend, may be repaired by burnishing with hand tools. This is not necessary in itself, but under a "Quick-Fix" sortie concept it will aid the technician in his damage evaluation. Repair lines with severe die marks, seams, or splits. Any crack or deformity in the flare is also unacceptable and cause for rejection. A dent less than 20% of the tube diameter is acceptable unless it is in the heel of the bend. Severely damaged line should be replaced. However, line may be repaired by cutting out the damaged section and inserting a repair section. Use hydraulic repair kit when applicable.

7-10. REPAIR HIGH-PRESSURE TUBING. Cut out and remove the damaged portion of tubing using the tubing to union method. Square, dean, and deburr the rough edges of the remaining tubing. If the damaged section of tubing does not exceed the length of a union, a new section is not needed. If flared AN fittings are to be used, place nuts and sleeves on prepared original tubing facing toward the end of the tubing. Then flare the end of the tubing. Place unions in position and torque. Measure the distance between the two installed unions. Next, prepare a replacement section using the same method as for the original line. Install the replacement section, torque properly, and check for pressure (Figure 7-3). MS flareless fittings may also be used in this repair. Ridged tubing may be repaired by using high pressure flex hose from hydraulic repair kit. Clamp tubing as required.

CAUTION

When positioning hose damps or tightening screws, take care to prevent the screws from chafing or damaging adjoining parts. Where damage is possible, reposition the clamps on the hose.

7-11. BD HOSE REPAIR. Aircraft hose assemblies are primarily used where flexibility is essential and vibrations are present. Therefore, battle damaged hose normally will be replaced and not repaired. Use hydraulic repair kit when applicable.

7-12. REPLACEMENT OF FLEX HOSES. When replacement of flex hose becomes necessary, use the same type, size, and length when possible. High pressure hose can be used to replace medium pressure hose. Install hose assemblies without twisting. Never stretch hose tight between two fittings; this will result in overstressing and eventual failure. The replacement hose should be long enough to provide slack Avoid tight bends in flex hose. Tight bends could result in hose failure. Do not try to straighten a hose that is in use or that will be reinstalled. Any excessive bending or twisting may cause kinking or weakening of the tube wall. All flex hoses should be supported at least every 24 inches. Closer supports are preferred. The hoses should be carefully routed and securely damped to avoid abrasion, kinking, or excessive flexing. Excessive flexing may cause weakening of the hose or loosening of the fittings. Partial hose replacement is also possible if union fittings are available. Use hydraulic repair kit when applicable.

7-13. INSTALLATION. When installing flareless fittings, use the following procedure to tighten nuts.

a. Tightening Fittings. Use a torque wrench to tighten flareless fitting nuts as follows:

- 1/4-inch tubing: 135 to 145 inch-pounds
- 3/8-inch tubing: 215 to 245 inch-pounds
- 1/2inch tubing: 470 to 510 inch-pounds

b. Leaks. If the connection leaks during a pressure check, tighten the nut an additional 1/6 of a turn.

c. Persistent Leaks.. If leakage persists, loosen, and completely disconnect nut. Inspect surfaces, correct or dean, and retorque.

7-14. FLARELESS FITTING SEAL. To eliminate leakage of flareless tube end fittings, use a Teflon ring seal. It is used as a temporary repair method where scratches or other sealing surface imperfections have caused undesirable sealing effects (See Figure 7-4). To install this seal:

- Inspect the tube end for burrs or sharp edges.
- Remove burrs or sharp edges as required.
- Slip seal over tube end to position shown in Figure 7-4.
- Hand tighten the B-nut to the point of sharply increasing torque.
- Tighten B-nut one wrench flat beyond point of initial torque increase.
- Make pressure check.

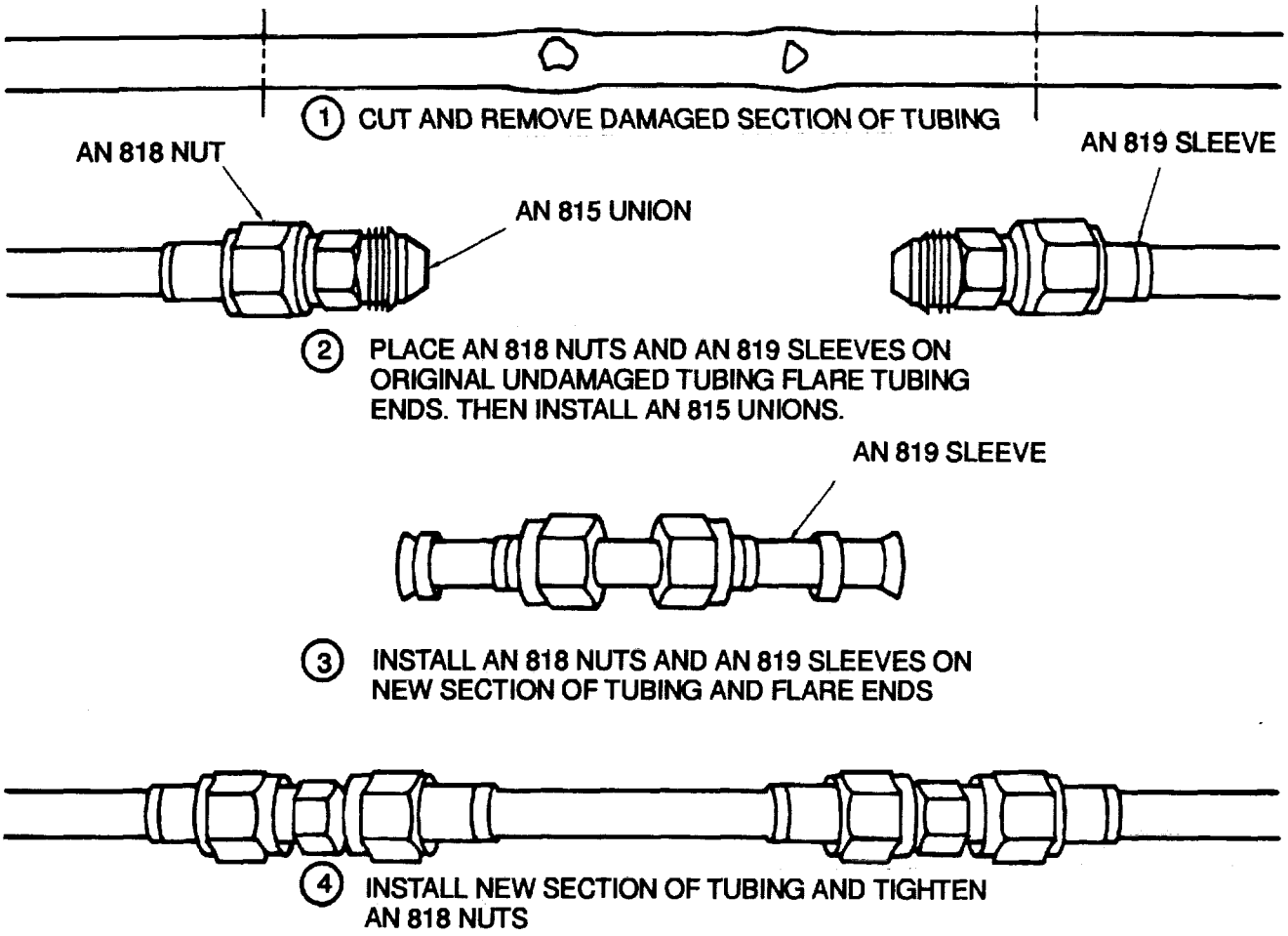


Figure 7-3. Tubing Repair (High Pressure)

PART NUMBER	TUBE OD REF	D DIA +.005	W +.005 -.005	SIZE SLEEVE NO.
CVC 4228-03	0.188	0.180	0.020	3
CVC 4228-04	0.250	0.241	0.020	4
CVC 4228-05	0.313	0.302	0.020	5
CVF 4228-06	0.375	0.363	0.020	6
CVC 4220-08	0.500	0.473	0.030	8
CVC 4228-10	0.625	0.598	0.030	10
CVC 4228-12	0.750	0.723	0.030	12
CVC 4228-16	1.000	0.973	0.040	16

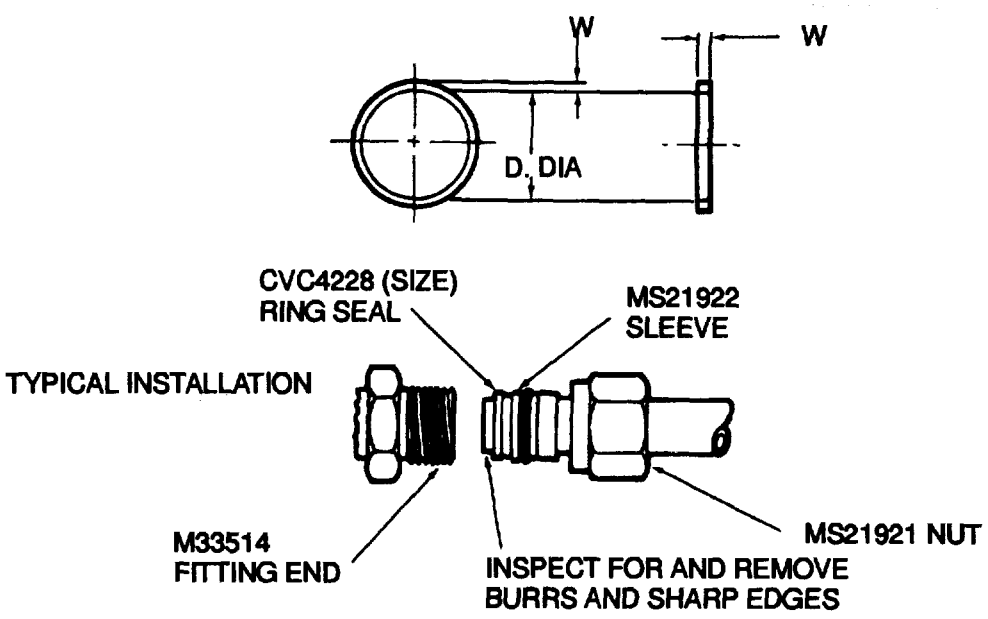


Figure 7-4. Repair (Flareless) Seat

7-15. BLEED AIR PIPELINES. Effective repair of hot bleed air ducts is considered temporary. Limited repair may be made as outlined below:

a. Repair Procedures. Repair should be limited to areas not exceeding two inches in diameter (Figure 7-5).

b. Insulation. Remove enough insulation blanket or permanent insulation to gain access to metal damaged area. Clean duct surface, and smooth out damaged area.

c. Installation. Install flexible stainless steel sheet (0.016 to 0.018 inch thick) or aluminum sheet with 2 wraps, around entire duct circumference. It should extend about two inches laterally in each direction beyond the damaged area or puncture.

d. Hose Clamp. Install enough hose damps (about five) to secure repair area. Exercise care when tightening damps. Overtightening may damage or crush the bleed air duct.

7-18. ALUMINUM TUBING DAMAGE

7-17. GENERAL INFORMATION. Aluminum tubing is subject to damage by projectiles and fragments. Replacement with original replacement parts is desirable, but not essential. In BDAR, tubing and hose, AN and MS fittings, and other similar components can be substitutes 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 MS fittings, OPTION 3, is probably the quickest fix.

7-18. LIMITATIONS. None

7-19. OPTION 1. In One Repair (damage to straight section of tubing).

a. Materials/Tools Required:

2 Repair Fittings-Shape Memory
Metal/Heat Shrink
Splice Tube
Tubing Cutter
Knife or File
Heat Gun

b. Procedural Steps:

(1) Cut and remove damaged section of tubing, Figure 7-6. Tube ends must be square.

(2) Clean ends of undamaged tubing with knife or file.

(3) Measure the distance between the two undamaged ends and prepare a tube splice replacement section of this size. Clean ends of splice section as done in Step 7-19.c.(2).

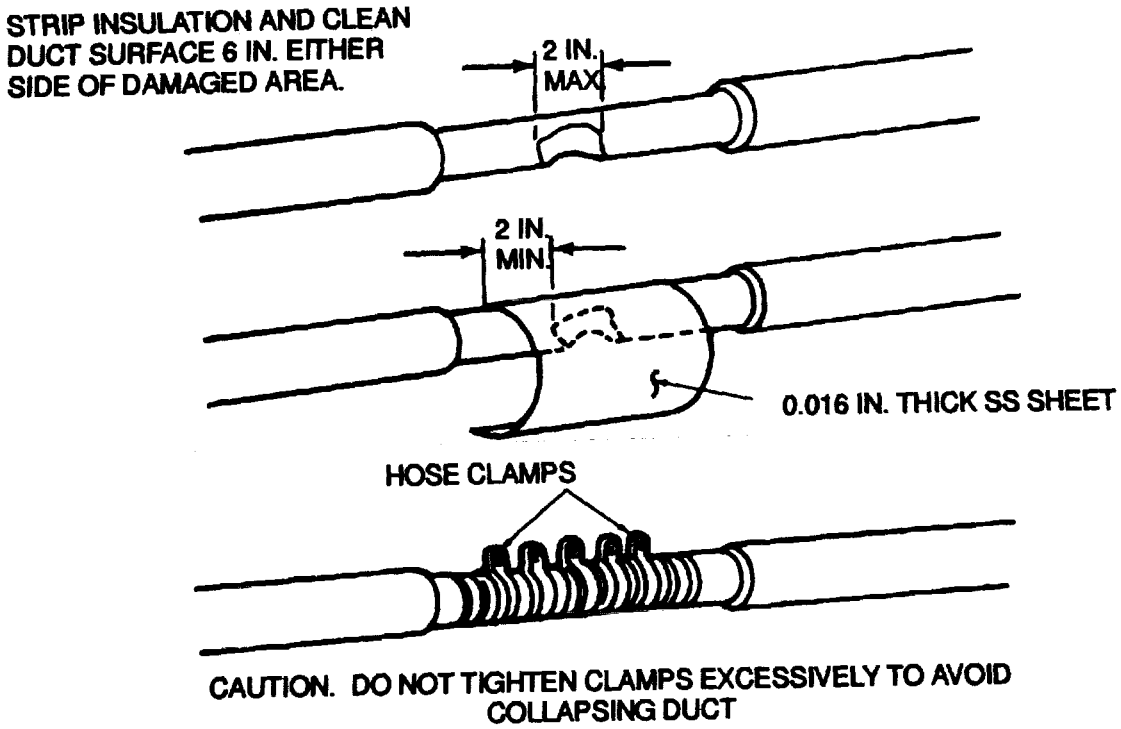


Figure 7-5. Repair Bled Air Pipelines

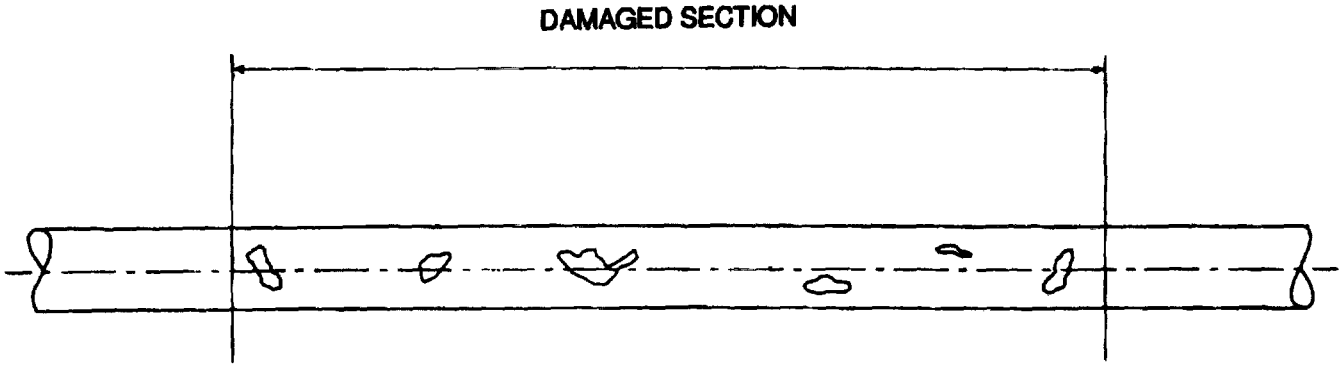


Figure 7-6. Damaged Tube Section Straight Tube

(4) Insert a repair fitting on each end of the splice tube, and place the splice tube between the undamaged ends of the tube, Figure 7-7.

(5) Slide the repair fittings o that they overlap on both the undamaged ends and the splice tube. The undamaged end and the splice tube should be butted up to each other at the mid potion of the repair fitting (use test coupling in BDR kit), Figure 7-8.

(6) Press the undamaged tube ends firmly against the splice tube and use the heat gun to blow hot air over the repair fitting. This will cause the fitting to shrink down on the tube ends.

(7) Record BDAR action taken.

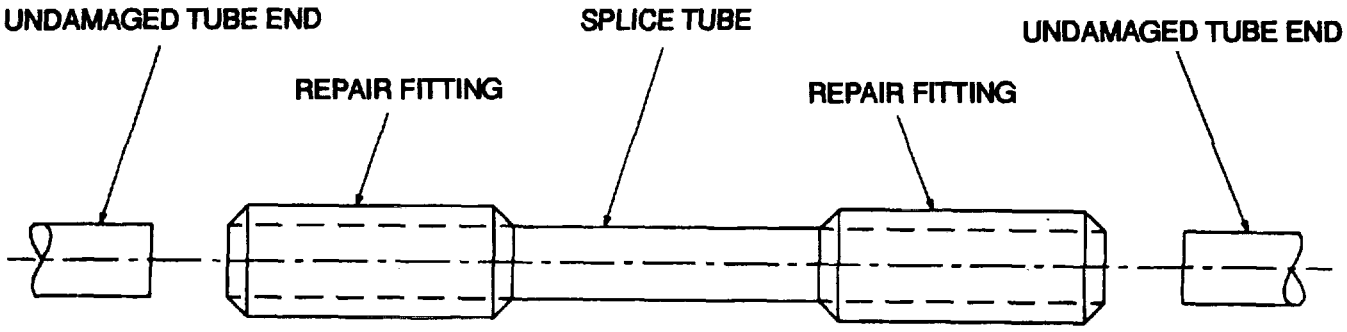


Figure 7-7. Splice Repair Assembly

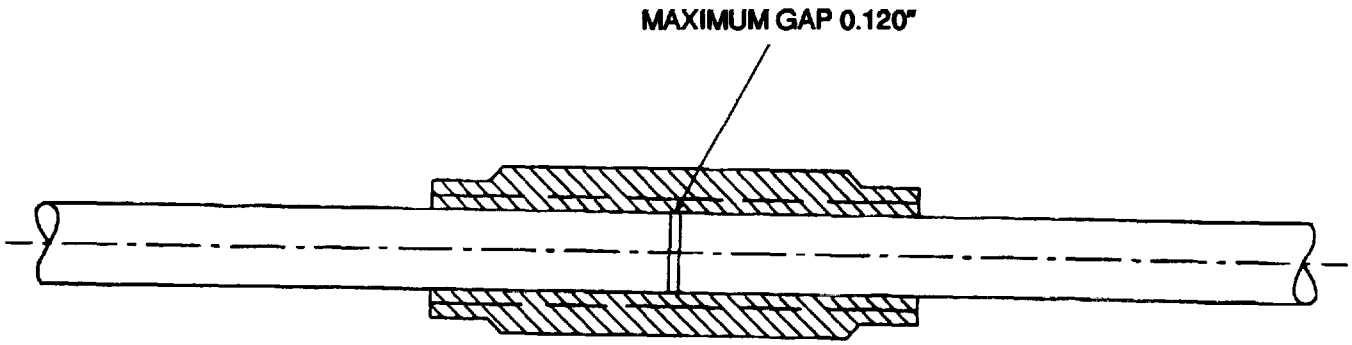


Figure 7-8. Repair Fitting and Tube installation

7.20. OPTION. Substitute with High Pressure Hose (damage to section of tubing with bends).

a. Materials/Tools Required:

Hydraulic Hose Assembly Complete with End Fittings
2 MS Unions
2 Splice Adapter Assembly
2 Repair Fittings
Tubing Cutter
Knife or File
Heat Gun

b. procedural Steps:

(1) Cut and remove damaged section of tubing, Figure 7-9. Tube ends must be square.

(2) Clean ends of undamaged tubing with knife or file.

(3) Install splice adapter assembly using repair fittings as shown in Figure 7-10. Procedure for connecting the splice adapter to the undamaged end is similar to OPTION 1 (paragraph 7-19), except the tube side of the splice adapter is the splice tube.

(4) Connect MS unions to both splice adapters, and complete the repair by connecting a hydraulic hose assembly from one union to the other (Figure 7-11). If the damaged length of tubing is long and more than one hose assembly is required, hose assemblies may be spliced together with unions. No harm will be done if the replace hose is too long.

(5) Clamp at convenient intervals, not exceeding 2 feet, to hard supports to secure the line.

(6) Record BDAR action taken.

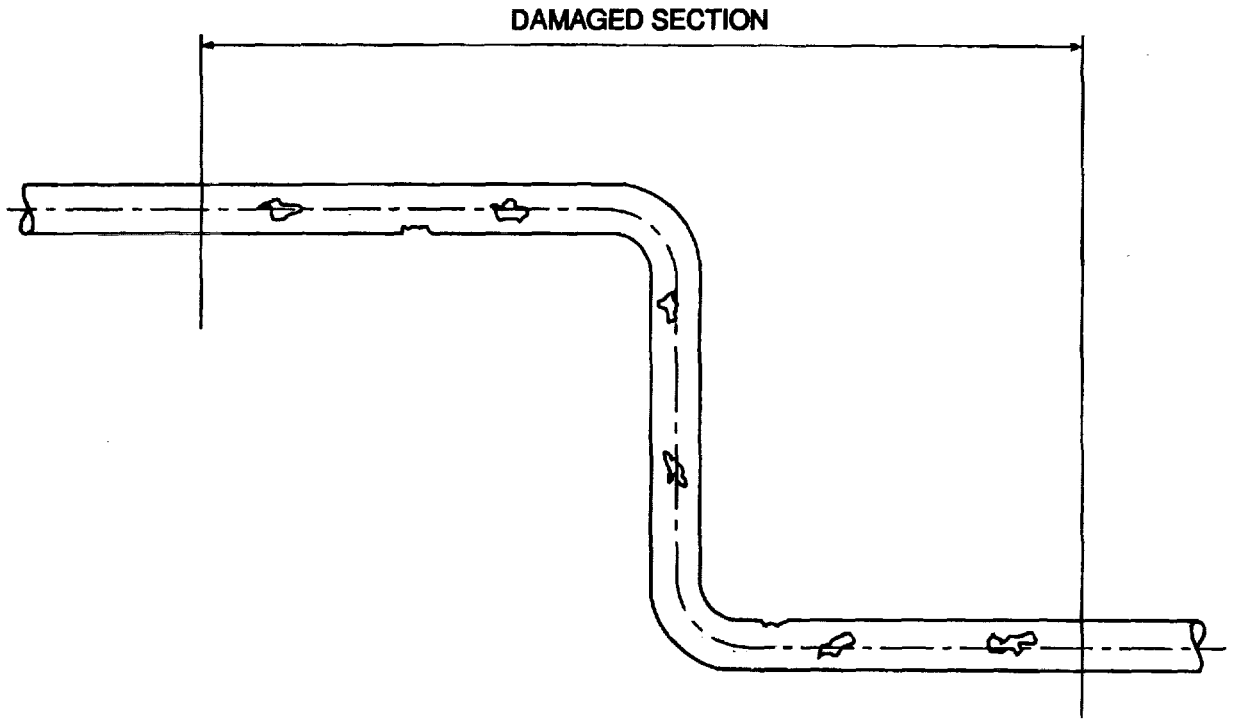


Figure 7-9. Damaged Tube Section - Complex Bends

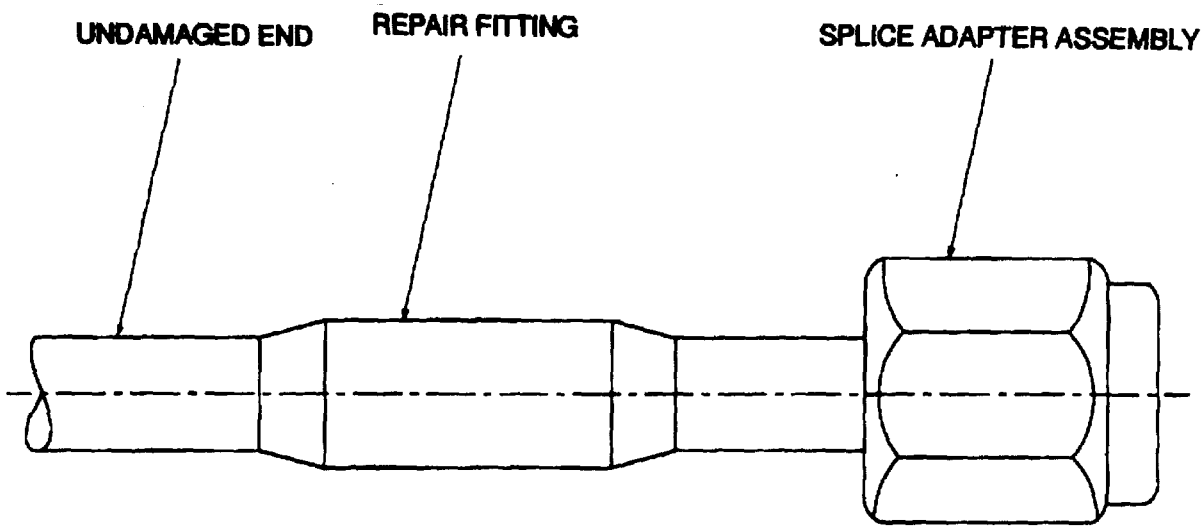


Figure 7-10. Splice Adapter Assembly installation

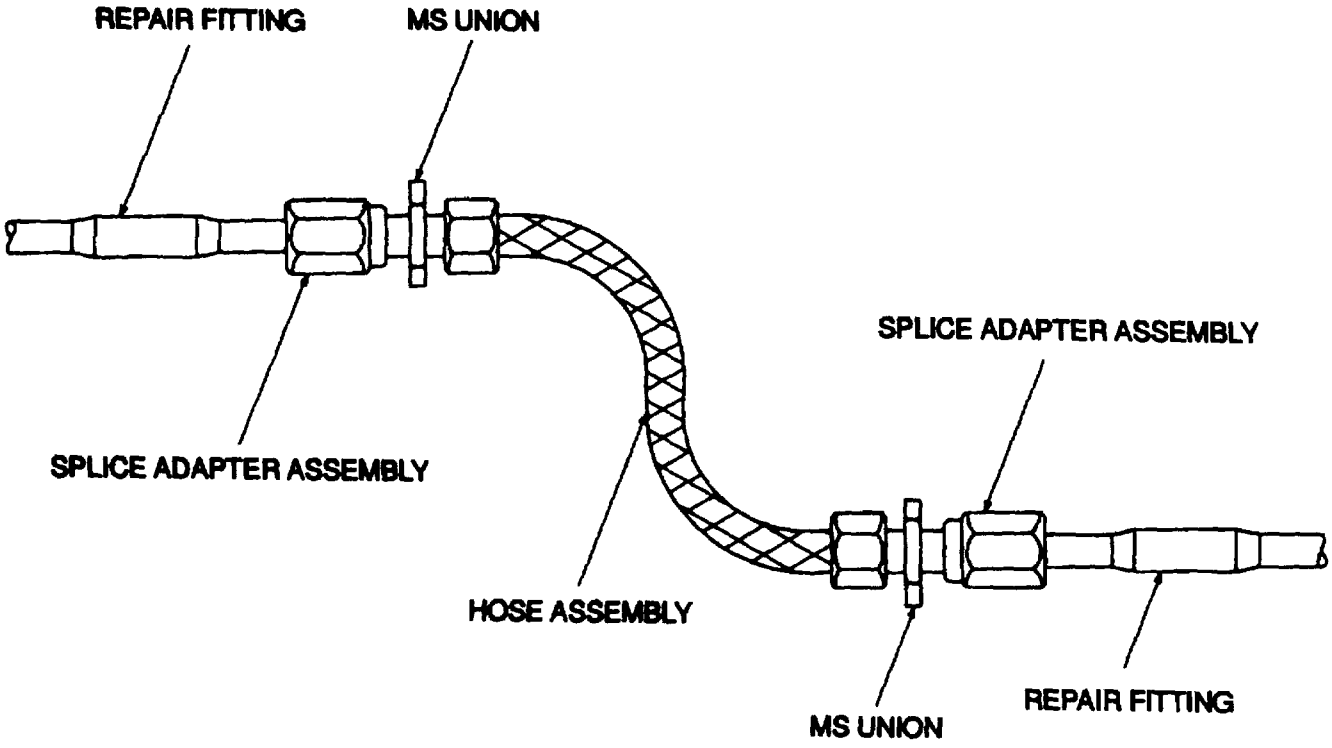


Figure 7-11. Substitute Hydraulic Hose Assembly

7-21. OPTION 3. Repair with MS Fitting (heat shrink fittings not available).

a. Materials/Tools Required:

Tubing or Hydraulic Hose Assembly
MS Fittings
Tube Cleaner
Tubing Cutter
Hacksaw
Hand File

b. Procedural Steps:

(1) Cut and remove damaged section of tubing, Figure 7-9 or Figure 7-10. Tube ends must be square.

(2) Clean ends of undamaged tubing and slip an MS socket, sleeve, and union over each end, as shown in Figure 7-12, and torque.

(3) For straight sections of damaged tubing (removed in step 7-21.b.(1)), measure the distance between the two fittings installed in step 7-21.b.(2), Figure 7-13, and prepare a tube replacement section. Put a socket and sleeve on each end of the replacement section and connect to the two fittings, Figure 7-14.

(4) I the damaged section of tubing (removed in step 7-21.b.(1)) has complex bends, connect the end fitting, Figure 7-13, using a hydraulic hose assembly, Figure 7-15.

(5) Torque and pressure check

(6) Record BDAR action taken. When mission is complete or as soon as feasible, repair using standard maintenance procedures.

