APPENDIX E

SAFETY AND TRAINING

Conduct mine training as if the mines were live. This is the only way soldiers form a habit of handling mines correctly and safely and gain a true appreciation of the requirements and the time it takes to perform an actual mine warfare mission. Live mine training gives soldiers the confidence needed to handle mines and their components. Accidents can usually be traced to ignorance, negligence, deliberate mishandling, overconfidence, mechanical failure, or fright. The first four can be overcome by training and proper supervision. Mechanical failure rarely happens; but if it does, it can be controlled by training and proper supervision. The last item, fright, is mastered through well-controlled, live mine training.

Mine training is inherently dangerous. Between FY85 and FY88, there were eight accidents in the active Army during mine warfare training (US Army Safety Center, Fort Rucker, Alabama). These accidents resulted in the deaths of three soldiers. In FY90, there were two mine accidents, resulting in eleven casualties. Live mine training is dangerous, in part, because several different types of mines and fuze systems are used throughout the world.

Detailed safety instructions for each type of mine are provided throughout this manual. This appendix merely points out the safety aspects of live mine training that are common to all types of mines.

STORAGE

There are three types of mines used in mine training—

Inert. Does not contain explosives.

Practice. Contains a low explosive (LE) charge or a smoke producing increment to simulate detonation.

HE. Actual mines used in combat.

Conventional mines are painted to enhance concealment, to retard rusting of exposed metal parts, and to help identify the type of mine and filler (HE, LE, or chemical agent). Older manufactured mines are painted according to the Five-Element Marking System; newer manufactured mines are painted according to the Standard Ammunition Color Coding System (see Table E-1, page E-2).

Note: Mines that are color-coded and marked according to the old system have been on hand for several years. Ensure all ammunition, whether color-coded according to the old or new system, is properly and fully identified.

Always handle mines with care. The explosive elements in fuzes, primers, detonators, and boosters are particularly sensitive to mechanical shock, friction, static electricity, and high temperatures. Boxes and crates containing mines should not be dropped, dragged, tumbled, walked on, or struck. Do not smoke within 50 meters of a mine or its components.

When it is necessary to leave mines in the open, set them on dunnage at least 2 inches above the ground. Place a waterproof cover (such as canvas) over them, and leave enough space for air circulation. Dig drainage trenches around the stacks to prevent water from collecting under the mines. Protect mines and their components against moisture by waterproofing them with grease coatings, tar

Table E-1. Mine color-coding system

Type of Ammunition	Five-Element Marking System (old)	*Standard Ammunition Color-Coding System (new)
Persistent casualty chemical agent	Gray with green markings and two green bands	Gray with green markings and two 1/2-inch green bands
Nerve agent	Gray with green markings and either two or three green bands	Gray with green markings and three 1/2-inch green bands
Incendiary	Gray with violet markings and one violet band	Light red with black markings and one yellow band
HE	Olive drab with yellow markings	Olive drab with yellow markings
Practice mine	Blue with white markings	Blue with white markings
Inert mine	Black with the word *INERT* in white	Blue with the word *INERT* in white

*Chemical ammunition containing HE has one 1/4-inch yellow band in addition to other markings.

paper, or tarpaulins. Additional maintenance procedures include—

- Do not open mine boxes in a magazine, at an ammunition dump, or within 30 meters of an explosive store. If available, use copper or wooden safety tools to unpack and repack mines.
- Do not fuze mines within 30 meters of an explosive or ammunition holding area. Mines can be fuzed at the mine dump.
- Use specifics authorized by the US Army Materiel Command and applicable technical manuals to disassemble mines and their components.
- Safety pins, safety forks (clips), and other safety devices prevent accidental initiation of the mine while it is handled. Remove them as the last step when arming the mine, and replace them before the mine is moved again.
- Place tape over firing device wells, cap wells, activator wells, and fuze cavities. Ensure they are clear of obstruction and free of foreign matter before attempting to install the fuze, detonator, or firing device.
- Mines usually function satisfactorily at temperatures from 40 degrees Fahrenheit (F) to 160 degrees F. Most mines are not appreciably affected by temperature changes. If the temperature fluctuates around freezing, take steps to prevent moisture or water from accumulating around the mine and subsequently freezing. Mines can become neutralized by the ice formations (see Chapter 12).
- Mines can be recovered (taken up and relaid) if proper procedures are observed and components do not show evidence of damage or deterioration.

- Practice or inert mines, or their components, are not present when live mines, or their components, are being used.
- Never mix inert mines with live mines.
- Do not display live mines or their components in museums, demonstrations, models, or similar layouts. Only inert equipment can be used for displays.
- Always handle explosive materials with appropriate care. The explosive elements in primers, blasting caps, and fuzes are particularly sensitive to shock and high temperatures.
- Assemble activators, standard bases, and firing devices before installing them. Do not carry them in pockets of your clothing.
- Do not point firing devices at anyone.
- When possible, complete camouflaging before removing the positive safety pin.

NOTE: Additional storage and safety precautions are outlined in TM 9-1300-206.

LIVE MINE TRAINING

Live mine training is the preparing, laying, arming, neutralizing, and disarming of live mines using live fuzes and components in a training environment.

