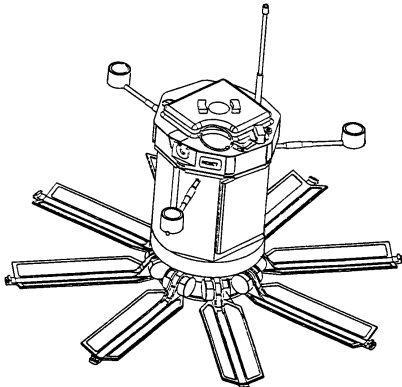


This reprint includes Changes 1, 2, and 3.

FM 20-32



Mine/Countermine Operations

Headquarters,
Department of the Army

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

Field Manual
No. 20-32

*FM 20-32
Headquarters
Department of the Army
Washington, DC, 29 May 1998

MINE/COUNTERMINE OPERATIONS

Table of Contents

	Page
LIST OF ILLUSTRATIONS	x
Figures.....	x
Tables.....	xv
PREFACE.....	xvii
CHAPTER 1. INTRODUCTION	1-1
MECHANICS OF MINES	1-1
Characteristics and Functioning	1-1
Components and Initiating Actions.....	1-2
ANTITANK MINES.....	1-4
Types of Kills	1-4
Types of Sensing	1-5
Types of Warheads	1-5
ANTIPERSONNEL MINES	1-5
Types of Kills	1-5
Types of Sensing	1-6
Types of Effects.....	1-6
ANTIHANDLING DEVICES	1-6

Part One. Mine Operations

CHAPTER 2. MINE-WARFARE PRINCIPLES.....	2-1
MINE-WARFARE CONCEPTS.....	2-1
TYPES OF MINEFIELDS.....	2-1
Protective Minefields.....	2-2
Tactical Minefields	2-3
Nuisance Minefields.....	2-4
Phony Minefields	2-4
PROTECTIVE VERSUS TACTICAL MINEFIELDS.....	2-5
TACTICAL MINEFIELDS	2-5
Minefield Variables	2-7
Design.....	2-10

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

*This manual supersedes FM 20-32, 30 September 1992.

	Page
TACTICAL-OBSTACLE INTEGRATION PRINCIPLES.....	2-14
Obstacle Emplacement Authority.....	2-14
Obstacle Control.....	2-14
Obstacle Control Measures.....	2-15
Fratricide Prevention.....	2-19
Maneuver-Plan Support.....	2-19
SITING AND EMPLACING TACTICAL MINEFIELDS.....	2-32
Coordinating with the Maneuver Commander.....	2-32
Siting the Minefield.....	2-37
Emplacing Minefields.....	2-39
Determining Resource Requirements.....	2-39
MINEFIELD SUPPLY OPERATIONS.....	2-39
Resupply Nodes.....	2-41
Resupply Rules.....	2-43
Supply Location.....	2-44
Resupply Methods.....	2-44
MINEFIELD MARKING.....	2-49
Criteria.....	2-49
Perimeter.....	2-50
Techniques.....	2-50
MINEFIELD TURNOVER.....	2-52
MINEFIELD INSPECTION AND MAINTENANCE.....	2-55
CHAPTER 3. SCATTERABLE MINES AND MINE DELIVERY SYSTEMS.....	3-1
GENERAL CHARACTERISTICS.....	3-1
Antipersonnel Mines.....	3-1
Antitank Mines.....	3-3
CAPABILITIES.....	3-5
Faster Response.....	3-5
Remote Placement.....	3-5
Increased Tactical Flexibility.....	3-5
Efficiency.....	3-5
Increased Lethality.....	3-5
LIMITATIONS.....	3-5
Extensive Coordination.....	3-5
Proliferation of Targets.....	3-6
Visibility.....	3-6
Accuracy.....	3-6
Orientation.....	3-6
LIFE CYCLE.....	3-6
LETHALITY AND DENSITY.....	3-7
Lethality and Tactical-Obstacle Effect.....	3-7
Density.....	3-8
COMMAND AND CONTROL.....	3-9
AUTHORITY.....	3-9
COORDINATION.....	3-10
EMPLOYMENT AND EMPLACEMENT.....	3-10
Area-Denial Artillery Munitions and Remote Antiarmor Mines.....	3-11
Gator.....	3-14
Volcano.....	3-17
Modular Pack Mine System.....	3-27

	Page
MARKING	3-26
Safety Zones	3-27
Fragment Hazard Zones.....	3-27
Fencing.....	3-28
CHAPTER 4. SPECIAL-PURPOSE MUNITIONS	4-1
M18A1 CLAYMORE	4-2
SELECTABLE LIGHTWEIGHT ATTACK MUNITION	4-3
Operating Modes.....	4-3
Antitamper Feature.....	4-6
M93 HORNET	4-6
Employment Considerations.....	4-7
Employment Roles.....	4-7
Tactical Emplacement.....	4-8
Recording and Marking.....	4-15
CHAPTER 5. CONVENTIONAL MINES	5-1
ANTITANK MINES	5-1
M15.....	5-1
M19.....	5-2
M21.....	5-2
ANTIPERSONNEL MINES	5-3
M14.....	5-3
M16.....	5-4
EMPLACING MINES.....	5-4
Mines With Prongs	5-4
Mines With Pressure Plates.....	5-4
Mines With Tilt Rods.....	5-6
Bearing Boards	5-6
Concealment	5-6
Maneuver Assistance.....	5-8
CHAPTER 6. ROW MINING	6-1
USE.....	6-1
RULES.....	6-1
LOGISTICS	6-3
Calculations	6-3
Task Organization	6-14
Site Layout.....	6-16
Mine-Laying Vehicles.....	6-18
Laying a Row Minefield.....	6-18
Immediate-Action Drill	6-24
Squad Drill.....	6-24
Marking, Recording, and Reporting Row Minefields.....	6-25
STANDARDIZED TACTICAL ROW MINEFIELDS	6-25
Disrupt and Fix.....	6-28
Turn.....	6-29
Block.....	6-31
HASTY PROTECTIVE ROW MINEFIELDS	6-33
Rules.....	6-34
Site Layout.....	6-34