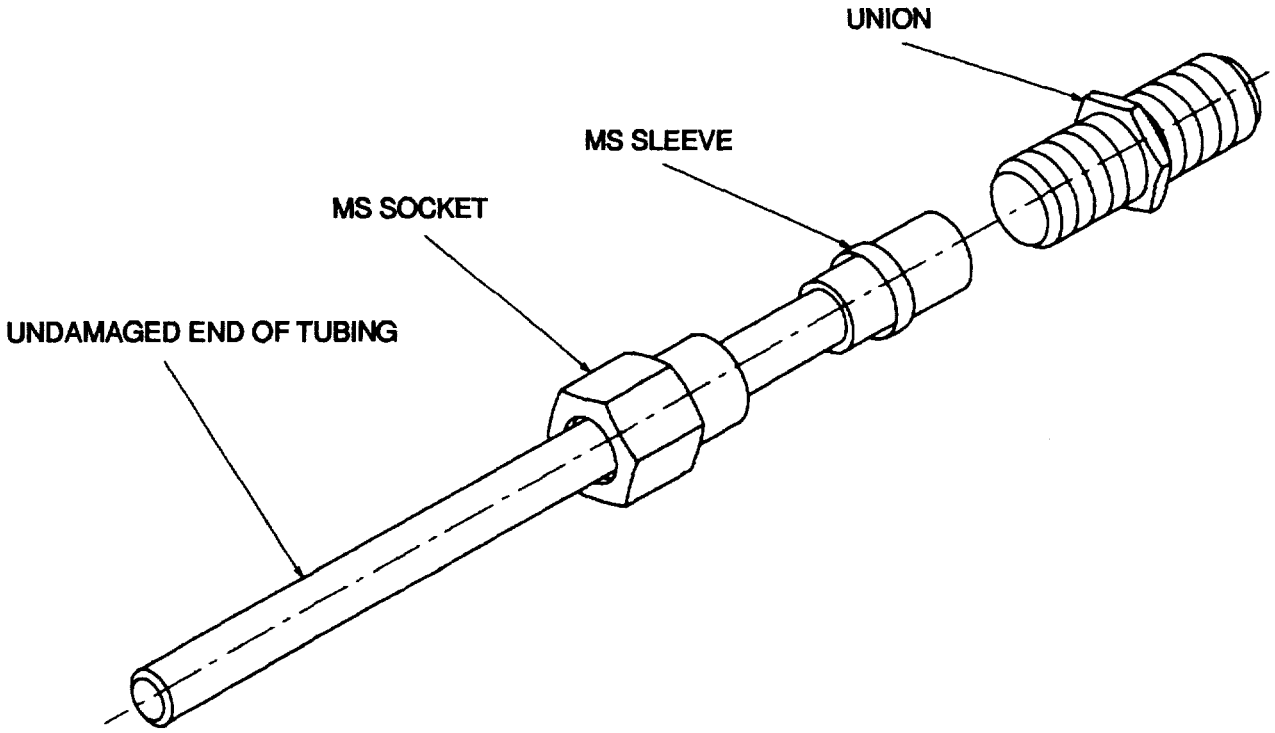


Figure 7-12. MS Fittings on Tubing Assembly

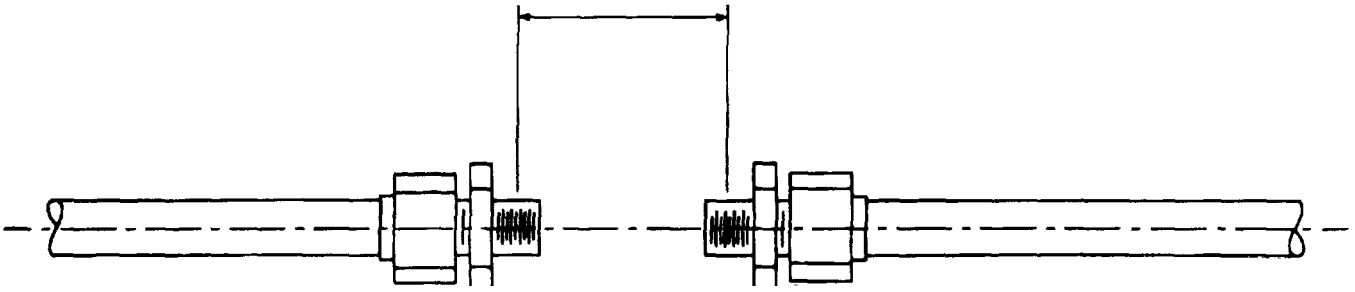


Figure 7-13. Tube Spice Length

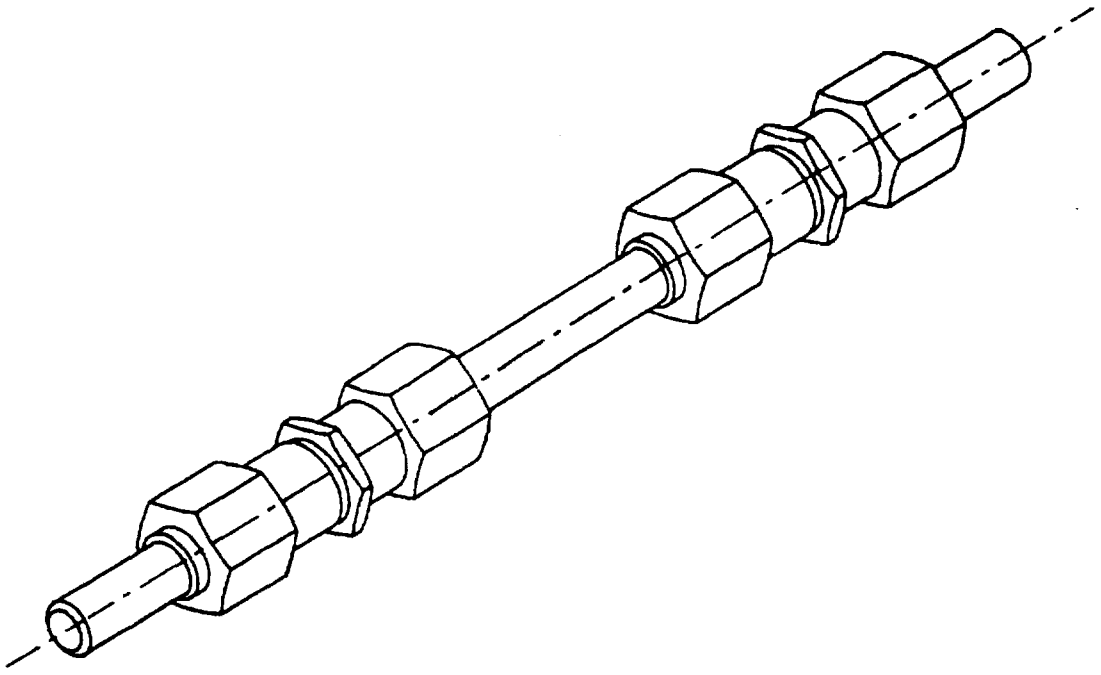


Figure 7-14. MS Fitting/Straight Tube Repair

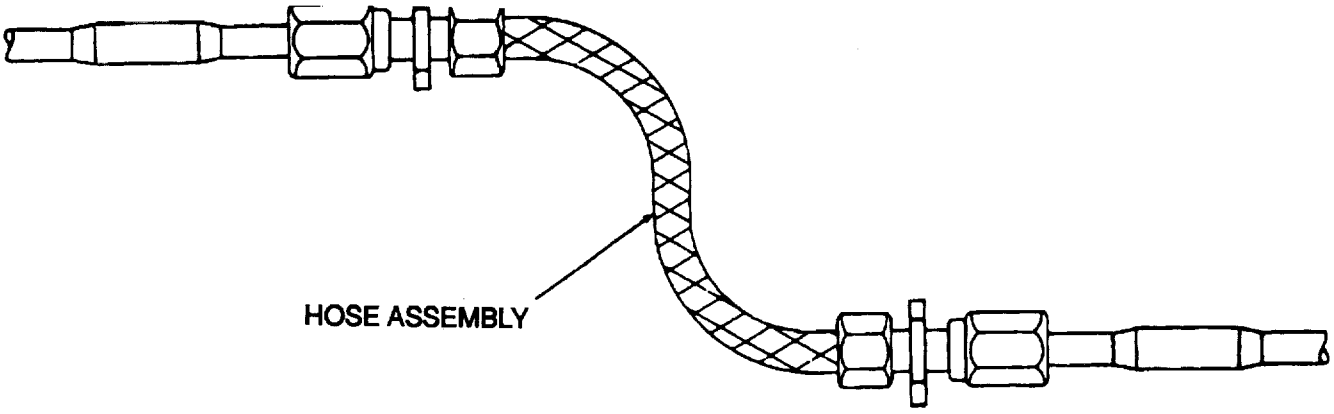


Figure 7-15. MS Fitting/Complex Bends Repair

CHAPTER 8
INSTRUMENTS

SECTION I. GENERAL

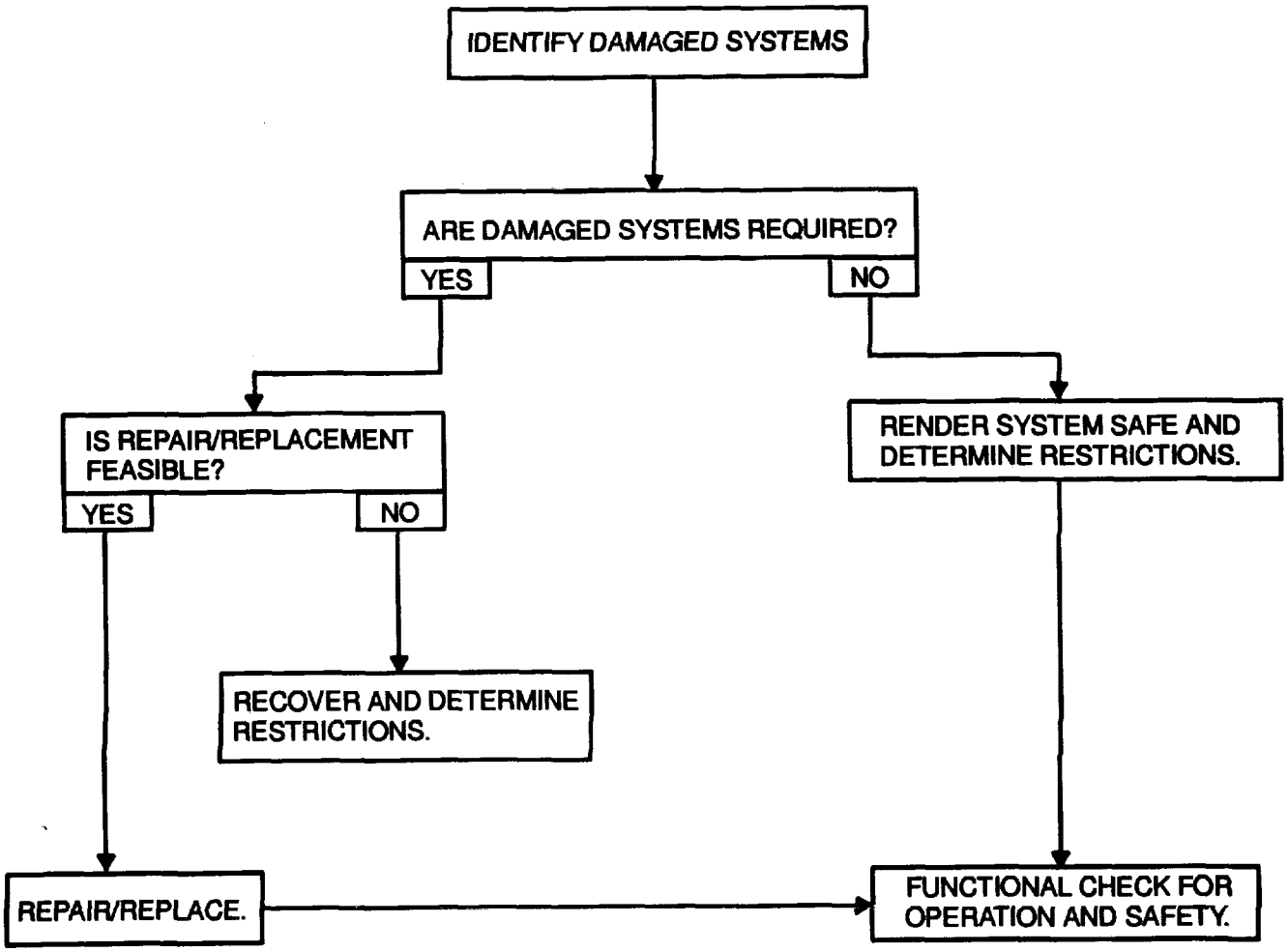


Figure 8-1. Instruments Assessment Logic

8-1. INSTRUMENT DAMAGE. Battle-damaged instruments normally will be replaced rather than repaired. Deferring repair of instruments may allow some aircraft to remain operational with limited mission capability.

8-2. ACCESSORIES. Instrument system accessories can be repaired as follows:

- Tubing and hose repairs can be found in Chapter 7.
- Wiring repair can be found Chapter 9.

CHAPTER 9
ELECTRICAL AND AVIONICS SYSTEM

SECTION I. GENERAL

9-1. INTRODUCTION. This chapter provides methods for assessing battle damage, deferring damage repair, and repairing electrical and avionics systems. Extensive repairs to complicated components or 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. The most frequent battle-damage repair for recoverable and repairable helicopter may be electrical wiring.

SECTION II. DAMAGE ASSESSMENT

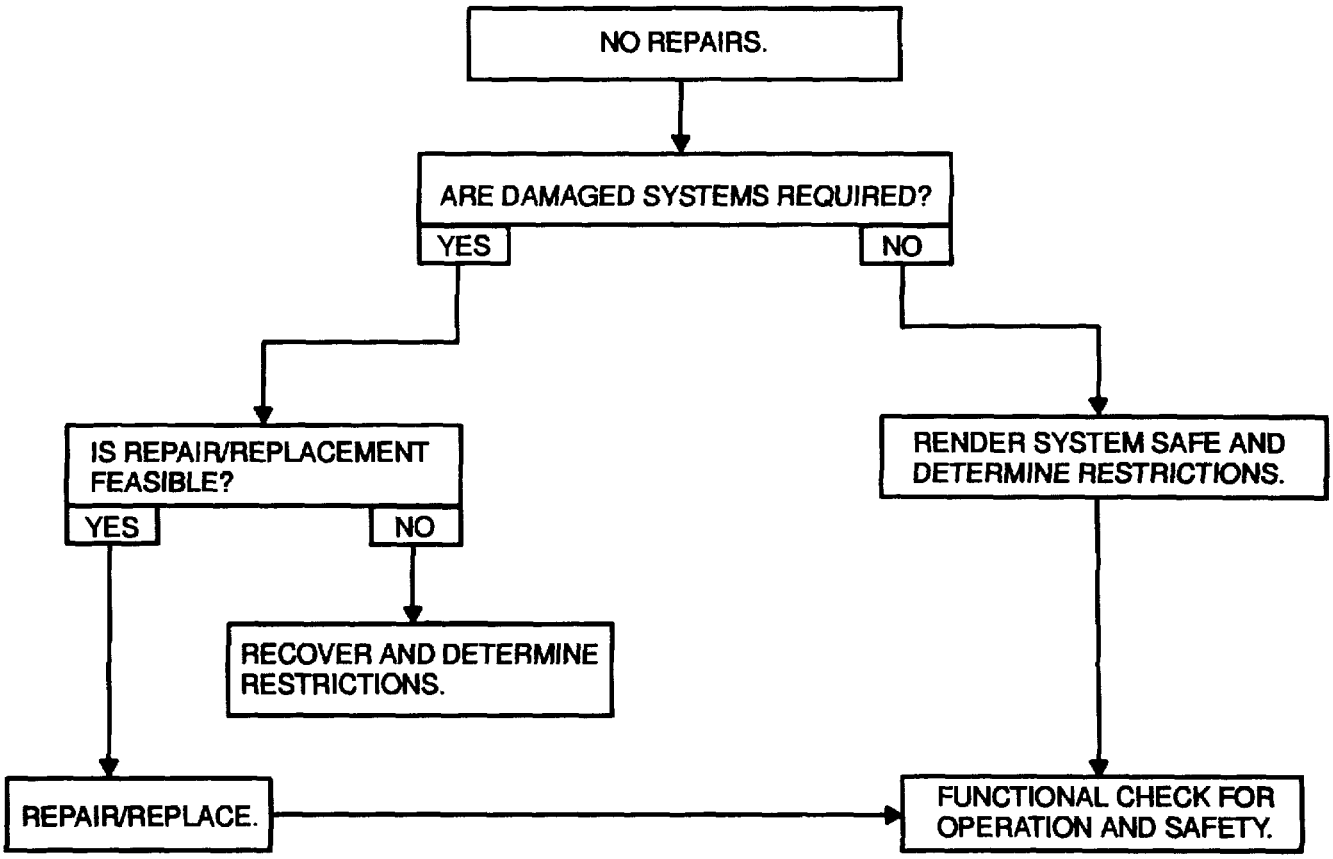


Figure 9-1. Electrical and Avionics Assessment Logic

9-2. DAMAGE ASSESSMENT PROCEDURES.

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 pieces, may be used. Use a material suitable for the ambient temperature range. Typical wire and circuit identification schemes are shown in Figure 9-2.

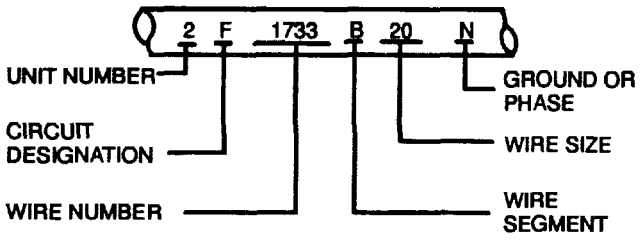


Figure 9-2. Circuit Identification

b. Circuits Identification. 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 AN or AL or 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).

9-3. DEFERMENT. Repair of systems and subsystems which 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 standards for repair and aircraft performance can be accepted. The commander may defer combat maintenance and battle-damaged repair, even if doing so places operational limitations on the aircraft.

SECTION III. BATTLE-DAMAGE REPAIRS

9-4. INTRODUCTION. The objective of electrical and avionics system battle-damaged repair is to restore damaged circuits which are essential. It is also used to make nonessential circuits safe. The repair procedures in this section are designed to quickly return an aircraft to a flyable condition.

9-5. ELECTRCTRICAL AND AVIONICS REPAIRS. Electrical and avionics equipment receiving significant battle damage will usually not be repairable. The equipment may require replacements for nonessential system units are not available, the technician should, when possible, make the necessary repairs or adjustments on the unit for one more combat sortie. However, avionics wiring, coaxial cables, and general aircraft wiring can be repaired using a variety of procedures and materials. Most of them are considered standard for temporary repairs.

9-6. ISOLATION OF NONESSFNTIAI SYSTEMS. To isolate damaged nonessential system wiring, crimp-on end caps, tape or any other insulating method may be used. Secure wires to some form of structure.

9-7. THE ACM/BDR WIRING REPAIR SET. The wiring repair set contains the necessary tools, materials, and test equipment for the repair of all combat damaged U.S. Army rotary-wing aircraft electrical wiring systems. Paragraph 9-7.a. describes the wiring repair set, and paragraph 9-7.b. contains general instructions for using its four major subassemblies.

a. Description. The wiring repair set consists of four major subassemblies (kits). The kits are packaged in militarized fiberglass cases and are transportable by one or more maintenance personnel. Each subassembly kit contains the necessary tools, materials, and test equipment to perform a specific portion of the aircraft wire repair task. Three kits are dedicated for use at the AVIM or AVUM areas as follows:

- Test Equipment Kit. Contains diagnostic and test equipment and adaptors.
- Connector Repair Kit. Contains electrical connector insertion or removal tools, crimping tools and dies, and wire stripping tools and dies.
- Wire Repair Kit. Contains wire, shield, and co-axial cable cutters, strippers, crimpers and splice materials. Also contains certain bulk wire, shield, and insulation materials, terminal boards, and cable tying materials. This kit also contains certain connector pins and sockets for use with the connector repair kit. A heat gun is included to complete environmentally protected splices.

The fourth kit is for use at the downed aircraft site. It contains materials and tools needed to perform emergency repairs that will allow self recovery of the aircraft. The emergency repair and aircraft recovery kit is compact to facilitate transport to the downed aircraft site.

b. Operation. The four kits also contain environmentally protected software as follows:

- Instruction Sheets. For the tools, repair materials, and test equipment contained within the kit.
- Contents Chart. For inventory control of the components contained within each kit storage compartment.
- Cross-Reference Charts. For re-ordering kit components.
- Application Charts. To provide proper selection of kit components for a specific task.

The information contained in the software is intended for use during combat to repair aircraft wiring systems without using any other TM. Recommended usage of the four kits is described in paragraphs 9-7b(1) through 9-7b(4).

(1) Test Equipment Kit.

(a) Mission And Major Components. The test equipment kit is used for diagnosing and troubleshooting damaged aircraft wiring systems and for verifying wiring repair. The kit contains electronic instruments for conducting necessary test. The instruments and their intended use are:

- Digital Multimeter (DMM). A digit multimeter is provided for measurement of circuit voltages (AC to 1000 VAC, DC to 1500 VDC); current (up to 10 amps); and resistance (0 to 20 ohm). An "instant-on" continuity indicator is provided. The DMM is waterproof and built for use in hostile environments.
- Time Domain Reflectometer (TDR). A TDR is provided to locate and analyze faults in coaxial cables. The TDR provides a CRT display of the cable condition. The display indicates the type of fault present (short, open, crimped, frayed, or crushed) and the distance of the fault (in 0.1 ft. increments) from a reference point at the TDR input. The TDR also provides a chart recorder which is used to make a permanent record of a repaired cable's TDR signature for inclusion in the aircraft records. The TDR may also be used to test twisted wires.

CAUTION

- **The TDR battery pack will discharge if left in the TDR during extended storage. Remove the battery pack from the TDR and place in compartment number 16 (spare) of the test equipment kit case during storage periods.**
- **The test equipment kit also contains test leads and adaptors to allow connection of the TDR or DMM to the wires or cable undergoing repair. Other support equipment such as a flashlight, illuminated magnifying glass, spare D-Cell, AAA, and 9-Volt batteries, and rolls or TDR chart recorder paper are provided.**

(b) Use. Prior to using kit contents, a good working knowledge of the test equipment operating procedures and adaptor selection is required. The software package duplicates the environmentally protected software within the kit and provides the operating instructions forth TDR and DMM. It also contains adaptor selection charts for connecting the TDR and DMM to co-axial cable connectors, connector pins and sockets, bare wires, and terminal boards. Proficiency in the use and

application of this material is necessary if the desired wire or cable diagnostic test capability is to be achieved.

(c) Procedures. The following procedures is to be followed when using the test equipment kit for electrical wiring system diagnostic test, troubleshooting, or verifying repairs:

- Perform necessary steps to make aircraft safe, such as making sure all electrical power is disconnected and all systems are deactivated. Disconnect the aircraft's battery.
- Review DA Form 2404 and apply this information to the aircraft serviceability tables.
- Establish cable or wire repair sequence, starting with the most essential requirement and proceeding to non-essential, as time permits.
- Determine test required (continuity with DMM; location and type o fault with TDR).
- Select proper adaptors from applicable charts.
- Perform necessary test using DMM or TDR operating instructions.
- Repair fault using the connector repair kit or the wire repair kit.
- Retest to determine effectiveness of repair. Take TDR readings of co-axial cable repairs for aircraft logs.
- Return all contents of the test equipment kit to the proper storage compartment. Inventory kit content, account for all components, and prevent FOD.
- After completing all repairs and verifying kit contents, perform standard check-out of aircraft and systems (powered).

(2) Connector Repair Kit.

(a) Mission And Major Components. The connector repair kit is used to repair damaged wiring connector pins and sockets. The kit contains the necessary tools to remove or insert connector pins and 94 sockets, strip wiring, and crimp wires to connector pins and sockets. The tools and their intended use are:

- Insertion and Removal Tools. Insertion and removal tools are supplied for use with front or rear release connector pins or sockets. Selection charts and tool instruction sheets are provided to aid in selection and use of the proper connector repair tool.
- Wire and Cable Strippers. Strippers are provided for wires and co-axial cables. Stripper blades are provided for the most common aircraft electrical wiring insulation materials. Instructions for blade selection and stripper operations are supplied.
- Connector Pin And Socket CrimpTools. The kit contains crimping tools, dies, and locating turrets for crimping connector pins and sockets to wire. Selection charts and the tool instruction sheets are supplied to aid in selection and use of the proper tools, dies, and turrets.

(b) Use. Prior to using the kits' contents, a working knowledge of the tool instructions, tool application charts, and tool selection charts is required. The software package duplicates the environmentally protected software within the kit and provides instructions for the use of the tools and tool selection charts. Proficiency in the use and application of this material is necessary if the desired connector repair capability is to be achieved.

(c) Procedure. Follow these procedures when using the connector repair kit:

- Perform necessary steps to make aircraft safe such as making sure all electrical power is disconnected and all systems are deactivated. Disconnect the aircraft's battery.
- Review DA Form 2404 and apply the information to the aircraft serviceability tables.
- Establish connector repair sequence, starting with the most essential requirement and proceeding to nonessential, as time permits.
- Perform diagnostic and troubleshooting tests as applicable per paragraph 9-7b(1).

- Demate connector, determine contact type (pin or socket) and gage affected.

- Use illuminated magnifying glass to aid in determining part number of connector to be repaired.

- Use illuminated magnifying glass to aid in determining type and gage of the wire used in the system.

- Refer to wire stripper selection chart to select the proper stripper blade and handle.

- Install blades into stripper handle using the Proto 9208 nut driver. Use the contents chart from compartment "A" to determine location of nut drivers, stripper blades, and handle.

- Refer to the tool selection charts to determine the contact's removal or installation tool, the crimp tool, the turret head positioner or die set, and replacement contact part number.

NOTE

Contact part numbers marked with an asterisk (*) in the charts are available in compartment B1 and B4 on the MK-0015 Wire Repair Kit. Contact part numbers not marked must be obtained from other stock areas.

- Remove the necessary tools from the kits' storage compartment. Assemble the turret head, positioner, or die set to the crimp tool handle.

- Remove the damaged pin or socket from the connector using the removal tool.

- Prepare the wire for the new pin or socket using the wire stripper. Splice in additional wire, if necessary (paragraph 9-7b(3)(b)).

- Select the proper pin or socket. Install into the prepared wire and crimp using the crimp tool assembly. You may observe proper wire insertion into the contact through the contact inspection hole.

- Install the pin and socket into the connector using the insertion tool.
- Perform the remaining repair actions.

- Use the test equipment kit to verify the repairs.

- Return all the components to the proper storage compartments, and prevent FOD.

- After completing all repairs and verifying kit inventory, check out aircraft and systems (powered).

(3) Wire Repair Kit.

(a) Mission and Major Components. The kit is used to repair damaged aircraft electrical wires and co-axial cables. The kit contains the necessary tools and materials to strip and splice wire and heat shrink the environmental seal insulation material. Environmentally protected splices are provided for shielded and unshielded wires and co-axial cables as well as the preassembled wire splice segments. Bulk, wire, wire shield, and heat shrinkable tubing stocks are also provided. The major tools and repair materials are:

- Model HT-900A Heat Gun. The Model HT-900A Heat Gun is a compressed air and nitrogen heating tool. It provides a portable source of heat for use with heat shrinkable tubing, environmentally sealed splices, and meltable solder fittings. The HT-900A may be used on fueled aircraft. The heat gun is self-contained, but requires compressed air or nitrogen and electrical power. Adaptors are for use with various air or nitrogen supply hoses and AC power sources.

- Wire Stripper and Cutters. Wire strippers and cutters are for use on unshielded and shielded wires, and co-axial cable. Stripper blades are provided for the most common aircraft wiring insulation materials. Instructions for blade selection and stripper operation are supplied.

- Crimp Tools. The kit provides crimp tools and instructions for both wire crimp splices and terminal lugs.

- Repair Materials. Repair materials for shielded or unshielded wire and co-axial cables are provided. Bulk stock of shielded and unshielded wire, tubular shield braid, heat shrinkable tubing and wire harness tie tape is provided on spools stored in a removable rack. Other repair materials are stored in plastic boxes to reduce FOD hazard. The boxes are labeled at each end with the repair materials location reference number, name, and part number. A label on the box cover contains abbreviated instructions for using the repair material. Additionally, four boxes are used to store connector pins and sockets.

(b) Use. Before using kit components, a working knowledge of the instructions, and material application charts is required. The software package duplicates the environmentally protected software. It provides instructions for the use of the tools, the component selection charts, and proper application of repair materials. Proficiency in the use and application of this material is necessary to achieve desired repair capability.

(c) Procedure. The following procedure is typical when using the kit to repair wire or cable:

- Perform necessary steps to make aircraft safe, such as making sure all electrical power is disconnected and all systems are deactivated. Disconnect the aircraft's battery.
- Review DA Form 2404 and apply the information to the aircraft's' serviceability tables.
- Establish the sequence for wire repair, starting with the most essential requirement and proceeding to non-essential, as time permits.
- Perform diagnostic and troubleshooting tests as applicable per paragraph 9-7b(1).
- Use illuminated magnifying glass to aid in determining type and gage of the wire used in the system.
- Use the repair component selection charts to determine the repair material to be used.
- Refer to the general wire repair procedure and material instructions to determine the tools required.
- Set up and check out the HT-900A Heat Gun at the repair site.
- Refer to the contents chart to located required tools and repair material.
- Remove the necessary tools and repair materials from the kits. Verify that the proper stripper blades are installed in the stripper handle. Change as necessary.
- Prepare the wire or co-axial cable for installation of repair material.
- Install repair material per instructions.
- Perform the remaining repairs on other wire or co-axial cables.
- Use the test equipment to verify the repair.

NOTE

Use the TDR to obtain a chart record of all repairs performed on co-axial cables. This record will be included in the aircraft maintenance records. It will provide a signature of the co-axial cable characteristics if a future system degradation occurs. Clearly annotate the chart record with the aircraft serial number, date, airframe hours, cable number, system, repair action performed, and vertical and horizontal TDR attenuations.

- Return all tools and unused repair materials to their proper storage compartment. Verify the kit inventory account for all components, and prevent FOD.
- After completing all repairs and verifying kit inventory, check out aircraft and systems (powered).

(4) Emergency Wire Repair and Aircraft Recovery Kit.

(a) Mission And Major Components. The kit is used for emergency repairs on a downed aircraft's' electrical wiring to allow a self-recovery flight to an AVIM or AVUM area. The kit contains the basic tools, repair

materials, and test equipment required to perform emergency splice repairs. The major tools, test equipment, and repair materials are:

- Digital Multimeter (DMM). A multimeter with probes is provided for measurement of AC and DC voltages and current and continuity tests. The DMM is waterproofed and built for use in hostile environments. This instruction is also provided in the test equipment kit (paragraph 9-7b(i)(a)).

- Wire Repair Segments. Partially assembled wire splice segments are provided in three gages to quickly repair severed wires. These splice segments have sealing sleeves attached to each end of the wire.

- Assorted Wire Splices. Assorted wire splices are packaged in three sizes. The splices are used for repairs other than those using the wire repair segments.

- Bulk Wire. Two spools of bulk wire are provided for use with the assorted wire splices. They are used for repairs other than those using the wire repair segments.

- Wire Strippers. Two wire strippers are provided; one for stripping M81381 (Kapton) insulated wires, and one with general purpose blades for stripping all other wire insulation materials.

- Crimp Tool. A crimp tool is provided to crimp wire repair segments and assorted splices.

- Swiss Army Knife. General purpose multiuse tool.

- Cable Ties and Teflon Tape. Used to secure wire splice insulation, wiring, and wire bundles.

- Flashlight and illuminated Magnifying Glass. Use in wire identification and work in reduced light levels.

- Diagonal Pliers. Used as a general purpose cutter for cables, tie wraps, and string ties.

- Wire Cutter. Use to cut wires ends during splicing operations.

(b) Use. Before using the kit's components, a working knowledge of the kit's test equipment, tools, repair materials, and instruction and content description charts is required. The software package duplicates the environmentally protected software. It provides both instructions for the use of the kits' DMM, tools, and repair materials, and content description charts. These instructions are used to make emergency wiring repairs. Proficiency in the use and application of this material is necessary to achieve emergency wire repair capability.

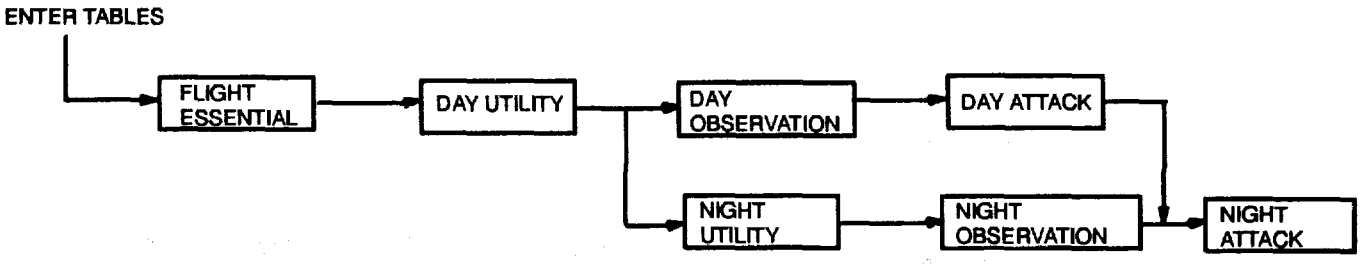


Figure 9-3. ACM/BDR Electrical Wiring System Repair Sequence Flow Diagram By Mission

(c) Procedures. The following procedures are typical when performing emergency wire repairs:

- Before leaving for the downed aircraft site, obtain copies of the "flight essential" serviceability tables (as a minimum) for the aircraft model to be recovered.
- At the site, perform an assessment of wire to be repaired prior to self-recovery flight of the aircraft. Use the serviceability tables to determine wires to be repaired.
- Select the necessary tools and materials and make necessary emergency wire repairs.
- Use the teflon tape to "cap" off severed nonessential wiring. The scissors of the Swiss Army knife may be used to cut the teflon tape. Non-essential wiring repair is deferred until return to an AVIM/AVUM area.
- Use the DMM to verify proper continuity (aircraft non-powered) and voltage levels (aircraft powered).
- Return the DMM, tools, and unused repair materials to the proper storage compartment. Verify the kits inventory and prevent FOD.
- Perform aircraft ground check and fly to an AVIM/AVUM area. This is a one-time flight of one hour maximum.
- At the AVIMIAVUM area, convert "emergency" repairs to "temporary" or "permanent" status using the HT-900 heat gun (paragraph 9-7b(3)).
- Perform ACM/BDR assessment of aircraft and make additional necessary repairs per paragraphs 9-7b(1), 9-7b(2), and 9-7b(3).

9-8. ACM/BDR ELECTRICAL WIRING SYSTEM REPAIR DEFINITIONS AND CAPABILITIES. The ACM/BDR wiring repair set provides for three types of aircraft electrical wiring repairs, classified as "PERMANENT," TEMPORARY" and "EMERGENCY" as defined in paragraphs 9-8a. through 9-8c. Examples of typical ACM/BDR repairs and techniques will be provided in paragraph 9-9.

a. Permanent Repair. 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.

b. Temporary Repair. 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 140 flight hours. At this time, a permanent repair will be performed or an extension of use for the temporary repair will be granted.

c. Emergency Repair. An emergency repair is performed to enable the recovery of a downed aircraft to an AVIM/AVUM area Emergency repairs are allowed for a one-time flight not to exceed one hour duration. Most emergency repairs can be easily upgraded to permanent or temporary status at the AVIM/AVUM area.

NOTE

Temporary and emergency repairs established in this TM will only be applied in time of war. The commander or his designated representatives may authorize deviations necessary to accomplish wartime requirements.

9-9. REPAIR TECHNIQUE. Electrical wiring system ACM/BDR is used to restore damaged circuits which are essential to the mission and to make nonessential circuits safe, in the shortest possible time. The best techniques and materials available are used to make the most suitable repair within the allotted repair time. The methods described are the most preferred, but are by no means exhaustive. In battle, situations may arise that will require the ACMIBDR assessor and repair personnel to develop innovative repair techniques beyond the scope of this TM. This paragraph describes and illustrates repair capabilities to broken and/or damaged wires, shielded and co-axial cables, electrical connectors and associated electrical components in the combat environment. Example of repairs meeting the ACM/BDR permanent, temporary, and emergency repair standards are shown.

a. Permanent Repair Techniques. This paragraph describes permanent repair techniques for:

- Unshielded and shielded primary wires.
- Cable shielding and cable shield termination.

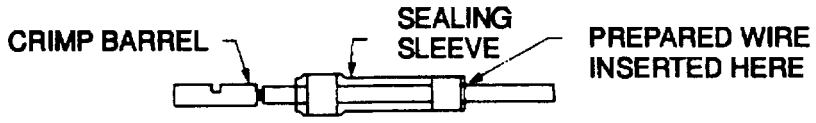
- Bundle forming and protection.
- Circular and flat connector repair.
- Terminal board replacement.
- Terminal lug installation.

Prior to performing any of the listed repairs, the repair technician must be knowledgeable in the application of the basic repair procedures, and proficient in the use of wiring repair tools and materials. The techniques illustrated, when applicable, duplicate the "short-form" instruction for each repair material that are affixed to the storage box cover.

