ATP 3-01.81

Counter-Unmanned Aircraft System (C-UAS)

AUGUST 2023

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This publication supersedes ATP 3-01.81 dated 13 April 2017.

Headquarters, Department of the Army

Army Techniques Publication
No. 3-01.81

Headquarters
Department of the Army
Washington, D.C., 11 August 2023

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Preface

ATP 3-01.81 provides brigades and below actions and considerations for conducting local security and counterreconnaissance to deny enemy unmanned aircraft systems from accomplishing their mission. This includes a description of threat unmanned aircraft systems, how to plan for them at brigade and below, defensive and offensive actions for Soldiers and units to take, resources for additional training, and example counter-unmanned aircraft system equipment a unit may be issued or can request.

ATP 3-01.81 is applicable to all members of the Army profession: leaders, Soldiers, and Army Civilians. The principal audience is brigade and below commanders and staff, junior leaders at the company, platoon, and squad level. This manual provides the foundation for counter-unmanned aircraft systems, training and Army education system curricula and future capabilities development across doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy (known as DOTMLPF-P).

To comprehend the doctrine contained in ATP 3-01.81, readers must first understand their military occupational specialty doctrine along with the fundamentals of the offense and defense and the language of tactics described in FM 3-90. They must be familiar with ATP 3-01.8 as well.

Commanders, staffs, and subordinates ensure that their decisions and actions comply with applicable United States, international, and in some cases, host-nation laws and regulations, and all applicable international treaties and agreements. Commanders at all levels ensure that their Soldiers operate in accordance with the law of war and applicable rules of engagement. (See FM 6-27 for more information on the law of war.) They also adhere to the Army Ethic as described in ADP 6-22.

ATP 3-01.81 uses joint terms where applicable. Selected joint and Army terms and definitions appear in both the glossary and the text. ATP 3-01.81 does not prescribe any proponent terms within this publication. For definitions shown in the text, the term is italicized, and the number of the proponent publication follows the definition.

ATP 3-01.81 applies to the Active Army, Army National Guard, and United States Army Reserve unless otherwise stated.

The proponent of ATP 3-01.81 is the Commanding General, United States Army Fires Center of Excellence and Fort Sill. The preparing agency is the Directorate of Training and Doctrine, Air Defense Artillery Branch. Send written comments and recommendations on a DA form 2028 (*Recommended Changes to Publication and Blank Forms*) to Directorate of Training and Doctrine, 700 McNair Avenue, Suite 128 ATTN: ATSF-DD, Fort Sill, OK 73503; by email to usarmy.sill.fcoe.mbx.dotd-doctrine-inbox@army.mil; or submit an electronic DA Form 2028.

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Introduction

ATP 3-01.81 establishes how the Army prevents threat unmanned aircraft systems (UASs) from impacting Army operations. Threat UASs are a condition of the modern battlefield that must be accounted for by leaders and Soldiers at every echelon. Countering unmanned aircraft systems is not a stand-alone effort or the sole responsibility of any warfighting function or branch. Counter-unmanned aircraft system (C-UAS) is part of local security and counterreconnaissance missions that is the responsibility of every Soldier and unit. C-UAS is not just when unmanned aircraft vehicles are flying, but also takes place “left of launch” and is part of the predictive analysis that intelligence sections do as part of their threat analysis and is incorporated into the targeting process.

Every echelon contributes to Soldier survivability by creating a layered defense. This layered defense is a combination of active and passive measures that prevents threat UASs from detecting, targeting, or destroying its intended target. Every action taken at each echelon makes the threat UAS harder to employ by increasing its risk and range it travels to accomplish its mission.

Enemy UAS is not a unique threat. The actions Soldiers take to counter-unmanned aircraft systems are not very different than actions taken to counter any other air threat such as an enemy helicopter or aircraft. While there are many systems at division and above dedicated to counter enemy air threats, each echelon works to ensure that every Soldier—no matter where they are on the battlefield, has the necessary information and ability to detect, identify, decide, and if needed to engage any air threat.

ATP 3-01.81 contains three chapters and two appendices:

Chapter 1 provides an overview of threat unmanned aviation systems.

Chapter 2 provides C-UAS planning considerations for brigades and below.

Chapter 3 provides defensive measures for units to take.

Chapter 4 provides offensive measures for units to take.

Appendix A provides C-UAS training resources that can be used while at home station.

Appendix B describes current counter unmanned aircraft systems equipment.

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Chapter 1

Threat Unmanned Aircraft Systems

Countering unmanned aircraft systems requires an understanding of how threats use unmanned aircraft systems and capabilities against U.S. Forces, allies, and partners. The focus of this chapter is to understand current threat unmanned aircraft systems' characteristics and capabilities.

INTRODUCTION

1-1. United States forces, allies, and partners face the proliferation of unmanned aircraft systems (UASs) as adversaries seek to take advantage of relatively inexpensive, flexible, and expendable systems while exploiting inherent difficulties with attribution and its implications for deterrence. Commanders at all levels face the challenge of being able to counter the air threat and adversarial reconnaissance within their operational environment. Countering air threats in general, and UAS threats specifically, is a shared joint and combined arms responsibility. Commanders and staffs must be prepared to address these across the entire competition continuum.

1-2. UASs come in a variety of sizes and capabilities. Some larger UASs can have a similar lethality to cruise missiles and can launch from a wide array of locations. Smaller UASs can not only launch virtually undetected, but with their low radar and sound profiles are also difficult to detect as they maneuver across the battlefield, making them an increasingly preferred method to carry out tactical-level strikes. To understand the threat better, there is a need to understand the different missions, UAS groups, UAS components, and a few additional considerations.

UAS MISSIONS

1-3. Advancement in unmanned technologies provides the threat additional means to accomplish their mission. As UAS technology and capability grows its military employment will also expand. A UAS may conduct several different missions separately or simultaneously while on one flight. Currently there are six different missions that UASs conduct:

- Intelligence, surveillance, and reconnaissance. UASs can provide adversaries with contemporary intelligence, surveillance, and reconnaissance capabilities in near real time via a video downlink.
- Situational awareness. UASs can provide an aerial view for the threat to know "what is around a hill" and allow the enemy commander to adjust operational orders based on real-time intelligence.
- Communications relay. UASs can serve to extend the communications between ground forces in an otherwise degraded or limited communications environment.
- Weapon delivery. UASs have been used to either deliver ordnance to a target or the UAS itself can become a loitering munition. This includes chemical and radiological attacks.
- Fire support. UASs can be used to provide forward observer functionality that can enable adjustment of indirect fire.
- Psychological warfare. UASs seen as a weapon delivery platform or conducting intelligence, surveillance, or reconnaissance prior to an attack can cause panic by their presence alone.

Note. A loitering munition is a type of UAS designed to engage beyond line-of-sight ground targets with an explosive warhead. Loitering munitions are often portable and meant to provide ground units such as infantry with a guided precision munition. They are equipped with high-resolution electro-optical and infrared cameras that enable the controller to locate, surveil, and guide the vehicle to the target. A defining characteristic of loitering munitions is the ability to "loiter" in an area of airspace for an extended period before striking, giving the controller time to decide when and what to strike.

UAS GROUPS

1-4. UASs are categorized into Groups 1 through Group 5, this designation is based on weight, operating altitude, and speed. The bigger the platform the more robust its suite of capabilities. While group designations help in understanding UASs and their capabilities, it is important that leaders understand the lines of differentiation between different groups operationally are not rigid. See table 1-1 for a brief description of the UAS Groups.

Table 1-1. UAS Groups

<table>
<tr><th>Group</th><th>Weight (lbs)</th><th>Speed (kts)</th><th>Normal Operating Altitudes (ft)</th><th>Notes</th><th>Threat & COTS Examples</th><th>Friendly Examples</th></tr>
<tr><td>Group 1: micro/ mini UAS</td><td>0 - 20</td><td><100</td><td>< 1,200 AGL</td><td>Generally, hand launched commercial-off-the-shelf, radio-controlled platforms. The have limited ranges and small payload capabilities. They offer real time video. Operated within line of sight of the user They offer real time video. Operated within line of sight of the user</td><td>DJI MAVIC, Enterprise Dual</td><td>RQ-11 Raven</td></tr>
<tr><td>Group 2: small tactical</td><td>21 - 55</td><td rowspan="2">101 - 250</td><td>< 3,500 AGL</td><td>Small airframes with low radar cross sections provide medium range and endurance. Launched from unimproved areas with a small number of people involved. Requires line of sight to the ground control station.</td><td>SKY-09Ps</td><td>Scan Eagle</td></tr>
<tr><td>Group 3: tactical</td><td>56 – 1,320</td><td>< FL 180</td><td>Similar to Group 1 and 2 UAS, requires a larger logistical footprint. Range and endurance varies significantly among platforms.</td><td>Shahed</td><td>RQ-7B Shadow</td></tr>
</table>

Table 1-1. UAS Groups (cont.)

Group	*Weight (lbs)*	*Speed (kts)*	*Normal Operating Altitudes (ft)*	*Notes*	*Threat & COTS Examples*	*Friendly Examples*
Group 4: Strategic or theater	> 1,320	Any speed	< FL 180	Relatively large systems operated at medium to high altitudes. This group has extended range and endurance capabilities. Normally requires a runway for launch and recovery.	Forpost	MQ-1C Gray Eagle MQ-1A/B Predator
Group 5: Strategic	> 1,320	Any speed	> FL 180	Operates at medium to high altitudes having the greatest range, endurance, and airspeed. Requires large logistical footprint like that of manned aircraft and has a suite of optics for targeting and weaponry for engagements	Wing Loong II	RQ-4 Global Hawk MQ-9 Reaper

AGL	above ground level	ft	feet	RQ	Reconnaissance unmanned aircraft system
COTS	commercial-off-the-shelf	Kts	knots	UAS	unmanned aircraft system
DJI	Da-Jiang Innovations	lbs	pounds		
FL	flight level	MQ	American military drone		

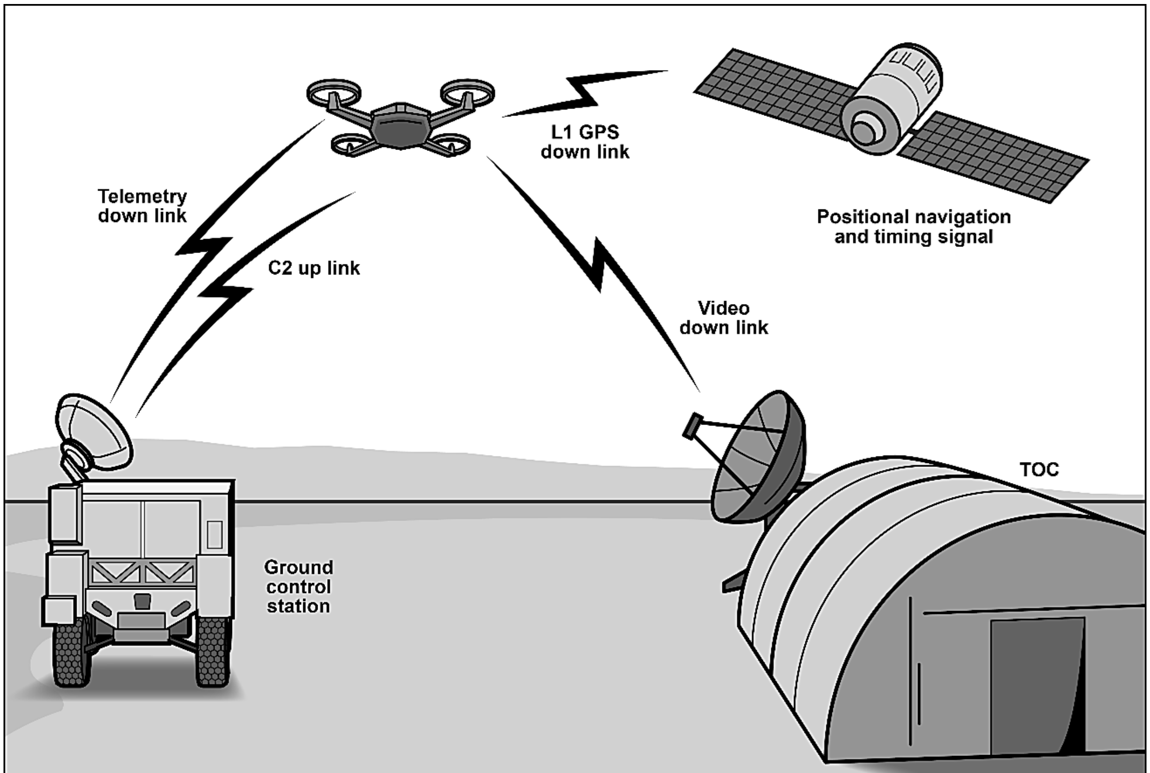
Note. UAS Groups 1 and 2 are commonly known as small-unmanned aircraft systems (sUASs). A sUAS has a lower radar cross-section than group 3, 4, and 5 UASs. Integrated air and missile defense (AMD) capabilities can effectively counter larger classes (group 3, 4, and 5). AMD assets have difficulty tracking, identifying, and defeating sUASs. The low radar cross-section is harder to detect by friendly forces' early warning and detection capabilities. Launch and recovery requirements allow sUASs launching capability from unimproved areas by a single person or small team, making them more difficult to find. Advances in technological capabilities enable the employ of sUAS with little to no operator interaction.

