

**Safety Concepts and Basic Considerations
for Unexploded Ordnance (UXO) Operations
16 February 1996**

1. Introduction. There is no "safe" procedure for dealing with UXO, merely procedures which are considered least dangerous. However, maximum safety in any UXO operation can be achieved through adherence to applicable safety precautions, a planned approach and intensive supervision. Only those personnel absolutely essential to the operation shall be allowed in the restricted/exclusion area during UXO operations (DoD 6055.9STD). Safety must be a firmly established habit when working with UXO. Safety is the leading edge of quality.

2. References. The following documents form a part of this document to the extent referenced.

ATFP 5400.7	Alcohol Tobacco and Firearms Explosives Laws and Regulations
27 CFR Part 55	Commerce in Explosives
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926 Construction	Safety and Health Regulations for
49 CFR 100-199	Transportation
DoD 6055.9-STD Standards	DoD Ammunition and Explosives Safety
DA Pam 385-64	Ammunition and Explosives Safety Standards
ETL 385-1-2	Generic Scope of Work for Ordnance Avoidance Activities
TM 9-1300-200	Ammunition General
TM 9-1300-214	Military Explosives
TM 9-1375-213-12 Manual (Including Repair Parts and Special List); Demolition Materials	Operators and Organization Maintenance Tools

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3. Definitions

a. Unexploded Ordnance (UXO). An item of ordnance which has failed to function as designed, or has been abandoned or discarded, and is still capable of functioning and causing injury to personnel or damage to material.

b. UXO Procedures. UXO procedures include, but are not limited to, the following actions:

(1) Gaining access to (manual excavation) and identifying subsurface anomalies, and assessing condition of buried UXO.

(2) Identifying and assessing condition of surface UXO.

(3) Recovery and final disposal of all UXO.

c. UXO Related procedures: UXO related procedures include, but are not limited to, the following:

(1) Location and marking of subsurface anomalies.

(2) Location and marking of suspected surface UXO.

(3) Transportation and storage of recovered UXO.

(4) Utilizing earth moving machinery (EMM) to excavate soil to no closer than approximately 12 inches of a subsurface anomaly.

d. UXO Qualified Personnel: UXO qualified personnel are US citizens who have graduated from the U.S. Army Bomb Disposal School, Aberdeen, MD, or the U.S. Naval Explosive Ordnance Disposal (EOD) School, Indianhead, MD. Graduates of the EOD Assistant Course, Redstone Arsenal, AL, or Elgin AFB, FL with more than three years combined active duty military EOD and contractor UXO experience shall also be UXO qualified.

4. General Safety Concerns.

a. UXO operations shall not be conducted until a complete plan for the operation involved is prepared and approved. Plans shall be based upon limiting exposure to a minimum number of

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personnel, for a minimum time, to the minimum amount of UXO consistent with safe and efficient operations.

b. Only UXO qualified personnel shall be involved in UXO procedures. Non-UXO qualified personnel may be utilized to perform UXO related procedures when supervised by UXO qualified personnel. All personnel engaged in operations shall be thoroughly trained in explosive safety and be capable of recognizing hazardous explosive exposures.

c. The use of electroexplosive devices (EED) susceptible to electromagnetic radiation (EMR) devices in the radio frequency (RF) range, that is, radio, radar, and television transmitters, has become almost universal. Some ordnance is particularly susceptible to EMR (RF) emission. A knowledge of ordnance that is normally unsafe in the presence of EMR (RF) is important so preventive steps can be taken if the ordnance is encountered in a suspected EMR (RF) field. The presence of antennas, communication and RADAR devices should be NOTED on initial site visits and/or preliminary assessments. When potential EMR hazards exist, the site shall be electronically surveyed for EMR/RF emissions and the appropriate actions will be taken. Minimum safe distances from EMR/RF sources are listed in Tables 2-2, 2-3, and 2-4 of TM 9-1375-213-12.

d. Do not wear outer or undergarments made of materials which have high static generating characteristics when working on UXOs. Materials of 100 percent polyester, nylon, silk, or wool are highly static-producing. Any person handling a UXO suspected of containing EEDs will ground himself/herself prior to touching the UXO. Refer to DA Pam 385-64 for more information regarding non-static producing attire.

