

FM 4-30.31 (FM 9-43-2)
MCRP 4-11.4A (FMFRP 4-34)

Recovery and Battle Damage Assessment and Repair

September 2006

DISTRIBUTION RESTRICTION: Approved for public release; distribution is unlimited.

Headquarters, Department of the Army

This page intentionally left blank.

Field Manual
No. 4-30.31
Marine Corps Reference Publication
No. 4-11.4A

Headquarters
Department of the Army
United States Marine Corps
Washington, DC, 19 September 2006

Recovery and Battle Damage Assessment and Repair

Contents

	Page
Preface	v
Chapter 1 Introduction to Recovery and Battle Damage Assessment and Repair	1-1
Recovery	1-1
Battle Damage Assessment and Repair	1-2
Chapter 2 Principles of Recovery	2-1
General.....	2-1
Fundamental Methods of Recovery	2-1
Chapter 3 Rigging	3-1
Rigging Fundamentals	3-1
Mechanical Advantage of Tackle	3-2
Anchors	3-9
Chapter 4 Recovery Operations	4-1
Safety Precautions	4-1
Recovery Procedures.....	4-5
Special Recovery Situations.....	4-19
Self-Recovery and Like-Vehicle Recovery.....	4-23
Chapter 5 Field Expedient Recovery	5-1
Recovery Expedients.....	5-1
Remobilizing Tracked Vehicles	5-4
Chapter 6 Battle Damage Assessment and Repair Procedures	6-1
BDAR Principles	6-1
Basic Rules of Assessment.....	6-2
BDA Guidelines	6-4

Distribution Restriction: Approved for public release; distribution is unlimited.

***This publication supersedes FM 9-43-2/FMFRP 4-34/TO 36-1-181, 3 October 1995.**

Contents

	Maintenance Procedures and BDAR.....	6-6
	Special Operating Environments	6-9
	BDAR in Joint Operations	6-10
	BDAR Tools and Equipment.....	6-10
	Expedient Repairs.....	6-18
Appendix A	Battle Damage Assessment and Repair Kits	A-1
Appendix B	Combined and Multinational Recovery and BDAR Operations	B-1
Appendix C	Hand and Arm Signals.....	C-1
Appendix D	Recovery Guidelines for Operators/Leaders	D-1
	GLOSSARY	Glossary-1
	REFERENCES.....	References-1
	INDEX	Index-1

Figures

Figure 2-1. Block components	2-3
Figure 2-2. Block configurations	2-4
Figure 2-3. Block classifications	2-4
Figure 2-4. Grade resistance	2-5
Figure 2-5. Overturning resistance	2-6
Figure 2-6. Mire resistance	2-6
Figure 2-7. First-class lever	2-11
Figure 2-8. Second-class lever	2-11
Figure 2-9. Compound tackle system	2-12
Figure 3-1. Terminology of simple tackle	3-1
Figure 3-2. Fleet angle	3-2
Figure 3-3. Winch line(s) MA	3-3
Figure 3-4. 4-to-1 MA.....	3-5
Figure 3-5. Backup method of rigging.....	3-6
Figure 3-6. Lead method of rigging.....	3-6
Figure 3-7. Sling arrangement	3-7
Figure 3-8. Floating block attachment	3-8
Figure 3-9. Tow cable attachment	3-8
Figure 3-10. Tow bar method.....	3-9
Figure 3-11. 3-to-1 MA towing method	3-9
Figure 3-12. Anchor symbol.....	3-9
Figure 3-13. Log deadman.....	3-10
Figure 3-14. Combination picket holdfast	3-11
Figure 3-15. Sand parachute	3-12
Figure 3-16. Scotch anchor.....	3-12