(1) Unshielded Primary Wire Splicing. The repair set provides wire splice capability for all 24 to 12 AWG wiring used on Army helicopters, regardless of the wire temperature ratings. Splices are provided for wires rated at 1050C or below (wires identified as M5086, MS26313, M7078/3, 5, 7, and M27500 A, B, C, P, AA, AB, or AD); TM 1-1520-240-BD and for wires rated at 125° C or above (wire identified as M22759/16, 18, 32, 34, 43 and M81381/7, 11). All primary wire stocked in the repair set is M22759/43, rated at 200°C. This wire may be spliced to any existing aircraft wiring provided that the splice selected is appropriate for the existing aircraft wiring temperature rating. Wire bundle repairs should be accomplished using the splicing techniques described in this section. Care should be exercised to stagger splices. Where possible, splices in adjacent wires in a bundle should be separated by at least one splice length. This may require the use of the pre-made splice segments (Figure 9-10) or locally manufactured jumper wires made from the kit primary wire stock spliced into the existing aircraft wiring. Figures 9-4, 9-5, and 9-6 illustrate the technique for the splicing of 125°C or above rated wires of the sizes indicated. Figures 9-7, 9-8, and 9-9 illustrate the technique for splicing wires rated at 105°C or below for the wire size indicated. Figure 9-10 illustrates the use of the premade wire repair segments on primary wires rated at 125°C or above. Adherence to these techniques results in a permanent, environmentally sealed primary wire splice.

Item B15 Crimp Splice for #26, 24, 22, 20 Wires Rated 125°C or Above

1. Strip wires .25 to .30 inch.
2. Insert one prepared wire into small end of sealing sleeve, and push crimp barrel out.

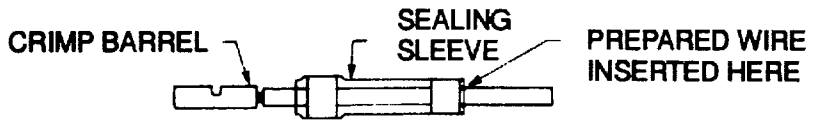


3. Crimp wires using red cavity of AD-1377 crimp tool (Item A19).
4. Shrink sealing sleeve over crimp. Use reflector Item A3. Temperature setting: 900°F.

Figure 9-4. Item B15 Crimp Splice

Item B16 Crimp Splice for #18, and #16 Wires Rated 125°C or Above

1. Strip wires .30 to .35 inch.
2. Insert one prepared wire into small end of sealing sleeve, and push crimp barrel out.

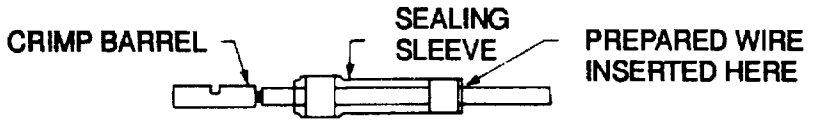


3. Crimp wires using red cavity of AD-1377 crimp tool (Item A19).
4. Shrink sealing sleeve over crimp. Use reflector Item A3. Temperature setting: 900°F.

Figure 9-5. Item B16 Crimp Splice

Item B17 Crimp Splice for #14, and #12 Wires Rated 125°C or Above

1. Strip wires .30 to .35 inch.
2. Insert one prepared wire into small end of sealing sleeve, and push crimp barrel out.

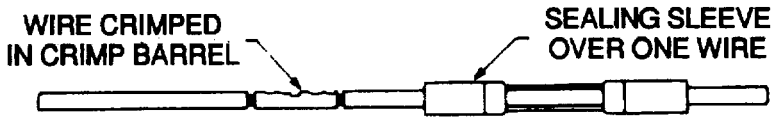


3. Crimp wires using red cavity of AD-1377 crimp tool (Item A19).
4. Shrink sealing sleeve over crimp. Use reflector Item A3. Temperature setting: 900°F.

Figure 9-6. Item B17 Crimp Splice

Item B18 Crimp Splice for #26, 24, 22, 20 Wires Rated 105°C or Below

1. Strip wires .25 to .30 inch.
2. Slide sealing sleeve into one of the wires.



3. Crimp wires using red cavity of AD-1377 crimp tool (Item A19).
4. Shrink sealing sleeve over crimp. Use reflector Item A3. Temperature setting: 900°F. Do not heat barriers at ends of sealing sleeve.

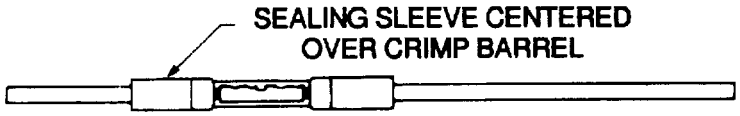
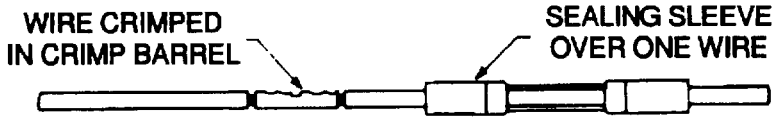


Figure 9-7. Item B18 Crimp Splice

Item B19 Crimp Splice for #18, and #16 Wires Rated 105°C or Below

1. Strip wires .30 to .35 inch.
2. Slide sealing sleeve into one of the wires.



3. Crimp wires using blue cavity of AD-1377 crimp tool (Item A19).
4. Shrink sealing sleeve over crimp. Use reflector Item A3. Temperature setting: 900°F. Do not heat barriers at ends of sealing sleeve.

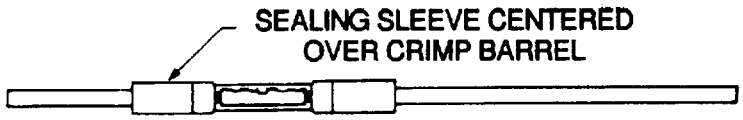
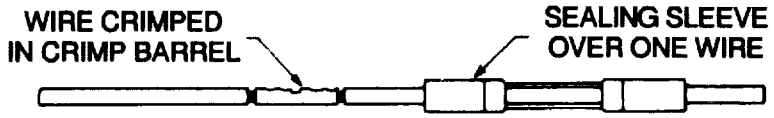


Figure 9-8. Item B19 Crimp Splice

Item B20 Crimp Splice for #14, and #12 Wires Rated 105°C or Below

1. Strip wires .30 to .35 inch.
2. Slide sealing sleeve into one of the wires.



3. Crimp wires using yellow cavity of AD-1377 crimp tool (Item A19).
4. Shrink sealing sleeve over crimp. Use reflector Item A3. Temperature setting: 900°F. Do not heat barriers at ends of sealing sleeve.

Figure 9-9. Item 820 Crimp Splice

Item B12 Wire Repair Segments

B12-1 RED **B12-2 BLUE** **B12-3 YELLOW**

1. Cut out damaged wire (up 9 inches in length).
2. Strip wires per table.
3. Explode crimp barrels and splice the wires. AD-1377 crimp tool cavity color to match crimp color code.
4. Shrink sealing sleeve over crimp. Use reflector Item A3. Temperature setting: 900°F.

Application Table for Items B12-1, B12-2, and B12-3

Wire Size	Item	Crimp Color Code	Wire Strip Length
26, 24, 22, 20	B12-1	Red	.25-.30
18, 16	B12-2	Blue	.25-.30
14, 12	B12-3	Yellow	.25-.30

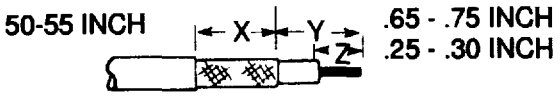
Figure 9-10. Item B12 Wire Repair Segments

NOTE

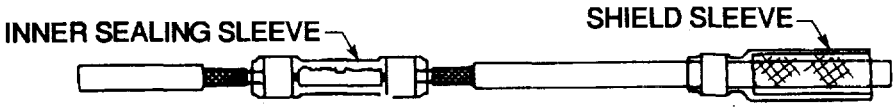
The item number on each illustration indicates the location of the repair material storage container and/or required tools within the wiring repair kit portion of the ACM/BDR wiring repair set (see Figures 9-37, 9-38, and 9-39).

(2) Shielded Primacy Wire Splicing. The repair set provides wire splice capability for 24 to 12 AWG shielded cables rated at 125°C or above. Shielded TM 1-1520-240-BD primary wire repair should be accomplished using the techniques described in this paragraph. Care should be exercised to stagger splices. Where possible splices in adjacent wires in a bundle should be separated by at least one splice length. This may require the use of the pre-made splice segments or locally manufactured jumper wires made from the kit primary shielded wire stock. Figures 9-11, 9-12, 9-13, and 9-14 illustrate the use of the pre-made shielded wire repair segments on shielded primary wires rated at 1250C or above. Adherence to the techniques will result in a permanent, environmentally-sealed shielded primary wire splice.

Item B21 Shielded Cable Splice for #26, 24, 22, 20 Shielded Cable Rated 125°C or Above



1. Shielded cable preparation:
2. Slide the (1) shield sleeve and (2) inner sealing sleeve onto one of the cables in the order given.
3. Splice the primary wires. Use the red cavity of the AD-1377 crimp tool (Item A19).
4. Shrink the inner sealing sleeve over splice. Use reflector Item A4. Temperature setting: 900°F. 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. Use same reflector and temperature.

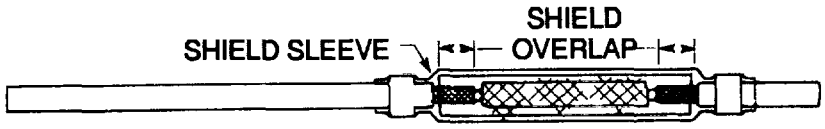
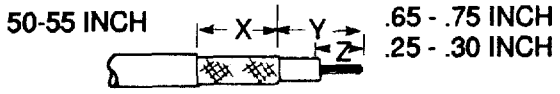
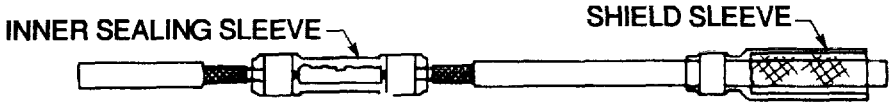


Figure 9-11. Item B21 Shielded Cable Splice

Item B22 Shielded Cable Splice for #18 and #16 Shielded Cable Rated 125°C or Above



1. Shielded cable preparation:
2. Slide the (1) shield sleeve and (2) inner sealing sleeve onto one of the cables in the order given.
3. Splice the primary wires. Use the red cavity of the AD-1377 crimp tool (Item A19).
4. Shrink the inner sealing sleeve over splice. Use reflector Item A4. Temperature setting: 900°F. 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. Use same reflector and temperature.

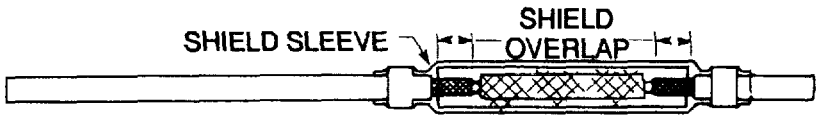
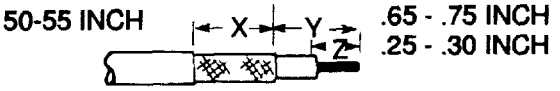
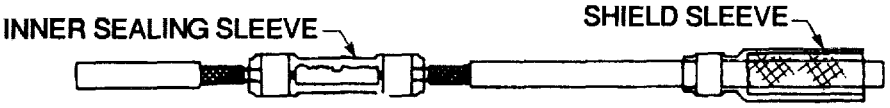


Figure 9-12. Item B22 Shielded Cable Splice

Item B23 Shielded Cable Splice for #14 and #12 Shielded Cable Rated 125°C or Above



1. Shielded cable preparation:
2. Slide the (1) shield sleeve and (2) inner sealing sleeve onto one of the cables in the order given.
3. Splice the primary wires. Use the yellow cavity of the AD-1377 crimp tool (Item A19).
4. Shrink the inner sealing sleeve over splice. Use reflector Item A4. Temperature setting: 900°F. 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. Use same reflector and temperature.

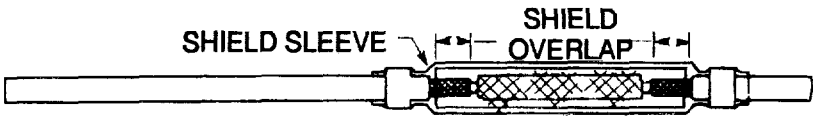
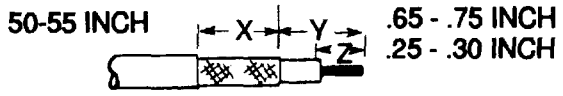


Figure 9-13. Item B23 Shielded Cable Splice

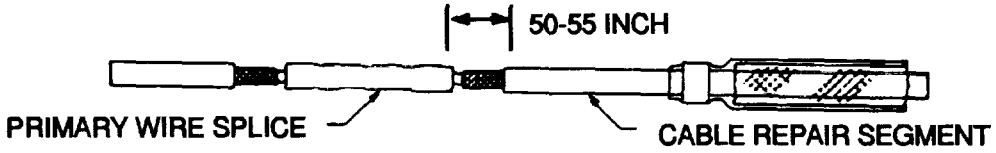
Item B13 Wire Repair Segments

B12-1 RED **B12-2 BLUE** **B12-3 YELLOW**

1. Cut out damaged wire (up 9 inches in length).



2. Strip dimensions for shielded cable:
3. Explode one crimp barrel, and splice the wires at one end
4. Shrink inner sleeve over splice. Use reflector Item A4.
5. Jacket strip dimension for repair segment:



6. Shrink shield sleeve over splice so that solder melts and flows. Shield sleeve braid must overlap cable braid at both ends. Use reflector Item A4. Temperature setting: 900° F.
7. Repeat 2 through 6 for other end of repair segment.

Figure 9-14. Item B13 Shielded Cable Repair

NOTE

The item number on each illustration indicates the location of the repair material storage container and/or required tools within the wiring repair kit portion of the ACMI/BDR wiring repair set.

(3) Shield Terminators. The repair set provides capability for terminating cable shields of various diameters and temperature ratings. The shield terminator techniques for the three different diameter terminators are shown in Figures 9-15, 9-16, and 9-17. When selecting a shield terminator for shielded wires, select the smallest terminator that slides easily over the prepared cable. For 125°C, only the folded back, end-strip method is authorized.

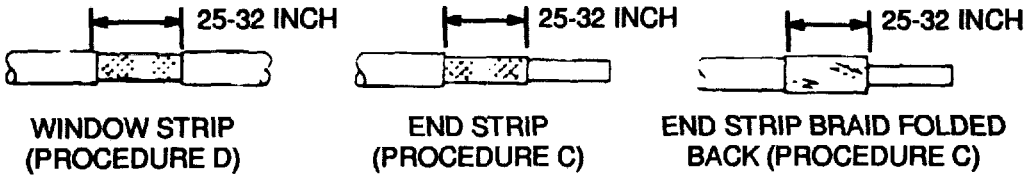
NOTE

The item number of each illustration indicates the location of the repair material storage container and/or required tools within the wiring repair kit portion of the repair set.

(4) Terminal Lugs and Terminal Boards. The repair set provides capability for repairing terminal lugs of stud sizes 6, 8, 10, and 1/4 inch wires of 22 thru 14 AWG and of stud sizes 4, 6, 8, and 10 for 24 AWG wires. The set also provides terminal boards and hardware for number 8 studs. Figure 9-19 provides instructions for terminal board replacement. Figure 9-20 provides the instructions and selection table for terminal lug repair.

Item B5 Shield Terminator M83519/2-7

1. Cable preparation:



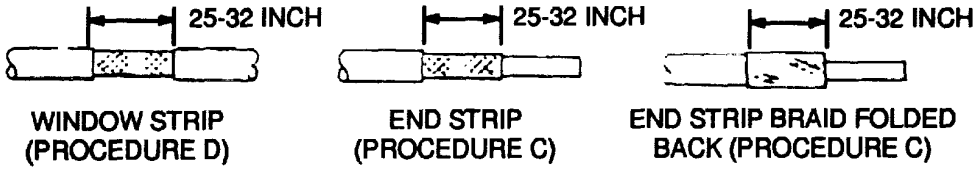
2. Position shield terminator on cable as showns:

3. Use reflector Item A3. Temperature setting: 900°F.
4. Heat until solder melts and flows into wire strands, red color disappears, and seals melt and flow at both ends.
5. Terminate the ground lead as directed in aircraft wiring manual.

Figure 9-15. Item B5 Shield Terminator M83519/2-7

Item B6 Shield Terminator M83519/2-8

1. Cable preparation:



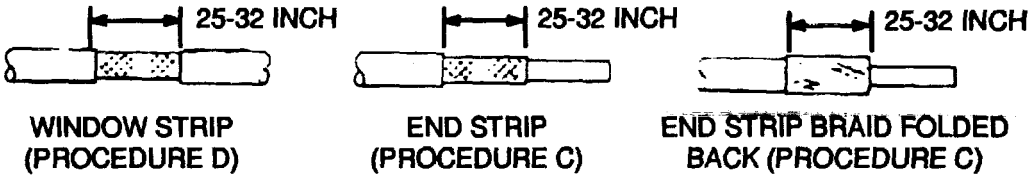
2. Position shield terminator on cable as showns:

3. Use reflector Item A3. Temperature setting: 900°F.
4. Heat until solder melts and flows into wire strands, red color disappears, and seals melt and flow at both ends.
5. Terminate the ground lead as directed in aircraft wiring manual.

Figure 9-16. Item B6 Shield Terminator M83519/2-8

Item B7 Shield Terminator M83519/2-10

1. Cable preparation:



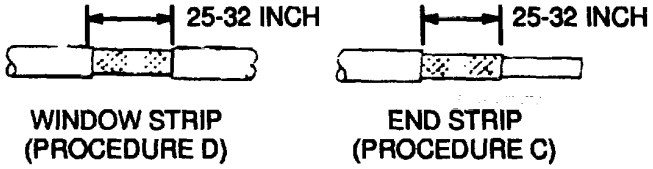
2. Position shield terminator on cable as shown:

3. Use reflector Item A3. Temperature setting: 900°F.
4. Heat until solder melts and flows into wire strands, red color disappears, and seals melt and flow at both ends.
5. Terminate the ground lead as directed in aircraft wiring manual.

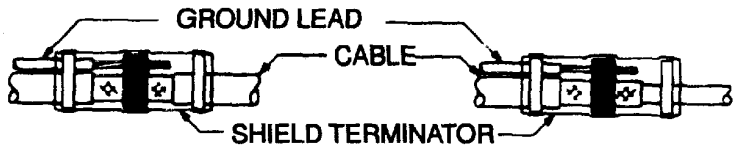
Figure 9-17. Item B7 Shield Terminator M8351912-10

Item B14 Terminators for Nickel-Plated Shields (Including Vermillion)

1. Strip ground lead .20 to .25 inch.
2. Cable preparation:



3. Position ground lead and shield terminator on cable as shown:



4. Use reflector Item A3. Temperature setting: 900°F.
5. Heat until solder melts; then continue heating for an additional 15 seconds or until sleeve starts to turn brown.
6. Terminate the ground lead as directed in aircraft wiring manual.

Figure 9-18. Item B14 Terminator

Item B10 Terminal Boards MS27212-1-8

The terminal boards provided are all 5 inches in length. They can be cut to shorter lengths using a hacksaw (not provided).

1. Tag and disconnect wires.
2. Remove terminal board.
3. Install replacement terminal board.
4. Connect wires to duplicate the original installation.

Figure 9-19. Item B10 Terminal Boards

Note

The item number of each illustration indicates the location of the repair material storage container and/or required tools within the wiring repair kit portion of the repair set.

(5) Shield Braid and Heat-Shrinkable Tubing. The repair set contains rolls of tubular shield braid of 3/16, 318, and 13/16 inch inside diameter. It also contains heat-shrinkable tubing of 318, 1/2, and 1 inch inside diameter for repair of single or multi-conductor shielded cables. The techniques for the application and use of the tubular-shield braid are illustrated in Figures 9-21 and 9-22 for the heat-shrinkable tubing. Use of the heat-shrinkable tubing results in an environmentally sealed repair.

NOTE

The item number of each illustration indicates the location of the repair material storage container and/or required tools within the wiring repair kit portion of the repair set. Figures 9-37, 9-38, and 9-39.

(6) Connector Pins and Sockets. The repair set contains tools for stripping, crimping, removing, and inserting most connector pins and sockets used on Army helicopters. It also contains commonly used replacement connector pins and sockets. The connector tools are located in the connector repair kit portion of the repair set. Replacement pins and sockets are located in the wire repair portion of the repair set. Paragraph 9-7b(2) contains procedures for applying, stripping, crimping, inserting, and removing connector pins, sockets, and sealing plugs. Figure 9-23 contains the part numbers of the stocked replacement connector contact and sealing plug for each of the individual storage containers. Occasionally, a damaged connector will have to be replaced. This may involve splicing as part of replacement The following method is preferred:

- Select wire pigtails so that splices can be staffered. Shortest wire should be a minimum of six inches long (Figure 9-24).

- Crimp wires to pins or sockets, then label wires and insert pins or sockets into the connector. The pigtailed connector then is spliced into the wire bundle. N connector is attached to shock-mounted equipment, wires should be long enough to allow the equipment to move freely on its shock mounts.

NOTE

Use applicable bulk stock wire and splices matched to the temperature rating of the existing aircraft wiring. DO NOT use high temperature (125°C or above) rating splices on low temperature (105°C or below) rating aircraft wiring.

Table 9-1. Selection Table for Item B30 -- B35

WIRE SIZE	ITEM	STUD SIZE	PART NUMBER	WIRE STRIP LENGTH (INCH)
24	B30	4 6 8 10	M7928/1-7 M7928/1-8 M7928/1-9 M7928/1-10	0.15
22	B31	6 8 10 1/4 inch	M7928/1-12 M7928/1-14 M7928/1-15 M7928/1-16	0.19
20	B32	6 8 10 1/4 inch	M7928/1-21 M7928/1-23 M7928/1-24 M7928/1-25	
18	B33	6 8 10 1/4 inch	M7928/1-30 M7928/1-32 M792811-33 M7928/1-34	0.25
16	B34	6 8 10 1/4 inch	M7928/1-39 M7928/1-41 M7928/1-42 M7928/1-43	
14	B35	6 8 10 1/4 inch	M7928/1-48 M7928/1-50 M7928/1-51 M7928/1-52	

Items B30 Through B35 Terminal Lugs

Procedure for crimping terminal lugs onto wires. Use M22520/10-01 crimp tool (Item A18).

1. Select a terminal lug to fit both the wire and terminal stud. (Table 9-1).
2. Strip the wire to the length.
3. Open the dies of the M22520/10-01 crimp tool (Item A18).
4. Place terminal in proper cavity of crimp tool dies (See Figure A). Size are stamped below each cavity on side of die.
5. Locate terminal with locator (See Figure B). Terminal should locate with flange over the top of the locator.
6. Insert wire to proper depth.
7. Close handle of tool until dies are closed and ratchet releases. The crimp is now complete (see Figure C).

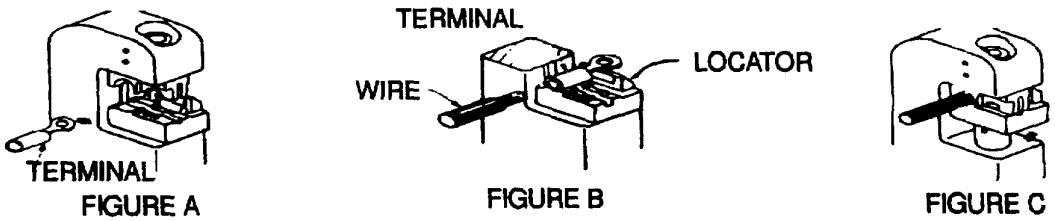


FIGURE A FIGURE B FIGURE C

Figure 9-20. Item 830 Through 835 Terminal Lugs

Items A40, A41, A42 Tubular Shield Braid

Table 9-2. Selection of Tubular Shield Braid

DIAMETER OF CABLE TO BE SHIELDED	SHIELD BRAID SIZE TO USE	ITEM NUMBER
UP TO 1/8 INCH	3/6 INCH	A40
1/8 - 5/16 INCH	3/8 INCH	A41
5/16 - 3/4 INCH	13/16 INCH	A42

a. Secure ends of small-diameter shield braid by overlapping and splicing using shield terminator Item B6 or B7. Pull out and discard the ground lead before installing the shield terminator.

b. Secure large-diameter shield braid by overlapping and tying with tie tape (Item A35) or by soldering. Cover overlap wth heat-shrinkable tubing (Items A43, A44, A45), or with heat-shrinkable repair tape (Item A6).

c. To make replacement multiple conductor shielded cable, use primary wire (Items A38, A39) with tubular shield braid (Items A40, A41). Twist wires three or four turns per foot. Use Items B15, B16, B17 for splicing primary wires to wires rated 125°C or above. Use Items B18, B19, B20 for splicing primary wires to wires rated 105°C or below. Splice shield braid as directed in paragraph a. or b. above.

d. Large diameter (13/16 inch) shield braid can be wrapped flat as shielding tape over large-diameter cables or where it is not practicable to slide shield braid over the wiring to be shielded. Solder the ends to the existing shield braid, and apply heat-shrinkable repair tape (Item A6) over the braid. (Temporary repair).

Figure 9-21. Items A40, A41, andA42

Items A43, A44, A45 Heat-Shrinkable Tubing

1. Select tubing size according to Table 9-3.

Table 9-3. Size Selection of Heat-Shrinkable Tubing

DIAMETER OF ITEM TO BE COVERED*	HEAT-SHRINKABLE TUBING TO USE	ITEM NUMBER
3/16 - 1/4 INCH	3/8 INCH	A43
1/4 - 1/2 INCH	1/2 INCH	A44
1/4 - 7/8 INCH	1 INCH	A45

* Items A43 and A44 will shrink to one-half the supplied diameter. Item A45 will shrink to one-quarter the supplied diameter.

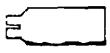
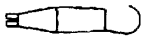
2. Cut 3/8-inch and 1/2-inch tubing to the length of the area to be covered. Cut 1-inch tubing 1.5 times the length to be covered, to allow for length shrinkage.
   - Be sure to cut tubing cleanly across. Cuts or tears in the ends can cause splitting.
3. Center tubing over area to be covered.
4. Shrink the middle first, to lock tubing in place. Then shrink toward each end in turn.
   - See Procedure F for heating tool operation. 
   - Use reflector Item A5 for 3/8-inch and 1/2-inch tubing.
   - Use reflector Item A29 for 1-inch tubing. 
   - Temperature setting. Start with 550°F; increase if necessary.

Figure 9-22. Items A43, A44, and A45

Item B1 Contacts and Sealing Plugs

Contacts: See connector repair kit for applications.
Sealing Plugs: Insert in each unused cavity, small end first.

MS27488-12 SEALING PLUGS	MS27488-20 SEALING PLUGS	M39029/1 -100 CONTACTS	M39029/1 -102 CONTACTS	422081-0900 APPLETON	C21P1620A0 HUGHES	C21S1620A0 HUGHES
MS27488-16 SEALING PLUGS	MS27488-22 SEALING PLUGS	M39029/1 -101 CONTACT	M39029/1 -507 CONTACTS	WTK2222S AIRBORNE	031-0900-001 CANNON	031-0905 000 CANNON

Item B2 Contacts
See connector repair kit for applications.

M39029)6 -348	M39029/56 -351	M39029/56 -352	M39029/56 -353	M39029/22 -191	M39029/22 -192	M39029/22 -193
M39029/58 -360	M39029/58 -363	M39029/58 -364	M39029/58 -365	M39029/30 -217	M39029/30 -218	M39029/30 -219

Item B3 Contacts
See connector repair kit for applications.

M39029/4 -110	M39029/4 -111	M39029/4 -113	M39029/29 -212	M39029/29 -213	M39029/64 -369	M39029/63 -368
M39029/5 -115	M390295 -116	M39029/5 -118	M39029/57 -354	M39029/57 -357	M39029/57 -358	M39029/57 -359

Item B3 Contacts
See connector repair kit for applications.

M39029/18 -177	M39029/18 -178	M39029/18 -179	M39029/31 -241	M39029/31 -229	M39029/31 -235	M28804/9 -1
M39029/16 -167	M39029/16 -168	M39029/16 -169	M39029/32 -260	M39029/32 -248	M39029/32 -254	M28804/10 -1

Figure 9-23. Items BI, B2, B3, and B4 Contacts

(7) Wire Bundle Forming. Tie Tape. and Cable Straps. The repair set provides for the forming of wire bundles through the use of tie-tape and/or self-clinching cable straps per MS3361-1-0. The material and necessary tools are located within the wire repair kit. Figure 9-25 illustrates the procedures and precautions to observe when using the nylon tie-tape. Figure 9-26 illustrates the procedures and precautions to observe when using the MS3361 -1-0 self-clinching cable straps.

NOTE

The item number of each illustration indicates the location of the repair material storage container and/or required tools within the wiring repair kit portion of the repair set.

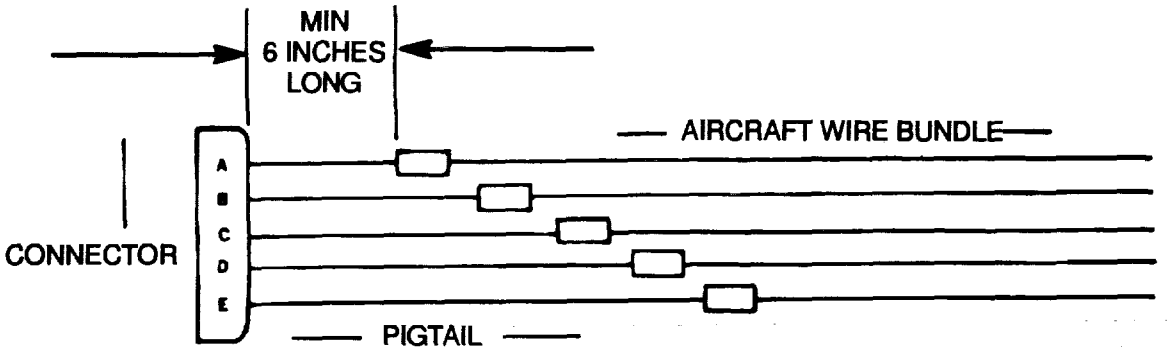


Figure 9-24. Replacement of Damaged Connectors

Item A-35 Tie Tape - General Procedures and Precautions

a. Tie bundles tightly enough to prevent slipping, but not so tightly that the tape cuts into or deforms the insulation. Be especially carefully when tying coaxial cable, which has a soft dielectric insulation between the inner and outer conductors.

b. Do not use ties on that part of a wire group or bundle located inside a conduit.

c. When tying wire bundles behind connectors, start ties far enough back from the connector to avoid splaying of contacts.

d. Tie all wire groups or bundles where supports are more than 12 inches apart. Space ties 12 inches or less.

NOTE

On Combat and Rapid Deployment Force aircraft, ties are usually spaced at greater intervals check with maintenance officer.

e. Harness branches can be secured by tying.

f. Use knot shown in figure.

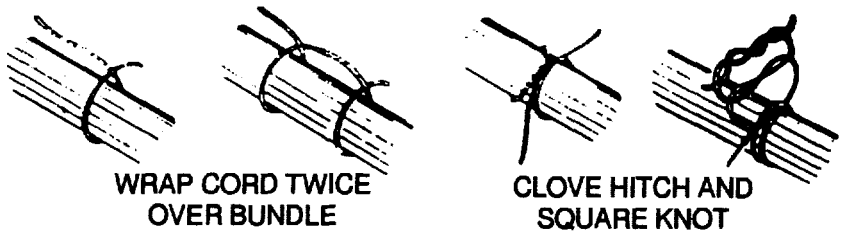


Figure 9-25. Item A35 Tie Tape

Item B9 Self-Clinching Cable Straps MS3361-1-0

CAUTION

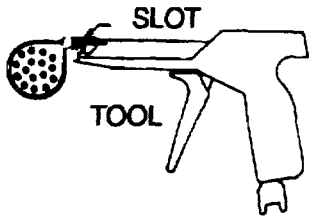
These straps are not to be used under the following conditions:

- **In temperature environments which exceed 85 C (185°F).**
- **On coaxial cables or bundles containing coaxial cables which do not have hard dielectrics.**
- **In areas where excess material from strap cuttings or failure of the mounted strap would allow plastic to fall into moving mechanical parts.**
- **On the outside of cables or bundles that will be dragged through tight or unreachable spaces during final aircraft installation.**
- **Where failure of the strap would permit movement of the wiring against parts which could damage the insulation or allow wiring to foul mechanical linkages.**
- **In high vibration areas.**
- **In areas of severe wind or moisture problems (SWAMP).**

When use of these straps is prevented by these restrictions, use tie tape (Item A35) for secondary ties between damps.

1. Position the strap around the bundle with the flat side of the large end against the bundle.
2. Thread tip through eye; then hand pull strap tight against the bundle.

3. Adjust the tool tension setting to 7 (Item A34).
4. Pass the free end of the cable tie through the slot in the end of the tool; then push tool snugly against the strap.



5. While holding strap firmly against side of tool and tool face squarely against large end of strap, pump handle several times without fully activating the tool's cutting knife. Once the strap has been stretched to its maximum, squeeze handle slowly and firmly until strap is cut.

WARNING

The strap must be cut flush with the surface in order to eliminate painful cuts and scratches from protruding strap ends.

6. If strap end is not cut flush, remove the strap and install a new strap in its place.
7. Pick up for appropriate disposal all broken straps and strap ends that were cut off.

Figure 9-26. Item B9 Self-Clinching Cable Straps

b. Temporary Repair Techniques. Repair performed under the guidelines of this paragraph may be used for a period of 140 flight hours. At this time of the temporary repair is to be inspected and a decision made to either extend the use of the temporary repair or make a permanent repair. This paragraph describes temporary repair techniques for co-axial cable and large wire-side splices, connection or junction boxes, terminal board bridging, and insulation repair with heat-shrinkable tape. Prior to performing any of the listed repairs, the repair technician must be knowledgeable in the basic repair procedures and proficient in the use of the wiring repair tools and materials.

(1) Co-Axial Cable Splice. The wire repair kit contains materials for making environmentally protected splices on aircraft co-axial cables. As these splices are a new item, and not fully qualified at this time, splices performed with these materials must be categorized as temporary, even though performance loss of a co-axial cable system using these splices in minimal. Figures 9-27 through 9-32 illustrate the basic procedure to splice co-axial cables of the types noted. These instructions are the same as the repair material storage container. One co-axial cable splice is allowable for every eight feet of co-axial cable length. Additional splices per cable may be authorized by the maintenance authority as local conditions warrant.