5. UXO Safety Precautions for Site Characterization.

a. Make every effort to identify the UXO. Visually examine the item for markings and other identifying features such as shape, size, and external fittings. However, do not move the item to inspect it. If an unknown UXO is encountered, the US Army Engineering and Support Center, Huntsville (USAESCH) representative will be notified.

b. Foreign UXO was returned to the United States for ex-

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exploitation and disposal. When a records search indicates the possibility of foreign UXO being on a site, appropriate safety precautions and procedures will be incorporated into UXO operation plans.

c. Any time a suspected chemical munition is encountered, all personnel will withdraw upwind from the munition. A two person UXO team, located upwind, shall secure the munition until relieved by the Technical Escort Unit (TEU) or Explosive Ordnance Disposal (EOD) personnel.

d. Ordnance items which penetrate the earth to a depth where the force of the explosion is not enough to rupture the earth's surface forms an underground cavity called a camouflet. Camouflets will be filled with the end product of the explosion, carbon monoxide gas. Camouflet detection and precautions must be considered if a records search indicates the site was used as an impact area.

e. Avoid inhalation of, and skin contact with smoke, fumes, and vapors of explosives and related hazardous materials.

f. Consider UXO which has been exposed to fire and detonation as extremely hazardous. Chemical and physical changes may have occurred to the contents which render it much more sensitive than it was in its original state.

g. Do not rely on the color coding of UXO for positive identification of contents. Munitions having incomplete or improper color coding have been encountered.

h. Avoid the area forward of the nose of a munition until it can be ascertained the item does not contain a shaped charge. The explosive jet can be fatal at great distances forward of the longitudinal axis of the item. Assume any shaped charge munitions to contain a piezoelectric (PZ) fuzing system until the fuzing system is positively identified. A PZ fuze is extremely sensitive, can function at the slightest physical change, and may remain hazardous for an indefinite period of time.

i. Examine a projectile for the presence or absence of an unfired tracer. Also examine the item for the presence or absence of a rotating band and its condition.

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j. Approach an unfired rocket motor from the side. Ignition will create a missile hazard and hot exhaust.

(1) Do not expose rocket motors to any EMR source.

(2) If an unfired rocket motor must be transported, it shall be positioned in the direction which offers the least exposure to personnel in the event of an accidental ignition.

k. Consider an emplaced landmine armed until proven otherwise. It may not be possible to tell, or it may be intentionally rigged to deceive.

(1) Many training mines contain firing indicator charges capable of inflicting serious injury.

(2) Exercise care with wooden mines that have been buried for a long time. Because of soil conditions, the wood deteriorates and the slightest inadvertent pressure/movement may initiate the fuze.

l. Assume a practice UXO contains a live charge until it can be determined otherwise. Expended pyrotechnic/practice devices may contain red/white phosphorus residue. Due to incomplete combustion, phosphorous may be present and reignite spontaneously if subjected to friction or the crust is broken and the contents exposed to air.

m. Do not approach a smoking white phosphorus (WP) UXO. Burning WP may detonate the burster or dispersal explosive charge at any time.

n. If the positive identification of suspected explosive materials is required, procedures in Chapter 13, TM 9-1300-214, "Military Explosives," or other approved explosives analysis shall be used to identify the explosives.

6. Ordnance Avoidance for HTRW Activities.

a. Investigative activities on potential ordnance contaminated sites will be accomplished using approved ordnance avoidance procedures.

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b. HTRW ordnance avoidance procedures are detailed in Engineering Technical Letter 385-1-2. This ETL is available on the Internet, or through the Quality and Technology team at USAESCH.