UAS COMPONENTS

1-5. A UAS is composed of everything required to operate an unmanned aircraft vehicle (UAV). The UAV is the actual device that flies. UAS includes the personnel, UAV, payload (sensors or weapons), control station, communication links, launch system, and recovery system. Different echelons and capabilities focus on defeating different parts of the system. Targeting cells should focus on the three main components: the UAV, the controller, and the communication links. When a UAV is in use, there are potentially up to four different communication links in action:

- L1 channel Global Positioning System (GPS) downlink. The UAV may rely on a commercial GPS (L1 channel), or a different navigations system such as BeiDou signal for stabilization. The GPS down link is needed to establish which way is up or down and its altitude. It is required if the UAS needs to fly to a specific point if a command and control signal is not being utilized. Advanced UAVs have inertial navigation system back-ups that don't rely on communication with the ground control station.
- Video downlink. A passive electronic activity that can't be used to detect the ground control station or UAV. It can be intercepted, disrupted, and exploited.
- Telemetry downlink. The controller uses a radio frequency to monitor various flight information about the UAV in real time such as position, altitude, heading, and speed.

- Command and control uplink. A controller is required to operate most UASs. The command and control uplink signal can be used to geo-locate the actual operator of the UAS. See figure 1-1 for visual representation of the different communication links for a UAS.



C2	command and control	L1	L-band channel 1
GPS	global positioning system	TOC	tactical operations center

Figure 1-1. UAS communication links

1-6. Each component has its own weakness. The UAV is vulnerable to electronic and lethal fires. The control station is vulnerable to link protocols and lethal fires. The different communications links can be exploited to geo-locate the UAV, control station, or the tactical operation center.

UAV TYPES

1-7. UAVs are divided into three common types: fixed-wing, rotary-wing/multirotor, and balloons. See Table 1-2 for examples of some advantages and limitations for each type.

Table 1-2. Advantages and limitations by UAV type

Type	*Advantages*	*Limitations*
Fixed-wing	• Increased flight time. • Generally low audible signature. • Carry larger payloads. • Greater speed.	• May have increased operational and sustainment requirements. • Needs room for takeoff and landing. • Must constantly move forward, not able to hover.

Table 1-2. Advantages and limitation by UAV type (cont.)

Type	*Advantages*	*Limitations*
Rotary-wing / multirotor	• Vertical take-off and landing capable, which means they can make off from almost anywhere. • Ability to hover and stare capability. • Requires little training. • Low cost easy to acquire and conceal.	• Low load carrying capacity. • Limited speed.
Balloon	• Long duration. • Able to operate at high altitudes. • High load carrying capacity.	• Limited ability to maneuver. • Needs room for takeoff and landing.

1-8. UAVs may be powered by either electric motors (quiet) or internal combustion engines (larger sound signature). UAVs carry a payload which is tailored to the mission the UAV is conducting. A UAV's payload may be equipped with one or more of the following types of sensors or weapons:

- Electro-optical or infra-red optics.
- Radar systems.
- Signal collecting and defeating devices.
- Laser designation devices.
- Electromagnetic detection devices.
- Electromagnetic attack devices.
- Electromagnetic jamming devices.
- Air-to-surface weapons.
- Explosives to create a loitering munition.

ADDITIONAL CONSIDERATIONS

1-9. Units should always assume the enemy is using a UAS to observe or attempt to observe them. Modern, friendly, and allied sensors—which include a host of robust long-range and short-range radars, optical devices, and audible alert systems—face challenges detecting the UAS Groups 1, 2, and 3 at sufficient ranges. Because of this, threat UASs may go undetected while operating at a standoff range. This limits friendly ability to detect them and creates smaller engagement windows.

1-10. Threat UASs have limitations. Poor weather conditions can short-circuit them or prevent their sensors from collecting. High winds can prevent them from flying at all. Some commercial UAS emit electronic data that if collected can reveal its operator's location. Weather conditions like heavy fog or cloud cover can degrade their intelligence collection capabilities.

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Chapter 2
Planning

This chapter covers the basic planning considerations done at brigade and below when specifically dealing with counter unmanned aircraft systems.

PLANNING CONSIDERATIONS

2-1. Planning is the first step toward effectively countering UAS threats. Neutralizing the UAS threat requires a combined arms approach that employs capabilities from all the warfighting functions. Effective planning synchronizes activities across echelons and warfighting functions to ensure complementary and redundant capabilities.

2-2. Planning considerations are part of a coherent planning structure that includes—

- Layered approach.
- Rules of engagement.
- Airspace control.
- Air defense warning condition.
- Weapon control status.
- Early warning network.
- Prioritized protection list (PPL).

LAYERED APPROACH

2-3. A layered defense provides multiple engagement opportunities, ideally beginning at the maximum range from friendly forces and areas, and before any attacking UAS can release their weapons. A layered defense normally includes support by necessary space, surface, and airborne early warning, detection and tracking assets.

2-4. The airspace control plan and area air defense plan should include detailed procedures for threat UAS detection, identification, decisions, and engagement. With the proliferation of friendly joint and multinational UASs, many of which do not have identify-friend-from-foe (known as IFF) capability and are similar or identical to threat UASs, the airspace control plan and special instructions should include specific procedural control and coordination measures for control and deconfliction of friendly UAS.

2-5. The seven air defense artillery employment tenets support layered defense against UASs. They are mutual support, overlapping fires and overlapping coverage, balanced fires, weighted coverage, early engagement, defense in depth, and resilience. The tenets are described briefly in the following:

- Mutual support. C-UAS capabilities are positioned so that tracking or engagement with one system can engage targets within dead zones of adjacent systems. When planning around dead zones, consider altitude and atmospherics for electromagnetic warfare capabilities. Mutual support can also cover nonoperational systems or systems at a lower state of readiness.
- Overlapping fires and overlapping coverage. C-UAS capabilities are positioned so that their engagement envelopes overlap. Because of the variety of altitudes, ranges, and speed from which threat air can attack or observe friendly operations, leaders ensure C-UAS capabilities overlap both vertically and horizontally. Overlapping coverage also ensures that C-UAS sensors are positioned so that their coverage does not leave any seam in the defense that might be used by threat UASs to ingress.

- Balanced fires. C-UAS weapons are positioned to deliver an equal volume of fires in all directions. This is necessary for C-UASs in an area where the terrain does not canalize the threat or when the avenues of approach are unpredictable.
- Weighted coverage. C-UAS capabilities are combined and concentrated toward the most likely threat air avenues of approach or direction of attack. Threat UAS avenues of approach may be unpredictable, so weighted coverage may focus instead on critical assets. Weighted coverage and balanced fires are not mutually achievable and requires leaders to decide and accept risk.
- Early engagement. C-UAS capabilities are positioned so they can engage the threat before ordnance release or friendly target acquisition. Early engagements enable destruction of enemy platforms over enemy forces and unoccupied areas, thereby reducing the possibility of friendly collateral damage and fratricide. As with weighted coverage, early engagement is achieved at the expense of balanced fires.
- Defense in depth. C-UAS capabilities are positioned so that the threat is exposed to a continuously increasing number of effects as it approaches the friendly protected asset or force. Defense in depth decreases the probability that attacking UASs will reach the defended asset or force.
- Resilience. Resilience is the quality of the defense to maintain continuity of operations regardless of changes in tactics by the enemy or loss of C-UAS capabilities. Leaders understand the capabilities of their C-UAS equipment and plan for agility to quickly reallocate capabilities as required, and redundancy so that if any C-UAS capability becomes non-operational, there are still means to prevent threat UAS from accomplishing its mission.

RULES OF ENGAGEMENT

2-6. Commanders have the responsibility to take whatever action is necessary to protect their forces and equipment against attack and ensure their Soldiers operate in accordance with established rules of engagement (ROE). A unit can push engagement authority of threat UAVs lower, but they balance the risks of a quicker response with the potential for UAV fratricide.

AIRSPACE CONTROL

2-7. Divisions and brigades distribute the airspace coordination order (known as ACO), the unit airspace plan, and the current air picture via command and control systems that subordinate units have access to. This includes systems such as the command post computing environment (known as CPCE) or the joint battle command-platform (JBC-P). Not all brigades and battalions have access to tactical airspace integration system (known as TAIS) which is the command and control system that manages the air picture, forward area air defense command and control (known as FAADC2), or air and missile defense early warning systems (known as AMDWS). Subordinate units without air defense and air management (ADAM) cells, and access to these systems, are not capable of maintaining awareness of the current friendly air picture rely on those echelons with those systems to share and create products they can use.

AIR DEFENSE WARNING CONDITIONS

2-8. Air defense warning (ADW) condition is an air defense warning given in the form of a color code corresponding to the degree of air threat probability. Warning conditions are a procedural control used to prepare units based on the assessed threat. Different conditions can be provided for different air threats. Subordinate commanders may issue higher, but not lower, conditions for their assigned area. Leaders ensure that every Soldier knows the current ADWs.

2-9. There are three types of ADWs: red, yellow, and white, with red being the most urgent. Descriptions of the ADWs are as follows:

- ADW red. An attack by hostile aircraft or missile is imminent or in progress.
- ADW yellow. An attack by hostile aircraft or missile is probable.
- ADW white. An attack by hostile aircraft or missile is improbable.

WEAPONS CONTROL STATUS

2-10. Weapon control status is a control measure that establishes the conditions under which air defense weapons (including small arms and crew served weapons) are permitted to engage threats. Weapon control statuses can apply to weapon systems, volumes of airspace, or types of air platforms. The tactical situation normally determines the degree or extent of control necessary over particular weapon systems. The brigade AMD cell either establishes separate weapon control statuses for various air threats, including fixed and rotary-wing aircraft, and UASs or an overall control status for any threat air engagement. The three weapon control statuses for C-UASs are—

- Weapons free. Engage any UAS that is not positively identified in accordance with ROE as friendly. This is the least restrictive weapon control status.
- Weapons tight. Engage only UASs identified as hostile in accordance with ROE.
- Weapons hold. Units may fire only in self-defense or when ordered by proper higher authority. This is the most restrictive weapon control status.

EARLY WARNING NETWORK

2-11. As part of their counterreconnaissance efforts, all units establish an air threat early warning network. This network is usually over frequency modulation (known as FM) and is a means of sharing air threat situational understanding for units without dedicated air defense command and control systems. These networks alert everyone. Units practice relaying information using this network to reduce the time required to notify everyone. See paragraphs 3-57 through 3-61 for additional details on establishing and using an early warning network.

PRIORITIZED PROTECTION LIST

2-12. Army units develop a PPL to prioritize the use of assigned or allocated protection capabilities. The PPL provides focus on defending critical assets such as command and control nodes or logistics areas as part of the overall protection plan. Critical assets can be people, property, equipment, activities, operations, information, facilities, or materials.

2-13. A brigade's protection cell uses information derived from the brigade commander's guidance and division's PPL, during mission analysis to identify critical assets. The brigade's protection cell uses criticality, threat vulnerability, and threat probability to prioritize identified critical assets. Once the protection working group determines which assets are critical for mission success, it recommends protection priorities and establishes the brigade's PPL. It is continuously assessed and revised throughout each phase or major activity of an operation.

PLANNING CAPABILITIES AND CONSIDERATIONS BY ECHELON

2-14. Brigade and higher headquarters are responsible for the integration of C-UAS into the military decision-making process and into the targeting, intelligence preparation of the battlefield (IPB), and protection processes. In addition, the ADAM and brigade aviation element (BAE) cells assist in managing the airspace and air defense weapon systems' employment. The C-UASs fight requires a multi-echelon approach, synchronizing resources of higher echelons to support mitigation of the UASs threat. Brigade and lower echelons execute protection and survivability activities to mitigate UAS threats on their positions and conduct engagement of immediate UAS threats.