	Page
CHAPTER 7. STANDARD-PATTERN MINEFIELDS	7-1
COMPONENTS	7-1
Mine Strips	7-1
Mine Clusters	7-1
Rules for Positioning Clusters Within a Strip	7-2
Standard-Pattern Minefield Rules	7-4
LOGISTICAL CALCULATIONS	7-9
Cluster Calculation	7-9
Platoon Organization	7-10
Mine-Emplacement Procedures	7-11
Mine Emplacement	7-13
NUISANCE MINEFIELDS	7-17
Siting	7-17
Location	7-17
Laying	7-18
Inspection and Maintenance	7-18
Handover	7-19
CHAPTER 8. REPORTING AND RECORDING.....	8-1
MINEFIELD/MUNITION FIELD REPORTS	8-1
Report of Intention	8-1
Report of Initiation	8-1
Report of Completion	8-2
Report of Transfer	8-2
Report of Change	8-3
Progress Reports	8-3
MINEFIELD/MUNITION FIELD RECORDS	8-3
Minefield Record	8-4
Hasty Protective Row Minefield Record	8-17
Nuisance Minefield	8-20
SCATTERABLE MINEFIELD/MUNITION FIELD REPORTING AND RECORDING	8-20
MINEFIELD/MUNITION FIELD OVERLAY SYMBOLS	8-25

Part Two. Counteroperations

CHAPTER 9. COUNTERMINE OPERATIONS	9-1
DEFINITIONS	9-1
Obstacle	9-1
Reduction	9-1
Breaching	9-1
Area Clearance	9-1
Route Clearance	9-1
Mine Neutralization	9-1
Proofing	9-2
Demining	9-2
BREACHING OPERATIONS	9-2
Intelligence	9-2
Fundamentals	9-4
Organization	9-4
Mass	9-5
Synchronization	9-5

	Page
CLEARING OPERATIONS.....	9-6
Upgrade of Breach Lanes	9-6
Area Clearance	9-7
Demining.....	9-7
CHAPTER 10. MINEFIELD REDUCTION	10-1
DETECTING	10-1
Visual	10-1
Physical	10-2
Electronic	10-3
Mechanical	10-6
REPORTING	10-7
REDUCING	10-7
Explosive	10-7
Mechanical	10-14
Electronic	10-22
Manual	10-22
PROOFING	10-24
MARKING	10-24
Lane-Marking Terms.....	10-25
Levels of Lane Marking and Patterns.....	10-27
Commander's Guidance for Lane Marking	10-33
Lane-Marking Devices	10-34
Marking Requirements of the North Atlantic Treaty Organization.....	10-36
CHAPTER 11. ROUTE AND AREA CLEARANCE.....	11-1
ROUTE CLEARANCE.....	11-1
Planning.....	11-1
Planning Considerations	11-3
Task Organization.....	11-7
Methods and Types.....	11-11
AREA CLEARANCE.....	11-15
Planning.....	11-16
Planning Considerations	11-17
Task Organization.....	11-18
Methods and Types.....	11-18
IMPROVISED MINE THREAT	11-19
MINE LOCATIONS	11-20
DISPOSITION OF MINES.....	11-20
Mine-Removal Techniques	11-21
Hand Neutralization	11-21
SAFETY.....	11-22
REPORTS	11-22
Situation Report	11-23
Progress Report	11-23
Mine Incident Report.....	11-26

Part Three. Special Mining Operations

CHAPTER 12. MINING OPERATIONS IN SPECIAL ENVIRONMENTS.....	12-1
STREAMBED AND RIVER MINING	12-1
Employment	12-1
Emplacement.....	12-2
Recovery.....	12-3
Recording.....	12-3
Safety	12-3
URBAN-TERRAIN MINING	12-6
Antipersonnel Mines.....	12-7
Conventional Antitank Mines	12-12
Scatterable Mines	12-13
Deception Measures.....	12-15
SPECIAL ENVIRONMENTS	12-16
Cold Regions.....	12-16
Jungles.....	12-17
Deserts.....	12-17
CHAPTER 13. BOOBY TRAPS AND EXPEDIENT DEVICES.....	13-1
Section I. Setting Booby Traps.....	13-1
TACTICS.....	13-2
SITING.....	13-4
TYPES OF TRAPS	13-4
COMPONENTS AND PRINCIPLES.....	13-5
ACTUATION METHODS	13-5
METHODS OF CONNECTION.....	13-5
Remote.....	13-5
Direct	13-8
PLANNING, SETTING, AND RECORDING	13-8
Timeliness.....	13-8
Orders and Briefing	13-8
Rehearsal.....	13-9
Organization and Procedure.....	13-9
Reporting and Recording	13-10
SITES	13-14
SAFETY	13-14
Section II. Clearing Booby Traps.....	13-14
INDICATIONS	13-15
DETECTION.....	13-15
CLEARING METHODS.....	13-15
COMBAT CLEARANCE	13-16
CLEARANCE IN SECURE AREAS.....	13-17
Policy and Planning	13-17
Control Point	13-18
Control and Size of Parties.....	13-18
Marking.....	13-18
Clearing of Open Areas.....	13-18
Clearing of Buildings	13-19
Exterior Reconnaissance and Entry.....	13-19
Search Techniques	13-19

