# UXO

Multiservice Procedures for Operations in an Unexploded Ordnance Environment

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10 July 1996
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EXECUTIVE SUMMARY

UXO
Multiservice Procedures
for
Operations in an Unexploded Ordnance Environment

Experience from Operation Desert Storm revealed that a battlefield strewn with unexploded ordnance (UXO) poses a twofold challenge for commanders at all levels: one, to reduce the potential for fratricide from UXO hazards and two, to minimize the impact that UXO may have on the conduct of combat operations. Commanders must consider risks to joint force personnel from all sources of UXO and integrate UXO into operational planning and execution. This tactics, techniques, and procedures (TTP) publication provides methodologies for planning, implementing, and executing procedures to protect forces from unexploded submunitions.

Submunition UXO Hazards

Chapter I defines the hazards and impacts on operations from air and surface delivered submunition ordnance. While the risk appears low to armored and mechanized forces, their personnel in dismounted operations and support elements face a much greater risk when exposed to UXO. Commanders must be aware of the hazards and make an assessment of the risk to their operations if transiting UXO hazard areas.

Joint Force Operations

Chapter II discusses the joint force procedures for reducing UXO casualties and fratricide potential. Staff responsibilities and procedures for joint force planning, reporting, tracking, and disseminating UXO hazard area information are identified. This chapter also includes recommended TTP for units transiting or operating within an UXO hazard area. Properly integrated, these procedures will save lives and reduce the impact of UXO on operations.

Service Operations and Procedures

Chapter III explains the individual service methodologies for planning, reporting, and tracking submunition ordnance. These methodologies include submunition ordnance employment and UXO found on the battlefield. Each of the service systems is discussed and procedures are established to integrate UXO tracking and reporting into planning and operations.
Chapter I

SUBMUNITION UNEXPLODED ORDNANCE (UXO) HAZARDS

1. Background

a. Saturation of unexploded submunitions has become a characteristic of the modern battlefield. The potential for fratricide from UXO is increasing. It applies throughout the battlefield (e.g., special operations forces [SOF]) in deep operations, maneuver forces in close operations, and the movement of forces and support operations within the rear area. Commanders must consider risks to soldiers, sailors, airmen, and marines from UXO and integrate UXO into their antifratricide planning. This tactics, techniques, and procedures (TTP) publication provides the methodologies for planning, implementing, and executing procedures to protect forces from unexploded submunitions.

b. United States (US) or allied casualties produced by friendly unexploded submunitions maybe classified as fratricide. Locations where unexploded submunitions have been or may be encountered require accurate tracking to assist commanders in reducing the potential for fratricide. Currently no system exists to accurately track unexploded submunitions to facilitate surface movement and maneuver. This publication addresses the impact of UXO on operations at the operational level and below and describes TTP to assist leaders at all levels in reducing the hazards of UXO. This chapter establishes the scope of the UXO problem and focuses on the potential effects of UXO on all surface forces throughout the battlefield (including SOF).

c. Joint Publication 1-02 defines unexploded explosive ordnance as “explosive ordnance which has been primed, fused, or otherwise prepared for action, and which has been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel or material and remains unexploded either by malfunction or design or for any other cause.” Although ground forces are concerned with all unexploded ordnance, the greatest potential for fratricide comes from unexploded submunitions. For this reason, the scope of this publication focuses on unexploded submunition hazards. However, if the situation warrants, the tracking process described in later chapters can be used to track all potential UXO hazards. While US weapon system examples are used in this publication, most foreign militaries possess similar systems. Appendices D-E list types and quantities of US and foreign submunitions ordnance. Family of scatterable mines (FASCAM) operations are beyond the scope of this publication.