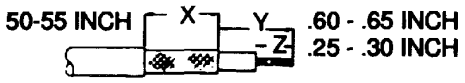
NOTE

- **The item number on each illustration indicates the location of the repair material storage container and/or required tools within the wiring repair kit portion of the repair set.**

- **After completing a co-axial splice, obtain a chart record of the co-axial cable signature for inclusion in the aircraft records. This chart record is to be obtained using the TDR. Annotate the chart record with aircraft serial number, date, cable number, vertical and horizontal TDR attentions, and any other data of interest. This chart record is to be used to verify the integrity of the repair and provide a baseline for future comparison in the event of system degradation.**

Item B24 Coax Splice for RG-136/U and RG179B/U

1. Coaxial cable preparation:



2. Slide the (1) shield sleeve and (2) inner sleeve onto one of the coaxial cables in the order given.
3. Splice the center conductor. Use the red cavity of the AD-1377 crimp tool (Item A19). The small yellow crimp splice used here is crimped in the red (small) cavity.
4. Shrink the inner sealing sleeve over splice. Use reflector Item A4. Keep hot air away from shield sleeve.

5. Center and shrink the shield sleeve over the splice area, so that the solder melts and flows. Shield sleeve braid must overlap coax braid at both ends. Use same reflector and temperature.

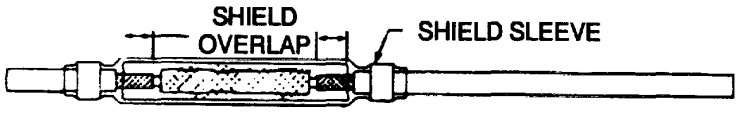
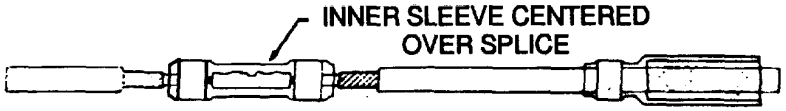


Figure 9-27. Item B24 Coax Spike

1. Coaxial cable preparation:

2. Slide the (1) shield sleeve and (2) inner sleeve, and (3) filler sleeve onto one of the coaxial cables in the order given.
3. Splice the center conductor. Use the **red** cavity of the AD-1377 crimp tool (Item A19). The small yellow crimp splice used here is crimped in the **red** (small) cavity.
4. Shrink the filler sleeve over the splice. Use reflector Item A4. Temperature setting: 900°F. Keep hot air away from inner and shield sleeves.
5. Shrink the inner sleeve over the splice. Use same reflector and temperature. Keep hot air away from the shield sleeve.



6. Center and shrink the shield sleeve over the splice area, so that the solder melts and flows. Shield sleeve braid must overlap coax braid at both ends. Use same reflector and temperature.

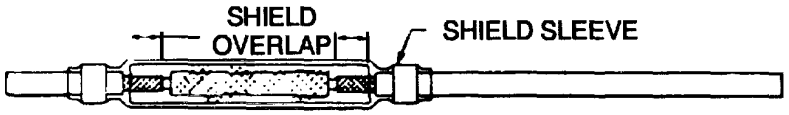
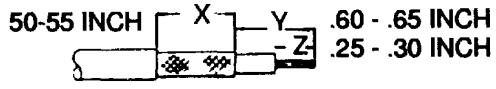


Figure 9-28. Item B25 Coax Splice

Item B26 Coax Splice for RG-124/U, RG-142B/U, RG-302/U, RG-303/U

1. Coaxial cable preparation:



2. Slide the (1) shield sleeve and (2) inner sleeve, and (3) filler sleeve onto one of the coaxial cables in the order given.
3. Splice the center conductor. Use the **red** cavity of the AD-1377 crimp tool (Item A19).
4. Shrink the filler sleeve over the splice. Use reflector Item A4. Temperature setting: 900°F. Keep hot air away from inner and shield sleeves.
5. Shrink the inner sleeve over the splice. Use same reflector and temperature. Keep hot air away from the shield sleeve.

6. Center and shrink the shield sleeve over the splice area, so that the solder melts and flows. Shield sleeve braid must overlap coax braid at both ends. Use same reflector and temperature.

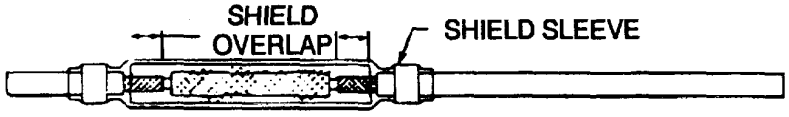
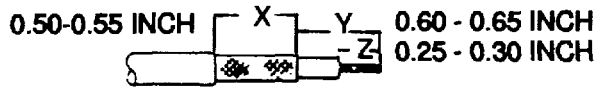
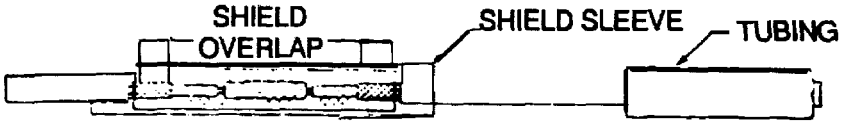


Figure 9-29. Item B26 Coax Splice

1. Coaxial cable preparation:



2. Slide the (1) tubing, (2) shield sleeve, and (3) filler sleeve onto one of the coaxial cables in the order given.
3. Splice the center conductor. Use the **yellow** cavity of the AD-1377 crimp tool (Item A19).
4. Shrink the filler sleeve over the splice. Use reflector Item A4. Temperature setting: 900°F. Keep hot air away from the shield sleeves and tubing.
5. Center and shrink the shield sleeve over the splice area, so that the solder melts and flows. Shield sleeve braid must overlap coax braid at both ends. Use same reflector and temperature. Keep hot air away from the tubing.

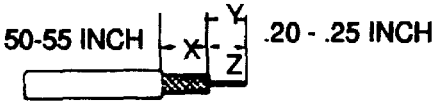


6. Center and shrink the tubing over the splice area. Use reflector Item A29. Temperature setting: 900°F.

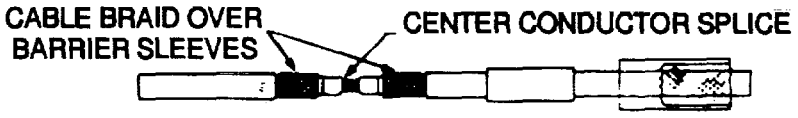
Figure 9-30. Item B27 Coax Splice

Item B28 Coax Splice for RG-58C/U and RG-233/U

1. Coaxial cable preparation:



2. Slide the (1) shield sleeve and (2) filler sleeve onto one of the coaxial cables in the order given.
3. Insert center conductors to overlap in center conductor splice. Barrier sleeve of center conductor splice fit under cable braids. Heat with reflector Item A4. Temperature setting: 900°F.



4. Shrink the filler sleeve over the splice. Use same reflector and temperature. Keep hot air away from the shield sleeve.
5. Center and shrink the shield sleeve over the splice area, so that the solder melts and flows. Shield sleeve braid must overlap coax braid at both ends. Use reflect Item A4. Temperature setting: 900°F.

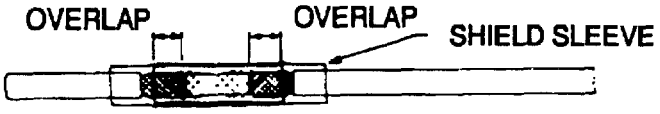
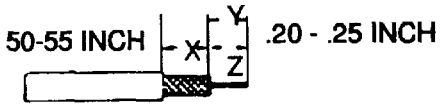


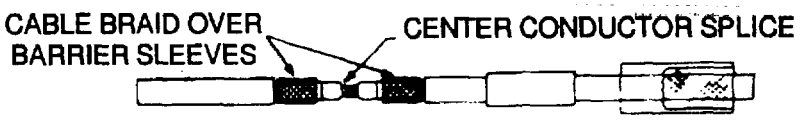
Figure 9-31. Item B28 Coax Splice

Item B29 Coax Splice for RG-59B/U and G-71 B/U

1. *Coaxial cable preparation:*



2. Slide the (1) shield sleeve and (2) filler sleeve onto one of the coaxial cables in the order given.
3. Insert center conductors to overlap in center conductor splice. Barrier sleeve of center conductor splice fit under cable braids. Heat with reflector Item A4. *Temperature setting:* 900° F.



4. Shrink the filler sleeve over the splice. Use same reflector and temperature. Keep hot air away from the shield sleeve.
5. Center and shrink the shield sleeve over the splice area, so that the solder melts and flows. Shield sleeve braid must overlap coax braid at both ends. Use reflect Item A4. Temperature setting: 900° F.

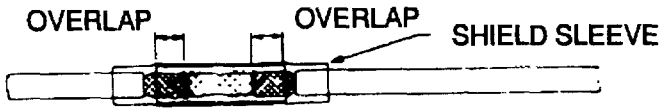


Figure 9-32. Item B29 Coax Splice

(2) Split-Bolt Splice Connectors (Large Wire AWG). The wire repair kit contains split-bolt splice connectors for use on temporary splice repairs of large gage (number 10, 8,6, and 4) AWG primary power wires and cables. Figure 9-33 illustrates repair techniques.

NOTE

The item number on' each illustration indicates the location of the repair material storage container and/or required tools within the wiring repair kit portion of the repair set.

(3) Bridging or By-pass of Connectors. Junction Boxes, and Terminal Strips. In most cases, it will be quicker not to replace bulkhead connectors, junction boxes or terminal strips. These circuits can be repaired by bridging or by-passing the damaged area with jumper wires spliced in to eliminate the damaged area or component (Figure 9-34).

(4) Insulation Repair. The wire repair kit contains heat-shrinkable tape to repair wiring where the outer insulation has been damaged but the wire conductor are intact. if the inner conductors are damaged, a permanent splice repair must be performed per paragraphs 9-9a(1) and 9-9a(2). Figure 9-35 illustrates techniques for using this tape when making repairs to damaged insulation.

NOTE

The item number on each illustration indicates the location of the repair material storage container and/or required tools within the wiring repair kit portion of the repair set.

Item B11 Split Bolt Splice Connectors

These components are used for making temporary splices in large-size wires (#4, 6, 8, 10). Sufficient wires must be spliced in a connector to provide firm clamping. Conductors can be folded back one or more times to fill the opening and provide firm clamping.

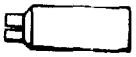
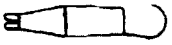
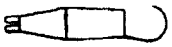
1. Slide a 3-inch length of large-diameter, heat-shrinkable tubing (Item A45) over one of the wires to be spliced.
2. Strip wires.
   - 1/2 inch if folding back is not required.
   - 1-1/4 inches if single folding back is required.
   - 2-1/2 inches if double folding back is required.
   - Use procedure A for #10 wires. For larger wires, use the score and flex method described in procedure C, steps 2 through f.
3. If required, fold conductor back to increase the effective diameter.
4. Insert wires into the connector from opposite sides.
5. Tighten the nut securely.
6. Wrap the splice with heat-shrinkable tape (Item A6).
   - Be sure to cover all metal parts and overlap onto the wire insulation.
   - Overlap the turns about one-third of the tape width.
7. Heat the end of the tape to soften the adhesive layer, and press it into position while warm.
   - See Procedure F for heating tool operation.
   - Use reflector Item A5. 
   - Temperature setting: 900°F.
8. Heat the tape to shrink it onto the splice and soften the adhesive layer.
   - Use reflector Item A29. 
   - Temperature setting: 900°F.
9. Center the heat-shrinkable tubing over the splice.
10. Heat the tubing to shrink it onto the splice.
    - Use reflector Item A29. 
    - Temperature setting: 900°F.
    - Begin in the middle and work toward the ends.
    - The tubing may not shrink completely onto the wire insulation. This is normal.

Figure 9-33. Item B11 Spilt Bolt Splice

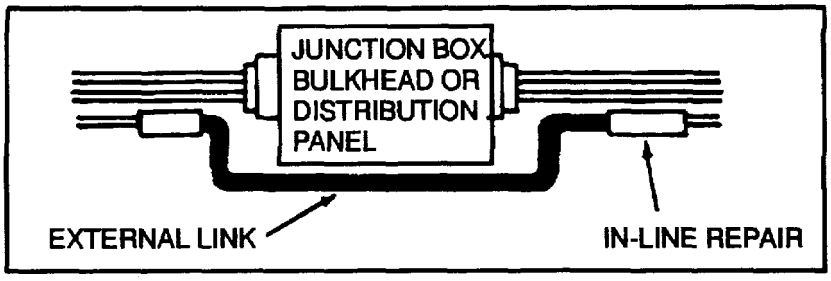


Figure 9-34. Bridging or Bypass of Connectors or Junction Boxes

Item A6 Heat—Shrinkable Repair Tape

1. Start wrapping at one end of area to be covered.
2. Overlap each run 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.

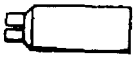
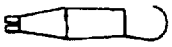
   - Wrap only tight enough to hold tape in place. The tape will shrink tightly when heated.
3. Apply heat to end of last lap to soften the meltable adhesive, and press it into position while warm.
   - See Procedure F for heating tool operation.
   - Use reflector Item A5. 
   - Temperature setting: 900°F.
4. Heat the tape to shrink it and melt the adhesive layer.
   - Use reflector Item A29. 
   - Temperature setting: 900°F.

Figure 9-35. Item A6 Heat-Shrinkable Repair Tape

c. Emergency Repair Techniques. Emergency repairs allows a downed aircraft to make a one-time flight of up to one hour duration to an AVIM or AVUM area. This paragraph describes emergency repair techniques for unshielded, primary wires, damaged insulation, and wire bundle forming. These repair are by no means exhaustive. Innovative repairs may be developed 'on-site" to recover the downed aircraft. Prior to performing any of the listed repairs, the maintenance technician must be knowledgeable in use of the repair tools and materials.

NOTE

Temporary and emergency repairs established in this manual will only be applied in time of war. The commander or his designated representatives may authorize deviations necessary to accomplish wartime requirements. Permanent repairs may be used at any time.

(1) Unshielded Primary Wire Splice. Unshielded primary wire splice repairs are performed with the splices of wire repair segments contained within the repair kit. The procedures are identical as those described in paragraph 9-9a(1), except the place sealing sleeve, heatshrink operation is deferred until the return of the aircraft to the AVIM or AVUM area. In lieu of the heat-shrink operation, the splice-seal sleeve is held in place with a short piece of Teflon tape. The Teflon tape is applied to the small end of the sealing sleeve after centering the sleeve over the crimp barrel as shown in Figure 9-36.

NOTE

The repair may be upgraded from emergency to permanent status upon return of the aircraft to a AVIM/AVUM area, removing the Teflon tape, and performing the heat-shrink operation per paragraph 9-9a(1).

(2) Insulation Repair. Emergency repair to damaged wire insulation may be accomplished by wrapping the damaged insulation with four layers of Teflon tape. Extend the tape wrap one inch from each end of the damaged area over undamaged insulation. If over 25% of the wire conductors are severed, and time permits, an emergency splice should be performed.

(3) Wire-Bundle Forming. Often, wire bundle tie tape and/or self-clinching cable straps will either be found to be damaged or will require removal prior to performing emergency repairs. The repair kit contains replacement self-clinching cable straps.

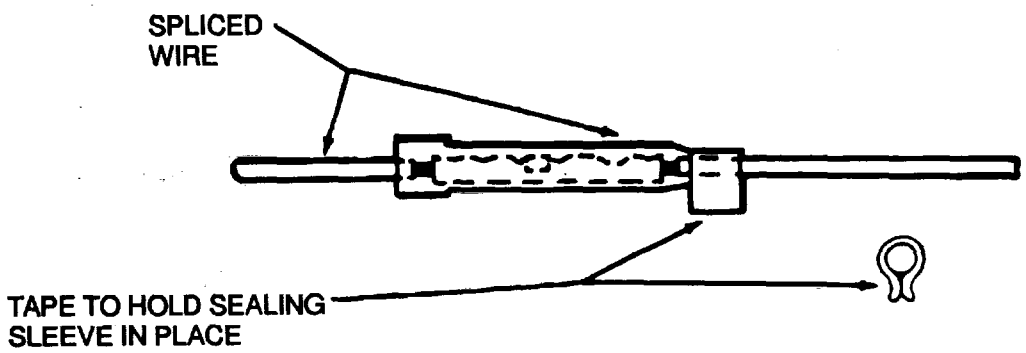


Table 9-4. Wire Size Selection

WIRE SIZE	SPLICE COLOR (ITEM 4)	WIRE STRIP LENGTH
24, 22, 20	RED	0.25 - 0.30
20, 18, 16	BLUE	0.30 - 0.35
16, 14, 12	YELLOW	0.30 - 0.35

INDIVIDUAL SPLICE

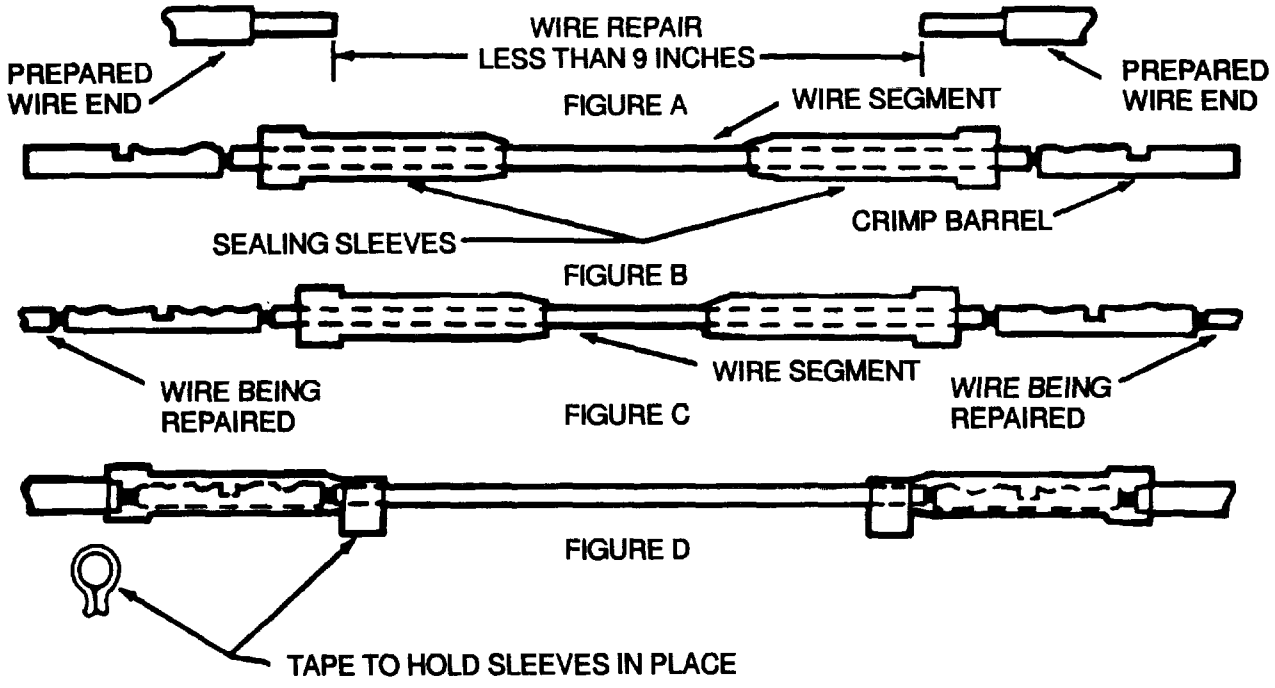
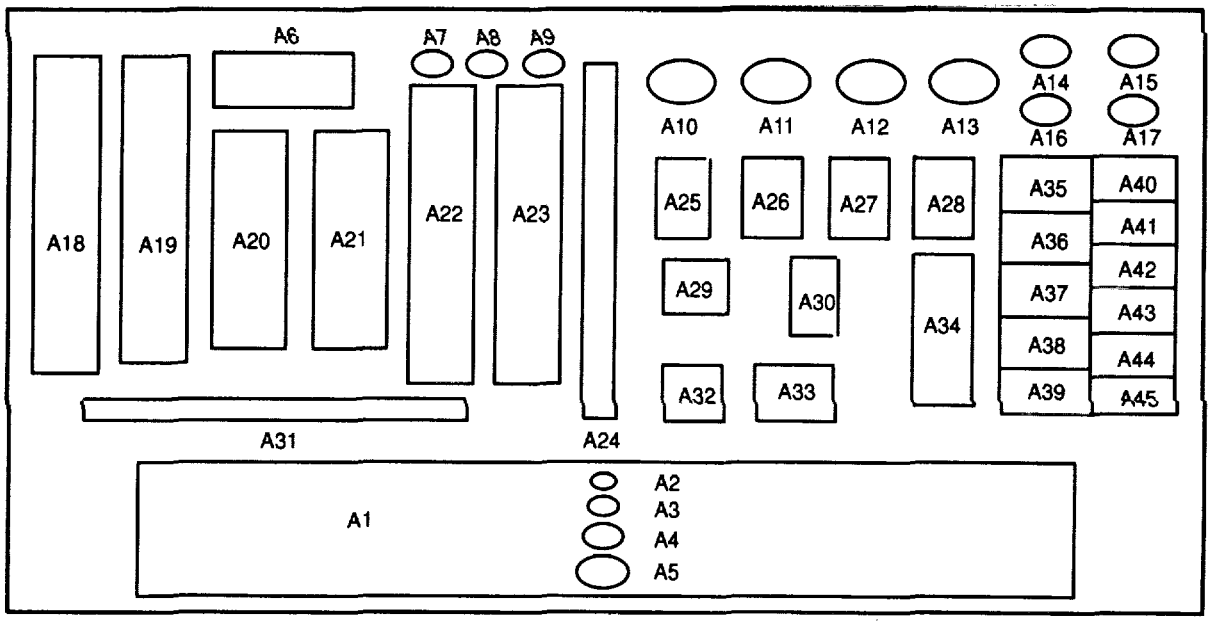


Figure 9-36. Wire Repair Splice Segment

COMPARTMENT A CONTENTS CHART



ITEM NO.	DESCRIPTION
A1	RAYCHEM HT-900A HEATING TOOL
A2	NEEDLE POINT REFLECTOR
A3	SMALL TERMINATION SLEEVE RELFECTOR
A4	LARGE TERMINATION SLEEVE REFLECTOR
A5	SMALL TUBING REFLECTOR
A6	HEAT-SHRINKABLE REPAIR TAPE
A7	QUICK-DISCONNECT FITTING
A8	QUICK-DISCONNECT FITTING
A9	QUICK-DISCONNECT FITTING
A10	NUT DRIVER
A11	HEX WRENCH FOR MTC CONNECTORS
A12	PHILLIPS SCREWDRIVER
A13	BLADE SCREWDRIVER
A14	BRAID SLITTER
A15	HOOK FOR PULLING WIRES
A16	UTILITY KNIFE
A17	6-INCH SCALE
A18	M22520/10-0 CRIMP TOOL
A19	AD-1377 CRIMP TOOL
A20	IDEAL L-9038 WIRE STRIPPER (BLACK)
A21	IDEAL L-9039 WIRE STRIPPER (RED)
A22	POWER ADAPTER
A23	POWER ADAPTER

ITEM NO.	DESCRIPTION
A24	SPARE HEATER ELEMENT FOR HT-900A
A25	IDEAL 45-123 WIRE CUTTER
A26	IDEAL STRIPPER BLADES (M16678 TYPE E)
A27	IDEAL STRIPPER BLADES (M22759)
A28	IDEAL STRIPPER BLADES (M81381)
A29	LARGE TUBING REFLECTOR
A30	DIAGONAL CUTTER
A31	MTC CONNECTOR WAFER REMOVAL TOOL
A32	BLADES FOR UTILITY KNIFE
A33	ILLUMINATING MAGNIFIER, 10 POWER
A34	CABLE STRAP INSTALLATION TOOL
	ON SPOOL RACK:
A35	TIE TAPE
A36	#16 SHIELDED CABLE, 200°C RATED
A37	#20 SHIELDED CABLE, 200°C RATED
A38	#12 WIRE, 200°C RATED
A39	#20 WIRE, 200°C RATED
A40	3/16-INCH TUBULAR SHIELD BRAID
A41	3/8-INCH TUBULAR SHIELD BRAID
A42	13/16-INCH TUBULAR SHIELD BRAID
A43	3/8-INCH HEAT-SHRINKABLE TUBING
A44	1/2-INCH HEAT-SHRINKABLE TUBING
A45	1-INCH HEAT-SHRINKABLE TUBING

Figure 9-37. MK-0015 Wire Repair Kit (Compartment A)

COMPARTMENT B CONTENTS CHART

SEE CROSS-REFERENCE CHART FOR PART NUMBER LISTING.

<table>
<tr><td>B1</td><td colspan="2">B5</td><td>B6</td><td>B7</td></tr>
<tr><td>B2</td><td colspan="2">B8</td><td>B9</td><td>B10</td></tr>
<tr><td>B3</td><td rowspan="3">B11</td><td colspan="3" rowspan="2">B12</td></tr>
<tr><td>B4</td></tr>
<tr><td>B14</td><td colspan="3">B13</td></tr>
<tr><td>B15</td><td colspan="2">B18</td><td>B24</td><td>B30</td></tr>
<tr><td>B15</td><td colspan="2">B19</td><td>B25</td><td>B31</td></tr>
<tr><td>B16</td><td colspan="2">B20</td><td>B26</td><td>B32</td></tr>
<tr><td>B16</td><td colspan="2">B21</td><td>B27</td><td>B33</td></tr>
<tr><td>B17</td><td colspan="2">B22</td><td>B28</td><td>B34</td></tr>
<tr><td>B17</td><td colspan="2">B23</td><td>B29</td><td>B35</td></tr>
</table>

ITEM NO.	DESCRIPTION
B1	SEALING PLUGS M27488 AND CONNECTOR CONTACTS M39029/1, 422081, WTK, C21, 031
B2	CONNECTOR CONTACTS M39029/22, /30, /56, /58
B3	CONNECTOR CONTACTS M39029/4, /5, /29, /57, /63, /64
B4	CONNECTOR CONTACTS M39029/16, /18, /31, /32, M28804/9, /10
B5	SHIELD TERMINATORS M83519/2-7
B6	SHIELD TERMINATORS M83519/2-8
B7	SHIELD TERMINATORS M83519/2-10
B8	MTC FLAT CONNECTOR REPAIR KIT
B9	SELF-CLINCHING CABLE STRAPS MS3367-1-0
B10	TERMINAL BOARDS MS27212-1-8
B11	SPLIT-BOLT SPLICE CONNECTORS FOR #4, 6, 8, 10 WIRES
B12	WIRE REPAIR SEGMENTS
B13	SHIELDED CABLE REPAIR SEGMENTS
B14	TERMINATORS FOR NICKEL-PLATED SHIELD (INCLUDING VERMILLION)
B15	SEALED SPLICES FOR #20, 22, 24 HI-TEMP WIRE
B16	SEALED SPLICES FOR #16, 18 HI-TEMP WIRE
B17	SEALED SPLICES FOR #12, 14 HI-TEMP WIRE
B18	SEALED SPLICES FOR #20, 22, 24 LO-TEMP WIRE
B19	SEALED SPLICES FOR #16, 18 LO-TEMP WIRE
B20	SEALED SPLICES FOR #12, 14 LO-TEMP WIRE
B21	SHIELDED SPLICES FOR #20, 22, 24 SHIELDED CABLE
B22	SHIELDED SPLICES FOR #16, 18 SHIELDED CABLE
B23	SHIELDED SPLICES FOR #12, 14 SHIELDED CABLE
B24	COAX SPLICES FOR RG-179B/U, RG-316/U
B25	COAX SPLICES FOR RG-180B/U
B26	COAX SPLICES FOR RG-124/U, RG-142B/U, RG-302/U, RG-303/U
B27	COAX SPLICES FOR RG-9B/U, RG-214/U, RG-225/U, RG-393/U
B28	COAX SPLICES FOR RG-58C/U, RG-223/U
B29	COAX SPLICES FOR RG-59B/U, RG-71B/U
B30	#24 TERMINAL LUGS M79281-7, -8, -9, -10
B31	#22 TERMINAL LUGS M79281-12, -14, -15, -16
B32	#20 TERMINAL LUGS M79281-21, -23, -24, -25
B33	#18 TERMINAL LUGS M79281-30, -32, -33, -34
B34	#16 TERMINAL LUGS M79281-39, -41, -42, -43
B35	#14 TERMINAL LUGS M79281-48, -50, -51, -52

Figure 9-38. MK-0015 Wire Repair Kit (Compartment B)

COMPONENT SELECTION CHART

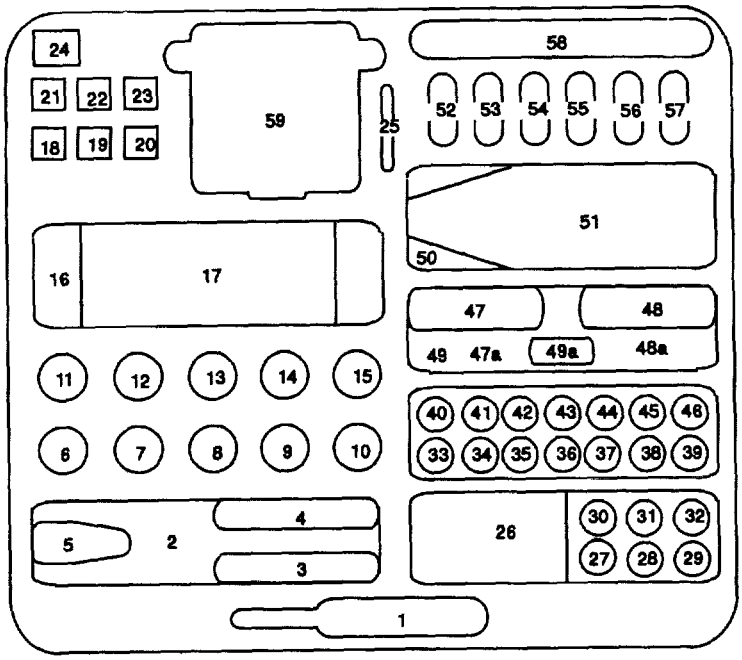
TYPE OF REPAIR	COMPONENT TO USE	T/P*	WIRE OR CABLE SIZE	ITEM	HEATING TOOL REFLECTOR AND TEMP. SETTING
UNSHIELDED PRIMARY WIRE SPLICING AND REPAIR	CRIMP SPLICE FOR WIRE RATED 105°C OR BELOW	P	20, 22, 24	B18	A3 900°
			16, 18	B19	
			12, 14	B20	
	CRIMP SPLICE FOR WIRE RATED 125°C OR ABOVE	P	20, 22, 24	B15	A3 900°
			16, 18	B16	
			12, 14	B17	
	SPLIT BOLT SPLICE CONNECTOR FOR LARGE WIRE SIZES	T	4, 6, 8, 10	B11	
	WIRE REPAIR SEGMENT FOR WIRE RATED 125°C OR ABOVE . (FOR WIRE RATED BELOW 125°C, USE ITEM B18, B19, OR B20 AND ITEM A38 OR A39.)	P	20, 22, 24	B12-1	A3 900°
			16. 18	B12-2	
			12, 14	B12-3	
SHIELDED CABLE SPLICING	SPLICE FOR SHIELDED CABLE RATED 125°C OR ABOVE	P	20, 22, 24	B21	A4 900°
			16, 18	B22	
			12, 14	B23	
	SHIELDED CABLE REPAIR SEGMENT (FOR UP TO 9-INCH DAMAGED LENGTH	P	20, 22, 24	B13-1	A4 900°
			16, 18	B13-2	
			12, 14	B13-3	
COAXIAL CABLE SPLICING	COAXIAL CABLE SPLICE	T	RG-9B/U (M17/4)	B27	A4 900°
			RG-58C/U (M17/28)	B28	
			RG-59B/U (M17/29)	B29	
			RG-71B/U (M17/90)	B29	
			RG-124/U	B26	
			RG-142B/U (M17/60)	B26	
			RG-179B/U (M17/94)	B24	
			RG-180B/U (M17/95)	B25	
			RG-214/U (M17/75)	B27	
			RG-223/U (M17/84)	B28	
			RG-225/U (M17/86)	B27	
			RG-302/U (M17/110)	B26	
			RG-303/U (M17/111)	B26	
			RG-316/U (M17/113)	B24	
			RG-393/U (M17/127)	B27	

Figure 9-39. MK-0015 Wire Repair Kit (Component Selection Chart) (Sheet 1 of 2)

COMPONENT SELECTION CHART

TYPE OF REPAIR	COMPONENT TO USE	T/P*	WIRE OR CABLE SIZE	ITEM	HEATING TOOL REFLECTOR AND TEMP. SETTING
CABLE SHIELD TERMINATION	SHIELD TERMINATOR FOR TIN- OR SILVER-PLATED SHIELDS	P	.055-.085 JACKET O.D.	B5	A3 900°
			.085-.170 JACKET O.D.	B6	A3 900°
			OVER .170 JACKET O.D.	B7	A4 900°
	SHIELD TERMINATOR FOR NICKEL-PLATED SHIELDS (INCLUDING VERMILLION)	P	UP TO .125 TOTAL INSULATION DIAMETER	B14-1	
			.125-200 TOTAL INSULATION DIAMETER	B14-2	A3 900°
WIRE OR SHIELDED CABLE INSTALLATION	PRIMARY WIRE	P	#20	A39	
			#12	A38	
	SHIELDED SINGLE CONDUCTOR CABLE	P	#20	A37	
			#12	A36	
CABLE SHIELD INSTALLATION	SHIELD BRAID	P	UP TO .15 DIAMETER	A40	
			.15-.35 DIAMETER	A41	
			.35-.75 DIAMETER	A42	
BUNDLE FORMING AID	TIE TAPE	P			
PROTECTION	HEAT-SHRINKABLE TUBING	P	UP TO .30 DIAMETER	A43	A4 550°
			.30-.40 DIAMETER	A44	A29 550°
			.40-.80 DIAMETER	A45	
	SELF-CLINCHING CABLE STRAPS FOR USE IN TEMPERATURES BELOW 85°C (185°C)	P	1/16-1-3/4 INCH DIAMETER BUNDLES	B9	
	HEAT-SHRINKABLE REPAIR TAPE	T		A6	A4 550°
CIRCULAR CONNECTOR REPAIR	CONNECTOR CONTACTS	P	SEE CONNECTOR REPAIR KIT	B1	
				B2	
				B3	
				B4	
	SEALING PLUGS	P	SEE CONNECTOR REPAIR KIT	B1	
MTC FLAT CONNECTOR REPAIR	MTC FLAT CONNECTOR REPAIR KIT	P	SEE USAGE INSTRUCTIONS	B8	A3 900°
TERMINAL BOARD REPLACEMENT	TERMINAL BOARD		SEE USAGE INSTRUCTIONS	B10	
TERMINAL LUG INSTALLATION	TERMINAL LUG (CRIMP-TYPE RING TERMINAL)	P	24	B30	
			22	B31	
			20	B32	
			18	B33	
			16	B34	
			14	B35	

