ARMY, MARINE CORPS, NAVY, AIR FORCE

JFIRE

MULTI-SERVICE TACTICS, TECHNIQUES, AND PROCEDURES FOR THE JOINT APPLICATION OF FIREPOWER

FM 3-09.32
MCRP 3-16.6A
NTTP 3-09.2
AFTTP(I) 3-2.6

DECEMBER 2007

AIR LAND SEA APPLICATION CENTER

MULTI-SERVICE TACTICS, TECHNIQUES, AND PROCEDURES

FOREWORD

This publication has been prepared under our direction for use by our respective commands and other commands as appropriate.

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This publication is available through the ALSA Web site (www.alsa.mil); through the Army at Army Knowledge Online (AKO) (www.us.army.mil) and at the General Dennis J. Reimer Training and Doctrine Digital Library (www.train.army.mil) Web sites; and through the Air Force at the Air Force Publishing Web site (www.e-publishing.af.mil).

PREFACE

Purpose

JFIRE is a pocket-size, quick-reference guide for requesting fire support in accordance with approved joint tactics, techniques, and procedures (TTP). JFIRE contains calls for fire, joint air attack team (JAAT) techniques, a format for joint air strike requests, close air support (CAS) coordination and planning procedures, communications architecture, and weapons data.

Scope

JFIRE applies to the tactical and special operating forces of the Army, Navy, Marine Corps, and Air Force. It is a United States (US) unilateral-only document, but includes some North Atlantic Treaty Organization (NATO) formats where appropriate. Information in JFIRE has been extracted from existing Service directives. It is primarily intended for use by members of battalion and squadron-level combat units.

Implementation Plan

Participating Service command offices of primary responsibility (OPRs) will review this publication, validate the information and, where appropriate, reference and incorporate it in Service manuals, regulations, and curricula as follows:

Army. Upon approval and authentication, this publication incorporates the procedures contained herein into the United States (US) Army Doctrine and Training Literature Program as directed by the Commander, US Army Training and Doctrine Command (TRADOC). Distribution is in accordance with applicable directives and the Initial Distribution Number (IDN) listed on the authentication page.

Marine Corps.[1] The Marine Corps will incorporate the procedures in this publication in US Marine Corps training and doctrine publications as directed by the Commanding General, US Marine Corps Combat Development Command (MCCDC). Distribution is in accordance with the Marine Corps Publication Distribution System (MCPDS).

Navy. The Navy will incorporate these procedures in US Navy training and doctrine publications as directed by the Commander, Navy Warfare Development Command (NWDC)[N5]. Distribution is in accordance with Military Standard Requisition and Issue Procedure (MILSTRIP) Desk Guide Navy Supplement Publication-409 (NAVSUP P-409).

Air Force. The Air Force will incorporate the procedures in this publication in accordance with applicable governing directives. Distribution is in accordance with Air Force Instruction (AFI) 33-360.

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[1] **Marine Corps PCN: 144 000033 00**

User Information

a. TRADOC, MCCDC, NWDC, Air Force Doctrine Development and Education Center (AFDDEC), and the Air Land Sea Application (ALSA) Center developed this publication with the joint participation of the approving Service commands. ALSA will review and update this publication as necessary.

b. This publication reflects current joint and Service doctrine, command and control organizations, facilities, personnel, responsibilities, and procedures. Changes in Service protocol, appropriately reflected in joint and Service publications, will likewise be incorporated in revisions to this document.

c. We encourage recommended changes for improving this publication. Key your comments to the specific page and paragraph and provide a rationale for each recommendation. Send comments and recommendations directly to—

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SUMMARY OF CHANGES

FM 3-09.32/ MCRP 3-16.6A/ NTTP 3-09.2/ AFTTP(I) 3-2.6
Multi-Service Tactics, Techniques, and Procedures for the Joint Application of Firepower.

This revision, dated 17 Dec 2007, provides a major overhaul of the document. The organization of the publication has been changed to: Chapter I – Planning Considerations, Chapter II – Surface-based Fire Support, Chapter III – Joint Air Attack Team and Close Combat Attack, Chapter IV – Close Air Support Execution, Appendix A – Capabilities and Communications Equipment, Appendix B – Brevity, Appendix C – Laser Operations, Appendix D – Fire Support Coordination Measures and Airspace Coordinating Measures, Appendix E – Aircraft-Delivered Munitions Descriptions, Appendix F – Risk-estimate Distances, Appendix G – General Information, Appendix H – Electronic Attack / Call for Electronic Fires, as well as a list of references and a glossary. (Appendix H is classified SECRET and available on ALSA's classified website http://www.acc.af.smil.mil/alsa/jfire.)

The revised publication presents the material to the reader in a more logical fashion and incorporates a large amount of new information such as: unmanned aircraft systems and inertially aided munitions considerations, US Army close combat attack procedures, details on joint fires observers and tactical shows of force, an expanded entry on AC-130 and fixed wing integration, as well as including briefing formats for electronic attack, airdrop (aerial resupply), casualty evacuation, and reconnaissance / surveillance missions. Additionally, in an effort to keep the publication current, the munitions descriptions and risk-estimate distances have been updated to include new weapons that have been fielded since the previous version of JFIRE was written. It also includes a more robust listing of rotary wing munitions as well as common allied / coalition weapons.

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JFIRE
MULTI-SERVICE TACTICS, TECHNIQUES, AND PROCEDURES FOR THE JOINT APPLICATION OF FIREPOWER

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FM 3-09.32 — **US Army Training and Doctrine Command, Fort Monroe, Virginia**

MCRP 3-16.6A — **Marine Corps Combat Development Command, Quantico, Virginia**

NTTP 3-09.2 — **Navy Warfare Development Command, Newport, Rhode Island**

AFTTP(I) 3-2.6 — **Air Force Doctrine Development and Education Center, Maxwell Air Force Base, Alabama**

17 Dec 2007

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* Supersedes FM 3-09.32/MCRP 3.16.6A/NTTP 3-09.2/AFTTP(I) 3-2.6, 29 October 2004.

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Chapter I: Planning Considerations

1. General Planning for Close Air Support / Joint Air Attack Team / Close Combat Attack

The following list of planning considerations applies to close air support (CAS), joint air attack team (JAAT), and close combat attack (CCA). It is not an all inclusive list, but gives a very broad spectrum of items to consider when planning for these missions. Ground commander's intent / mission objectives:

Orientation / Situation

(1) Terrain
- (a) Map Datum, Common Geographic Reference System (CGRS) / Global Area Reference System (GARS).....**(See p.93)**
- (b) Observation / Fields of Fire
- (c) Avenues of Approach
- (d) Key Terrain
- (e) Obstacles
- (f) Cover and Concealment
- (g) Urban Environment / Lighting

(2) Weather
- (a) Ceiling / Visibility
- (b) Temperature / Dew-point
- (c) Winds (surface and at altitude)
- (d) Sunrise / Begin Morning Nautical Twilight
- (e) Sunset / End Evening Nautical Twilight
- (f) Solar Elevation / Azimuth
- (g) Moon Data (rise / set, elevation, azimuth, percent illumination, lux)
- (h) Diurnal / Thermal Crossover
- (i) Relative / Absolute Humidity

(3) Enemy
- (a) Buildings identified as significant for cultural or religious reasons should be placed on no-fire lists. Damage or destruction would result in negative mission impact.
- (b) Target Type, Size, Activity, and Location
- (c) Enemy Strengths and Weaknesses
- (d) Courses of Action
  1. Most Likely
  2. Most Dangerous
- (e) Observed Tactics, Techniques, and Procedures (TTP)
- (f) Enemy Air, Air Defense, and Surface Threat (type / location)
- (g) Target Priorities
- (h) Intelligence Collection Plan / Products Request
- (i) Plan for intelligence updates before launch and en route.

(4) Friendly
- (a) Main Effort
  1. Forward Line of Own Troops (FLOT) / Forward Edge of the Battle Area (FEBA) / Operations
  2. Scheme of Maneuver
- (b) Higher

(c) Adjacent
(d) Supporting Assets Available (Operations [S-3] / Fire Support Officer [FSO] / Air Liaison Officer [ALO])
1. Rotary-Wing (RW)
a. Assault
b. Attack
2. Fixed-Wing (FW)
a. CAS
Fighters
Bombers
Unmanned Aircraft Systems (UASs)
b. Electronic Warfare (EW) / Suppression of Enemy Air Defenses (SEAD)
c. Tanker
d. Communications System
e. Intelligence, Surveillance, and Reconnaissance (ISR)
3. Indirect Fires
a. Cannon
b. Multiple Launch Rocket System (MLRS)
c. Mortar
d. Naval Surface Fire Support (NSFS)
4. Ground Observers
a. Joint Terminal Attack Controllers (JTACs)
b. Scout
c. Combat Observation Lasing Team (COLT) / Fire Support Team (FIST) (USA) / Joint Fires Observer (JFO)
d. Special Operations Forces (SOF)

Mission

(1) Commander's Guidance
(2) Objectives
(3) Success Criteria
(4) Tactical Risk Assessment
(5) Targeting Priorities

Execution

(1) Prepare Situation Update (JFIRE Format 14).....**(See p.47)**
(2) Command and Control (C2)
(a) Agencies
1. Theater C2 (Airborne Warning and Control System [AWACS], control and reporting center [CRC], Joint Surveillance Target Attack Radar System [JSTARS], tactical air operations center [TAOC] (USMC), etc.)
2. Air Support Operations Center (ASOC) / Direct Air Support Center (DASC) (USMC)
3. Tactical Air Coordinator (Airborne) (TAC[A]) / Direct Air Support Center (Airborne) (DASC[A])
4. JTAC / Forward Air Controller (Airborne) (FAC[A])
(b) Nets / Frequencies
(c) Cryptologic Changeover
(d) Digital CAS

(e) Authentication Procedures
(3) Friendly Location Marking Procedures
(4) Target Marking Procedures
(a) Smoke / White Phosphorous (WP) / High Explosive (HE)
(b) Laser.....**(See p.83)**
1. Self Lase
2. Buddy Lase
3. Ground Based Lase
4. Laser Code Deconfliction
(c) Infrared (IR) Pointers / Laser Target Markers (LTMs)
(5) Prepare CAS Attack Briefing (9-Line Format 15 / NATO Format 18)...**(See p.48/p.62)**
(6) 9-Line Remarks Considerations
(a) Target Description
(b) Threats
(c) Artillery
(d) Clearance (Final Control / Abort Code)
(e) Desired Ordnance Effects
(f) Restrictions
(g) Timing / Deconfliction Plan
(h) Airspace Coordination Areas (ACAs)
(i) Weather
(j) SEAD / EW and Location
(k) Laser, Illumination, Night Vision Capability
(l) Danger Close
(7) Fire Support Coordination
(a) Airspace Coordinating Measures (ACMs) / Fire Support Coordination Measures (FSCMs), Kill Box Plans.....**(See p.87)**
(b) Artillery / Mortar Position Areas (PAs)
(c) Gun-target Line (GTL)
(d) Minimum / Maximum Ordinate
(e) Attack Plan
(f) Support by Fire and Maneuver
(g) Schedule of Fires Worksheet
(h) High-payoff Target List
(i) Attack Guidance Matrix
(j) Target Precedence List (TPL)
(k) Target Marking (Smoke / Laser / Illumination)
(l) SEAD
(8) Fixed-wing.....**(See p.69)**
(a) Type
(b) Ingress / Egress Considerations
(c) FW Holding Plan
(d) Altitudes
(e) Deconfliction Plan
(f) Sensors
(g) Munitions.....**(See p.95)**
1. Type and Number

(12) Personnel Recovery / Combat Search and Rescue (CSAR) / Tactical Recovery of Aircraft and Personnel (TRAP) [USMC]
  (a) Embedded / On-call
  (b) Spider Routes (CSAR assets)
(13) Airdrop / Resupply.....**(See p.64)**
(14) Casualty Evacuation (CASEVAC).....**(See p.63)**
(15) Bomb Hit Assessment / Battle Damage Assessment (BDA) Passage
  (a) CAS Aircraft
  (b) ASOC/DASC
  (c) S-3
  (d) Intelligence (S-2)
(16) Contingencies

Coordinating Instructions

(1) Airspace Control Order (ACO)
(2) Air Tasking Order (ATO)
(3) Special Instructions (SPINS)
(4) Rules of Engagement (ROE)
(5) Collateral Damage Estimate (CDE)
(6) Minimum-risk Routes (MRRs)
(7) Named Areas of Interest (NAIs)
(8) Target Areas of Interest (TAIs)
(9) Preplanned Contact Points (CPs) / Initial Points (IPs)
(10) Landing Zones (LZs)
(11) Unit Boundaries
(12) FSCMs.....**(See p.87)**
  (a) Coordinated Fire Line (CFL)
  (b) Battlefield Coordination Line (BCL) (USMC)
  (c) Restrictive Fire Line (RFL)
  (d) Restrictive Fire Area (RFA)
  (e) No-fire Area (NFA)
  (f) Free Fire Area (FFA)
  (g) Airspace Coordination Area (ACA)
  (h) Missile Engagement Zone (MEZ)
  (i) Fighter Engagement Zone (FEZ)

Tactical Air C2

(1) ASOC / DASC / Joint Operations Center (JOC) / Tactical Operations Center (TOC) / CRC / AWACS connectivity and interface.
(2) Satellite Communications (SATCOM), Ultrahigh Frequency (UHF), Very High Frequency (VHF), Frequency Modulation, Secure, Have Quick, and internet relay chat (IRC) usage.
(3) Civilian air traffic and deconfliction with military operations – liaison officers.
(4) Areas lacking radar and communications requiring procedural deconfliction methods.

2. Convoy Escort

The following are planning considerations when air assets are tasked in support of convoy operations. This is not an exhaustive list, but is designed to provide a basis for further mission specifics. For more information see Field Manual (FM) 4-01.45 / Marine Corps Reference Publication (MCRP) 4-11.3H / Navy Tactics, Techniques, and Procedures (NTTP) 4-01.3 / Air Force Tactics, Techniques, and Procedures (Interservice) (AFTTP(I)) 3-2.58*, Multi-Service Tactics, Techniques, and Procedures for Tactical Convoy Operations*.

a. Frequency
   (1) JTAC
   (2) Convoy

b. Number of Vehicles
   (1) JTAC Vehicle #___ of ___ in Convoy
   (2) Additional JTACs
   (3) Cordon Dimensions of Convoy

c. Type of Vehicles
   (1) Military
   (2) Civilian (car / sport utility vehicle / etc.)
   (3) Other

d. Number of Passengers
   (1) US
   (2) Friendly / Coalition
   (3) Other

e. Marking Ability
   (1) Mortars / Round Type
   (2) Laser with Code
   (3) IR Marker / Strobe / Smoke
   (4) Mirror / VS-17 Panel / Flares / Thermal Panel

f. Coordinates / Elevation / Wind
   (1) Mk-7 (coordinates and elevation)
   (2) Map Type / Falcon View
   (3) Kestral 4000 (wind measurement)

g. Convoy Gameplan
   (1) Ground Commander Intent
   (2) Ground Commander Call Sign
   (3) Ground Commander Initials
   (4) Start Point
   (5) Middle Point
   (6) End Point

h. Employment Contract
   (1) Show of Force.....**(See p.59)**
   (2) 9-Line Briefing / Attack plan.....**(See p.48)**
   (3) Communication Plan (secure or plain)
   (4) Abort Code
   (5) JTAC's Game Plan for Use of Air Assets
      (a) Counter-improvised Explosive Device (IED)
      (b) Route Reconnaissance (Recce)
      (c) Medical Evacuation / CASEVAC.....**(See p.63)**

(6) Vehicle Smoke Use During Attack

i. Foot Patrol

(1) Number of Troops

(2) Marking of Lead / Trail Individuals (VS-17, etc.)

(3) Smoke Use During Attack

(4) Cordon Dimensions

3. Urban / Mountain Considerations

a. Communications Plan

(1) Line of Sight (LOS) Limitations

(2) Optimal Communications Locations

b. Alternate Communications Assets

(1) Airborne (e.g., TAC(A), JSTARS)

(2) Ground (e.g., JTAC)

c. Targeting / Marking

(1) Mission Materials

(a) Large Scale Maps with Labels

(b) Gridded Reference Graphic (GRG) Highlights

(c) Other Standardized Maps

(d) Target Reference Points (TRPs)

(2) Marking

(a) Cultural Washout

(b) LOS Considerations

(c) Laser Safety

d. Holding Plan

(1) Terrain Elevation Considerations

(2) Cultural Areas / Lines of Communications (LOCs)

e. Employment / Weaponeering

(1) Fuzing (instantaneous versus delayed)

(2) Final Attack Plan

(a) Laser Target Line (LTL) / Final Attack Heading / Lase Leg for LOS

(b) Impact Parameters (angle, velocity, azimuth, etc.)

(3) Podium Effect

(4) Effects of Density Altitude on Aircraft Performance

(a) Weapons Delivery

(b) Dive Recovery

f. ROE and CDE Considerations

NOTE: Additional references are found in joint publication (JP) 3-09.3 *Joint Tactics, Techniques, and Procedures for Close Air Support* and FM 3-06.1 / MCRP 3-35.3A / NTTP 3-01.4 / AFTTP(I) 3-2.29, *Multi-Service Procedures for Aviation Urban Operations*.

4. Timeline Considerations

The ability to accurately and succinctly transmit targeting and control information is critical to responsive and effective CAS. Deviation from jointly agreed TTP

increases the opportunity for misunderstanding and delays execution. This is unacceptable when mission success and safety of friendly forces is at stake.

5. Unmanned Aircraft Systems Considerations

UASs consist of one or more unmanned aircraft (UA), a control station, datalinks, and payloads. The capability of UASs to support or execute CAS varies greatly between systems. For example, US Air Force (USAF) MQ-1 and MQ-9 are armed with air-to-surface weapons, have radio communications aboard the UA, and are flown by rated aviators trained in CAS procedures. Other systems may not be similarly equipped or flown by CAS-qualified crews but may be employed for situational awareness, target marking, or as an observer for Types 2 or 3 control by the controlling JTAC. (See appendices A and B for more information on UASs.) The following UAS CAS considerations are intended for use with CAS-capable UAS and CAS-qualified UAS operators only:

a. Threat: Unmanned aircraft are unlikely to survive in a heavily defended environment. Consideration must be given to enemy air-to-air and surface-to-air weapons with the ability to engage a UA at its operating location and altitude. UAs are not normally equipped with warning receivers or countermeasures and depend on threat avoidance for mission survivability. Datalinks may be susceptible to jamming or interference.

b. Weather: UAs are susceptible to turbulence, icing, and visible precipitation. Electro-optical (EO) / IR sensors and laser designators / range finders / target markers require unobstructed LOS to the target. Intervening haze, clouds, or blowing dust may interfere with or prevent mission accomplishment. On the other hand, synthetic aperture radar (SAR) and inertially aided munitions (IAMs) are unaffected by haze, cloud cover, or dust. High winds aloft may make it difficult for the UA to maintain station in a highly restricted location or may unacceptably delay transit between target areas.

c. Signature: UAs vary in visual, radar, IR, and acoustic signature and in system ability and crew proficiency to manage the signature. For example, when minimum noise is desired to avoid tipping off a target, it may be possible to modulate power and trade altitude for airspeed in order to reduce the noise signature while approaching closer to a target. On the other hand, it may be desirable to announce presence in order to stimulate a desired response or intimidate the target.

d. Deconfliction: While UASs presently lack the ability to see and avoid other aircraft, there are other means to integrate UASs (e.g., voice radio; tactical datalinks; identification, friend or foe [IFF]). Formal and informal airspace control measures apply to UASs. UAs may hold overhead or offset from a target. Relatively slow airspeeds can permit a UA to operate in a smaller segment of airspace than other aircraft. Depending upon performance capabilities of the specific UAS and communications with the crew, it may take several minutes to reposition the UA or change altitude blocks. JTACs must trade off the best position for the UASs to employ sensors / weapons against the desired target(s) with the ability to best employ other assets. Consideration should also be given to the “lost link” profile autonomously flown by UA if the control datalink is lost. Upon initial check-in, the JTAC should query the UAS operator for the currently programmed lost-link profile. If unacceptable due to airspace limitations or other

reasons, the JTAC should direct a new lost-link profile and receive verification that the UA has been programmed.

e. Communication and Situational Awareness: Some UAs have onboard radios and / or secure voice providing the ability to communicate with the UAS pilot as with any manned aircraft. In addition, some UASs have secure chat and voice over Internet Protocol, as well as additional air and ground situational awareness displays. Providing the ground scheme of maneuver to the supporting UAS can significantly increase the crew's situational awareness and subsequent mission support.

f. Video Downlink (VDL) and Machine-to-machine Datalinks: Some UASs can accept and provide machine-to-machine digital targeting information and many UASs provide LOS video downlinks to users with compatible video receivers. This can significantly reduce voice traffic and reduce information transfer errors. (See table 21 VDL – Link / Frequency / Player Reference on p.77 for more information.)

g. Tactics: UASs employ using a variety of tactics ranging from a wheel to a variant of an IP-target run-in. UA performance characteristics and sensor and weapons capabilities, along with the environmental and tactical situation, influence the selection of tactics, ranges, altitudes, and timing considerations.

h. Time on Station: In general, UAs have a much longer time on station when compared to manned aircraft. An extended time on station enables the UAS crew to develop high situational awareness with and for the supported unit. Suitably equipped UASs are excellent candidates to provide target marking or target designation for other aircraft.

i. Altitude Blocks: Altitude blocks for employment of UAs vary greatly due to widely varying performance characteristics of the aircraft and sensors. For example, many man-portable UAs are employed at a few hundred feet of altitude above ground level (AGL), while the MQ-1 Predator routinely operates anywhere between 5,000-20,000 feet above mean sea level (MSL). Consider sensor capabilities against the desired target set as well as other aircraft requirements during the mission planning process.

j. Weapons Delivery: UAS weapon delivery tactics vary based on the type of UAS and standard tactical considerations for aircraft.

k. Further Information: For more information and considerations on UASs, see FM 3-04.15 / NTTP 3-55.14 / AFTTP(I) 3-2.64 *Multi-Service Tactics, Techniques, and Procedures for the Tactical Employment of Unmanned Aircraft Systems.*

6. Considerations for High Altitude, Level Delivery of Precision Munitions

These considerations may be applied to any aircraft dropping precision munitions from high altitude in a level delivery. (Formerly known as "Bomber CAS.")

a. Deliveries may be from fighters, bombers, or UASs.

b. Deconflict airspace based on extended weapon delivery distance and expected weapon flight path.

c. Depending on aircraft type, IP selection may require extended distances compared to low altitude deliveries.

d. Release points will likely have bomb ranges outside of visual range. Because of these long bomb ranges and weapons profiles, nose position may not be indicative of where weapons will impact. Use of Type 2 or Type 3 control is

recommended if allowed by the tactical situation. See figure 1 below for communication example.
e. JTAC may request weapons prerelease call.
f. JTAC may request expected weapon(s) impact time.
g. Restrictions may be required, but excessive restrictions could preclude weapon delivery.
h. Expect extended delays with reattacks (up to several minutes depending on aircraft type.)

Communication / Activity
JTAC sends 9-Line.
Crew maneuvers to release point and calls **"IN"** at 30 sec from release.
JTAC ensures area clear and calls **"Cleared hot**.**"**
Crew calls "Weapons away, (weapon TTT)."

Figure 1. Sample Communication

7. Inertially Aided Munitions
a. IAMs can be delivered at night or through weather on a set of coordinates by various aircraft. The effectiveness of an IAM depends upon the tactical situation (type of target, desired weapons effects, target movement, global positioning system (GPS) jamming, etc.) and target location error (TLE) of the target coordinates. In addition, planners and aircrew must ensure that the World Geodetic System 1984 (WGS-84) coordinate datum plane is used by both controller and weapon delivery platform when employing IAMs. Datum planes should be verified prior to deployment / mission as part of deployment / mission checklist and coordinated or confirmed with the ASOC / DASC and / or higher echelons. **Significant errors can result if different datums are used. This will increase the likelihood of fratricide and/or reduce weapons effects.**
b. Aircraft altitude and speed can yield significant standoff ranges (in excess of 10 nm). Therefore, it is necessary to deconflict high altitude / long range release profiles from other systems operating below and above (in the case of glide weapons) the release altitudes. Significant issues exist when using weapons that transit over or around friendly forces using preprogrammed flight paths and impact points. Once released, these weapons may not be redirected. Due to the standoff capability, aircraft and aircrews can effectively avoid many enemy point defense weapons systems by employing IAMs. However, if stand-off is not required, aircrews may be able to minimize release ranges to mitigate airspace deconfliction issues.
c. The footprint for IAMs in the event of a malfunction, such as loss of guidance or control fin hard-over, is very large and, in some cases, increases the probability of fratricide. **Like all other weapons, when able, precision-guided munitions such as IAMs should be employed parallel to the FLOT.**
d. The time required to coordinate for and receive IAM weapons effects must be weighed against the time required to provide any immediate weapons effects (guns, general purpose bomb, etc.) on a time-sensitive target. Additional

consideration must be given to the type (1, 2, or 3) control required by the supported commander.

e. IAMs may be employed via two methods: bomb on coordinate (BOC) or bomb on target (BOT). Both delivery methods are equally accurate, the only difference being the associated TLE. The tactical situation (type of target, desired weapons effects, closest friendlies, etc.) determines the acceptable delivery method.