2. Hazards

Both surface and air-delivered ordnance produce unexploded submunitions. Several factors, such as the delivery technique, age of submunition, ambient air temperature, and type of impact medium, influence the reliability of submunitions. The actual hazard area produced depends on the type of ordnance and the density of the UXO.

a. Surface Delivery Systems. The Army and Marine Corps employ a variety of rockets, missiles, and cannon artillery. Each system is capable of delivering improved conventional munitions (ICMs) that contain submunitions. A typical Army heavy division is equipped with 9 Multiple Launched Rocket Systems (MLRSs) and 72 tubes of cannon artillery. Cannon artillery basic load is generally 60-70 percent dual-purpose, improved conventional munition (DPICM), while 100 percent of the MLRS and Army Tactical Missile System (ATACMS) basic loads are submunitions. Thus every MLRS and ATACMS fire mission and over half of the fire missions executed by cannon artillery
produces UXO hazard areas. Additionally, the Tomahawk land attack missile. Version D (TLAM-D), is the submunition version of the Tomahawk missile and has the potential to produce similar UXO hazard areas.

(1) MLRS Unexploded Submunition Hazards. MLRS submunition function reliability requirement is no less than 95 percent. With a 95 percent submunition function reliability, 1 MLRS rocket (with 644 submunitions) could produce up to 38 unexploded submunitions. A typical fire mission of 36 MLRS rockets could produce an average of 1368 unexploded submunitions. The numbers of submunitions that fail to properly function and the submunitions’ dispersion determine the actual density of the hazard area.

(2) Cannon Artillery. Cannon artillery employs the same submunitions as MLRS. The difference is the number of submunitions per round. A battalion-2 (24 cannon firing 2 rounds each for a total of 48 rounds) with a 95 percent submunition reliability produces, on average, 212 unexploded submunitions.

b. Air Delivery Systems. There is no set air delivery mission profile. Most airframes are capable of delivering a variety of submunitions. The UXO hazard area depends on the submunition, mission profile, target type, and number of sorties. Air Force and naval air power employ cluster bomb units (CBUs) containing submunitions that produce UXO hazard areas similar to MLRS/cannon artillery submunitions. Air delivered canisters contain varying amounts of CBUs (see Appendix C). One CBU-58 or three CBU-87/CBU-52 contain approximately the same number of submunitions as one MLRS rocket. AB-52 dropping a full load of 45 CBUs (each CBU-58/CBU-71 contains 650 submunitions) may produce an UXO hazard area that is significantly more dense than an MLRS UXO hazard area. A typical F-16 flying close air support (CAS) against a point target may drop two CBUs per aircraft per run, thus producing a very low-density UXO hazard area. Again, the type and number of canisters dropped will determine the density of the UXO hazard area.

3. UXO Impact on Forces

UXO affects operational and tactical planning and execution of operations. Types of munitions employed, self-destruct times, and submunition densities must be evaluated regarding the forces that deal with them. Variables affecting the degree of risk include, but not limited to, the types of submunitions employed; protection available to US personnel (e.g., armored vehicles versus dismounted infantry); mission of the affected force; and terrain and climatic conditions within affected operational areas. Planners must consider the risks of UXO for any mission, regardless of the unit.

a. Operational Impacts of UXO. Planners need to consider the types of submunitions, where they are/were employed, and their potential impact on future operations. Without careful planning, maintaining the operational tempo will be difficult in an UXO environment. Planners must allocate additional time for the operation if a deliberate breach or bypass of UXO hazard areas is required. Additionally, planners should consider—

   (1) Tracking and reporting requirements.

   (2) Task organization/additional force requirements (e.g., requirement for additional engineer or explosive ordnance disposal assets).

   (3) Reconnaissance requirements.

   (4) Breaching requirements.

   (5) Maneuver requirements (restrictions on avenues/axis of attack).

   (6) UXO hazard area marking requirements.

