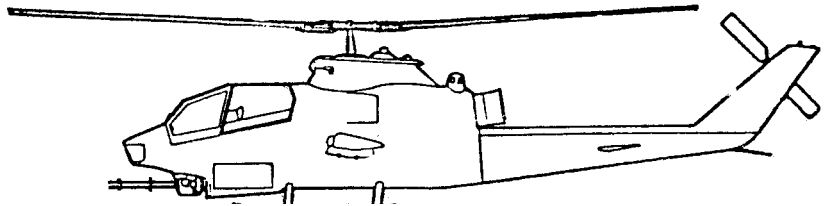


TECHNICAL MANUAL

OPERATORS, AVIATION UNIT,
AND AVIATION
INTERMEDIATE MAINTENANCE



BATTLEFIELD DAMAGE ASSESSMENT AND REPAIR

FOR
HELICOPTER,
ATTACK

AH-1E
1520-01-192-2478

AH-1 F
1520-01-168-4260

AH-1P
1520-01-168-4259

CHAPTER 1. GENERAL INFORMATION
CHAPTER 2. ASSESSING BATTLEFIELD DAMAGE
CHAPTER 3. GENERAL REPAIR
CHAPTER 4. AIRFRAME
CHAPTER 5. ALIGHTING GEAR
CHAPTER 6. POWER PLANT INSTALLATION
CHAPTER 7. ROTORS
CHAPTER 8. DRIVE TRAIN SYSTEM
CHAPTER 9. HYDRAULIC SYSTEMS
CHAPTER 10. INSTRUMENT SYSTEMS
CHAPTER 11. ELECTRICAL & AVIONICS SYSTEMS
CHAPTER 12. FUEL SYSTEM
CHAPTER 13. FLIGHT CONTROLS SYSTEM
CHAPTER 14. UTILITY SYSTEMS
CHAPTER 15. ENVIRONMENTAL CONTROL SYSTEM
CHAPTER 16. MISSION EQUIPMENT
CHAPTER 17. EMERGENCY EQUIPMENT
APPENDIX A REFERENCES
APPENDIX B SPECIAL OR FABRICATED TOOLS
APPENDIX C EXPENDABLE/DURABLE SUPPLIES & MATERIALS
APPENDIX D SUBSTITUTE MATERIALS/PARTS
APPENDIX E BDAR TRAINING PROCEDURES
APPENDIX F AVIONICS CONFIGURATIONS

HEADQUARTERS, DEPARTMENT OF THE ARMY

26 NOVEMBER 1990

Technical Manual

No. 55-1520-244-BD

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

TECHNICAL MANUAL
OPERATORS, AVIATION UNIT, AND AVIATION INTERMEDIATE MAINTENANCE
BATTLEFIELD DAMAGE ASSESSMENT AND REPAIR
FOR
HELICOPTER, ATTACK

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

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

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

TABLE OF CONTENTS

	Page
HOW TO USE THIS MANUAL	x
CHAPTER 1- GENERAL INFORMATION	
Section I. Introduction	1-1
Section II. Standards and Practices	1-3
Section III. Tasks and Responsibilities	1-5
CHAPTER 2- ASSESSING BATTLEFIELD DAMAGE	
Section I. Introduction	2-1
Section II. General Fault Assessment Table	2-3
CHAPTER 3- GENERAL REPAIRS	3-1
CHAPTER 4- AIRFRAME	
Section I. Introduction	4-1
Section II. Airframe Repairs	4-36
CHAPTER 5- ALIGHTING GEAR	
Section I. Introduction	5-1
Section II. Skid Tube	5-4
CHAPTER 6- POWER PLANT INSTALLATION	
Section I. Introduction	6-1
Section II. Oil Tanks	6-1
Section III. Oil Pressure Indicator/Transmitter	6-10

TABLE OF CONTENTS (Cont)