Supervisors must adhere to the following safety considerations when conducting live mine training:

- Only personnel who are qualified and certified according to the local range SOP are allowed to supervise activities or training in which live mines or their components are used.
- Minimum personnel requirements to conduct live mine training are—
  - Range officer (OIC).
  - Range safety officer (RSO).
  - One NCO supervisor for each arming bay.
  - Mine explosive breakdown NCO.
  - One medic per four arming bays.
  - Guards, as required by the range SOP.
- A sound organization is a must before live mine training can begin. The OIC and supervising NCOs conduct a demonstration/briefing to ensure the practice runs smoothly.
- The training officer must foresee hazards that can occur through personnel nervousness or material failure. The commander conducts a risk assessment according to AR 385-10.
- The OIC takes his place at the control point or post. Once he is satisfied that all safety regulations have been observed, he orders the first detail to start training.
- Soldiers are trained on inert and practice mines before arming live mines according to guidelines established by the Standards in Training Commission (STRAC).
- Do not insert fuzes into mines until ordered to do so by the OIC.
- An NCO supervisor must be present when soldiers arm live mines. He ensures soldiers adhere to procedures and regulations.
- Only one soldier arms a mine at any given time.
- Disarm the mine before arming the next one.
- Never arm an M16 AP mine in the trip-wire mode during live mine training.
- Instructors inspect fuzes and mines for serviceability before starting practice.
- After each student has gone through the station, the instructor inspects mines and their components for damage and excessive wear. If damage or wear is found, replace the mine and the fuze.

- All personnel wear a helmet, with a serviceable chin strap fastened, and body armor when arming and disarming mines.
- Ear protection is not permitted in the arming bays. The student must be able to hear the NCO supervisor and certain distinct noises (such as a firing pin dropping).
- Post guards at all entrances to the range. They communicate by radio, wire, voice, or signal with the RSO. No one enters the range without permission from the RSO.
- Keep mine records and inventory sheets. Maintain accountability of all mines and fuzes, before and after each exercise.
- The instructor draws and returns supplies; checks equipment for issue; and ensures live mines are safe, serviceable, and unarmed. He ensures the requirements contained in AR 385-63, appropriate range regulations, and SOPS are observed. He also ensures that no one does anything to prejudice safety.
- Clearly mark the word *LIVE* on all live mines and their components used for live mine training. Maintain them separately from practice and inert mines.
- Do not use live AHDs with live mines during training. They can be used with practice and inert mines.
- Conduct all arming and disarming in the prone position according to TM 9-1345-203-12&P.
- Waiting personnel are located in a bunker, behind a suitable barricade, or a safe distance from mine training.
- Supervisors ensure live mine training is not rushed. There are no shortcuts. Allow the soldier ample time to arm and disarm the mine. Most soldiers are already in a high state of stress from dealing with live munitions. Rushing them only serves to heighten their stress level.

LIVE MINE DEMONSTRATION

Live mine firing demonstrations show mine characteristics and capabilities using M 14, M16, and M18 AP mines and M15, M19, and M21 AT mines. The appropriate authority must authorize the demonstration, and firing personnel must be fully conversant with all safety and technical aspects pertaining to live mine firing.

Rules

An OIC and RSO are appointed for each activity involving live mine firing. The amount of explosive contained in the mine cannot exceed the maximum amount allowed for the range. Only one mine is fired at a time.

Upon arriving at the range, the instructor and his assistants establish areas according to the following rules (areas are signposted for large demonstrations):

Firing point. Sited outside the danger area and near the OIC to facilitate coordination, commentaries, and firing.

Spectator area. Sited outside the danger area and within earshot of the commentator. It is large enough to provide a good view of the explosion.

Supply area. Any suitable area away from spectators.

Explosive area. Sited away from supplies and spectators.

Mine area. Mines are set out in full view of the OIC and spectators. Individual mines are a minimum of 25 meters apart.

Target area. Targets are positioned and inspected by spectators before the blasting cap is inserted into the mine.

M14 AP Mine

Safety distance: 100 meters.

Firing procedures:

1. Roll out 100 meters of electric firing cable and attach it to a stake or picket in the ground (leave at least 3 feet of free end). Test the firing cable for continuity.

2. Dig a hole in the ground deep enough so the top of the M 14 is flush with the ground surface. Ensure there is enough clearance under the mine for the electric blasting cap, which protrudes from the base of the mine. Do not remove the safety clip. The actuating dial remains on the SAFE (S) position.

3. Test an electric blasting cap (under a sandbag) with the demolition test set.

4. Attach the ends of the blasting cap leads to the end of the electric cable, and insulate the joints with tape. Place the blasting cap in the detonator well and secure it with a rubber band or adhesive tape. (See Figure E-1.)

5. If desired, place a target on top of the mine (a boot full of sand is suitable).

6. All personnel withdraw to the firing point.

7. Conduct normal prefire checks, then fire the mine.

NOTE: The mine explodes instantaneously. The demonstration clearly illustrates the sound of an M14 explosion, the size of the crater left by an M14, and the effect on a rubber-sole boot.

Misfires: If the mine misfires, the RSO disposes of the mine by placing a block of C4 as close to the mine as possible, without touching it. He destroys the mine by normal nonelectric means.

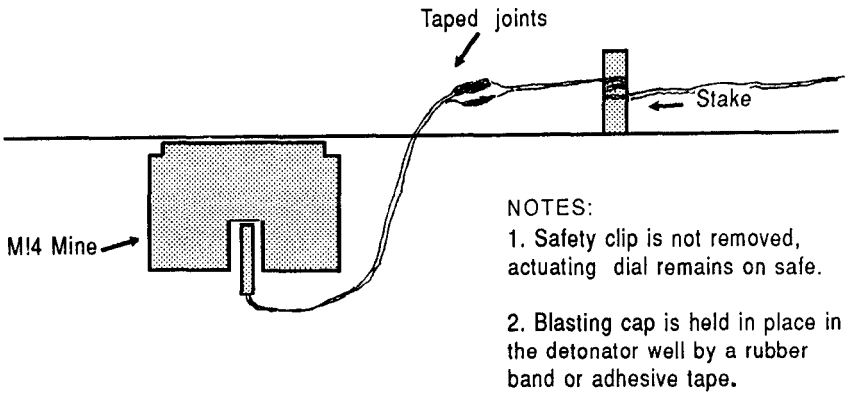

Figure E-1. M14 AP mine

M16 AP Mine

Safety distance: 300 meters.