2-15. Every echelon has and employs different air defense capabilities. Divisions and above analyze and plan to mitigate the UAS threat. They direct C-UAS capabilities to enhance survivability of subordinate friendly forces and critical assets. These assets may be pushed to a brigade to provide overlapping and mutual support with a brigade's organic weapon systems. Divisions also ensure U.S. forces and allies maintain a real-tie common threat air operating picture relevant to the UAS threat. While most brigades do not have dedicated air defense capabilities, they do have a dedicated air defense personnel on the brigade staff who can assist with planning and coordinating air defense activities both with their higher and subordinate echelons. Battalions do not have as robust of staffs as brigade and depend on brigade's products and systems to assist their assigned companies. Companies and below have no dedicated staff and account for threat UASs just like they do with any other form of contact.

BRIGADE PLANNING CONSIDERATIONS

2-16. Brigades establish C-UAS plans to protect friendly forces operating in their assigned area. Brigades direct positioning of assets, plan sensor coverage, and conduct movement of forces consistent with division and corps' plans and objectives. This includes any changes to priority tasks and security of critical assets.

2-17. Brigade planning considerations should include reporting techniques, positive identification, alert dissemination, and rules of engagement. Brigade C-UAS planning considerations include, but are not limited to—

- Disseminate air defense warning and weapons control status.
- Establish general and local air defense warnings (based on running estimates of the air threat).
- Refine PPL based on intelligence preparation of the battlefield, risk, and commander's assessment.
- Refine the UAS rules of engagement.
- Determine the identification authority.
- Disseminate and refine division's engagement authority.
- Coordinate coverage that may extend beyond the brigade's organic sensor capabilities.
- Coordinate with friendly mission command nodes and airspace users to reduce fratricide.
- Establish notification procedures.
- Create appropriate command or support relationships between arrayed C-UAS capabilities.

Brigade ADAM/BAE Cell

2-18. The brigade ADAM cell along with the BAE cell work together to maximize the combat effectiveness of counter-air systems and minimize the risk of friendly fire incidents and collateral damage. To do this they take the following actions:

- Manage, develop, and implement a C-UAS layered defense plan by—
  - Planning the employment of C-UAS equipment, sensors, and capabilities.
  - Understanding how best to use the various C-UAS systems.
  - Understanding how C-UAS capabilities affect friendly operations.
  - Developing and disseminating the brigade's airspace plan (Annex C, Appendix 10).
  - Creating standard operating procedures for friendly air actions and how to respond to threat air.
  - Developing and refining counter-air tactics, techniques, and procedures tailored to the estimated threat environment.
- Integrate friendly C-UAS capabilities into the brigade common operational picture.
- Coordinate with the intelligence section to develop the enemy air situational template (known as a SITEMP).
- Implementing higher headquarters' C-UAS ROEs, rules for use of force, and special instructions (known as SPINS).
- Recommending unit ROEs, rules for use of force, and special instructions (known as SPINS) to the brigade commander.
- Implement and adhere to required host-nation policies and procedures for C-UAS.
- Assess the effectiveness of the C-UAS layered defense after a C-UAS engagement, adjusting as necessary, and providing feedback via lessons learned to both higher echelons and subordinate units.

Note. The ADAM capabilities resident in a combat aviation brigade and maneuver enhancement brigade do not have an aviation operations component and therefore have a very limited capability to perform BAE functions.

Brigade C-UAS Running Estimate

2-19. The brigade ADAM/BAE cell maintain a C-UAS running estimate. The estimate includes, but is not limited to—

- Location and status of all brigade C-UAS assets.
- Capabilities of available C-UAS equipment.
- Enemy UAS activity—past, current, and anticipated.

BATTALION PLANNING CONSIDERATIONS

2-20. Battalions integrate brigade guidance to form a coherent scheme of protection. For a battalion to effectively respond to an unknown UAV, it needs to have situational awareness of any friendly aircraft in their assigned area. Battalions shape their C-UAS planning and actions through—

- Integrating and disseminating unit airspace plan from Annex C, Appendix 10, to maintain awareness of friendly manned and unmanned aircraft to facilitate C-UAS identification and minimize fratricide.
- Integrating attack guidance, targeting processes, and reporting requirements from Annex D to assist in the targeting process.
- Integrating and adhering to air defense coordinating instructions, and ROE guidance such as ADW and WCS from Annex D, Appendix 7. This also informs proper employment or assigned, allocated, or attached air defense and C-UAS assets and capabilities.
- Determining the best array of assigned, attached, and allocated C-UAS capabilities to provide a layered defense for the battalion.
- Integrating and understanding brigade's collection efforts and reporting requirements from Annex L.

2-21. The battalion intelligence section as part of IPB creates products that assist the battalion in developing their concept of protection, which includes a threat assessment. A threat assessment includes, but is not limited to—

- Possible threat UAS groups operating in battalion area of operations.
- Capabilities of threat UASs.
- Number of threat UASs expected in area of operations.
- UAS employment techniques.
- Potential launch and recovery sites.
- Probable payload capabilities.
- Threat UAS flight profiles.
- Sensor coordination with brigade.

2-22. The battalion develops their concept of protection, which incorporates C-UAS actions based on intelligence estimates and analysis. The concept of protection focuses assets, resources, and expertise to effectively mitigate UAS and other threats. Additional instructions for the companies are included under coordinating instructions; this includes guidance such as threat UAS reporting procedures, weapon control status, and threat UAS engagement criteria. The battalion staff ensures that all subordinate unit C-UAS battle drills are nested with the battalion concept of protection.

COMPANY AND BELOW PLANNING CONSIDERATIONS

2-23. Companies and below take the concept of protection developed at battalion and implement it. Their main focus during troop leading procedures is to focus on reacting to air contact battle drills. Leaders at company and below conduct rehearsals and examine their unit's active and passive measures. Rehearsals will check things such as air guard locations, assigned sectors, UAS reporting procedures, communication plans, ADW status, weapon control status, engagement criteria, and threat UAS identification.

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Chapter 3
Defensive C-UAS Actions

This chapter covers the passive measures units take to avoid detection from threat UAVs and the active measures to take once a UAV is detected.

OVERVIEW

3-1. Once a threat UAV is in the air, a unit focuses on survivability. *Survivability* is a quality or capability of military forces which permits them to avoid or withstand hostile actions or environmental conditions while retaining the ability to fulfill their primary mission (ATP 3-37.34). It represents the degree to which a formation is hard to kill. Survivability is relative to a unit's capabilities and the type of enemy effects it must withstand, its ability to avoid detection, and how well it can deceive enemy forces. Survivability is also a function of how a formation conducts itself during operations.

3-2. Leaders assess survivability as the ability of a friendly force to withstand enemy effects while remaining mission capable. Armor protection, mobility, tactical skill, avoiding predictability, and situational awareness contribute to survivability. Enforcement of overhead security techniques and avoiding detection while initiating contact on favorable terms also increases survivability.

3-3. Contact with unidentified UAVs may be a precursor to an imminent attack. All units who were in the UAV's path should assume they were observed and prepare for indirect fire on their positions. All units must react quickly, respond appropriately, and report when recognizing signs of possible enemy observation or attack. Whether a dedicated C-UAS or counter-air capability is available or not, units implement passive and active defensive measures to nullify or reduce the effectiveness of enemy UAV operations. Passive measures are all measures taken to prevent threat UAVs from detecting and targeting friendly forces and assets. Active measures are actions taken to detect, identification, decide, and potentially engage UAVs by lethal and non-lethal means.

PASSIVE MEASURES

3-4. Passive measures improve survivability by reducing the likelihood of detection and targeting of friendly assets and mitigating the potential effects of an air attack. Passive air defense measures are the first line of defense against air threats. While this book is focused on C-UASs, these measures can apply for all counter-air operations. All units employ passive defense measures to protect themselves from detection, observation, and attack. These measures include—

- Camouflage and concealment.
- Deception.
- Dispersion.
- Displacement.
- Hardening and protective construction.

CAMOUFLAGE AND CONCEALMENT

3-5. The more closely a target resembles its background, the more difficult it is for threat UAVs to distinguish between the two. Adhering to this fundamental principle of camouflage and concealment requires awareness of the surroundings, proper camouflage and concealment skills, and the ability to identify threat electromagnetic sensors.

3-6. When existing concealment is insufficient, military forces can alter the physical environment to provide or improve concealment for personnel and physical assets. Similarly, they can employ camouflage to confuse, mislead, or evade the enemy. Camouflage and concealment prevent observation. Units apply camouflage to prevent detection both horizontally and vertically.

3-7. Target acquisition can be accomplished by a variety of sensors that operate throughout the electromagnetic spectrum. This poses a challenge to camouflage and concealment planning and employment—determining which enemy sensors the camouflage and concealment activities should defeat. Unfortunately, no single answer is correct for all situations. Leaders without specific guidance from their higher echelon assess their tactical situation and plan camouflage and concealment activities accordingly. If intelligence data indicate that an enemy UAV uses visual sensors, then visual countermeasures are employed. For infrared or radar sensors, countermeasures that are effective in those spectra are employed. If a multispectral or hyperspectral threat is anticipated, camouflage and concealment activities are conducted to protect a unit in its most vulnerable electromagnetic bandwidths. Very few available camouflage materials or techniques provide complete broadband protection.

3-8. Sometimes it is easier to remove the source of a signal instead of trying to camouflage it. For example, there are readily and cheaply available sensors capable of detecting Wi-Fi or Bluetooth signals off of a “smart device”. When operating in a non-urban environment where there are not a lot of other civilian signals to mask that signature, leaders should weigh the benefit of the smart device with the risk of detection, and if that risk is too high, have Soldiers turn off and remove those smart devices.

Threat Sensor Systems

3-9. The most plentiful, reliable, and timely enemy sensors are visual. Therefore, effective camouflage and concealment techniques in the visual portion of the electromagnetic spectrum are extremely important. Something that cannot be seen is often difficult to detect, identify, and target. Field uniforms, standard camouflage screening paint patterns, ultra-lightweight camouflage-net system (ULCANS), and battlefield obscurants provide effective camouflage and concealment against visual sensors. Full-coverage camouflage and concealment (to include vertical camouflage) help to avoid visual detection by the enemy. When time is short, apply camouflage and concealment first to protect from the most likely direction of attack—then treat the remainder as time allows.

3-10. Near-infrared sights are effective at shorter ranges. While red filters help preserve night vision, they cannot prevent near-infrared sensors from detecting light from long distances. Therefore, careful light discipline is an important countermeasure to near-infrared sensors and visual sensors (such as image intensifiers). Standard camouflage screening paint patterns, battlefield obscurants, and certain uniforms are designed to help defeat near-infrared sensors.

3-11. Natural materials and terrain shield heat sources from infrared sensors and break up the shape of cold and warm military targets viewed on infrared sensors. Do not raise vehicle hoods to break windshield glare because this exposes a hot spot for infrared detection. Even if the infrared system can locate a target, the identity of the target can still be disguised. Avoid building fires and using vehicle heaters. Infrared-defeating obscurants, chemical-resistant paints, and certain uniforms are designed to help break up infrared signatures, but they do not defeat infrared sensors.

3-12. Enemy use of ultraviolet sensors poses a significant threat in snow-covered areas. Winter paint patterns, the arctic-style lightweight camouflage screen system (known as LCSS), and terrain masking are critical means for defending against these sensors. Any kind of smoke defeats ultraviolet sensors. Field-expedient countermeasures, such as constructing snow walls, also provide a means of defeating ultraviolet sensors.

3-13. To defeat these various sensors, units need to—

- Minimize movement. Movement attracts enemy attention and produces several signatures (tracks, noise, hot spots, dust). In operations that inherently involve movement (such as offensive tasks), leaders plan and manage movement so that signatures are reduced as much as possible. If movement must be done, slow, regular movement is usually less obvious than fast, erratic movement.

- Avoid operational patterns. An enemy can often detect and identify different types of units or operations by analyzing the signature patterns that accompany their activities. For example, an offensive is usually preceded by the forward movement of engineer obstacle reduction assets; petroleum oils, and lubricants; and ammunition. Such movements are very difficult to conceal; therefore, as an alternative, the pattern of resupply can be modified. An enemy recognizes repetitive use of the same camouflage and concealment techniques.

3-14. To camouflage effectively from aerial observation, units consider the threat viewpoint. Prevent patterns in anti-detection countermeasures by applying the following recognition factors to tactical situations. These factors describe a target's contrast with its background.

Reflectance

3-15. Reflectance is the amount of energy returned from a target's surface compared to the energy striking the surface. Reflectance is generally described in the following three ways, according to the part of the electromagnetic spectrum in which the reflection occurs:

- Visual reflectance. Visual reflectance is characterized by the color of a target. Color contrast can be important, particularly at close ranges and in homogeneous background environments, such as snow or desert terrain. The longer the range, the less important color becomes. At very long ranges, colors tend to merge into a uniform tone. Also, the human eye cannot discriminate color in poor light.
- Temperature reflectance. Temperature reflectance is the thermal energy reflected by a target (except when the thermal energy of a target is self-generated, as in the case of a hot engine). Infrared imaging sensors measure and detect differences in temperature-reflectance levels (known as thermal contrast).
- Radar-signal reflectance. Radar-signal reflectance is the part of the incoming radio waves that is reflected by a target. Radar sensors detect differences in a target's reflected radar return and that of the background. Since metal is an efficient radio-wave reflector and metals are still an integral part of military equipment, radar return is an important reflectance factor.