	Page
Clearing Installations and Facilities.....	13-21
Clearing Obstacles.....	13-21
Clearing Secure Areas.....	13-21
CLEARANCE METHODS.....	13-22
IMPROVISED TRAPS.....	13-23
NONEXPLOSIVE TRAPS.....	13-23
Punji.....	13-23
Closing Trap.....	13-23
Spike Board.....	13-28
Venus Flytrap.....	13-28
Section III. Expedient Devices.....	13-29
AUTHORIZATION.....	13-29
EMPLOYMENT AND CONSTRUCTION TECHNIQUES.....	13-29
High-Explosive, Artillery-Shell Antitank Device.....	13-30
Platter Charge.....	13-31
Improvised Claymore.....	13-31
Grapeshot Antipersonnel Device.....	13-32
Barbwire Antipersonnel Device.....	13-32
APPENDIX A. INSTALLATION AND REMOVAL OF US MINES	
AND FIRING DEVICES.....	A-1
Section I. Antipersonnel Mines.....	A-2
M14.....	A-2
Characteristics.....	A-2
Installation.....	A-3
Removal.....	A-5
M16.....	A-6
Characteristics.....	A-6
Installation.....	A-7
Removal.....	A-10
Section II. Antitank Mines.....	A-11
M15.....	A-11
Characteristics.....	A-12
Installation Using the M624 Fuse.....	A-13
Removal Using the M624 Fuse.....	A-17
Installation Using the M603 Fuse.....	A-17
Removal Using the M603 Fuse.....	A-20
M19.....	A-21
Characteristics.....	A-22
Installation.....	A-22
Removal.....	A-24
M21.....	A-24
Characteristics.....	A-25
Installation.....	A-26
Removal.....	A-29
Section III. Firing Devices and Activators.....	A-29
M5 PRESSURE-RELEASE FIRING DEVICE (MOUSETRAP).....	A-30
Characteristics.....	A-30
Installation.....	A-31
Removal.....	A-31

	Page
M142 MULTIPURPOSE FIRING DEVICE.....	A-32
Characteristics	A-33
Arming and Disarming	A-33
M1 AND M2 ACTIVATORS.....	A-33
APPENDIX B. CONTROLS AND COMPONENTS OF	
SPECIAL-PURPOSE MUNITIONS	B-1
SELECTABLE LIGHTWEIGHT ATTACK MUNITION.....	B-1
M93 HORNET	B-1
APPENDIX C. THREAT MINE/COUNTERMINE OPERATIONS	C-1
MINE OPERATIONS.....	C-1
CHEMICAL MINES.....	C-6
COUNTERMINE OPERATIONS	C-7
Organization.....	C-7
Equipment	C-11
APPENDIX D. AIR VOLCANO	D-1
COMPONENTS	D-1
M87-Series Mine Canister.....	D-1
M139 Dispenser.....	D-2
LIMITATIONS.....	D-2
EMPLOYMENT.....	D-2
Deep Operations.....	D-3
Close Operations	D-4
Rear Operations	D-5
Minefield Effects	D-6
Planning	D-8
EMPLACEMENT	D-18
Outside Friendly Territory	D-20
Within Friendly Territory.....	D-20
REPORTING.....	D-22
Scatterable Minefield Warning	D-22
Scatterable Minefield Report and Record.....	D-22
APPENDIX E. SAFETY AND TRAINING	E-1
STORAGE.....	E-1
LIVE-MINE TRAINING	E-3
LIVE-MINE DEMONSTRATIONS	E-5
M16 Antipersonnel Mine	E-5
M18A1 Antipersonnel Munition.....	E-6
M15, M19, and M21 Antitank Mines.....	E-7
RISK ASSESSMENT FOR LIVE-MINE DEMONSTRATIONS.....	E-8
RISK ASSESSMENT FOR LIVE-MINE TRAINING.....	E-10
APPENDIX F. MINE AWARENESS.....	F-1
SOLDIER	F-1
Visual Indicators	F-1
Probing.....	F-2
AN/PSS-12 Metallic Mine Detector.....	F-3
Evacuation Drills	F-13

	Page
LEADER	F-17
Risk Management.....	F-17
Recording and Mine-Data Tracking	F-20
Mine-Incident Report	F-21
TRAINING	F-21
Individual Training	F-21
Leader Training.....	F-22
Unit Training.....	F-23
APPENDIX G. COUNTERMINE DATA	G-1
BREACHING ASSETS VERSUS THREAT OBSTACLES.....	G-1
FOREIGN MINE DATA	G-1
FOREIGN MINEFIELD EMPLACEMENT DATA.....	G-1
FOREIGN MINE DELIVERY SYSTEMS	G-1
APPENDIX H. METRIC CONVERSION CHART	H-1
GLOSSARY	Glossary-1
REFERENCES	References-1
INDEX	Index-1