	Page
Section IV. Fuel Filter.	6-14
Section V. Fuel Control and Accessory Gearbox	6-14
Section VI. Emergency Engine Start.	6-17
CHAPTER 7 - ROTORS	
Section I. Introduction.	7-1
Section II. Main Rotor Hub and Blade.	7-1
Section III. Tail Rotor System.. . . .	7-19
CHAPTER 8 - DRIVE TRAIN SYSTEM	
Section I. Introduction.	8-1
Section II. Transmission.	8-1
Section III. Tail Rotor Driveshaft.	8-14
CHAPTER 9 - HYDRAULIC SYSTEMS	
Section I. Introduction.	9-1
Section II. Hoses.	9-11
Section III. Metal Tubing.	9-15
Section IV. Hydraulic Components	9-21
Section V. Hydraulic System Isolation	9-23
Section VI. O-Ring, Packing, and Gaskets	9-30
Section VII. Hydraulic Fluid Substitutions.	9-31
CHAPTER 10 - INSTRUMENT SYSTEM.. . . .	10-1
CHAPTER 11 - ELECTRICAL AND AVIONICS SYSTEM	
Section I. Introduction.	11 - 1
Section II. Wire and Cable Splicing.	11 - 6
Section III. Connector Repair.	11-24
Section IV. Overcurrent Protection Devices	11-25
Section V. Bus Bars	11-30
Section VI. Power Relays	11-34
Section VII. Antennas	11-46
Section VIII. Electrical Wire Insulation.	11-50
CHAPTER 12 - FUEL SYSTEM	
Section I. Introduction	12-1
Section II. Lines and Hoses	12 - 1
Section III. Fuel Cells	12 - 7
Section IV. Fuel Boost Pumps	12-23
Section V. Fuel Filters	12-23

TABLE OF CONTENTS (Cont)

	Page
CHAPTER 13 - FLIGHT CONTROL SYSTEM	
Section I. Introduction.	13-1
Section II. Flight Control Tubes.	13-5
CHAPTER 14 - UTILITY SYSTEMS	
CHAPTER 15 - ENVIRONMENTAL CONTROL SYSTEM	
Section I. Introduction.	15-1
Section II. Environmental Control Unit (ECU)	15-1
Section III. Ducting.	15-6
Section IV. Bleed Airlines.	15-9
CHAPTER 16- MISSION EQUIPMENT	
Section I. Introduction.	16-1
Section II. Wiring.	16-3
Section III. Hydraulics.	16-5
Section IV. Air Data Subsystem.	16-5
CHAPTER 17 - EMERGENCY EQUIPMENT.	
APPENDIX A - REFERENCES	A-1
APPENDIX B - SPECIAL OR FABRICATED TOOLS	B-1
APPENDIX C - EXPENDABLE/DURABLE SUPPLIES AND MATERIALS	C-1
APPENDIX D - SUBSTITUTE MATERIALS/PARTS.	D-1
APPENDIX E - BDAR TRAINING PROCEDURES.	E-1
APPENDIX F - AVIONICS CONFIGURATION.	F-1
GLOSSARY	G L O S S - 1
INDEX	INDEX - 1

LIST OF ILLUSTRATIONS

Figure	Title	Page
1-1	DA Form 2408-13.	1-6
1-2	DA Form 2408-18.	1-7
1-3	Damage Assessment Markings (Sheet 1 of 3).	1-8
4-1	Aircraft Zones.	4-2
4-2	DA Form 2404.	4-7
4-3	Measuring Cap or Longeron Damage	4-9
4-4	Damaged Cross Section	4-9
4-5	Measuring Skin Panel Damage	4-11
4-6	Measuring Damage in Floors or Decks	4-11
4-7	Measuring Damage in Honeycomb Panels	4-12
4-8	Airframe Reference Lines	4-15
4-9	Primary Structural Caps L/H	4-16

LIST OF ILLUSTRATIONS (Cont)