Figure 4-1. Unsafe areas during an angle pull	4-2
Figure 4-2. Hook positions	4-3
Figure 4-3. Chocking/blocking wheeled vehicles	4-4
Figure 4-4. Safety keys and shackle pins	4-5
Figure 4-5. Winching using a 2-to-1 MA and a change of direction block	4-7
Figure 4-6. Highway towing	4-8
Figure 4-7. Cross-country towing	4-8
Figure 4-8. Winching with two recovery vehicles	4-9
Figure 4-9. 2-to-1 MA	4-10
Figure 4-10. Tracked towing with holdback vehicle	4-11
Figure 4-11. Tracked towing	4-12
Figure 4-12. Chocking/blocking tracked vehicles	4-13
Figure 4-13. Classifying a grade	4-14
Figure 4-14. Surveying level	4-14
Figure 4-15. Eyesight and pace method	4-15
Figure 4-16. Fifth wheel towing device	4-16
Figure 4-17. Recovery with AKERR	4-19
Figure 4-18. Recovery of a nosed cargo truck	4-20
Figure 4-19. Recovery of overturned vehicles	4-20
Figure 4-20. A recovery vehicle winching a nosed tracked vehicle	4-23
Figure 4-21. Lifting operation	4-23
Figure 4-22. Recovering a mired cargo truck in tandem	4-24
Figure 4-23. Winching with like or heavier class wheeled vehicle	4-25
Figure 4-24. Self-recovery operation	4-25
Figure 4-25. Recovery of a mired tank using one like vehicle	4-26
Figure 4-26. Recovering a nosed tracked vehicle with like vehicles	4-26
Figure 4-27. Recovering an overturned tracked vehicle with like vehicles	4-27
Figure 4-28. Towing a disabled tracked vehicle	4-27
Figure 4-29. Towing with vehicles issued one tow cable	4-28
Figure 4-30. Marine recovery with tow hooks and ropes attached to lifting eyes	4-29
Figure 4-31. Recovery to shore with tow hooks and cables attached to tow lugs	4-29
Figure 5-1. Pry bar recovery	5-1
Figure 5-2. Substitute jack (front wheels)	5-2
Figure 5-3. Substitute jack (rear or tandem wheels)	5-2
Figure 5-4. Wheels used as winches	5-3
Figure 5-5. Girth hitch and using an A-frame in recovery operations	5-3
Figure 5-6. A log used to anchor tracks	5-4
Figure 5-7. Cables used to anchor tracks	5-5
Figure 5-8. Moving a vehicle with both tracks broken	5-5
Figure 5-9. Moving a vehicle onto a track	5-6
Figure 5-10. Installing a track	5-6

Contents

Figure 6-1. BDA guidelines	6-5
Figure 6-2. Example of a DD Form 1577	6-7
Figure 6-3. Example of a DA Form 2404	6-8
Figure 6-4. Example of a ULLS-generated DA Form 5988-E	6-9
Figure 6-5. Hull and metal component repair materials	6-11
Figure 6-6. Fluid line repair items	6-11
Figure 6-7. Low-pressure line fitting repair	6-13
Figure 6-8. Low-pressure line repair	6-14
Figure 6-9. Electrical repair materials	6-15
Figure 6-10. Tire patch materials and tire plug kit	6-16
Figure 6-11. Environmental plugs, radiator sealant, and a link belt	6-16
Figure 6-12. Tube-type radiator core repair	6-17
Figure 6-13. Attaching tandem axle to frame	6-18
Figure 6-14. Defective differential	6-19
Figure 6-15. Suspending road wheel	6-20
Figure 6-16. Road wheel expedient technique	6-20
Figure 6-17. Short track expedient technique	6-21
Figure 6-18. Shear pin substitute	6-22
Figure A-1. Crew/operator BDAR kit	A-2
Figure A-2. Maintainer's BDAR kit	A-2
Figure C-1. Signals for raise the hoist cable and lower the hoist cable	C-2
Figure C-2. Signals for raise the boom and lower the boom	C-2
Figure C-3. Signals for raise the spade and lower the spade	C-3
Figure C-4. Signals for inhaul the main winch cable and pay out the winch cable	C-3
Figure C-5. Signals for extend the boom and retract the boom	C-4
Figure C-6. Signals for swing the boom right or left and button up-unbutton	C-4
Figure C-7. Signal for stop	C-5

Tables

Table 2-1. Estimated winch variable capacity	2-9
Table 4-1. Prime movers for FWTD	4-17
Table 4-2. Vehicle weights	4-18

Preface

This manual provides the authoritative doctrine guidance on using recovery and repair assets on the battlefield. Practical methods of recovering or repairing equipment (disabled or immobilized) due to hazardous terrain, mechanical failure, or a hostile action are also addressed.