Figure 9-39. MK-0015 Wire Repair Kit (Component Selection Chart) (Sheet 2 of 2)



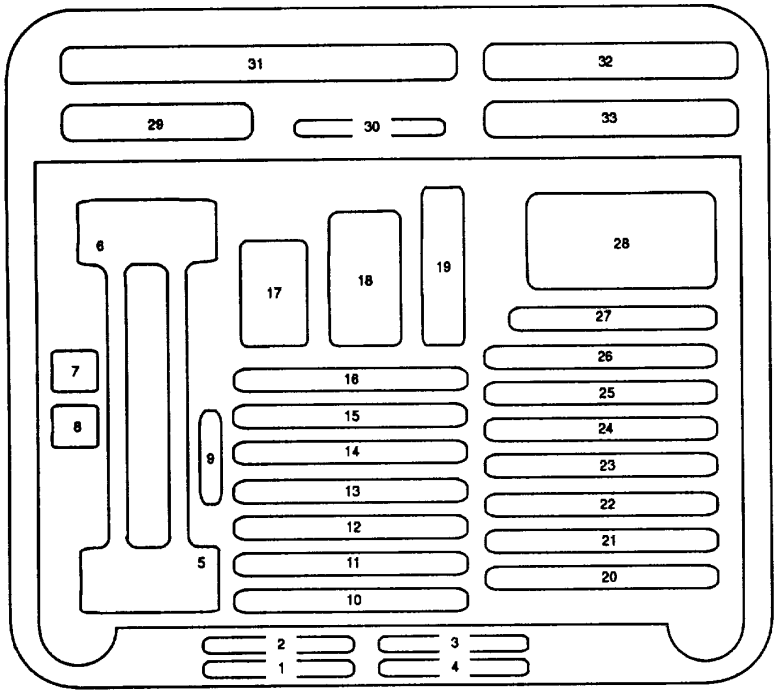
ITEM	DESCRIPTION
A1.	9208(PROTO) 1/4 NUT DRIVER
A2.	M2252/1-01 CRIMPING TOOL FRAME
A3.	M22620/3-1 IN-SERVICE INSPECTION GAGE
A4.	74008(ALLEN) 9/64 HEX WRENCH
A5.	M22620/1-05 UNIVERSAL HEAD
A6.	M22620/1-02 TURRET HEAD
A7.	M22620/1-03 TURRET HEAD
A8.	M22620/1-04 TURRET HEAD
A9.	M22620/1-12 TURET HEAD
A10.	M22620/1-13 TURRET HEAD
A11.	M22620/1-14 TURRET HEAD
A12.	TH122(DANIELS) TURRET HEAD
A13.	TH343(DANIELS) TURRET HEAD
A14.	TH484(DANIELS) TURRET HEAD
A15.	G2P330(DANIELS) OR M22520/31-02 SINGLE POSITION HEAD-USE WITH A17.
A16.	M22520/5-17 DIE SET
A17.	GS200-1(DANIELS) OR M22520/31-01 CRIMPING TOOL-USE WITH ITEM A15.
A18.	M22520/5-17 DIE SET
A19.	M22520/5-25 DIE SET
A29.	M22520/529 DIE SET
A21.	M22520/553 DIE SET
A22.	Y219 (DANIELS) DIE SET
A23.	Y289 (DANIELS) DIE SET
A24.	M22520/5-100 DIE SET
A25.	HX3-82(DANIELS) DIE REMOVAL TOOL
A26.	M22520/2-01 CRIMPING TOOL FRAME
A27.	K25 (DANIELS) POSITIONER
A28.	K187 (DANIELS) POSITIONER
A29.	K325 (DANIELS) POSITIONER
A30.	K330-3 (DANIELS) POSITIONER

ITEM	DESCRIPTION
A31.	K600 (DANIELS) POSITIONER
A32.	K642 (DANIELS) POSITIONER
A33.	M22520/2-02 POSITIONER
A34.	M22520/2-04 POSITIONER
A35.	M22520/2-04 POSITIONER
A36.	M22520/2-07 POSITIONER
A37.	M22520/2-10 POSITIONER
A38.	M22520/2-11 POSITIONER
A39.	M22520/2-13 POSITIONER
A40.	M22250/2-14 POSITIONER
A41.	M22250/2-15 POSITIONER
A42.	M22250/2-24 POSITIONER
A43.	M22250/2-30 POSITIONER
A44.	K495 (DANIELS) OR M22250/2-32 POSITIONER
A45.	K323 (DANIELS)OR M22250/2-34 POSITIONER
A46.	K473 (DANIELS) OR M22250/2-36 POSITIONER
A47.	45-162 (IDEAL) COAXIAL STRIPPER
A47a.	SPARE BLADES FOR 45-162 (IDEAL) COAXIAL STRIPPER
A48.	45-163 (IDEAL) COAXIAL STRIPPER
A48a.	SPARE BLADES FOR 45-163 (IDEAL) COAXIAL STRIPPER
A49.	45-164 (IDEAL) COAXIAL STRIPPER
A49a.	SPARE BLADES FOR 45-163 (IDEAL) COAXIAL STRIPPER
A50.	L-9038 (IDEAL) WIRE STRIPPER HANDLE
A51.	L-9039 (IDEAL) WIRE STRIPPER HANDLE
A52.	45-1608-1 (IDEAL) BLADE SET USE WITH ITEM A51
A53.	45-1654-1 (IDEAL) BLADE SET USE WITH ITEM A50
A54.	45-1610-1 (IDEAL) BLADE SET USE WITH ITEM A51
A55.	45-1611-1 (IDEAL) BLADE SET USE WITH ITEM A50
A56.	L-5562 (IDEAL) BLADE SET USE WITH ITEM A51
A57.	L-5563 (IDEAL) BLADE SET USE WITH ITEM A50
A58.	45-123 (IDEAL) WIRE CUTTER
A59.	227-901-2500 (AMPHENOL) COAXIAL TRIM KIT

Figure 9-40. DM664A Repair Kit (Compartment A)

COMPARTMENT "B"

Warning: Foreign object damage FOD can abort a mission or cause loss of life. Make sure all tools are accounted for after using this kit.



CAUTION: Before closing Compartment "B" Flyer.
1. Assure all tools are returned to Compartment "B" and "C".
2. Insert Compartment "C" Tray with tools into Compartment "B" Storage Area.
3. Close and Secure Compartment "B" Flyer.

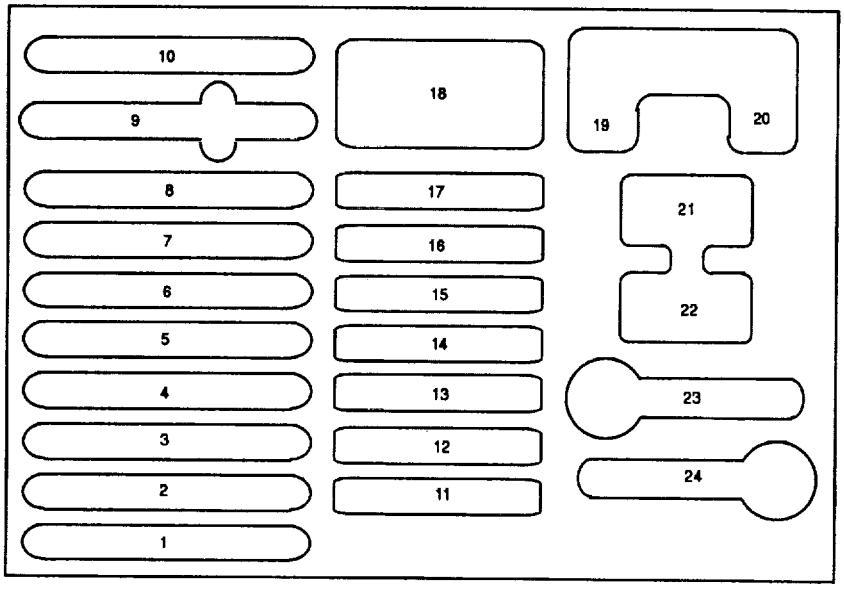
CONTENTS CHART

ITEM	DESCRIPTION
B1.	CG12 (DANIELS) CONTACT GAGE
B2.	CG16 (DANIELS) CONTACT GAGE
B3.	CG20 (DANIELS) CONTACT GAGE
B4.	CG22 (DANIELS) CONTACT GAGE
B5.	TH0001P000 (HDL) W/ TM01619901 (TIP HUGHES)
B6.	TH0001P000 (HDL) W/ TM0181PS01 (TIP HUGHES)
B7.	TM0161GS00 (HUGHES) GAGE
B8.	TM0161GP00 (HUGHES) GAGE
B9.	TW000SW00 (HUGHES) SPANNER WRENCH (4 SUPPLIED)
B10.	MS1969/B-05 (MS27495A20) INSTALLING TOOL
B11.	MS1969/B-01 (MS27495A22M) INSTALLING TOOL
B12.	MS1969/B-10 (MS27495R12) REMOVAL TOOL
B13.	MS1969/B-08 (MS27496R16) REMOVAL TOOL
B14.	MS1969/B-06 (MS27496R20) REMOVAL TOOL
B15.	MS1969/B-02 (MS27496R22M) REMOVAL TOOL
B16.	DAK83-20 (DANIELS) INSTALLING TOOL
B17.	MS1969/16-04 OR 51515-23 (DUETCH) INSTALLING/REMOVAL TOOL (10 SUPPLIED)
B18.	MS1969/16-01 OR 81515-20 (DUETCH) INSTALLING/REMOVAL TOOL (10 SUPPLIED)
B19.	MS1969/16-02 OR 81515-16 (DUETCH) INSTALLING/REMOVAL TOOL (5 SUPPLIED)
B20.	DRK83-12 DANIELS) REMOVAL TOOL
B21.	DRK83-18 (DANIELS) REMOVAL TOOL
B22.	DRK83-20 (DANIELS) REMOVAL TOOL
B23.	DRK145 (DANIELS) REMOVAL TOOL
B24.	DRK223-22 (DANIELS) REMOVAL TOOL
B25.	DAK238-22 (DANIELS) INSTALLING TOOL
B26.	DRK238-22 (DANIELS) REMOVAL TOOL
B27.	DRK238 (DANIELS) REMOVAL TOOL
B28.	MS1969/16-03 OR 81515-12 (DEUTCH) INSTALLING/REMOVAL TOOL (5 SUPPLIED)
B29.	CTJ-R12 (DEUTCH) MODULE REMOVAL TOOL
B30.	CTJ-R06 (DEUTCH) MODULE REMOVAL TOOL
B31.	BT-A-488 (DANIELS) SOFT JAW PLIERS
B32.	BT-BS-609 (DANIELS)STRAP WRENCH
B33.	BT-A-6010 (DANIELS) REPLACEMENT STRAP USE WITH ITEM B32.

Figure 9-41. DM664A Connector Repair Kit (Compartment B)

COMPARTMENT "C"

Warning: Foreign object damage FOD can abort a mission or cause loss of life. Make sure all tools are accounted for after using this kit.



CAUTION: Before closing Compartment "B" Flyer.
1. Assure all tools are returned to Compartment "B" and "C".
2. Insert Compartment "C" Tray with tools into Compartment "B" Storage Area.
3. Close and Secure Compartment "B" Flyer.

ITEM	DESCRIPTION
C1.	MS1969/17-03 (MS24256A20) INSTALLING TOOL
C2.	MS1969/19-09 (MS24256R12) REMOVAL TOOL
C3.	MS1969/19-08 (MS24256R16) REMOVAL TOOL
C4.	MS1969/19-07 (MS24256R16) REMOVAL TOOL
C5.	DRK 36 (DANIELS) REMOVAL TOOL
C6.	DAK39 (DANIELS) INSTALLING TOOL
C7.	DRK39 (DANIELS) REMOVAL TOOL with DRK39-2A-SA TIP (PIN) ASSEMBLY
C8.	4-1150 (DANIELS) 6" SCALE w/WIRE GAUGE
C9.	DAK96-20 (DANIELS), INSTALLIGN TOOL
C10.	AD-1464 (RAYCHEM) REMOVAL TOOL
C11.	MS1869/18-01 (MS17805) INSTALLING TOOL
C12.	MS1969/20-01 (MS17806) REMOVAL TOOL
C13.	MS1896/18-02 INSTALLING TOOL
C14.	MS1969/20-02 REMOVAL TOOL
C15.	DAK145 (DANIELS) INSTALLING TOOL
C16.	DAK81-20 (DANIELS) INSTALLING TOOL
C17.	DRK81-20 (DANIELS) REMOVAL TOOL with 6783 PROBE FOR SIZE 20 PIN 6784 PROBE FOR SIZE 20 SOCKET
C18.	M-7LB (ELECTRO OPTICIX) ILLUMINATED MAGNIFIER
C19.	KTD-81 (KINGS) DIELECTRIC TRIM JIG
C20.	KTJ-24 (KINGS) TRIM TOOL
C21.	294540 (AMPHENOL) INSTALLING TOOL (2 SUPPLIED)
C22.	294-541 (AMPHENOL)REMOVAL TOOL (2 SUPPLIED)
C23.	DRK300-1SA (DANIELS) REMOVAL TOOL HANDLE
C24.	DRK106-20-2 (DANIELS) REMOVAL TOOL PROBE DRK105-22-02 (DANIELS) REMOVAL TOOL PROBE DRK106-22M-2 (DANIELS) REMOVAL TOOL PROBE DRK110-12-2 (DANIELS) REMOVAL TOOL PROBE DRK110-16-2 (DANIELS) REMOVAL TOOL PROBE DRK110-20-2 (DANIELS) REMOVAL TOOL PROBE DRK130-16-2 (DANIELS) REMOVAL TOOL PROBE DRK130-20-2 (DANIELS) REMOVAL TOOL PROBE

Figure 9-42. DM664A Connector Repair Kit (Compartment)

CROSS REFERENCE CHART

COMPARTMENT "A"

ITEM	PART NO.	NSN	CAGEC
Al	9208		77053
A2	M22420/1-01	5120-01-165-3912	81349
A3	M22520/3-1	5220-00-000-6722	81349
A4	74008	5120-00-177-7341	11851
A5	M22520/1-05	5120-00-165-3911	81349
A6	M22520/1-02	5120-00-016-6382	81349
A7	M22520/1-03	5120-00-116-6554	81349
A8	M22520/1-04	5120-00-016-6554	81349
A9	M22520/1-12	5120-01-036-9220	81349
A10	M22520/1-13	5120-01-036-9221	81349
All	M22520/1-14	5120-01-036-9222	81349
A12	TH122	5120-01-118-2893	11851
A13	TH343	5120-01-361-9705	11851
A14	TH484	5120-01-361-9453	11851
A15	G2P330	3436-01-063-2139	11851
	M22420/31-02		81349
A16	M25520/5-01	5120-00-132-6913	81349
A17	GS200-1	5120-00-117-4700	11851
	M22520/31-01		81349
A18	M22520/5-17	5120-00-133-0597	81349
A19	M22520/5-25	5120-00-133-0622	81349
A20	M22520/5-29	5120-00-116-3285	81349
A21	M22520/5-100	5120-00-596-9313	81349
A22	M22520/5-53	5120-00-116-3160	81349
A23	Y219	5120-01-361-9351	11851
A24	Y289	5120-01-232-0017	11851
A25	HX3-82	5120-00-596-8313	11851
A26	M22520/2-01	5120-00-494-9237	81349
A27	K25	5120-01-053-5805	11851
A28	K187	5120-00-127-4559	11851
A29	K325	5120-01-104-7967	11851
A30	K330-3	5120-01-096-8488	11851
A31	K600	5120-01-361-9662	11851
A32	K642	5120-01-361-9664	11851

Figure 9-43. Cross Reference Chart (Sheet 1 of 4)

CROSS REFERENCE CHART (Continued)

COMPARTMENT "A" (Continued)

ITEM	PART NO.	NSN	CAGEC
A33	M22520/2-02	6120-00-165-3913	81349
A34	M22520/2-04	5120-00-017-3640	81349
A35	M22520/2-07	5120-00-017-3827	81349
A36	M22520/2-08	5120-00-017-3921	81349
A37	M22520/2-10	5120-00-017-3932	81349
A38	M22520/2-11	5120-00-017-3934	81349
A39	M22520/2-13	5120-00-132-6939	81349
A40	M22520/2-14	5120-00-132-6962	81349
A41	M22520/2-15	5120-00-132-6978	81349
A42	M22520/2-24	5120-00-348-7531	81349
A43	M22520/2-30		81349
A44	K49G		81349
	M22520/2-32	5120-01-135-3078	81349
A45	K323		11851
	M22520/2-34	5120-00-117-4706	81349
A46	K473	5120-01-162-4893	11851
	M2252012-36	5120-01-162-4893	81349
A47	45-162	5110-01-216-4464	30119
A48	45-163	5110-01-232-4239	30119
A49	45-164	5110-01-218-5828	30119
A50	L-9038	5110-01-232-0019	30119
A51	L-9039	5110-01-232-5708	30119
A52	45-1608-1	5110-01-231-5707	30119
A53	45-1610-1	5110-00-088-1598	30119
A54	45-1611-1	5110-00-133-1885	30119
A55	45-16541	5110-01-159-2275	30119
A56	L-5562		30119
A57	L-5563		30119
A58	45-123	5110-01-037-1408	30119
A59	227-001-2500		74868

Figure 9-43. Cross Reference Chart (Sheet 2 of 4)

CROSS REFERENCE CHART (Continued)

COMPARTMENT "B"

ITEM	PART NO.	NSN	CAGEC
B1	CG12	5220-01-116-3020	11851
B2	CG16	5220-01-116-3021	11851
B3	CG20	5220-01-116-3022	11851
B4	CG22	5220-01-116-3023	11851
B5	TH0001P000		27832
	TM0161 PP01	5120-00-409-5215	26732
B6	TH0001P000		27832
	TM1 61 PS01	5120-00-409-5214	27832
B7	TM0161GS00	5120-00-409-5242	27832
B8	TM01 61 GPOO	5120-00-409-5200	27832
B9	TWOOOSWOO		27832
B10	M81969/8-05	5120-00-845-7913	81349
B11	M81969/8-01	5120-00-251-9503	81349
B12	M81969/8-10	5120-00-103-9708	81349
B13	M81969/8-08	5120-00-409-5206	81349
B14	M81969/8-06	5120-00-177-6966	81349
B15	M81969/8092	5120-00-146-6558	81349
B16	DAK83-20		11851
B17	M81969/16-04	5120-00-132-5808	81349
B18	M81969/18-01	5120-00-930-7504	81349
B19	M81969/18-02	5120-01-227-3173	81349
B20	DRK83-12	5120-01-116-6115	11851
B21	DRK83-16	5120-01-116-6574	11851
B22	DRK83-20	5120-01-335-8716	11851
B23	DRK145	5120-01-361-9408	11851
B24	DRK223-22	5120-01-361-9419	11851
B25	DAK238-22	5120-01-152-2317	11851
B26	DRK238-22	5120-01-361-9393	11851
B27	DRK246	5120-01-232-0016	11851
B28	M81969/16-03	5120-00-132-5451	81349
B29	CTJ-R12	5120-01-232-0023	11139
B30	CTJ-R06	5120-01-097-5219	11139
B31	BT-SJ-468	5120-01-231-5724	11851
B32	BT-BS-609	5120-01-335-8842	11851

Figure 9-43. Cross Reference Chart (Sheet 3 of 4)

CROSS REFERENCE CHART (Continued)

COMPARTMENT "C"

ITEM	PART NO.	NSN	CAGEC
C1	M81969/17-03	5120-00-079-4598	81349
C2	M81969/19-09	5120-00-079-9461	81349
C3	M81969/19-08	5120-00-079-4602	81349
C4	M81969/19-07	5120-00-079-4601	81349
C5	DRK36	5120-00-987-0785	11851
C6	DRK39	5120-00-947-9965	11851
C7	DRK39	5120-00-869-0728	11851
	DRK392A-SA		11851
	DRK392-SA		11851
C8	4-1150	5210-01-233-8308	11851
C9	DAK96-20	5120-01-361-9595	11851
C10	AD-1 464	5120-01-032-4250	06090
C11l	M81969/18-01	5120-00-930-7504	81349
C12	M81969/20-01	5120-00-177-2077	81349
C13	M81969/18-02	5120-01-227-3173	81349
C14	M81969/20-02	5120-01-338-2697	81349
C15	DAK145	5120-01-361-9583	11851
C16	DAK223-22	5120-01-361-9606	11851
C17	DRK81-20	5120-01-361-9431	11851
	6783		11851
	6784		11851
C18	M-7LB		
C19	KTD-81	5110-01-236-9651	91836
C20	KTJ-24	5110-01-233-1847	91836
C21	ON089564		74868
C22	ON089565		74868
C23	DRK300-1 SA	5120-01-231-5722	11851
C24	DRK1 05-20-2	5120-01-135-3294	11851
	DRK105-22-2	5120-01-135-3295	11851
	DRK105-22M-2	5120-01-136-1538	11851
	DRK110-12-2	5120-01-335-8678	11851
	DRK110-16-2		11851
	DRK110-20-2	5120-01-335-8676	11851
	DRK130-16-2	5120-01-361-9385	11851
	DRK130-20-2	5120-01-361-9386	11851

Figure 9-43. Cross Reference Chart (Sheet 4 of 4)

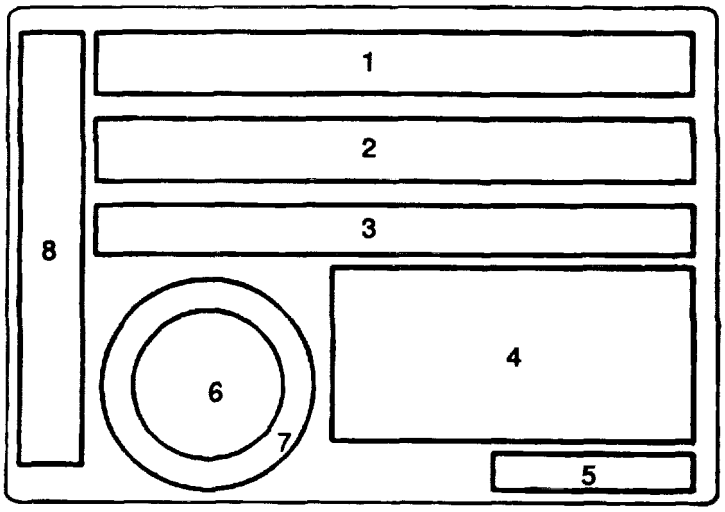
INSTRUCTION AND TOOL DESCRIPTION CHARTS

70700 - 20637 - 041
EMERGENCY WIRING REPAIR/AIRCRAFT RECOVERY KIT
COMBAT MAINTENANCE/BATTLE DAMAGE REPAIR SET

CONTENTS

Figure 9-44. Emergency Wiring Repair Kit (instruction and Tool Description Chart)

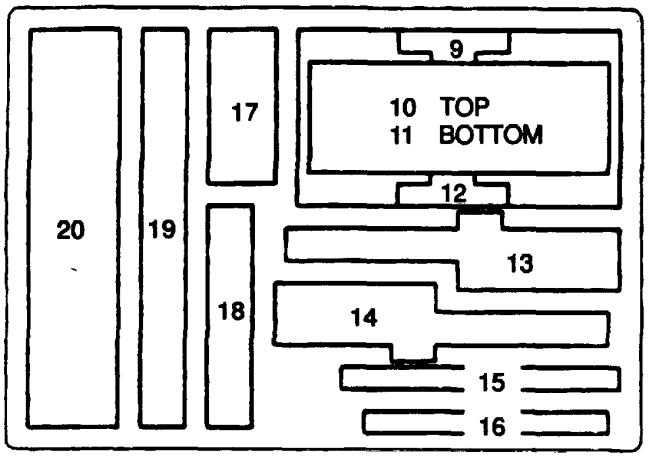
CONTENTS CHART
PREVENT FOREIGN OBJECT DAMAGE (FOD).
ACCOUNT FOR ALL ITEMS IN THIS KIT AFTER USE.



ITEM NO.	ITEM DESCRIPTION
1.	RAYCHEM D-505-0008 NO. 20 AWG WIRE SEGMENTS (90 REQD)
2.	RAYCHEM D-505-0009 NO. 16 AWG WIRE SEGMENTS (60 REQD)
3.	RAYCHEM D-505-0010 NO. 12 AWG WIRE SEGMENTS (30 REQD)
4.	RAYCHEM MK-0015-301 ASSORTED SPLICES
5.	VICTORINOX 5012 KNIFE, SWISS ARMY
6.	RAYCHEM MK-0015-304 NO. 12 AWG WIRE
7.	CHR HM-350 TEFLON TAPE (36 YDS)
8.	MS3367-1-0 CABLE TIES (40 REQD)

Figure 9-45. Emergency Wire Repair Kit (Contents Chart, Items 1-8)

CONTENTS CHART
PREVENT FOREIGN OBJECT DAMAGE (FOD).
ACCOUNT FOR ALL ITEMS IN THIS KIT AFTER USE.



ITEM NO.	ITEM DESCRIPTION
9.	POMONA 1437-0 ALLIGATOR CLIP, BLACK
10.	BECKMAN HD-110 DIGITAL MULTIMETER (TOP)
11.	BECKMAN TL-245 TEST LEADS (BOTTOM)
12.	POMONA 1437-2 ALLIGATOR CLIP, RED
13.	IDEAL 45-1610 WIRE STRIPPER
14.	IDEAL 45-1654 WIRE STRIPPER
15.	IDEAL 45-123 WIRE CUTTER
16.	KLEIN TOOLS D202-5 DIAGONAL PLIERS
17.	RAYCHEM MK-0015-303 NO. 20 AWG WIRE
18.	ELECTRO OPTIX M-7LB MAGNIFYING GLASS
19.	RAYCHEM AD-1377 CRIMP TOOL
20.	FULTON MX-992/U FLASHLIGHT

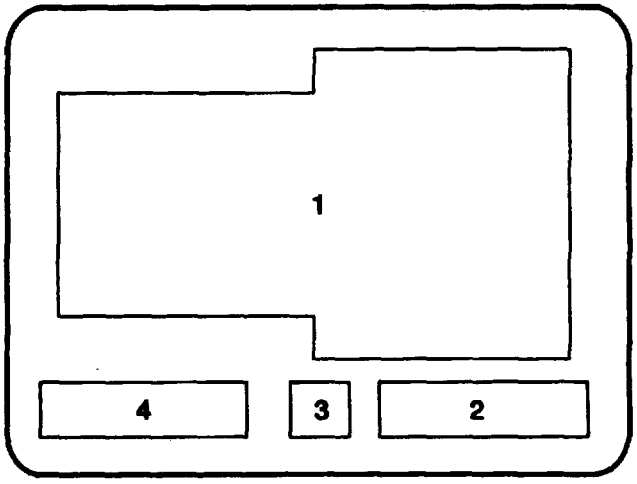
Figure 9-46. Emergency Wire Repair Kit (Contents Chart, Items 9-20)

CROSS REFERENCE OF KIT CONTENTS

ITEM NO.	PART NUMBER	NSN	CAGEC
1	D-505-0008		06090
2	D-505-0009		06090
3	D-505-0010		06090
4	D-MK-0015-301		06090
5	5012	5110-01-274-9919	23116
6	D-MK-0015-304		06090
7	HM-350	9570-00-723-5413	71643
8	MS3367-1-0	5970-00-984-6582	96906
9	1437-0		71643
10	HD-110		80053
11	TL-245		80053
12	1437-2	5999-01-152-8390	05276
13	45-1610	5110-00-088-1598	30119
14	45-1654	5110-00-177-7286	30119
15	45-123	5120-00-037-1408	30119
16	D202-5		75347
17	MK-0015-303		06090
18	M-7LB		57235
19	AD-1377		06090
20	MX-992/U	6230-00-269-3034	80053

Figure 9-47. Emergency Wire Repair Kit (Cross Reference Chart)

CONTENTS CHART
PREVENT FOREIGN OBJECT DAMAGE (FOD).
ACCOUNT FOR ALL ITEMS IN THIS KIT AFTER USE.



ITEM No.	ITEM DESCRIPTON
1.	TEKTRONIX 1502 MODEAOPT4 TIME DOMAIN
2.	BECKMAN HD-110 DIGITAL MULTIMETER
3.	BECKMAN TL-245 TEST LEADS
4.	FULTON IND. MX-992/U FLASHLIGHT

Figure 9-48. Test Equipment Kit

CONTENTS CHART
PREVENT FOREIGN OBJECT DAMAGE (FOD).
ACCOUNT FOR ALL ITEMS IN THIS KIT AFTER USE.

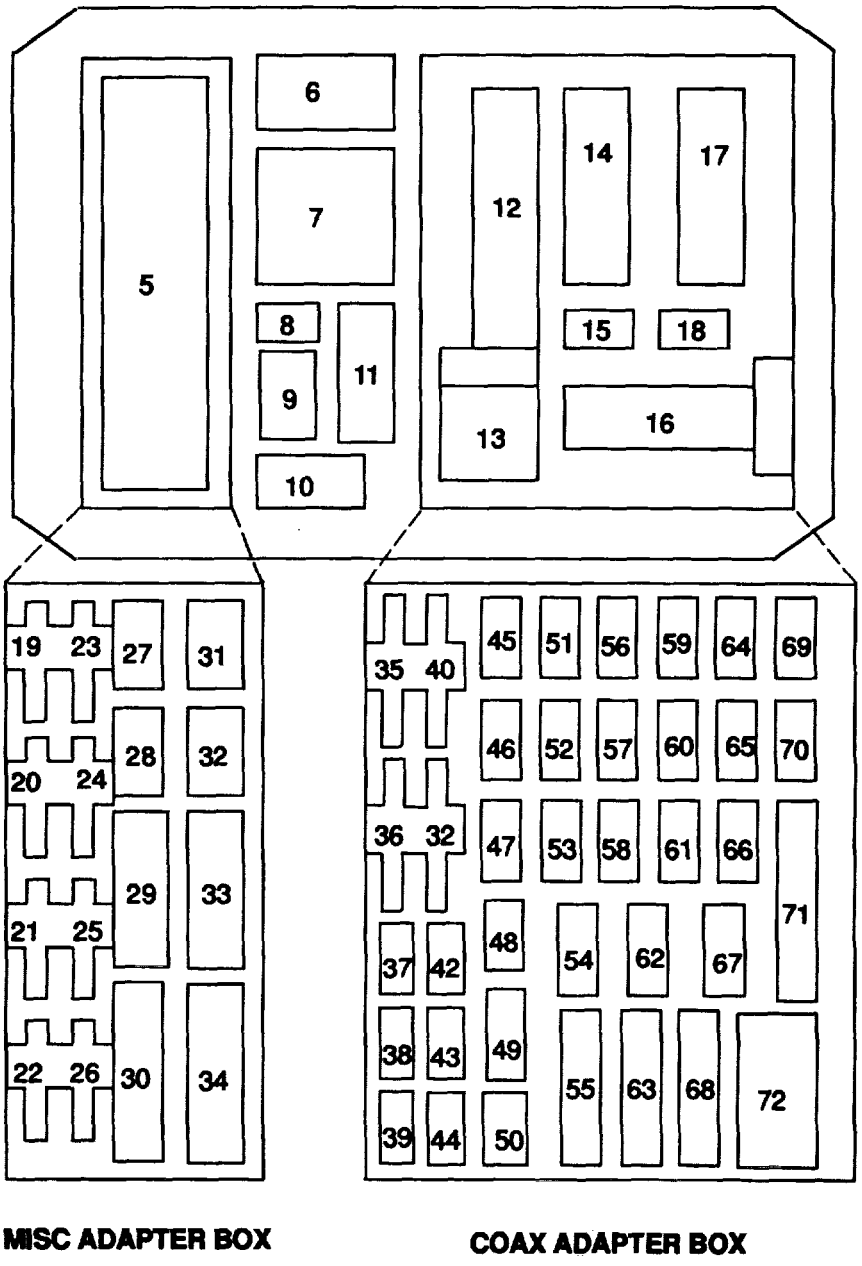


Figure 9-49. Test Equipment Kit (Cross Reference Chart) (Sheet 1 of 2)

CONTENTS CHART
PREVENT FOREIGN OBJECT DAMAGE (FOD).
ACCOUNT FOR ALL ITEMS IN THIS KIT AFTER USE.