Firing procedures:

1. Roll out 300 meters of firing cable and attach it to a stake or picket in the ground (leave at least 3 feet of free end). Test the firing cable for continuity.

2. Place the mine in the ground (dig in level with the surface). Remove the shipping plug.

3. Test a blasting cap (under a sandbag) with the demolition test set.

4. Attach the ends of the blasting cap leads to the end of the electric cable, and insulate the joints with tape. Place the blasting cap in the fuze well. (See Figure E-2.)

Suggested target: A circle of tar paper, 20 feet in diameter, supported by 6-foot pickets. Spectators can later view shrapnel effects.

NOTE: This method dispenses with the M605 igniter. The mine cannot be detonated by pull or pressure. The expulsion charge and millisecond delay fuzes are still operated, and the mine bounds out of its casing (which remains in the ground) before exploding in the air. Although the normal firing delay is removed, it does not detract from the demonstration. The blasting cap is suspended two-thirds of the way down the fuze well to initiate the expelling charge and delay elements.

Misfires: In the event of a misfire, the RSO disposes of the mine by placing a block of C4 as close to the mine as possible, without touching it. He destroys the mine by normal non-electric means.

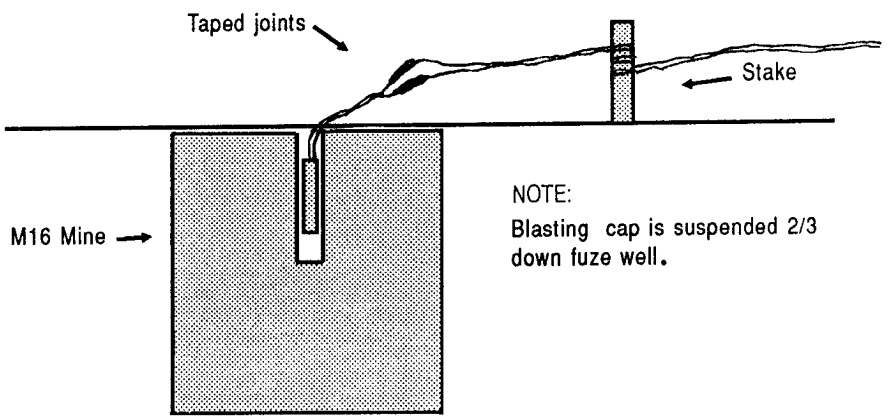

Figure E-2. M16 AP mine

M18A1 AP Mine

Safety distance: 300 meters.

Firing procedures:

1. Roll out 300 meters of firing cable and attach it to a stake or picket in the ground (leave at least 3 feet of free end). Test the firing cable for continuity.

2. Place the mine on the ground. (Ensure the front of the mine faces away from the firing point.) Remove the shipping plug.

3. Test an electric blasting cap (under a sandbag) with the demolition test set.

4. Attach the blasting cap to the firing cable and secure the splice with tape. Place the electric blasting cap in the detonator well. (See Figure E-3.)

Suggested target: Several E-type silhouette targets 15 to 100 meters from the mine.

NOTE: The procedure detailed here applies only to demonstration firings. Standard accessories are used on all other occasions. The mine explodes instantaneously and clearly illustrates the sound of an M18A1 explosion.

Misfires: In the event of a misfire, the RSO disposes of the mine by placing a block of C4 as close to the mine as possible, without touching it. He destroys the mine by normal nonelectric means.

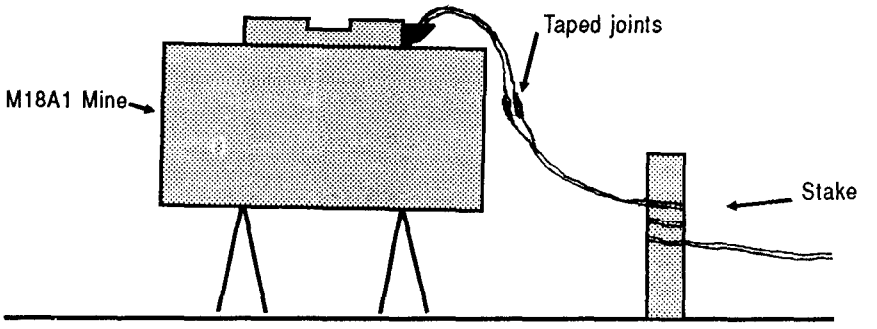

Figure E-3. M18A1 AP mine

M15, M19, and M21 AT Mines

Safety distance: 1,000 meters.

Firing procedures:

1. Roll out 1,000 meters of firing cable and attach it to a stake or picket in the ground (leave at least 3 feet of free end). Test the firing cable for continuity.

2. Place the mine in the ground; leave the top exposed. A target is used only when the mine can be placed without disturbing the target. A derelict vehicle is a suitable target.

3. To detonate M15 and M19 mines, place a block of C4 on top of them. (See Figure E-4.)

4. To detonate an M21 mine, remove the shipping plug from the booster well and pack the well with C4. Insert an electric blasting cap into the C4. (See Figure E-5.)

NOTE: Do not remove safety devices, and keep arming dials in the SAFE position. The mine explodes instantaneously and clearly demonstrates the blast /shaped charge effect.

Misfires: In the event of a misfire, the RSO disposes of the mine by placing a block of C4 as close to the mine as possible, without touching it. He destroys the mine by normal nonelectric means.