Figure	Title	Page
4-10	Structural Webs L/H	4-16
4-11	Primary Structural Caps R/H	4-17
4-12	Structural Webs R/H	4-17
4-13	Fuselage Box Beam Panels.	4-18
4-14	L/H Fuselage Beam	4-19
4-15	R/H Fuselage Beam	4-20
4-16	Upper Panels.	4-21
4-17	Lower Panels.	4-22
4-18	Pylon Support	4-26
4-19	Post Member Consisting of Three Elements	4-28
4-20	Tail Boom	4-30
4-21	Fin.	4-31
4-22	Skin Panel Damage WL Versus Frame Spacing S.	4-34
4-23	Typical Skin Panel and Frame Damage	4-34
4-24	AH-1S Left Wing - Skins Removed	4-36
4-25	Typical Former Repair.	4-39
4-26	Cut and Drill Former Repair.	4-40
4-27	Cutout in Damaged Skin	4-42
4-28	Stringer/Stiffener Repair.	4-42
4-29	Expedient Cap/Longeron Repair	4-44
4-30	Repair of Damage Bulkhead Flange	4-46
4-31	Typical Combination Repair (angle view).	4-47
4-32	Typical Combination Repair (side view).	4-48
4-33	Damaged Honeycomb Core Panel - Small Damage to One Skin and and Core.	4-50
4-34	Damaged Honeycomb Core Panel, 2-8 Inch Damage - One Skin and Core.	4-50
4-35	Repaired Honeycomb Core Panel, 2-8 Inch Damage - One Skin and Core.	4-51
4-36	Damaged Honeycomb Core Panel, 2-8 Inch Damage - Both Skins and Core.	4-52
4-37	Repaired Honeycomb Core Panel, 2-8 Inch Damage - Both Skins and Core.	4-52
4-38	Damage Repair, Accessible One Side Only.	4-54
4-39	Fabrication of Patch Plate.	4-54
4-40	Repair of Honeycomb Core Panel - Damage Over 8 Inches - Both Skins and Core.	4-55
4-41	Fracture Lacing with Safety Wire	4-57
5-1	Landing Gear and Support Installation.	5-3
5-2	Skid Tube Damage Zones	5-3
5-3	Skid Shoe Repair.	5-5
5-4	Clamp Repair.	5-5
5-5	Fabricated Clamp.	5-6
6-1	Engine, Right-Hand View.	6-2
6-2	Engine, Left-Hand View	6-3
6-3	Oil Tank.	6-5
6-4	Wood Plug.	6-7
6-5	Sealant Repair.	6-8
6-6	Screw, Washer, and Gasket.	6-8

LIST OF ILLUSTRATIONS (Cont)

Figure	Title	Page
6-7	Hose Assembly, Sealant, Nut, and Bolt	6-9
6-8	Sheet Metal with Sealant or Blind Rivets	6-11
6-9	Oil Pressure Transmitter	6-12
6-10	Torque Pressure Transmitter	6-13
6-11	Fuel Control Assembly and Accessory Gearbox Assembly	6-15
6-12	Tach Generator Removal	6-16
6-13	External Power Plug	6-18
7-1	Main Rotor System	7-2
7-2	Application of Tape	7-5
7-3	Marking Work Area	7-7
7-4	Application of Adhesive and Position of Patch	7-7
7-5	Balance Adjustment for Patches (K747 Blade) (Sheet 1 or 2)	7-9
7-6	Maximum Allowable Repairable Damage to Rotor Blade	7-11
7-7	Typical Double Plug Patch Repair	7-12
7-8	Marking Work Area	7-13
7-9	Removal of Damage Skin	7-14
7-10	Setting Router Depth	7-15
7-11	Insertion of Patch	7-16
7-12	Drag Brace	7-18
7-13	Tail Rotor installation	7-20
7-14	Tail Rotor Blade-Area Authorized for Patch-Type Repair	7-21
7-15	Aluminum Skin Patch	7-21
7-16	Skin Patch Tape Cover	7-22
8-1	Drive Train (Typical)	8-2
8-2	Transmission Oil Pressure Switch and Transmitter Repair	8-5
8-3	Transmission Assembly, Unaltered	8-6
8-4	Altered Configuration (Transmission Oil System) Bypassing Filter and Outlet Hose	8-7
8-5	Altered Configuration (Transmission Oil System) Bypassing Oil Filter	8-9
8-6	Altered Configuration (Transmission Oil System) Bypassing Filter and Inlet Hose	8-11
8-7	Altered Configuration (Transmission Oil System) Substituting Hose at Sump Outlet (Sheet 1 of 2)	8-12
8-8	Damage Passing Through Center of Shaft	8-16
8-9	Damage Not Passing Through Center of Shaft	8-17
8-10	Balance Restoring Repair for Damage Not Passing Through Center of Shaft	8-18
8-11	Y and S Graph	8-19
8-12	Area and Diameter Graph	8-19