(1) **Bomb on Coordinate.** Using this method, IAMs guide to a designated impact angle and azimuth over the coordinates entered into the munition via the aircraft system. The aircrew may be passed the coordinates by a JTAC or other controlling agency, or the coordinates may be generated on-board the aircraft and then manually entered into the weapon / steerpoint / waypoint (as appropriate per weapon and platform), and then employed upon. Great care must be taken to ensure that the most accurate target location (i.e., lowest TLE) based on the tactical situation is obtained and correctly input into the weapon / system prior to employment. Per JP 3-09.3, if executing an IAM attack via BOC and working with a JTAC / FAC(A), each aircraft delivering an IAM is required to read back the target coordinates, elevation, and restrictions from the weapon / system to the JTAC / FAC(A). When using aircraft system targeting, aircrew will confirm the coordinates loaded into the waypoint, offset, or target points. Aircrew will verify correct data is selected prior to the **"IN"** call.

(2) **Bomb on Target.** Many aircraft can deliver IAMs via self-derived targeting. Examples include head-up display employment, forward-looking infrared (FLIR) or targeting pod slews, radar, or relative bit employment. This method indicates that aircraft are employing an IAM based on a sensor as opposed to bombing on a coordinate.

(a) BOT or self-derived targeting assumes that the aircrew is tally / has captured the JTAC's intended target or aim point. TLE for a BOT delivery will depend on aircraft / sensor type as well as the variables discussed in paragraph 7.f.(2)(a) below. This delivery mode is advantageous in dynamic situations such as mobile target sets (currently at rest), low threat environments, situations where controllers are not able to generate low TLE coordinates for BOC employment, or when aircrew are tally / have captured the target and to delay the attack in order to generate a coordinate for BOC employment would unacceptably increase the time to kill.

(b) When employing via BOT, all release restrictions and normal methods of deconfliction apply. If an IAM is delivered via BOT, the original coordinates passed should serve as a baseline for refining the target's exact position via sensor. Once the controller has correlated that the aircraft has the target (via VDL, talk-on, correction from mark, etc.), BOT IAM delivery may be treated like any other weapon delivery.

f. Target Location Error

(1) The definition of TLE is the difference between the coordinates generated for a target and the actual location of that target. TLE is expressed primarily in terms of circular and vertical errors, or infrequently, as spherical error.

(2) In order to facilitate the communication of targeting accuracy, TLE is characterized in six categories (CATs). The first row presents the categories of TLE which range from best (CAT 1) to worst (CAT 6) and are used to classify the accuracy of any coordinate generating system. See table 1 below.

(a) Proper coordinate generation procedures must be followed when stating that a given system is capable of a specific TLE category. In reality, variables such as slant range, altitude, beam divergence of the laser spot, and aim point on the target all have significant effects on the accuracy of the coordinate generated.
(b) Aim point is a significant factor in the TLE of all coordinate generation systems. As an example, Precision Strike Suite for Special Operations Forces is capable of CAT 1 coordinates, but a JTAC may not be able to produce a CAT 1 solution for a vehicle parked in a field that is not adequately depicted in his / her system. Likewise, a fixed-wing aircraft / targeting pod combination may be capable of CAT 2 coordinates, but not able to generate a CAT 2 solution for a target / aim point that is not sensor significant such as a bunker, trench line, or emplacement with overhead cover and concealment.
(3) There are currently no requirements to transmit TLE categories during any CAS transmission, and this data is presented for situational awareness only. If TLE categories are transmitted during a CAS mission, it should be done at the time of coordinate generation, based on the real-time assessment of aircraft TLE capabilities in accordance with (IAW) paragraph 7.f.(2)(a). NOTE: Expect USAF aircrews to communicate TLE category capability upon check-in and whenever target coordinates are generated by the aircrew. This information should be considered a tool that can be used if time/conditions permit in a given tactical situation and is not intended to alter standard procedures for CAS employment.

Table 1. Target Location Error Categories

Cat 1	Cat 2	Cat 3	Cat 4	Cat 5	Cat 6
0-20 ft 0-6 m	21-50 ft 7-15 m	51-100 ft 16-30 m	101-300 ft 31-91 m	301-1000 ft 92-305 m	>1001 ft > 305 m

8. Hybrid / Dual-mode Weapons
a. Hybrid weapons are capable of using both laser energy as well as a GPS-aided INS for guidance providing all-weather strike capability. The weapon may be released in a BOC mode as described in the IAMs section above, and then refined using laser energy to effectively reduce TLE to zero. If no laser energy is seen, the bomb will act as a standard IAM.
b. Advantages of hybrid / dual-mode weapons: all-weather capability, increased standoff range, expanded delivery envelope, and greater capability against moving targets (up to 60 mph). Some hybrids allow off-boresight release as well as programmable impact parameters.
c. The two main types of hybrid / dual-mode weapons are Enhanced Paveway II and Laser JDAM. See appendix E, paragraph 2.d (p.96) for specifics on each weapon.

9. DD Form 1972, Joint Tactical Air Strike Request

Department of Defense (DD) Form 1972 is used at battalion level and higher headquarters (HHQ) to submit air support requests (ASRs) when automated systems with an air strike request submission capability are not available. See figure 2, pg.16. Below are basic instructions on filling out the form line by line.

SECTION I – MISSION REQUEST

LINE 1:

UNIT CALLED

Identifies the unit designation / call sign / pre-assigned number.

THIS IS

Identifies the request originator by unit designation / call sign / pre-assigned number.

REQUEST NUMBER

For preplanned missions, indicates the originator's request number in series. For an immediate mission, this number is assigned by the ASOC/DASC.

SENT

Indicates the time and the individual who transmitted the request.

LINE 2: (Mission Categories):

PREPLANNED – Precedence or Priority

For preplanned requests, make an entry at precedence (block A) or at priority (block B).

(a) Precedence is stated numerically in descending order of importance, as determined by the requestor.

(b) Priority is expressed as #1 for emergency, #2 for priority, or #3 for routine. See below.

IMMEDIATE – Priority

For immediate requests, enter a priority number at block C. A precedence entry is not required for immediate requests because, by definition, all immediate requests are precedence #1. Use the numerical designation below to determine the priority (e.g., define the tactical situation) for preplanned (block B) or for immediate (block C):

(a) Emergency is #1 – Targets that require immediate action and supersede all other categories of mission priority.

(b) Priority is #2 – Targets that require immediate action and supersede routine targets.

(c) Routine is #3 – Targets of opportunity which do not demand urgency in execution.

RECEIVED – Indicates the time and the individual who received the request.

LINE 3: TARGET IS / NUMBER OF

Describes the type, approximate size, and mobility of the target to be attacked. It is necessary to specify, even if a rough estimate, the number of targets (e.g., 10 tanks) or the size of the target area (e.g., personnel on a 500 meter front). Otherwise planners cannot accurately determine what force is required – aircraft numbers / type and ordnance amount / type.

LINE 4: TARGET LOCATION IS

(a) Coordinates block A – Locates a point target or starting point.

(b) Coordinates block B – When used together with A, provides from A to B coordinates.
(c) Coordinates block C – When used together with A and B, provides a route.
(d) Coordinates block D – When used together with A through C, provides a route or describes a target area.
(e) Target Elevation – Target elevation in feet above MSL.
(f) Sheet no. – Self-explanatory.
(g) Series – Self-explanatory.
(h) Chart No. – Self-explanatory.

CHECKED – Indicates with who target information has been crosschecked.

LINE 5: TARGET TIME / DATE

ASAP – As soon as possible.
NLT – The target is to be attacked before, but not later than the time indicated.
AT – Indicates time at which target is to be attacked.
TO – Denotes end of period of time in which support such as airborne alert or column cover is required. When TO is used, NLT and AT are unnecessary.

LINE 6: DESIRED ORD / RESULTS

Indicates the requestor's desired air strike results. This is essential information for the planner and must be carefully considered by the requestor.

(a) Ordnance – Desired ordnance.
(b) Destroy – Self-explanatory.
(c) Neutralize – Self-explanatory.
(d) Harass / Interdict – Self-explanatory.

LINE 7: FINAL CONTROL

Indicates the final controller (e.g., JTAC, FAC[A]) who will conduct the briefing and control the release of ordnance.

(a) FAC – Transmit the type of terminal control.
(b) Call Sign – Call sign of terminal controller.
(c) Freq – Recommended tactical air direction (TAD) frequency.
(d) Fix / Cont Pt – Military grid coordinates and / or navigational aid fix of a control point which is the furthest limit of an attack aircraft's route of flight prior to control by the final controller.

LINE 8: REMARKS

Allows incorporation of briefing information not included elsewhere in the request. Enter data of the 9-line CAS brief.

SECTION II – COORDINATION

LINE 9: NSFS – Naval surface fire support coordination.
LINE 10: ARTY – Artillery coordination.
LINE 11: AIO / G-2 / G-3

Air Intelligence Officer (AIO), G-2, or G-3, or other Service equivalent coordination.

LINE 12: REQUEST – Indicates the approval or disapproval of the request.
LINE 13: BY – Indicates the individual who approved or disapproved the request.
LINE 14: REASON FOR DISAPPROVAL – Self-explanatory.
LINE 15: RESTRICTIVE FIRE / AIR PLAN

The ACA establishes airspace that is reasonably safe from friendly surface-delivered non-nuclear fires. The ACA provides a warning to aircrew of the parameters of surface-delivered fire in a specified area. A plan number or code name is issued, as appropriate.

LINE 16: IS IN EFFECT
Establishes the time period that the applicable ACA plan will be in effect.

LINE 17: LOCATION
Grid coordinates of the start / end points of the ACA's centerline.

LINE 18: WIDTH (METERS)
Defines ACA from either side of the centerline.

LINE 19: ALTITUDE / VERTEX
ACA altitude given in feet MSL.

LINE 20: MISSION NUMBER
Self-explanatory.

LINE 21: CALL SIGN
Self-explanatory.

LINE 22: NO. AND TYPE AIRCRAFT
Self-explanatory.

LINE 23: ORDNANCE
Type of ordnance either by code number or actual nomenclature.

LINE 24: EST / ACT TAKEOFF
Estimated or actual time the mission aircraft will take off.

LINE 25: EST TOT
Estimated time on target.

LINE 26: CONT PT (COORDS)
The farthest limit of the attack aircraft's route of flight prior to control by the final controller. Same as Line 7, item D, when designated in the request.

LINE 27: INITIAL CONTACT
Indicates the initial control agency the flight is to contact.

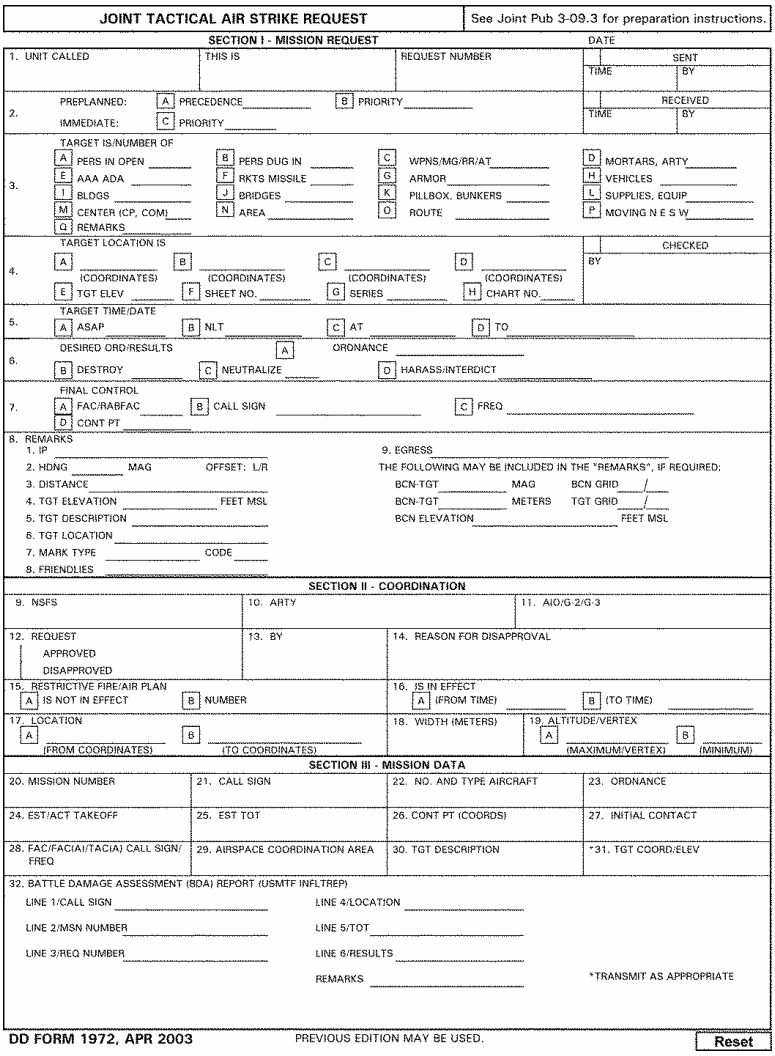
LINE 28: FAC / FAC(A) / TAC(A) CALL SIGN / FREQ
Call sign and frequency of the final control agency.

LINE 29: AIRSPACE COORDINATION AREA
Refer to lines 15 through 19 for this data.

LINE 30: TGT DESCRIPTION
Self-explanatory.

LINE 31: TGT COORD / ELEV
Self-explanatory.

LINE 32: BATTLE DAMAGE ASSESSMENT (BDA) REPORT
This optional space is used to record BDA.



JOINT TACTICAL AIR STRIKE REQUEST — See Joint Pub 3-09.3 for preparation instructions.

SECTION I - MISSION REQUEST — DATE

1. UNIT CALLED | THIS IS | REQUEST NUMBER | SENT: TIME / BY

2. PREPLANNED: [A] PRECEDENCE [B] PRIORITY
IMMEDIATE: [C] PRIORITY
RECEIVED: TIME / BY

3. TARGET IS/NUMBER OF
[A] PERS IN OPEN [B] PERS DUG IN [C] WPNS/MG/RR/AT [D] MORTARS, ARTY
[E] AAA ADA [F] RKTS MISSILE [G] ARMOR [H] VEHICLES
[I] BLDGS [J] BRIDGES [K] PILLBOX, BUNKERS [L] SUPPLIES, EQUIP
[M] CENTER (CP, COM) [N] AREA [O] ROUTE [P] MOVING N E S W
[Q] REMARKS

4. TARGET LOCATION IS — CHECKED / BY
[A] (COORDINATES) [B] (COORDINATES) [C] (COORDINATES) [D] (COORDINATES)
[E] TGT ELEV [F] SHEET NO. [G] SERIES [H] CHART NO.

5. TARGET TIME/DATE
[A] ASAP [B] NLT [C] AT [D] TO

6. DESIRED ORD/RESULTS
[A] ORDNANCE
[B] DESTROY [C] NEUTRALIZE [D] HARASS/INTERDICT

7. FINAL CONTROL
[A] FAC/RABFAC [B] CALL SIGN [C] FREQ
[D] CONT PT

8. REMARKS
1. IP
2. HDNG MAG OFFSET: L/R
3. DISTANCE
4. TGT ELEVATION FEET MSL
5. TGT DESCRIPTION
6. TGT LOCATION
7. MARK TYPE CODE
8. FRIENDLIES

9. EGRESS
THE FOLLOWING MAY BE INCLUDED IN THE "REMARKS", IF REQUIRED:
BCN-TGT MAG BCN GRID /
BCN-TGT METERS TGT GRID /
BCN ELEVATION FEET MSL

SECTION II - COORDINATION

9. NSFS | 10. ARTY | 11. AIO/G-2/G-3

12. REQUEST: APPROVED / DISAPPROVED | 13. BY | 14. REASON FOR DISAPPROVAL

15. RESTRICTIVE FIRE/AIR PLAN: [A] IS NOT IN EFFECT [B] NUMBER | 16. IS IN EFFECT: [A] (FROM TIME) [B] (TO TIME)

17. LOCATION: [A] (FROM COORDINATES) [B] (TO COORDINATES) | 18. WIDTH (METERS) | 19. ALTITUDE/VERTEX: [A] (MAXIMUM/VERTEX) [B] (MINIMUM)

SECTION III - MISSION DATA

20. MISSION NUMBER | 21. CALL SIGN | 22. NO. AND TYPE AIRCRAFT | 23. ORDNANCE

24. EST/ACT TAKEOFF | 25. EST TOT | 26. CONT PT (COORDS) | 27. INITIAL CONTACT

28. FAC/FAC(A)/TACP(A) CALL SIGN/FREQ | 29. AIRSPACE COORDINATION AREA | 30. TGT DESCRIPTION | *31. TGT COORD/ELEV

32. BATTLE DAMAGE ASSESSMENT (BDA) REPORT (USMTF INFLTREP)
LINE 1/CALL SIGN
LINE 2/MSN NUMBER
LINE 3/REQ NUMBER
LINE 4/LOCATION
LINE 5/TOT
LINE 6/RESULTS
REMARKS

*TRANSMIT AS APPROPRIATE

DD FORM 1972, APR 2003 — PREVIOUS EDITION MAY BE USED. — Reset

Figure 2. Sample DD Form 1972

NOTE: Per CJCSI [Chairman of the Joint Chiefs of Staff Instruction] 3900.01C, *Position (Point and Area) Reference Procedures*, users will reference coordinates to the WGS-84 system for all joint operations. Users will also report the vertical model referenced within WGS 84.

1. Artillery / Mortar Fire

a. Elements of a Call for Fire (CFF). A call for fire is a concise message prepared by the observer. It contains all information needed by the fire direction center (FDC) to determine the method of target attack. It is a request for fire, not an order. When voice transmissions are used, six elements of the call for fire are sent to the FDC in three transmissions: the observer identification, warning order, target location, target description, method of engagement, and method of fire and control. There is a break after each transmission as the FDC reads back data. Expect a challenge and response after the last readback. See figure 3.

Elements and Transmissions of a Call for Fire
1st Transmission
1. Observer Identification (ID). (Call Sign) 2. Warning Order (Adjust Fire; Fire for Effect; Immediate Suppression; Immediate Smoke; SEAD; Suppress; Mark; Adjust Fire / Polar; Adjust Fire / Shift) "_____" (Insert the known point or target number)
2nd Transmission
3. Target Location (Can be given in three ways: grid, polar plot, or shift from a known point.)
3rd Transmission
4. Target Description (Brief but accurate statement describing the target.) 5. Method of Engagement (Danger Close, High Angle, Ammunition Type Requested, Mark) 6. Method of Fire and Control (At My Command, Request Time of Flight, Request Splash, Request TOT, Direction)

Figure 3. Elements and Transmissions of a Call for Fire

b. Warning Order (Type of Mission).

(1) Adjust Fire. When the observer believes that an adjustment must be made (because of questionable target location or lack of registration corrections), the observer announces ADJUST FIRE.

(2) Fire for Effect (FFE). The observer should always strive for first-round FFE. FFE accuracy depends on the accuracy of target location and the ammunition being used. When the observer is certain that the target location is accurate and that the first volley should have the desired

effect on the target so that little or no adjustment is required, the observer announces FIRE FOR EFFECT.

(3) Suppress. To quickly bring fire on a target that is not active, the observer announces SUPPRESS (followed by the target identification). Suppression missions are normally fired on preplanned targets and a duration is associated with the call for fire.

(4) Immediate Suppression and Immediate Smoke. When engaging a planned target or target of opportunity that has taken friendly maneuver or elements under fire, the observer announces IMMEDIATE SUPPRESSION or IMMEDIATE SMOKE (followed by the target location).

c. Target Location Methods. There are three methods to define target location: grid coordinates, polar plot, and shift from a known point. The most common method is grid coordinates. In a grid mission, a minimum of six-place grids normally are sent. Eight-place grids or greater can be sent if available for greater accuracy. The call for fire formats listed here are set up for the grid coordinates method. Grid coordinates are normally in UTM [universal transverse mercator] six-digit format. If other methods are desired, substitute these formats into the second (mandatory) transmission (3. target location). For polar missions, the FDC must know the observer's location; for shift-from-a-known-point missions, the location of the known point must be known to both the observer and the FDC.

d. Message to Observer. After the FDC processes the call for fire, it will send the following:

(1) Call sign of the unit firing the mission (mandatory). This is given as the last letter of the call sign of the unit firing the mission. If two letters are given, the first letter is the unit that will fire for effect and the second is the unit firing the adjusting rounds.

(2) Changes to the call for fire (if any are made).

(3) Number of rounds (rnds) (mandatory). Number of rounds per tube that will fire for effect.

(4) Target number (mandatory). For tracking subsequent missions or to record as a target for future use.

(5) Time of flight (TOF) (if requested by observer). Time in seconds from shot to impact. Announced when time of flight is requested by observer or when firing high angle, aerial observer, moving target, or coordinated illumination missions. ("H, 1 round, Target AA7742, over).

e. Artillery / Mortar / Naval Gunfire Definitions.

(1) AT MY COMMAND – Command used when observer desires to control exact delivery time of fires.

(2) CHECK FIRING – Command from anyone in the fire support net to halt firing immediately.

(3) DANGER CLOSE – Term included with the method of engagement segment of a call for fire which indicates friendly troops are within close proximity of the target. The exact distance is determined by the munition fired. The creeping method of adjustment (no adjustment greater than 100 meters) will be used exclusively during danger close missions.

(4) DIRECTION – Term used by spotter / observer to indicate the direction from the observer to the target. Also known as the observer target line (OTL). When the observer anticipates he / she will be required to adjust fire, the observer will send a direction to the FDC.
(5) MARK – Term indicates the ground burst of a spotting or illumination round and is used to indicate targets to aircraft, ground troops, or fire support.
(6) MAXIMUM ORDINATE (MAX ORD) – In artillery and naval gunfire support, MAX ORD indicates the height of the highest point in the trajectory of a projectile above the horizontal plane passing through its origin. MAX ORD passed from the FSO is in meters AGL. To arrive at MSL altitude for aircraft deconfliction, conversion needs to be made to feet AGL, and then add firing location elevation.
(7) REPEAT – During adjustment, this term is a request by the observer to fire again using the same firing data. During fire for effect, this term is a request to fire the same number of rounds using the same method of fire.
(8) SHOT – Term indicates rounds fired. It is announced by the FDC to alert the observer.
(9) SPLASH – Rounds will impact in 5 seconds. It is announced by FDC.
(10) SURVEILLANCE – Term used for BDA by the Navy only.
(11) TIME ON TARGET – Time the observer desires round(s) to impact.

f. Mission Formats

Format 1. Adjust Fire Mission (Grid Method)
Observer: **"_____ this is _____, Adjust Fire, Over"** (FDC Call Sign) (Observer Call Sign**)** **"Grid _____, Over"** (Minimum 6-digits) Target Description: **"_____"** (Target Description, Size, Activity) Method of Engagement (optional): (Danger Close, Mark, High Angle, Ammo / Fuze Type) Method of Fire and Control (optional): (At My Command, Time on Target, Request Splash, Request TOF, Request Ordinate Altitude Information) **"Over"** FDC may challenge after they read back the above. The observer should be prepared to authenticate.
Message to Observer (* = Mandatory Call)
Units to Fire* (Firing Unit, Adjusting Unit) Changes to Call for Fire (If any) Number of Rounds* (Per Tube) Target Number* Time of Flight (Seconds) Ordinate Altitude Information
Given After Message to Observer
"Direction _____, Over" (Mils or Degrees*) [*Mils is the default – specify if using degrees.] When requesting mortar fires, direction is given as OTL when talking to the FDC. Direction is given as GTL when sending directly to the mortar crew. (See FM 3-22.90, *Mortars*.)
Adjustments
"Left/Right _____" (Meters, Distance from Impact to OTL) **"Add/Drop _____ , Over"** (Meters, Distance from Impact to Target) **"Up/Down _____"** (Only for Airburst Rounds – typically USMC only) (Meters, Distance from Height of Burst (HOB) to Desired HOB)
Mission Completion
"End of Mission ____, Over." (BDA and Target Activity) or **"Refinements, Record as Target, End of Mission, and Surveillance (RREMS)"** RREMS transmission is optional.