7. Restricted/Exclusion Area Operations.

a. On Ordnance and Explosives sites, the contractor's site safety personnel shall establish a restricted/exclusion area for each UXO team operating on the site. The purpose of the area is for the protection of the public and other personnel from the blast and fragmentation hazards of an accidental detonation. The area shall be established based on the following minimum factors:

(1) Previous site use that caused the contamination: impact area, open burn/ open detonation, burial, etc.

(2) Project type: surface clearance, subsurface clearance, sifting operation, sampling, etc.

(3) Known ordnance contamination, distances to public exposure, terrain, etc.

b. When multiple UXO teams are operating on a site, the restricted/exclusion area and team separation distances shall never be less than 200 feet.

c. During the time frame that UXO operations are being accomplished, only personnel necessary for the UXO operation shall be within the restricted/exclusion area. When non-essential personnel enter the restricted/exclusion area, all UXO operations will cease.

(1) Plan for, provide, and know the measures to be taken in the event of an accident.

(2) Provide a designated emergency vehicle in the area in case of an accident or other emergency.

(3) Coordinate with the appropriate airspace representative and assure appropriate notification procedures are arranged.

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(4) When non-essential personnel must enter the restricted/exclusion area, the following must be accomplished: a) The individual must receive a safety briefing, b) be escorted by a UXO qualified individual; and c) all UXO operations must cease within the fragmentation radius of the largest item expected to be encountered within the area.

d. Before any movement of a UXO, the fuze condition must be ascertained. If the condition is questionable, consider the fuze to be armed. The fuze is considered the most hazardous component of a UXO, regardless of type or condition.

(1) In general, a projectile containing a Base Detonating (BD) fuze is to be considered armed if the projectile has been fired.

(2) Arming wires and pop out pins on unarmed fuzes should be secured by taping in place prior to movement.

(3) Do Not dismantle or strip any UXO.

(4) Do Not depress plungers, turn vanes, or rotate spindle, levers, setting rings, or other external fittings on UXOs. Such actions may arm or activate the UXO.

(5) Do Not subject mechanical time fuzes to any unnecessary movement.

(6) Do Not remove any fuzes from UXOs.

(7) Some ordnance items do not contain any positive safety features. Positively identify and review all safety precautions prior to handling any ordnance.

e. Personnel working within the Restricted area/Exclusion zone shall comply with the following:

(1) Do not conduct operations without an approved Site Specific Safety and Health Plan and an approved Work Plan.

(2) Do not smoke, except in authorized areas.

(3) Do not have fires for heating or cooking, except in authorized areas.

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(4) Do not conduct explosive operations during electrical, sand, dust, or snow storms.

(5) Explosive operations will be conducted during daylight only.

(6) During magnetometer operations, UXO teams shall not wear safety shoes or other footwear which would cause the magnetometer to present a false indication.

f. Do not undertake the handling or disposal of liquid propellant fuels or oxidizers if not familiar with the characteristics of the material.

g. Civil War projectiles shall be treated as any other UXO.

h. If records search indicated WP munitions were fired or destroyed in the area, extra care shall be taken when uncovering a buried UXO. A buried WP munition may be damaged and when exposed to air, may start burning and detonate. An ample supply of water and mud shall be immediately available if excavation reveals a WP UXO. Appropriate protective equipment (leather gloves, face shield, and flame-retardant clothing) and first aid shall also be immediately available.

8. Storage.

a. During Ordnance and Explosives projects, storage of explosives and UXO falls into two categories, on-DoD installations and off-DoD installations.

b. On-DoD Installation Storage.

(1) The provisions of DoD 6055.9-STD shall be followed. Generally, an installation should have an explosive storage area that meets requirements in DoD 6055.9-STD. Permitting and compliance requirements for existing facilities are an installation responsibility. Compatibility of explosives found in Chapter 3, DoD 6055.9 -STD shall be complied with. UXO awaiting disposal shall not be stored with other explosives.

(2) If an installation does not have an existing storage facility, the provisions of paragraph c below shall apply.

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c. Off-DoD Installation Storage.