LIST OF ILLUSTRATIONS (Cent)

Figure	Title	Page
8-13	Damaged Shaft; Petals Straightened Smooth.	8-21
8-14	Repaired Shaft.	8-22
8-15	Shaft Area (in*) vs. Number of Rivets.	8-23
9-1	Hydraulic System Schematic (Sheet 1 of 2).	9 - 2
9-2	Hydraulic System - SYSTEM No. 2 (Sheet 1 of 2)	9 - 4
9-3	Hydraulic System - SYSTEM No. 1.	9 - 6
9-4	Hydraulic System - Armament (Sheet 1 of 2)	9 - 7
9-5	Emergency (Electric Motor Driven) Hydraulic System	9 - 9
9-6	Two-Part Fitting.	9-12
9-7	Four-Part Fitting.	9-12
9-8	Installation of MS Hose Fitting Socket and Sleeve.	9-14
9-9	Assembly of MS Fitting	9-14
9-10	Using Tube Cutter.	9-16
9-11	Properly Burred Tubing	9-16
9-12	Damaged Tube Sections	9-18
9-13	MS Tube Fitting Installation	9-19
9-14	Completed Tubing Installation.	9-19
9-15	Completed High Pressure Hose Substitution.	9-20
9-16	MS Union Installation	9-21
9-17	Lock-Out Valve Assembly.	9-22
9-18	Hydraulic System Unaltered	9-24
9-19	Hydraulic System, Isolating No. 1 System	9-25
9-20	Hydraulic Pump and Drive Pad	9-27
9-21	Hydraulic System, Isolating No. 2 System	9-29
11-1	Circuit Identification.. . . .	11- 3
11-2	Crimp Splice	11- 8
11-3	Splicing with Terminal Lug Barrel.	11- 9
11-4	Twist Wire Splice	11-11
11-5	Replacement Section; Twist Wire Splice	11-11
11-6	Metal Casing Splice.	11-12
11-7	Replacement Section; Terminal Lug Repair	11-13
11-8	Ram Wire Repair	11-14
11-9	Shielded Cable Repair Preparation.	11-15
11-10	Shielded Cable Splice Preparation.	11-16
11-11	Completed Shielded Cable Splice.	11-16
11-12	Sheath Connector Splice.	11-17
11-13	Pigtail Sheath Splice	11-19
11-14	Substitute Shielded Braid Splice	11-20
11-15	Shield Terminator Repair Preparation	11-22
11-16	Shield Terminator Repair.	11-22
11-17	Component Bypass.	11-23
11-18	Connector Pin and Socket.	11-24
11-19	Damaged Connector and Wire	11-25
11-20	Typical Original Circuit Breaker Connection.	11-26
11-21	Construction of Fuse Link.	11-28
11-22	Typical Fuses.	11-29
11-23	Fabricated Fuse, Type A...	11-30
11-24	Fabricated Fuse, Type B.	11-30
11-25	Splicing Bus Bars.	11-32