Format 2. Adjust Fire Mission (Polar Plot)
Observer: **"_____ this is _____, Adjust Fire Polar, Over"** (FDC Call Sign) (Observer Call Sign**)** **"Direction _____"** in mils / degrees method (observer to target line – nearest 10 mils / 1 degree) **(*Note:*** Must specify degrees to FDC only if direction is given in degrees.**)** **"Distance _____"** in meters (to nearest 100m) **"Up/Down _____"** in meters (to nearest 5m) **(*Note:*** Difference in target altitude is with respect to observer, not given if less than a 35m elevation difference between the observer and target. For polar missions, the FDC must know the observer's location.**)** Target Description: **"_____"** (Target Description, Size, Activity) Method of Engagement (optional): (Danger Close, Mark, High Angle, Ammo / Fuze Type) Method of Fire and Control (optional): (At My Command, Time on Target, Request Splash, Request TOF, Request Ordinate Altitude Information) **"Over"** FDC may challenge after they read back the above. The observer should be prepared to authenticate.
Message to Observer (* = Mandatory Call)
Units to Fire* (Firing Unit, Adjusting Unit) Changes to Call for Fire (If any) Number of Rounds* (Per Tube) Target Number* Time of Flight (Seconds) Ordinate Altitude Information
Adjustments
"Left/Right _____" (Meters, Distance from Impact to OTL) **"Add/Drop _____ , Over"** (Meters, Distance from Impact to Target) **"Fire for Effect, Over"** (Sent with the final correction, when effects on target are observed.)
Mission Completion
"End of Mission ____, Over." (BDA and Target Activity) or **"Refinements, Record as Target, End of Mission, and Surveillance (RREMS)"** RREMS transmission is optional.

Format 3. Adjust Fire Mission (Shift from a Known Point)
Observer: **"_____ this is _____, Adjust Fire,** (FDC Call Sign) (Observer Call Sign) **Shift _____, Over"** (Identify known point, for example, target AA7733) **"Direction _____"** in mils / degrees grid (OTL – nearest 10 mils / 1 degree) (***Note:*** Must specify degrees to FDC only if direction is given in degrees.) **"Left/Right _____"** in meters (Lateral shift to nearest 10m) **"Add/Drop _____"** in meters (Range shift to nearest 100m) **"Up/Down _____"** in meters (Vertical shift to nearest 5m) (***Note****:* Difference in target altitude is with respect to observer, not given if less than a 35m elevation difference between the observer and target. For shift from a known point mission, the location of the known point must be known to both the observer and the FDC.) Target Description: **"_____"** (Target Description, Size, Activity) Method of Engagement (optional): (Danger Close, Mark, High Angle, Ammo / Fuze Type) Method of Fire and Control (optional): At My Command, Time on Target, Request Splash, Request TOF, Request Ordinate Altitude Information) **"Over"** FDC may challenge after they read back the above. The observer should be prepared to authenticate.
EXAMPLE – MIL RELATIONSHIP The observer knows the distance from his location to a known point (church) is 2,500 meters. With binoculars, the observer measures an angular deviation of 62 mils from the church to the target. The observer calculates the lateral shift as follows: W = R x mils (Width of lateral shift = Range (km) x mils) W = 2500/1000 x 62 = 155 meters = approximately 160 meters (Lateral shift expressed to nearest 10 meters.) **"Left 160"** (***Note:*** one degree = 17.45 mils)
Message to Observer (* = Mandatory Call)
Units to Fire* (Firing Unit, Adjusting Unit) Changes to Call for Fire (If any) Number of Rounds* (Per Tube) Target Number* Time of Flight (Seconds) Ordinate Altitude Information
Adjustments
"Left/Right _____" (Meters, Distance from Impact to OTL) **"Add/Drop _____, Over"** (Meters, Distance from Impact to Target) **"Fire for Effect, Over"** (Sent with the final correction, when effects on target are observed)
Mission Completion
"End of Mission ____, Over." (BDA and Target Activity) or **"Refinements, Record as Target, End of Mission, and Surveillance (RREMS)"** RREMS transmission is optional.

Format 4. Fire for Effect Mission (Grid Method)
Observer: **"_____ this is _____, Fire for Effect, Over"** (FDC Call Sign) (Observer Call Sign) **"Grid _____, Over"** (Minimum 6-digits) Target Description: **"_____"** (Target Description, Size, Activity) Method of Engagement (optional): (Danger Close, Mark, High Angle, Ammo/Fuze type) Method of Fire and Control (optional): (At My Command, Time on target, Request Splash, Request TOF, Request Ordinate Altitude Information) **"Over"** FDC may challenge after they read back the above. The observer should be prepared to authenticate.
Message to Observer (*=Mandatory Call)
Units to Fire* (Firing Unit, Adjusting Unit) Changes to Call for Fire (If any) Number of Rounds* (Per tube) Target Number* Time of Flight (Seconds) Ordinate Altitude Information
Adjustment
Prior to 1st Adjustment: **"Direction _____, Over"** (Mils or Degrees – Mils is the default, specify if using degrees.) **"Left/Right _____"** (Meters, Distance from Impact to OTL) **"Add/Drop _____"** (Meters, Distance from Impact to Target) **"Up/Down _____"** (Only for Airburst Rounds – typically USMC only) (Meters, Distance from Height of Burst (HOB) to Desired HOB) **"Repeat, Over"**
Mission Completion
"End of Mission ____, Over." (BDA and Target Activity) or **"Refinements, Record as Target, End of Mission, and Surveillance (RREMS)"** RREMS transmission is optional.

Format 5. Suppression / Immediate Suppression / Smoke Mission (Grid Method)
Observer: "_____ this is _____" (FDC Call Sign) (Observer Call Sign) **"Suppress / Immediate Suppression / Smoke_____, Over"** (Target # / 6-digit Grid)
Note: USMC may include a "Duration" call after target location. USA will only fire one volley. Call "Repeat" if additional volley is required.

Format 6. Marking Mission (Grid Method)
Observer: "_____, this is _____, Fire for Effect, Over" (FDC Call Sign) (Observer Call Sign) **"Grid _____, Over"** (Minimum 6-digits) "Marking round, white phosphorous, at my command, request time of flight, Over." Method of Engagement (optional): (Danger Close, Mark, High Angle, Ammo / Fuze type) Method of Fire and Control (optional): (At My Command, Time on Target, Request Splash, Request TOF, Request Ordinate Altitude Information) FDC may challenge after they read back the above. The observer should be prepared to authenticate.
Message to Observer (*=Mandatory Call)
Units to Fire* (Firing Unit, Adjusting Unit) Changes to Call for Fire (If any) Number of Rounds* (Per tube) Target Number* Time of Flight (Seconds) Ordinate Altitude Information
Mission Completion
"End of Mission ____, Over." (BDA and Target Activity) or **"Refinements, Record as Target, End of Mission, and Surveillance (RREMS)"** RREMS transmission is optional.
Note: CAS TOT for marking, WP delivered 30-45 sec prior and illumination on deck delivered 45 sec prior to CAS TOT.

Format 7. Suppression of Enemy Air Defenses Mission (Marine Corps – Grid Method)
Observer: **"_____, this is _____, SEAD, Over"** (FDC Call Sign) (Observer Call Sign) **"Grid to Suppress _____, Grid to Mark _____, Over"** (Minimum 6-digits) (Minimum 6-digits) **"_____, _____, _____ CAS TOT / TTT, Over"** (Target Description) (Continuous/Interrupted) (Timing)
Note: Continuous: TOT-60, TOT-30, TOT, TOT+30, TOT+60 |----------|----------|---------|-----------| Interrupted: TOT-60, TOT-30 Non-standard: As desired by observer.

Format 8. Artillery / Mortar – Quick Smoke Request
Observer: **"_____, this is _____, Adjust Fire, Over"** (FDC Call Sign) (Observer Call Sign) **"Grid _____, Over"** (Minimum 6-digits) **"Screen _____"** (Target Description) Method of Engagement (optional): a. L = Length of Smoke Screen Desired b. M = Maneuver Target Line c. D = Direction of Wind: (Head, Tail, Right/Left Cross) d. T = Time or duration the smoke screen is to be effective. **"Smoke / WP / RP in Effect, Over"**
Adjust Fire Up / Down
For Ground Burst: **"Up 100"** ***Note:*** If using high explosive rounds to adjust onto the desired target area, the observer will request shell smoke once the 200 meter bracket is broken. The observer will then request "Fire for Effect."

Format 9. Artillery / Mortar Illumination Request – Call for Fire
Warning: Use of illumination requires care and adequate coordination to avoid adverse impact on the operations of adjacent and supporting units using night-vision devices.
Observer: **"_____, this is _____"** (FDC Call Sign) (Observer Call Sign) Warning Order: **"_____, Over"** Target Location: **"_____, Over"** (Grid, Polar, Shift) Target Description: **"_____, Over"** (Target Description, Size, Activity) Method of Engagement: **"Illumination"** Method of Fire and Control: **"_____, Over"** (By Shell, At My Command, Request Ordinate Information) **"Direction _____, Over"** (Adjustment of Illumination) ***Note:*** Observer will give direction if grid mission.
Adjustments Include: **"Right / left _____"** (In 200 meter increments) **"Add / drop _____"** (In 200 meter increments) **"Up / down _____"** (In 50 meter increments) Adjust illumination over adjusting point/target. When maximum illumination is obtained, the overseer transmits: **"illumination mark."**
When target is verified, observer transmits **"coordinated illumination"** and attacks with desired munitions using the call for fire format. ***Note:*** Coordinated illumination directs the FDC to calculate and direct the firing of the illumination and the attack munitions at a time that should result in the attack munitions impacting when the target is at maximum illumination. Observers desiring to control the firing of both the illumination and the attack munitions transmit: **"By shell, at my command"**
To receive 2- or 4-gun illumination during an illumination mission, transmit the following under Method of Fire and Control: For 2-gun illumination: **"range spread"** or **"lateral spread"** For 4-gun illumination: **"range and lateral spread"**

2. Naval Surface Fire Support

Format 10. Naval Surface Fire Support Call for Fire (Grid / Polar Plot / Shift from a Known Point)
(CFF given in two transmissions)
First Transmission
"_____, this is _____, Fire Mission, (Ship Call Sign) (Observer Call Sign) **Target # _____, Over"** (Assigned by Observer)
Second Transmission
Target Location – Grid
"Grid _____, Altitude _____, (Minimum 6-digits) (Meters MSL) **Direction _____, Over"** (mils/grid)
Target Location – Polar Plot
"Direction _____" in mils/deg (to nearest 10 mils/deg) **"Distance _____"** in meters (to nearest 100 m) **"Up/Down _____"** in meters (to nearest 5 m) (vertical shift)
Target Location – Shift from a Known Point
"Shift _____" (target number/reference point) **"Direction _____"** in mils/deg (to nearest 10 mils/degrees) (from observer to target) **"Right/Left _____"** in meters (to nearest 10 m) (lateral shift) **"Add/Drop _____"** in meters (to nearest 100 m) (range shift) **"Up/Down _____"** in meters (to nearest 5 m) (vertical shift)
Target Description: (Type, Size, Degree of Protection) Method of Engagement: (Danger Close, Trajectory, Ammo/Fuze type, # Guns, # Salvos, Special Instructions) Method of Control: (Spotter Adjust, Ship Adjust, Fire for Effect, Cannot Observe, At My Command)
Prefiring Report (Spotter Reads Back)
Gun-Target Line (From Gun to Target) Line of Fire (If firing ILLUM) First Salvo at _____ (Danger close missions only) Summit(MAX ORD in feet for Air Spotter, Meters for Ground Spotter) Changes to Call for Fire Ready/Time of Flight (Time of flight in seconds) **"FIRE OVER"** (Command from Spotter after Prefiring Report is read back)

Table 2. Field Artillery Cannons

Artillery	Ammunition		Danger Close	Range (Meters)			Rates of Fire / Notes
	Projectile	Fuze		Max	DPICM	RAP	
105mm M119A1	HE, HC, WP, ILLUM, APICM, DPICM	PD, VT, MT, ET, MTSQ, Delay	600 m[1]	11,500	14,100	19,500	Sustained rate of fire: 3 rnds/min. Max rate of fire: 10 rnds/min
155 mm M198	HE, HC, WP, ILLUM, CPHD, APICM, DPICM, M825 Smoke, SCAT-MINE	PD, VT, MT, ET, MTSQ, Delay	600 m[1]	18,300 or 22,000 with M795 HE, M825 Smoke	18,000 or 28,200 with M864	30,100	Sustained rate of fire: 2 rnds/min. Max rate of fire: 4 rnds/min
155 mm M109A5/A6	HE, HC, WP, ILLUM, CPHD, APICM, DPICM, M825 Smoke, SCAT-MINE	PD, VT, MT, ET, MTSQ, Delay	600 m[1] 170m with XM982	18,200 or 21,700 with M795 HE, M825 Smoke; 24,500 with XM982 Block 1-1a[2]	17,900 or 28,100 with M864	30,000	Sustained rate of fire: 1 rnd/min. Max rate of fire: 4 rnds/min
155 mm M777-series	HE, HC, WP, ILLUM, CPHD, APICM, DPICM, M825 Smoke, SCAT-MINE	PD, VT, MT, ET, MTSQ, Delay	600 m[1] 170m with XM982	22,200 w/ M201A1 Chg 8S or 22,500 w/ M232, Zone 5; 24,500 w/ XM982 Block 1-1a Smoke; 24,500 w/ XM982 Block 1-1a	N/A	30,000	Sustained rate of fire: 2 rnds/min IAW Thermal Warning Device. Max rate of fire: 4 rnds/2 min

[1]See appendix F: *Surface-to-Surface Risk-Estimate Distances* for detailed discussion of "danger close."
[2]Excalibur not authorized for M109A5.
APICM – antipersonnel improved conventional munition, CPHD – copperhead, DPICM – dual purpose improved conventional munition, ET – electronic time, HC – hexachloroethane, HE – high explosive, ILLUM – illumination, MT – mechanical time, MTSQ – mechanical time superquick, PD – point detonating, RAP – rocket assisted projectile, SCAT-MINE – scatterable mines, VT – variable time, WP – white phosphorous.

Table 3. Mortars						
Wpn	Ammunition		Danger Close	Range (m)		Rates of Fire
	Model	Type		Min	Max	
60 mm M224	M720	HE	600 m	70	3,489[1]	30 rnds/min for 4 min[2] then 20 rnds/min sustained. Diameter of illumination: M721 – 500 m, M83A3 – 300 m
	M888	HE		70	3,489	
	M722	WP		70	3,489	
	M721	ILLUM		200	3,489	
	M302A1	WP		35	1,830	
	M83A3	ILLUM		725	950	
	M49A4	HE		45	1,830	
81 mm M29A1	M374A2	HE	600 m	70	4,600	25 rnds/min for 2 min then 8 rnds/min sustained. Diameter of illumination: 360 m
	M374A3	HE		73	4,800	
	M375A2	WP		70	4,595	
	M301A3	ILLUM		100	3,150	
81mm M252	M821	HE	600 m	80	5,800	18 rnds/min for 2 min then 8 rnds/min sustained. Diameter of illumination: 650 m
	M889	HE		83	5,800	
	M374A3	HE		73	4,800	
	M819	RP		300	4,875	
	M375A2	WP		73	4,595	
	M853A1	ILLUM		300	5,060	
	M301A3	ILLUM		100	3,950	
120 mm M120	M57	HE	600 m	200	7,200	16 rnds/min for 1 min then 4 rnds/min sustained. Diameter of illumination: 1,500 m
	M68	WP		200	7,200	
	M91	ILLUM		200	7,100	
	M933	HE/PD		200	7,200	
	M934	HE/MOF		170	7,200	
	M929	WP		170	7,200	
	M930	ILLUM		170	7,200	

HE – high explosive
ILLUM – illumination
MOF – multi-option fuze
PD- point detonating
RP – red phosphorus
WP – white phosphorus
wpn - weapon
[1]Bipod-mounted, charge 4 (maximum handheld is 1,300 meters).
[2]Charge 2 and over. 30 rounds per minute can be sustained with charge 0 or 1.

Table 4. Artillery / Mortar / Rocket Illumination Factors				
Weapon	Type	Height of Burst (meters)	Burn Time (seconds)	Rate of Fall (m/sec)
60 mm	M83A1 M83A2/3	160	25 32	6
70 mm (2.75")	M-257 (Overt)	550	120	4.5
70 mm (2.75")	M-278 (Covert)	800	180	4.5
81 mm	M301A3	600	60	6
105 mm	M314A2 M314A3	750	60-65	12
120 mm	M930	500	50	5
155 mm	M118 M485-series	750 600	60 120	10 5

Table 5. 5"/54 and 5"/62 Naval Gun Data	
Maximum Range	23,100 m (Full Charge) 12,200 m (Reduced Charge)
Danger Close*	750 m
Fire Rate: Maximum / Sustained	20 / 16-20 rounds per minute for both systems
Ammunition	HE, Illum, WP
Fuzes	Quick (Q), Mechanical Time (MT), Controlled Variable Time (CVT), Variable Time (VT), Delay (DEL)
Illumination	Mk 88: HOB = 500 m Burn Time (sec) = 45 – 72 Rate of Fall = 5 m/sec Mk 91: HOB = 325 m Burn Time (sec) = 65-70 Rate of Fall = 5 m/sec
Note: Data applies to 5"/62 firing conventional munitions. * Danger Close Mission (<750 m for naval gunfire). Give cardinal direction and distance to friendlies. Use first salvo offset and "creeping" method for adjustments in 50 m increments. Directions are normally given in mils relative to grid north. Any other combination may be used but must be specified (e.g., "Direction 180 degrees magnetic.")	

Table 6. Cannon / Mortar Targets and Suggested Ammunition		
Targets	Cannons	Mortars
Personnel or light vehicles in open	ICM, DPICM, HE/VT, HE/TI, Excalibur/VT/PD	HE/MOF, HE/VT, HE/TI, HE/PD
Personnel or light vehicles in light overhead cover	ICM, DPICM, HE/TI, HE/PD, HE/D, Excalibur/PD/D	HE/MOF, HE/TI, HE/PD, HE/D
Personnel or light vehicles in trees	HE/TI, HE/D	HE/MOF, HE/TI, HE/PD, HE/D
Covered positions or heavy vehicles in the open	DPICM, HE/PD, HE/D, Excalibur/PD/D	HE/MOF, HE/PD, HE/D
Large bunker complexes	HE/CP, HE/D, HE/PD	HE/MOF, HE/PD, HE/D
Small bunkers	Copperhead, HE/CP, HE/PD, HE/D, Excalibur/D	HE/MOF, HE/PD, HE/D
Armored vehicles	DPICM, Copperhead, HE/PD, HE/D	HE/MOF, HE/PD, HE/D
Urban Structures	Excalibur/VT	
CP - concrete piercing D - delay DPICM - Dual Purpose, Improved Conventional Munitions HE - high explosive ICM - Improved Conventional Munitions MOF - multi-option fuze PD - point detonating TI - time VT - variable time		
Note: MOF has the following actions – Impact (IPM), Delay (DLY), Near Surface Burst (NSB), and Proximity (PRX).		

Table 7. Artillery Precision-guided Munitions			
Munitions	Variant	Payload	Range
Guided 155mm Projectile	XM982 Block 1a-1	Similar to HE M107	7.5-24 km
Target Types: Precisely located targets – Personnel, lightly armored targets (stationary), and structures where collateral damage must be restricted.			
Note: Excalibur is fired only by the M777 and M109A6 cannon weapons.			

Table 8. Multiple Launch Rocket System / High Mobility Artillery Rocket System				
Munition	Variant	Payload	Range	Targets
Rockets (MLRS)	M26	644 M77 DPICM	10-32 km	Personnel, Light Armor, Soft Vehicles (Stationary), Buildings (GMLRS Only)
	M26A2 ER-MLRS	518 PI M77	13-45 km	
Guided Rockets (GMLRS)	M30	404 PI M77 DPICM	15-60 km	
	M31	51.5 lbs Unitary HE	15-60 km	
ATACMS	Block 1 M39 (JEE)	950 M74 APAM bomblets	25-165 km	Personnel, Light Armor, Soft Vehicles (Stationary)
	Block 1A M39A1 (JEN)	300 M74 APAM bomblets	70-300 km	
	Quick Reaction Unitary (QRU)	Single Burst, HE/PD Fuze	70-270 km	Block 1 – 1A targets when duds / collateral damage are precluded. Fixed infrastructure sites (building, etc.)
	ATACMS Unitary	Single unitary warhead with multi-function fuze – Proximity, PD, or Delay	70-300 km	
APAM – Anti-Personnel, Antiarmor ATACMS – Army Tactical Missile System DPICM – Dual Purpose, Improved Conventional Munitions ER-MLRS – Extended Range Multiple Launch Rocket System GMLRS – Guided Multiple Launch Rocket System HE – High Explosive JEE, JEN – Computer Munitions Identification Codes MLRS – Multiple Launch Rocket System PD – Point Detonating PI – Product Improved ***Note*:** Default rates of fire are 5 seconds between rockets and 15 seconds between missiles.				

Table 9. Tomahawk Land Attack Missile			
Munition	Variant	Payload	Target Type
BGM-109	C (Block III)	1000-lb class unitary warhead	Fixed infrastructure sites (bldgs, etc.)
	E (Block IV)		
	D (Block III)	166 BLU-97 submunitions	Sam sites, surface-to-surface missile sites
TLAMs are near-precision sub-sonic cruise missiles launched from cruisers, destroyers, and submarines. Guidance: INS aided by GPS / terrain contour matching / digital scene matching area correlation with TOT options. Block IV weapons can be datalinked in-flight via UHF satellite digital datalink for retargeting.			

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Chapter III: Joint Air Attack Team and Close Combat Attack

1. Army Aviation

Army aviation units are organic, assigned, or attached to corps, divisions, and regiments and perform missions as part of a combined arms team. Army helicopter units normally receive mission type orders and execute as an integral unit/maneuver element. Special situations may arise where attack helicopters are employed in smaller units. The Army does not consider its attack helicopters a CAS system, although they can conduct attacks employing CAS JTTP when operating in support of other forces. The doctrinal employment method is as an integral unit, operating under the control of a maneuver commander executing mission-type orders.

2. Army Close Combat Attack Procedures

a. US Army CCA is defined as a coordinated attack by Army aircraft against targets that are in close proximity to friendly forces. During CCA, the attack team engages enemy units with direct fires that impact near friendly forces. Targets may range from tens of meters to a few thousand meters from friendly forces. CCA is coordinated and directed by a team, platoon, or company-level ground unit using the standard CCA brief. Once the aircrews receive the brief from the ground commander, they develop a plan then engage the enemy force, while maintaining freedom to maneuver. Due to capabilities of the aircraft and the enhanced situational awareness of the aircrews, terminal control from ground units or controllers is not necessary. **CCA is not synonymous with CAS.**

b. Army attack teams will brief the information in format 11 at check-in:

Format 11. Close Combat Attack Check-In (Aircraft Transmits to Ground Unit)
Aircraft: **"_____, this is _____"** (Ground unit in contact) (Aircraft Call Sign) Aircraft Team Composition and Location Munitions Available (Rockets / Guns / Missiles) Night Vision Capability and Type (If Appropriate) Station Time (In minutes)

c. The Army utilizes a "5-line" CCA brief for briefing attack aviation assets conducting CCA. It can be used for all threat conditions. It does not affect the aircrew's tactics in executing CCA. Transmission of the brief constitutes clearance to fire except in a danger close situation. Danger close must be declared in Line 5 when applicable. See format 12.

Format 12. Close Combat Attack Briefing – Ground to Air (5-Line)
1. Observer / Warning Order **"_____, this is _____, Fire Mission, Over"** (Aircraft Call Sign) (Observer Call Sign) 2. Friendly Location / Mark **"My position _____, marked by _____"** (TRP, Grid, etc) (Strobe, Beacon, IR Strobe, etc.) 3. Target Location **"Target Location _____"** (Bearing [magnetic] and Range [meters], TRP, Grid, etc.) 4. Target Description / Mark **"_____, marked by _____"** (Target Description) (IR Pointer, Tracer, etc.) 5. Remarks (Threats, Danger Close Clearance, Restriction, At My Command, etc.) **"Over"**
AS REQUIRED: 1. Clearance: Transmission of the 5-Line CCA Brief is clearance to fire (unless danger close.) For closer fire, the observer/commander must accept responsibility for increased risk. State "Cleared Danger Close" in line 5. This clearance may be preplanned. 2. At My Command: For positive control of the aircraft, state **"At My Command"** on line 5. The aircraft will call **"Ready for Fire"** when ready.

d. The AMC or flight lead must have direct communication with the ground commander on the scene to provide direct fire support. After receiving the CCA brief from the ground forces, the pilots must be able to conduct combat identification to positively identify the location of the friendlies prior to the engagement. Methods for marking the location of friendlies and the enemy include, but are not limited to: laser handover, tracer fire, marking rounds (flares or mortars), smoke grenades, signal mirrors, VS-17 panels, IR strobe lights, LTM, or chemical sticks. Once the crew has identified both the enemy and friendly locations, flight leads will formulate an attack plan and brief the supported commander and his/her other attack team members.

3. Joint Air Attack Team

a. JAAT is a method of integrating rotary-wing and fixed-wing aircraft to locate and attack high-priority targets and targets of opportunity. JAAT is a method of employment, not a mission. JAAT fires are integrated, mutually supportive, and synergistic, not simply deconflicted.

b. JAAT can be employed anywhere on the battlefield across the spectrum of operations. CAS procedures may/may not be required depending on the proximity of friendly forces and requirement for detailed integration.

c. JAAT is a combination of attack and/or scout rotary-wing aircraft and fixed-wing CAS aircraft operating together to locate and attack high-priority targets and other targets of opportunity. JAAT normally operates as a coordinated effort supported by fire support, air defense artillery (ADA), NSFS, ISR systems, EW systems, and ground maneuver forces against enemy forces. JTACs may

perform duties as directed by the AMC in support of the ground commander's scheme of maneuver.

d. A mission commander will be designated for JAAT operations. The mission commander should be the element with the highest situational awareness and ability to provide C2.

e. JAAT can be accomplished with minimum coordination, provided that the participants are trained and proficient. Maximum JAAT synergy occurs when the JAAT mission commander at the tactical level, normally an AMC, possesses the authority to coordinate attack execution directly with the other team members. In non-CAS JAAT application, direct attack coordination is more efficient because there is no requirement for JTAC / FAC(A) control.

f. When JAAT is employed where CAS procedures are required, Type 2 or 3 control offers increased flexibility that can preserve JAAT synergy if the tactical situation allows.