Field manual (FM) 4-30.31 is directed toward both the leader and the technician. Tactically, it provides an overview of how recovery and battle damage assessment and repair (BDAR) assets are employed on the battlefield. Technically, it provides principles of resistance and mechanical applications to overcome them. Equipment, rigging techniques, and expedient repairs are summarized as a refresher for recovery-trained military personnel and as general guidance for others.

The procedures and doctrine in this manual apply to both wartime operations and military operations other than war. Normally, BDAR should be used when and where standard maintenance practices are not practical because of the mission, enemy, terrain and weather, troops and support available, time available, civil considerations (METT-TC) or METT-T space and logistics (METT-TSL) for USMC. BDAR is not intended to replace standard maintenance practices but rather to supplement them under certain conditions. Standard maintenance procedures provide the best, most effective means of returning disabled equipment to the operational commander—provided adequate time, parts, and tools are available.

High-risk battle damage repairs (involving possible danger to personnel or further damage to equipment) are only permitted in emergencies, normally in a battlefield environment, and only when authorized by the unit commander or his designated representative. The goal is to return a combat system to the battlefield in the least amount of time, while minimizing danger to personnel and equipment.

BDAR techniques are not limited to simply restoring minimal functional combat capability. If full mission capability can be restored expediently with a limited expenditure of time and assets, it should be restored. This decision is based on METT-TC.

Some BDAR techniques, if applied, may result in shortened lifespan or further damage to components. The commander must decide whether the risk of having one less piece of equipment outweighs the risk of applying a potentially destructive field-expedient repair. Each technique provides appropriate warnings and cautions, which list the system's limitations caused by the action. Personnel must use ground guides and extreme caution when operating recovery assets around or on an aircraft.

The proponent of this publication is the United States Training and Doctrine Command. Users of this manual are encouraged to submit suggestions, changes, or comments to improve this manual. Comments with justifications should be keyed to the specific page, paragraph, and line of text; prepared on Department of the Army (DA), DA Form 2028 (Recommended Changes to Publications or Blank Forms); and forwarded to Commander, U.S. Army Combined Arms Support Command, ATTN: ATCL-AO, Fort Lee, VA 23801-6000.

The provisions of this publication are subject to international Quadripartite Standardization Agreement 171.

This publication applies to the United States Marine Corps, Active Army, the Army National Guard/Army National Guard of the United States, and the U.S. Army Reserve unless otherwise stated.

This is a joint service manual. Other Armed Forces should use their appropriate service forms in place of the DA forms listed herein. All Department of Defense (DD) forms listed in this manual will be used by all Armed Forces.

Basic issue items (BII) and additional authorization list (AAL) are Army terms. The Marine Corps' equivalent of these terms is on-vehicle equipment (OVE).

This page intentionally left blank.

Chapter 1

Introduction to Recovery and Battle Damage Assessment and Repair

Recovery and battle damage assessment and repair (BDAR) are subsets of maintenance. Both are the owning units' responsibilities; both have a fundamental purpose of returning combat assets to the battlefield as soon as possible. The purpose of recovery is to rapidly remove disabled or mired equipment from the battlefield, while the purpose of BDAR is to rapidly repair the equipment to continue the mission or allow self-recovery. Recovery vehicles, both wheeled and tracked, should carry a minimum of one BDAR kit to assist in recovery operations.

RECOVERY

1-1. Recovery is retrieving, that is, freeing immobile, inoperative, or abandoned equipment from its current position and returning it to operation or to a maintenance site for repair. These actions typically involve towing, lifting, or winching. Towing is usually limited to moving equipment to the nearest unit maintenance collection point (UMCP). Recovery consists of—

- Self-recovery: Actions require using only the equipment's assets.
- Like-recovery: Actions involve assistance from a second, like, or heavier class vehicle.
- Dedicated-recovery: Actions require assistance from a vehicle specifically designed and dedicated to recovery operations.

1-2. Unless specifically mentioned, recovery tactics, techniques, and procedures, and doctrine, organization, training, materiel, leadership and education, personnel, and facilities considerations apply to both combat and noncombat range of military operations (ROMO).

SELF-RECOVERY

1-3. Self-recovery starts at the location where the equipment becomes mired or disabled. The operator/crew uses the BII and AAL or OVE items to perform self-recovery.

1-4. When the equipment has a mechanical failure, the operator/crew will use the equipment's technical manual (TM) to perform troubleshooting procedures with the tools available in the BII and AAL or OVE. When self-recovery fails, the operator/crew can request assistance from available like vehicles.