ITEM	ITEM DESCRIPTION
5.	POMONA 2249-C 360S COAX EXTENSION CABLE
6.	BESCMAN DL-243 TEST LEAD KIT
7.	BECKMAN FG-3000-600-283 TEST LEAD EXTENSION
8.	ELECTRO OPTIX M7LB MAGNIFYING GLASS
9.	SPARE
10.	SPARE
11.	SPARE
12.	TEXTRONIX 006-1658-01 TDR CHART PAPER (4 REQD.)
13.	BA3030/UD-CELL BATTERY (2 REOD.)
14.	SPARE
15.	DURACELL MN2400 BATTERY (2 REQD.)
16.	SPARE
17.	POMONA 2249-C-120S COAX EXTENSION CABLE
18.	SPARE
19.	POMONA 3562-0 ADAPTER-MS SOCKET #16 BLACK POMONA 3562-2 ADAPTER-MS SOCKET #16 RED
20.	POMONA 3563-0 ADAPTER-MS PIN #16 BLACK POMONA 3563-2 ADAPTER-MS PIN #16 RED
21.	POMONA 3564-0 ADAPTER-MS SOCKET #12 BLACK POMONA 3564-2 ADAPTER-MS SOCKET #12 RED
22.	POMONA 3565-0 ADAPTER-MS PIN #12 BLACK POMONA 3565-2 ADAPTER-MS PIN #12 RED
23.	POMONA 4890-0 ADAPTER-MS SOCKET #22 BLACK POMONA 4690-2 ADAPTER-MS SOCKET #22 RED
24.	POMONA 4691-0 ADAPTER-MS PIN #22 BLACK POMONA 4891-2 ADAPTER-MS PIN #22 RED
25.	POMONA 3560-0 ADAPTER-MS SOCKET #20 BLACK POMONA 35602 ADAPTER-MS SOCKET #20 RED
26.	POMONA 3561-0 ADAPTER-MS PIN #20 BLACK POMONA 3561-2 ADAPTER-MS PIN #20 RED
27.	SPARE
28.	SPARE
29.	SPARE
30.	SPARE
31.	POMONA 1269 ADAPTER-BNCIDUAL BANANA PLUG
32.	POMONA 1452 ADAPTER-BNCIDUAL BANANA JACK
33.	POMONA 2630 ADAPTER-BNC/ALLIGATOR CLIPS
34.	POMONA 3073 ADAPTER-BNC/DUAL BANANA PLUGS
35.	SCHAAL ASSOC. SA-5147 ADAPTER-COAX PIN/SMA
36.	SCHAAL ASSOC. SA-5195 ADAPTER-COAX PIN/SMA
37.	AMPHENOL 31-30468-2 TRIAXIAL JACK-D POL.
38.	AMPHENOL 31 30468-2 TRIAXIAL JACK-F POL
39.	AMPHENOL 31-30468-4 TRIAXIAL JACK-H POL.
40.	SCHAAL ASSOC.SA-5146 ADAPTER-COAX
41.	SCHAAL ASSOC. SA-5194 ADAPTER-COAX SOCKET/SMA
42.	POMONA 3840-50 ONM TERMINATION
43.	SPARE
44.	SPARE
45.	TED AJC-2-F ADAPTER BNC/DM-F PLUG
46.	TED AJC-2-K ADAPTER BNC/DM-K PLUG
47.	TED AJC-2-M ADAPTER BNC/DM-M PLUG
48.	UG-1368/U ADAPTER BNC/N PLUG
49.	UG-349A/U ADAPTER BNC/N PLUG
50.	AMPHENOL UG-201/U ADAPTER BNCIN JACK
51.	TED AJC-3-B ADAPTER BNCIDM-B JACK
52.	TED AJC-20E ADAPTER BNCIDM-E PLUG
53.	TED AJC-3-E ADAPTER BNC/DM-E JACK
54.	UG3086AI BNC RIGHR ANGLE
55.	TEKTRONIX 017-0090-00 ADAPTER 50/125 OHM
56.	TED AJC-2-A ADAPTER BNC/DM-APLUG
57.	TED AJC-3-A ADAPTER BNC/DM-A JACK
58.	TED AJC-2-B ADAPTER BNCIDM-B PLUG
59.	AMPHENOL 79025 ADAPTER BNC/TNC PLUG
60.	AMPHENOL 79675 ADAPTER BNC/MNC JACK
61.	AMPHENOL UG-914/U ADAPTER BNC/GR PLUG
62.	TEKTRONIX 017-0063-00 ADAPTER BNC/GR PLUG
83.	TEKTRONIX 017-0092-00 ADAPTER 50/93 OHM
64.	UG 635U ADAPTER BNCC PLUG
65.	AMPHENOL 901-167 ADAPTER BNC/SMA PLUG
66.	AMPHENOL 901-166ADAPTER BNC/SMA JACK
67.	TEKTRONIX 017-0064-00 ADAPTER BNC/GR PLUG
68.	TEKTRONIX 017-0091-00 ADAPTER 50/75 OHM
69.	SPARE
70.	KINGS ELEC. KH-99-04 ADAPTER BNC/HN PLUG
71.	SIKORSKY EWR60127 ADAPTER 4 PIN AUDIO
72.	SIKORSKY EWR60128 ADAPTER 5 PIN AUDIO

Figure 9-49. Test Equipment Kit (Cross Reference Chart) (Sheet 2 of 2)

CROSS REFERENCE OF KIT CONTENTS

ITEM	PART NO.	NSN	CAGEC
1	1502MODEADPT4		80009
2	110-110		80053
3	TL-245		80053
4	MX992AU	6230D00-269-3034	80053
5	2249-C-3608		05276
6	DL-243		80053
7	FG-3000-600-283		80053
8	H-7LB		57235
9			
10			
11			
12	006-1688-01	7630-01-041-8024	80009
13	DA3030/U	6135-09304030	80058
14			
15	NN2400	6135-00-826-4798	90303
16			
17	2249-C-1209		05276
18			
19	3562-0	5935-01-101-9495	05276
	3562-2	5935-01-098-8596	05276
20	3563-0	5935-01-098-7264	05276
	3563-2	5935-01-100-4834	05276
21	3564-0	5935-01-100-4835	05276
	3564-2	6625-01-016-8171	05276
22	3565-0	6625-01-128-6952	05276
	3565-2	5999-01-137-1360	05276
23	4690-0	6625-01-159-7957	05276
	4690-2	6625-01-159-7958	05276
24	4691-0	6625-01-159-7959	05276
	4691-2	6625-01-159-7960	05276
25	3560-0	6625-01-051-3428	05276
	3560-2	6625-01 -024-2981	05276
26	3561-0	6625-01-038-2105	05276
	3561-2	6625-01-038-0803	05276
27			
28			
29			
30			
31	1269	5935-00-053-9454	05276
32	1452	5935-102-5652	05276
33	2630	6625-00-761 -6670	05276

Figure 9-50. Test Equipment Kit (Cross Reference Chart) (Sheet 1 of 2)

CROSS REFERENCE OF KIT CONTENTS (Continued)

ITEM	PART NO.	NSN	CAGEC
34	3073	6625-00-175-1472	05276
35	SA-5147		
36	SA-5195		
37	31-30468-2		74868
38	31-30468-3		74868
39	31-30468-4		74868
40	SA-5146		
41	SA-5194		
42	3840-50	6625-01-026-8770	05276
43			
44			
45	AJC-2-F		05209
46	AJC-2-K		05209
47	AJC-2-H		05209
48	UG-1368/J	5935-00-733-6475	80058
49	UG-349AIU	5935-00-739-2242	80058
50	UG-201/U		74868
51	AJC-3-B		05209
52	AJC-2-E		05209
53	AJC-3-E		05209
54	UG-306A/U	5935-01-032-5404	81349
55	0178-0090-00	5935-01-047-3268	80009
56	AJC-2-A		05209
57	AJC-3-A		05209
58	AJC-2-B		05209
59	79025	5935-00-676-7720	74868
60	79675	5935-00-701-2215	74868
61	UG-914/U	5935-01-037-3476	81349
62	017-0063-00	5935-00-765-5481	80009
63	017-0092-00	5935-01-047-3267	80009
64	UG-635/l	5935-00-201-8420	81349
65	901-167	5938-00-320-6636	74868
66	901-166	5935-00-321-7969	74868
67	017-0064-00	5935-00-984-5563	80009
68	017-0091-00	5935-01-049-2873	80009
69			
70	KH-99-04		91836
71	EWR-60127		78286
72	EWR-60128		78286

Figure 9-50. Test Equipment Kit (Cross Reference Chart) (Sheet 2 of 2)

Table 9-5. ACMI/BDR Wiring Repair Set Permanent Repair Capabilities (One Hour/One Flight)

TYPE OF REPAIR	COMPONENT TO USE	WIRE OR CABLE SIZE
UNSHIELDED PRIMARY WIRE SPLICING AND REPAIR	CRIMP SPLICE FOR WIRE RATED 105°C OR BELOW	20, 22, 24,16, 18 12,14
	CRIMP SPLICE FOR WIRE RATED 125°C OR ABOVE	20, 22, 24, 16, 18 12, 14
	WIRE REPAIR SEGMENT FOR WIRE RATED 125°C OR ABOVE	20, 22, 24, 16,18 12,14
SHIELD CABLE SPLICING	SPLICE FOR SHIELDED CABLE RATED 125°C OR ABOVE	20, 22, 24, 16, 18 12,14
	SHIELD CABLE REPAIR SEGMENT (FOR UP TO 9-INCH DAMAGED LENGTH)	20, 22, 24,16, 18
CABLE SHIELD TERMINATION	SHIELD TERMINATOR FOR TIN- OR SILVER-PLATED SHIELDS	055 - .085 JACKET O.D. 085 - .170 JACKET O.D. OVER .170 JACKET O.D.
	SHIELD TERMINATOR FOR NICKEL-PLATED SHIELDS (INCLUDING VERMILLION)	UP TO .125 TOTAL INSULATION DIAMETER .125 - .200 TOTAL INSULATION DIAMETER
WIRE OR SHIELDED CABLE INSTALLATION	PRIMARY WIRE	#20 #12
	SHIELDED SINGLE CONDUCTOR CABLE	#20 #16
CABLE SHIELD INSTALLATION	SHIELD BRAID	UP TO .15 DIAMETER .15- .35 DIAMETER .35 - .75 DIAMETER
BUNDLE FORMING AND PROTECTION	TIE TAPE HEAT-SHRINKABLE TUBING	UP TO .30 DIAMETER .30 - .40 DIAMETER .40- .80 DIAMETER
	SELF-CLINCHING CABLE STRAPS FOR USE IN TEMPER-ATURES BELOW 850C (185°F)	1/16 - 1-3/4 INCH DIAMETER BUNDLES
CIRCULAR CONNECTOR REPAIR	CONNECTOR CONTACTS	12, 16, 20, 22
	SEALING PLUGS	12, 16, 20, 22
MTC FLAT CONNECTOR REPAIR	MTC FLAT CONNECTOR REPAIR KIT	20, 22, 24
TERMINAL BOARD REPLACEMENT	TERMINAL BOARD	8 - NO 6 TERMINALS

Table 9-5. ACIWBDR Wiring Repair Set Permanent Repair Capabilities (One Hour/One Flight) (Continued)

TYPE OF REPAIR	COMPONENT TO USE	WIRE OR CABLE SIZE
TERMINAL LUG INSTALLATION	TERMINAL LUG (CRIMP-TYPE RING TERMINAL)	24 (4, 6, 8, & 10 STUD) 22 (6, 8, 10 & 1/4 STUD) 20 (6, 8, 10 & 1/4 STUD) 18 (6, 8, 10 & 1/4 STUD) 16 (6, 8, 10 & 1/4 STUD) 14(6, 8, 10 &1/4 STUD)
UNSHIELDED PRIMARY WIRE SPLICING AND REPAIR	SPLIT BOLT SPLICE CONNECTOR FOR LARGE WIRE SIZES	4, 6, 8,10
CO-AXIAL CABLE SPLICING	CO-AXIAL CABLE SPLICE	RG-9B/U (M17/4) RG-58C/U (M17/28) RG-5BJ (M17/29) RG-71 B/U (M17/90) RG-124/U RG-142B/U (M17/60) RG-179B/U (M1 7/94) RG-180B/U (M17/95) RG-214/U (M17175) RG-223/U (M17/84) RG-225/U (M17/86) RG-302/U (M1 7/110) RG-303/U (M17/111) RG-316/U (M17/113) RG-393/U (M171127)
BUNDLE FORMING AND PROTECTION	HEAT-SHRINKABLE REPAIR TAPE	
CONNECTOR PIN/SOCKET BY-PASS	CRIMP SPLICE WITH PRIMARY WIRE, WIRE REPAIR SEGMENTS	20, 22, 24,16,18 12,14
UNSHIELDED PRIMARY WIRE SPLICING AND REPAIR	CRIMP SPLICE FOR WIRE RATED 1250C OR ABOVE	20, 22, 24,16,18 12,14
	WIRE REPAIR SEGMENT FOR WIRE RATED 1250C OR ABOVE	20, 22, 24, 16,1812,14
WIRE OR SHIELDED CABLE INSTALLATION	PRIMARY WIRE	#20 #12
BUNDLE FORMING AND PROTECTION	NYLON TAPE	SEE NOTE
CONNECTOR PIN/SOCKET BY-PASS	CRIMP SPLICE WITH PRIMARY WIRE, WIRE REPAIR SEGMENTS	20, 22, 24,16, 18 12, 14

NOTE: EMERGENCY REPAIRS MAY BE UPGRADED TO PERMANENT REPAIR UPON REMOVAL OF TEFLON TAPE AND HEAT SHRINKING THE SPLICE INSULATION WITH THE HT-9OOA HEAT GUN.

CHAPTER 10
FUEL SYSTEM

SECTION I. GENERAL

10-1. INTRODUCTION. This chapter provides methods for assessing battle-damage, deferring damage repair, and repairing fuel systems. The primary emphasis is on providing the assessor with the proper guidance to perform the assessment process. Simplified logic trees and related illustrations will also aid the assessor.

SECTION II. DAMAGE ASSESSMENT

10-2. DAMAGE ASSESSMENT PROCEDURE. Each fuel tank must be carefully evaluated and classified. Examine both confined areas and open areas exposed to the airstream. Determine which leaks require immediate repair before flight and which leaks are not a flight hazard. Determine the exact location of a leak and thoroughly examine the leak area. Refer to Figure 10-1 for assessment logic.

10-3. DEFERMENT. Scheduled maintenance may be deferred. Unscheduled maintenance such as the repair of systems and subsystems which 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 standards for repair and aircraft performance can be accepted. The commander may defer combat maintenance and battle damage repair, even if doing so places operational limitations on the aircraft.

SECTION III. BATTLE-DAMAGE REPAIR

10-4. FUEL TANKS. Battle-damage repair of fuel tanks is limited to those repairs specified in this manual.

1**0-5. FUEL SYSTEM SEALS**. Preformed packings removed during fuel system component maintenance may be reused if they are not damaged or swelled to a point where they do not fit snugly into the preformed paddngs groove. Swelled preformed packings may be reused if they are allowed to dry and shrink to the original size. Seals composed of rubber inserts may be reused if they are not damaged or if compression set is not more than 60 percent when compared with a new gasket.

CAUTION

Reused preformed packings and seals must be inspected after every flight for leakage until replaced.

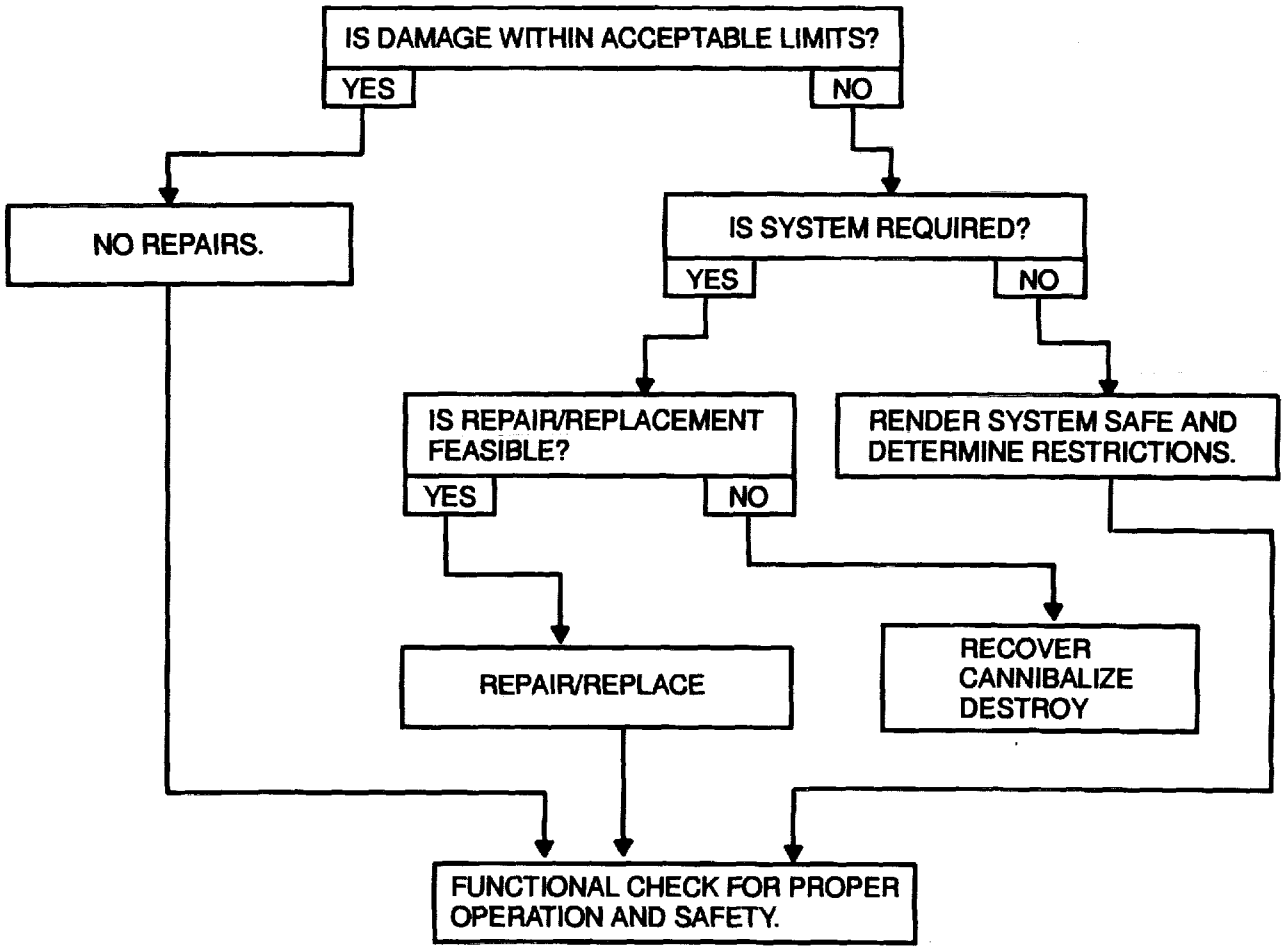


Figure 10-1. Fuel System Assessment Logic

10-6. FUEL LINES

a. Fuel Line Fabrication. Repair fuel lines by removing the damaged section. Then install replacement sections, fabricated from rubber hose. Rubber hose should be secured by hose damps and sealant (Figure 10-2).

WARNING

Adhesives and materials must be compatible with the system fluid.

b. Bead Repair. To improve the strength of the joint, and if an adequate size range of hoses are not available, fuel lines may be repaired. First, form a bead on the end of the tubing to be joined. Next, wrap safety wire around the tube and set it in adhesive or sealant This will help seal the repair (Figure 10-3). For repairs using dual damps, position damp securing screws 180 degrees opposite each other.

10-7. BEND DAMAGE. Repair fuel tubes with bends by removing the damaged bend and installing a new tubing section. Use rubber hose and sealant. Damage to lines with wire braid or bellows will be acceptable as long as the affected area does not leak under pressure (Figure 10-4).

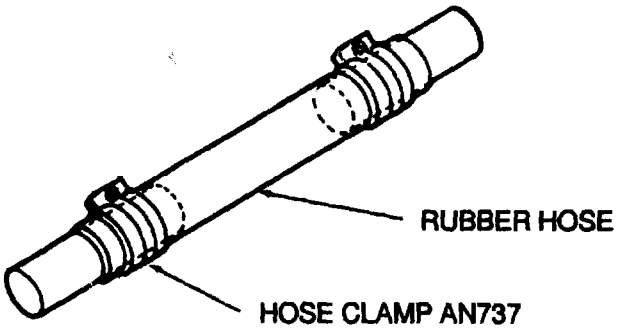


Figure 10-2. Single Clamp Fuel Tubing Repair

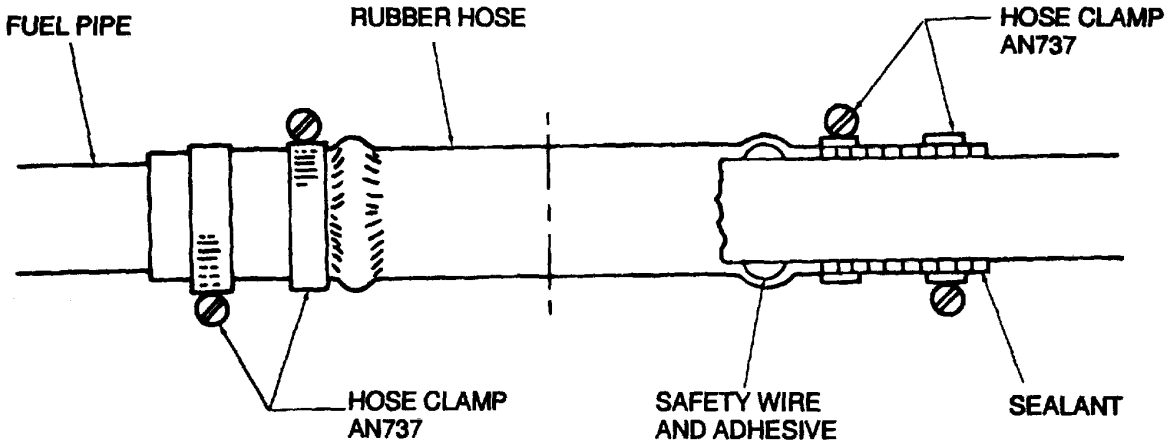


Figure 10-3. Dual Clamp Fuel Tubing Repair (One Time Flight)

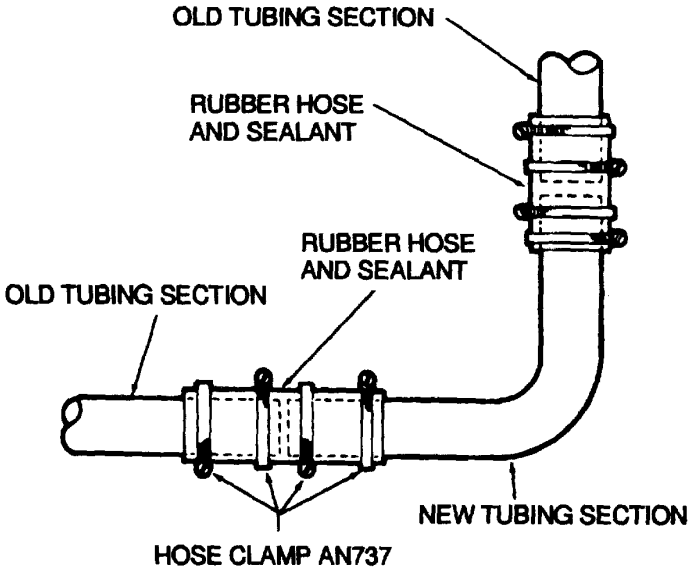


Figure 10-4. Fuel Tubing Elbow Repair (One Time Flight)

CHAPTER 11
FLIGHT CONTROLS SYSTEM

SECTION I. GENERAL

11-1. INTRODUCTION. This chapter provides methods for assessing battle damage, deferring damage, and repairing flight control systems. The primary emphasis is on providing the assessor with the proper guidance to perform the assessment process. Simplified logic trees and related illustrations will also aid the assessor.

SECTION II. DAMAGE ASSESSMENT

11-2. DAMAGE ASSESSMENT PROCEDURE. When combat damage is sustained, the pilot will be debriefed to determine the presence of any abnormal behavior in the flight control systems. This will aid in determining the extent of damage. All cables, tumbuckles, fair-leads, pulleys, bellcranks, and pushrods in the entire damaged area will be inspected and the damage evaluated before beginning repairs. See Figure 11-1 for assessment logic.

SECTION III. BATTLE-DAMAGE REPAIRS

11-3. DEFERMENT. Scheduled maintenance may be deferred. Unscheduled maintenance, such as the repair of systems and subsystems which are not critical to mission accomplishment, may be deferred if safety of flight is not significantly degraded.

11-4. CONTROL RODS. RefertoTM55-1520-240-23.

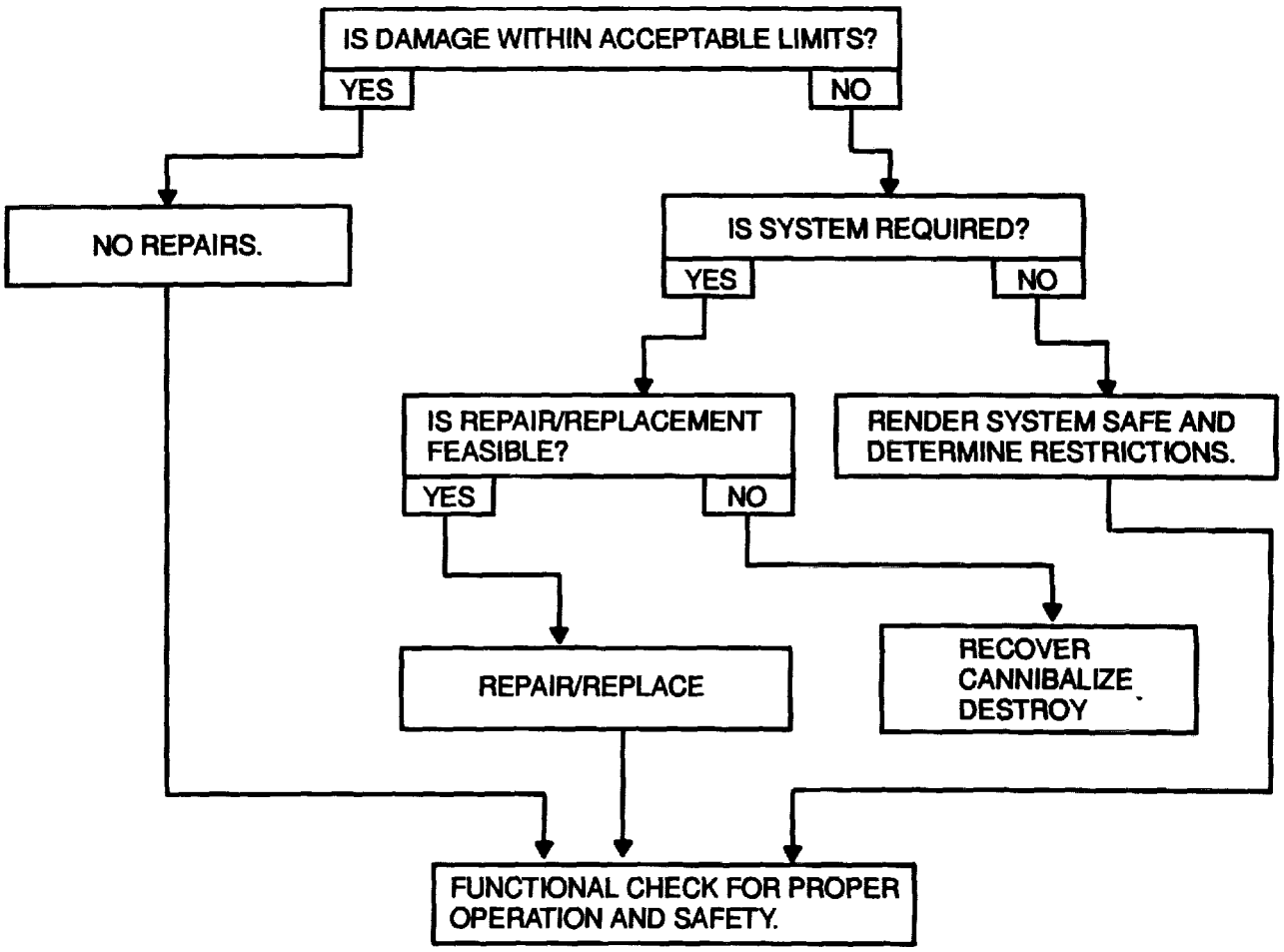


Figure 11-1. Flight Controls Assessment Logic

CHAPTER 12
AIRCRAFT AERIAL RECOVERY FOR CH-47D

SECTION I. GENERAL

NOTE

This chapter is recommended procedure for airlifting the damaged CH-47D.

12-1. HOISTING. The 414-100 Chinook can be hoisted using three methods. The three methods are illustrated in Figure 12-1.

a. Sheet 1 shows a spreader bar type of lift. This method puts little or no stress on the helicopter. The adapters thread into the forward and aft rotor shafts. Maximum gross weight is 33,000 pounds.

b. Sheet 2 shows a method using aircraft lifting sling 234G0002-1 secured on one end to adapters threaded into the forward and aft rotor shafts. It is important that the dimensions and angles shown be rigidly adhered to. Otherwise, structural damage can occur. Maximum gross weight is 33,000 pounds.

c. Sheet 3 shows a nylon sling having four legs. Two legs attach to built-in fittings at station 122.25. The other two legs attach to fittings at station 475.3. This method is limited to 23,900 pounds gross weight.

d. Ground Support Equipment.

(1) Spreader Bar Sling 234G0005-1.

(2) Nylon Sling 114G1013-1 (23,900 Ib capacity).

(3) Threaded Eye Lift Ring 11 4E5909-8 (2).

(4) Aircraft Lifting Sling 234G0002-1.

SECTION II. HOISTING PROCEDURES

12-2. HOISTING PROCEDURES. The following is a recommended procedure for airlifting the damaged CH-47D. The lifting sling will attach to the (4) airframe fittings located at stations 122.25 and 475.31 on the damaged aircraft and run to the forward and aft cargo hooks, respectively, on the lifting aircraft.

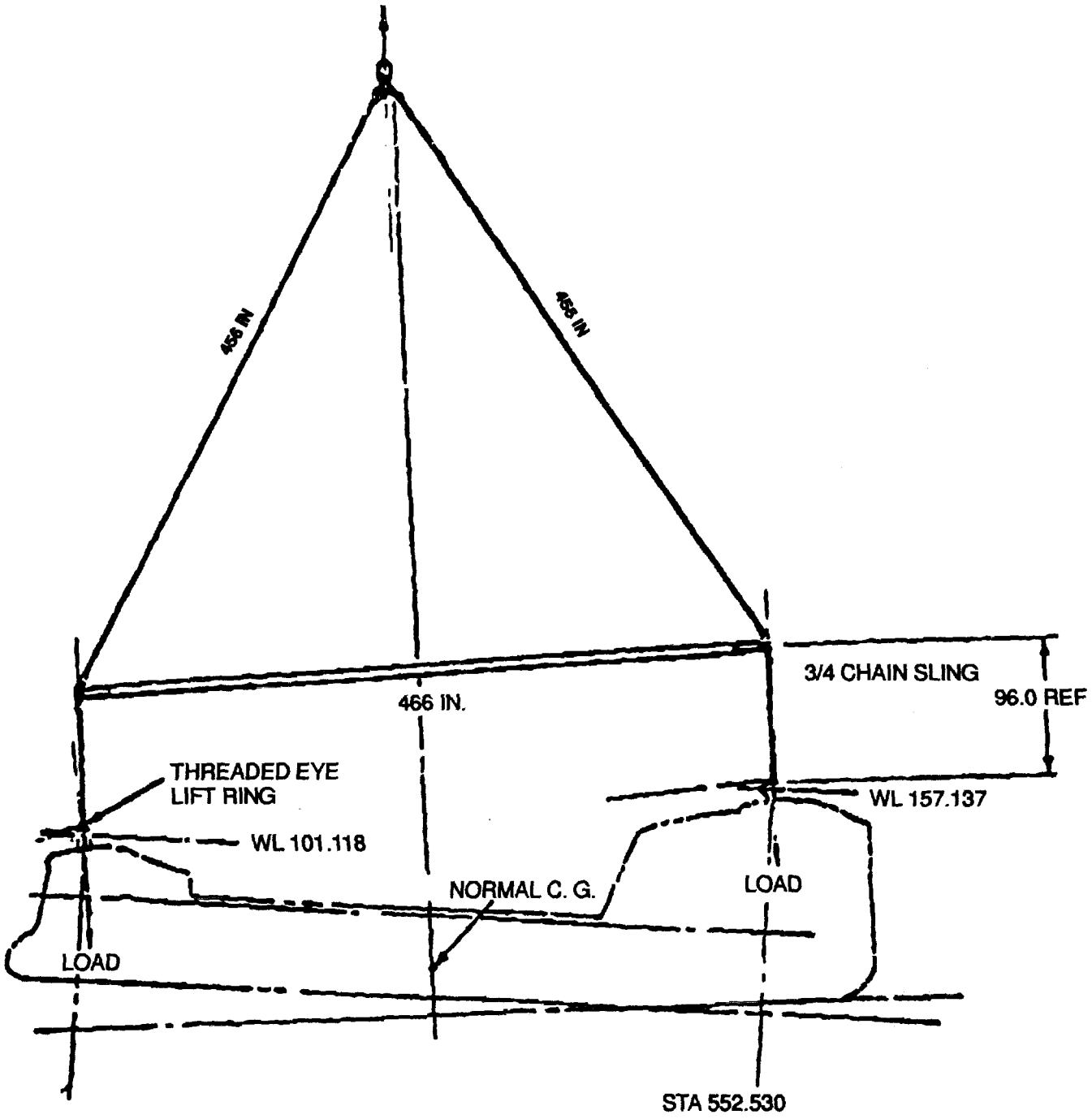
a. Preparation of Damaged Aircraft.

(1) Remove AFT pylon and AFT XMSN.

(2) Remove forward pylon fairing and forward XMSN.