4. Joint Air Attack Team Execution

a. JAAT Sample Mission Flow
   (1) Supporting aircraft contacts the AMC on check-in or strike frequency.
   (2) AMC verifies aircraft received the current target / threat information.
   (3) AMC briefs situation updates followed by the JAAT attack plan.

b. Key JAAT Components
   (1) Check-in and Briefing. JAAT participants check in with the AMC IAW check-in briefing (Format 11). The 9-Line CAS brief is the standard for providing information. If items in the CAS 9-Line are unknown or do not apply, they will be briefed as such. However, JP 3-09.3 readback requirements must be adhered to. The following items are required: attack method (combined or sectored), firepower timing options (simultaneous, sequential, or random), and targeting plan within engagement area (target sort, fire distribution).
   (2) Clearance Authority. When JAAT is employed using CAS procedures, the JTAC / FAC(A) must provide clearance for aircraft to expend ordnance. When CAS procedures are not in effect, clearance to expend ordnance rests with individual shooters IAW theater ROE. In both situations, all participants retain abort authority.
   (3) Attack Types. The attack methods describe control techniques for attacking targets within an objective area. Methods may apply to the joint attack as a whole and within the attacking flight or unit's individual plan of attack. The two methods are illustrated in figures 4 (p.40) and 5 (p.41).
      (a) Combined – During this attack, JAAT aircraft may utilize the same avenue of approach to a common engagement area.
      (b) Sectored – During this attack, JAAT aircraft will utilize different avenues of approach that are separated by an acknowledged and well defined boundary / terrain feature.
   (4) Firepower Timing Options. Firepower timing options integrate and deconflict fires. Timing options apply to any altitude option (low, medium, or high). The AMC will clearly deconflict altitudes for all JAAT participants. See table 10 for more information.

(a) Simultaneous – All elements attack at the same time.
1. Advantages: masses fires, maximizes shock effect, complicates enemy ADA targeting scheme, unpredictable.
2. Disadvantages: complicates target array sorting and direct fire planning, simultaneous impacts can interfere with one another.

(b) Sequential – All elements attack in a predetermined sequence.
1. Advantages: target area marked for subsequent attackers, continuous pressure on target over time, allows attackers to reposition while other attackers shoot, less weapons interference for subsequent shooters, ensures targets are not double-targeted.
2. Disadvantages: air defenses have greater opportunity to target airborne participants, takes longer, less shock effect, and could provide opportunities to enemy.

(c) Random – All elements attack at will.
1. Advantages: easiest on pilots, no timing required, reduced C2 requirements, unpredictable.
2. Disadvantages: complicates deconfliction, no guarantee of effects, possibly less pressure on enemy, can complicate fire support plan.

(5) Targeting Plan. The targeting plan integrates and deconflicts fires and targets within the engagement area (target sort, fire distribution). Examples include but are not limited to:
(a) Target reference point
(b) Sectored
(c) Quadrant
(d) Fire pattern
(e) Target array

(6) Weapons Delivery Considerations. Information should be passed from the attacking aircraft to the AMC to coordinate specific weapons delivery profiles and/or effects. These items are not required, but may include the following:
(a) Attack heading
(b) Weapons selection
(c) Ingress and release altitudes
(d) Dive angle
(e) Distance from target

(7) Coordinating Instructions. Establishing the attack method and the timing option are vital. If all else fails, use plain language.

(8) Deconfliction. Four common methods to deconflict airspace and weapons effects in the target area are listed below. See JP 3-09.3 *Joint Tactics, Techniques, and Procedures for Close Air Support*, along with figures 19 (p.92) and 20 (p.93) for a detailed description of each.
(a) Lateral / geographic separation
(b) Altitude separation
(c) Timing separation
(d) Any combination of the above

(9) Mission Abort. The AMC maintains abort authority. Considerations for abort criteria should include weather, fallout, threat level, degraded

systems, and target priority / commander's guidance. Procedures must be established to ensure all participants are notified of an abort decision.

(10) Battlefield Handover. When the AMC must hand over the target area to another asset, the following information should be covered:
  (a) Friendly situation (ground order of battle, airborne assets, location, ordnance, and time on station)
  (b) Enemy situation (targets destroyed / remaining, ADA, etc.)
  (c) Control measures in effect
  (d) Clearance authority (if applicable)
  (e) Frequencies and call signs

(11) Disengagement. Consideration must be given to the disengagement phase of the operations. Considerations include:
  (a) Covering fires – suppressive fires, artillery, SEAD, etc.
  (b) Egress route – mutual support / escort may be required
  (c) BDA – IAW inflight report format from JP 3-09.3

c. Night Considerations. Night JAAT procedures remain the same as for day. However, tactics require a more deliberate tempo. Consider the following when conducting night operations:

(1) Visual descriptions – Perspective / target resolution varies based on aircraft systems. A terrain feature visible by night vision goggle (NVG) or FLIR equipped rotary-wing aircraft at 50 ft may not be recognized by an NVG equipped pilot or a FLIR / targeting pod equipped aircraft at 20,000 ft.

(2) Night vision capabilities – These vary greatly between weapons systems. A thorough understanding of these capabilities will enhance success during night JAAT.

Table 10. Coordinated Attack Types			
Type of Attack	Simultaneous	Sequential	Random
COMBINED Same avenue of attack	Visual separation, TOT or TTT	Visual separation, TOT or TTT	NOT normally used for low altitude
SECTORED Acknowledged sector	Visual separation, TOT or TTT	Visual separation, TOT or TTT	Free flow*
* Must ensure strafe fan/bomb and missile fragmentation deconfliction.			

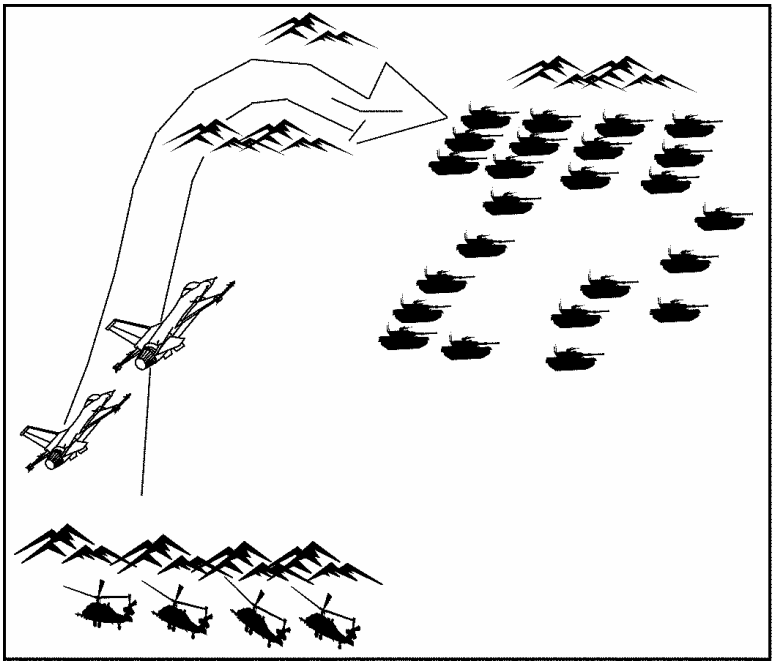


Figure 4. Example of a Combined Attack

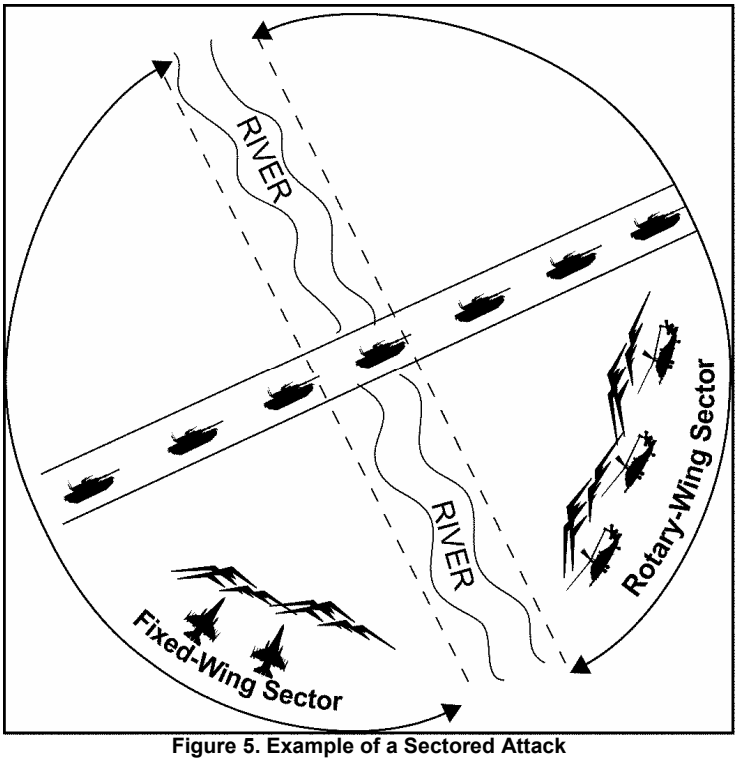


Figure 5. Example of a Sectored Attack

5. Joint Air Attack Team Communications

a. Communication Nets. JAAT communication nets depend upon the availability of different radios in the various aircraft and on the tactical situation. Figure 6 shows possible communication links.

b. Command Net. The AMC uses this net to coordinate the JAAT with other maneuver unit commanders and to keep them informed on the situation in the battle area.

c. Admin / Check-in Frequency. If required / desired, all participants should check-in on this frequency to reduce clutter on the strike frequency. It is used to pass updates for the mission and build situational awareness of aircraft arriving after the JAAT has begun.

d. Strike Frequency / TAD. The AMC uses the strike frequency ATO-assigned TAD to coordinate the ongoing JAAT with all participants.

e. Authentication. Service authentication tables differ. The AMC should coordinate authentication between all participants.

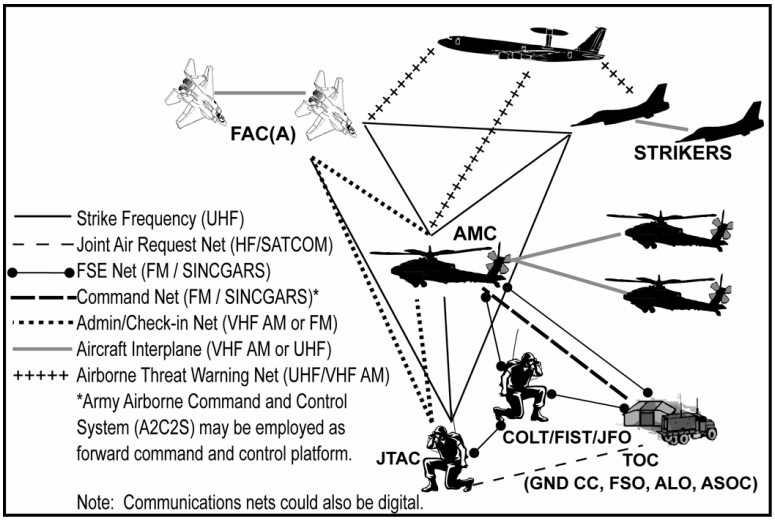


Figure 6. Sample Joint Air Attack Team Communications Net

Supporting aircraft passes CAS check-in brief (Format 13)
AMC passes target information in 9-Line format (Format 15)
AMC: **"Hog 01, 9-Line to follow…lines 1 through 3 N/A. 2014 feet. Target is a column of 5 tanks in choke point. PL385211.**
AMC passes remainder of 9-Line brief: **"Laser 1688, SW 2500, Egress south."**
If conducting a CAS mission, readback lines 4, 6, and restrictions. (Required IAW JP 3-09.3).
AMC passes remarks (as applicable): **"Wind is 15 knots from the east."**
AMC confirms associated threat: **"ZSU located 4 km north of target area."**
AMC passes attack method and firepower timing option: **"Sectored, sequential. Your sector is west of road running through target area. Helos will be east of the road conducting diving fire with a coordinating altitude of 2500 ft."**
AMC passes targeting plan and TOT: **"Hog 01, hit western tanks, helos have eastern. Your TOT is 1350. Call 60 seconds out."**
AMC passes attack restrictions (if any): **"Hog 01, attack south to north only."**
Supporting aircraft verifies receipt of information and compliance: **"Hog 01, Wilco."**
At 60 seconds from TOT, supporting aircraft calls: **"Hog 01, 60 seconds."**
AMC: **"Hog 01, roger."** Supporting aircraft makes laser calls as required.
AMC maintains the ability to abort the attacking aircraft, as necessary.
Hog 01 conducts target attacks IAW mission brief.

Figure 7. Joint Air Attack Team Mission Flow Example

Chapter IV: Close Air Support Execution

1. Joint Terminal Attack Controller

a. A JTAC is a qualified (certified) Service or coalition member who, from a forward position, directs the action of combat aircraft engaged in CAS and other offensive air operations. A qualified and current JTAC is recognized across the Department of Defense as capable and authorized to perform terminal attack control. Terminal attack control is the authority to control the maneuver of and grant weapons release authority to attacking aircraft. Based on a risk assessment, the supported commander will weigh the benefits and liabilities of authorizing a particular type of terminal attack.

b. There are three types of terminal attack control (Type 1, 2, and 3). Type 1 control is used when the JTAC must visually acquire the attacking aircraft and the target for each attack. Type 2 control is used when the JTAC requires control of individual attacks but assesses that either visual acquisition of the attacking aircraft or target at weapons release is not possible or when attacking aircraft are not in a position to acquire the mark / target prior to weapons release / launch. Type 3 control is used when the JTAC requires the ability to provide clearance for multiple attacks within a single engagement subject to specific attack restrictions. Type 3 control does not require the JTAC to visually acquire the aircraft or the target; however, all targeting data must be coordinated through the supported commander's battle staff.

c. As the battlefield situation changes, the supported commander and staff make continuous tactical risk assessments. Risk assessments involve the processing of available information to ascertain a level of acceptable risk during mission accomplishment. Risks include failure to create desired effects, collateral damage, and the potential for fratricide. Based on the current risk assessment, the supported commander will weigh the benefits and liabilities of authorizing particular types of munitions and proximity of employment to personnel and other avoidance areas. In most cases the recommended option is to allow aircrew to best match weapons carried against target effects desired. **Specific levels of risk should not be associated with each type of terminal attack control.**

Tactical Risk Assessment Considerations:
(1) Confidence and training of the unit, staff, and key personnel.
(2) Timeliness of information.
(3) Absence of information.
(4) Information flow and communications.
(5) Confidence in battle tracking (friendly force locations, noncombatant locations, enemy locations).
(6) Confidence in targeting information (source and accuracy, stationary or moving, ability to mark the target, level of difficulty for aircrew to acquire mark/target).
(7) Ordnance available for attack (capabilities, limitations, restrictions, proximity of friendlies / noncombatants, ability of JTAC to predict impact).
(8) Risk-estimate distance (troops in contact, danger close).

Figure 8. Risk Assessment

Table 11. Close Air Support Terminal Attack Attributes			
Type	Attributes	JTAC Observes Target and Aircraft	Timely and Accurate Target Data Provided
1	Clearance required for each attack. JTAC maintains abort authority.	Required[1]	By JTAC (Inherent to Type 1 control)
2	Clearance required for each attack. JTAC maintains abort authority.	Not Required[2]	By JTAC, Observer, or through other JTAC sensors[3]
3	Blanket clearance provided by JTAC within prescribed guidance/subject to specific attack restrictions. JTAC maintains abort authority.	Not Required[2]	By JTAC, Observer, or through other JTAC sensors[3] if targets comply with prescribed guidance[4]

Notes:
[1]JTAC will visually acquire the attacking aircraft and analyze attack geometry to reduce the risk of the attack affecting friendly forces.
[2]**Warning:** Even though the JTAC is not required to observe the aircraft and/or target during Type 2 / 3 controls, if able the JTAC should do so in order to provide an additional measure of control to abort the attack if necessary.
[3]Observer: JFO, Scout, COLT, FIST, UAS, SOF, aircrew, or assets that provide real-time targeting information.
[4]Supported commander delegates weapons release authority to the JTAC for all types of control. JTAC will provide "cleared hot" as appropriate for each attack in Type 1 and 2 controls and "cleared to engage" for Type 3 control.

Table 12. Advantages and Disadvantages of Types of Control		
Type	Advantages	Disadvantages
1	- Provides JTAC most control over fratricide concerns - Real time abort provides positive fratricide prevention - Simpler target verification process when unguided ordnance is to be employed - JTAC has control of individual attacks - JTAC maintains abort authority	- JTAC must see target and aircraft - May limit useable munitions due to typical proximity of friendlies - Restricts tactics and may limit choice of munitions due to requirement of JTAC to predict impact based on flight path
2	- Permits use of stand-off weapons and full range of aircraft sensors - Greater aircraft tactics flexibility - Allows full use of observation assets - JTAC has control of individual attacks - JTAC maintains abort authority	- More difficult target verification - More intensive communication requirements when using observers and remote sensors
3	- Least restrictive to CAS aircraft - Expedites ordnance employment on multiple targets in an engagement area - Reduced JTAC workload - Least communication load - JTAC maintains abort authority	- Most difficult to quickly ascertain target validity and confirm BDA - CAS aircraft may be required to find their own target - JTAC does not control individual attacks - Least direct JTAC control of weapons effects

2. Joint Fires Observer

a. A JFO is a certified and qualified Servicemember who can request, adjust, and control surface-to-surface fires, provide targeting information in support of Type 2 and 3 CAS terminal attack controls, and perform terminal guidance operations (TGO).

b. JTACs cannot be in a position to see every target on the battlefield. Trained JFOs, in conjunction with JTACs, assist maneuver commanders with timely planning, synchronization, and responsive execution of all joint fires and effects. JFOs increase the capability to conduct TGO missions by training with J-LASER (JP 3-09.1) TTP and communication procedures with aircrew. TGO requires the

JFO to have direct or indirect communications with the individual commanding the delivery system plus C2 connectivity with the JFO's maneuver commander, and/or appropriate weapons release authority. JFOs provide the capability to exploit opportunities that exist in the operational area to efficiently support air-delivered fires and facilitate targeting for the JTAC.

c. Terminal guidance is different than terminal attack control. TGO are those actions that provide electronic, mechanical, voice, or visual communications that provide approaching aircraft and / or weapons additional information regarding a specific target location. Enemy targets, such as mobile high-payoff targets, that are difficult to locate from the air are often more visible to ground forces. Small ground elements can sometimes search for, identify, and precisely report the location of these targets and with systems like GPS, laser designators, etc. or combinations of the above can provide target locations. These forces may also be able to provide precise BDA of attacks on targets that otherwise may be obscured or hidden. **TGO do not include authority to clear aircraft to release ordnance and should not be confused with terminal attack control.**

3. Close Air Support Execution with Non-Joint Terminal Attack Controller Personnel (Emergency Close Air Support)

a. Units that have a reasonable expectation to conduct terminal attack control need to have certified JTACs available. In rare circumstances, the ground commander might require CAS when no JTAC is available. Non-JTAC controllers must clearly state to attacking aircraft that they are **"non-JTAC qualified."** In these instances, qualified JTACs, FAC(A)s, and/or CAS aircrew should assist these personnel / units to the greatest extent possible in order to bring fires to bear.

b. Due to the complexity of CAS, the commander must consider the increased risk of fratricide when using personnel who are not qualified JTACs and accept full responsibility for the results of the attacks. The requester must notify/alert his/her command element when a JTAC or FAC(A) is unavailable to conduct Type 1, 2, or 3 controls. If the maneuver commander accepts the risk, he / she forwards the request to the CAS controlling agency. This information will alert the CAS controlling agency (ASOC/DASC) that aircrew will be working with non-JTAC-qualified personnel. In the absence of the ASOC / DASC, the joint air operations center can perform as a CAS controlling agency.

c. Ground personnel will:

(1) Identify themselves as **"non-JTAC qualified"** on aircraft check-in.
(2) Make every effort to involve a qualified JTAC / FAC(A) in the situation.
(3) Provide as much of the 9-Line briefing as possible.
(4) As a minimum, pass target elevation, target location, target description, and restrictions.

d. Aircrew in this situation will:

(1) Make every effort to involve a qualified JTAC / FAC(A) in the situation.
(2) Be prepared to **"PULL"** information to complete the critical portions of the CAS briefing.
(3) Exercise vigilance with target identification, weapons effects, and friendly location.

4. Close Air Support Execution Procedures

Format 13. Close Air Support Check-In (Aircraft Transmits to Controller)
Aircraft: **"**_____**, this is** _____**"** (Controller Call Sign) (Aircraft Call Sign) Identification / Mission Number: **"**_____**"** ***Note*:** Authentication (initiated by the net control agency) and appropriate response suggested here. The brief may be abbreviated for brevity / security (**"as fragged"** or **"with exception"**) Number and Type of Aircraft: **"**_____**"** Position and Altitude: **"**_____**"** Ordnance: **"**_____**"** (Fuzing, Laser Code) Time on Station: **"**_____**"** Abort Code: **"**_____**"** * Remarks: **"**_____**"** (NVG, data-link, helmet mounted cueing system (HMCS), FAC(A), targeting pod (TGP), VDL, TLE, etc.)
Notes: Flight lead will establish abort code. JTAC can brief abort code to follow on aircraft. Abort code may be N/A during secure communications. * Optional entry.

Format 14. Situation Update (Controller to Close Air Support Aircraft)
Situation Update # _____ (if applicable) Threat Activity (surface-to-air threats observed: who, what, when, where) Target – General Enemy Situation ("SALUTE" format – size, activity, location, uniform, time, equipment) Friendly Situation (disposition / posture, locations) Artillery Activity (GTL, Max Ord, etc.) Clearance Authority (Who has final control?) Ordnance Requested Restrictions Hazards (weather, terrain, obstructions) Remarks (JTAC capabilities, to include TLE if appropriate)
Note: The situation update is normally given when a CAS aircraft first checks in. Higher echelons (e.g., division / brigade) may assign an alphanumeric tracking number to facilitate subsequent check-ins at lower echelons. - Situation update may be passed to TAC(A) or other supporting airborne platforms (e.g., JSTARS) to speed information flow and reduce transmission on the JTAC frequency. - This briefing should be broad in scope and will not be used as a substitute for a 9-Line CAS briefing.

Format 15. Close Air Support 9-Line Briefing

Do not transmit line numbers. Units of measure are standard unless briefed. Lines 4, 6, and restrictions are mandatory readback (*). JTAC may request additional readback.

JTAC: **"**_____**, this is** _____**"**
(Aircraft Call Sign) (JTAC Call Sign)
"Type _____ **(1, 2, or 3) Control"**

1. IP/BP: **"**_____**"**
2. Heading: **"**_____**"**
(Degrees Magnetic, IP/BP-to-Target)
Offset: **"**_____**"**
(Left / Right, when required)
3. Distance: **"**_____**"**
(IP-to-target in nautical miles, BP-to-target in meters)
4*. Target Elevation: **"**_____**"**
(In feet MSL)
5. Target Description: **"**_____**"**
6*. Target Location: **"**_____**"**
(Lat/Long or grid to include map datum or offsets or visual)
7. Type Mark: **"**_____**"** Code: **"**_____**"**
(WP, Laser, IR, Beacon) (Actual Laser Code)
8. Location of Friendlies: **"**_____**"**
(From target, cardinal direction and distance in meters)
Position marked by: **"**_____**"**
9. **"Egress:** _____**"**
Remarks (as appropriate): **"**_____**"**
(**Restrictions***, Ordnance delivery, threats, final attack heading, hazards, ACAs, weather, target information, SEAD, LTL/GTL [degrees magnetic], night vision, danger close [with commander's initials])
Time on Target: **"**_____**"** or
Time to Target: **"**_____**"**
"Standby _____ **plus** _____**, ready, ready, HACK"**
(minutes) (seconds)

Note: When identifying position coordinates for joint operations, include map data. Grid coordinates must include 100,000 meter grid identification.

a. “Keyhole” Template:

(1) Keyhole Specifics: An effective and efficient method for selecting an IP is to anchor the location of that IP off of the target. When CAS aircraft are passed to a JTAC from a contact point, the JTAC should immediately pass target coordinates (precise if able) to those CAS players, and then anchor their hold point off of the target with a direction and distance. There are several techniques that can be used to do this. One technique, depicted in figure 9, is to label each of the cardinal directions with a letter: A – North, B – East, C – South, D – West, and E – Overhead Target.

(2) IP Selection: The JTAC selects the IP based on enemy threat capabilities, target orientation, friendly location, weather, aircraft capabilities, and fire support coordination requirements.