Note. According to current Army doctrine, an equipment self-recovery winch can be used only to recover the equipment on which it is mounted. Self-recovery winches should not be used to recover other mired equipment. Self-recovery winches can be used to assist in a recovery effort by providing stabilizing or holdback capabilities. Refer to the equipment operator's manual for like-vehicle recovery procedures and limitations. This does not apply to the United States Marine Corps (USMC).

LIKE-RECOVERY

1-5. Like-vehicle recovery is used when self-vehicle recovery fails. The principle is to use another piece of equipment—of the same weight class or heavier—to extract or tow the mired equipment by using tow bars,

chains, tow cables, and/or allied kinetic energy recovery rope (AKERR). When self-recovery and like-recovery are not practical or are unavailable, use dedicated recovery assets.

Note. AKERR is used to extract mired equipment; it is not designed as a towing device (see chapter 4 for more details on AKERR).

DEDICATED RECOVERY

1-6. Dedicated-recovery vehicles are used when self-recovery or like-vehicle recovery is not possible because of the severity of the situation, safety considerations, or the inability to use like-vehicle assets employed in their primary mission. Recovery managers and supervisors must ensure recovery vehicles are used only when absolutely necessary. Dedicated recovery vehicles must be returned as quickly as possible to a central location to support the unit. In addition to its recovery mission, this equipment is often used for the heavy lifting required in maintenance operations. Recovery managers and supervisors must use all available resources carefully to provide sustained support.

BATTLE DAMAGE ASSESSMENT AND REPAIR

1-7. BDAR is the procedure used to rapidly return disabled equipment to the operational commander by field-expedient repair of components. BDAR restores the minimum essential combat capabilities necessary to support a specific combat mission or to enable the equipment to self-recover. BDAR is accomplished by bypassing components or safety devices, cannibalizing parts from like or lower priority equipment, fabricating repair parts, jury-rigging, taking shortcuts to standard maintenance, and using substitute fluids, materials or components. Depending on the repairs required and the amount of time available, repairs may or may not return the vehicle to a fully mission-capable status. Operators/crew, maintenance teams (MTs), maintenance support teams (MSTs), combat repair teams (CRTs), or recovery teams may perform BDAR.

PEACETIME BATTLE DAMAGE ASSESSMENT AND REPAIR APPLICATIONS AND TRAINING

1-8. Army Regulation (AR) 750-1, Army Maintenance Management Policy, paragraph 8-8, and USMC's TM-4700-15/1 require unit commanders to conduct nondestructive peacetime BDAR training. Soldiers must become familiar with the components in the BDAR kits that enable many repairs which otherwise would not be possible. Each crewmember should know how to perform battle damage assessment (BDA) for assigned equipment.

1-9. Maintenance standards are based on TMs and preventive maintenance checks and services. Low-risk, nondestructive BDAR can be applied as training during a ROMO. The goal of training is to simulate combat conditions as closely as possible. Commanders can direct the employment of BDAR for normal maintenance failures to evaluate training or validate new procedures. Unit commanders should develop sustainment training in which vehicle crews and field maintenance mechanics conduct BDAR and recovery operations. Skills required to perform BDAR are found in individual and collective training tasks. Unit commanders should know which military occupational specialties require knowledge of BDAR. Company and battalion Army Training and Evaluation Program tasks, especially in combat service support units, require some knowledge of BDAR. Military qualification standards also require ordnance officers of all grade levels to have awareness of BDAR policy and doctrine incorporated in developmental training.

1-10. Peacetime BDAR training is necessary for Soldiers to perform these vital tasks on the battlefield. Recent military operations have highlighted how U.S. forces can be deployed almost overnight into situations where combat is expected and normal logistical arrangements are underdeveloped or unavailable.

1-11. Mechanics should master BDAR techniques very quickly since they have already received maintenance and mechanical training. Vehicle crewmembers should be familiar with BDAR techniques for their specific equipment. Cross training of mechanics is also necessary. Crewmembers and mechanics that can change a fan belt or fuel filter can easily learn to perform BDAR for these same items. Experience in live-fire tests at Aberdeen Proving Ground, MD, and Meppen, Germany, has shown that Soldiers can learn BDAR procedures with minimal training. With the adoption of the U.S. Army Tank-automotive and Armaments Command ground