   (7) Civil-military operations requirements (impact on civilian population).

b. Tactical Impacts of UXO. UXO inhibits maneuver by potentially restricting use of
terrain, increasing reconnaissance requirements, and reducing momentum (speed of maneuver and rates of march). UXO also inhibits night movement, increases risk to combat support (CS)/combat service support (CSS) elements, ties up engineers or other forces clearing/marking lanes, and reduces available firepower because of increased loss of personnel and equipment.

c. Armored/Mechanized Forces. Armored and mechanized forces consist of tracked and wheeled vehicles. Commanders must consider the force as a whole when planning operations. Chance of significant damage to armored, light armored vehicles (LAV), and other wheeled armored vehicles is relatively low. The primary damage occurs where the track or wheel contacts the submunition. Depending on the type of submunition, a mobility kill could occur. There is little possibility of casualties from crossing UXO hazard areas as long as the crews stay mounted. Armored and mechanized commanders must also consider the increased risk to their organic wheeled vehicles and dismounted forces when operating in UXO environments. High mobility multipurpose wheeled vehicles (HMMWVs) and other "soft skin" vehicles accompanying and supporting combat elements are at greater risk. Anytime crews must dismount their vehicles, they are increasing their risk.

d. Dismounted Forces. Dismounted forces face the greatest danger of death or injury from UXO. Unexploded ordnance is a significant obstacle to dismounted forces. Dismounted forces require detailed knowledge of the types and locations of submunitions employed.

e. Wheeled Vehicles. Personnel being transported by wheeled vehicles face nearly the same risk to UXO as dismounted forces. The protection afforded by wheeled vehicles is negligible. Wheeled vehicles are vulnerable to damage from UXO. Chance of catastrophic destruction is slight; however, contact with UXO normally results in disabled wheeled vehicles. Maintenance evacuation may be required depending on the type vehicle and where the damage occurred.

f. Air Assault and Aviation Forces. Air assault and aviation forces are also at risk to UXO. Aircraft in defilade, flying nap-of-the-earth, or in ground effect are vulnerable to submunitions. US Rockeye and Soviet PTAB submunitions incorporate piezoelectric crystals that can react to aircraft in ground effect. Antipersonnel and antimateriel (APAM) and M42/M46 grenades are also sensitive enough to function as a result of rotor wash. It is imperative aviation units know the location of employed submunitions and conduct thorough reconnaissance of the area before conducting operations or occupying assembly areas and forward arming refueling points (FARPs).

g. Amphibious Landing Craft. UXO has the potential to significantly damage certain types of landing craft and in some cases result in casualties of embarked personnel.

4. UXO Hazard Quantified

This section compares the UXO hazard area encounter probability with a minefield encounter probability. The probability of encounter is roughly equal for a minefield and an UXO hazard area of equal density (Figures I-1 and I-2). The minefield is more lethal as every mine is designed to detonate by some action, where the unexploded submunition results from a malfunction and may or may not detonate upon contact. They may also detonate without contact because of climatic changes, corrosion, etc., Figures I-3 and I-4 illustrate the expected damage/casualties for various densities of UXO hazard areas. Comparing Figure I-1 with Figures I-3 and I-4 gives a potential impact on the mission.

a. Figure I-2 illustrates the vehicle probability of encountering a single unexploded submunition versus the hazard area UXO density. The UXO probability of encounter is very similar to that of a minefield; however, the lethality of the UXO hazard area is lower.
b. Figures I-3 and I-4 show the expected damage and casualty rates for various densities of DPICM and bomb live unit (BLU) 97 UXO hazard areas. These charts represent one vehicle/person passing through a one-half kilometer deep UXO hazard area. The probabilities shown are per vehicle/person. To calculate the expected number of casualties, multiply the number of vehicles/persons (or passage lanes) by the probability of encounter. The X-axis (mines per meter front) is a linear density expression of the average number of mines within a 1 meter path through the minefield’s depth. The vehicle and tank probabilities differ because of the differences in width and the area in contact with the ground (track versus tire width). Each chart is based on Army Materiel Systems Analysis Activity Studies that show 40 percent of the duds on the ground are hazardous and for each encounter with an unexploded submunition there is a 13 percent probability of detonation. The probability lines within the graphs reflect 13 percent probability of detonation per encounter. Thus, even though an unexploded submunition is run over, kicked, stepped on, or otherwise disturbed, and did not detonate, it is not safe. Handling the unexploded submunition may eventually result in arming and subsequent detonation. Troops moving through a hazard area must be fully familiar with the hazards of the submunitions they will encounter.
Figure I-2. Vehicle Submuniton Encounter Probability Versus UXO Density