(a) If the tactical situation dictates that an IP north of the target is necessary, then holding instructions for the CAS players might sound like this:

JTAC: “Stang 11, advise when ready to copy target coordinates.”
CAS Player: “Stang 11, ready to copy.”
JTAC: “Ten-digit grid to follow. NU 87138 50874, elevation 1456.”
CAS Player: “I copy NU 87138 50874, elevation 1456.”
JTAC: “Stang 11, proceed to Alpha 8, angels 15, report established.”
CAS Player: “Stang 11, established Alpha 8, angels 15.”

(b) Sometimes a cardinal direction is not appropriate for an IP. In these situations, any radial from the target can be used for holding instructions. For example:

JTAC: “Stang 11, proceed to the 240 at 8, angels 15, report established.”
CAS A/C: “Stang 11, established 240 at 8, angels 15.”

(3) This template allows for unlimited flexibility in IP selection and precludes the need to generate IPs for an entire area of operations (AO), many of which may never be used.

(4) Use of the keyhole template is also useful in coordinating a UAS orbit with CAS aircraft by assigning separate radials and orbit points. Consideration must be given to altitudes, turn direction, and orbit locations, for both deconfliction and / or utilizing the UAS for target observation or designation.

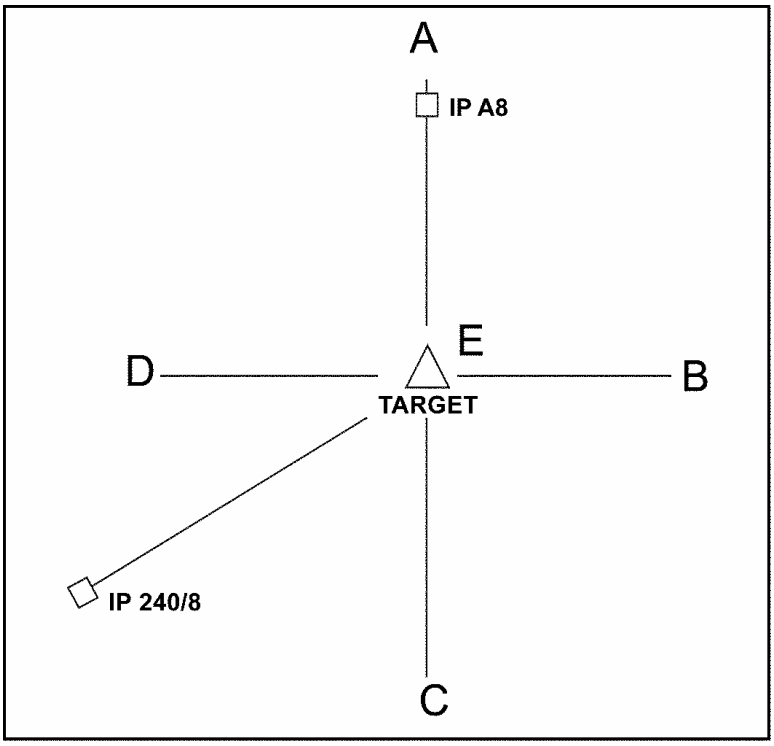


Figure 9. Keyhole Example

(5) Generating a 9-Line brief when using the keyhole template is quite simple, and several of the lines in a traditional 9-Line brief are already known. For example:

1. A8
2. 180° left
3. 8.0
4. 1465
5. Three T-72 tanks
6. NU 87138 50874
7. None
8. Northwest 2500
9. Egress east to B8, and then back to A8.

Remarks: Final attack cone 180 to 220, stay above 2000 AGL.

Format 16. AC-130 Call for Fire
1. Warning Order: **"_____, this is _____, Fire Mission, Over"** (AC-130 Call Sign) (Observer Call Sign) 2. Friendly Location / Mark: **"My position _____, marked by _____"** (TRP, Grid, etc.) (Strobe, Beacon, etc.) 3. Target Location: **"_____"** (Magnetic bearing and range in meters, TRP, grid, etc.) 4. Target Description / Mark: **"_____ marked by _____"** (Target Description) (LTM, Tracer, etc.) 5. Remarks: **"_____, Over"** (Threats, Danger Close, Restrictions, At My Command, etc.) As Required 1. Clearance: Transmission of the fire mission is clearance to fire (unless danger close). For AC-130, danger close is 165m for the 105mm, 75m for the 40mm, 100m for the 30mm, and 65m for the 25mm. For closer fire, the observer must accept responsibility for increased risk. State **"Cleared Danger Close"** (with commander's initials) on Line 5. This clearance may be preplanned. 2. At My Command – For positive control of a gunship, state **"At My Command"** on Line 5. The gunship will call **"Ready to Fire"** when ready.
Adjusting AC-130 Gunship Fire
1. If significant miss distance or wrong target, adjust round impact by giving cardinal direction (north, south, east, west) and range (meters) from impact to desired target. **"Northeast 200, Over."** 2. Marking / confirming targets can also be accomplished using covert illumination (Burn) or with the laser marker (Sparkle). 3. To move Burn or Sparkle, say **"Move Burn / Sparkle 300m west"** or **"Roll Burn / Sparkle 100m east."** 4. Once Burn / Sparkle is over target, say **"Freeze Burn / Sparkle."** (If you say **"Stop Burn / Sparkle"** the gunship will turn it off.)
Notes: 1. Do not ask the gunship to identify colors. 2. Do not reference clock positions. 3. Do not pass run-in headings / no-fire headings (give no-fire areas and friendly troop positions only). 4. Do not correct left / right or short / long. 5. If applicable, pass multiple target locations in precedence ASAP in order to allow AC-130 to engage as rapidly as possible to preclude enemy scatter effect.

b. Fixed-wing / AC-130 Integration. The following TTP allow continuous support to ground forces while integrating the firepower of the AC-130 and various CAS aircraft. They are predicated on four conditions:

(1) Firepower should be massed and constant. AC-130s and CAS aircraft attack in unison. Any breaks in weapons deliveries should be limited to IR conflicts and/or flight path conflicts.

(2) The AC-130 flies a continuous (approximately 3 minute) orbit around the target, or approximately 40-45 seconds per sector.

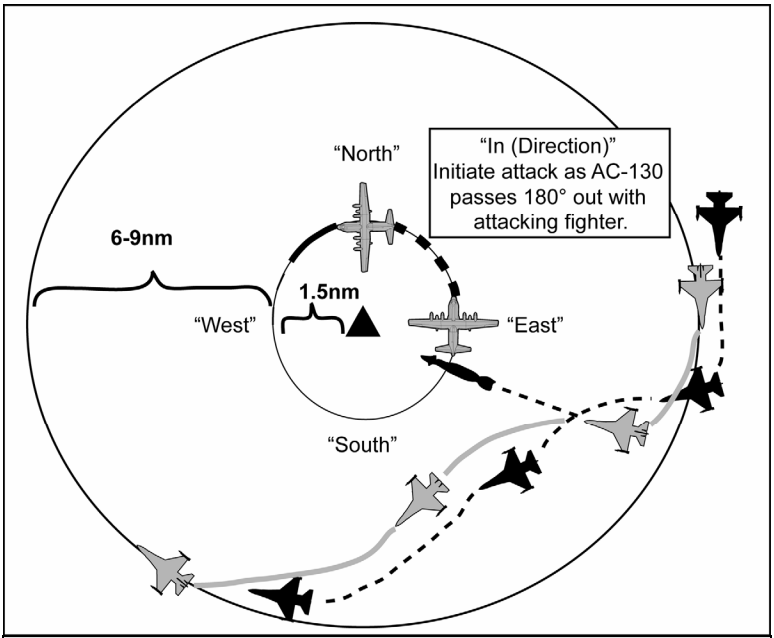
(3) The AC-130 must never be in the flight path of a CAS aircraft or its weapons during time of fall.

(4) The CAS aircraft must never be in the flight path of the AC-130 or its gun-target line.

Table 13. AC-130 Integration Attributes

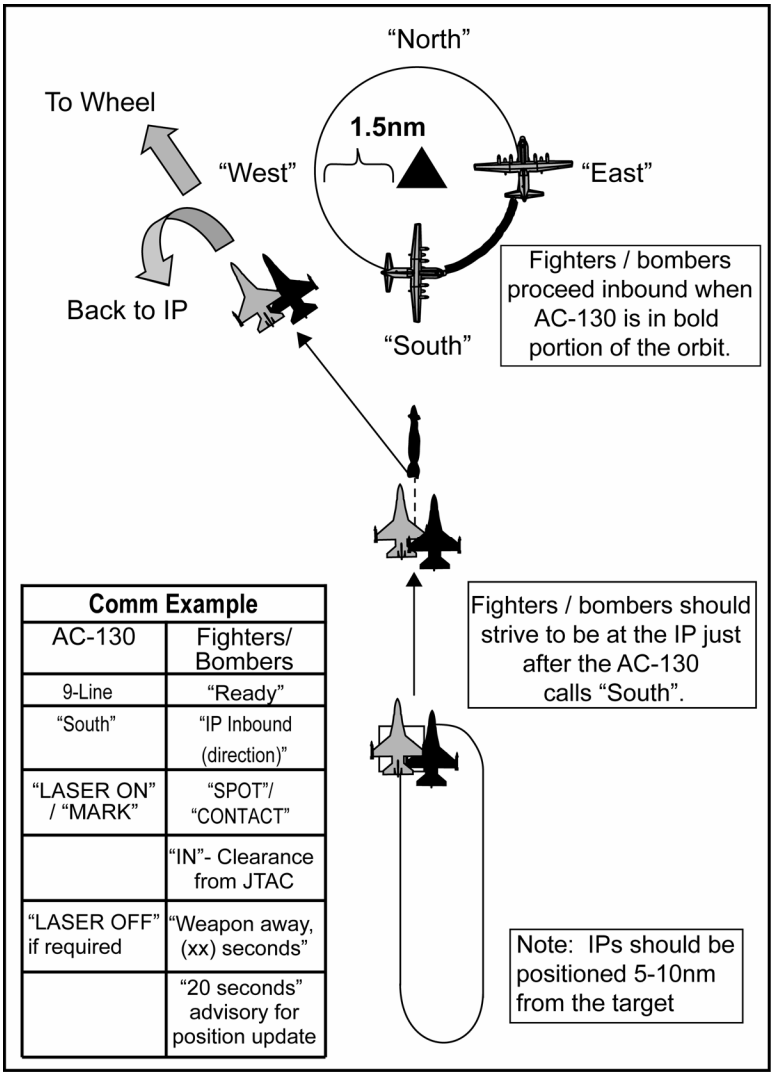
Tactic	Deconfliction	Advantages	Disadvantages
Wheel	Visual	Easiest to execute Less airspace required Allows constant fires from CAS aircraft and AC-130 Keeps CAS aircraft and gunship target area situational awareness high	CAS aircraft must remain visual Fighter only due to small turn radius required Requires NVG and use of covert lighting on AC-130
IP-Target Run-in	Procedural	Familiarity with standard IP-to-target attack Effective for non-TGP equipped fighters or bombers	Higher workload, communications intensive Less frequent attacks
Opposite Sector	Procedural	Works well for non-NVG, TGP-equipped fighters Allows for operations with gunship below a cloud deck and fighters above Can incorporate more than one set of CAS aircraft	Higher workload, communications intensive Fighter only due to small turn radius required Less frequent attacks

Note: Marking, laser, and standard CAS brevity terms will be used as required.



Wheel Communication Example		
AC-130	**CAS Aircraft**	**Explanation**
9-Line	"Ready"	"Ready" signifies execution start
"South" (or East, North, West)		
"10 seconds to mark"	"Contact / Tally"	Assurance that CAS aircraft see the correct target
	"Visual"	Required call prior to roll in.
	"In Hot / Dry (Direction)"	Fighter is rolling in to attack. (JTAC provides final clearance authority.)
	"Weapon away, (XX) seconds"	XX seconds until weapon impact. AC-130 cease firing on the same target
	"Off Hot / Dry"	CAS aircraft is repositioning to the wheel post attack
Note: Call **"ALTITUDE"** only if passing through AC-130 altitude. Expect AC-130 to call **"COLD."** Requires attacker to call **"CLEAR"** once deconfliction is assured.		

Figure 10. AC-130 Integration in the Wheel



Comm Example	
AC-130	Fighters/ Bombers
9-Line	"Ready"
"South"	"IP Inbound (direction)"
"LASER ON" / "MARK"	"SPOT"/ "CONTACT"
	"IN"- Clearance from JTAC
"LASER OFF" if required	"Weapon away, (xx) seconds"
	"20 seconds" advisory for position update

Figure 11. AC-130 Integration with IP-to-target Run-in

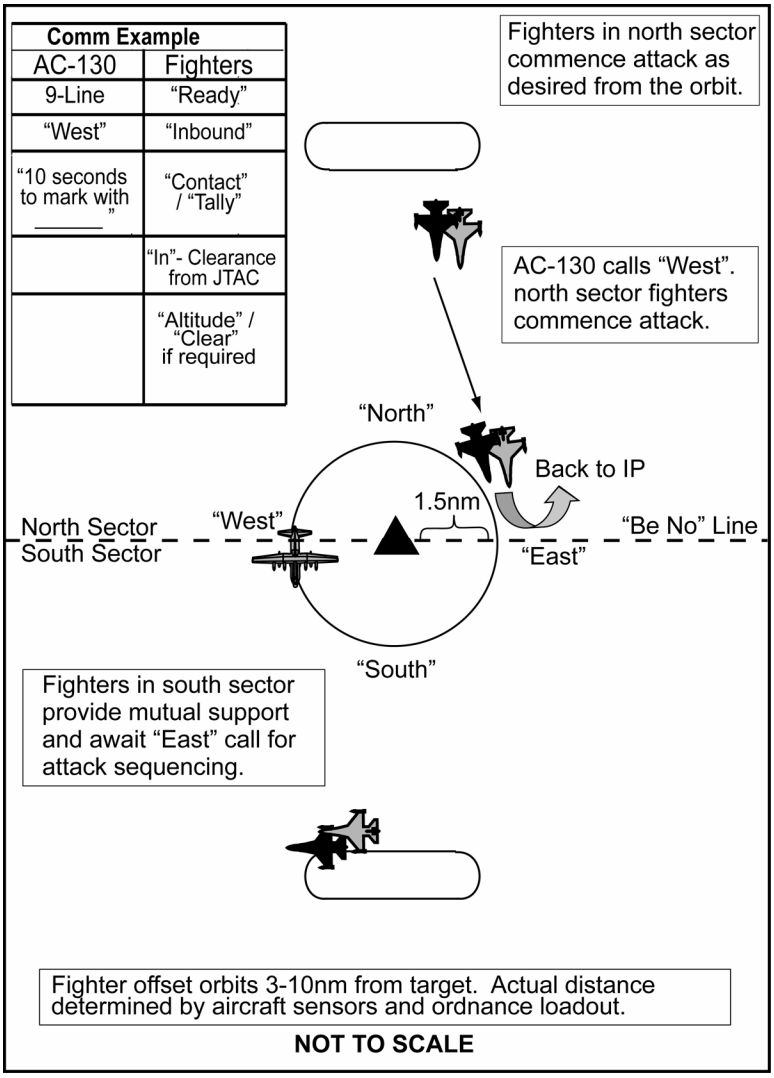


Figure 12. AC-130 Opposite Sector Attack

Warning: The words "CLEARED" or "ENGAGE" will only be used when ordnance is actually to be delivered. Use standard radio calls to the maximum extent possible. This will reduce the chance of dropping ordnance on dry passes and reduce the risk of fratricide.

Abort Call Illustration	
The JTAC call sign is "NAIL 11", the CAS flight is "SPIKE 41." SPIKE 41 flight has chosen abort code "BR" (authenticated "D").	
Radio Call	**Action Taken**
(During the CAS check-in briefing): "Nail 11, this is Spike 41, abort code Bravo Romeo."	Nail 11 notes the correct reply for "BR" is "D"
(The JTAC calls for an abort): "Spike 41, Nail 11, Abort Delta, Abort Delta, Abort Delta"	Spike 41 aborts the pass.
Note: Some NATO countries use "STOP" rather than "ABORT." Controllers must verify procedures in use.	

Figure 13. Abort Call Illustration

5. Joint Terminal Attack Controller Brevity Codes

a. ABORT – Directive call to cease action/attack/event/mission. Abort the pass. Do not release ordnance. Abort code should be included with the ABORT transmission.
b. CLEARED HOT – Ordnance release is authorized in Type 1 or 2 terminal attack controls.
c. CLEARED TO ENGAGE – JTAC Type 3 control clearance. Attack aircraft flight leaders may initiate attacks within the parameters imposed by the JTAC. Attack platforms will provide a "Commencing Engagement" call prior to engaging targets and an "Engagement Complete" call to JTAC, indicating completion of ordnance release.
d. CONTINUE – Continue present maneuver. Does not imply a change in clearance to engage or expend ordnance. Used to acknowledge aircraft without providing clearance to release ordnance.
e. CONTINUE DRY – Continue present maneuver, ordnance release not authorized. Used to provide approval to aircraft to continue the pass without expending ordnance during Type 1, 2, or 3* controls. (*JTAC must use **"Type 3, Continue Dry"** for dry Type 3 controls.)

6. Electronic Attack / Call for Electronic Fires

a. Electronic attack (EA) involves the use of electromagnetic (EM) energy, directed energy, or antiradiation weapons to attack personnel, facilities, or equipment with the intent of degrading, neutralizing, or destroying enemy combat capability and is considered a form of fires. EA can be targeted against very specific portions of the radio frequency (RF) spectrum to obtain the needed effects. For more detailed information on EA, see appendix H

(classified SECRET) on the ALSA classified website, http://www.acc.af.smil.mil/alsa/jfire.

(1) Virtually any EM sensor utilizing the RF spectrum is potentially vulnerable to electronic attack. With the proper electronic support, particularly signals intelligence, an appropriate EA system can be programmed to influence the enemy's use of the electromagnetic spectrum at a time and place of our choosing.

(2) Since both friendly and enemy forces and infrastructure utilize the RF spectrum for communications, navigation, sensing, information storage, and processing, proper coordination measures are necessary to effect enemy systems of interest without interference with friendly systems. Without proper RF deconfliction, friendly ground jammers would interfere with JTAC communications. For further info on RF targets and information on deconflicting EA with friendly communications, see appendix H as referenced above.

(3) EA is the primary joint nonlethal fire support means.

b. EA terms and definitions:

(1) Jamming Control Authority (JCA): The JCA, appointed by the joint force commander, conducts on-station, real-time coordination and deconfliction of jamming efforts. The JCA monitors the electromagnetic spectrum, assesses effects on friendly and enemy forces, and maintains contact with EA assets to provide direction and coordination of EA efforts. Jamming will not normally be conducted without approval of the JCA. JCA can be, and usually is, delegated well down the chain of command. JCAs will be designated in the SPINS.

(2) Joint Restricted Frequency List (JRFL): The JRFL is a time and geographically-oriented listing of "Taboo", "Protected", and "Guarded" functions, nets, and frequencies designed to minimize frequency conflicts between friendly emitters and friendly jamming equipment. It consists of a listing of prioritized frequencies essential to the conduct of the battle and restricted from targeting by friendly forces. Requests for deviation from JRFL requirements may be granted depending on the situation.

(a) TABOO: Frequencies of international safety and distress systems that cannot be jammed.

(b) PROTECTED: High priority friendly frequencies of systems that should not be jammed. This is not a list of all friendly C2.

(c) GUARDED: High priority enemy frequencies that are being used for collection by intelligence assets. Intelligence gain/loss determinations need to be done on these frequencies prior to jamming.

(d) CEASE BUZZER: "Cease Buzzer" is the cessation of jamming certain radio frequencies.

(e) CEASE MUSIC: "Cease Music" is the cessation of all jamming activities.

c. Commercial Off the Shelf (COTS) emitters targeted by EA:

Table 14. Commercial Off the Shelf Emitters Targeted by Electronic Attack	
System	Frequency (MHz)
HF Automatic Link Engagement Voice	1.5 – 30
Low Very High Frequency Voice	30 – 88
Low Very High Frequency Frequency Hoppers	30 – 88 / 225 – 400
VHF / UHF Voice	88 – 300 / 300 – 520
Air / Ground Controlled Intercept	100 – 500
Long Range Cordless Phone	240 – 270 / 370 – 400
Frequency Modulation Repeaters	100 – 300 / 300 – 500
Trunked Mobile Radio	100 – 520
Radio Broadcast	88 – 108
Television Broadcast	64 – 450
GSM 900 (Cellular)	890 – 960
Digital Cellular System 1800	1710 – 1880
Troposcatter	475 – 625 / 4400 – 5000
LOS Radio Relay	138 – 7500
Thuraya (Mobile Satellite phone)	1525 – 1560
INMARSAT (Mobile Satellite phone)	1525 – 1560
IRIDIUM (Mobile Satellite phone)	1616 – 1626.5
VSAT (Remote Telephone and Internet)	3000 – 4000 / 11000
GLOBALSTAR (Mobile Satellite phone)	2483.5 – 2500

d. Electronic fires support falls within three operational timelines:
1) preplanned, 2) preplanned on-call, and 3) immediate.

e. Requesting airborne EA support for ground operations is similar to requesting CAS. Request EA effects via normal request process (JTAR / ASR – DD Form 1972) and provide the information below either in the remarks section (Section 8) of JTAR or via theater specific EA Request Format (EARF). The EARF (figure 14) needs to be completed and forwarded through component chain of command to complement JTAR.

Table 15. Joint Tactical Air Strike Request Remarks Information (Section 8)		
1	Target Location	
2	Prioritized Target Description and Jam Freqs	
3	TOT (window)	
4	JTAC / JCA Call Sign and Freq	
5	Friendly Force Disposition (i.e., troop movement route)	
6	Friendly Frequency Restrictions	
7	Remarks	

(1) Target Location: Coordinates (point or area) where effect is requested; type of terrain (mountainous, urban, etc.).
(2) Target Description: RF system or device to be affected; frequency and coverage desired (if known) listed in order of priority.
(3) TOT: Desired beginning time of effects (Zulu) and duration needed.
(4) JTAC / JCA Call Sign and Frequency: Primary communication frequencies and back-up communication plan.
(5) Friendly Force Disposition: Friendly force locations and maneuver route.
(6) Friendly Frequency Restrictions: Prioritized "no-jam" friendly frequencies (communications and UAS / weapons systems data-links).
(7) Remarks: Amplyfing information as required.

Electronic Attack Request Format	
Requesting Major Supported Command:	
Requesting Unit:	
Contact Information: This person will be responsible to verify that the EARF has been approved before the mission starts and to relay the information to the executing unit.	
JTAR Number: Enter the corresponding JTAR number that will be submitted with this EARF.	
Concept of Operation: Describe the concept of operations. This will include objective, forces used, timeline of mission, and coordination efforts required for mission success. Relate the impact of mission success to specific objectives for the integrated tasking order.	
EA Concept of Operations: Describe the role EA will play, timelines for EA effects, and the objective for EA effects.	
Cease Buzzer (Jamming) Procedures: This should be directly as stated in SPINS. If other procedures are to be used, details establishing JCA must be specific and a way for JCA and the EA asset to communicate must be specified. Ground-to-ground procedures for request must be established as well. Any asset can request a cease-buzzer, but only the JCA can direct EA systems to turn off jamming.	
Friendly Frequency Evaluation:	
Target Communication Systems/Frequencies to be Jammed/Denied:	Details of Systems:
Target Location:	
Jamming date-time group(s): From – To, in Zulu	
Type of EA Requested: Preplanned – Scheduled / On-Call	
This form is SECRET when filled in.	

Figure 14. Electronic Attack Request Format

7. Tactical Show of Force

a. A tactical show of force is an operation designed to demonstrate friendly forces resolve that involves increased visibility of CAS aircraft in an attempt to

defuse a specific situation that, if allowed to continue, may be detrimental to friendly forces interests or objectives.
b. Plan shows of force in the same manner as a low altitude CAS mission. Clearance into the designated show of force area is "Continue." Low altitude release of flares and supersonic speeds may require approval from higher command authority.