LIST OF ILLUSTRATIONS

Figures

	Page
Figure 1-1. Mine components	1-2
Figure 1-2. Methods of actuating mines	1-3
Figure 1-3. Types of fuses	1-4
Figure 1-4. AHD incorporating a release mechanism.....	1-7
Figure 1-5. AHD not attached to the mine	1-7
Figure 1-6. Hand-emplaced US AHDs	1-8
Figure 2-1. Tactical versus protective obstacles.....	2-6
Figure 2-2. Tactical-obstacle effects.....	2-6
Figure 2-3. Minefield variables	2-7
Figure 2-4. Vehicle mine encounter probability versus minefield density	2-9
Figure 2-5. Disrupt-effect group.....	2-10
Figure 2-6. Fix-effect group	2-11
Figure 2-7. Turn-effect group	2-12
Figure 2-8. Block-effect group	2-13
Figure 2-9. Obstacle zones.....	2-16
Figure 2-10. Obstacle belts	2-17
Figure 2-11. Obstacle groups.....	2-18
Figure 2-12. TF defense COA	2-24
Figure 2-13. TF direct-fire analysis	2-25
Figure 2-14. TF obstacle-intent integration and priorities.....	2-26
Figure 2-15. Obstacle-plan refinement	2-28
Figure 2-16. Scheme-of-obstacle overlay.....	2-30
Figure 2-17. Sample obstacle-execution matrix	2-31
Figure 2-18. Minefield siting.....	2-38
Figure 2-19. Example of minefield resourcing	2-40
Figure 2-20. Mine resupply	2-41
Figure 2-21. Supply-point resupply method.....	2-46
Figure 2-22. Service-station resupply method.....	2-47
Figure 2-23. Tailgate resupply method.....	2-48
Figure 2-24. Minefield marking	2-51
Figure 2-25. Marking of minefields and obstacle groups.....	2-52
Figure 2-26. Sample obstacle-turnover work sheet.....	2-54
Figure 3-1. AP SCATMINES	3-2
Figure 3-2. AT SCATMINE	3-3
Figure 3-3. Emplacement of ADAMs and RAAMs	3-11
Figure 3-4. Gator SCATMINE system.....	3-15
Figure 3-5. Gator minefield	3-17
Figure 3-6. Volcano mine system	3-18
Figure 3-7. Volcano components	3-18
Figure 3-8. Volcano disrupt and fix minefields	3-21
Figure 3-9. Volcano turn and block minefields.....	3-22
Figure 3-10. MOPMS	3-22

	Page
Figure 3-11. MOPMS emplacement and safety zone.....	3-23
Figure 3-12. MOPMS in a disrupt minefield	3-25
Figure 3-13. MOPMS in a fix minefield	3-26
Figure 3-14. Ground Volcano minefield	3-27
Figure 4-2. M18A1 claymore.....	4-2
Figure 4-3. SLAM	4-3
Figure 4-4. SLAM in bottom-attack mode.....	4-4
Figure 4-5. SLAM in side-attack mode.....	4-5
Figure 4-6. SLAM in timed-demolition mode.....	4-5
Figure 4-7. SLAM in command-detonation mode.....	4-5
Figure 4-8. M93 Hornet.....	4-6
Figure 4-9. Hornet reinforcing a conventional minefield	4-9
Figure 4-10. Hornet reinforcing a Volcano minefield	4-10
Figure 4-11. Hornet area-disruption obstacle.....	4-11
Figure 4-12. Hornet gauntlet obstacle (one cluster)	4-12
Figure 4-13. Hornet gauntlet obstacle (platoon).....	4-13
Figure 4-14. Hornet-enhanced turn-and fix-obstacle groups	4-14
Figure 5-1. AT mines.....	5-1
Figure 5-2. AP mines.....	5-3
Figure 5-3. Prong-activated AP mine	5-5
Figure 5-4. Trip-wire-activated AP mine	5-5
Figure 5-5. Buried mine with pressure plate.....	5-6
Figure 5-6. Buried mine with tilt rod.....	5-7
Figure 5-7. Buried and concealed mines	5-7
Figure 6-1. Minefield requirements computation work sheet.....	6-5
Figure 6-2. Step-by-step procedures for completing the minefield requirements computation work sheet.....	6-9
Figure 6-3. Site layout.....	6-19
Figure 6-4a. Laying a minefield.....	6-20
Figure 6-4b. Laying a minefield (continued).....	6-21
Figure 6-5. Laying an IOE short row	6-21
Figure 6-6. Sample strip feeder report	6-22
Figure 6-7. Laying a row minefield	6-23
Figure 6-8. Measuring distances between mines with sandbags.....	6-25
Figure 6-9a. Sample DA Form 1355 for a row minefield (front)	6-26
Figure 6-9b. Sample DA Form 1355 for a row minefield (back)	6-27
Figure 6-10. Standardized disrupt and fix row minefields	6-28
Figure 6-11. Standardized turn row minefield	6-30
Figure 6-12. Standardized block row minefield	6-32
Figure 6-13. Site layout.....	6-35
Figure 7-1. Minefield layout.....	7-2
Figure 7-2. Cluster compositions	7-3
Figure 7-3. Arrangement of clusters in a mine strip	7-3
Figure 7-4. IOE baseline with short strips.....	7-4
Figure 7-5. Clusters on an IOE short strip	7-7
Figure 7-6. Minefield lanes and gaps	7-8
Figure 7-7. Mine-emplacement procedures.....	7-11
Figure 7-8. Laying and fusing mines.....	7-14
Figure 7-9. Lane closure.....	7-16