LIST OF ILLUSTRATIONS (Cont)

Figure	Title	Page
11-26	Lengthening Bus Bars.	11-32
11-27	Battery Cell Layout.	11-33
11-28	Block Diagram Power Relay, Check and Test.	11-34
11-29	AH-1 PROD Battery Compartment, Forward View (Sheet 1 of 2)	11-36
11-30	AH-1 PROD Battery Compartment, Side View (Sheet 1 of 2).	11-38
11-31	AH-1 ECAS and MC Battery Compartment (Sheet 1 of 2).	11-40
11-32	AH-1 ECAS and MC Battery Compartment (Sheet 1 of 3).	11-42
11-33	Block Diagram, Typical Power Relays.	11-45
11-34	Jumper Wire Fabrication.	11-45
11-35	Frequency vs. Wavelength	11-47
11-36	Preparation of Coax	11-47
11-37	Installation of Field Expedient Antenna.	11-49
11-38	Pigtail Termination for Shielded Wire.	11-50
11-39	Heat Shrinkable Tape.	11-52
11-40	Insulation Repair with Sleeving.	11-52
12-1	Fuel System	12-2
12-2	Use of String Bead.	12-5
12-3	Long Replacement Tube Section.	12-5
12-4	Repair of Small Hole in Tube	12-6
12-5	Expedient Repair of Damaged Hose	12-8
12-6	Replacement of Damaged Hose Section.	12-8
12-7	Inlet Line to Fuel Control.	12-10
12-8	Emergency Mechanical Clamp Repair	12-11
12-9	Rubber Repair Plug Assembly	12-13
12-10	Plug Modification for Three Plane (Corner) Repair.	12-14
12-11	Aft Cell Isolation Access Panels	12-16
12-12	Crossover Line Flange Template	12-17
12-13	Blocked Off Crossover Line	12-18
12-14	Fuel Manifold.	12-19
12-15	Blocked Off Fuel Cell.	12-22
12-16	Floor Baffle Assembly	12-24
12-17	Fuel Quality Probe; Fuel Inlet	12-25
12-18	External Fuel Filter Assembly.	12-26
12-19	External Fuel Filter.	12-28
12-20	Bypassing External Fuel Filter	12-29
13-1	Flight Controls	13-2
13-2	Stability and Control Augmentation System (SCAS)	13-3
13-3	Collective Flight Controls	13-6
13-4	Cyclic, Lateral Controls	13-7
13-5	Cyclic, Fore and Aft Controls	13-8
13-6	Tail Rotor Controls.	13-9
13-7	Control Tube Splice.	13-12
13-8	Control Rod with Bearing and Clevis Assemblies	13-14
13-9	Flattened End of Fabricated Flight Control	13-15
13-10	Corner Rounding on Fabricated Flight Control	13-15
13-11	Bell Crank or Lever Assembly Connection of Fabricated Flight Control	13-15
15-1	Environmental Control System	15-2
15-2	ECU Housing.	15-4

LIST OF ILLUSTRATIONS (Cont)