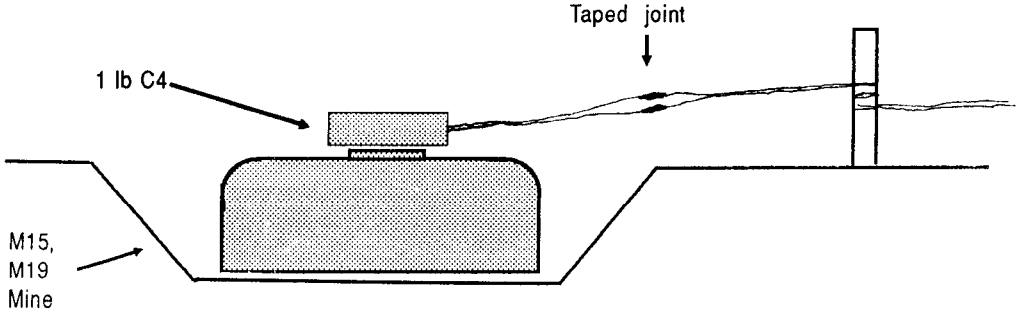

Figure E-4. M15 and M19 AT mines

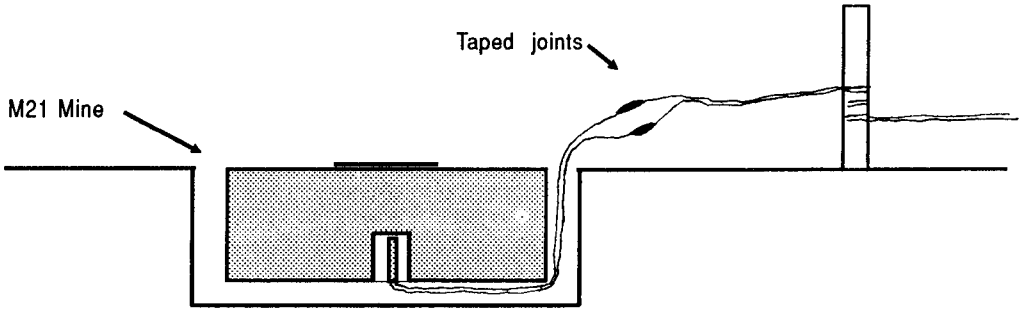

Figure E-5. M21 AT mine

RISK ASSESSMENT FOR LIVE MINE DEMONSTRATIONS

The following risk assessment is provided as a guideline for live mine demonstrations using M14 and M16 AP mines. It must be carefully reviewed before conducting a demonstration. Live mine demonstrations can be conducted in a safe manner. The risk of injury to personnel is significantly minimized if you adhere to established procedures.

During the demonstration, mines are not armed with standard fuzes. They are activated by electric blasting caps placed inside the fuze wells. The safety clip on the M14 mine is **not** removed.

A demonstration shows the effectiveness of M14 and M16 AP mines. Spectators do not handle the mines or explosives. To show the effectiveness of an M14 mine, a boot is filled with sand and placed over the mine; for an M16 mine, a sheet paper is placed in a semi-circle around the mine. Spectators remain in bunkers or at a safe distance while mines are primed with electric blasting caps and during the detonation. After the mines have been detonated and the RSO has cleared the area, spectators are allowed to view the results of each mine. Misfires are handled by the RSO.

Figure E-6, pages E-9 and E-10, is a risk assessment prepared by the Department of Transportation.

QUALITATIVE RISK ASSESSMENT.

Qualitative risk assessment techniques are used to place a value on the level of risks created by hazards in an operation. The principal qualitative technique is the Risk Assessment Code (RAC) described in MILSTD-882B. This method was established as a common way to set priorities for DOD-wide hazard abatement programs and uses a RAC matrix format to combine the concepts of frequency and severity into a single, numerical code. It is very useful in comparing different risks such as those from different programs or even differences such as health vs. safety risks.

RACs are implemented, for the Army, in AR 385-10. In that regulation, the two qualities of Hazard Severity and Hazard Probability are described as follows:

Category I - CATASTROPHIC. "May cause death or loss of a facility." In this case "loss" does not mean a period of interrupted service; it means destruction of the facility or operation.

Category II - CRITICAL. "May cause severe injury, severe occupational illness, or major property damage.

Category III - MARGINAL. "May cause minor injury, minor occupational illness, or minor property damage."

Category IV - NEGLIGIBLE. "Probably would not affect personnel safety or health, but nevertheless in violation of specific standards."

Figure E-6. Excerpt from Risk Assessment Techniques Manual, prepared by the Department of Transportation's Transportation Safety Institute, August 1986

Mishap Probability. This is "the probability that a hazard will result in a mishap, based on an assessment of such factors as location, exposure in terms of cycles or hours of operation and affected population." This expression combines the idea of the probability of an event and the exposure to the event. These probabilities are expressed as letters conforming to the following scaling system:

Subcategory A - "Likely to occur immediately."
Subcategory B - "Probably will occur in time."
Subcategory C - "May occur in time."
Subcategory D - "Unlikely to occur."

The two qualities are combined to yield a RAC by use of the following table:

AR 385-10 Risk Assessment Code Table

		Mishap Probability			
		A	B	C	D
Hazard Severity	I	1	1	2	3
	II	1	2	3	4
	III	2	3	4	5
	IV	-	-	-	-

Table 3

In using the AR 385-10 RAC system, it's important to note that the IA and IIA classifications are termed "imminent danger." Though their RAC codes of 1 are the same as that of the IB entry, their immediacy makes them more critical. The codes are useful in assessing an operation as it begins, but they must be updated as the operation continues, the facility ages, etc. to account for degrading condition or performance.