	Page
Figure 8-1. Conventional minefield/munition field reporting chain	8-2
Figure 8-2a. Sample DA Form 1355 (front side) for a standard-pattern minefield/munition field.....	8-5
Figure 8-2b. Sample DA Form 1355 (inside) for a standard-pattern minefield/munition field.....	8-6
Figure 8-2c. Sample DA Form 1355 (back side) for a standard-pattern minefield/munition field.....	8-7
Figure 8-3a. Sample DA Form 1355 (front side) for a Hornet minefield/munition field.....	8-12
Figure 8-3b. Sample DA Form 1355 (back side) for a Hornet minefield/munition field	8-13
Figure 8-4. Sample DA Form 1355-1-R	8-18
Figure 8-5. Hasty protective row minefield/munition field record.....	8-19
Figure 8-6a. Sample DA Form 1355 (front side) for a nuisance minefield/munition field.....	8-21
Figure 8-6b. Sample DA Form 1355 (inside) for a nuisance minefield/munition field	8-22
Figure 8-7. Scatterable minefield/munition field report and record work sheet	8-23
Figure 8-8. Sample SCATMINWARN.....	8-24
Figure 8-9. Scatterable minefield/munition field report and record for an ADAM/RAAM artillery mission	8-24
Figure 8-10. Sample SCATMINWARN for an artillery mission	8-25
Figure 8-11. Minefield/munition field overlay symbols	8-26
Figure 9-1. Sample OBSTINTEL report.....	9-3
Figure 10-1. AN/PSS-12 mine detector.....	10-3
Figure 10-2. ASTAMIDS.....	10-4
Figure 10-3. IVMMD components	10-5
Figure 10-4. MICLIC	10-8
Figure 10-5. AVLM	10-8
Figure 10-6. MICLIC employment in a minefield less than 100 meters deep.....	10-10
Figure 10-7. MICLIC employment in a minefield of uncertain depth or greater than 100 meters	10-10
Figure 10-8. Skip zone	10-11
Figure 10-10. APOBS.....	10-13
Figure 10-11. Bangalore torpedo.....	10-13
Figure 10-12. Skim technique	10-15
Figure 10-13. MCB.....	10-15
Figure 10-14. Mine-blade width compared to track-vehicle widths.....	10-16
Figure 10-15. MCR.....	10-17
Figure 10-16. Mine-roller width compared to track-vehicle widths.....	10-17
Figure 10-17. Panther.....	10-19
Figure 10-18. MiniFlail.....	10-20
Figure 10-19. Grizzly	10-20
Figure 10-20. CEV with mine rake	10-21
Figure 10-21. Tripod	10-23
Figure 10-22. Initial lane marking.....	10-28
Figure 10-23. Intermediate lane marking	10-30
Figure 10-24. Full lane marking	10-32
Figure 10-25. Marking devices.....	10-35
Figure 10-26. NATO standard marker	10-37
Figure 10-27. NATO lane-marking conversion	10-37
Figure 10-28. NATO standard marking for limited visibility	10-38
Figure 11-1. IBASIC	11-6

	Page
Figure 11-2. Platoon-size sweep team	11-9
Figure 11-3. Squad-size sweep team	11-10
Figure 11-4. Sweep teams in echelon	11-11
Figure 11-5. Linear clearance method.....	11-12
Figure 11-6. Combat clearance method.....	11-13
Figure 11-7. Deliberate route clearance	11-14
Figure 11-8. Hasty route clearance	11-15
Figure 11-9. Area clearance site layout.....	11-19
Figure 11-10. Sample enemy obstacle report.....	11-24
Figure 11-11. Sample route status report	11-25
Figure 11-12. Sample mine incident report	11-26
Figure 12-1. Outrigger techniques	12-3
Figure 12-2a. Sample DA Form 1355 (front side) for river mining	12-4
Figure 12-2b. Sample DA Form 1355 (inside) for river mining	12-5
Figure 12-3. Building sketch and mine plan (DA Form 1355)	12-7
Figure 12-4. Underground passageway.....	12-8
Figure 12-5. Open spaces	12-8
Figure 12-6. Street obstacles.....	12-9
Figure 12-7. Roof obstacles	12-9
Figure 12-8. Building obstacles	12-10
Figure 12-9. Probable M14 AP mine emplacement	12-11
Figure 12-10. Probable M16 AP mine emplacement	12-11
Figure 12-11. Probable M18A1 AP mine emplacement.....	12-12
Figure 12-12. AT mine emplacement in urban areas	12-13
Figure 12-13. AT mine emplacement in industrial and transportation areas	12-13
Figure 12-14. ADAM/RAAM employment.....	12-14
Figure 12-15. MOPMS employment	12-16
Figure 13-1. Typical electric and nonelectric booby traps.....	13-6
Figure 13-2. Methods of actuation.....	13-7
Figure 13-3. Remotely connected traps	13-7
Figure 13-4. Standard booby-trap sign.....	13-9
Figure 13-5a. Sample DA Form 1355 (front side) for a booby-trapped area	13-12
Figure 13-5b. Sample DA Form 1355 (inside) for a booby-trapped area	13-13
Figure 13-6. Improvised electrical FDs	13-24
Figure 13-7. Improvised nonelectric FDs (shear-pin operated)	13-25
Figure 13-8. Improvised nonelectric FDs (spring-operated)	13-25
Figure 13-9. Improvised, electric delay devices	13-26
Figure 13-10. Improvised, nonelectric delay devices.....	13-26
Figure 13-11. Typical punjis	13-27
Figure 13-12. Side-closing trap	13-27
Figure 13-13. Spike board	13-28
Figure 13-14. Venus fly trap	13-28
Figure 13-15. HE, artillery-shell AT device	13-30
Figure 13-16. Platter charge	13-31
Figure 13-17. Improvised claymore device.....	13-32
Figure 13-18. Grapeshot AP device	13-33
Figure 13-19. Barbwire AP device	13-33
Figure A-1. M14 AP mine.....	A-2
Figure A-2. M22 wrench.....	A-3
Figure A-3. M14 mine in ARMED position	A-4
Figure A-4. Removal of safety clip	A-4