Figure	Title	Page
15-3	Ducts, Flexible Plastic	15-7
15-4	Ducts, Rigid Plastic.	15-8
15-5	Bleed Air Lines.	15-10
15-6	Bleed Line Patch Repair.	15-11
16-1	Turret Gun Brake Toggle (ECAS and MC).	16-4
16-2	Outboard Wing Stores Pylon.. . . .	16-6
16-3	ADS Pneumatic Lines.	16-7
F-1	UHF Command Communication System AN/ARC-116() or AN/ARC-164 (Sheet 1 of 2)	F-1
F-2	VHF Command Communication System AN/ARC-115 (Sheet 1 of 2) .	F-5
F-3	VHF Command Communication System AN/ARC-115 or AN/ARC-186 (Sheet 1 of 2)	F-7
F-4	FM Liaison Communication System AN/ARC-114 (Sheet 1 of 3). .	F-9
F-5	FM Liaison Communication System AN/ARC-114A (Sheet 1 of 3) .	F-14
F-6	Gyromagnetic Compass System AN/ASN-43 (Sheet 1 of 2)	F-19
F-7	Automatic Direction Finder AN/ARN-89B (Sheet 1 of 2)	F-23
F-8	VOR/MB/GS Receiving Set Radio AN/ARN-123(V)3 (Sheet 1 of 3).	F-27
F-9	Doppler Navigation System AN/ASN-128 (MC) (Sheet 1 of 2) . .	F-37
F-10	Radar Altimeter System AN/APN-209 (Sheet 1 of 2)	F-42
F-11	IFF System AN/APX-72 (Sheet 1 of 2).	F-45
F-12	IFF System AN/APX-100(V) (Sheet 1 of 2).	F-50
F-13	Radar Warning System AN/APR-39(V)1 (Sheet 1 of 2).	F-54
F-14	Countermeasures Set AN/ALQ-136 (MC) (Sheet 1 of 2)	F-57
F-15	Countermeasures Set AN/ALQ-144(V) (MC) (Sheet 1 of 2). . . .	F-59

LIST OF TABLES

Table No.	Title	Page
2-1	General Decision Logic	2-2
2-2	Assessment Table.	2-3
4-1	Structure Damage Assessment Procedures	4-4
4-2	Allowable Fuselage Damage Limits-Condition 1, Fuselage Caps.	4-24
4-3	Allowable Tail Boom Damage Limits-Condition 1, Tail Boom Longerons.	4-32
5-1	Lighting Gear Assessment Procedures	5-2
6-1	Power Plant Assessment Procedures.	6-4
7-1	Rotor Assessment Procedures.	7-3
7-2	Plug Patch Kits.	7-11
8-1	Drive Train Assessment Procedures.	8-3
8-2	Shaft Area (in ²) vs. Number of Rivets.	8-23
9-1	Hydraulic System Assessment Procedures	9-10
11-1	Electrical and Avionics Assessment Procedures.	11-2
11-2	Function and Designation Letters	11-3
11-3	Unshielded Crimp Splice Application.	11-7
11-4	Shielded Cable Repair	11-15
11-5	Fuse Link Strands.	11-27
12-1	Fuel System Assessment Procedures.	12-3

LIST OF TABLES (Cont)

Table No.	Title	Page
13-1	Flight Control System Assessment Procedures.	13-4
13-2	Control Tube Dimensions.	13-10
13-3	Bolt/Drill Sizes for Control Tube Repairs.	13-11
14-1	Utility Systems Assessment Procedures.	14-2
15-1	Environmental Control System Assessment Procedures	15-3
16-1	Mission Equipment Assessment Procedures.	16-3
D-1	Spare and Repair Parts	D-2
D-2	Armament Parts.	D-10
D-3	Packing Reference and Temperature Guides Chart	D-12
D-4	Substitute U.S. Fuels.	D-17
D-5	Substitute Foreign Fuels.. . . .	D-18
D-6	Substitute Commercial Fuels.	D-19
D-7	Alternate and Expedient Fuel Blends.	D-20
D-8	Substitute Lubricants and Hydraulic Fluids	D-21
D-9	Metal Substitution Chart.. . . .	D-24
F-1	UHF AN/ARC-1160, Wire Chart	F-4
F-2	UHF AN/ARC-1640, Wire Chart	F-4
F-3	VHF AN/ARC-1150, Wire Chart	F-6
F-4	VHF Command Communication System AN/ARC-115 or AN/ARC-186, Wire Chart.	F-8
F-5	FM AN/ARC-1140, Wire Chart (with KY-28) PROD and ECAS	F-12
F-6	FM AN/ARC-1140, Wire Chart (with KY-28) MC.	F-17
F-7	AN/ASN-43,Wire Chart	F-21
F-8	AN/ARN-89B, Wire Chart, ADF.	F-25
F-9	AN/ARN-123(V)3, Wire Chart, MC, P, E	F-30
F-10	AN/ASN-128,Wire Chart...	F-39
F-11	AN/APN-209,Wire Chart...	F-44
F-12	AN/APX-72,Wire Chart	F-47
F-13	AN/APX-100,Wire Chart...	F-52
F-14	AN/APR-39,Wire Chart	F-56
F-15	AN/ALQ-136,Wire Chart...	F-58
F-16	AN/ALQ-144,Wire Chart...	F-61