For risk managers there are some important organizational/management considerations to RAC codes. AR 40-10 (Health) also contains a RAC system, but due to a difference in definitions, the health RAC code may be a lower number indicating a higher degree of risk. This is important to managers that are comparing health risks to others ranks under AR 385-10; the health issue would always win if no compensation or consideration were factored into the codes. From the managerial standpoint it must be remembered that RACs are judgmental and not necessarily held to be the same by different managers or evaluators. When differences in perception occur, the differences are likely based in either the understanding of the operation's behavior or the criteria for selecting the probability and severity. You'll find it wise to listen for the basis of others' RAC choices and attempt to develop a common understanding.

QUANTITATIVE RISK ASSESSMENT.

Quantitative risk assessment techniques are used to prepare estimates of risk levels using performance data, when available, to improve the accuracy of risk estimates used in risk acceptance decision making. These assessments are numeric values representing the safety risk of an Army activity, system operation, or comparable endeavor, based on actuarial or derived numeric data. Though RACs are numerical, they are derived from judgments and are not demonstrable in records of performance. If it is desirable that performance be measured, it's necessary that quantified estimates of risk levels be established, that risk levels must be predictive so that future performance has a base of comparison, and that risk levels be assigned numeric values.

Figure E-6. Excerpt from Risk Assessment Techniques Manual, prepared by the Department of Transportation's Transportation Safety Institute, August 1986 (continued)

RISK ASSESSMENT FOR LIVE MINE TRAINING

The USAEC, Department of Instruction (DOI), obtained information for the following risk assessment from the Collective Training Branch, Department of Training and Doctrine (DOTD), and the Field Engineering Branch for Engineer Officer Basic Course (EOBC) demolitions training. Hazards are identified and analyzed on preliminary hazard analysis work sheets (see Figures E-7 through E-18, pages E-11 through E-24.) Risk assessment codes are assigned to each hazard based on severity and probability of occurrence.

References used in the risk analysis process include this manual and the following publications:

- DA Pam 350-38.
- AR 385-10.
- AR 385-16.
- AR 385-63.
- STP 5-12B1-SM.
- ★ TC 25-8.
- TM 9-1345-203-12&P.
- TM 43-0001-36.

PRELIMINARY HAZARDS ANALYSIS WORK SHEET

Operation Name: Arming the M14 AP Mine
Date Prepared: 11 October 1990
Sheet Number: 1 of 1

Hazards	System Effects	Causal Factors	RAC	Actions	Controlled RAC	Standards/Comments
(1) Damaged mine used	(1) None	(1) Lack of training/improper training (2) Improper supervision (3) Incomplete or no inspection	IV B (-)	(1) Train/inspect supervise (2) Do not use mine (3) Contact QASAS to investigate (4) Turn in the mine for disposal	IV D (-)	(1) Proper training (2) Soldiers proficient on training aid mines first (3) 1 instructor to 1 soldier (4) All training is conducted in the prone position (5) Mine training is done after identified by a unit's METL and only with select personnel
(2) Too much pressure on the pressure place (without detonator installed)	(1) Belleville spring snaps firing pin in extended position	(1) Improper handling procedures	II C (3)	(1) Ensure proper handling when the safety clip is removed (2) Do not use mine	IV C (-)	(6) Training is conducted in the proper environment (7) Soldiers are in the proper protective gear
(3) Screwing detonator into the mine with a firing pin in the extended position	(1) Mine detonates	(1) Lack of training/improper training (2) Improper supervision (3) Incomplete or no inspection	II C (3)	(1) Ensure proper inspection is conducted. (2) Contact QASAS	II D (4)	(8) No trip wires or AHDs are used with a live M14 mine
(4) Improper handling of detonator	(1) Detonator detonates	(1) Improper soldier handling (2) Lack of training/improper training (3) Improper supervision (4) Incomplete or no inspection	III C (4)	(1) Handle detonator properly	III D (5)	
(5) Weakened Belleville spring	(1) Mine detonates at pressure lower than designed pressure	(1) Belleville spring weakening	I C (2)	(1) Inform units of lower detonating pressure	I D (3)	

Figure E-7. Preliminary hazards analysis work sheet (arming M14)

PRELIMINARY HAZARDS ANALYSIS WORK SHEET

Operation Name: Disarming the M14 AP Mine
Date Prepared: 11 October 1990
Sheet Number: 1 of 1

Hazards	System Effects	Causal Factors	RAC	Actions	Controlled RAC	Standards/Comments
(1) Remove camouflage	(1) Mine detonates	(1) Pressure on pressure plate (2) Damage or malfunction (3) Lack of training/improper training (4) Improper supervision (5) Incomplete or no inspection	I B (1)	(1) Do not apply pressure (2) Remove camouflage slowly or do not camouflage mine at all	I D (3)	(1) See comments on arming an M14 AP mine
(2) Replace safety clip	(1) Mine detonates	(1) Pressure on pressure plate	I C (2)	(1) Ensure proper handling when installing safety clip	I D (3)	
(3) Turn pressure plate to SAFE	(1) Mine detonates	(1) Pressure on pressure plate (2) Weakened Belleville spring	I C (2)	(1) Do not apply pressure to pressure plate	I D (3)	
(4) Remove mine from hole	(1) Mine detonates	(1) Dropped mine	I C (2)	(1) Ensure proper handling	I D (3)	
(5) Remove detonator	(1) Detonator detonates	(1) Soldier improperly handles mine (2) Lack of training/improper training (3) Improper supervision	I C (2)	(1) Handle detonator properly	I D (3)	

Figure E-8. Preliminary hazards analysis work sheet (disarming M14)

PRELIMINARY HAZARDS ANALYSIS WORK SHEET

Operation Name: Arming the M15 AT Mine
Date Prepared: 11 October 1990
Sheet Number: 1 of 1