	Page
Figure A-5. Bottom view of M14 mine	A-5
Figure A-6. M16A1 AP mine	A-6
Figure A-7. M16A1 mine and M25 wrench.....	A-7
Figure A-8. M605 fuse	A-8
Figure A-9. Safety pins	A-9
Figure A-10. Buried mine with a trip wire	A-9
Figure A-11. Metal collar on an M605 fuse	A-10
Figure A-12. M15 AT mine	A-12
Figure A-13. M20 wrench	A-13
Figure A-14. Correct safety-pin configuration.....	A-14
Figure A-15. Greasing the M624 fuse	A-14
Figure A-16. Tightening the fuse with the extension rod.....	A-15
Figure A-17. M15 mine in the hole	A-15
Figure A-18. Extension-rod assembly	A-16
Figure A-19. Assembly of the extension rod into the fuse ring	A-16
Figure A-20. Removal of safety pin	A-17
Figure A-21. ARMED position.....	A-18
Figure A-22. SAFE position.....	A-18
Figure A-23. Safety fork	A-19
Figure A-24. Clearance test.....	A-20
Figure A-25. M15 mine in the hole	A-20
Figure A-26. M19 AT mine	A-21
Figure A-27. Removal of the pressure plate	A-22
Figure A-28. Firing pin.....	A-23
Figure A-29. M21 AT mine	A-25
Figure A-30. M607 fuse	A-26
Figure A-31. M26 wrench	A-26
Figure A-32. Buried M21 mine.....	A-27
Figure A-33. Removing the band and the stop	A-28
Figure A-34. M5 FD	A-30
Figure A-35. Arming the M15	A-31
Figure A-36. M142 FD	A-32
Figure A-37. M1 activator	A-34
Figure B-1. SLAM components	B-1
Figure B-2. Hornet components	B-3
Figure B-3. Hornet controls and indicators	B-4
Figure C-1. GMZ armored tracked mine layer	C-2
Figure C-2. Threat-style rapidly emplaced minefield	C-3
Figure C-3. Threat-style antitrack minefield	C-3
Figure C-4. Threat-style antihull minefield	C-4
Figure C-5. Threat-style AP minefield.....	C-4
Figure C-6. UMZ SCATMINE system	C-6
Figure C-7. Chemical-mine employment	C-7
Figure C-8. BAT-M with BTU bulldozer blade.....	C-8
Figure C-9. KMT-4 plow	C-8
Figure C-10. IMP portable mine detector	C-9
Figure C-11. DIM mine detector	C-9
Figure C-12. KMT-5 plow-roller combination	C-10
Figure C-13. IMR armored engineer tractor	C-10
Figure C-14. M1979 armored mine clearer	C-11

	Page
Figure D-1. Air Volcano system.....	D-1
Figure D-2. Turn obstacle	D-6
Figure D-3. Block obstacle	D-7
Figure D-4. Disrupt obstacle.....	D-7
Figure D-5. Fix obstacle	D-8
Figure D-6. Site layout	D-15
Figure D-7. Sample Volcano card	D-17
Figure D-8. Fencing for an air Volcano minefield.....	D-21
Figure E-1. M16 AP mine.....	E-6
Figure E-2. M18A1 AP mine.....	E-7
Figure E-3. M15 and M19 AT mines	E-8
Figure E-4. M21 AT mine.....	E-8
Figure E-5. Excerpt from Risk-Assessment Techniques Manual, prepared by the Department of Transportation's Transportation Safety Institute, August 1986	E-9
Figure E-6. Preliminary hazard-analysis work sheet (arming M15).....	E-11
Figure E-7. Preliminary hazard-analysis work sheet (disarming M15).....	E-12
Figure E-8. Preliminary hazard-analysis work sheet (arming M16).....	E-13
Figure E-9. Preliminary hazard-analysis work sheet (disarming M16).....	E-14
Figure E-10. Preliminary hazard-analysis work sheet (arming M19).....	E-15
Figure E-11. Preliminary hazard-analysis work sheet (disarming M19).....	E-16
Figure E-12. Preliminary hazard-analysis work sheet (arming M21).....	E-17
Figure E-13. Preliminary hazard-analysis work sheet (disarming M21).....	E-18
Figure E-14. Preliminary hazard-analysis work sheet (command detonation)	E-19
Figure E-15. Preliminary hazard-analysis work sheet (peripheral factors)	E-20
Figure F-1. AN/PSS-12 metallic mine detector.....	F-4
Figure F-2. AN/PSS-12 packed components	F-4
Figure F-3. Electronic unit.....	F-5
Figure F-4. Battery installation.....	F-5