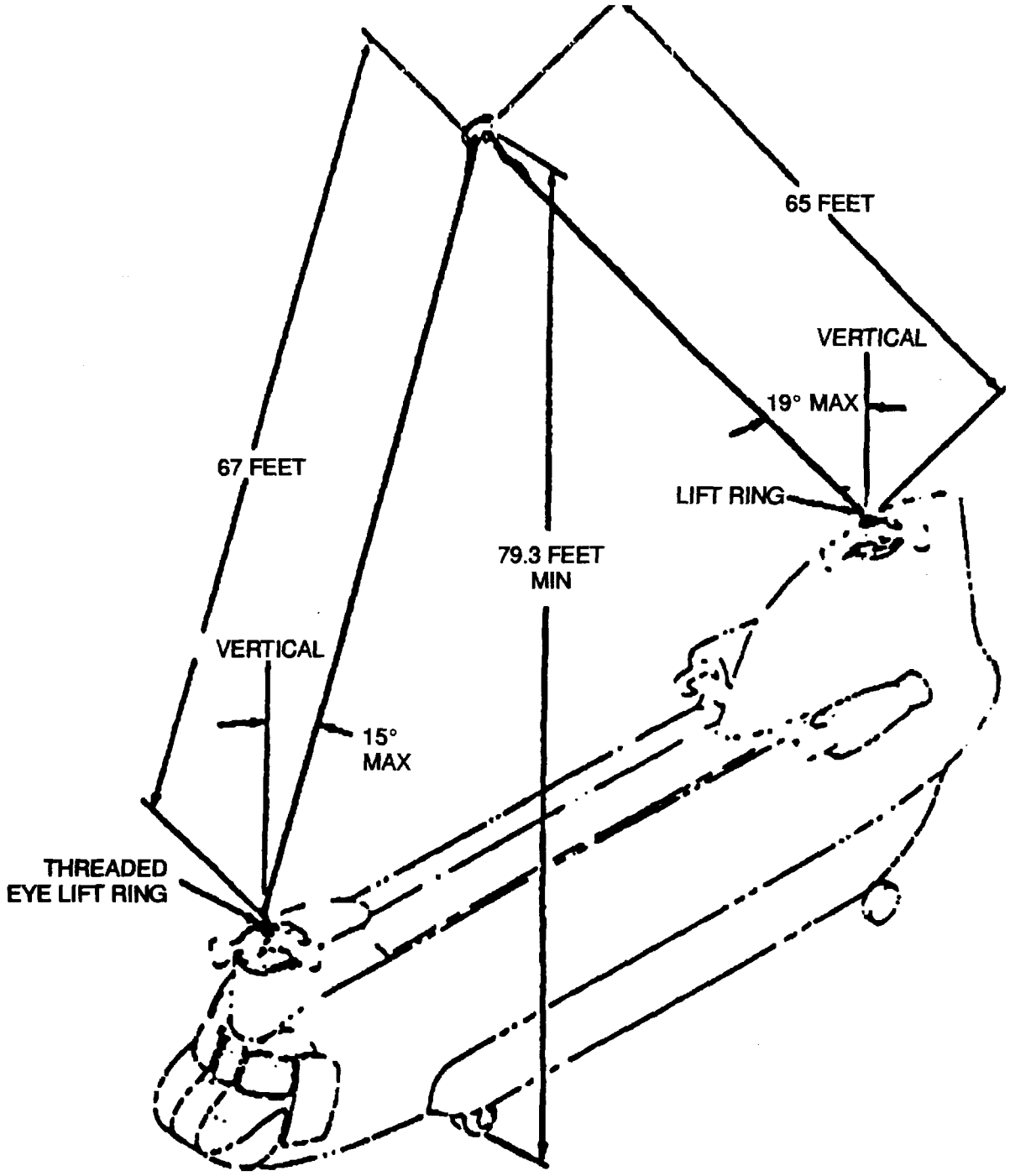
(3) Secure or remove forward work platforms, located on the left and right side of the forward pylon.

(4) Remove flight control rods to allow access to the airframe lifting attach points located at station 122.25.



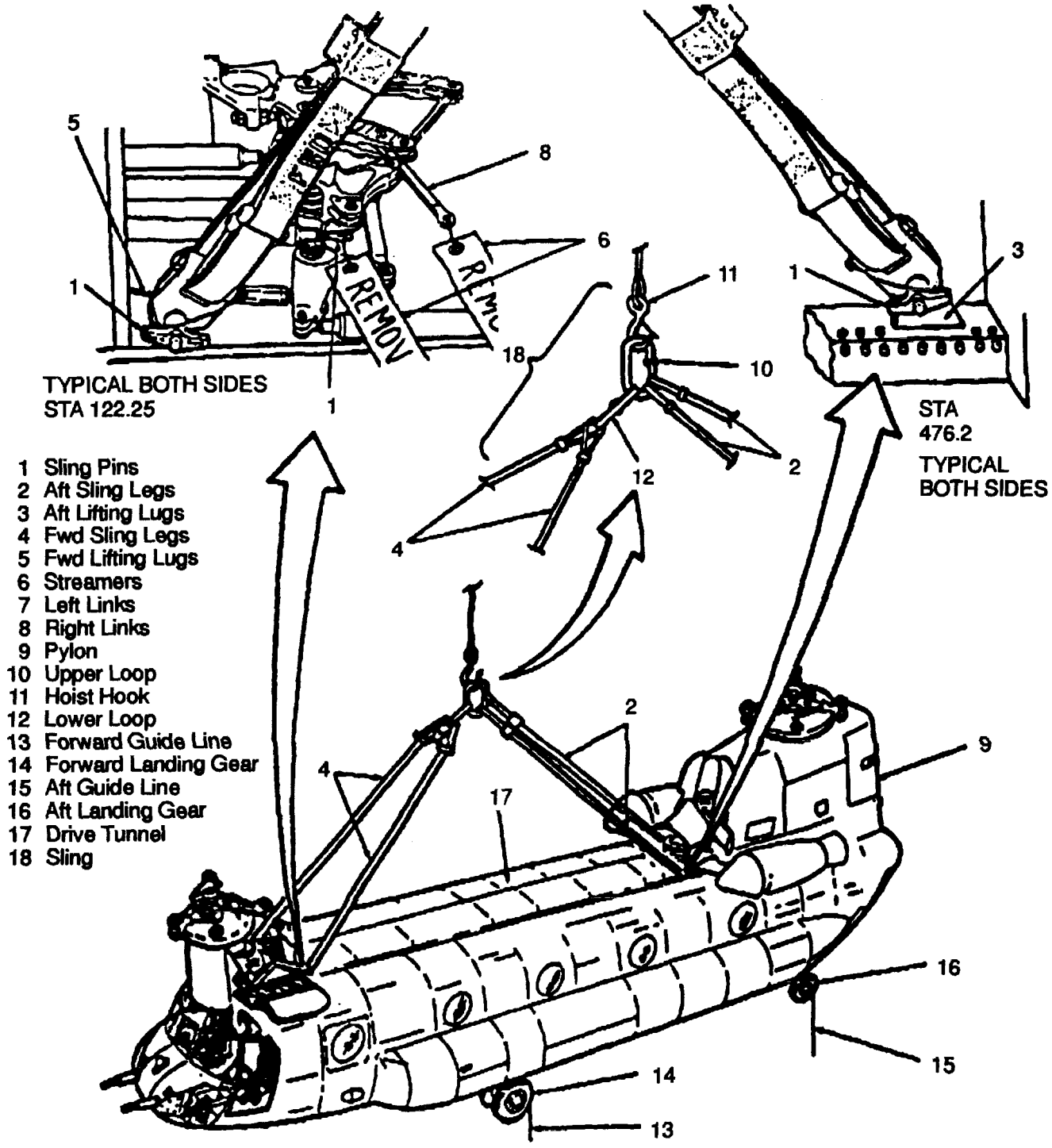
HOISTING USING SPREADER BAR SLING 234G0005-1
FOR HELICOPTERS WEIGHING UP TO 33,000 POUNDS

Figure 12-1. Hoisting (Sheet 1 of 3)



HOISTING USING AIRCRAFT LIFTING SLING 234G0002-1,
FOR HELICOPTERS WEIGHING UP TO 33,000 POUNDS

Figure 12-1. Hoisting (Sheet 2 of 3)



HOISTING USING NYLON SLING 114G1013-1 FOR
HELICOPTERS WEIGHING UP TO 23,000 POUNDS

Figure 12-1. Hoisting (Sheet 3 of 3)

b. Fabrication of Lifting Sling.

(1) Option (1). A (4) leg lifting sling can be fabricated to the dimensions shown using cable and shackles rated at 10,000 pounds. Refer to Figure 12-2.

(a) Remove the (2) small loops from the center of 114G1013-1 sling, so that the (4) legs are separated.

(b) Two legs of 114G1013-1 are 18 1/2 feet long (FWD LEGS), with two remaining legs being 16 1/2 feet long (AFT LEGS).

(2) FWD Sling. Attach a 30 foot length of cable (rated at 10,000) to each of the longer legs, making (2) separate slings. Refer to Figure 12-2.

(3) AFT Sling. Attach a 34 foot length of cable (rated at 10,000) to each of the shorter legs, making (2) separate slings. Refer to Figure 12-2.

(4) Option (2). The 114G1013-1 lifting sling can be modified for this application as follows:

WARNING

Maximum airspeed should not exceed 50 knots.

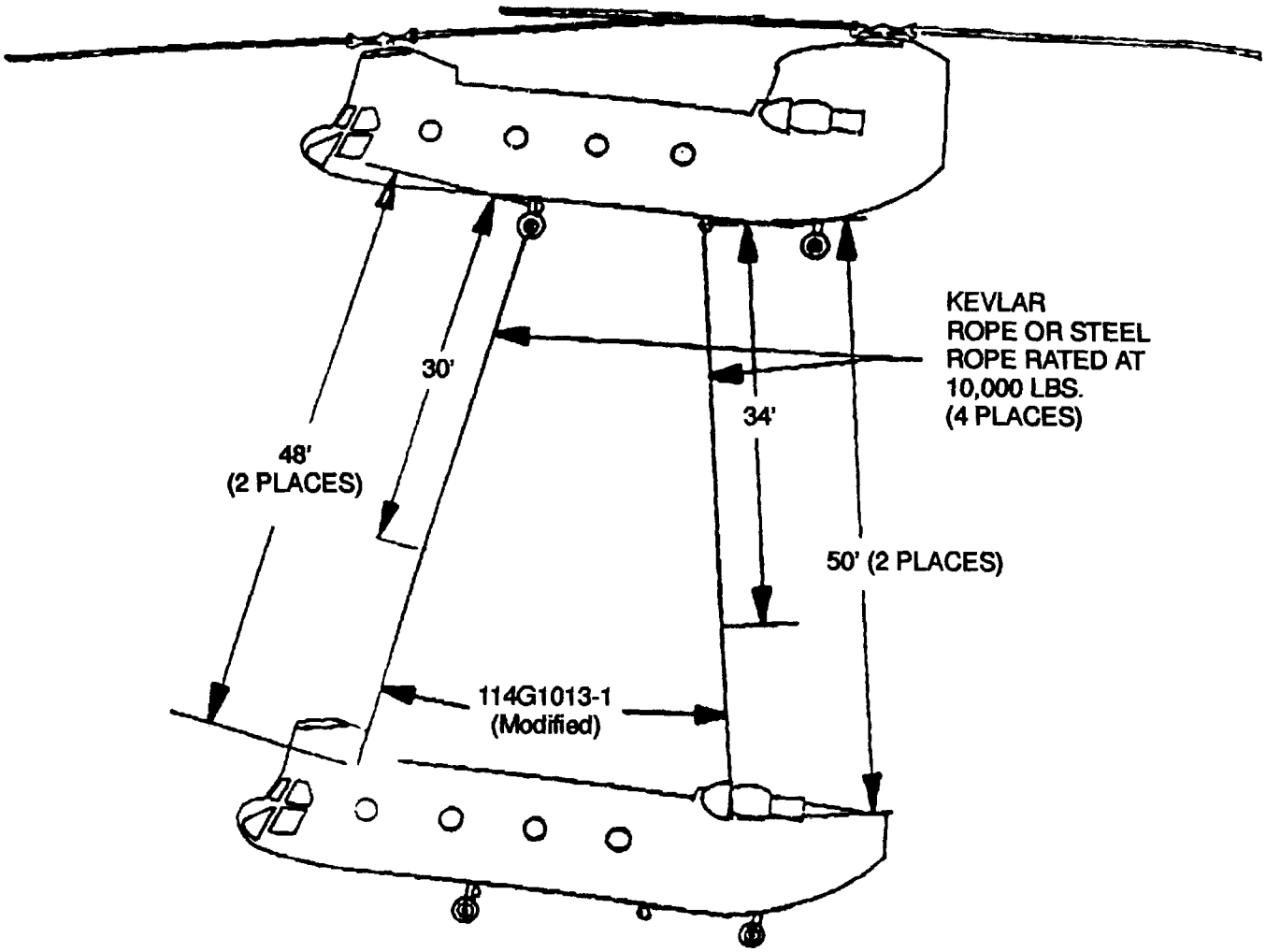


Figure 12-2. Dual Hook Lifting Configuration (Sheet 1 of 4)

Lifting CH-47D by Rotor Shafts
(Prepared By Airframe Design)

1. Basic sling configuration is established by the maximum angle that the sling may make relative to the aircraft vertical axis. These angles are 15 degrees at the forward rotor and 19 degrees at the aft rotor. Angles were established by stress engineering to limit horizontal loading induced into the fuselage during lifting operations.
2. To meet this requirement and using a single hook on the lifting aircraft the sling lengths would need to be:

   Forward rotor shaft - 822" (68'6")
   Aft rotor shaft - 780" (65')

   This configuration will result in the lifted aircraft hanging with a nose up angle of 3 degrees at hover.

3. If tandem hooks are used on the lifting aircraft, the sling lengths should be:

   Forward rotor shaft - 553" (46'1")
   Aft rotor shaft - 502" (41'1 0")

   This would result in the same 3 degree nose up attitude if the lifting aircraft hovers with 4.3 degree nose up attitude.

4. There is some merit to the use of a single hook configuration for this operation, since with the single hook the geometry of the slings relative to the aircraft does not change with aircraft attitude or with swinging of the slung aircraft. Dual hooks allow the aircraft/sling configuration to act as a four bar chain, with consequent changes in sling geometry with load displacement, or changes in attitude of the lift aircraft. The dual hook configuration can be made acceptable by increasing the length of the slings to ensure that the sling angles remain within limits during all normal load displacement. (Note: This additional length has been calculated and the minimum sling lengths should be 65 feet to the forward rotor and 63 feet to the aft rotor which will not exceed the critical angles at airspeeds up to 80 knots.)
5. Weight of an empty CH-47D with the rotor blades removed is approximately 21,319 lbs. with the dual hook configuration shown this results in calculated hook loads of 10,386 on the forward hook and 10,933 lbs. on the aft hook.

Figure 12-2. Dual Hook Lifting Configuration (Sheet 2 of 4)

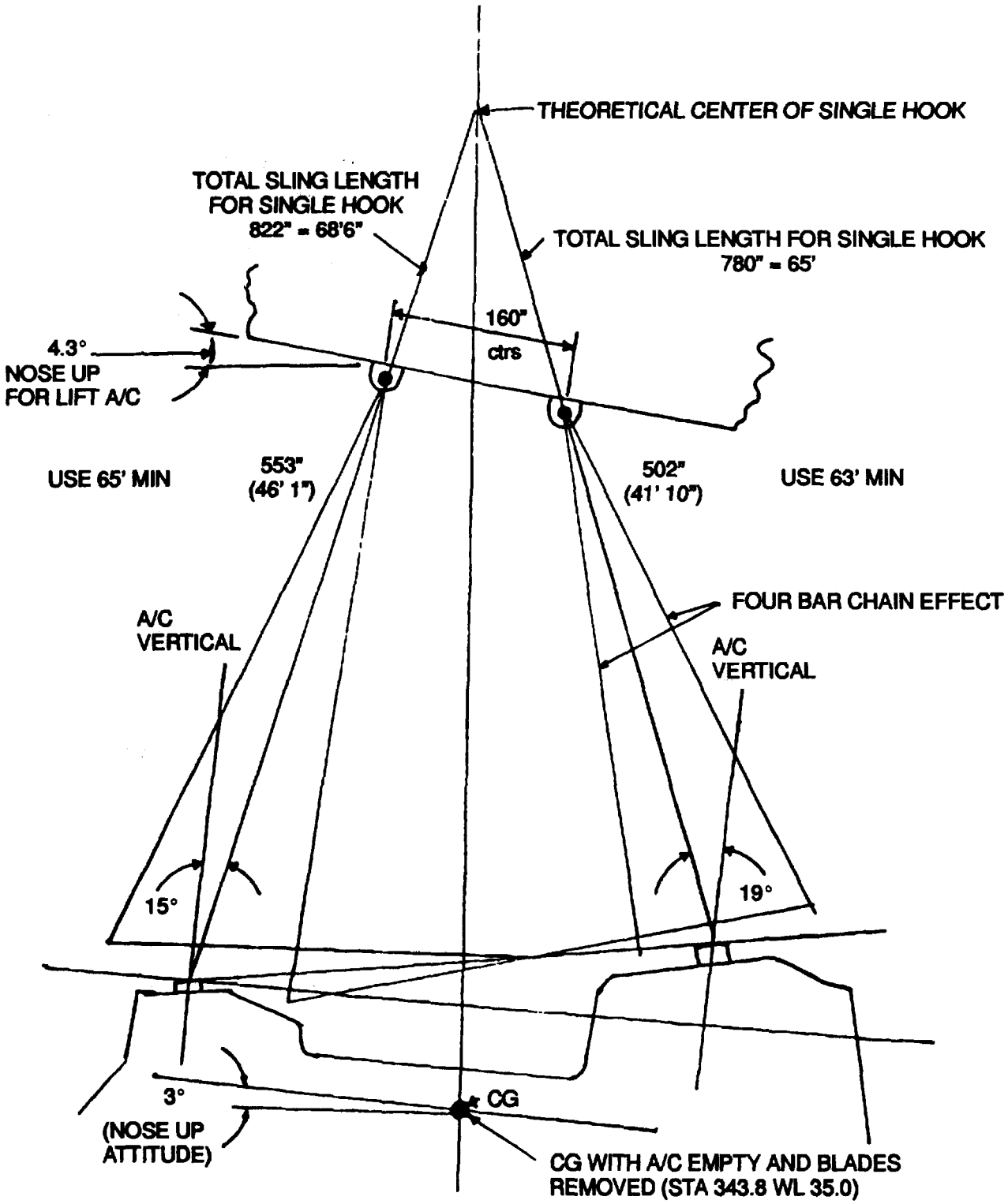


Figure 12-2. Dual Hook Lifting Configuration (Sheet 3 of 4)

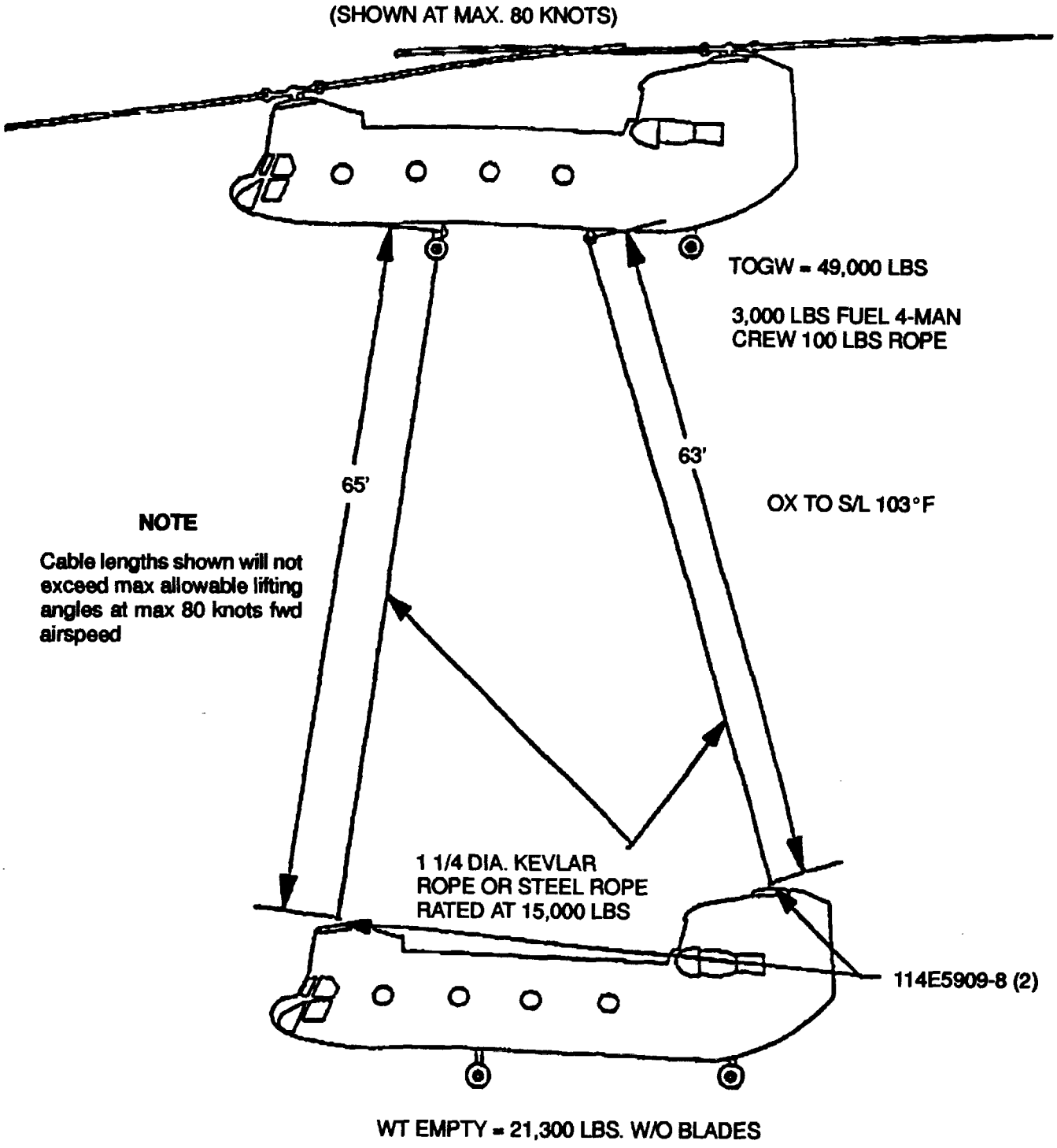


Figure 12-2. Dual Hook Lifting Configuration (Sheet 4 of 4)

APPENDIX A
REFERENCES

PUBLICATION NUMBER	TITLE
AR 710-2	Material Management for Using Unit, Support Units and Installations
AR 750-1	Army Materiel Maintenance Concepts and Policies
DA Form 2404	Equipment Inspection and Worksheet
DA Form 2408-13	Aircraft Inspection and Maintenance Record
DA Form 2408-18	Equipment Inspection List
DA Form 2408-15	Historical Record for Aircraft
DA Form No.	Debriefing Report
MIL-STD-12	Military Standard Abbreviations for Use on Drawings and in Specifications, Standards and Technical Documents.
TB 55-1500-307-24	Aircraft Components Requiring Maintenance Management and Historical Data
DA Pam 738-751	Functional Users manual for the Army Maintenance Management System Aviation (TAMMSA)
TM 1-1500-204-23	General Aircraft Maintenance Manual
TM 55-1520-240-23	Aviation Unit and Aviation Intermediate Maintenance Manual: CH-47D Helicopter

APPENDIX B
SPECIAL OR FABRICATED TOOLS

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 TOOLS LISTINGS

a. The items listed in this appendix will enhance crew members and mechanics at all levels to accomplish battlefield damage assessment and repairs.

b. Special tools, containers, and test equipment are listed below. Each tool or piece of test equipment has an item number assigned for ease of location and reference. When an item number is unknown, locate special tools and test equipment by the alphanumeric arrangement within the table. When an item is referenced in the manual, locate the item by its T designator and item number. T designators are used only with special tools and test equipment. The special tools and test equipment table is found only within this chapter: therefore, the table number is not referenced within the text. A complete listing of all special tools, containers, and test equipment authorized for use to perform maintenance on CH-47D helicopter/accessories is in the helicopter parts manuals.

SPECIAL TOOLS LIST FOR BATTLE-DAMAGE REPAIRS

ITEM NO.	PART NO.	NOMENCLATURE
1	145G003-1	Container, Aft Vertical Shaft
2	145GS279-1	Torque Applicator
3	114E5903-1	Sling Assembly, Engine Transmission
4	114E5128-3	Hoisting Unit
5	145G0035-1	Socket, Horizontal Hinge Pin, Locknut (End Cap)
6	114E5803-1	Pusher, Rotor Head
7	Model 247000	OHM Meter, Low Resistance (Biddle)
8	114E5809-1	Puller, Outboard Seal
9	114E5813-6	Puller, Bearing, Rotor Head
10	114E5814-7	Puller, Bearing and Seal, Rotor Hub
11	234G0096-1	Drift, Outboard Seal Installation
12	114E5824-4	Guide Set, Roller Bearing Seals, Rotor Hub
13	114E5840-1	Adapter, Rotor Head Assembly
14	114E5852-16	Sling, Rotor Head Controls
15	145E5871-1	Adapter, Forward Transmission
16	114E5872-35	Adapter, Powerplant
17	145E5874-1	Adapter, Aft Transmission
18	114E5878-60	Adapter, Vertical Shaft Assembly

SPECIAL TOOLS UST FOR BATTLE-DAMAGE REPAIRS - Continued

ITEM NO.	PART NO.	NOMENCLATURE
19	114GO020-1	Adapter, Rotary-Wing Set
20	114E5888-1	Adapter, Combining Transmission
21	114G1025-1	Heater Exhaust Cover
22	114E5897-11	Pin Set, Blade Folding Pitch Lock
23	PD1220	Torque Pack, Rotor Hub Retaining Nut
24	114E5909-8	Ring Assembly, Forward Transmission and Aft Vertical Shaft
25	114G0039-1	Tool Set (Easy-Out), Replacement, Tiedown Receiver
26	145G0037-1	Reaction Adapter
27	145G01 41-1	Socket, Hub Nut
28	114E5899-19	Lifting Device, Rotor Head Assembly
29	114E5900-17	Safety Blocks
30	145E5902-1	Hoisting Eye, Forward Transmission and Aft Shaft
31	145G1471-1	Guide, Lip Seal, Vertical Hinge Pin
32	145E5903-1	Sling Assembly, Combining Transmission
33	145E5911-101	Sling, Handling, Rotary-Wing Assembly
34	1 45G0024-1	Container, Combining Transmission
35	145G0023-1	Container, Aft Transmission
36	114E5918-8	Container, Engine Transmission
37	145E5941-11	Rigging Set, Controls
38	114E5060-1	Line Tiedown
39	11 4E5998-1	Rate Table, Aircraft Displacement (AN/ASM-120 equiv)
40	145G5002-1	Dummy Link Assembly (Dash Actuator), p/o 145E5941-11 (T39)
41	145G5004-1	Rigging Pin A, First Stage Mixing Linkage, p/o 145E5941-11 (T39)
42	145G5004-2	Rigging Pin B. First Stage Mixing Linkage, p/o 145E5941-11 (T39)
43	145G5004-3	Rigging Pin C, First Stage Mixing Linkage, p/o 145E5941-11 (T39)
44	PD1434	Reaction Adapter Set, Vertical Hinge Pin
45	PD1201	Torque Wrench
46	114E5119-2	Sling, p/o 114E5124-1 (T85)
47	145E5996-1	Securing Device, Aft Vertical Shaft
48	145G0009-1	AFCS Line Test Set
49	145G0008-1	AFCS Bench Test Set
50	145GS278-1	ILCA Bench Test Set
51	114E5855-2	Sling, Aft Pylon
52	114E5856-22	Skid, Aft Pylon
53	1730CH47-002	Outrigger, Aft Pylon Skid
54	145G0054-1	Test Manifold
55	114G1023-25	Rotary-Wing Head Covers Forward and Aft

SPECIAL TOOLS UST FOR BATTLE-DAMAGE REPAIRS - Continued

ITEM NO.	PART NO.	NOMENCLATURE
56	114G1024-1	Heater Inlet Cover
57	145G0004-1	Hydraulic Cooler Exhaust Cover
58	145G0005-1	Apu Exhaust Cover
59	114GS215-1	Spark Plug Thimble Gag
60	114GS216-1	Feeler Gage
61	114GS225-1	Spanner Wrench, Viscous Damper
62	114G0019-1	Accessory Kit, Track and Balance (VIBREX)
63	145G0001 -1	Oil Cooler Inlet Cover
64	145G0002-5	Oil Cooler Exhaust Cover
65	145G0002-6	Oil Cooler Exhaust Cover
66	114G0021-1	Replacement Fixture, Nickel Erosion Cap
67	114G0017-1	Protective Cap, Vertical Pin
68	114G1013-1	Sling Assembly, Aircraft Housing
69	114G1014-17	Rigging Tool, Lead-Lag Damper
70	114G1017-70	Shipping Container, Rotary-Wing Head
71	145G0022-1	Shipping Container, Forward Transmission
72	114G1034-46	Steering Bar, Aft Landing Gear
73	145G0003-1	Air Inlet Cover
74	114G1049-14	Attachment Fittings, Transport Tiedown
75	114G1102-11	Assembly Fixture, Pitch Link
76	114G1137-10	Puller, Vertical Pin, Rotor Head
77	114G1323-1	Engine Outlet Cover
78	11 4E5040-33	Pitot Tube Cover
79	114G1354-1	Adapter, Handling
80	114E5124-1	Hoist, Aft Transmission
81	114G0015-65	Container, Shipping and Storage, Rotor Blade
82	114G1185-1	Pusher, Horizontal Hinge Pin
83	BH22231	Heater Probe
84	1 45G0059-1	Bracket Locating Fixture
85	114G1038-86	Test Set, Hydraulic System
86	145G0140-1	Adapter, Socket, Forward Transmission Mounting Bolts
87	114G1200-1	Drift, Bearing, Aft Landing Gear
88	114G1203-1	Drift, Bearing, Aft Landing Gear
89	114G0018-6	Puller/Pusher Damper Bracket Bushing
90	114G1208-1	Test Set, Viscous Damper
91	BH112JB-53	Jetcal Analyzer, Temperature Tester
92	114G1236-1	Puller Assembly, Bearing, Pitch Housing

SPECIAL TOOLS UST FOR BATTLE-DAMAGE REPAIRS - Continued

ITEM NO.	PART NO.	NOMENCLATURE
93	145G0006-1	Protective Cover, Cockpit
94	BH22101	Test Harness, Engine PIT Indicator System and Power
95	114G1263-1	Swaging Tool, Pitch Link
96	114G1306-1	Setting Fixture, Blade Shock Absorber
97	114G1322-1	Container, Blade Lag Shock Absorber
98	114G1334-1	Staking Die, Shock Absorber Mount
99	114G1359-1	Staking Tool, Aft Engine Mount
100	114G1373-1	Fixture, Locating, Sliding Bearing, Rotor Head Controls
101	BH22223	Tempcal Probe, Temperature Transmitter Chip Detector
102	114G0188-1	Test Harness, Self-Tuning Dynamic Absorber
103	114G1410-1	Locating and Drill Fixture, Brackets, Sync Shaft
104	114G1411-1	Locating and Drill Fixture, Brackets, Sync Shaft
105	145G1414-1	Test Harness Set, N1 Actuator System
106	145G104-1	Repair Fixture, Rotor Blade Trailing Edge
107	145G0055-1	Test Block, Flight Control Power Control Module Accumulator
108	145G0056-1	Test Block Ptu Motor Shaft Seal
109	145G5310-1	Yaw Travel Quadrant, p/o 145E5941 -11 (T39)
110	145G5310-5	Roll Travel Quadrant, p/o 145E5941-11 (T39)
111	145G5310-8	Pitch Travel Quadrant, p/o 145E5941-11 (T39)
112	114E5941-4	Thrust Rig Pin, p/o 145E5941-11 (T39)
113	114E5941-21	Cockpit Rig Fixture, pro 145E5941-11 ('T39)
114	114E5941-26	Pointer Assembly, p/o 145E5941-11 (T39)
115	11 4E5941-57	Control Stick Yoke, p/o 145E5941-11 (T39)
116	114E5941-73	Pedal Pointer, pro 145E5941-11 (T39)
117	114E5941-74	Pedal Rig Pin, pro 145E5941-11 (T39)
118	114E5941-108	Transfer Bellcrank Rig Pin, p/o 145E5941-11 (T39)
119	145G5306-1	Dash Actuator Rigging Tool, p/o 145E5941-11 (T39)
120	219G1001-1	Engine Inlet Cover (Helicopter with Screens)
121	114G1206-1	Engine Inlet Cover (Helicopter without Screens)
122	114E5941-4	Pallet Rig Pin, p/o 114E5941-11 (T39)
123	LTCT14700	Sling, Engine
124	114E5985-9	Second Stage Rig Pin, p/o 114E5941-11 (T39)
125	D12102C01-1	Repair Kit, Hydraulic Tube, p/o D12102C-15-H10 (T181)
126	D12102C06-06	Repair Kit, Hydraulic Tube, p/o D12102C-15-H10 (T181)
127	D12102C09-04	Repair Kit, Hydraulic Tube, p/o D12102C-15-H10 (T181)
128	D1 2025-001	Power Supply, Hydraulic Tube Repair, p/o D1 2102C-15-H10 (T172)
129	KM13	Tool Kit, Rosan Adapter