Shape

3-16. Unnatural shapes stand out in nature. Natural background is random, and most military equipment has regular features with hard, angular lines. Even an erected camouflage net takes on a shape with straight-line edges or smooth curves between support points. An enemy can easily see silhouetted targets, and its sensors can detect targets against any background unless their shape is disguised or disrupted. Size, which is implicitly related to shape, can also distinguish a target from its background.

3-17. Some equipment such as radar arrays can't be covered by camouflage nets since it interferes with its operations. Camouflage nets can be used to cover most of the equipment and only have the operational face of the radar exposed. The net needs to help break up the straight lines of the radar or anything it is covering.

3-18. ULCANS is the standard Army camouflage net. ULCANS reduces a vehicle's visual, near-infrared, and radar signatures. ULCANS are only effective if there is at least 2 feet of space between the ULCANS and the camouflaged equipment and if the completely covers the equipment. There are different colors and there is a radar-transparent model that can also be used. Leaders and Soldiers need to ensure to keep track of the radar-transparent and the radar-scattering ULCANS versions so as not to impede their own radar antennas.

Shadow

3-19. Shadows need to be accounted for when camouflaging. Shadows can be divided into two types:

- Cast shadow. A cast shadow is a silhouette of an object projected against its background. It is the more familiar type of shadow and can be highly conspicuous. In desert environments, a shadow cast by a target can be more conspicuous than the target itself.
- Contained shadow. A contained shadow is the dark pool that forms in a permanently shaded area. Examples are the shadows under the track guards of an armored fighting vehicle, inside a slit

trench, inside an open cupola, or under a vehicle. Contained shadows show up much darker than their surroundings and are easily detected by an enemy.

Texture

3-20. A rough surface appears darker than a smooth surface, even if both surfaces are the same color. For example, vehicle tracks change the texture of the ground by leaving clearly visible track marks. This is particularly true in undisturbed or homogeneous environments, such as a desert or virgin snow, where vehicle tracks are highly detectable. In extreme cases, the texture of glass or other very smooth surfaces causes a shine that acts as a beacon. Under normal conditions, very smooth surfaces stand out from the background. Therefore, eliminating shine is a high priority in camouflage and concealment.

Patterns

3-21. Rows of vehicles and stacks of supplies create equipment patterns that are easier to detect than random patterns of dispersed equipment. Equipment patterns should be managed to use the surroundings for vehicle and equipment dispersal. However, equipment dispersal should not be implemented in such a way that it reduces the unit ability to accomplish a mission.

3-22. Equipment paint patterns often differ considerably from background patterns. The critical relationships that determine the contrast between a piece of equipment and its background are the distance between the observer and the equipment and the distance between the equipment and its background. Because these distances usually vary, it is difficult to paint equipment with a pattern that always allows it to blend with its background. As such, no single pattern is prescribed for all situations. Field observations provide the best match between equipment and background.

3-23. The overall terrain pattern and the signatures produced by military activity on the terrain are important recognition factors. If the unit is to remain unnoticed, it matches the signatures produced by stationary equipment, trucks, and other activities with the terrain pattern. Careful attention is also paid to vehicle tracks and their effect on the local terrain during unit ingress, occupation, and egress.

Camouflage and Concealment Discipline

3-24. Camouflage and concealment discipline avoids activities that change the appearance of an area or reveal the presence of military equipment. Camouflage and concealment discipline is a continuous necessity that applies to every Soldier. If the prescribed visual and audio routines of camouflage and concealment discipline are not observed, the entire camouflage and concealment effort may fail. Vehicle tracks, spoil, and debris are the most common signs of military activity. Their presence can negate efforts of proper placement and concealment. Units and personnel continually reassess and improve their camouflage and concealment.

3-25. Camouflage and concealment discipline denies an enemy the indications of unit location or activities by minimizing disturbances to a target area. To help maintain unit viability, a unit integrates all available camouflage and concealment means into a cohesive plan. Camouflage and concealment discipline involves regulating light, heat, noise, spoil, trash, and movement. Successful camouflage and concealment discipline depends largely on the actions of individual personnel. Some of these actions may not be easy on a Soldier, but failure to observe camouflage and concealment discipline could defeat the camouflage and concealment efforts of an entire unit and possibly impact unit survivability and mission success.

3-26. Standard operating procedures that prescribe camouflage and concealment procedures aid in enforcing camouflage and concealment discipline, and they should—

- List specific responsibilities for enforcing established camouflage and concealment countermeasures and discipline.
- Detail procedures for individual and unit conduct in assembly areas or other situations that may apply to the specific unit.

3-27. Successful units have frequent camouflage and concealment battle drills. Camouflage and concealment discipline is a continuous requirement that calls for strong leadership, which produces a disciplined camouflage and concealment consciousness throughout the entire unit.

Light and Heat Discipline

3-28. Though always important, light and heat discipline is crucial at night. As long as visual observation remains a primary reconnaissance method, concealing light signatures remains an important camouflage and concealment countermeasure. Lights not blacked out at night can be observed at great distances. For example, the human eye can detect campfires from a distance of 8 kilometers (4.97 miles) and vehicle lights from 20 kilometers (12.43 miles). Threat surveillance can also be used to detect heat from engines, stoves, and heaters from great distances. When moving at night, vehicles in the forward combat area should use ground guides and blackout lights. When the use of heat sources is unavoidable, use terrain masking, exhaust baffling, and other techniques to minimize thermal signatures of fires and stoves.

Spoil

3-29. The prompt and complete policing of debris and spoil is an essential camouflage and concealment consideration. Proper spoil discipline removes a key signature of a unit's current or past presence in an area.

Track

3-30. Vehicle tracks are clearly visible from the air, particularly in selected terrain. Therefore, track and movement discipline is essential. Use existing roads and tracks as much as possible. When using new paths, ensure that they fit into the existing terrain pattern. Units minimize, plan, and coordinate movement; and take full advantage of cover and dead space.

Camouflage and Concealment Techniques

3-31. There are five general techniques of employing camouflage and concealment. They are hiding, blending, disguising, disrupting, and decoying.

3-32. The hiding technique screens a target from enemy sensors. The target is undetected because a barrier hides it from a sensor's view. Every effort should be made to hide all operations; this includes using conditions of limited visibility for movement and terrain masking. Examples of hiding include—

- Placing vehicles beneath tree canopies.
- Placing equipment in defilade positions.
- Covering vehicles and equipment with nets.
- Hiding roads and obstacles with linear screens.
- Using battlefield obscurants, such as smoke.

3-33. The blending technique alters target appearance so that it appears to become a part of the background. Generally, it involves arranging or applying camouflage material on, over, and/or around a target to reduce its contrast with the background. Characteristics to consider when blending include the terrain patterns in the vicinity and the target size, shape, texture, color, EM signature, and background.

3-34. The disguising technique applies materials on a target to mislead the enemy as to its true identity. Disguising changes a target appearance so that it resembles something of lesser or greater significance. For example, a missile launcher might be disguised to resemble a cargo truck, or a large building might be disguised to resemble two small buildings.

3-35. The disrupting technique alters or eliminates regular patterns and target characteristics. Disrupting techniques include pattern painting, deploying camouflage nets over selected portions of a target, and using shape disrupters (such as camouflage sails) to eliminate regular target patterns.

3-36. The decoying technique deploys a false or simulated target within a target scene or in a position where the enemy might conclude that it has found the correct target. Decoys generally draw fire away from real targets. Depending on their fidelity and deployment, decoys greatly enhance survivability.

DECEPTION

3-37. Except for a few select types, preconstructed decoys are not widely available. A typical Army unit can construct effective, realistic decoys to replicate key equipment and features through imaginative planning and working knowledge of the electromagnetic signatures emitted by the unit. Units use decoys to set up false locations, to draw attention away from an operation, or to confuse threat collection activities which can conceal unit activities from enemy detection.

3-38. The proper use of decoys provides alternate targets against which an enemy expends ammunition, possibly revealing its position in the process. Decoys also enhance friendly survivability and deceive an enemy about the number and location of friendly weapons, troops, and equipment.

3-39. Decoys are used to attract enemy attention for a variety of tactical purposes. Their main use is to draw enemy fire away from critical assets. Their design depends on several factors, such as the target to be decoyed, a unit's tactical situation, available resources, and the time available to a unit for camouflage and concealment employment. Decoys are generally expendable, and they can be elaborate or simple.

3-40. Proper decoy employment serves a number of tactical purposes, including—

- Increasing the survivability of key unit equipment and personnel.
- Deceiving the enemy about the strength, disposition, and intentions of friendly forces.
- Drawing enemy fire, which reveals its positions.
- Encouraging the enemy to expend munitions on relatively low-value targets (decoys).

3-41. The two most important factors regarding decoy employment are—

- Location. Logically placing decoys greatly enhances their plausibility. Decoys are usually placed near enough to the real target to convince an enemy that it has found the target. However, a decoy must be far enough away to prevent collateral damage to the real target when the decoy draws enemy fire. Proper spacing between a decoy and a target depends on the size of the target, the expected enemy target-acquisition sensors, and the type of munitions directed against the target.
- Fidelity (realism). Decoys are constructed according to a friendly unit standard operating procedure and include target features that an enemy recognizes. The most effective decoys are those that closely resemble the real target in terms of both shape and electromagnetic signatures. Completely replicating the signatures of some targets, particularly large and complex targets, can be very difficult. Therefore, decoy construction should address the electromagnetic spectral region in which the real target is most vulnerable. When evaluating decoy fidelity, the decoy should be recognizable in the same ways as the real target, only more so. Try to make the decoy slightly more conspicuous than the real target. For example, enhance the realism of a decoy command post by having it send and receive fake electronic traffic. Use a ULCANS to only partially cover the decoy command post, thus making it a more conspicuous target than the real command post.

DISPERSION

3-42. *Dispersion* is the spreading or separating of troops, material, establishments, or activities which are usually concentrated in limited areas to reduce vulnerability (JP 5-0). To increase their survivability units disperse personnel and capabilities to the maximum extent possible. Leaders at all levels balance the degree of dispersion with other factors such as their ability to command and control forces and provide mutual support to adjacent units.

3-43. Friendly forces use dispersion to degrade or deny the enemy's ability to effectively locate, target, and engage friendly forces. While all the mission variables impact the degree of a unit's dispersion at any given time, terrain is usually a key determining factor in how much a unit can disperse. Generally, the more open the terrain, such as deserts or farmland, the more a unit disperses to increase its survivability against aerial threats. Conversely, in terrain such as heavily wooded areas or urban centers, a unit may decrease dispersion due to the availability of overhead concealment provided by vegetation or buildings to increase their overhead security.

3-44. Dispersion is applicable to stationary and moving forces. Stationary forces combine dispersion with other survivability techniques, such as camouflage and concealment, and hardening facilities to increase their survivability. Moving forces maintain dispersion during movement, maneuver, and halts. Dispersion is particularly important when executing movement in canalizing terrain such as along roads or trails. During halts units maintain and may even increase their dispersion. Whenever possible units halt in areas where the terrain provides concealment.

3-45. If friendly forces are detected and engaged by enemy forces, dispersion lessens target density and reduces the lethal effects of any enemy weapon system. Area weapon system become less effective when units are dispersed.

DISPLACEMENT

3-46. If friendly assets are observed or an attack begins, units can displace to an alternate location to prevent additional attacks or to render the current attack ineffective. Ideally, a displacement is conducted without degrading the performance of a unit's primary objective. During the planning process unit's will account for the employment of enemy UAS and its known capabilities. Based on the assessment of the UAS's capabilities, the unit commander identifies displacement criteria and the actions to take if the criteria are met. This can range from repositioning from a primary position to an alternate position to a full withdrawal.

HARDENING AND PROTECTIVE CONSTRUCTION

3-47. While hardened facilities are specifically reinforced for protection against direct and indirect fire, the concept extends to include additional protection of key assets from explosive and nonexplosive hazards. For aerial threats this focuses on overhead cover that is thick enough to withstand enemy artillery fire or any ordnance an enemy UAV could drop, such as grenades or mortar rounds.