8. North Atlantic Treaty Organization Procedures

Table 16. North Atlantic Treaty Organization Standard Rear Briefing
Rear Briefing. Briefing information passed by a rear briefing agency should normally be divided into what is mandatory and what may also be required by the tactical situation. The briefing should comprise the following items in the order shown:
1. Mandatory Items: a. Target location in grid or lat/long with target elevation in feet above mean sea level (mandatory readback and recording of actions). b. Target description (may include advisory or mandatory attack headings). c. "No friendlies within" distance or nearest friendly location (mandatory readback and record action).
2. Additional Items: a. Target Area Threats b. Navigation Hazards c. Hazards d. Other items

Sample North Atlantic Treaty Organization Close Air Support Worksheet (Check-in Information)			
Call Sign			
Mission #			
Authentication			
Aircraft Number and Type			
Ordnance			
Position			
Playtime			
Abort Code			
	LST / Datum / NVG	LST / Datum / NVG	LST / Datum / NVG

Figure 15. Sample North Atlantic Treaty Organization Close Air Support Worksheet

Format 17. North Atlantic Treaty Organization Close Air Support Check-in Briefing
Permissive Environment
Aircraft: **"**_____**, this is** _____**"** (Controller Call Sign) (Aircraft Call Sign) Identification / Mission Number: **"**_____**"** Authentication: **"Authenticate** _____**"** (JTAC should authenticate before continuing with the brief.) Number and Type of Aircraft: **"**_____**"** Ordnance: **"**_____**"** Position: **"**_____**"** Time on Station: **"**_____**"** Rear Briefing Identifier: **"**_____**"** Abort Code: **"**_____**"**
Nonpermissive Environment
Aircraft: **"**_____**, this is** _____**"** (Controller Call Sign) (Aircraft Call Sign) Identification / Mission Number: **"**_____**"** Authentication: **"Authenticate** _____**"** JTAC should authenticate before continuing with the brief. **"As fragged with briefing** _____**"** (Rear Briefing Identifier)

Format 18. North Atlantic Treaty Organization
15-Line Controller to Attack Aircraft Briefing

Mission Call Sign _____ Abort Code _____
- Items A through J are mandatory, K through O are optional.
- Items **A, D, G,** and **H (Bold)** are mandatory readback (*) even if "None."
- Headings and bearings are Magnetic unless True is requested.

A*. IP "_____"
B. Bearing "_____"
C. Distance "_____"
D*. Target Location "_____"
(Grid or Lat/Long)
E. Target Elevation "_____"
F. Target Description "_____"
G*. Attack Heading "_____"
H*. Friendly Forces "_____"
I. Attack Time (TOT / TTT) "_____"
J. Attack Clearance JTAC Call Sign "_____" TAD "_____"
K. Target Indications:
1. Reference Point
2. Smoke
3. Light / Mirror
4. Laser Code / Laser to Target Line (in degrees)
5. Beacon:
Frequency
Bearing (in degrees)
Distance (in meters)
Elevation (in feet MSL)

L. Threats "_____"
M. Weather (if significant) "_____"
N. Hazards "_____"
O. Egress "_____"

9. Other Briefing Formats

a. Casualty Evacuation (CASEVAC) Procedures. This portion of JFIRE is not intended to provide in-depth detail on the CASEVAC briefing, but to provide familiarity to aircrew if required to relay information or to assist in some manner.

Format 19. Casualty Evacuation Briefing		
Line	**Item**	**Explanation**
1	Location of Pickup	Encrypt the grid coordinates
2	Radio freq, Call sign, and Suffix (if used)	Call sign and suffix may be transmitted in the clear
3	# of Patients by Precedence	A – Urgent B – Surgery C – Priority D – Routine E – Convenience
4	Special Equipment Required	A – None B – Hoist C – Extraction equipment D – Ventilator
5	# of Patients by Type	L + # of patients (Litter) A + # of patients (Ambulatory)
6	Security of Pickup Site	N – No enemy in area P – Possible enemy in area, use caution E – Enemy in area, approach with caution X – Enemy in area, armed escort required
7	Method of Marking Pickup Site	A – Panels B – Pyrotechnic signal C – Smoke signal D – None E – Other
8	Patient Nationality and Status	A – US military B – US citizen C – Non-US military D – Non-US citizen E – Enemy prisoner of war
9	CBRN Contamination	C – Chemical B – Biological R – Radiological N – Nuclear

b. Airdrop Procedures

Format 20. Airdrop Briefing (Aerial Resupply)
Do not transmit line numbers. Units of measure are standard unless briefed. Lines **3** (C-17 only), **4, 5,** and **7** (restrictions only) are mandatory readback **(*)**. JTAC may request additional readback. JTAC: **"**_____**, this is** _____ **for airdrop control."** (Aircraft Call Sign) (JTAC Call Sign) 1. Drop Zone (DZ) Visual Description: **"**_____**"** (Open north/south field, Road 'T', etc.) 2. Location of Friendlies: **"**_____**"** (from DZ, cardinal direction and distance in meters) Position marked by: **"**_____**"** 3.* **IP /** Heading **/ Distance: "**_____**"** (*Degrees magnetic, IP-to-DZ, when required) Offset: **"**_____**"** (Left / Right, when required) 4.* **Point of Impact Location: "**_____**"** (Lat/Long, grid to include map datum [e.g., WGS-84]) 5.* **Point of Impact Elevation: "**_____**"** (in feet above MSL) 6. Point of Impact Marking: **"**_____**"** (Code letter, mirror, IR strobe, IR chemstick, etc.) 7.* **Restrictions: "**_____**"** Remarks in Restrictions as appropriate. [Applicable ground threats to aircraft / suppression coordinated / hazards (terrain, towers) / surface winds / estimated ceiling and visibility / GTL / final attack heading / additional friendly aircraft in the area / # of container delivery system (CDS) bundles / type CDS bundles / egress direction (if different than assigned ingress heading).] Time on Target (TOT): **"**_____**"** or Time to Target (TTT): **"**_____**"**
Note: When identifying position coordinates for joint ops, include map data. Grid coordinates must include 100,000 meter grid identification.

(1) Notes on Airdrop Format:
   (a) Strictly intended for time-sensitive preplanned airdrop (aerial resupply) operations only.
   (b) C-130: Line 3 is optional, brief according to situation.
   (c) C-17: If rectangular DZ, heading is required in Line 3. Optional for circular DZ.
   (d) DZ – area for expected aerial resupply.
   (e) Point of Impact – requested specific aerial resupply point of impact.
   (f) If required, direct aircraft to call 1 min and/or 30 seconds to release. Release authority is the ground controller or briefed ground signal. Utilize "CLEARED TO DROP" via radio.
   (g) No abort code; utilize "NO DROP" via primary radio for airdrop cancellation.
   (h) Absolute minimum information required to conduct airdrop (aerial resupply): Lines 3 (C-17 only), 4, 5, and 7 (restrictions only).
(2) Planning Considerations:
   (a) Threat permitting, hold airlift aircraft at low-medium altitude outside of the objective area. Response time dependent on hold point location, but expect 20 minutes.
   (b) Point of impact should be 200 yards from nearest friendlies.
   (c) Refer to AFI 13-217, *Drop Zone and Landing Zone Operations,* for DZ size. Expected impact area for C-130 low altitude delivery of 16 x CDS is 100 yards wide by 200 yards long.
   (d) If able, minimize the effect of terrain on ingress/egress routing due to airlift aircraft performance limitations.
   (e) This airdrop briefing format can be used for high altitude and/or Joint Precision Aerial Delivery System.

c. Reconnaissance / Surveillance Procedures

Format 21. Reconnaissance / Surveillance Briefing
Do not transmit line numbers. There are no mandatory readback items. However, JTAC may request readback of certain items. JTAC: **"**_____ (Aircraft Call Sign)**, this is** _____ (JTAC Call Sign)**, call when ready for reconnaissance/surveillance briefing."** Aircrew: **"Ready to copy"** 1. Reference Point: **"**_____ (IP, Anchor Point, Start Point, etc.)**"** 2. Description: **"**_____ (What to look for? What is the Gnd commander objective?)**"** 3. Location and Elevation: **"**_____ (Point-to-point, route recce, area search, NAI coordinates/elevation)**"** 4. Friendlies in area: YES / NO **"**_____ (Amplifying Data)**"** 5. Airspace Control Measures: **"**_____ (ACA, Arty, Sector/Altitude Restrictions, etc.)**"** 6. Remarks (as appropriate): "_____" - Hazards to Aviation - Weather - ROVER Frequency - Time to Accomplish - Reporting Instructions
Note: When identifying position coordinates for joint ops, include map data. Grid coordinates must include 100,000 meter grid identification.

(1) Notes on Reconnaissance / Surveillance Briefing Format:

(a) JTACs will use this briefing to pass information rapidly to aircrew for use with fixed- and rotary-wing aircraft which are given immediate reconnaissance/surveillance taskings. It is used for all threat conditions and does not dictate the tasked aircrew's tactics.

(b) The brief must be accurate, concise, and executed quickly. Map datum must be considered when determining reference and search point / area coordinates. The mission brief could change during the mission. Only line items which change must be passed by the JTAC to the aircrew. Others may be stated "as briefed."

(c) This briefing does not provide clearance to employ ordnance. It is NOT to be used to brief aircrew for the purpose of conducting an attack. The CAS 9-Line (Format 15) is to be used to prepare aircrew for a CAS attack.

(2) Planning Considerations:

(a) Reference Point – This reference point could be a nearby IP, a road intersection, a set of coordinates, or any point designated for use during the mission. This point could then be used as a talk-on reference and / or as an IP for follow-on 9-Line CAS briefings to execute an attack if necessary. See JP 3-09.3, *Joint Tactics, Techniques, and Procedures for Close Air Support,* for proper procedures to establish procedural control measures.

(b) Description – What does the JTAC want the aircrew to look for? Improvised explosive device (IED) search, armed enemy forces, weapons, vehicles, buildings, movement / stationary, etc. JTACs can greatly aid in the aircrew's reconnaissance / surveillance work if they convey the ground commander's intent for the actions on the ground being supported. (Route recce, area search, cordon-and-search, or raid support, etc.)

(c) Location and Elevation – One or more point NAIs (include coordinates in WGS-84 with map datum). The elevation for any coordinates should be included in height above ellipsoid (HAE) or feet above MSL using Earth Gravitational Model 1984 (EGM-84) to provide the most accurate placement of aircraft sensors. Coordinates and elevations should be converted from their native datum into WGS-84 and HAE/EGM-84 respectively using geographic translators (GEOTRANS) available from the National Geospatial-Intelligence Agency at http://earth-info.nga.mil/GandG/geotrans/index.html.

(d) Friendlies in Search Area – YES or NO. If YES, include location/number of friendlies in the search area, number/type of vehicles, movement plan, etc. Providing information of friendly forces in the area will aid aircrew during their search for suspicious/enemy forces, and hopefully reduce false positive reports.

(e) Airspace Control Measures – JTACs will inform aircrew of ACMs (ACA, ROZ, high-intensity airspace control zone (HIDACZ), etc.), artillery activity, sector/altitude deconfliction from other aircraft in the area, etc. in effect in the search area. Although all preplanned ACMs should be posted in the ACO and available to aircrew, tasked aircrew may be responding to an immediate request in an area they had not pre-mission planned to be operating in.

(f) Remarks – Include any other pertinent information as remarks after providing each line of the briefing. For example:

1. Hazards to Aviation – Pass any hazards to aviation in the area (significant terrain features, large towers, power lines, etc.) which may affect safety of flight.
2. Weather – Provide aircrew with winds, cloud ceiling, and visibility as accurately as possible. Let aircrew know if weather information is system generated or personnel's best estimate.
3. ROVER Frequency – The JTAC will provide the ROVER frequency in use in that area. If the JTAC does not have one, request ROVER frequency being used by the aircrew. Aircrew will notify the JTAC if unable to use stated frequency, and what options are available.

4. Time to Accomplish – The JTAC will provide aircrew with desired search timing (duration or end of search time in Zulu) if applicable. Aircrew should check back in with the JTAC at expiration of any timing, regardless of search tasking status.
5. Reporting Instructions – The standard is for the aircrew to report back to the JTAC (or other controlling agency) who provided the reconnaissance / surveillance briefing on the same TAD / frequency. If something different is desired, the JTAC will provide the aircrew with the desired reporting call sign and TAD / frequency. Aircrew should use the size, activity, location, type (SALT) format for reporting anything they find.

10. Forms Prescribed/Adopted

All forms in this publication are adopted. For form designations and titles, see table of contents under the figures (figure 2: Sample DD Form 1972).

Table 17. Fixed – Wing Capabilities and Communication Equipment

Aircraft	Ordnance	Marking Capability	Beacon	Other Systems	Freq Band	Freq Hopping	Secure Capable
AV-8B Harrier II	LGB, AGM-65E, GP bombs, CBU, JDAM, 2.75" rockets, 5" Zuni	Rockets, 25mm, LTM, LUU-2/19 flares	None	CCD TV, NVG, GPS, FLIR, Litening Pod, SAR[1]	UHF VHF–AM/FM	HQ II SINCGARS	KY-58
A-10 A/C	LGB, AGM-65, GP bombs, CBU, JDAM[2], 2.75" rockets, 30mm cannon	Illum / WP Rockets, LTD, LTM , 30mm, LUU-½/5/6/19 flares	None	NVG, GPS, Litening Pod	UHF VHF–AM/FM	HQ II	KY-58
AC-130H	105mm howitzer (136 rds), 40mm cannon (512 rds)	105mm, 40mm, IZLID, ATI	PPN-19 SST-181 SMP-1000/2000	FLIR, GPS, PLS, LLLTV, Beacon tracking rdr	UHFx2 SATCOM HF VHF-AM/FMx3	HQ II No No SINCGARS	KY-58/100 KY-58/100 KYV-5 KY-58
AC-130U	105mm howitzer (100 rds), either 2x30mm (1004 rds) or 1x40mm (256 rds), 1x25mm cannon (3000 rds)	105mm, 40mm, 25mm, LIA	PPN-19 SST-181 SMP-1000/2000	FLIR, GPS, ALLTV, SAR[1]	UHFx2 SATCOM HF VHF-AM/FMx3	HQ II No No SINCGARS	KY-58/100 KY-58/100 KYV-5 KY-58

Table 17. Fixed – Wing Capabilities and Communication Equipment

Aircraft	Ordnance	Marking Capability	Beacon	Other Systems	Freq Band	Freq Hopping	Secure Capable
B-1B	JDAM, GP bombs, CBU/WCMD	None	PPN-19 SMP-1000	SAR[1], GPS, NVG	UHF or SATCOM VHF/UHF HF	HQ II SINCGARS	KY-58 KY-100
B-2	JDAM, JSOW, GP bombs, CBU	None	X Band KU Band	SAR[1], GPS	VHF/UHF HF SATCOM	HQ II No	KY-58 KY-100
B-52	JDAM, GP bombs, CBU/WCMD, LGB	None	PPN-19, PPN-20, SMP-1000	FLIR, LLLTV, Radar, NVG, GPS	VHF/UHF HF SATCOM	HQ II	KY-58/100 KYV-5
F-15E	JDAM, LGB, CBU/ WCMD, EGBU-28, GP bombs, AGM-130/65, GBU-15/24, JSOW, 20mm	LTD, LTM	None	NVG, FLIR, GPS, SAR [1], Link-16, Sniper, Litening, Lantirn	UHF UHF/VHF/FM	HQ II HQ II	KY-58 KY-58
F-16	JDAM, LGB, GP bombs, CBU/ WCMD, HARM[5], AGM-65, JASSM, 2.75” rockets, 20mm cannon	LTM, LTD, Rockets	None	GPS, SADL[3] IDM/IDT[4,5], NVG, Link-16[5,6], Sniper/Litening, HTS[5], HMCS[5,6]	UHF VHF-AM/FM	HQ II No	KY-58 KY-58

Table 17. Fixed – Wing Capabilities and Communication Equipment							
Aircraft	Ordnance	Marking Capability	Beacon	Other Systems	Freq Band	Freq Hopping	Secure Capable
F-18 A/C/D/E/F	JDAM, JSOW, HARM, AGM-65E/F, CBU, GP bombs, SLAM (+ER), LGB, 2.75" rockets, 5 " Zuni, 20mm cannon	LTM, LTD, Rockets, LUU-2/19 flares	None	GPS, SAR[1] Link-16, NVG, Litening AT, ATFLIR, NIGHTHAWK	UHF VHF-AM/FM	HQ II SINCGARS	KY-58
F-22A	JDAM	None	None	GPS, NVG, Link-16	UHF VHF-AM	HQ II	KY-58 KY-58
P-3	SLAM-ER, Various	None	None	SAR[1]	VHF/UHF HF SATCOM	HQ II	KY-58 Link 11
MQ-1B Predator	AGM-114[7] (K, M, N, P)	LTD, LTM	None	FLIR, GPS, EO	UHF VHF-AM/FM SATCOM ROVER	No	KY-100
MQ-9 Reaper	AGM-114[7] (K, M, N, P), GBU-12	LTD, LTM	None	FLIR, GPS, EO	UHF VHF-AM/FM SATCOM ROVER	No	KY100
Pioneer		None	None	FLIR, EO			
RQ-7 Shadow		LTD		FLIR, EO			
RQ-11 Raven		LTM[8]		FLIR, EO			

Table 17. Fixed – Wing Capabilities and Communication Equipment

Aircraft	Ordnance	Marking Capability	Beacon	Other Systems	Freq Band	Freq Hopping	Secure Capable
Tornado GR 4 (UK)	EPW (II & III), PW II & III, PW IV (IOC 2009), Mk-83, CBU, ALARM, Stormshadow, Brimstone, 27 mm cannon	LTD, LTM	None	FLIR, LST, NVG, Gnd mapping radar with TFR	UHF VHF-AM	HQ (I&II)	Yes
Harrier GR 7/9 (UK)	EPW II, PW II/III/IV, GP 1000-lb and 540-lb, CBU, Brimstone (IOC 2008), CRV7, AGM-65	LTD, LTM	None	FLIR, LST, NVG, Gyro Binoculars, TIALD, Sniper	UHF VHF-AM Tac VHF	HQ (I&II)	Yes

Notes: [1]Synthetic aperture radar with ground mapping modes. [2] A-10C only. [3] Block-25/30/32. [4] Block 40/42. [5] Block 50/52. [6] Some Block 40/42. [7] Predator equipped with Hellfire has no SAR capability. [8]Raven B only.

ALLTV – all light level television, ATFLIR – advanced targeting FLIR, CCD – charge-coupled device, EO – electro-optical, FLIR – forward-looking infrared, GPS – global positioning system, HMCS – helmet mounted cueing system, HTS – HARM targeting system, IDM – improved data modem, IDT – interflight data transfer (also known as interflight datalink), IZLID – infrared zoom laser illuminator designator, LIA – laser illuminator assembly, LLLTV – low-light level television, LST – laser spot tracker, LTD – laser target designator :1.06 micron PRF [pulse repetition frequency] coded for weapons guidance, LTM – laser target marker :530nm “green beam” or 860nm for visual or NVG and targeting pods (commonly referred to as an IR pointer or IR marker), NVG – night vision goggles, PLS – personal locator system, SADL – situational awareness data link, SAR – synthetic aperture radar, TFR – terrain following radar, TIALD – thermal imaging airborne laser designator, TV – television, WP – white phosphorous

Table 18. Rotary – Wing Capabilities and Communication Equipment

Aircraft	Service	Ordnance	Marking Capability	Other Systems	Freq Band	Freq Hopping	Secure Capable
UH-1N/Y	USMC	7.62 MG, .50 cal MG, 2.75" rockets	WP Rockets, LTM, LTD	NVG, GPS, BRITE STAR, STAR SAFIRE	UHF VHF-AM/FM	HQ II SINCGARS	KY-58
AH-1F[1]	Foreign	TOW, 2.75" rockets, 20mm cannon	Rockets	NVG	UHF VHF-AM/FM		
AH-1W/Z	USMC	TOW, Hellfire B/K/N/M, 2.75"/5" rockets, 20mm cannon	Rockets, LTM, LTD[2]	NVG, GPS, NTS (W only), TSS (Z only)	UHF VHF-AM/FM	HQ II SINCGARS	KY-58
AH-64A	US Army	Hellfire, 2.75" rockets, 30mm cannon	LTM, LTD[3], Rockets	FLIR, GPS, NVG, DTV/DVO	UHF VHF-FMx2 VHF-AM	HQ I or II SINCGARS	KY-58 KY-58
AH-64D	US Army	Hellfire (Laser or RF), 2.75" rockets, 30mm cannon	LTM, LTD[3], Rockets	FLIR, INS/GPS, NVG, MMW Rdr, DTV/DVO, IDM	UHF VHF-FMx2 VHF-AM	HQ II SINCGARS	KY-58 KY-58
OH-58D	US Army	Hellfire, 2.75" rockets, .50 cal MG	Laser, Rockets	FLIR, TVS, NVG, IDM	VHF-FM UHF	SINCGARS HQ II	KY-58

Table 18. Rotary – Wing Capabilities and Communication Equipment

Aircraft	Service	Ordnance	Marking Capability	Other Systems	Frequency Band	Frequency Hopping	Secure Capable
MH-53J	USAF	7.62 MG, .50 cal MG	None	FLIR, GPS, INS, NVG, TFR	UHF UHF-AM/FM VHF-AM HF SATCOM	Yes Yes SINCGARS Yes No	KY-58 No KY-100 USC-43 (ANDVT)
AH-6	US Army	7.62 MG, .50 cal MG, Hellfire, TOW, 2.75" Rockets, 30 mm chain gun, MK19 40 mm grenade MG, ATAS	Rockets	NVG, GPS, FLIR	VHF-FM UHF	SINCGARS	KY-58
CH-47	US Army	7.62 MG	None	NVG, GPS	VHF-FM UHF	SINCGARS	KY-58

Notes: [1]The AH-1F is no longer in service in the US Army, but is widely used by other nations.
[2]The AH-1W can designate codes 1111-1788, but has max effectiveness from 1111-1148.
[3]The AH-64 can designate codes 1111-2888, but cannot designate codes containing "9."
ANDVT – advanced narrowband digital voice terminal, ATAS – Air-to-air Stinger, DTV – day television, DVO – direct view optics, FLIR – forward looking infrared, GPS – global positioning system, HQ – Have Quick, IDM – improved data modem, INS – inertial navigation system, LTD – laser target designator:1.06 micron PRF-coded for weapons guidance, LTM – laser target marker: 530nm "green beam" or 860nm for visual or NVG and targeting pods (commonly referred to as an IR pointer or IR marker), MMW – millimeter wave, NTS – night targeting system, NVG – night vision goggles, SINCGARS – single-channel ground and airborne radio system, TSS – target sensing system, TVS – television sensor

Table 19. Targeting Pod Capabilities				
Targeting Pod	Sensor	LTD	LST	LTM/IR Pointer
SNIPER	IR/CCD	Yes	Yes	Yes
LITENING	IR/CCD	Yes	Yes	Yes
LANTIRN	IR	Yes	No	No
Night Hawk	IR	Yes	No[1]	No
STAR SAFIRE	IR	Yes	No	No[2]
BRITE STAR	IR	Yes	Yes	No[2]
NTS[3]	IR, DVO, CCD	Yes	No	No
TSS[3]	IR, DVO, CCD	Yes	No	No
MTADS[3]	IR	Yes	Yes	No
TADS[3]	IR	Yes	Yes	No
TISS	IR	Yes	No	No

Notes: Laser Target Designator (LTD) – 1.06 micron PRF-coded for weapons guidance. Laser Spot Tracker (LST). Laser Target Marker (LTM) – 530nm "Green Beam" or 860nm for visual or NVG and targeting pods (commonly referred to as an IR Pointer or IR Marker.)
[1]Aircraft may be carrying a laser spot tracker onboard.
[2]LTM/IR Pointer carried onboard UH-1 for aircrew pointer capability.
[3]LTM/IR Pointer is mounted on the gun for AH-64/AH-1 helicopters.
MTADS – multisensor towed array detection system
NTS – night targeting system
TADS – target acquisition and designation system
TISS – thermal imaging sensor system
TSS – target sensing system

Table 20. Attack Helicopter Weapons Capabilities	
Weapon	Maximum Effective Range (meters)
2.75” Rocket, 10-lb (Mk66/M151)	7,500
2.75” Rocket, 17-lb (Mk66/M229/M146)	7,000
2.75” Rocket, MPSM (Mk66/M261)[1]	7,000
2.75” Illumination M257 (overt)	3,500
2.75” Illumination M278 (covert)	3,000
7.62mm mini-gun	1,000
.50 cal machine gun	1,830
20mm cannon (PGU/AH-1W)	1,888 / 2,200
30mm cannon (AH-64A/D)	3,500
TOW (BGM-71)	3,750
Hellfire (AGM-114)	8,000
5” Zuni Rocket (USMC)	7,200
[1]Recommended minimum employment range 2,500 meters due to sub-munition arming and dispersion pattern considerations. MPSM – multi-purpose submunition TOW – tube-launched, optically tracked, wire guided	

Table 21. Video Downlink – Link / Frequency / Player Reference			
Aircraft / UAS	Link Type	Frequency	Player
ATFLIR (F/A-18*)	L Analog	1.71 – 1.85 GHz	C_L Analog
Dragon Eye	L Analog	1.71 – 1.85 GHz	C_L Analog
Fire Scout	Ku – CDL	14.4 – 15.35 GHz	Ku Player
Hunter	C Analog	4.4 – 4.85 GHz	C_L Analog
Ignat	C Analog	4.4 – 4.85 GHz	C_L Analog
Litening Pod*	C Rover or C Analog	5.24 – 5.85 GHz or 4.4 – 4.85 GHz	Rover Player or C_L Analog
P-3*	Ku – CDL or C Rover	14.4 – 15.35 GHz or 5.24 – 5.85 GHz	Ku Player or Rover Player
Pioneer	C Analog	4.4 – 4.85 GHz	C_L Analog
Pointer	L Analog	1.71 – 1.85 GHz	C_L Analog
Predator	C Rover or C Analog	5.24 – 5.85 GHz or 4.4 – 4.85 GHz	Rover Player or C_L Analog
Raven	L Analog	1.71 – 1.85 GHz	C_L Analog
Scan Eagle	S Band	2.0 – 4.0 GHz	Rover Player
Scathe View	C Rover	5.24 – 5.85 GHz	Rover Player
Shadow	C Analog	4.4 – 4.85 GHz	C_L Analog
Sniper Pod*	C Analog	4.4 – 4.85 GHz	C_L Analog
Swift	L Analog	1.71 – 1.85 GHz	C_L Analog
Tern	L Analog	1.71 – 1.85 GHz	C_L Analog
Wasp	L Analog	1.71 – 1.85 GHz	C_L Analog
* Not all aircraft with these pods have downlink capability. ATFLIR – advanced targeting forward-looking infrared			

Table 22. Joint Terminal Attack Controller / Observer Communication Equipment			
Service	Frequency Band[1]	Frequency Hopping	Secure Capable
US Army Fire Support Team	VHF-FM	SINCGARS	ICOM
Combat Observation and Lasing Team (COLT)	VHF-FM UHF-SATCOM	SINCGARS	ICOM
USAF/USMC TACP SOF Special Tactics Team	SATCOM HF UHF-AM/FM VHF-AM/FM (HI/LO[2]) TLDHS (USMC) ROVER	HQ II SINCGARS	ANDVT KY-57 VINSON HPW (DATA) KG-84 (DATA)

[1] Frequency bands for ground radios are as follows:

HF = 1.6 to 29.999 MHz

VHF-FM = 29.950 to 87.995 MHz

VHF-AM = 116.000 to 149.975 MHz

UHF = 225.000 to 512.000 MHz

[2] PRC-150 VHF FM (LO band) 30 to 59.999 MHz

ANDVT – advanced narrowband digital voice terminal
HPW – high power waveform
HQ II – Have Quick II
ICOM – integrated communications security
ROVER – remotely operated video enhanced receiver
SINCGARS – single-channel ground and airborne radio system
SATCOM – satellite communications
TLDHS – target location designation handoff system

Note: To request CAS, use the Tactical Air Request-Helicopter Request Net / Joint Air Request Net. Conduct control of CAS aircraft on TAD net.