SPECIAL TOOLS UST FOR BATTLE-DAMAGE REPAIRS - Continued

ITEM NO.	PART NO.	NOMENCLATURE
130	KM14	Tool Kit, Rosan Adapter
131	KM18	Tool Kit, Rosan Adapter
132	KM19	Tool Kit, Rosan Adapter
133	KM30	Tool Kit, Rosan Adapter
134	KM31	Tool Kit, Rosan Adapter
135	130-8500800	Bender Set, Hydraulic Tube
136	REA048D	Drive Tool, Clinch Nut, Aft Transmission
137	REA064D	Drive Tool, Clinch Nut, Aft Transmission
138	RF12LPDE	Removal Tool, Rosan Adapters
139	RF16LPDE	Removal Tool, Rosan Adapters
140	RF9812DW	Drive Tool, Rosan Adapters
141	RF9816DW	Drive Tool, Rosan Adapters
142	TD428L	Insertion Tool, Cargo Hook
143	TD1032L	Insertion Tool, Cargo Hook
144	TKNC06	Insertion Tool, Cargo Hook
145	34-151	Spanner Wrench - Spring Return Assembly Cargo Hook
146	2TE414P0200-8	Test Set, Fuel Vent Check
147	145G0051 -1	Torque Reactor, Fwd Transmission Mounting Bolts
148	145G0034-1	Torque Plate, Aft Transmission
149	PD1612	Tee Handle, p/o PD1220 (T23)
150	1323TF100-1	Test Fixture, Accumulator
151	11 4E5924-1	Sling, Handling, Aft Transmission (alternate, use with T3)
152	114E6058-23	Tackle Block
153	Aero 14C	Bomb Hoist, (NSN 1730-00-685-562:6
154	756460/756461	Seal and Window Retainer Installation Tool, (NSN 5120-00-366-5065), p/o KIT CS1154
155	756470/756476	Seal Filler Installation Tool, (NSN 5120-00-075-8307), pro KIT CS1154
156	114G1425-1	Roller Staking Kit
157	MMM8897	Spray Gun
158	145G1019-29	Trim Tab Fixture
159	D12102C-15-H10	Tool Set, Hydraulic Tube
160	130-850080	Tube Bending Set, Acro
161	234SK033-3	Tool Kit, Combining Transmission Support Fitting Replacement
162	PSD60-1 AF	Fuel Quantity Test Set
163	PSDAF-106	Fuel System Test Cable (use with T168)

TOOL KIT: D-100-MIL-2
PART NO.: D-100-MIL-2
NATIONAL STOCK NUMBER: 5180-01-201-4979
KIT CONTENTS:

ITEM	DESCRIPTION	PART NO.	NSN ASSIGNMENT
1	Blind Fastener Installation Tool Hand operated, hydraulic, 3,500 lbs. cap. Stress-proof steel nose, all black, 23 oz.	D-100-1	
2	1/8 Nose Piece for -4 dia. rivets, hole dia. to meet M7885/6-4 & 17-4 reqmts.	F159	
3	3/16 Nose Piece for -4 through -6 dia. rivets, hole dia. to meet M7885/6-6 & /7-6 reqmts.	F143	
4	1/4 Nose Piece for -8 dia. rivets, hole dia. to meet M7885/6-8 & 17-8 reqmts.	F142	
5	1/8 Nutplate Nose Piece for -3 and -4 dia. nutplate rivets	F156	
5-1	3/16 Nose Piece for -6 dia. Monobolts	F168	
5-2	1/4 Nose Piece for -8 dia. Monobolts	F169	
5-3	1/4 Nose Piece for -8 dia. T" Rivets	F155	
6	6-32 Pull-up Stud for threaded fasteners	F360	
7	#6 Driving Anvil	F367	
8	8-32 Pull-up Stud for threaded fasteners	F361	
9	#8 Driving Anvil	F364	
10	10-32 Pull-up Stud for threaded fasteners	F362	
11	#10 Driving Anvil	F365	
12	1/4-28 Pull-up Stud for threaded fasteners	F363	
13	1/4" Driving Anvil	F366	
14	10-24 Pull-up Stud for threaded fasteners	F372	
15	#10 TSN Driving Anvil for TSN fasteners	F176	
16	1/4-20 Pull-up Stud for threaded fasteners	F373	
17	1/4" TSN Driving Anvil for TSN fasteners	Fl 77	
18	5/16-18 Pull-up Stud for thread fasteners	F374	
19	5/16" Driving Anvil	F378	
20	3/8-16 Pull-up Stud for threaded fasteners	F375	
21	3/8" Driving Anvil	F379	
22	Master Shaft	F170-A	
23	Turn Nut	F171	
24	Adaptor Sleeve for pulling head use	F187-1A	
25	Adaptor Puller Shaft for pulling head use	F187-2A	
26	Straight Extension Pulling Head*	F1074	5130-01-104-5370
27	Right Angle Pulling Head*	F1075	5130-01-045-3507
28	Offset Pulling Head*	F1076	5130-01-044-7196
29	D-100-MIL-2 Weather-tight Metal Case	F602	

*Pulling Heads: hole diameter meets M7885/6-6 & M7885/76 requirements

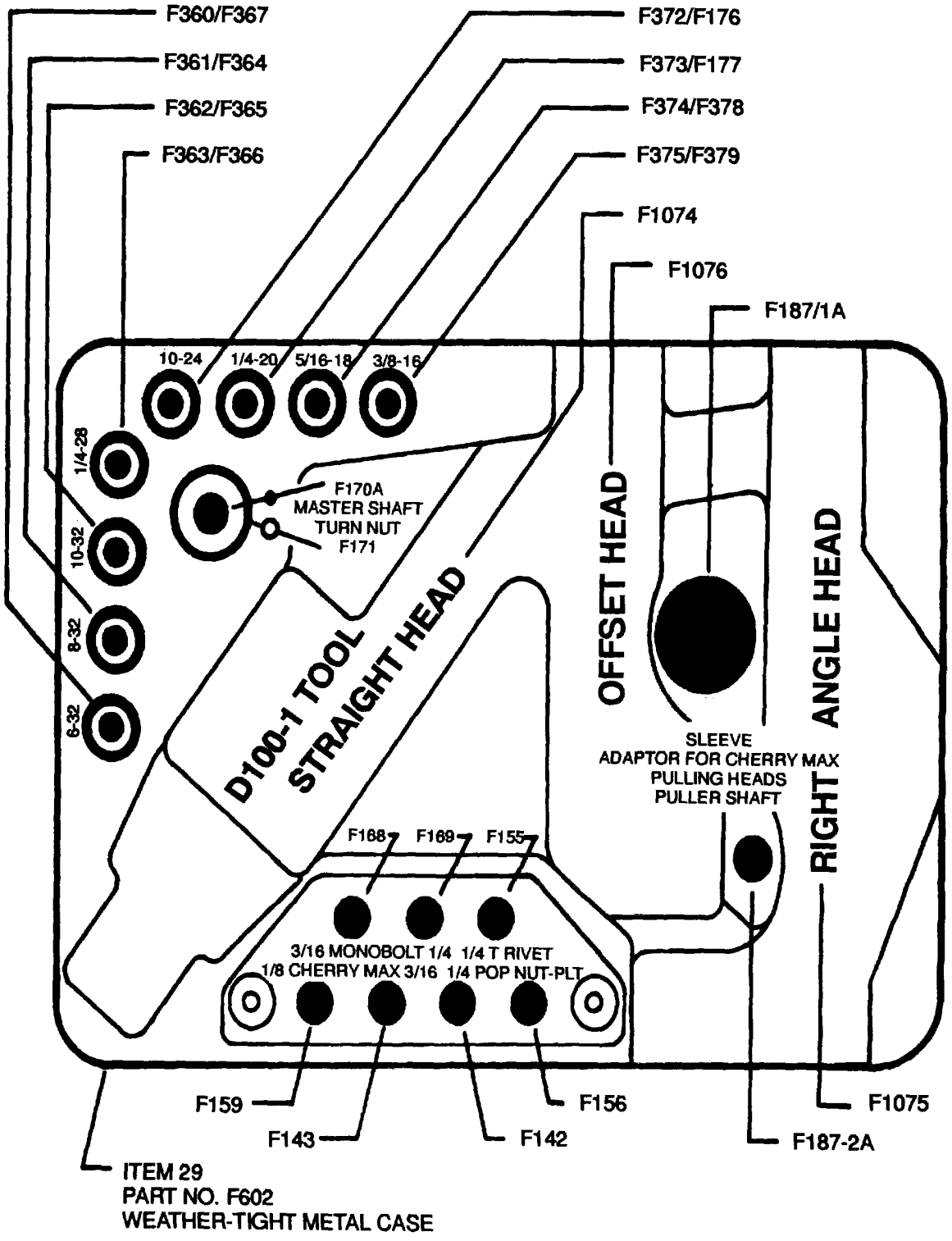


Figure B-1. Blind Fastener Installation

APPENDIX C
EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

SECTION I. INTRODUCTION

C-1. SCOPE. This appendix lists expendable supplies and materials needed to make BDAR fixes on the CH-47D helicopter. Items are listed alphabetically by the item name shown in the description column. These items are authorized to you by CTA50-970, Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items) or CTA 8-100.

C-2. EXPLANATION OF COLUMNS ,

a. Item Number. 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.

SECTION II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS

EXPENDABLE/DURABLE SUPPLES AND MATERIALS LIST

ITEM NUMBER	NATIONAL STOCK NUMBER	DESCRIPTION	U/I
1	7910-00-753-5242	Abrasive pad, Scotch Brite type A.	
2	5350-00-619-9168	Abrasive paper silicone carbide, 60grit.	SH
3	5350-00-619-9167	Abrasive paper silicone carbide, 80grit.	SH
4	5350-00-721-8115	Abrasive paper silicone carbide, 120-grit.	SH
5	5350-00-721-8117	Abrasive paper silicone carbide, 180grit.	SH
6	5350-00-224-7207	Abrasive paper silicone carbide, 240grit	SH
7	5350-00-224-7205	Abrasive paper silicone carbide, 280grit.	SH
8	5350-00-192-5080	Abrasive paper silicone carbide, 320grit	SH
9	5350-00-224-7202	Abrasive paper silicone carbide, 360grit	SH
10	5350-00-224-7201	Abrasive paper silicone carbide, 400grit.	SH
11		Abrasive paper silicone carbide, 420grit	SH
12	5350-00-224-7216	Abrasive paper silicone carbide, 500-grit	SH
13	5350-00-224-7215	Abrasive paper silicone carbide, 600grit.	SH
14		Accelerator, 611 for 610 filter resin; Palmer Products Co. (or equiv).	EA
15	6810-00-184-4796	Acetone, technical	QT
16	8040-00-028-7098	Activator, Scotchcal bracd A-2	KT

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST (Continued)

ITEM NUMBER	NATIONAL STOCK NUMBER	DESCRIPTION	U/I
17		Adhesive, consisting of. Component A, Epon 828; Component B Epon 812, Shell Chemical Co. (or equiv); Component C, Versamid 115; and Component D, Versamid 125, General Mills In. (or equiv)	
18	8040-00-104-5292	Adhesive, component AB, Hysol 4405; and Component CD, Hysol 3538.	KT
19		Adhesive, consisting of: Component AB, J11 70-1; and Component CD, E-18-1; Armstrong Cork Co. (or equiv).	KT
20		Adhesive consisting of: Component AV, Sa Co 2862 (Component 1); and Component CD, Sa Co 2862 (Component 2); Sherwooand Co., Inc.(or equiv).	KT
21		Adhesive consisting of: Component AB, X,S-i7325A; and Component CD, XS-1173625B; Minnesota Mining and Mfg. Co. (or equiv).	KT
22		Adhesive consisting of: Component AB, 183C-417; and Component CD 183-C-418; W.P. Fuller Paint Co. (or equiv).	KT
23		Adhesive consisting of: Component AB, 522; and Component CD 542; Technical Research Co. (or equiv).	KT
24		Adhesive consisting of: 190-H-1 Resin and 191-B-10 Catalyst, W.P. Fuller and Co. (or equiv)	
25		Adhesive consisting of: 190-H-1 Resin and 191-C-21 Catalyst, W.P Fuller and Co. (or equiv)	
26		Adhesive, EC1239B-1/2 and EC1239B-4, Minnesota Mining and Mfg. Co. (or equiv)	
27	8040-00-145-0530	Adhesive, EC-2216, parts A and B, Minnesota Mining and Materials Mfg., Co (or equiv),	KT
28	8040-00-200-4390	Adhesive, EPON VI.	PT
29	8040-00-531-8030	Adhesive, EPON VIII.	PT
30	8030-00-086-1506	Adhesive, EPON 828, GRA Class 3	PT
31	8040-00-086-1506	Adhesive, EPON 901, Shell Chemical Co. (or equiv)	PT
32	8040-00-936-4672	Adhesive kit C319RTV, consisting of adhesive and catalyst A-4000.	KT
33		Adhesive, Pro Seal 719B-1/2, 719B-2 and 719-B4, Coast Pro Seal and Mfg. Co. (or equiv)	
34		Adhesive, Pro Seal 501, Coast Pro Seal and Mfg. Co. (or equiv)	
35		Adhesive, PR1710, Products Research Co. (or equiv)	
36		Adhesive, PR9021B-2 and PR9021-B-4, Products Research Co. (or equiv)	
37		Adhesive, Q-2-0046; Dow Coming Corp. (or equiv).	KT
38		Adhesive, Tereco No. 68, Technical Research Co. (or equiv)	

EXPENDABLE/DURABLE SUPPUES AND MATERIALS LIST (Continued)

ITEM NUMBER	NATIONAL STOCK NUMBER	DESCRIPTION	U/I
39	8040-00-828-4936	Adhesive, Uralane 5716, Parts A and B. Furane Plastics (or equiv.)	KT
40	8040--828-4936	Adhesive, Uralane 8089, Parts A and B.	KT
41		Adhesive, Velcro No. 40 (or equiv).	PT
42		Adhesive, 92-018; Dow Coming Corp. (or equiv).	PT
43		Antichafing Tape	
44	8135-00-753-4661	Barrier material, grade A	SH
45		Catalyst B1, for EOIB 901, Shell Chemical Co. (or equiv)	
46		Catalyst B3, for EOIB 901, Shell Chemical Co. (or equiv)	
47	8040-00-291-0162	Catalyst, Lupersol DDM	PT
48	8040-00-266-0215	Catalyst, PS-18, component B.	PT
49	8040-00-526-1910	Catalyst, PS-18, component A.	PT
50		Cement, EC-1128, Minnesota Mining and Mfg. Co. (or equiv)	
51		Cement, M6249, U.S. Rubber Co (or equiv)	
52		Cement, Pro Seal 590M, Coast Pro Seal and Mfg. Co. (or equiv)	
53	8040-00-526-1910	Cement Resin, PS-18, Component A	
54	8030-00-811-3723	Chemical Films, and Chemical Film Materials for Aluminum and Aluminum Alloys	
55		Cloth, Abrasive, Aluminum Oxide, Grade 600 to 800	
56	8305-00-753-2967	Cloth, Cleaning	
57	8305-00-191-3977	Cloth, cotton, airplane	
58	5350-00-221-0872	Cloth Crocus	
59	5350-00-865-5688	Cloth, emery, No. 120 grit.	SH
60	5350-00-854-6968	Cloth, emery, No. 180 grit.	SH
61	5351-00-174-1000	Cloth, emery, No. 220 grit.	SH
62	5350-00-174-0997	Cloth, emery, No. 520 grit.	SH
63	5350-00-174-0985	Cloth, emery, No. 600 grit	SH
64	8305-00-530-0109	Cloth, glass, No. 150 and 180.	SH
65	8305-00-530-0109	Cloth, glass, style 181.	SH
66		Cloth, Glass, Style 181-75	
67		Coating, corrosion-resistant	
68	1560-00-305-7912	Composite Repair Kit.	SH
69	6850-01-597-1528	Compound, alkaline descaling.	KT
70	8030-00-201-0996	Compound, antisieze thread, white lead base. TT-S-1 732.	PT
71	6850-00-935-0985	Compound, cleaner-polish.	QT
72	6850-00-935-0995	Compound, cleaning, aircraft surface.	DR

EXPENDABLE/DURABLE SUPPUES AND MATERIALS LIST (Continued)

ITEM NUMBER	NATIONAL STOCK NUMBER	DESCRIPTION	U/I
73	8030-00-244-1297	Compound, corrosion-preventive, solvent cutback cold application type I, II, and III, exterior surface.	EA
74	5680-00-926-4640	Core material, aluminum, 3.4-1/4-15N-3003.	SH
75	5680-00-926-4637	Core material, aluminum, 6.5-318-50N-3003.	SH
76	5680-01-122-8726	Core, honeycomb, Nomex, 1/8-inch cell gr. 3.0, full depth, 36 inches long.	SH
77	5680-01-084-3900	Core, honeycomb, Nomex, 1/8-inch cell gr. 2.0, full depth, 36 inches long.	SH
78	5680-01-303-4041	Core, honeycomb, Nomex, HRH-10-3/16-4.0, Hexcel Corp. (or equiv)	SH
79	5680-01-303-4042	Core, honeycomb, Nomex, HRH-10/0X-3116-4.0.	SH
80	6810-00-201-4000	Cotton, Grade B	
81	6810-00-995-4840	Curing agent, DTA.	PT
82		Enamel, Camouflage, Quick Drying	
83	8040-00-213-4798	Epoxy, EA 9309.3.	PT
84	8010-00-082-2450	Epoxy primer.	PT
85	1560-00-169-9222	Fiberglass Repair Kit.	KT
86		Filler, anti-oxidizing, rubber, No. 33197-R, Inland Mfg. Div., General Motors Corps (or equiv)	
87	8010-00-060-3253	Filler, Cabo-Sil, Godfrey L. Cabot Inc (or equiv)	PT
88	8030-00-149-0137	Filler, Corfil 615, Bloomingdale Rubber Co. (or equiv)	PT
89	8040-00-016-8662	Filler, EA934B/A, Hysol Div., Deter Co.	PT
90	9330-01-006-5310	Foam, G-506, Napco Chemical Co. (or equiv)	SH
91	9330-01-008-7428	Foam, Polyurethane, Sheet, Density V-2, Strux Div of Aircraft	
92	6510-00-598-7245	Gauze	
93	6810-00-855-6160	Isoprophyl Alcohol, Commercial Grade	
94		Kant Fray, Aero Leather Products Co (or equiv)	
95	8010-00-527-2483	Lacquer, green, color No. 14187	
96	8010-01-053-2650	Lacquer, Glossy, Orange-Yellow, Color No. 13538	
97		Lacquer, Lusterless, Black, Color No. X37038	
98	8010-00-082-2479	Lacquer, Lusterless, Olive-Drab, Color No. X34087	
99	6850-00-656-1292	Metal conditioner and rust remover, (phosphoric acid base).	GL
100	6810-00-174-5190	Methanol (Methyl Alcohol)	
101	6810-00-281-2785	Methyl-ethyl-ketone.	PT
102	6810-00-238-8117	Naphta, aliphatic, Type II	PT
103	6810-00-223-9067	Naphta, aromatic.	PT
104	6850-00-664-7530	Oakite No. 24, 36, 61, and M-3 Oakite Products, inc.	

EXPENDABLE/DURABLE SUPPUES AND MATERIALS LIST (Continued)

ITEM NUMBER	NATIONAL STOCK NUMBER	DESCRIPTION	U/I
105	8010-00-866-6810	Paint, non-skid, Epolux 100E6AS (or equiv)	GL
106	8135-00-292-2345	Paper Tag	
107	9330-00-585-8678	Phenolic sheet, laminated, type FBM.	SH
108		Plastic, Nylon, Flexible, Molded or Extruded	
109		Polcarbonate sheet, L-P-393; Lexan General Electric Co. (or equiv) or Merlon, Mobay Chemical Co. (or equiv) 0.040 and 0.050-inch thick.	SH
110		Polyamide, Nylon, Plastic, Rigid, Rod and Flats	
111	8040-01-936-4672	Primer, A-4014, for A-4000 adhesive.	PT
112	8010-00-064-0018	Primer coating, vinyl-zinc chromate.	PT
113	8010-00-297-0593	Primer Coating, zinc-chromate.	PT
114	8010-00-526-2523	Primer, fast drying.	PT
115	8040-00-104-8225	Primer H, for Uralane 5716 or 8089 (or equiv)	PT
116		Primer J. for Uralane 5716 or 8089 (or equiv).	PT
117		Primer, PR1711, Product Research Corp. (or equiv)	
118		Primer, RTV1200, for 92-018 and Q-2-0046 adhesive; Dow Corning Corp. (or equiv).	PT
119	8030-00-015-6104	Primer, wash.	PT
120		Primer, 90-198; Dow Coming Corp. (or equiv).	PT
121	8040-00-270-8148	Promoter, PS-18. Component C	PT
122	8030-00-086-1506	Resin compound, 611, Palmer Products Co. Inc. (or equiv)	PT
123	8030-00-949-6707	Resin, Paraplex P-43, (or equiv)	PT
124	9320-00-618-3180	Rubber, Cellular, Chemically-Brown, Type II, Medium, Grade A	
125	9535-00-416-8553	Screen, 0.040 inch perforated grill, diamond pattern, 0.5-inch wide x 0.75-inch long, Dramond Mfg., Co. (or equiv)	SH
126	8305-00-443-5601	Scrim Cloth HS-32, Hess and Goldsmith (or equiv)	
127	8030-00-723-2746	Sealing compound, EC-1675 classes, B-2, C-24, C-48, and C-80.	PT
128	8030-00-721-8929	Sealing compound, EC-801 MIL-S-7502.	PT
129	8030-01-058-9968	Sealing compound, PR9021 A-1, A-2 and A-4.	OZ
130	8030-00-723-5345	Sealing compound, ProSeal 700, Hexcel Corp, (or equiv)	
131		Sealing compound, ProSeal 719A-2, Hexcel Corps (or equiv)	
132	8030-00-685-0915	Sealing compound, Pro-Seal 890 B-1, B-2, C-24, C-48 and C-80, Hexcel Corp. (or equiv)	TB
133	8030-00-104-9321	Sealing compound, Pro Seal 896. (or equiv)	PT
134	8030-00-181-8372	Sealing compound, retaining, single component, anacrobic.	PT
135	8135-00-582-5170	Sheet, Cellophane, Commercial Grade	

EXPENDABLE/DURABLE SUPPUES AND MATERIALS LIST (Continued)

ITEM NUMBER	NATIONAL STOCK NUMBER	DESCRIPTION	U/I
136	9535-00-529-8910	Sheet magnesium, AZ31 B-H24, 0.100 inch thick.	SH
137	9535-00-529-8910	Sheet magnesium, QQ-M-44, 0.100 inch thick	SH
138	9320-01-157-9096	Sheet, Silicone Rubber.	SH
139	9320-00-949-8363	Sheet, teflon.	SH
140	8520-00-228-0598	Soap, toilet, White, Floating	
141	6850-01-067-6670	Solution, zinc-cleaning, Dalic Sifco Metachemical Inc. (or equiv)	QT
142	6850-01-066-5614	Solution, zinc-plating.	QT
143	6850-00-264-9037	Solvent, dry cleaning, type I.	DR
144	6850-00-285-8011	Solvent, dry cleaning, type II.	DR
145	7510-00-266-6707	Tape, masking.	YD
146	7510-00-105-3092	Tape, Mylar.	YD
147		Tape, No. 428, type A, Minnesota Mining and Mfg. Co. (or equiv)	YD
148	7500-00-720-7516	Tape, pressure-sensitive adhesive, aluminum-backed	
149	7510-00-074-5124	Tape, pressure-sensitive adhesive, Waterproof type IV	YD
150	9330-01-101-7505	Tape, Scotchal 455, antichafing.	YD
151	5970-00-181-0306	Tape, Teflon glass, Warren Ware Co. (or equiv)	YD
152		Tedlarfilm-100 GB30TR-EI DePont De Nemours (or equiv)	
153	8310-00-227-1244	Thread, nylon, type II, size B, class II, gray.	RL
154	6515-00-753-4533	Tongue Depressor (wood spatula)	
155	6810-00-184-4800	Trichloroethylene, technical.	QT
156	5610-00-857-4393	Walkway material, type 11 (rough) black color No. 37038.	GL
157	8040-00-213-4393	Walkway material, type II (rough) black, color No. 37038, MIL-D-23003.	GL
158	5350-00-240-2920	Wool, Steel, Fine, Commercial Grade	

GLOSSARY

SECTION I. TERMS AND DEFINITIONS

This appendix contains terms and definitions used in the task of airframe battle-damage assessment and repair.

Airframe Section - A major part of the airframe such as the cockpit, cabin or tailcone.

Airframe Zone - An area or section of the airframe defined for the purpose of assessing battle damage.

Area Loss - The fractional planform area of a structural member removed by ballistic damage.

Assessment Rule - A specific criterion used to assess a particular damage condition.

Assessor - A trained maintenance technician whose function it is to assess aircraft battle damage.

Axial - Pertaining to the line about which a rotating body turns.

Axial Load - Force or stress along the line about which a rotating body turns.

Battle -Damaged Assessment - The process used to determine if repair of a battle-damaged aircraft or system can be safely deferred either for a one-time evacuation flight of the aircraft or to return the aircraft to service for a limited number of flight-hours. The three major tasks of battle-damage assessment are damage inspection, damage evaluation, and repair deferability assessment.

Bay Group - Two or more adjacent bays in either direction.

Cap - Flat Strip attached along top or bottom edge of spar, or around rib.

Category I Structure - Primary framing members such as frames, beams, bulkheads and longerons.

Category II Structure - Primary skins and stringers.

Category III Structure - Fixed secondary structures such as formers, intercostals, and channels.

Category IV Structure - Removable secondary structures such as fairings, cowlings, doors and panels.

Channels - Structural member of channel form (eg top hat, or U).

Compression - The act of pressing together.

Cowlings - A streamlined housing for aircraft components.

Damage, Battle - Damage caused by ballistic projectiles, explosions, and fire.

Damage, Primary - Damage caused directly by the ballistic projectiles, explosions, or fire associated with an attack.

Damage, Secondary - Damage to structural members not directly exposed to the attack caused by flying the aircraft with battle-damaged members failed or missing.

Damage Cleanup - The process of removing and/or smoothing damaged material.

Damage Diagram - A sketch of a portion of the airframe used to define the location of damaged members.

Damage Evaluation - The process used to determine whether a damaged structure is serviceable or failed.

Damage Inspection - The process of inspecting for the purpose of locating, identifying, classifying, and recording battle damage.

Damage Labels - Marks and symbols placed on a structural member to identify areas of damage.

Damage Limit - The amount of damage to a member which, if exceeded, requires the member to be classified as failed.

Damage Measurement - The process of determining the dimensions of damage to a structure.

Damage Mode - A type of damage such as a crack, hole or spall.

Damage Monitoring - Periodic inspections of unrepaired damage to check for deterioration and damage growth.

Damage Report - A form for recording damage by type, location and nature of damage. Damage measurements and failure criteria are also recorded.

Debriefing, Flight-Crew - An interview with the aircraft flight crew concerning the conditions at the time of the combat encounter and during the returning flight for the purpose of acquiring information that will aid in the assessment of damage.

Deferrable Damage - Damage whose repair can be postponed, allowing the aircraft to execute a one-time evacuation flight or return to service for a limited number of flight-hours.

Doubler - Additional layer of sheet or strip to reinforce structural joint.

Expedient Repair - A repair used under combat conditions whose objective is speed the return of damaged aircraft to service (a time-expedient repair) and/or to salvage an aircraft that would be unrepairable by peacetime field repair standards (a methods-expedient repair). Expedient repairs generally ignore peacetime repair standards concerning weight, aerodynamic cleanliness, and appearance. They may restore the structure to less than original strength, may have a limited service life, and may require special monitoring.

Failure - The state a damaged element occupies when it is no longer able to support a minimum required load for a minimum required period of service and/or cannot meet the minimum required functional performance.

Failure Criteria - The limits on damage of various types which, if exceeded, require an element to be classified as failed.

Fairings - Secondary structure whose function is to reduce drag; eg streamlined cover, or junction between two parts.

Formers - Light secondary structure added to maintain or improve external shape.

Fuselage Bay - The structure between vertical framing members such as frames, formers and bulkheads. A bay is continuous around the circumference of the airframe. The frame, former or bulkhead forward of the bay is considered to belong in that bay.

Gusset - Small flat member used to reinforce joints or angles.

Intercostals - Flat longitudinal structural member (stringer) joining adjacent frames or ribs, usually to support access door or equipment.

Joggle - Small vertical offset along edge of sheet or strip to allow it to overlap adjacent component.

Longerons - A main longitudinal brace or support on an aircraft.

Lugs - A projection or head on a metal part to serve as a cap, handle support, or fitting connection.

Mounting Bosses - Locally thickened area to provide support for shaft bearing, threaded connection, or other lead.

Maintenance Authority - The unit commander or his representative design-attomake decisions on maintenance priority for battle-damage repair.

Planform - Geometric shape in plan esp of wings and other airfoils.

Proximity Relationship - The spatial relationship between elements in a structure within and among zones.

Repair Deferability Assessment - The process used to determine if an airframe containing failed structural members must be repaired or can be safely flown without repair, either for a one-time evacuation flight of the aircraft or to return the aircraft to service for a limited number of flight hours.

Restricted Operation - Limits placed on the use of a damaged aircraft during an evacuation fight.

Ribs - Primary structural member running across wing, or other airfoil essentially in chordwise direction.

Section, Structural - The area or length of a structural member as viewed from an endwise direction.

Section Loss - The fractional cross sectional area of a structural member removed by ballistic damage.

Shear Load - Load (force) applied in shear (stress in which parallel planes of loaded material tend to slide past each other).

Skin Panel - The area of skin bounded by longitudinal framing members above and below and by vertical framing members fore and aft.

Spall - A chip or fragment removed from the surface or edge of the material, usually on the back surface of a part that has been ballistically penetrated.

Spar - Any principal structural member in airfoil running from tip to top, or from root to tip.

Stringer - A long light structural member used as longitudinal members in an airframe.

Structure - An assembly of connected structural elements.

Structure, Nonessential - Structure whose function is only to enhance aerodynamics or to protect and provide access to internally housed components. Except for secondary damage that may be caused by a structure separating from the aircraft in flight, failure or loss of nonessential structure will have no significant effect on the performance or short-term reliability of the aircraft.

Structure, Primary - Structure that is essential to the airworthiness of the aircraft, failure or loss of which, alone or in combination with other failures, could severely degrade the flight safety, ballistic survivability, and/or crashworthiness of the aircraft.

Structure, Secondary - Structure that is essential to the functional performance of the aircraft, failure or loss of which, alone or in combination with other failures, could degrade the mission capability of the aircraft.

Structures Category - One of four classifications which describe the contribution of a structural component to the airworthiness and mission capability of the aircraft.

Structural Component - A structural element or an assembly of structural elements (door, stabilator, etc.).

Structural Element - One of the constituent parts of the airframe (frame, beam panel, etc.) Structural Member A structural element.

Tension - The force tending to increase the dimension of a body in the direction of the force.

Torsion - The internal movement of a body subjected to twisting force.

Triage - The sorting out and classification of casualties of war or other disaster to determine priority of need and proper place of treatment.

Type I Repair Deferment - 100 flight-hour deferment' unrestricted operating envelope.

Type II Repair Deferment - One-time flight defermentv restricted operating envelope.

Web - Principal vertical member of a beam, spar, or other primary structure running length of wing or fuselage.

Wounds - Damage caused by ballistic impacts and penetrations.

SECTION II. ACRONYMS AND ABBREVIATIONS

Acft	-	Aircraft
AC	-	Alternating current
ACM/BDR	-	Aircraft combat maintenance/battle-damage repair
AL	-	Alumel
Amps	-	Amperes
AN	-	Air Force-Navy
AP	-	Armor piercing
API	-	Armor pierdng incendiary
APU	-	Auxiliary power unit
ATT	-	Attitude
AVIM	-	Aviation intermediate maintenance
AVUM	-	Aviation unit maintenance
BD	-	Battle-damage
BDR	-	Battle-damage repair
B.L.	-	Butt line
C	-	Celsius
CB (zone)	-	Cabin
CD	-	Damage depth
CL	-	Damage length
CN		Constantan
CP (zone)		Cockpit
CR		Chromel
CRT		Cathode-Ray tube

CU	-	Copper
D	-	Damage distance between sites
DA	-	Department of the Army
DEG	-	Degrees
DIA	-	Diameter
DIR	-	Direction
DIST	-	Distance
DMM	-	Digital Multimeter
EA	-	Each
EMI	-	Electromagnetic interference
EQUIV	-	Equivalent
F	-	Fahrenheit
FE	-	Iron
FOD	-	Foreign object damage
FS.	-	Fuselage station
Fwd	-	Forward
HEI	-	High explosive incendiary
HRS	-	Hours
HT	-	Heat
in.	-	inches
IR	-	Infrared
KTS	-	Knots
L.H.		Left hand
LRU	-	Line replaceable unit
Min	-	Minimum
MOS	-	Military occupational specialty
MP (zone)	-	Main rotor pylon
MWO	-	Modification work order
NAS	-	National aircraft standard
NBC	-	Nuclear, biological, and chemical
NO	-	Number
Nz	-	Vertical load factor
PY (zone)	-	Pylon
QCA	-	Quick change assembly
REF	-	Reference
Req'd	-	Required
R.H.	-	Right hand
SD	-	Stiffener depth
SL	-	Stiffener length
ST (zone)	-	Stabilator
STA	-	Station
TB	-	Technical bulletin
TC (zone)	-	Tailcone
TDR	-	Time domain reflectometer
TM	-	Technical manual
VAC	-	Variable alternating current
VDC	-	Variable direct current
WL	-	Damage width
W.L	-	Water line
WT	-	Weight

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By Order of the Secretary of the Army:

DENNIS J. REIMER
General, United States Army
Chief of Staff

Official:

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
03351

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To: mpmt%avma28@st-louis-emh7.army.mil

Subject: DA Form 2028

1. ***From:*** Joe Smith
2. *Unit:* home
3. ***Address:*** 4300 Park
4. ***City:*** Hometown
5. ***St:*** MO
6. ***Zip:*** 77777
7. ***Date Sent:*** 19-OCT-93
8. ***Pub no:*** 55-2840-229-23
9. ***Pub Title:*** TM
10. ***Publication Date:*** 04-JUL-85
11. *Change Number:* 7
12. *Submitter Rank:* MSG
13. ***Submitter FName:*** Joe
14. *Submitter MName:* T
15. ***Submitter LName:*** Smith
16. ***Submitter Phone:*** 123-123-1234
17. ***Problem:*** 1
18. *Page:* 2
19. *Paragraph:* 3
20. *Line:* 4
21. *NSN:* 5
22. *Reference:* 6
23. *Figure:* 7
24. *Table:* 8
25. *Item:* 9
26. *Total:* 123
27. ***Text:***

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BE EXACT PIN-POINT WHERE IT IS

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The Metric System and Equivalents

Linear Measure

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

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 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 milliliters = .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: 075359-000