Hazards	System Effects	Causal Factors	RAC	Actions	Controlled RAC	Standards/Comments
(1) Damaged mine used	(1) None	(1) Lack of training/improper training (2) Improper supervision (3) Incomplete or no inspection	IV B (-)	(1) Do not use mine (2) Contact QASAS to investigate (3) Turn mine in for investigation/disposal	IV D (-)	(1) Proper training (2) Soldier proficient on inert mines first (3) 1 instructor to 1 soldier (4) All training is conducted in the prone position (5) Mine training is done after identified by a unit's METL and only with select personnel
(2) Too much force on extension rod/pressure ring (M624 fuze)	(1) Mine detonates	(1) Soldier bends/pushes on rod or fuze	I B (1)	(1) If the extension rod is used, the safety stop and band will not be removed **OR** (2) Remove the extension rod before removing safety stop and band	I D (3)	(6) Training is conducted in the proper environment (7) Soldiers are in the proper protective gear (8) No trip wires or AHDs are used with an M15 mine
(3) Too much pressure on pressure plate (M603 fuze)	(1) Mine detonates	(1) Soldier applies excessive pressure	I D (3)	(1) See comments	I D (3)	
(4) Fuze improperly seated in the fuze well (M603 fuze)	(1) Mine detonates	(1) Excessive debris/corrosion in well (2) Lack of training/improper training (3) Improper supervision (4) Incomplete or no inspection	I C (2)	(1) Perform depth check with wrench	I D (3)	(9) Using the cap to perform the fuze depth check is not authorized. Use wrench.
(5) Improper handling of fuze (M603 fuze)	(1) Fuze detonates	(1) Pressure applied to fuze with safety fork removed	II D (4)	(1) Handle fuze properly	II D (4)	

Figure E-9. Preliminary hazards analysis work sheet (arming M15)

PRELIMINARY HAZARDS ANALYSIS WORK SHEET

Operation Name: Disarming the M15 AT Mine
Date Prepared: 11 October 1990
Sheet Number: 1 of 1

Hazards	System Effects	Causal Factors	RAC	Actions	Controlled RAC	Standards/Comments
(1) Remove camouflage	(1) Mine detonates	(1) Too much pressure on pressure plate (2) Damage to the mine	I D (3)	(1) Do not apply pressure to pressure plate (2) See comments	I D (3)	(1) See comments under arming the M15 AT mine (2) See attached separate risk assessment for command detonating a mine in place with explosives
(2) Not being able to turn the mine to safe or reinstall safety ring, safety stop, or safety pin	(1) Mine detonates	(1) Too much resistance (M603 fuze) to turning indicator (2) Safety band (M624), safety stop or safety pin has become damaged (3) Foreign material has entered the fuze well	I C (2)	(1) Controlled detonation in place	None	
(3) Remove fuze/install safety fork	(1) Fuze detonates	(1) Pressure on the pressure plate of fuze (2) Fuze is not removed	II D (4)	(1) Follow proper procedures	II D (4)	

Figure E-10. Preliminary hazards analysis work sheet (disarming M15)

PRELIMINARY HAZARDS ANALYSIS WORK SHEET

Operation Name: Arming the M16 Series AP Mine
Date Prepared: 11 October 1990
Sheet Number: 1 of 1

Hazards	System Effects	Causal Factors	RAC	Actions	Controlled RAC	Standards/Comments
(1) Damaged mine used	(1) None	(1) Lack of training/improper training (2) Improper supervision (3) Incomplete or no inspection	IV C (-)	(1) Do not use mine (2) Contact QASAS to investigate (3) Turn in the mine for investigation/ disposal	None	(1) Proper training (2) Soldiers proficient on inert mines first (3) 1 instructor to 1 soldier (4) All training is conducted in the prone position (5) Mine training is done after the need is identified by a unit's METL and then only with select personnel
(2) Faulty fuze used (M605)	(1) Mine detonates	(1) Safety pins missing (2) Prongs bent (3) Fuze head does not turn freely (4) Pins installed incorrectly	IB (1)	(1) Do not use fuze (2) Contact QASAS to investigate (3) Turn mine in for investigation/disposal (4) Conduct quality control check before training	ID (3)	(6) Training is conducted in the proper environment (7) Soldiers are in the proper protective gear (8) No trip wires or live AHDs are used with an M16 mine (9) In the event of damage or loss of any safety pins, stop training with this particular mine and destroy it
(3) Pressure applied to prongs after the positive safety pin is removed	(1) Mine detonates	(1) Pressure is applied inadvertently	IB (1)	(1) Do not at any time remove the positive safety pin	ID (3)	
(4) Fuze improperly armed	(1) Mine detonates	(1) Individual pushes in on release pin while or after positive safety pin is removed (2) Wrong sequence for removing pins (3) Locking safety pin is removed; click is heard; soldier continues	IB (1)	(1) Do not at any time remove the positive safety pin	ID (3)	

Figure E-11. Preliminary hazards analysis work sheet (arming M16)

PRELIMINARY HAZARDS ANALYSIS WORK SHEET

Operation Name: Disarming the M16 Series AP Mine
Date Prepared: 11 October 1990
Sheet Number: 1 of 1

Hazards	System Effects	Causal Factors	RAC	Actions	Controlled RAC	Standards/Comments
(1) Remove camouflage	(1) Mine detonates	(1) Too much pressure on M605 fuze pressure prongs	I C (2)	(1) Close supervision (2) Procedure is not rushed (3) Do not camouflage mine	I D (3)	(1) It is highly recommended that this mine not be fully armed by leaving positive safety pin in the fuze at all times (2) See comments for arming the M16 AP mine
(2) Replace safety pins	(1) Mine detonates	(1) Pins not replaced (2) Pull on release pin ring (3) Pressure on fuze pressure prongs (4) Pins replaced in wrong order	I C (2)	(1) Close supervision (2) Procedure is not rushed	I D (3)	(3) See attached separate risk assessment for command detonating a mine in place with explosives
(3) Remove M605 fuze	(1) Mine detonates	(1) Safety pins not properly in place, thus allowing pressure to be applied to the fuze, pressure prongs, or release pin	I C (2)	(1) Close supervision (2) Assure pins are secure and replaced correctly	I D (3)	