Figure I-3. UXO Expected Damage/Casualties Versus DPICM UXO Hazard Area Density
Figure I-4. UXO Expected Damage/Casualties Versus BLU 97 UXO Hazard Area Density
Chapter II

JOINT FORCE OPERATIONS

1. Background

a. This chapter addresses the joint force command and control procedures for coordinating use of submunition ordnance and reporting all UXO encountered on the battlefield. As such, it defines the command and staff procedures for planning, reporting, and tracking UXO to minimize risk to joint forces.

b. Ensuring personnel safety and precluding undue constraints on movement of forces and maneuver elements require proper planning and coordination. Although UXO is not a mine, UXO hazards pose problems similar to mines concerning both personnel safety and the movement and maneuver of forces on the battlefield. Coordination and information flow are the integral components that bind the planning, reporting, and tracking. Providing the proper information, at the right time, to the responsible authority is paramount.

2. Staff Responsibilities

Coordination between component commanders and the joint force commander (JFC) may be required before use of submunitions by any delivery means. To ensure UXO does not occur in areas that negatively affect current and projected operations, coordination is conducted and guidance established before the use of submunition ordnance. The following areas identify the minimum responsibilities for joint force UXO procedures. During planning, evaluate the impact of known UXO hazard areas on mission accomplishment from both an offensive and defensive posture. The employment of submunitions must balance with troop safety and mission accomplishment. Table II-1 lists staff and unit primary responsibilities for UXO planning, reporting, and tracking.

a. JFC. The commander addresses specific considerations for employing ICMs/CBUs and their associated UXO hazards when providing intent and planning guidance. The JFC intent provides safety guidance and establishes antifratricide procedures within the joint operations area (JOA).

b. Plans Directorate of a Joint Staff (J-5). During the planning phase, the J-5 incorporates commander’s guidance regarding joint force submunition reporting, tracking, and dissemination procedures into operational plans. During the plan formulation, emphasis is on minimizing the impact of UXO. Using the special instructions (SPINS) section of the air tasking order (ATO) and coordinating instructions on the operations plan (OPLAN), components are alerted not to employ submunitions in particular areas or on certain targets because of the UXO danger to personnel or maneuver. The J-5 ensures planning includes adequate safety of personnel and antifratricide procedures. Planning considerations also include terrain management, the impact of potential UXO hazard areas on friendly operations, and any munitions’ restrictions. Planning must address proper training and equipping of personnel and units for reducing and clearing UXO hazards.

(1) Other considerations include-

(a) Preplanning, deconflicting, and coordinating with other components.

(b) Impact of residual effects on friendly operations.

- Planned use of current enemy controlled terrain, including airfields and airstrips.
• Requirements for dismounted operations. (Security operations—patrolling, reconnaissance, etc.)

• Requirements for mounted operations only.

• Availability of engineer and explosive ordnance disposal (EOD) support.

(c) Impact on terrain management.

• Friendly troops transiting or occupying the area.

• Locations of proposed main supply route (MSR).

• Restricted areas—proposed logistics base sites.

• Availability of engineers and EOD units.

(d) Communications requirements.

• Availability of automation and communications equipment to rapidly disseminate information.

• Information requirements.

• Information flow to inform friendly forces of expected UXO locations.

(e) Risk to noncombatants.

c. Operations Directorate of a Joint Staff (J-3). The J-3 staff responsibility includes planning and executing the commander’s guidance and establishing procedures to ensure subordinate components receive UXO hazard areas information. The J-3, in coordination with the joint force engineer and EOD staffs, establishes joint force reporting requirements and procedures.

d. Joint Rear Area Coordinator (JRAC). In the joint rear area (JRA), the JRAC plays a significant and critical role in UXO reporting. The JRAC must be part of the coordination and information network dealing with UXO. The JRAC is responsible for creating a secure environment in the JRA to facilitate sustainment, host nation support (HNS), infrastructure development, and joint force movements. The JRAC establishes tracking and dissemination procedures ensuring personnel and units operating in the JRA are knowledgeable of UXO hazards.