3-48. This could be as simple as adding layers of sandbags, or pieces of steel on top of existing buildings or vehicles. It could also be as complex as purposefully constructing a shelter or bunker with specific materials such as concrete and steel to protect against indirect fire and aerial attacks. Care should be taken to balance the increased survivability that overhead cover provides with the effect it has on the vehicle or structure as not all are rated to have that additional weight and could fail.

3-49. While hardening can apply to both vehicles or building, protective construction is limited to fixed sites and is typically done by engineers. Soldiers can do some protective construction on their own such as filling sandbags or collecting Class IV materials, or using found objects like logs, rocks, or large amounts of earth. Engineers can assist with protective construction and need to be given a priority of work.

> ***Note.*** A technique to check the effectiveness of your passive measures, if time and capabilities are available, is to have friendly UAS or air assets try to detect a friendly force's position.

ACTIVE MEASURES

3-50. Active defense measures are a multi-step sequence that units and Soldiers do to detect, identify, decide, and potentially engage an unknown UAS. The quicker these steps can be applied, the more effective the response against threat UAS.

DETECT

3-51. UAS are small, maneuverable, and quiet. Even to the trained eye they are often very difficult to observe in flight. Environmental conditions can make such systems difficult to detect without the use of special technological tracking and identification devices. Time of day, ambient light levels, meteorological conditions, and observer alertness will all impact on the ability to observe a potential hostile UAS. Moreover, an experienced operator can fly a UAS in a tactical manner as such to further enhance the ability to exploit UAS characteristics. This may include—

- Flying at low level, using terrain, obstacles with vertical extent and/or urban environment to mask an approach to a potential target location.
- Making a series of false take-offs and approaches to intended target location.
- Use of erratic, dynamic flight profiles to confuse and deceive personnel, making visual observation challenging.
- Using the sun or cloud cover to effectively mask the UAS from sight.
- Flying upwind approaches to minimize the ability to detect the sound of the UAS.

- Use of sport flying modes to increase speed and agility and minimize the time to observe the UAS.
- Use of multiple UAS to confuse, deceive, and overwhelm observers and make tracking leading to defeat more difficult.
- Flying a pre-programmed flight profile to minimize risk to the operator, allowing for the link to be disconnected in flight from the control station and re-established over the target area from another position.

3-52. The types of sensors and their placement determine the unit's detection capability. Threat UAS types, threat axis of advance, terrain, weather, time-distance analysis, friendly defended assets, desired engagement zone, surveillance requirements, and the number of available assets impact how best to place and employ sensors. For sensor placement, integrating and networking sensors to develop the enemy threat UAS situation should be applied. The use of various types of sensors is warranted as currently there is no one type of sensor that is 100% effective.

3-53. Various sensor capabilities outside of visual (observer) could include RADAR, radio frequency, audible, and optical devices. The goal is to form an integrated sensor network that includes various sensor types. Sensor capabilities in support of low-level air threats are planned accordingly and coordinated in advance. Leaders may have to coordinate through higher echelons for additional sensor capabilities. No matter what sensor capabilities a unit has, all soldiers need to be aware of the air threats and constantly look up before and during any movements. Dedicated air guards are another way units can assist in air threat detection and engagement.

Air Guards

3-54. Air guards need to be vigilant with eyes on the horizon. Air guards are responsible for spotting aerial threats within proximity to the unit's location and to provide early warning by alerting the unit of possible air threats. Sector limits cover likely avenues of approach for threat aircraft. Air guards can be used during mounted and dismounted offensive and defensive operations.

3-55. If equipped with C-UAS assets, air guards can engage in accordance with ROE and weapon control status. Soldiers serving as air guard should establish positions within visual ranges of the unit (between 500 meters and 1.5 kilometers). This should allow the air guard to see, hear, and report potential threats.

3-56. Air guards should have the ability to conduct operations under all conditions. They should be equipped with the necessary optical gear to perform search and scan techniques to reduce the enemy's ability to evade detection.

3-57. When scanning for UAS, do not limit the search too near the horizon and miss higher-flying aircraft or search too high above the horizon and miss lower flying targets. The correct limit of search is 20 degrees above and below the horizon. A Soldier's arm fully outstretched arm with fingers fully extended is approximately 20 degrees. See figure 3-1 for an example of this method.

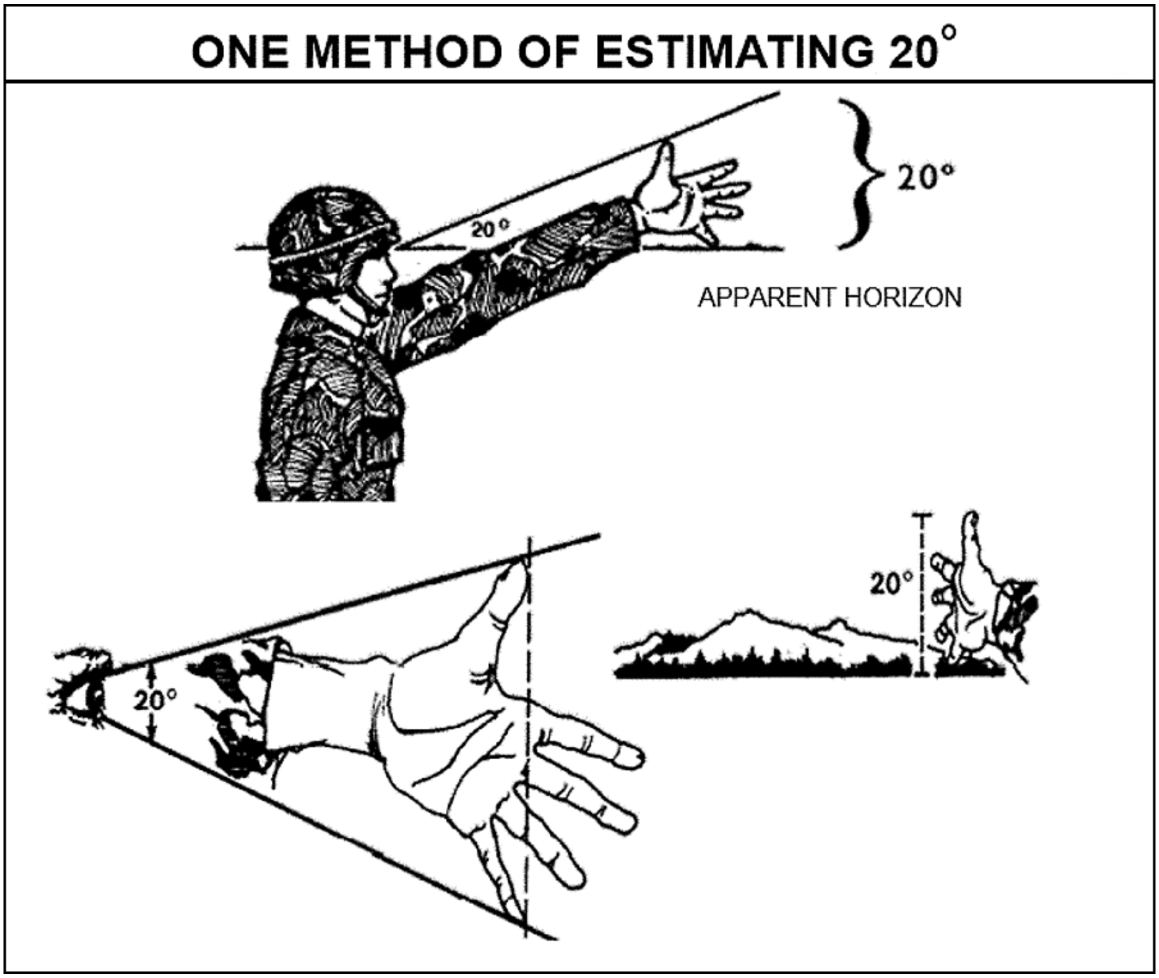


Figure 3-1. A method of estimating 20 degrees

3-58. The vertical scan is the technique used to optimize a Soldier's vision for finding air threats. By using upward eye movements toward the sky, then downward to the horizon and continuing across the terrain the air guard should scan using the same pattern to approximately 20 degrees above and below the horizon to account for all air threats. Figure 3-2 on page 3-10, shows the vertical scan and figure 3-3 on page 3-10, shows the horizontal scan.

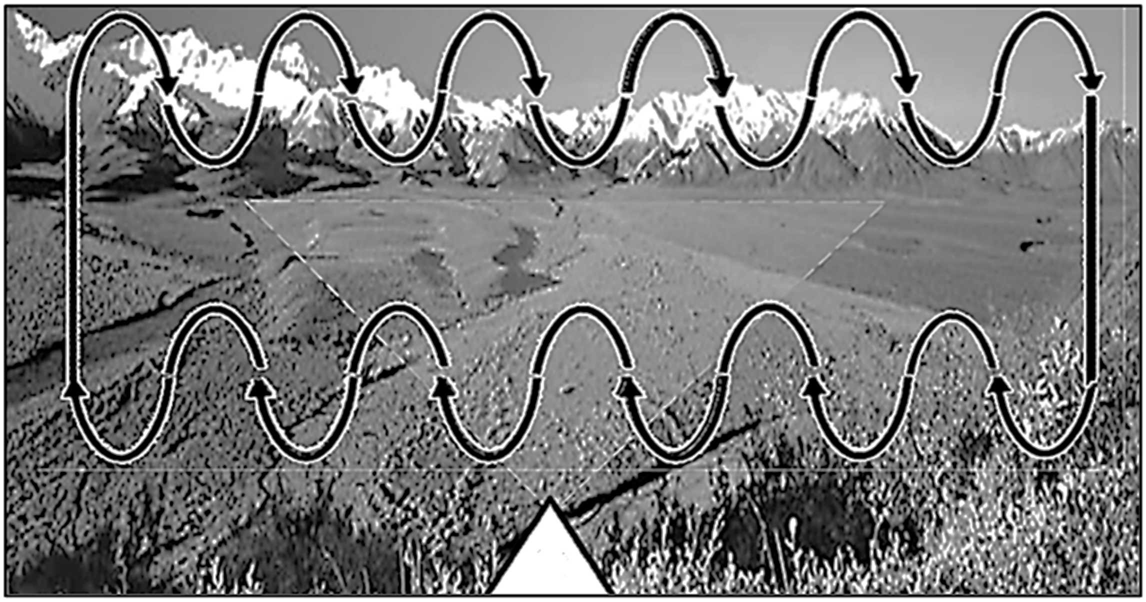


Figure 3-2. Vertical scan method

3-59. The horizontal scan is viewed from the horizon, the air guard should search using eye movements across the sky while working upward to approximately 20 degrees. As in vertical scanning, the air guard should continue the search and scan technique to 20 degrees below the horizon to detect low flying air threats. Figure 3-3 shows the horizontal scan.

Figure 3-3. Horizontal scan method

Air Guard Checklist

3-60. Before assuming duty as an air guard, leaders perform precombat inspection to ensure the designated air guard has the correct equipment and has been briefed on the current threat. The air guard checklist includes, but is not limited to—

- Understanding on types and characteristics of threat UAS.
- Understanding of current UAS trends.
- Specific data on local air threats and named areas of interest.
- Detection equipment (such as binoculars, night vision devices, thermal weapon sights).
- C-UAS equipment available.
- Secure radio operations and frequencies to send out early warning.
- Unit call signs to request support.
- Military map of area.
- Orientation techniques (location, heading, speed, and line-of-sight).
- Range card.

Warning

3-61. Once an air threat is detected, all friendly forces need to be quickly warned. This can happen by two methods—a top-down approach, or a bottom-up approach. Small UAVs are typically detected by forward units first, so rehearsing the use of the unit early warning net and rehearsals from the bottom-up are critical. No matter which approach is used, the information is passed using the SALUTE report format. Receipt of this report should trigger additional follow-on actions for all units. These follow-on actions could be for units to freeze in place or engage with lethal or non-lethal means. When possible, units detecting air threats alert adjacent units. Table 3-1 shows some additional information to collect on unknown UAS and to include in a SALUTE report.

Table 3-1. Example counter- unmanned aircraft system detection report (SALUTE format)

Line	*Information*	*Example*
1	***Size***	Report the number of UASs (unmanned aircraft systems), or size of the formation.
2	***Activity***	Report detailed account of actions: What is the UAS's direction of movement? Was there any hostile action? Is the threat UAS loitering in one spot? Is it flying straight? Was the threat UAS approach observed or was it spotted overhead?
3	***Location***	Report where you saw the activity. Include 6 to 8- digit grid coordinate of reporting element and either grid or distance and direction from reporting element location (known point).
4	***Unit*** ***(Description of UAS)***	*Include details such as—* • Fixed-wing or rotor/multi-rotor. • If fixed wing— • Estimated length of wingspan. • Tail configuration. • If rotor/multi-rotor— • Number of rotors. • Height. • Payload, sensors, and weapons. • Any lights. • Other distinguishable markings.