Figure E-12. Preliminary hazards analysis work sheet (disarming M16)

PRELIMINARY HAZARDS ANALYSIS WORK SHEET

Operation Name: Arming the M19 AT Mine
Date Prepared: 11 October 1990
Sheet Number: 1 of 1

Hazards	System Effects	Causal Factors	RAC	Actions	Controlled RAC	Standards/Comments
(1) Damaged mine used	(1) None	(1) Lack of training/improper training (2) Improper supervision (3) Incomplete or no inspection	IVB (-)	(1) Do not use mine (2) Contact QASAS to investigate	IVB (-)	(1) Proper training (2) Soldiers proficient on inert mines first (3) 1 instructor to 1 soldier (4) All training is conducted in the prone position (5) Mine training is done after identified by a unit's METL and only with select personnel
(2) Improper handling of detonator	(1) Detonator detonates	(1) Soldier handles detonator improperly (2) Lack of training/improper training (3) Improper supervision (4) Incomplete or no inspection	IID (4)	(1) Handle detonator properly	IIID (5)	(6) Training is conducted in the proper environment (7) Soldiers are in the proper protective gear (8) No trip wires or AHDs are used with a live M19 mine
(3) Pressure on pressure plate	(1) Mine detonates	(1) Soldier applies too much pressure	ID (3)	(1) See comments	ID (3)	
(4) Weakened Belleville spring	(1) Mine detonates at pressure lower than designed pressure	(1) Belleville spring weakening	IC (2)	(1) Inform soldiers of less pressure required to detonate	ID (3)	

Figure E-13. Preliminary hazards analysis work sheet (arming M19)

PRELIMINARY HAZARDS ANALYSIS WORK SHEET

Operation Name: Disarming the M19 AT Mine
Date Prepared: 11 October 1990
Sheet Number: 1 of 1

Hazards	System Effects	Causal Factors	RAC	Actions	Controlled RAC	Standards/Comments
(1) Remove camouflage	(1) Mine detonates	(1) Too much pressure on pressure plate (2) Damage or malfunction	I D (3)	(1) Do not camouflage mine	I D (3)	(1) See comments under arming the M19 AT mine
(2) Not being able to turn the mine to safe	(1) Mine detonates	(1) Too much resistance turning the dial indicator (2) Foreign material has entered the fuze well	I C (2)	(1) Controlled mine detonation in place	I D (3)	(2) See attached separate risk assessment for command detonating a mine in place with explosives
(3) Remove fuze assembly and replace detonator with shipping plug	(1) Detonator detonates	(1) Dropping fuze assembly with detonator (2) Dropping the detonator	II C (3)	(1) Handle fuze assembly and detonator properly	II D (4)	

Figure E-14. Preliminary hazards analysis work sheet (disarming M19)

PRELIMINARY HAZARDS ANALYSIS WORK SHEET

Operation Name: Arming the M21 AT Mine
Date Prepared: 11 October 1990
Sheet Number: 1 of 1

Hazards	System Effects	Causal Factors	RAC	Actions	Controlled RAC	Standards/Comments
(1) Damaged mine used	(1) None	(1) Lack of training/improper training (2) Improper supervision (3) Incomplete or no inspection	IV B (-)	(1) Do not use mine (2) Contact QASAS to investigate (3) Turn mine in for investigation/disposal	IV B (-)	(1) Proper training (2) Soldiers proficient on inert mines first (3) 1 instructor to 1 soldier (4) All training is conducted in the prone position (5) Mine training is done after identified by a unit's METL and only with select personnel
(2) Too much force on extension rod/pressure ring (M607 fuze)	(1) Mine detonates	(1 Soldier bends/pushes on rod or fuze	IB (1)	(1) If the extension rod is used, the safety stop and band will NOT be removed **OR** (2) Remove the extension rod before removing the safety stop and band	ID (3)	(6) Training is conducted in the proper environment (7) Soldiers are in the proper protective gear (8) No trip wires or AHDs are used with an M21 mine
(3) Fuze improperly seated in the fuze well	(1) Mine detonates	(1) Excessive debris/corrosion in well (2) Lack of training/improper training (3) Improper supervision (4) Incomplete or no inspection	IC (2)	(1) See comments	ID (3)	
(4) Improper handling of fuze	(1) Fuze detonates	(1) Pressure applied to fuze while mine is armed	IID (4)	(1) Handle fuze properly	None	

Figure E-15. Preliminary hazards analysis work sheet (arming M21)

PRELIMINARY HAZARDS ANALYSIS WORK SHEET

Operation Name: Disarming the M21 AT Mine
Date Prepared: 11 October 1990
Sheet Number: 1 of 1