e. Joint Force Engineer Function. The joint force engineer is the principal staff element in the planning, reporting, and tracking of UXO hazard areas. During planning, the engineer element includes UXO as part of the mission analysis and, in coordination with EOD, advises the JFC on task organization and equipment required for clearing and breaching UXO hazards. During operations, the joint force engineer receives and consolidates reports, forwards reports to EOD, and incorporates UXO hazard area information into the engineer obstacle overlay. The engineer overlay is the primary source of UXO hazard areas classified as obstacles or barriers. The engineer staff maintains reports on historical UXO hazard areas while the EOD element maintains information on all UXO hazards.

f. Joint Force EOD Function. The joint force EOD function provides technical expertise during the mission analysis by assessing hazards and risks from all sources of UXO, including US, allied, and threat munitions. During the conduct of operations, EOD personnel provide technical assistance for marking, breaching, and clearing operations. EOD personnel coordinate with the engineers to obtain information on all known UXO hazards. The EOD function normally maintains UXO historical files that include all unexploded munitions. This historical file provides information for follow-on units and to civil-military units for post-conflict operations.
g. Units. Unit responsibilities include marking, reporting, and tracking UXO hazards within their assigned AO. Units follow guidance contained in FM 21-16/ FMFM 13-8-1, *Unexploded Ordnance (UXO) Procedures*, when required to conduct limited breaching and clearing operations or self-extract to reestablish operations in another location.

h. Joint Force Air, Land, and Maritime Component Commanders. Reporting requirements established per joint force guidance normally include antifratricide procedures and component reporting architecture and requirements. Component commanders normally establish coordination and reporting procedures with other components. Each component consolidates reports and maintains current and historical records concerning UXO. For example, the land component engineer compiles the obstacle, barrier, and minefield reports while the EOD staffs compile reports tracking all UXO on the battlefield. The joint force air component commander (JFACC) publishes and maintains UXO hazards based on the ATO.

i. Risk Management. Risk management is the commander’s decision. Many factors contribute to this decision; one of which is the impact of submunitions on current and future operations. The current and future operations, level of protection available to the committed force, the type and amount of engineer or EOD support, and time available are factored into the commander’s decision. This assessment results in the commander’s guidance on types of munitions and areas of employment.

3. Reporting

Immediate reporting is essential. UXO hazard areas are lethal and unable to distinguish between friend and foe. Positive control and a rapid and continuous flow of information are necessary. Reactive and predictive reporting are necessary to give the commander the true picture of the hazards.

a. Land Forces. Land force units send spot reports (Appendix B) relaying information on confirmed UXO locations and reporting locations of previously employed submunition ordnance.

1) UXO Spot Report. The UXO Spot Report is the first-echelon report sent when encountering an UXO hazard area. It is a detailed 2-way reporting system that clarifies the UXO hazard area location, identifies clearance priority, and identifies affected units. The report also serves as a request for assistance with an UXO hazard.

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(2) Reported Locations. Land force units report UXO hazard areas according to the JFC’s guidance. Once reported, units treat UXO hazard areas as obstacles. As such, UXO information received requires processing, plotting, and disseminating to higher, lower, and adjacent units. The engineer representative converts the UXO obstacle report into obstacle overlays for dissemination to subordinate units.

b. Air Units. Air units can report submunition ordnance employment through their battle damage assessment (BDA), munitions effectiveness assessment reporting, and correlation with the ATO standard conventional load for each mission tasking. Also, air units can use intelligence reports (INTREPs), in-flight reports (INFLTRPTs), or mission reports (MISREPs) for munitions reporting.