Table 3-1. Example counter-unmanned aircraft system detection report (SALUTE format) (cont.)

Line	*Information*	*Example*
5	**Time**	Report the time the activity was observed.
6	**Equipment**	If possible, report all equipment associated with the UAS, such as payload or weapons.
UAS unmanned aircraft system		

Top-down Approach

3-62. At brigade and above, AMD cells provide threat identification and site alarming by disseminating early warning both digitally and by voice to all their subordinate units. Digitally, this is done automatically from the staff planning and battlespace situational awareness tool (currently AMDWs) through the JBC-P. Since not every digital system works appropriately, or is being monitored, units also use voice communication.

3-63. The brigade AMD cell uses frequency modulation (known as FM) radio and transmits a flash message that a threat UAS is observed in the area of operations over the brigade operations and intelligence net. Battalions quickly transmit this over their operations and intelligence net. Companies then transmit this over the company net. Platoons transmit this over their platoon internal nets, and if appropriate over the necessary squad communications systems to ensure that all personnel are aware. This process takes time, so the quicker these flash messages are relayed, the quicker the force can take appropriate action.

Bottom-up Approach

3-64. When any observer detects an air threat, they begin the process in reverse. They use their local platoon net to pass their flash message, it is then relayed to the company net, which is then relayed to the battalion operations and intelligence net, and then relayed to the brigade operations net. There the brigade AMD cell inputs the necessary information into the appropriate system to ensure early warning across the entire formation. The first echelon with a battlefield situational awareness tool (such as the JBC-P) creates a digital warning to assist in quickly warning the entire formation.

3-65. No matter how a Soldier is alerted, upon receiving the air threat warning, their first reaction is to freeze. The threat can detect movement. After a quick assessment that they are not currently being observed, they move to cover and concealment and await the all clear report before resuming their current mission.

Track

3-66. Simultaneous with providing warning, friendly forces track the target and monitor the target's movement. Keeping track of the target needs to occur until a decision is made to engage or not engage the target and is successful. A location is a static estimated report or display of where an air threat is located at a given moment. A system track is a compilation of location reports over a period of time. Depending on the system employed the system track can be reported as a heat map display, quadrant alert, or a circle to indicate estimated center and location error or line of bearing. The detection plan contributes directly to the unit’s ability to track airborne objects continuously and efficiently.

IDENTIFY

3-67. Identification is the process of determining the friendly or hostile characteristics of an unknown detected contact. The employment of C-UAS capabilities requires early identification of UAS to maximize engagement times and avoid fratricide. The problem of distinguishing friendly, neutral, and hostile aerial objects while employing various weapon systems against threat UAS is a highly complex task. The same UAS may be flown by both friendly and enemy forces. Accurate identification allows leaders to make engagement decisions and enhances situational awareness. Timely identification improves weapons employment options, helps conserve friendly resources, and reduces the risk of friendly fire.

3-68. There are two methods of identification, procedural and positive. Positive identification is the preferred method of operation, but generally, some combination of positive and procedural identification is used. Procedural identification separates airspace users by geography, altitude, heading, time, and maneuver.

Positive identification is an identification derived from observation and analysis of target characteristics including visual recognition, electronic support systems, non-cooperative target recognition techniques, identification friend or fore systems, or other physics-based identification techniques (JP 3-01).

3-69. Identification of a UAS should lead to a specific name or category or the exact make and model of the UAS. Identification of its payload is also important if it can be determined. The process of assigning an identification to a track likely will depend on several criteria. Characteristics that assist in identifying an unknown UAV include identifying:

- If fixed wing—
  - Estimated length of wingspan.
  - Tail configuration.
- If rotor/multi-rotor—
  - Number of rotors.
  - Height.
- Estimated size.
- Payload, both sensors and weapons.

DECIDE

3-70. Decide is actually two decisions. First, whether there is a need to engage. Second if the decision to engage is made, the methods used to lessen or eliminate the threat posed by a UAS. These methods include physical and nonphysical. Some organizations will be equipped with cyber capabilities which include both physical and nonphysical methods. The degree of delegation is consistent with the rules of engagement, the available airspace, potential for collateral damage, and the inherent right of self-defense.

3-71. Physical methods engage with and either destroy or damage the device so that it is not operational. Examples of physical methods include, but are not limited to—

- Explosive munitions.
- Small arms.
- Projectiles.
- Entanglement.
  - Streamers.
  - Spray foam.
- Directed Energy.
  - Laser.
  - High-power microwaves.
- Capture.
  - Nets.

Small Arms Defense Techniques

3-72. Small arms techniques used in air defense incorporate the use of volume fire and proper aiming points according to the target's direction. If Soldiers are trained to apply an appropriate sequence of engagement techniques for UASs based on the rules for selecting aiming points, the response will be automatic upon command. Small arms are limited to the range and destructive capability of the weapon and should be used only on low flying UASs.

3-73. The decision to fire small arms against threat UASs is the unit commander's and is based on the situation. Considerations should at a minimum include the severity of the threat versus the potential impact of the unit's effectiveness and the area of engagement (urban versus rural).

Volume Fire

3-74. Volume fire is an effective method to employ when using small arms fire against aerial threats. The key to success in engaging enemy aircraft with small arms is to put out a high volume of fire towards the immediate threat. The more bullets a unit can put in the sky, the greater the chance the enemy will fly into them. Even if these fires do not hit the enemy, throwing up a "wall of lead" in the sky can intimidate threat UAS pilots, ultimately breaking off their attack or distracting them from taking proper aim. One of the most important points about volume fire is that once the lead distance is estimated, you must aim at the estimated aiming point and fire at that single point until the aircraft has flown past that point. Maintain the aiming point, not the lead distance. Once you start firing, do not adjust your weapon.

3-75. When the decision is made to engage an aircraft with small arms, every weapon (M4, M240, M249, and M2) should be used with the goal of placing as many bullets as possible in the enemy's flight path. That does not mean that everyone fires in some random direction. Instead, everyone selects an aiming point in front of the target and fires at that point. This aiming point is determined using the football field technique. When deciding to fire upon an enemy UAS, practical considerations need to be taken into account before engaging. An example is engaging a UAS from a range of 3 kilometers. It is important to consider the capabilities of the available weapons. Using small arms at this range is ineffective while the best possibility may be the use of the main gun on a tank or tracked vehicle. Small arms have a low probability of kill against attacking UAS due to their size, speed, and maneuverability.

Football Field Technique

3-76. The football field technique is a simple method of estimating lead distance. The theory is that most people have played or watched football and have a concept of how long a football field is. When told to lead the target by one football field, everyone aims at approximately the same point in space. One person's error in making the football field estimate will be offset by another person's error. The variation in aiming points will ensure that massed fire is delivered into a volume of space in front of the target rather than on a small point. Also, the differing perspectives from which the Soldiers view the target will act to further distribute the fire over a volume of space.

Aiming Points

3-77. Aiming points used to engage threat UAVs are different but may be used on a variety of different threats. An example of this technique would apply if enemy helicopters were detected and the decision was made to engage it should be engaged as a group 5 rotary wing UAV. The rules for selecting aiming points are simple, easily learned, and retained. The various aiming points are summarized in table 3-2.

Table 3-2. Aiming Points

UAV Type	***Course***	***Aiming Point***
Group 1 UAS	Crossing	0.5 football fields in front
Group 2 UAS	Crossing	1 football field in front
Group 3 - 5 UAS	Crossing	2 football fields in front
All UAS	Directly at you	Slightly above the UAV body
Rotary wing	Hovering	Slightly above the UAV body
UAS unmanned aircraft system UAV unmanned aircraft vehicle		

Firing Position Techniques For Small Arms

3-78. Except for the prone position, the firing positions used in rifle marksmanship are the same firing positions used to counter threat UAS with small arms. Firing at UAVs when lying down means the individuals are lying on their backs (supine), aiming their rifles into the air. If you are in an individual fighting position, stay there and return fire from the supported standing position. If you are not in an individual firing position, you should look for a tree, a large rock, or supportive object to help stabilize the weapon and provide protection. Use the following firing positions accordingly:

- You can use all the basic firing positions for air defense except the prone position. Instead, use the reverse position; lie on your back (supine) and point your weapon upward.

- Always take cover when available. If you are in an individual fighting position, stay there. Assume a supported standing position and return fire. The bipod on the M249 and M240 machine guns assists you in firing your weapon more effectively at hostile aerial platforms.
- If cover and concealment are good, use the high-kneeling position. If cover and concealment are less substantial, use the low kneeling position.

3-79. When using the M240 machine gun, the gunner will also fire from a protected position if possible. He needs to get the weapon up in the air. The gunner can hold it up or use some support such as a tree limb. In an emergency, another Soldier can act as a hasty firing support.

Engaging With Machine Guns

3-80. The machine gun is effective against slow-moving UAVs. To sustain the volume of fire and kill a target, a continuous burst of 20-to-25 rounds fired using a tracer on target method, allowing the gunner to adjust rounds on target.

3-81. Vehicle's machine guns are useful weapons against UAVs. They can be fired quickly unleashing a high-volume of fire. Ensure that the area is clear of friendly personnel. Use the following guidelines when using crew served weapons:

- When targets are hovering or inbound, aim high with the machine gun and fire a continuous burst, adjusting onto target by observing the travel and impact of tracers remembering, tracers may appear to be striking the target when they are actually going under it.
- If engaging a moving target, track along its flight path using a lead of 50 meters or half a football field. Fire a continuous burst, forcing the target to fly through the cone of fire.

3-82. When coordinated effectively, the aircraft will fly through the unit's cone of fire. Vehicle commanders must not try to track high-speed aircraft because they fly too fast. When enemy aircraft fly directly at vehicles, vehicle commanders are responsible for engaging them with controlled machine gun bursts of 50-to-100 rounds. Select an aiming point slightly above the nose to position the UAV in the cone of fire.

3-83. Because of the speed of some types of UAVs, the best technique to use against them is to fire all automatic weapons in continuous bursts. If the UAVs are inbound, aim slightly above the nose or fuselage and fire. If the UAV is crossing, use a lead of 200 meters (two football fields) and fire letting the UAV fly through the cone of fire from the machine guns. Do not try to track or traverse your fire for group 3 and above UAVs since they fly too fast.

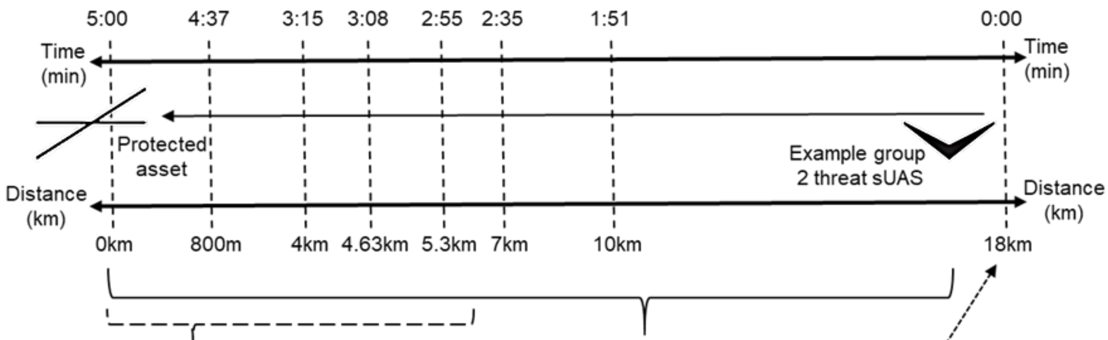
3-84. Nonphysical methods defeat the device by disrupting, blocking, or controlling the signal between the UAV's optical, flight control, and ground control station. Even though nonphysical methods are used on the UAV, these methods may still cause it to crash and cause collateral damage. Examples of nonphysical methods include, but are not limited to—

- Radio frequency jamming.
- GPS jamming.
- GPS spoofing.
- Dazzling.
- Position, navigation, and timing (known as PNT) jamming.

DEFEAT

3-85. Defeat techniques begin once airspace deconfliction and target engagement authority has been passed down to the tactical level. To confirm the identity of the sUAS and prevent fratricide multiple processes and procedures. Depending on the engagement method, area RF deconfliction may be required. Depending on the frequencies, there may be opportunities where operational RF spectrums overlap with the control frequency of the sUAS. Key leaders must determine and mitigate frequency fratricide during defeat measures. Defeat measures can follow non-lethal or lethal procedures. During non-lethal responses, it is crucial to continue jamming, until the UAS is inoperable. After lethal or non-lethal responses, and once the UAS has shown no control-link, explosive ordnance disposal must be requested to render the UAS safe. Once the UAS is safe, the UAS may submit for weapons intelligence and analysis. see figure 3-3 on page 3-16, C-sUAS Time/Distance Engagement Sequence Planning Considerations.