Tables

Table 2-1. Echelons of obstacle control and effect	2-15
Table 2-2. Planning factors for the mine dump	2-21
Table 2-3. Planning factors for work rates.....	2-21
Table 2-4. Planning factors for standardized row minefields	2-22
Table 2-5. Planning factors for scatterable minefields.....	2-22
Table 2-6. Ranges of common weapons	2-23
Table 2-7. Personnel requirements for a Class IV/V supply point.....	2-42
Table 2-8. Class IV/V haul capacity.....	2-45
Table 3-1. Characteristics of AP SCATMINES	3-2
Table 3-2. Characteristics of AT SCATMINES	3-4
Table 3-3. SD windows	3-7
Table 3-4. Emplacement authority.....	3-9
Table 3-5. Coordination responsibilities.....	3-10
Table 3-6. RAAM and ADAM minefield density and size	3-14
Table 3-7. Marking scatterable minefields	3-26
Table 3-8. Safety and fragment hazard zones.....	3-28
Table 4-1. Hornet minimum emplacement distances.....	4-15

Table 5-1. Characteristics of AT mines.....	5-2
Table 5-2. Characteristics of AP mines.....	5-3
Table 5-3. Sympathetic detonation chart	5-8
Table 7-1. Platoon organization and equipment	7-10
Table 7-2. Sample mines tally sheet	7-15
Table 8-1. Minefield/munition field obstacle numbering system	8-8
Table 8-2. Abbreviations for obstacle types.....	8-9
Table 9-1. Lane widths	9-4
Table 10-1. Lane-marking levels, unit responsibilities, and trigger events	10-33
Table 10-2. Guidelines for lane-marking devices.....	10-34
Table 11-1. Sample task organization for a route clearance	11-2
Table 11-2. Personnel and equipment requirements for a sweep team.....	11-8
Table 11-3. Sample task organization for an area clearance.....	11-17
Table 13-1. Tactical reports.....	13-11
Table 13-2. Clearing equipment.....	13-17
Table C-1. Normal parameters for threat-style minefields	C-2
Table D-1. Air Volcano capabilities and limitations	D-4
Table D-2. Air Volcano minefield data.....	D-6
Table D-3. Planning process (H-hour sequence)	D-11
Table D-4. Air Volcano dispensing times based on air speed	D-19
Table E-1. Mine color-coding system	E-2
Table F-1. Risk-assessment criteria.....	F-18
Table F-2. Sample risk assessment.....	F-19
Table G-1. Mounted breaching assets versus threat obstacles	G-2
Table G-2. Dismounted breaching assets versus threat obstacles	G-5
Table G-3. Foreign track-width AT mines.....	G-9
Table G-4. Foreign full-width AT mines.....	G-10
Table G-5. Foreign side-attack AT mines	G-11
Table G-6. Foreign pressure-fused AP mines.....	G-11
Table G-7. Foreign trip-wire/break-wire-fused AP mines.....	G-12
Table G-8. Foreign emplaced minefields	G-13
Table G-9. Foreign mine delivery systems	G-14
Table H-1. Metric conversion chart.....	H-1

Preface

Field Manual (FM) 20-32 provides United States (US) armed forces with tactical, technical, and procedural guidance for conducting mine and countermine operations. It applies to all elements of the combined arms team for maneuver and engineer staff planning and coordination. The manual is presented in three parts—mine operations, counteroperations, and special-mining operations.

The guidance provided focuses on individual skills of emplacing and removing mines, team and squad tasks, platoon and company organization and planning, and battalion/task force (TF) organization and coordination for successful obstacle reduction and breaching operations.

The provisions of this publication support existing doctrine established by FMs 5-34, 5-100, 90-7, and 90-13-1. It also contains new and improved techniques for emplacing row mines; marking, reporting, and recording minefields; reducing simple and complex obstacles; and emplacing a standard-pattern minefield. This manual reflects new doctrine from FMs 5-10, 5-71-2, and 5-71-3.

This publication implements the following International Standardization Agreements (STANAGs) between North Atlantic Treaty Organization (NATO) forces:

- STANAG 2036. *Land Minefield Laying, Marking, Recording, and Reporting Procedures*. Edition 5.
- STANAG 2889. *Marking of Hazardous Areas and Routes Through Them*. Edition 3.
- STANAG 2990. *Principles and Procedures for the Employment in Land Warfare of Scatterable Mines with a Limited Laid Life*. Edition 1.

NOTE: US policy regarding the use and employment of antipersonnel land mines (APLs) outlined in this FM is subject to the Convention on Certain Conventional Weapons and Executive Orders. Current US policy limits the use of non-self-destructing APLs to (1) defending the US and its allies from armed aggression across the Korean demilitarized zone and (2) training personnel engaged in demining and countermine operations. The use of the M18A1 claymore in the command-detonation mode is not restricted under international law or Executive Order.