Table 23. Control Node Communications Equipment			
Agency	Frequency Band[1]	Freq Hopping	Sec Capable
ASOC (USAF)	HF/VHF, AM/FM/UHF Multiband SATCOM, JTIDS Microwave	SINCGARS HQ II	KY-57 KY-99
DASC(A) KC-130 (USMC)	UHF-AM VHF-AM/FM HF UHF SATCOM VIASAT	HQ II SINCGARS[2]	KY-58 KY-58 KY-99 KY-58
DASC (USMC)	UHF/VHF-AM HF SATCOM	HQ II SINCGARS	KY-58 KY-99
JSTARS[3]	VHF-AM/FM UHF-AM UHF SATCOM JTIDS, Link-16 IDM, SCDL, HF	HQ II	KY-58 KY-58 KYV-5 (ANDVT)
E-3 AWACS	VHF-AM/FM UHF-AM UHF SATCOM HF	HQ II	KY-58 KY-58 KY-75/KYV-5
E-2C (NAVY)	VHF/UHF-AM/FM HF, SATCOM JTIDS / LINK-16	HQ II, JTIDS	KY-57/58 JTIDS

[1] Frequency bands for ground radios are as follows:
HF = 2.000 to 29.999 MHz in 1kHz increments
VHF-FM = 29.950 to 79.950 MHz in 50 kHz increments
VHF-AM = 116.000 to 149.975 MHz in 25 kHz increments
UHF = 225.000 to 399.975 MHz in 25 kHz increments

[2] No frequency hopping capability

[3] JSTARS frequencies
HF = 2.000 to 29.999 MHz in 1kHz increments
VHF-FM = 30.000 to 87.975 MHz in 25 kHz increments
VHF-AM = 108.000 to 115.975 MHz in 25 kHz increments (Receive Only)
VHF-AM = 116.000 to 151.975 MHz in 25 kHz increments (Transmit / Receive)
UHF = 225.000 to 399.975 MHz in 25 kHz increments

ASOC – air support operations center, AWACS – Airborne Warning and Control System, DASC – direct air support center, HQ – Have Quick, IDM – improved data modem, JSTARS – Joint Surveillance Target Attack Radar System, JTIDS – Joint Tactical Information Distribution System, SATCOM – satellite communications, SCDL – surveillance control data link, SINCGARS – single-channel ground and airborne radio system

Table 24. US Air Force / Army Communications Nets				
Net	Purpose	Net Control	Stations on Net	Freq Band
BCT / BDE Fire Support	CFF, Clear fires	BCT / BDE FSC	FSCOORD, MVR BN FSO, FSC BDE FSO & FSE COLTS	FM
MVR BN fire support	CFF from non-FA observers	MVR BN FSE	MVR BN FSE, MVR BN FSO, FOs, MVR BN mortar FDC, FIST HQ, any FDC, FSO, or COLTs as req'd, MVR BDE FSCOORD	FM
MVR BN mortar FDC	Tactical and technical fire direction and CFF to the mortar FDC	MVR BN mortar FDC	MVR BN FSE/FSO, MVR CO FOs, MVR BN mortar FDC, FIST HQ, COLT(s), any FSO or observer as required	FM
BCT Fires BN/DS fire direction	Tactical and technical fire direction and CFF to FA BN, battery or platoon FDCs	BCT Fires BN/DS BN FDC	BCT Fires BN FDC / DS BN FDC, PLT FDCs, FIST HQ, FOs, AN/TPQ-36 radar, COLT(s), BN FSE / FSO, MVR BDE FSE / FSO, FA battery FDCs, FA PLT FDCs	FM
Joint Air Request Net	JTAC request immediate air support	ASOC	TACP, ASOC, ALO	HF SATCOM
NGF ground spot	Fire control teams request and adjust NGF	BN FSE	CO, BN FSE, BDE FSC, DIV FSC, DS ship, general support ship as req'd	HF (pri) VHF (alt)

ALO – air liaison officer, ASOC – air support operations center, BCT – brigade combat team, BDE – brigade, BN – battalion, CFF – call for fire, CO – Company, COLT – combat observation and lasing team, DIV – division, DS – direct support, FA – field artillery, FDC – fire direction center, FIST – fire support team, FO – forward observers, FSC – fire support cell, FSCOORD – fire support coordinator, FSE – fire support element, FSO – fire support officer, JTAC – joint terminal attack controller, MVR – maneuver, NGF – naval gunfire, PLT – platoon, TACP – tactical air control party.

Appendix B: Brevity

1. Marking Brevity Terms

a. BLIND – No visual contact of friendly aircraft/ground position. Opposite of VISUAL.
b. BURN – EO / IR illuminator is being used to provide illumination of surface points of interest.
c. (target/object) CAPTURED – Specific surface target / object has been acquired and is being tracked with an on-board sensor.
d. CONTACT – 1) Sensor contact at the stated position. 2) Acknowledges sighting of a specified reference point (either visually or via sensor). 3) Individual radar return within a GROUP or ARM.
e. NO JOY – Aircrew does not have visual contact with the target / bandit / landmark. Opposite of TALLY.
f. PULSE – Illuminate / illuminating an enemy position with flashing IR energy.
g. ROPE – Circling an IR pointer around an aircraft to help the aircraft identify the friendly ground position.
h. SNAKE – Oscillate an IR pointer about a target.
i. SPARKLE – 1) Mark/marking target by IR pointer. 2) Platform is IR point capable.
j. STEADY – Stop oscillation of IR pointer.
k. STOP – Stop IR illumination of a target.
l. TALLY – Sighting of a target, non-friendly aircraft, landmark, or enemy position. Opposite of NO JOY.
m. VISUAL – Sighting of a friendly aircraft/ground position. Opposite of BLIND.

2. Laser Brevity Terms

a. DEADEYE – Laser designator system inoperative.
b. LASER ON – Start / acknowledge laser designation.
c. LASING – The speaker is firing the laser.
d. NEGATIVE LASER – Aircraft has not acquired laser energy.
e. SHIFT (direction) – Shift laser / IR / radar device energy. 1) Can be used to shift from the offset position onto the target. 2) Also used during multi-aircraft attack to shift laser energy to the next target.
f. SPOT – 1) Acquisition of laser designation. 2) Platform is laser spot tracker capable.
g. STARE (with laser code and reference point) – Cue the laser spot search / tracker function on the specified laser code in relation to the specific reference point. Reference point may include the following: steerpoint, GEOREF, bearing, and range or datalink point.
h. TEN SECONDS – Standby for "LASER ON" call in approximately 10 seconds.
i. TERMINATE – Stop laser illumination of a target.

3. Video Downlink Brevity Terms

a. CHECK CAPTURE – Target appears to be no longer tracked by sensor.
b. CHECK FOCUS – Sensor image appears to be out of focus.
c. HANDSHAKE – Full motion video signal and data operative to ROVER.
d. HOLLOW – Lost full motion video signal and/or data to ROVER.

e. (expect) HOLLOW – A condition will likely exist that limits ROVER reception (maneuvers, terrain, etc.).
f. SET – No longer slewing sensor and awaiting further updates.
g. SHADOW – Follow indicated target.
h. STAKE – 1) Reference point for air-to-surface (A/S) targeting operations. 2) A full motion video system mark has been set and is used as a frame of reference.
i. SWITCH CAMERA – Switch full motion video to EO or IR.
j. SWITCH POLARITY – Switch IR polarity to black hot or white hot.
k. ZOOM (IN / OUT) – Increase / decrease the sensor's focal length. ZOOM IN / OUT is normally followed by "ONE, TWO, THREE, or FOUR": to indicate the number of fields of view (FOVs) to change. (***Note:*** It is recommended only one change in or out at a time be used for the FOV.)

4. Other Brevity Terms

a. ARIZONA – No antiradiation missiles remaining.
b. (weapon) AWAY – Release / launch of specified weapon (e.g., PIGS AWAY, LONG RIFLE AWAY, etc.) Note: Include launch location in bullseye format and weapon track direction for PIGS and LONG RIFLE.
c. BINGO – Fuel state needed for recovery.
d. CHATTERMARK – Begin using briefed radio procedures to counter communications jamming.
e. HOLD FIRE – An emergency fire control order to stop firing on a designated target, to include destruction of any missiles in-flight.
f. JOKER – Fuel state above BINGO at which separation / bugout / event termination should begin.
g. LONG RIFLE – Friendly long range A/S missile launch (e.g., AGM-130, stand-off land attack missile-expanded range [SLAM-ER]). See (weapon) AWAY.
h. MAGNUM (system / location) – Launch of friendly antiradiation missile.
i. OFFSET (direction) – Maneuver in a specified direction with reference to a target.
j. PIG(S) – Friendly glide weapon(s) (e.g., joint stand-off weapon [JSOW]). See (weapon) AWAY.
k. PLAYTIME – Amount of time aircraft can remain on station, given in hours plus minutes (e.g., ONE PLUS THIRTY equals one hour and thirty minutes).
l. (freq) POGO (freq) – Switch to communication channel number preceding POGO. If unable to establish communications, switch to channel number following POGO. If no channel number follows POGO, return to this channel.
m. REMINGTON – No ordnance remaining except gun or self-protect ammunition.
n. RIFLE – Friendly A/S missile launch.
o. SPLASH – 1) (A/S) Weapons impact. 2) (surface-to-surface) Informative call to observer or spotter five seconds prior to estimated time of impact. 3) (air-to-air [A/A]) Target destroyed.
p. SUNSHINE – Illuminating target with artificial illumination.
q. THUNDER – One minute until A/S weapons impact.
r. WINCHESTER – No ordnance remaining.

Appendix C: Laser Operations

1. Joint Terminal Attack Controller Laser Responsibilities

a. Avoid the 20-degree safety zone whose apex is at the target and extends 10-degrees on either side of the LTL for aircraft run-ins. (See figures 16 and 17, p.85.)
b. The best acquisition area for attack is a 90-degree fan whose apex is at the target and extends to 45-degrees on either side of the LTL. The allowable acquisition area extends an additional 15-degrees on either side of the best acquisition area, excluding the safety zone.
c. Prebrief pilot if possible.
d. Plan early. Get the laser target designator (LTD) ready for the mission.
e. Ensure laser code in LTD matches the code that the pilot passed.
f. Ensure LTD in designate/mark mode.
g. Explain ordnance and aircraft characteristics.
h. Explain minimum safe distances of ordnance used. (Risk-estimate distances for aircraft-delivered ordnance are found in tables 33 (p.107) and 34 (p.110).)
i. Immediately prior to execution, confirm actual LTL is no more than 5-degrees off briefed LTL.
j. Ensure communications are in place – the simpler the better.
k. Update friendly locations and determine if they are a factor.

2. Laser Communications Examples

a. Example 1

Fixed-wing CAS aircraft, laser-guided bomb (LGB) attack from a level-delivery at high altitude. Assumptions: Type 2 control, CAS aircraft has already acquired the target, JTAC passed laser target line and final attack heading in the remarks section of the attack brief, and JTAC is guiding the LGB with a ground-based laser. Communication starts from the target attack run-in:

A/C: "Viper 11, inbound."
JTAC: "Continue."
A/C: "Viper 11, IN heading 180."
JTAC: "Viper 11, cleared hot."
A/C: "Viper 11, one away 30 seconds (time of fall)."
A/C: "10 seconds"
JTAC: "Continue."
A/C: "Viper 11, Laser ON."
JTAC: "Lasing."
Weapon impact observed.
A/C: "Terminate."

b. Example 2
Fixed-wing CAS aircraft LGB attack from a bunt or roll-in profile. Assumptions: Type 1 control, CAS aircraft is tally the target and can bunt / roll-in visually, JTAC passed laser target line and final attack heading in the remarks section of the attack brief. The JTAC is using a ground-based laser designator for the mark and will guide the LGB to impact. Communication starts prior to bunt / roll-in:

A/C: "Viper 11, tally target."
JTAC: "Continue."
CAS aircraft approaching roll-in.
A/C: "Viper 11, 10 seconds."
JTAC: "Continue."
A/C: "Viper 11, IN, LASER ON."
JTAC: "LASING."
A/C: "Viper 11, SPOT."
Once JTAC has visually acquired the A/C and visually acquired the target:
JTAC: "Viper 11, Cleared HOT."
A/C: "Viper 11, one away 15 seconds (time of fall.)"
Weapons impact observed.
A/C: "Viper 11, Terminate."

3. Laser Designation Zones

Warning: LTM / IR pointers or laser sources should not be used as the sole source for target mark / verification. Attack aircraft may confuse IR pointer or laser energy source with the intended target. When using IR pointers or lasers to mark, include "IR POINTER" or "LASER" in the marks portion (Line 7) of the CAS briefing. JTACs should also provide the Pointer-Target-Line or Laser-Target-Line, also known as the Designator-Target-Line, in degrees magnetic from the operator to the target. JTACs should consider the use of a discriminate target mark whenever possible.

Warning: CAS aircraft must use all tools available to confirm that the location of the intended target agrees with previously briefed descriptions.

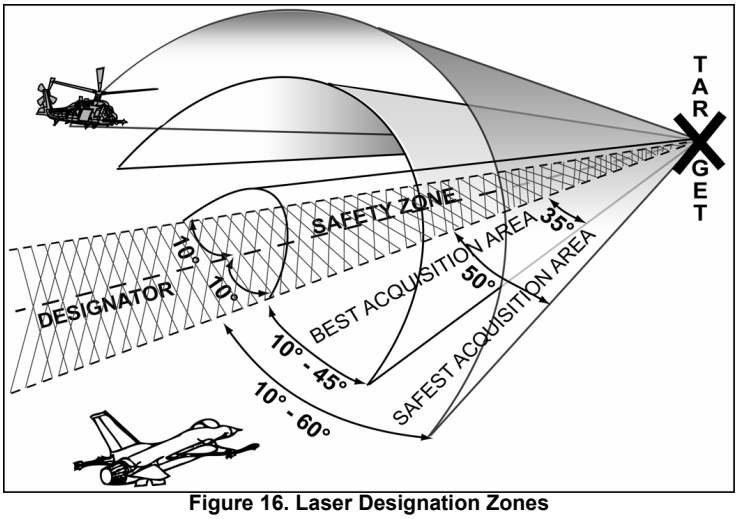


Figure 16. Laser Designation Zones

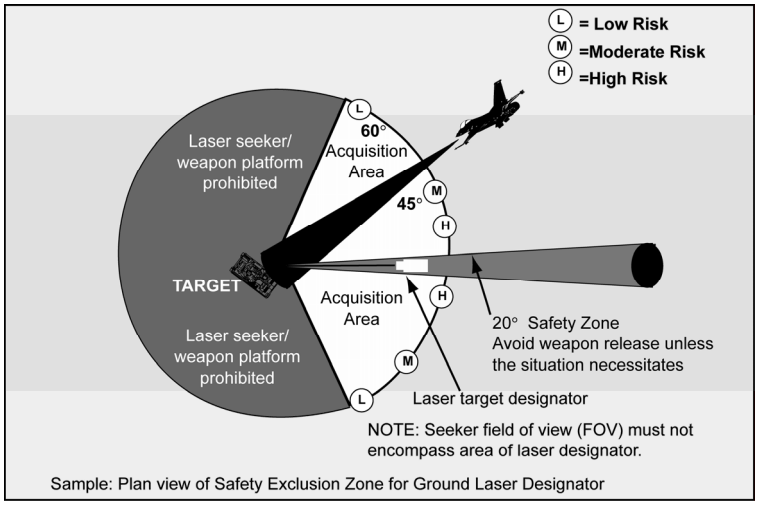


FIgure 17. 2-Dimensional Laser Safety and Optimal Attack Zones

4. Hellfire Designator Exclusion Zone

a. Within 30-degrees of the shooter aircraft's line of fire (in the designator exclusion zone), there is a possibility that the missile may track and impact an obstruction (e.g., trees, grass, or hills) near the designator operator if it is accidentally illuminated by the laser beam.

b. The designator shall have a clear, unobstructed line of sight to the target. Take care to ensure designator line of sight is unobstructed across the entire path of a moving target during the time of missile flight to impact.

c. Airborne designators must ensure that they are either over ground conditions which do not create dust or are at altitudes where rotor downwash does not create dust.

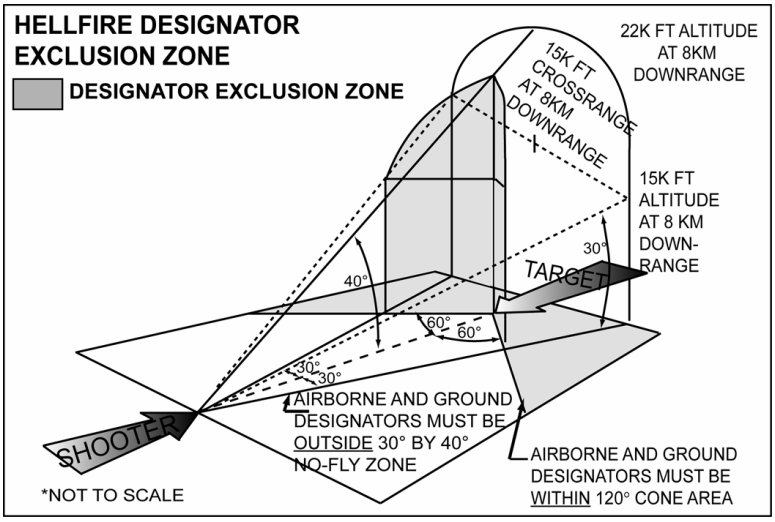


Figure 18. Hellfire Designator Exclusion Zone

Appendix D: Fire Support Coordination Measures and Airspace Coordinating Measures

Note: For detailed descriptions of fire support coordination measures (FSCMs) and airspace coordinating measures (ACMs), see JP 3-09, *Joint Fire Support*, and JP 3-52, *Joint Doctrine for Airspace Control in the Combat Zone*.

1. Permissive and Restrictive Fire Support Coordination Measures

Commanders employ permissive and restrictive FSCMs. With the exception of the fire support coordination line (FSCL), permissive measures normally require no further detailed coordination for the engagement of targets with conventional means. Coordination of attacks beyond the FSCL is especially critical to commanders of air, land, and special operations forces. In exceptional circumstances, the inability to conduct this coordination will not preclude the attack of targets beyond the FSCL. However, failure to do so may increase the risk of fratricide and could waste limited resources. Restrictive measures impose requirements for specific coordination before engagement of targets with the primary purpose of safeguarding an asset.

a. Free Fire Area (FFA). A specific area into which any weapon system may fire without additional coordination with the establishing headquarters. It is used to expedite joint fires and to facilitate emergency jettison of aircraft munitions.

b. Coordinated Fire Line (CFL). A line beyond which conventional indirect surface joint fire support means may fire at any time within the boundaries of the establishing headquarters without additional coordination. The purpose of the CFL is to expedite the surface-to-surface engagement of targets beyond the CFL without coordination with the ground commander in whose area the targets are located.

c. Restrictive Fire Line (RFL). A line established between converging friendly forces that prohibits joint fires or their effects across that line without coordination with the affected force. The purpose of the line is to prevent fratricide and duplication of engagements by converging friendly forces.

d. No-fire Area (NFA). An NFA is an area designated by the appropriate commander into which fires or their effects are prohibited. There are two exceptions:

(1) When the establishing HQ approves joint fires within the NFA on a mission by mission basis.

(2) When an enemy force within the NFA engages a friendly force and the engaged commander determines there is a requirement for immediate protection and responds with the minimal force needed to defend the force.

e. Restrictive Fire Area (RFA). An area in which specific restrictions are imposed into which fires that exceed those restrictions will not be delivered without coordination with the establishing headquarters. The purpose of the RFA is to regulate joint fires into an area according to the stated restrictions.

f. Airspace Coordination Area (ACA). A three-dimensional block of airspace in a target area, established by the appropriate ground commander, in which friendly aircraft are reasonably safe from friendly surface fires. The airspace coordination area may be formal or informal.

2. Maneuver Control Measures

Unit Boundaries. A boundary is a line that delineates surface areas for the purpose of facilitating coordination and deconfliction of operations between adjacent units, formations, or areas (JP 3-0, *Joint Operations*). Direct fires may be employed across boundaries without clearance at specific point targets that are clearly and positively identified as enemy. Indirect fires may not be employed across boundaries without receiving clearance from the unit into whose AO the fires will impact.

3. Battlefield Coordination Line

a. The BCL is an exclusive Marine Corps FSCM, similar to a FSCL, which facilitates the expeditious attack of targets with surface indirect fires and aviation fires between this measure and the FSCL. To facilitate air-delivered fires and deconflict air and surface fires, an ACA will always overlie the area between the BCL and the FSCL.

b. BCL location is graphically portrayed on fire support maps, charts, and overlays by a solid black line with the letters “BCL” followed by the establishing headquarters in parentheses above the line and effective date-time group below the line. BCL is not currently supported by automated systems for depiction.

Table 25. Permissive Measures

Name	Establishing Headquarters (HQ)	Coordination Required for Fires?				Notes
		Short of / within measure		Beyond measure		
		Surface to Surface	Air to Surface	Surface to Surface	Air to Surface	
FFA	Normally DIV or HHQ. However, it can be established by any Commander who owns the ground such as BDE.	No	No	N/A	N/A	A specific area into which any weapon system may fire w/o additional coordination with establishing HQ. Normally on identifiable terrain.
CFL	Normally established by BDE or DIV – can be consolidated by DIV.	Yes	Yes	No	Yes IAW other control measures	Purpose is to expedite surface to surface attack beyond CFL.
BCL	MAGTF	No CFL Dependent	Yes HHQ	No Only if IAW ACA	No Only if IAW ACA	Note 1.

Table 25. Permissive Measures

Name	Establishing Headquarters (HQ)	Coordination Required for Fires?				Notes
		Short of / within measure		Beyond measure		
		Surface to Surface	Air to Surface	Surface to Surface	Air to Surface	
FSCL	Land or Amphibious Forces Commander	No, CFL Dependent	Yes Establish HQ	Yes HHQ	No	Does not divide AO

[1]Aviation may strike any target within the USMC AO beyond the BCL and short of the FSCL without further coordination, including targets in an adjacent Marine commander's zone between the BCL and FSCL. Before firing, the ground commander should coordinate with the DASC if surface-delivered fires will violate ACAs associated with the BCL.
AO – area of operations, BDE – brigade, DIV – division, HHQ – higher headquarters, MAGTF – Marine air-to-ground task force.

Table 26. Restrictive Measures

Name	Establishing Headquarters (HQ)	Coordination Required for Fires?				Notes
		Short of / Within Measure		Beyond Measure		
		Surface to Surface	Air to Surface	Surface to Surface	Air to Surface	
RFL	HHQ of converging forces	N/A	N/A	Yes; affected force	Yes; affected force	Established between converging forces. Prevents fratricide and duplication of attacks. Located on identifiable terrain if possible.
NFA	Any HQ	Prohibits all fires or effects into the area with the following exceptions: - Establishing HQ approves fires or effects on a mission-by-mission basis. - Enemy forces inside NFA engage friendly forces and engaged commander requests fires.				Located on identifiable terrain or by radius from established point.
RFA	BN HQ or higher	Specifies certain restrictions on fires into the area - Fires which violate restriction prohibited - Fires which do not violate restriction allowed				Located on identifiable terrain or by radius from established point.
ACA Formal	Airspace Control Authority	Yes	Yes	N/A	N/A	Defined by min/max altitude, length, width, and effective date time group.
ACA Informal	Any HQ					Air and surface fires separated by lateral, altitude, lateral and altitude, or time.