- Commanders, staffs, and Soldiers execute C-sUAS layered defense activities as part of an overall protection plan employing the five principles of protection: comprehensive, integrated, layered, redundant, and enduring.
- Utilizing air defense employment tenets of early engagement and defense in depth will allow the maneuver commander greater standoff against threat sUAS; however, such will shorten the timelines and distances associated with detection through defeat/engagement sequence depicted above.
  - Early engagement: sensors and weapons are positioned so they engage the threat before ordnance release or detection of friendly forces.
  - Defense in depth: sensors and weapons are positioned so that the threat is exposed to a continuously increasing volume of fire as it approaches the friendly protected asset or force.
- Target identification and engagement authorities, air defense weapons control statuses, and rules of engagement are subject to theater-specific conditions and orders.
- Threat sUAS detection will trigger local tactical SOP battle drill/reaction.



Defeat
- Target engagement authority delegation
- Airspace/radio frequency deconfliction
- Kinetic/non-kinetic response
- Weapons control statuses
- Rules of engagement
- Report

Track and Identify
- Via radar/electromagnetic, visual aircraft recognition, or procedural methods
- Via "wings, engine, fuselage, tail" method
- Via friendly procedural airspace control measures
- Target identification authority delegation

Detect
- Via radar/electromagnetic, visual aircraft recognition, or procedural detection
- Defense in depth
- Early engagement
- Layered defense

Time/distance chart based on example group 2 threat sUAS traveling at 4.3km/min (160 knots), and notional detection range of 18km. If example group 2 threat sUAS traveled at 7.7km/min (250 knots), the sUAS would reach/strike defended asset 2:18 minutes from 18km detection.

C-sUAS	counter-small unmanned aircraft system
km	kilometer
min	minute
SOP	standard operating procedure
sUAS	small unmanned aircraft system

Figure 3-3. CsUAS time/distance engagement sequence planning consideration

Engage

3-86. Once a decision is made to engage and with what capability, the determined capability engages. Other capabilities continue to track in case the target was missed, and they can engage or re-engage as necessary.

Exploit

3-87. Exploitation plays a key role in the development of UAS countermeasures. Effort should be made to collect downed UAS systems and their components. When Soldiers encounter a downed UAS, and the current situation allows it, they will use their optics from a safe distance to look for indicators or presence of suspicious items (is it carrying explosives, does it look modified, or is there any other type of explosive payload?). If possible, they conduct a check of the immediate area for potentially dropped payloads or additional grounded UAVs. If Soldiers determine no explosive hazards exist, they will collect up as much of the UAV as they can and expediate its movement to their higher echelon for exploitation.

3-88. If an explosive hazard is suspected, mark and report the UAV for action by explosive ordnance disposal or other trained personnel once operational conditions allow. Units will mark the hazard with engineer tape, VS-17 panel, or any other high visibility durable material that allows the explosive ordnance disposal team to identify the hazard's location from 50 to 100 meters. The location of the item should be marked on the units' situational awareness system (such as JBC-P) or Joint Capabilities Release (known as JCR) with a ten-digit grid. Units request explosive ordnance disposal through their chain of command using the necessary reports.

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Chapter 4
Offensive C-UAS Actions

This chapter covers how units can offensively find and target unmanned aircraft systems before or after the UAV takes flight.

OVERVIEW

4-1. The best time to defeat a threat UAS is while the UAV is on the ground. By attacking parts of the system, like the ground control station, it prevents the launch or recovery of a UAV. Each echelon uses IPB to determine the UAS threats in its assigned area, information collection to find threat UAS, and the targeting process to allocate resources and defeat the threat UAS.

INTELLIGENCE PREPARATION OF THE BATTLEFIELD

4-2. IPB, as part of the air defense approach, supports force protection planning by identifying threat UAS capabilities and likely employment concepts, strategies, and tactics. It is a continuous four step process of define the operational environment, describe the environmental effects, evaluate the threat, and determine the threat course of action, as outlined in paragraphs 4-3 through 4-7.

4-3. The first step is to define the operational environment. No additional considerations are required for C-UAS.

4-4. The second, iterative, step is to describe the environmental effects. This step evaluates the environment's effect on both adversary UAS operations and friendly C-UAS operations. Units analyze the terrain focusing on ground and air avenues of approach and likely enemy defensive positions. Larger UAS require open areas or hard surfaces to use as runways while smaller UAS used by lower echelon forces may be employed in the vicinity of defensive battle positions to provide early warning. For C-UAS an electromagnetic spectrum template can be used to assist in determining potential threat air avenues of approach. The electromagnetic interference template should take into account all electromagnetic emitters to include:

- Radars.
- Radios.
- Jammers.
- GPS.

4-5. Terrain and weather analyses are inseparable. The weather assessments needed to support C-UAS operations are climatology, current weather, and forecast weather. Every enemy and friendly weapon system has operational limitations associated with weather conditions.

4-6. The third step is to evaluate the threat. This step examines in detail the capabilities and limitations of every UAS the threat is assessed to possess, and how the threat will organize for combat and conduct operations with those platforms under normal conditions. The results of the threat evaluation are portrayed in appropriate threat models and graphical representations of the threat's UAS capabilities and limitations. The creation of an unmanned aircraft system template is done and works to answer the following information requirements:

- Duration of UAV flight. How long can the UAV operate before needing to refuel or return to its launch and recovery asset? Can this be used to determine likely launch and recovery points? Also known as endurance.

- Flight trajectories. How does the UAV get from launch point to the operating area? Can data such as trajectories, speeds, path, and behavior, be utilized to assist in the classification and identification of the UAS threat?
- Threat UAV counter measures. Does the threat UAV carry any countermeasures?
- Number of UAS platforms. How many UAS are in the enemy inventory?
- Launch platform(s). How many launch platforms does the enemy have? Are there any shared platforms? Can this information be used to develop a defense against the UAS threat and to calculate threat COAs?
- Threat UAS radar homing capability. What frequency bands are the threat UAS capable of targeting? How many threat UAS have this capability? How will the threat use this capability?
- Maximum UAS sortie generation. How may UAS be used simultaneously? What is the rate of launch for subsequent UAS employment? How long can the adversary sustain continuous UAS operations?
- UAV loiter time. How long will a threat UAV wait to accomplish its mission?
- UAV guidance. How is the UAV guided? Does it require a line of sight or a beyond line of sight connection to a control station? Does the UAV rely on GPS, waypoints, terrain comparison or other methods to guide it to its intended mission area? Is there a way that this guidance can be interrupted or inhibited?
- UAV speed. What are the speeds the threat UAVs can travel at? How does this effect C-UAS ability to detect, identify, decide, and engage?
- UAV altitude. What are the assessed altitudes that the threat UAV can or will travel at? How will this effect C-UAS ability to detect, identify, decide, and engage?
- UAV range. What is the maximum and minimum range of the threat UAS? Do any of these ranges allow for the removal of a UAS platform as a viable threat?
- UAS launch platform. Identify any launch limitation that can be used to refine the launch platform or launch area.
- UAV recovery. How is the UAV recovered? How long does it take to refuel and refit and be put back into action?

4-7. The final step in the IPB process is to determine the threat course of action. This step integrates the results of the previous steps into meaningful conclusions. At a minimum, this step creates a threat most dangerous course of action, and a most likely course of action. These courses of actions are developed by creating event templates and matrices focused on threat UAS actions independently, or in support of a larger threat action.

INFORMATION COLLECTION

4-8. For offensive C-UAS operations, information collection provides necessary information for effective targeting. Information collection plans are adjusted to include threat UAS information requirements that were developed during IPB. All the components of the UAS are targeted with the four different information collection tasks working to collect on the threat.

4-9. Analysts identify those areas and times where the threat is most likely to employ UASs to achieve their objectives through IPB and then task information collection assets to answer priority intelligence requirements to enable decision making and targeting. This aids in identifying the times and locations when UASs may be most likely used against friendly forces. As an example, early identification of potential ground control stations or launch sites by reconnaissance assets can lead to their targeting by either lethal or nonlethal means before the UAS can be used.

TARGETING

4-10. Offensive C-UAS operations are not a standalone mission but are a supporting effort to any operation. Effectively targeting threat UASs requires building on the products and knowledge gained during IPB and the execution of information collection activities during the decide and detect portions of the Army targeting process. Units align delivery assets to provide lethal and nonlethal means to attack UASs. This targeting can include lethal and nonlethal means such as attacking these capabilities and locations with artillery, aerial fires, or electromagnetic warfare capabilities. Fires planners incorporate enemy UAS capabilities into the high payoff target list and attack guidance matrices with the goal of defeating, degrading, delaying, destroying, diverting, or suppressing threat UASs. Air defense and UAS operations officer involvement in targeting working groups is critical for proper analysis and integration of C-UAS into the targeting cycle.

TARGETING CONSIDERATIONS FOR THREAT UAS COMPONENTS

4-11. What to target and why are always important decisions to make as part of the targeting process since there are only limited detection and delivery agents available. Paragraphs 4-12 through 4-16 describe various components of the unmanned aircraft system and the effects that targeting them have on the overall threat system.

Launch and Recovery Assets

4-12. Large fixed-wing UAVs require an airfield with a paved runway of sufficient length for take-off and landing. Small to medium-sized fixed wing UAVs have significantly fewer infrastructure requirements and are either launched from a catapult or some other vehicle-mounted system. Large balloons require enough open space to get clear of any local obstacles. Rotary wing UAVs don't need much in terms of launch and recovery equipment, usually just enough room for the UAV to clear local obstacles. Launch and recovery equipment is highly vulnerable and successful destruction of launch and recovery equipment, and personnel will cause the UAV to remain grounded until the equipment is repaired or replaced. It is common practice for multiple UAVs to use a single set of launch and recovery equipment, so the redundancy of launch and recovery equipment is less likely, which makes this an important target.

Ground Control Stations

4-13. The ground control station is where the UAV's pilot and payload operator are physically located and can be in a variety of locations. The largest impact to their location is whether the UAV requires a line-of-sight connection or beyond line-of-sight connection is needed. The physical destruction of a ground control station will likely disrupt current operations of all UAVs linked to it if there are no redundant systems in place. Just like launch and recovery assets, usually multiple UAVs rely on a single ground control station which makes it a highly valuable target.

Communications Equipment

4-14. Most UAV are dependent on a connection with ground control stations for command and control data links. The required communication equipment for the UAS operating in line of sight is usually attached to the ground control station or can be found near its location. As the mode indicates, radio antennas require a line of sight with the UAV, therefore they have to be placed quite openly and on elevated positions, making them high pay-off targets. UAS operating in beyond line of sight use large satellite ground terminals that are several meters in diameter. These radars are usually located at a great distance from the forward line of troops and are less accessible to friendly interdiction. The large satellite dimensions make them vulnerable to identification by any aerial or space imagery. Even though the destruction of the ground control station and the communications equipment causes a delay in the mission of the enemy UAS, the threat may recover quickly with the introduction of redundant ground control station or communications equipment. In this regard, striking the launch and recovery unit or the actual UAV is a more preferred option.

Logistics and Support Systems

4-15. Although the UAV does not require a crew on board, it is a flying platform, which requires similar logistics to most manned aircraft. UAS logistical support should cover the required support for all subsystems of the UAS. The support system depends on many different things, including the type of the UAS, its operational requirements, and its operational environment. For a small hand-launched UAVs, relatively little logistical support is required, while larger UASs usually need more logistical support. The destruction of a logistics chain has deep effects and it effects might not be seen in the short-term but cause inevitable challenges to UAS life cycle management.

JOINT CONSIDERATIONS

4-16. Countering UASs is not just an U.S. Army responsibility. U.S. Air Force, Navy, and Marine Corps aviation assets can assist especially against the larger UAS groups by conducting air interdiction. *Air interdiction* are air operations to perform interdiction conducted at such distances from friendly forces that detailed integration of each air mission with the fire and movement of friendly forces is not required (JP 3-03). *Interdiction* is as an action to divert, disrupt, delay, or destroy the enemy's military surface capability before it can be used effectively against friendly forces or otherwise be used to achieve enemy objectives (JP 3-03). While physical destruction of C-UAS is desired, if the threat perceives that it could be destroyed, it will achieve a delay and diversion of resources.

4-17. Group 4 and 5 UASs due to their size and range should be on the joint integrated prioritized task list (known as the JIPTL). Elevated sensors such as the active electronically scanned array (known as AESA) radar on a F-35 aircraft are a great means of detecting small and low flying UAVs. While this is probably not the best use of a joint asset, the U.S. Air Force should be able to provide some means of wide-area surveillance to assist in detecting threat UAVs. Once they are detected, the tracks can be transferred to other air space management systems and eventually C-UASs for further action. U.S. Army assets such as the AN/APG-78 Longbow fire control radar on the Apache attack helicopter and various electromagnetic warfare packages on Grey Eagle UAVs can also assist detecting threat UAS.