All references to US employment of non-self-destructing APLs (such as row mining) in this manual are intended to provide doctrine for use in Korea only. This information is provided in bold lettering throughout the manual. Detailed doctrine on APLs is also provided to ensure that US forces recognize how the enemy can employ these weapons.

As the US military seeks to end its reliance on APLs, commanders must consider the increased use of other systems such as the M18A1 claymore, nonlethal barriers (such as wire obstacles), sensors and surveillance platforms, and direct and indirect fires.

This publication includes the following appendixes:

- Appendix A. Installation and Removal of US Mines and Firing Devices.
- Appendix B. Controls and Components of Special-Purpose Munitions.
- Appendix C. Threat Mine/Countermine Operations.
- Appendix D. Air Volcano.
- Appendix E. Safety and Training.
- Appendix F. Mine Awareness.
- Appendix G. Countermine Data.
- Appendix H. Metric Conversion Chart.

The proponent for this publication is Headquarters, US Army Training and Doctrine Command (TRADOC). Forward comments and recommendations on Department of the Army (DA) Form 2028 to Commandant, US Army Engineer School, ATTN: ATSE-DME-MWF, Fort Leonard Wood, Missouri 65473-5000.

Unless this publication states otherwise, nouns and pronouns do not refer exclusively to men.

Chapter 1

Introduction

This chapter provides the mechanics and characteristics of antitank (AT) mines and munitions, antipersonnel (AP) mines and munitions, and antihandling devices (AHDs). The information contained in this chapter also provides a foundation for the rest of the manual.

Land-based mines and munitions are hand-emplaced, remote-delivered, ground-delivered, or air-delivered:

- Hand-emplaced mines and munitions require manual arming and are labor-, resource-, and transport-intensive.
- Remote- and air-delivered mines and munitions require less time and labor; however, they are not as precisely placed as hand-emplaced mines and munitions.
- Ground-delivered mines are less resource-intensive than hand-emplaced mines. They are not precisely placed; however, the minefield boundaries are.

Soldiers can surface lay or bury mines and munitions and can place AHDs on hand-emplaced AT mines.

NOTE: Some countries employ AHDs on AP mines, but US forces are not authorized to employ AHDs on any type of AP mine.

MECHANICS OF MINES

CHARACTERISTICS AND FUNCTIONING

A land mine is an explosive device that is designed to destroy or damage equipment or personnel. Equipment targets include ground vehicles, boats, and aircraft. A mine is detonated by the action of its target, the passage of time, or controlled means. There are two types of land-based mines—AT and AP. Mines generally consist of the following parts (Figure 1-1, page 1-2):

- Firing mechanism or other device (sets off the detonator or igniter charge).
- Detonator or igniter (sets off the booster charge).
- Booster charge (may be attached to the fuse or the igniter or be part of the main charge).
- Main charge (in a container; usually forms the body of the mine).
- Casing (contains all the above parts).

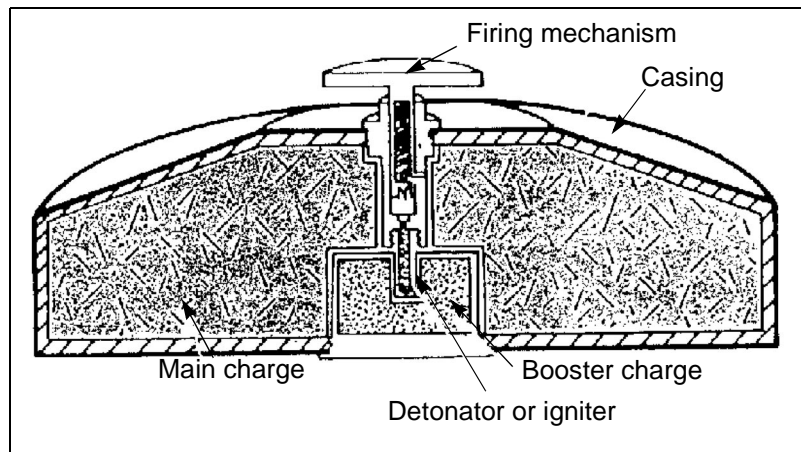


Figure 1-1. Mine components

COMPONENTS AND INITIATING ACTIONS

A firing mechanism prevents the mine from exploding until it makes contact with, or is influenced by, its target. Once a mine has been armed, the firing mechanism may be actuated by the following methods (Figure 1-2):

- Applying pressure (including tilt rod).
- Pulling a trip wire.
- Releasing tension or breaking a trip wire.
- Releasing pressure.
- Passage of time (time-delay mechanism).
- Impulses.
 - Electrical.
 - Vibration.
 - Magnetic-influence.
 - Electromagnetic-frequency.
 - Infrared-sensored.
 - Acoustic.

To arm some mines, you must position the igniter, set the mechanism properly, and disengage the safety device (usually by removing a safety pin). The fuse is the initial component in the firing chain; it has a low-explosive (LE) powder but is highly sensitive. The fuse is actuated by an initiating action. Although mines are issued with a standard fuse, alternate fuses are issued separately for some mines.

The four main fuse types are shown in Figure 1-3, page 1-4.