4. Tracking

The JFC establishes the required UXO tracking level. Tracking of every submunition ordnance may not be required. The JFC bases the tracking level on the location, amount of potential UXO, or other criteria. The J-3, coordinating with the Intelligence Directorate of the joint staff (J-2) and component commanders’ headquarters, tracks UXO hazard area information. The J-3 should maintain a historical database that includes type, quantity of ordnance dropped or observed, location, and date dropped or observed, of possible and known UXO hazard areas. Components update this database as required (frequency of update, ordnance type, and amount) by the JFC or J-3. The J-3 disseminates UXO information affecting maneuver, movement, and protection of land forces. Primary means of dissemination is by obstacle overlay. Alternate methods include providing location (aim point), delivery system, type and quantity of ordnance.

5. Operations

a. When setting up operational bases or work sites, units must consider the UXO threat. Hard surface roads are the best evacuation routes and easiest to clear. Units develop clearance plan procedures to reconnoiter and mark clear paths to other unit positions and to the nearest hard surfaced road or clear area. Extraction procedures resemble in-stride breach or clearing operations.

b. Combat units that have the assets to conduct an in-stride breach can do so. Their breach reduces the hazard and allows follow-on forces to continue in the original direction of the march. CS and CSS units must rely on alternate routes or breached lanes. After discovery of an UXO hazard, units take immediate actions to alert personnel, locate the submunition or scatterable mines, and provide protection for personnel and equipment. When dealing with an UXO hazard the following tactical factors should be assessed:

  (1) Effects of the delay on the mission.
  
  (2) Threat from direct and indirect fire. The risk of casualties from direct or indirect fire may be greater than that from the submunitions or scatterable mines.
  
  (3) Terrain. The terrain determines the effectiveness of submunitions or scatterable mines, their visibility, and, consequently, their ability to be detected, avoided, or neutralized.
  
  (4) Alternate routes or positions available.
  
  (5) Degree of protection available.
  
  (6) Specialized support, such as EOD or engineer teams and equipment available.

c. After assessing the situation, three main options are available—

  (1) Accept the risk of casualties and continue with the assigned mission.
(2) Employ tactical breaching procedures and extract to alternate routes or positions.

(3) Employ preplanned alternate tactical plans according to the current OPORD.

d. Units bypass UXO hazard areas if possible. When bypassing is not feasible, units must try to neutralize the submunitions and scatterable mines that prevent movement. There is no single device or technique that will neutralize every submunition or scatterable mine in every situation. The differences in fusing, self-neutralization, terrain, and unit mission mean that multiple techniques must be considered. The following extraction techniques should be considered in the order listed:

1. Perform area reconnaissance and mark a cleared route.
2. Use engineer equipment to remove or neutralize items.
3. Destroy items using explosive charges.
4. Destroy items using direct-fire weapons.
5. Contain the item by building barricades.
6. Move UXO out of the way remotely.

**DANGER**

Employing breaching techniques on ordnance other than submunitions or scatterable mines is not recommended. The amount of explosives involved would create more of a hazard to your operations than the UXO itself.

**WARNING**

Before employing breaching techniques, make sure that none of the items contain chemical or biological agents.

e. Using engineer equipment is the preferred method of breaching small submunitions and scatterable mines. This procedure allows for the quickest clearance of an evacuation route. Suitable equipment includes a bulldozer, combat engineer vehicle, and an armored combat engineer earthmover. If an unarmored vehicle is used (such as a bulldozer), the operator’s cab requires protection against fragmentation. Three major disadvantages to heavy force breaching are—

1. Equipment may be damaged or operators injured. If either happens, extraction through the area will be hampered.
2. Equipment may only partially clear the area, requiring further clearance procedures.
3. Equipment may bury some submunitions or scatterable mines, keeping them from being detected while using the evacuation route.

f. Mine-clearing Line Charge (MICLIC). The MICLIC is a rocket-propelled explosive line charge used to reduce minefield containing single-impulse, pressure-activated antitank (AT) mines and mechanically activated antipersonnel (APERS) mines. The MICLIC will explosively clear a path through an area. Several MICLICs may be required in the same area to ensure that a wide enough path is cleared. It has limited effectiveness against magnetically activated mines, including scatterable mines and those containing multiple-impulse or delay-time fuses. Three major disadvantages to using MICLICs are—