(1) Generally, the contractor is responsible for construction of a temporary explosive storage area that meets all local, state, ATF requirements, and as much of DoD 6055.9-STD as is practical to implement. The establishing of an explosive storage area must meet the following requirements:

(a) The area shall, if possible, meet the inhabited building and public traffic route distances specified in DoD 6055.9-STD. If the distances are less than required by DoD 6055.9-STD, a proposed barricading and berm plan to protect the public from accidental detonation must be submitted and approved.

(b) Magazines must meet requirements of ATF Regulations, and each magazine must have a Net Explosive Weight established for the explosives to be stored.

(c) Each magazine must have lightning protection IAW Chapter 7, DoD 6055.9-STD and must meet intramagazine distances as defined in Chapter 9, DoD 6055.9-STD.

(d) A physical security survey shall be conducted to determine if fencing or guards are required. Generally, a fence around the magazines is needed, but the contractor is responsible for determining the degree of protection required to prevent the theft of explosives and UXO.

(2) A fire plan for On-DoD or Off-DoD storage areas shall be prepared and coordination with the nearby fire department shall be conducted. Placarding of magazines shall be in accordance with local, state, and federal requirements.

9. Excavation Operations.

a. Hand excavation is the most reliable method for uncovering UXO; however, unless the UXO is very near the surface, hand

excavation exposes more people to the hazard of detonation for a longer period of time than any other method. Hand excavation will be accomplished only by UXO qualified personnel.

b. Earth moving machinery (EMM) may be used to excavate

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buried UXO, if the UXO is estimated to be deeper than 12 inches.

EMM shall not be used to excavate within 12 inches of a UXO. When excavation gets within approximately 12 inches of a UXO, hand excavation shall be used to uncover the UXO. EMM may be operated by non-UXO personnel, under the direct supervision of UXO personnel.

(1) If more than one EMM will be used on the same site, they will be separated by the same separation distances required for multiple teams on that site.

(2) During excavation operations, only those personnel absolutely necessary for the operation shall be within the restricted area/exclusion zone.

(3) Excavation and trenching shall comply with the provisions of 29 CFR 1926 subpart P.

10. Disposal Operations.

a. As a general rule, UXO will be detonated in place when the situation allows. All detonation-in-place operations shall be conducted by electrical means to assure maximum control of the site, except in situations where static electricity or EMR hazards are present. Non-electrical means can be used when the situation dictates.

(1) Do not allow one person to work alone in disposal operations. At least one person shall be available near the disposal site to give warning and assist in rescue activities in the event of an accident.

(2) Loose initiating explosives include lead azide, mercury fulminate, lead styphnate, and tetracene. These explosives manifest extreme sensitivity to friction, heat, and impact. Extra precautions may be required when handling these types of explosives. Keep initiating explosives in a water-wet condition at all times until ready for final preparation for detonation. The sensitivity of these explosives is greatly increased when dry.

(3) Only condition "Code A" or "Code C" explosive items shall be used as donor explosives for disposal operations.

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(4) Exercise extreme care in handling and preparing high explosives for detonation. They are subject to detonation by heat, shock, and friction.

(5) Do not pack bomb fuze wells with explosives unless it can be positively confirmed that the fuze well does not contain any fuze components.

(6) Photo flash bombs must be handled with the same care as black powder filled munitions.

(7) WP UXO shall not be detonated into the ground. The UXO shall be counter-charged on the bottom center line when possible.

b. The following safety rules will be adhered to at all times:

(1) Carry blasting caps in approved containers and keep them out of the direct rays of the sun, and located at least 25 feet from other explosives, until they are needed for priming.

(2) Do not handle, use, or remain near explosives during the approach or progress of an electrical storm. All persons should retire to a place of safety.

(3) Do not use explosives or accessory equipment that is obviously deteriorated or damaged. They may cause a premature detonation or fail completely.

(4) Always point the explosive end of blasting caps, detonators, and explosive devices away from the body during handling.