HOW TO USE THIS MANUAL

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

1. Organization of the Manual. This manual contains a general information chapter (chapter 1), a general assessment chapter (chapter 2), and specific repair chapters (chapters 4 thru 17). Chapter 3 is not used. It also contains five appendixes.
2. Chapter 2 is used to assess the helicopter in general and references specific chapters for detailed repair procedures of the major functional groups. The major functional groups correspond with the functional groups of the -23 series manuals that are employed in routine repairs to the helicopter.
3. Chapter 3 is not used in this manual. It would normally contain repairs for equipment which does not fall under one of the standard helicopter functional groups.
4. Each functional group chapter is organized as follows:
 - a. Section I - Introduction.
 - (1) Scope. Purpose of the chapter.
 - (2) Assessment Procedures. General assessment information for the repairs covered therein.
 - (3) Repair Procedure Index.
 - b. Section II - Repair Item. A subsection is included for each repair item covered in that functional group. It contains the following:
 - (1) General. About the nature and cause of damage and repair.
 - (2) Item and trouble statement with:
 - (a) Limits given.
 - (b) Personnel and time required to effect repairs.
 - (c) Materials and tools needed.
 - (d) Procedural steps to accomplish the repair.
 - (3) If more than one method of repair can be used, the various options will be included next.

NOTE

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

HOW TO USE THIS MANUAL (Cont)

5. Finding Repairs in this Manual.

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

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

6. Preparation.

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

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

7. Expendable/Durable Supplies and Materials.

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

Example: **MATERIALS/TOOLS REQUIRED:**

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

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

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

CHAPTER 1

GENERAL INFORMATION

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

Section I. INTRODUCTION

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

1-2. SCOPE.

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

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

c. All possible types of combat damage and failure modes cannot be predicted, nor are all effective field expedient repairs known. This TM provides guidelines for assessing and repairing battlefield

failures of helicopters and is not intended to be a complete catalog of all possible emergency repairs. The repairs described here will serve as guidelines and will stimulate the experienced mechanic/operator to devise repairs as needed to rapidly return equipment to operation in a combat situation.

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

1-3. APPLICATION.

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

b. BDAR techniques are not limited to simple restoration of minimum functional combat capability. If full functional capability can be restored expediently with a limited expenditure of time and assets, it will be accomplished.

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

1-4. DEFINITIONS.

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

b. Repair or Fix. Any expedient action that returns a damaged part or assembly to a full or an acceptably degraded operating condition, including:

(1) Short cuts in parts removal or installation.

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

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

(4) Bypassing of noncritical components in order to restore basic functional capability.

(5) Expeditious cannibalization procedures.

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

(7) Jury-rigging.

(8) Use of substitute materials.

c. Damage Assessment. A procedure to rapidly determine what is damaged, whether it is repairable, what assets are required to make the repair, who can do the repair (e.g., crew, maintenance team or maintenance support team), and where the repair should be made. The assessment procedure includes the following steps:

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

(2) Isolate the damaged areas and components.

(3) Determine which components must be fixed.

(4) Prescribe fixes.

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

(6) Estimate the manpower and skill required.

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

(8) Establish the priority of the fixes.

(9) Decide where the fix shall be performed.

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

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