Hazards	System Effects	Causal Factors	RAC	Actions	Controlled RAC	Standards/Comments
(1) Remove camouflage	(1) Mine detonates	(1) Too much pressure (2) Tilt extension rod (3) Damage or malfunction	I B (1)	(1) DO NOT USE extension rod (2) Close supervision	I D (3)	(1) See comment for arming the M21 AT mine
(2) Replace band, stop, and cotter pin	(1) Mine detonates	(1) Too much pressure (2) Tilt extension rod (3) Damage to stop, band, or cotter pin	I B (1)	(1) DO NOT use extension rod (2) Close supervision	I C (2)	(2) In the event of damage or loss of stop, band, or cotter pin, stop training with this particular mine and destroy it
(3) Remove extension rod and/or fuze	(1) Mine detonates	(1) Too much pressure (2) Tilt extension rod	I C (2)	(1) DO NOT USE extension rod (2) Ensure proper placement of band, stop, and cotter pin	I D (3)	(3) See attached separate risk assessment for command detonating a mine in place with explosives.
(4) Remove booster	(1) Booster detonates	(1) Soldier improperly handles booster	II D (4)	(1) Handle booster properly	None	

Figure E-16. Preliminary hazards analysis work sheet (disarming M21)

PRELIMINARY HAZARDS ANALYSIS WORK SHEET

Operation Name: Preparing charges and priming explosives to be used for mine demolition (detonated in place)
Date Prepared: 11 October 1990
Sheet Number: 1 of 1

Hazards	System Effects	Causal Factors	RAC	Actions	Controlled RAC	Standards/Comments
(1) Defect wire or faulty test of wire	(1) No detonation	(1) Wire will not carry electrical charge to detonate explosive	IV D (-)	(1) Do not use wire (replace it)	None	(1) After testing, ensure wire ends are twisted together
(2) Electric blasting cap check done incorrectly or not done at all	(1) Blasting cap detonates	(1) Cap improperly handled (2) Cap not put under sandbag	III C (4)	(1) Handle cap properly (2) Place cap under sandbag	IV D (-)	
(3) Blasting cap attached incorrectly to firing wire	(1) Blasting cap detonates	(1) Cap/firing wire improperly handled (2) Firing wire end not shunted	III C (4)	(1) Ensure firing wire is shunted (2) Ensure proper handling of blasting cap	IV D (-)	
(4) Blasting cap inserted incorrectly/too forcefully into one-pound demolition charge	(1) Blasting cap and/or one-pound demolition charge detonates	(1) Too much pressure on blasting cap (2) Cap improperly handled	I D (3)	(1) Ensure proper handling of blasting cap	I D (3)	(2) Only 1 demolitions person and 1 safety person will be at the mine when the blasting cap is inserted into the demolitions
(5) Charge does not detonate	(1) No detonation	(1) Faulty blasting cap (2) Faulty blasting machine (3) Faulty firing wire	IV C (-)	(1) OIC declares a misfire (2) Follow RSO procedures for a misfire	IV C (-)	(3) RSO is responsible for clearing misfires (4) RSO keeps a "misfire kit" under his control

Figure E-17. Preliminary hazards analysis work sheet (preparing charges and priming explosives)

PRELIMINARY HAZARDS ANALYSIS WORK SHEET

Operation Name: Mine arming/disarming peripheral factors (not all-inclusive)
Date Prepared: 11 October 1990
Sheet Number: 1 of 1

Hazards	System Effects	Causal Factors	RAC	Actions	Controlled RAC	Standards/Comments
(1) Good weather	(1) None direct	(1) Temperature between 45 and 70 degrees Fahrenheit (2) Clear or partly cloudy (3) Wind less than 5 mph	IV A (-)	None	None	(1) This list is not conclusive and will depend on the particulars of the unit, the training, and the range facilities
(2) Minimal weather	(1) None direct	(1) Temperature between 32 to 44 or 71 to 80 degrees Fahrenheit (2) Drizzle (3) Winds between 5 and 15 mph	III A (2)	(1) Close supervision (2) Do not rush training to get in shelter (3) Postpone or cancel training	III C (4)	
(3) Bad weather	(1) Wet, miserable soldiers (2) Wet munitions	(1) Temperature less than 32 or greater than 80 degrees Fahrenheit (2) Moderate to heavy rain (3) Snow or ice (4) Winds greater than 15 mph	I C (2)	(1) Postpone or cancel training	I D (3)	
(4) Lack of references	(1) The sequential arming or disarming not done correctly, causing the fuze and/or mine to detonate	(1) Current doctrine not available (2) Questions or confirmation of techniques not quantified	I B (1)	(1) Stop training if unsure of a task (2) Have proper references available	I D (3)	
(5) Lack of support materials or components	(1) Improper procedures or practices introduced, causing the fuze and/or the mine to detonate	(1) Not enough or incorrect fuzes, wrenches and/or washers used	I C (2)	(1) Ensure proper support material is available (2) Stop training if the proper material is not available	I D (3)	

Figure E-18. Preliminary hazards analysis work sheet (mine arming/disarming)

PRELIMINARY HAZARDS ANALYSIS WORK SHEET

Operation Name: Mine arming/disarming peripheral factors (not all-inclusive)
Date Prepared: 8 June 1990
Sheet Number: 1 of 1

Hazards	System Effects	Causal Factors	RAC	Actions	Controlled RAC	Standards/Comments
(6) Condition of soldiers	(1) Improper procedures or practices introduced, causing the fuze and/or the mine to detonate	(1) Long amount of training with little or no sleep (2) Strenuous training conducted before or during live mine training	I D (3)	(1) Ensure soldiers have adequate sleep (2) Allow for breaks during training (3) Stop training if soldiers appear to be heavily fatigued	None	Additional peripheral factors a unit commander may wish to consider: level of proficiency, time of event (day or night), availability and extent to emergency response assets, train up (rehearsals and dry runs), terrain, and location of instructor in relation to soldier during the training
(7) Protective clothing	(1) Improper or lacking protective clothing, increasing the severity of an accident if it does occur	(1) Improper or lacking protective clothing	I C (2)	(1) All soldiers participating in mine training will have kevlar, flak vest, and boots	None	

Figure E-18. Preliminary hazards analysis work sheet (mine arming/disarming) (continued)