(5) Use only standard blasting caps of at least the equivalent of a commercial No. 8 blasting cap.

(6) Use electric blasting caps of the same manufacturer for each demolition shot involving more than one cap.

(7) Do not bury blasting caps. Use detonating cord to position blasting caps above the ground. Buried blasting caps are subject to unobserved pressures and movement which could lead to premature firing or misfires.

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(8) Test electric blasting caps for continuity at least 25 feet from any other explosives prior to connecting them to the firing circuit. Upon completion of testing, the lead wires will

be short-circuited by twisting the bare ends of the wires together. The wires will remain shunted until ready to be connected to the firing circuit.

c. When disposing of explosives by detonation, do not approach the disposal site for at least thirty minutes after the expected detonation time, in the event of a misfire. When conducting non-electric procedures, the wait time shall be thirty minutes plus time fuse burn time.

d. A post-search of the detonation site shall be conducted to assure a complete disposal was accomplished.

e. If the situation dictates, protective measures to reduce shock, blast, and fragmentation shall be taken. Army Technical Manual (TM) 5-855-1, *Fundamentals of Protective Design for Conventional Weapons*, contains data on blast effects, ground shock, cratering, ejection, and fragmentation. The following distances shall be used unless protective measures are implemented.

(1) For non-fragmenting explosive materials, evacuation distance should be a minimum of 1250 feet.

(2) For fragmenting explosive materials, evacuation distance should be a minimum of 2500 feet. For bombs and projectiles with caliber 5-inches or greater, use a minimum evacuation distance of 4000 feet.

(3) Items with lugs, strong backs, tail plate sections, etc., should be oriented away from personnel locations as fragmentation from these items tends to travel farther than normal. Consideration should be given to tamping the UXO to control fragments, if the situation warrants. Fragments shall be minimized not only to protect personnel but also property, such as buildings, trees, etc.

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g. Open burning of explosives and smokeless powder or chemical decomposition of explosives shall not be accomplished without prior approval of the contracting officer.

(1) Do not inhale the smoke or fumes of burning pyrotechnic or incendiary materials. The fumes and dust from many of these materials are irritating and/or toxic if inhaled.

(2) Do not use water on incendiary fires. Water may induce a violent reaction or be completely ineffective, depending on the mixture.

(3) Anticipate a high order detonation when burning pyrotechnics or incendiary-loaded UXO. Safety measures for personnel and property must be based upon this possibility.

h. Inert Ordnance will not be disposed of or sold for scrap until the internal fillers have been exposed and unconfined. Heat generated during a reclamation operation can cause the inert filler, moisture, or air to expand and burst the sealed casings. Venting or exposure may be accomplished in any way necessary to preclude rupture due to pressure from being confined.

11. Transportation.

a. If UXO must be transported off-site for disposal, the provisions of 49 CFR 100-199, DA Pam 385-64, state and local laws shall be followed.

b. Armed fuzes will only be transported when absolutely necessary and when all other avenues of "in place" disposal have been exhausted. Transportation to an on-site disposal area for these items is preferred.

c. Do not transport WP munitions unless they are immersed in water, mud, or wet sand.

d. If loose pyrotechnic, tracer, flare, and similar mixtures are to be transported, they shall be placed in #10 mineral oil or equivalent to minimize fire and explosion hazards.

e. Incendiary loaded munitions should be placed on a bed of

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sand and covered with sand to help control the burn if a fire should start.

f. If an unfired rocket motor must be transported, it shall be positioned in such a manner as to offer the maximum protection to personnel in the event of an accident.

g. If base-ejection type projectiles must be transported to a disposal area or collection point, the base will be oriented to the rear of the vehicle and the projectile secured, in the event the ejection charge functions en route.

h. If a UXO, with exposed hazardous filler (HE, etc), has to be moved to a disposal area, the item shall be placed in an appropriate container with packing materials to prevent migration of the hazardous filler. Padding should also be added to protect the exposed filler from heat, shock, and friction.