Appendix A
C-UAS Training

This appendix includes resources and some considerations when conducting C-UAS training.

A-1. C-UAS training can be a stand-alone situational training exercise, but a greater training benefit would come from incorporating into already planned training. Units should focus on UAS threat capabilities, the dangers that threat UASs may impose on the unit, and associated battle drills once the UAS is detected. Examples of key tasks to integrate into unit training are—

- Train visual observers how to look for and track UAS.
- Perform visual air threat recognition training.
- Practice various passive measures.
- Establish and use an early warning notification network.

A-2. Leaders leverage specifically designed training aids, devices, simulators, and simulations from their installation's training support center to enhance collective task training in the defeat and mitigation of C-UAS threats. An installation's range control can also provide guidance on both how to fly UASs and the requirements for different types of engagements. Leaders use video and other data collected from the flown threat UAS to assess their unit's ability to conduct both passive and active defensive measures.

A-3. Threat UASs and their employment techniques change faster than doctrine does. Leaders update their training and education with the most current and relevant information based on lessons learned, enemy trends, and friendly C-UAS tactics, techniques, and procedures. To stay current leaders can use the resources listed in table A-1 as a starting point.

Table A-1. C-UAS training resources

References	***Description***
Joint Knowledge Online (JKO) C-sUAS (Counter-Small Unmanned Aircraft Systems) community page (https://jkodirect.jten.mil/Atlas2/page/desktop/DesktopHome.jsf)	A repository of material and links to online training developed by the Joint C-sUAS Office. To access— • go to the JKO Online portal at: https://jkodirect.jten.mil/; • login using government issued common access card; • go to "Community" on the gray banner at the top of the page; • select "Joint C-sUAS Office."
Center for Army Lessons Learned (CALL) (https://call2.army.mil/)	Repository for Army lessons learned as well as observations, insights, after action reports, etc.

Table A-1. C-UAS training resources (cont.)

References	***Description***
Joint Lessons Learned Information System (JLLIS) (https://www.jllis.mil/apps)	Repository for joint lessons learned as well as observations, insights, after action reports, etc.
Classes	***Description***
Starting in October 2023, the Joint C-sUAS University (JCU) at Fires Center of Excellence, Fort Sill, OK will provide Joint Service personnel (military, civilian, and contractors) training in the areas of C-sUAS system operator, planning, and installation protection. Classes start October 2023. Courses are currently listed in the Army Training Requirements and Resources System (ATRRS) FY24 C-sUAS Master Trainer (Joint Operator Course), C-sUAS Leader Planner (Joint Planner Course). https://sill-www.army.mil/adaschool/csuas.html	The school currently conducts three classes: • The Joint C-sUAS Operator Course (9E-SIU5/ASIU5/920-ASIU5) is non-service/branch/military occupational specialty (MOS)-specific. It is primarily focused on the operations of the joint C-sUAS Office (JCO) down-select systems. Upon completion of this course, operators will be able to do the following: deter the UAS threat via passive air defense measures; detect the UAS threat via visual /audible identification and C-sUAS equipment sets; mitigate the UAS threat via C-sUAS kinetic/non-kinetic equipment sets and combined arms for air defense; and report UAS threats via applicable policies and procedures. Culminates with a hands-on training exercise incorporating red air. • The Joint C-sUAS Planner Course (9E-SIU1/ASIU1/920-ASIU1) is non-service/branch/MOS specific. It is primarily focused on contingency sUAS threat considerations within the joint planning process framework. Upon completion of this course, planners will have experience developing courses of action to deter, detect/identify, report, and mitigate the UAS threat via integrating the employment of available C-sUAS capabilities. Culminates with a planning exercise incorporating red air. • Joint Installation Protection Course (current non-ATTRS) is designed for Installation Commanders and Force Protection teams (e.g. Anti-Terrorism/Force Protection Officers, Mission Analyst, Physical Security Managers). It is a competency-based course: the learning objectives are based on the requirements for CONUS/OCNUS Unmanned Aerial Vehicles (UAV) threat reporting and deterring. The course prepares Commanders and Force Protection personnel (military and civilian) to successfully integrate C-sUAS systems within existing force protection programs. It introduces personnel on roles and responsibilities for C-sUAS management, Federal regulations and reporting standards, engagement authorities, Environmental Protection Agency Assessment, and installation C-sUAS systems capabilities and limitations. Additionally, students will develop a 130i reporting package and complete a course of action for varied installation threats from UAVs. Upon completion of the course individuals will be able to successfully advise commanders on procedures and requirements for safe execution against UAV threat.
JCO Policy Training Module https://intelshare.intelink.gov/sites/JCO/Shared%20Documents/1_JKO%20Policy%20Training%20Module	Provides instructions for DOD planners and leaders on policies, authorities, and authorized actions that affect C-sUAS and UAS procedures, planning, and operations.

Table A-1. C-UAS training resources (cont.)

Basic C-sUAS Awareness Training (https://jkodirect.jten.mil/html/COI.xhtml?course_prefix=JCSUAS&course_number=A-US1401)	Provides a basic awareness of general UAS threats, types and categories of UAS, and basic reporting requirements. This module is a prerequisite for all other C-sUAS modules on JKO.
Basic C-sUAS Familiarization Training (https://jkodirect.jten.mil/html/COI.xhtml?course_prefix=JCSUAS&course_number=A-US1402)	Provides a review of the basic UAS awareness and an overview of select C-sUAS systems and capabilities.
Basic C-sUAS Installation Training (https://jkodirect.jten.mil/html/COI.xhtml?course_prefix=JCSUAS&course_number=-US1403)	Provides a threat overview, information on policies and authorities associated with UAS and counter UAS operations at installations and fixed sites, planning considerations, and reporting procedures.
Basic C-sUAS Tactics, Techniques, and Procedures (https://jkodirect.jten.mil/html/COI.xhtml?course_prefix=JCSUAS&course_number=-US1404)	Provides an overview of the threat and operational environment, general tactics, techniques and procedures for C-sUAS, reporting procedures, and select UAS case studies.

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Appendix B
Example C-UAS Equipment

This appendix provides a brief overview of potential C-UAS equipment that a unit may receive or request from their higher headquarters and are currently not programs of record.

BAL CHATRI 2

B-1. The Bal Chatri 2 is a passive radio frequency detection capability used to detect and identify threat UASs (see figure B-1). The system employs a software defined radio frequency detection system used to detect and identify drones. The radio can be configured for body-worn detection capability or for a small, fixed site location.

B-2. Bal Chatri is a passive radio frequency detection capability used to detect and identify drones. Key considerations for this system include:

- Range: 3-5 kilometers.
- Power source: 1x PRC-148 battery or plug-in.
- Battery life: 4 hours.
- Weight: 2.5 lbs.

Figure B-1. Bal Chatri 2

DRONE BUSTER

B-3. The Drone Buster provides detect and defeat capability against threat UASs (see figure B-2). It is a handheld, battery-operated, dismounted, electronic attack device specifically designed to defeat group 1 and 2 UASs. The unit exploits weaknesses in commercial-off-the-shelf drone communication protocols enabling the operator to jam the control signal forcing the unmanned aircraft to execute pre-programmed "lost signal" protocols.

B-4. Drone Busters operate strictly by line of sight, and it requires the operator to maintain eyes on the target throughout the engagement. If there is loss of line of sight during the engagement, the threat my regain control of the UAV. Drone Buster is designed to disrupt remote controlled and GPS guided UASs. Key considerations for this system include:

- Range: 400m.
- Power source: 1x BB2847 rechargeable battery.
- Battery life:
  - Continuous jamming: approximately 1 hour.
  - Continuous detect: approximately 4-6 hours.
  - Complete battery discharge: approximately 10 days.
- Weight: 2.5 lbs.

Figure B-2. Drone Buster

MODI

B-5. The Modi is a dismounted, man portable electronic warfare system that enables detect and defeat capability (see figure B-3). Modi systems provide integrated tactical electronic warfare capabilities to defeat many UASs. The unit may be employed solely as a dismounted system or, using a mounted power amplifier, may be used in a fixed site or mounted configuration and dismounted when required. It can operate from -4 to 140 degrees Fahrenheit. Key considerations for this system include:

- Range: 400m.
- Power source: 3x BB2590 batteries.
- Battery life: unknown.
- Weight: 40.25 pounds (dismounted with pack).

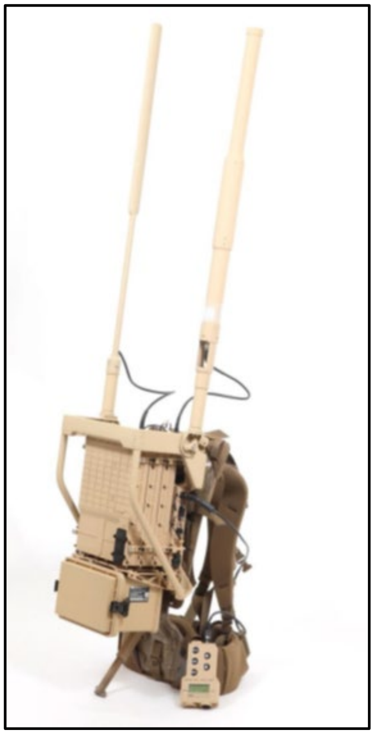

Figure B-3. Modi

SMART SHOOTER

B-6. The Smart Shooter is a sight that mounts to existing individual weapon systems and enables the operator to defeat UAS threats (see figure B-4). Smart Shooter is compatible with existing military rifles and can be mounted on any rail on a weapon system. When the Smart Shooter is employed, it will only fire when the sight is aligned to hit the target, this includes the required "lead" on a moving target. Key considerations for this system include:

- Range: 120m.
- Power source: Rechargeable smart lithium ion battery.
- Battery life: 72 hours or up to 3,600 assisted shots.
- Weight: 2 pounds and 1 ounce.

Figure B-4. Smart Shooter

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Glossary

This glossary contains acronyms and terms used throughout this publication.

SECTION I – ACRONYMS AND ABBREVIATIONS

ADA	Air defense artillery
ADAM	air defense and air management
ADP	Army doctrine publications
ADW	air defense warning
AMD	air and missile defense
ATP	Army techniques publication
BAE	brigade aviation element
C-UAS	counter-unmanned aircraft system
C-sUAS	counter-small unmanned aircraft system
DA	Department of the Army
DOD	Department of Defense
FM	field manual
GPS	Global Positioning System
IPB	intelligence preparation of the battlefield
JBC-P	joint battle command-platform
JP	joint publication
MCTP	Marine Corps tactical publication
PPL	prioritized protection list
ROE	rules of engagement
sUAS	small-unmanned aircraft system
UAS	unmanned aircraft system
UAV	unmanned aircraft vehicle
ULCANS	ultra-lightweight camouflage-net system

SECTION II – TERMS

air interdiction

Air operations to perform interdiction conducted at such distances from friendly forces that detailed integration of each air mission with the fire and movement of friendly forces is not required. (JP 3-03)

dispersion

The spreading or separating of troops, materiel, establishments, or activities, which are usually concentrated in limited areas to reduce vulnerability. (JP 5-0)

interdiction

An action to divert, disrupt, delay, or destroy the enemy's military surface capability before it can be used effectively against friendly forces or otherwise be used to achieve enemy objectives. (JP 3-03)

positive identification

An identification derived from observation and analysis of target characteristics including visual recognition, electronic support systems, non-cooperative target recognition techniques, identification friend or fore systems, or other physics-based identification techniques. (JP 3-01)

survivability

A quality or capability of military forces which permits them to avoid or withstand hostile actions or environmental conditions while retaining the ability to fulfill their primary mission. (ATP 3-37.34)

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These documents contain relevant supplemental information.

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Basic C-sUAS Familiarization Training: https://jkodirect.jten.mil/html/COI.xhtml?course_prefix=JCSUAS&course_number=A-US1402.

Basic C-sUAS Installation Training: https://jkodirect.jten.mil/html/COI.xhtml?course_prefix=JCSUAS&course_number=-US1403.

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Central Army Registry: https://atiam.train.army.mil.

Center for Army Lessons Learned (CALL): https://call2.army.mil/.

Joint C-sUAS University (JCU): https://sill-www.army.mil/adaschool/csuas.html.

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Joint Knowledge Online (JKO) portal: https://jkodirect.jten.mil/.

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ATP 3-01.81
11 August 2023

By Order of the Secretary of the Army:

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DISTRIBUTION:
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PIN: 201565-000