4. Integration Techniques

There are numerous separation techniques used by JTACs in the field. There is no one preferred technique, but JTACs should always plan on the one that allows for the most firepower on the target. If at all possible, never shut off artillery when flying CAS or vice versa. In many cases providing the artillery information to the aircrew and allowing the aircrew to determine a lateral or altitude deconfliction measure is most effective. The same logic can be applied to deconflict UAs and manned aircraft.

Table 27. Integration Techniques			
Parameters	CAS target same as or near surface target	CAS target distant from surface target	CAS target along gun-target line
High / Medium Altitude Attack	Time / Altitude Separation	Time / Altitude / Lateral Separation	Time / Altitude Separation
Low / Very Low Altitude Attack	Time Separation	Time / Altitude or Lateral Separation	Time / Altitude Separation

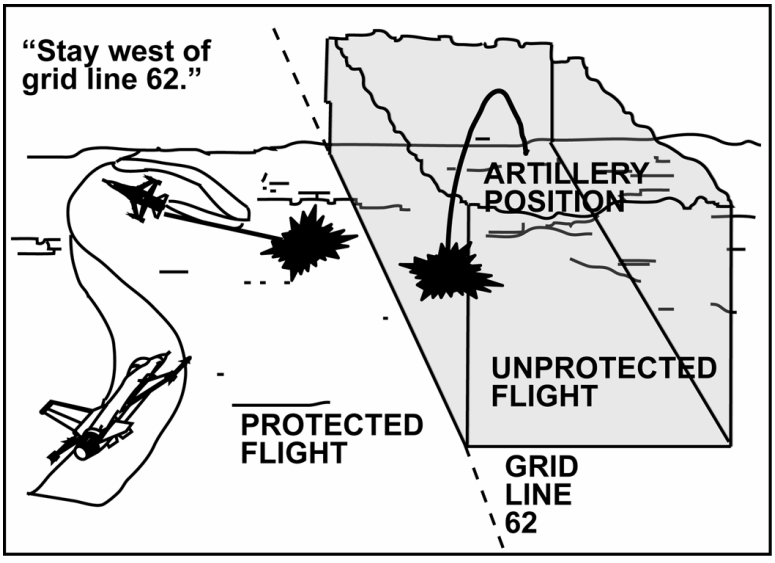


Figure 19. Artillery Close Air Support Lateral Separation

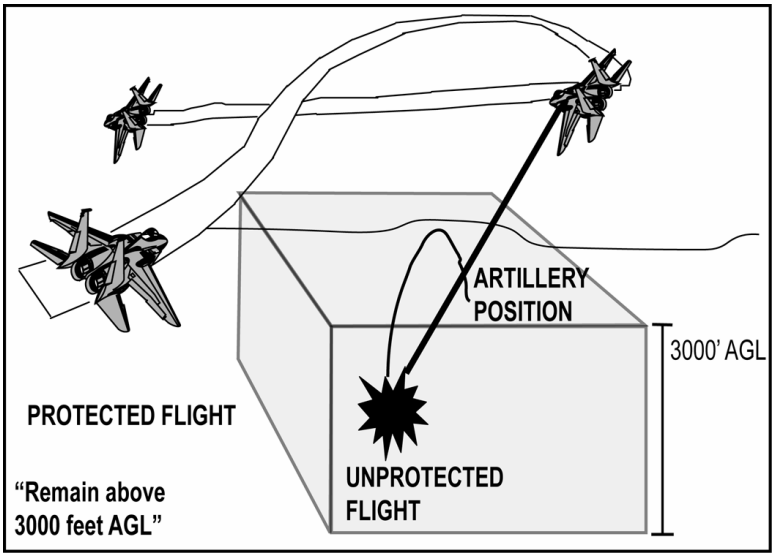


Figure 20. Artillery Close Air Support Altitude Separation

5. Common Geographic Reference System and Global Area Reference System

Both the CGRS and GARS are administrative measures used to clearly define two-dimensional geographical areas for battlespace coordination, deconfliction, and synchronization. The CGRS / GARS defined cells themselves are not FSCMs, ACMs, or maneuver control measures, but simply a common reference system that complements joint fire support and / or airspace control systems and measures. However, these systems may be used to define lateral ACM and FSCM boundaries. See theater-specific standard operating procedures for using CGRS. GARS has been established as the Department of Defense-approved reference system. Until it is fully implemented by all Services and in all theaters, CGRS might still be referenced.

NOTE: The CGRS or GARS should not be confused with kill box methodology. For kill box operations, refer to FM 3-09.34 / MCRP 3-25H / NTTP 3-09.2.1 / AFTTP(I) 3-2.59 *Multi-Service Tactics, Techniques, and Procedures for Kill Box Employment* and theater-specific SOP.

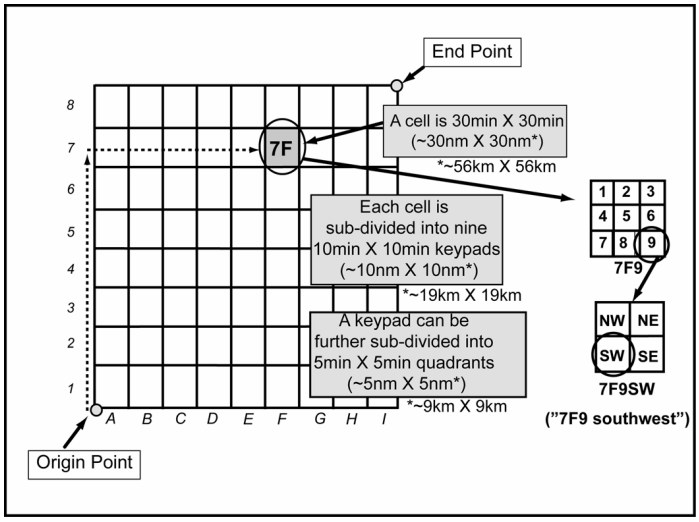


Figure 21. Common Geographic Reference System Example

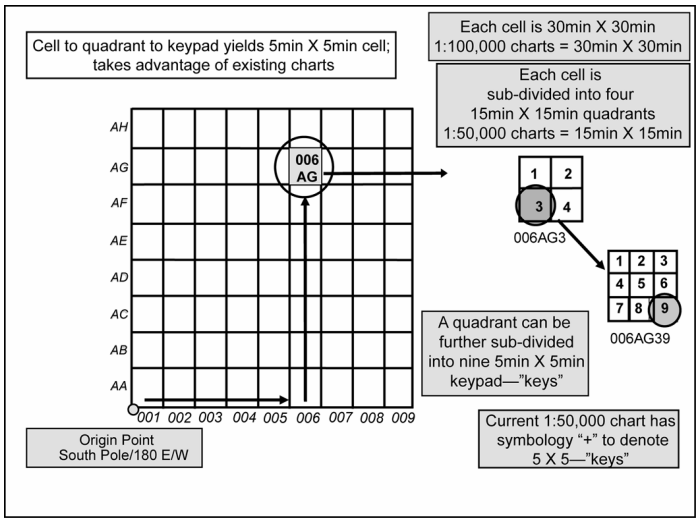


Figure 22. Global Area Reference System Example

Appendix E: Aircraft-delivered Munitions Descriptions

1. General Purpose Munitions

a. All general purpose (GP) munitions are similar in construction and vary only in size and weight with a streamlined cylindrical body. Conical fins are designed for low drag (LD) releases. Retarding fins / air inflatable retarder (AIR) are designed for high drag (HD) releases.

b. 500-pound LD / HD
   (1) Mk-82: Selectable HD / LD when fit with AIR or retarding fins.
   - Effects: blast, fragmentation, and limited cratering.
   (2) BLU-111: Improved, thermally protected GP bomb.
   - Effects: blast, fragmentation, and limited cratering.
   (3) BLU-126 – 500 lb thermally protected low collateral damage bomb (LCDB) (20% explosive fill BLU-111)
   - Effects: blast and limited fragmentation.

c. 1000-pound LD / HD
   (1) Mk-83: Selectable HD / LD when fit with AIR or retarding fins.
   - Effects: blast, fragmentation, and cratering.
   (2) BLU-110/B: Improved, thermally protected GP bomb.
   - Effects: cratering and hard target penetration.

d. 2000-pound LD / HD
   (1) Mk-84: Selectable HD / LD when fit with AIR or retarding fins.
   - Effects: blast, fragmentation, and cratering.
   (2) BLU-109/B: Penetrator, improved protected GP bomb.
   - Effects: cratering and hard target penetration.
   (3) BLU-117: Improved, thermally protected GP bomb.
   - Effects: blast, fragmentation, and cratering.

e. Other weights:
   (1) BLU-113 Penetrator bomb: 4,400-pound improved GP bomb.
   - Effects: cratering and hard target penetration.
   (2) M-117: 750-pound GP bomb with very thin bomb casing.
   - Effects: more blast and less fragmentation than other GP bombs.
   (3) M-117R: Selectable HD / LD by means of retarding tail assembly.

2. Guided Bombs

a. IAMs are accurate (near precision), all weather, INS / GPS-guided bombs for use against stationary targets. Multiple IAMs can be dropped on different targets in a single pass. Effects: blast / fragmentation or cratering with a delayed fuze (Mk-83/84 bomb body) or hard target penetrator with (BLU-109/110 bomb body).
   (1) GBU-38 JDAM w/ Mk-82 bomb body
   (2) GBU-38 (v)4/B JDAM w/BLU-126 bomb body (USN)
   (3) GBU-32 (v)2/B JDAM w/ Mk-83 bomb body (USN / USAF)
   (4) GBU-32 (v)4/B JDAM w/ BLU-110 bomb body (USN)
   (5) GBU-31 (v)1/B (USAF) or (v)2/B (USN) JDAM w/ Mk-84 bomb body
   (6) GBU-31 (v)3/B (USAF) or (v)4/B (USN) JDAM w/ BLU-109 bomb body
   (7) GBU-39 / Small Diameter Bomb (SDB). An accurate, extended range all-weather, 250-pound class, GPS guided munition. It is effective

against fixed or stationary targets and has limited penetration capabilities. Multiple weapons can be dropped on different targets in a single pass. As a standoff weapon, the SDB may climb in altitude after release to assume its glide profile. The weapon's flight path may present deconfliction problems depending on the ACAs in place.

- Effects: blast / fragmentation or penetration.

b. Paveway II – Laser-guided, free-fall weapon. Laser codes are pre-flight selectable (code 1511-1788). These weapons can be fuzed for instantaneous (fragmentation) or delayed (cratering) detonation.
   (1) GBU-12 uses an Mk-82 bomb body.
   (2) GBU-16 uses an Mk-83 or BLU-110 bomb body.
   (3) GBU-10 uses an Mk-84 or BLU-109 bomb body.
   (4) GBU-15/EGBU-15 – TV- or IR-guided, automatically or manually by the weapon system operator (WSO). Mk-84 or BLU-109 body. Effects: same as Mk-84/BLU-109. The hybrid EGBU-15 incorporates GPS / INS guidance providing precision adverse weather capability for autonomous or man-in-the-loop deliveries.
   (5) GBU-51/B – Laser-guided, free-fall GBU-12 kit with a BLU-126 LCDB body.

c. Paveway III – Low-level, laser-guided, maneuverable free-fall weapon. Uses Mk-84 (GBU-24), BLU-109 (GBU-24A) or BLU-116 advanced unitary penetrator (AUP) bomb bodies. AUP is a 2,000-lb class penetrator bomb with twice the penetration capability of the BLU-109. Used only in GBU-24C/B (USAF) and GBU-24D/B (USN).
   - Effects: cratering and hard target penetration. GBU-24E/B adds GPS / INS guidance to allow adverse weather capability with BLU-109 bomb body. Can be released from very low or very high altitudes. Can be released below a low overcast (3,000–4,500' AGL) if the correct mode switches have been set prior to takeoff. Can be launched without laser signal acquisition. Effects: same as Mk-84.

d. Hybrid weapons – Guided by laser and / or GPS-aided INS.
   (1) GBU-12F/B Dual-mode LGB (DMLGB) – 500-lb bomb with LASER and IAM capability.
   (2) GBU-28 (GBU-37) – Laser-guided (GPS) BLU-113. 4,700-lb weapon used for hard target penetration.
   (3) GBU-52/B DMLGB – similar to GBU-12F/B but with BLU-126 LCDB body.
   (4) GBU-54 Laser JDAM (LJDAM) – a multi-mode 500-lb weapon that includes guidance via GPS with coordinate refinement through laser updates. It uses a GBU-38 tail kit with the addition of a laser kit attached to the nose and can be used in legacy mode as GPS only with no degradation in capability. LJDAM is capable of hitting high speed moving targets. Target heading and velocity can be programmed into the weapon to generate an impact point in front of the target. At 4.5 km, if laser energy is present, the LJDAM will calculate new coordinates based on the movement of the laser. The weapon will then guide to the updated lead point. LJDAM is a coordinate seeking weapon and does not guide on laser energy like an Enhanced PWII. It continuously

calculates new coordinates based on the laser spot. Therefore, if the weapon loses laser energy it will guide on the last known coordinates.

3. Guided Missiles

a. AGM-65 (Maverick) – Tactical, air-to-surface guided missile designed for high probability of strike against tanks and a variety of tactical targets, including moving vehicles. Maverick seeker is locked on to the target prior to release and guides autonomously (except AGM-65E), providing standoff ranges of up to 10 nm.
   (1) Guidance: TV (A,B,H,K); IR (D,F,G2); Laser (E).
   (2) Warheads: 125 lbs. shaped charge jet and blast (A,B,D,H) or 300-lbs. penetrator / blast-fragmentation (E, F, G2, K).

b. AGM-84E Stand-Off Land Attack Missile (SLAM)-AGM-84H (SLAM-Expanded Range [ER]) – An intermediate range (over 150 nm for SLAM-ER) missile designed to provide day, night, and adverse weather precision strike capability against land targets and ships in port. The SLAM uses an inertial navigation system with GPS, infrared terminal guidance, and is fitted with a titanium warhead for better penetration.

c. AGM-88 High-speed Antiradiation Missile (HARM). A supersonic air-to-surface tactical missile designed to seek and destroy radar-equipped air defense systems. The AGM-88 can detect, attack, and destroy a target with minimum aircrew input. (Range > 40 nm).

d. AGM-114 (Hellfire) – Solid propellant laser or radar frequency guided anti-armor missile. Can also be used against buildings and field fortifications. Hellfire variants include shaped charge, blast fragmentation, and metal augmented charge warheads. Max effective range: 8,000 meters. Min range is based on employment technique, but 500 meters should be used as a guide. Radar frequency Hellfire (Longbow) is all weather capable.
   (1) A/B/C/F/K – Shaped Charge Warhead – Designed for use against armored vehicles.
   (2) L – Shaped Charge Warhead – Radar guided compatible with Apache Longbow.
   (3) M – Blast-Fragmentation Warhead – Designed for personnel and thin-skinned vehicles.
   (4) N – Thermobaric Warhead – Designed to kill by overpressure in confined spaces.
   (5) P – Shaped Charge Warhead – AGM-114K designed for use on MQ-1 and MQ-9.

e. AGM-130 – Rocket-powered version of GBU-15. Standoff range between 15 and 40 nm. Midcourse guidance version uses GPS for guidance (WSO is still able to steer the weapon during terminal guidance for pinpoint accuracy).

f. AGM-154 JSOW. A low-observable, all weather 1,000-lb class family of stand off air-to-ground glide weapons. Modular payload assembly to attack armored and light-armored vehicle columns, surface-to-air targets, and personnel.
   (1) Guidance: AGM-154A & B-INS/GPS
   AGM-154C (Navy only) INS / GPS w/ IR Seeker.

(2) Warheads: AGM-154A = 145 BLU-97 bomblets
AGM-154B = 6 BLU-108s (24 skeets)
AGM-154C = BLU-111 or BROACH
(3) Range: 15nm at low altitude, >40nm at high altitude.

g. AGM-158A Joint air-to-surface stand-off missile (JASSM). A precision cruise missile designed for launch from outside area defenses to kill hard, medium-hardened, soft, and area type targets. Guidance: Imaging, Infrared Radar. 2,000-lb Unitary Warhead.

h. BGM-71 Tube-launched, Optically tracked, Wire-guided (TOW) Missile. Solid propellant, wire-guided, anti-armor missile. Range: min. 500 m; max 3750 m; max time of flight: 21.5 sec.

4. Guns

a. 7.62 Mini-Gun – Up to 6,000 rounds / min. target practice (TP), armor piercing (AP), tracer.

b. 50 Cal – 1,150 to 1,250 rounds / min. TP, AP, armor piercing incendiary (API), and tracer.

c. 20mm – 750 to 850 rounds/min. AP, HE, and incendiary.

d. 20mm Gatling – 2,500-6,000 rounds / min. TP, high explosive incendiary (HEI), API, target practice tracer (TPT), HEIT, PELE [penetrator with enhanced lateral efficiency].

e. 25mm Gatling (GAU-12) – 3,600-4,200 rounds / min (AV-8B) or 1,800 rounds / min (AC-130) TP, HEI, API, TPI, or HEIT.

f. 30mm (M230 cannon AH-64) – TP, high explosive dual purpose (HEDP) (Shaped charge and fragmentation.) Target types: personnel, material, and light armor.

g. 30mm Gatling (GAU-8) – 3,900 rounds / min. 1.5-lb projectile TP, HEI, API on A-10 (can fire 1,174 rounds in 10, 2-second bursts).

h. 30mm (M44 on AC-130) – 200 rounds / min, PGU-13/B HEI.

i. 40mm (AC-130) – 100 rounds / min. HEI, API, high explosive incendiary-plugged (HEI-P). Target types: personnel undercover and all light vehicles. Fired from 4,500 ft AGL min altitude to 18,000 ft AGL max altitude.

j. 105mm (AC-130) – 10 rounds / min. HE and HE/High Fragmentation, Proximity. Target types: personnel, light vehicles, buildings. Fired from 4,500 ft AGL min altitude to 18,000 ft AGL max altitude.

5. Rockets

a. 2.75" Rocket Warheads
(1) Mk Mk-67 mod 1—Smoke Red Phosphorous (RP).
(2) Mk-67 mod 0—Smoke White Phosphorous (WP).
(3) M-151—(10-lb. HE). Fuses: point detonating (PD), proximity (P), time delay (TD); primary fragmentation against personnel, material, and light armor.
(4) M-156—WP. Used for target marking.
(5) M-229—(17-lb HE). Same as M-151.
(6) M-257— Overt illumination.
(7) M-261— Multi-purpose submunition (MPSM), Fuse TD; 9 shape charge / fragmentation submunitions; AP, anti-material, and light armor.

(8) M-278 – Delivers covert (Near IR / NVG) illumination.
(9) M-255E1—Flechette for antipersonnel.
(10) WDU-4A/A—Flechette for antipersonnel (USMC).
(11) WTU-1/B—TP. A practice M-151.

b. 5.00" Rocket Warheads.
(1) Mk-63 mod 0—Fuzes: PD, P, TD; HE-fragmentation; AP, anti-material.
(2) Mk-24 GP—Fuses: PD, P, TD; fragmentation, AP, anti-material, and light armor.
(3) Mk 32 Antitank (AT)/AP—Fuses: PD, P, TD; for use against personnel.
(4) Mk 34 Mod2 RP—Fuses: PD, P, TD; smoke.
(5) MK 84—Chaff rocket for use against radar threats
(6) Mk 6/24/32 and WTU-11/B practice rounds – Inert practice variants.

6. Cluster Munitions

a. Mk-20 and CBU-99/100 cluster munitions (USN) – Excellent weapon against armor, personnel, artillery, etc. Dispenses 247 Mk 118 mod 0/1 bomblets in an oval pattern. Bomblet density and pattern size vary with release parameters.

b. CBU-78 GATOR (USN) – Rockeye dispenser loaded with 60 submunition mines. 45 BLU-91/B antitank and 15 BLU-92/B anti-personnel mines are in each weapon. Submunitions must be set to one of three self-destruct times: T1 (3.2-4.0 hours), T2 (38.2-48.0 hours), and T3 (288-360 hours).

c. CBU-87/B Combined Effects Munitions (CEM) – Excellent weapon against armor, personnel, artillery, etc. Dispenses 202 BLU-97 bomblets with a shaped charge for armor, steel-scored liner for fragmentation, and incendiary ring. (***Note:*** Dispersion is an oval with density and size of the area covered dependent upon release parameters and spin rates.)

d. CBU-89/B GATOR – SUU-64 Tactical Munitions Dispenser loaded with a mix of 72 BLU-91/B anti-armor and 22 BLU-92/B anti-personnel mines with preset self-destruct time. (***Note:*** Dispersion varies from circular at high altitudes to linear at low angles.)

e. CBU-97/B Sensor-Fuzed-Weapon (SFW) – SUU-64 with an airbag dispensing system and 10 BLU-108/B submunitions. Provides multiple kills per pass capability against tanks, armored vehicles, artillery, armored personnel carriers (APCs), and support vehicles. This cluster weapon is dropped over an area with armor. The fuze sensors detect heat and fires down at the engine of the armored vehicle.

f. CBU-103 to 105 Wind Corrected Munitions Dispenser (WCMD) – All weather, INS-guidance tail kit for CBU. The tail kit inertially steers the munition from a known release point to precise target coordinates while compensating for launch transients, winds aloft, surface winds, and adverse weather.
(1) CBU-103 = CBU-87/B + WCMD tail kit.
(2) CBU-104 = CBU-89/B + WCMD tail kit.
(3) CBU-105 = CBU-97/B + WCMD tail kit.

g. CBU-107 Passive Attack Weapon – 1000-lb CBU-87 canister loaded with a mix of inert kinetic energy penetrators (364 large, 1004 medium, 2406 small

rods) fuzed with an FZU-39/B proximity sensor and equipped with a WCMD tail kit.

h. PDU-5 Leaflet Dispenser (USN) – CBU-100 munition body loaded with leaflet materials for psychological operations purposes.
i. BL-755 – European munitions loaded with 147 anti-armor submunitions. Designed for low-altitude, low-angle deliveries against armor. (***Note:*** Dispersion is a rectangular pattern).

7. Illumination Flares

a. LUU-1/B, 5B, 6D (target marking flares)—Designated for a 30-minute burn time on the ground, providing a colored flame. LUU-1 burns red, LUU-5 burns green, and LUU-6 burns maroon.
b. LUU-2A/B – B/B Flare—Parachute flare with a 4-minute burn time at an average of 1.6 million candle power.
c. LUU-19B – A/B Covert Flare—Parachute flare with a burn time of approximately 7 minutes in the IR spectrum.
d. M257—2.75-inch rocket delivers overt (visible) illumination that provides 1 million candlepower for an average 120-sec. burn time.
e. M278—2.75-inch rocket delivers IR (.7 – 1.1 microns) illumination that provides 180 seconds of coverage.

8. Incendiary Munitions

Mk-77 Fire Bombs (USN) – 500 lbs class incendiary munition filled with 63 gallons of hydrocarbon fuel and 44 pounds of dry gelling mixture. This weapon is effective against personnel, light-skinned vehicles, and stockpiled stores.

9. Inert and Practice Munitions

a. BDU-33—25-lb practice bomb with spotting charges.
b. BDU-48/B—Practice bomb that simulates Mk-82 HD ballistics. (Similar to Mk-106.)
c. BDU-45—Mk-82 inert 500-lb practice bomb (USN).
d. BDU-50—Mk-82 inert 500-lb practice bomb (USAF).
e. BDU-56—Mk-84 inert 2,000-lb practice bomb.
f. Mk-83 (inert) – Mk-83 inert 1,000-lb practice bomb (USN).
g. Mk-106—Practice bomb simulating HD ballistics with spotting charge.
h. Mk-76—Navy version of BDU-33.
i. LGTR-Laser guided training round with 12 preflight selectable laser guidance codes. Ballistics are similar to GBU-12.

10. Common United Kingdom Weapons

a. Paveway II (PWII) – Laser guided free-fall weapons. Laser codes are pre-flight selectable (code 1511-1788). These weapons can be fuzed for instantaneous (fragmentation) or delayed (cratering) detonation, preset on the ground. The bomb is a 1000-lb class weapon, slightly broader than the US Mk-83.
b. Enhanced Paveway II (EPWII) – Hybrid version of the PWII. Weapon can be released in legacy (no GPS) or GAINS mode. If released using the GPS (GAINS) mode, then the target position can be refined by the use of the

laser – the seeker will prioritize a valid laser return over the GPS position. Laser codes are pre-flight selectable (1511-1788). These weapons can be fuzed for instantaneous (fragmentation) or delayed (cratering) detonation. Carried by Tornado GR4, Harrier GR7 and Typhoon. The E prefix means "enhanced."

c. Enhanced Paveway II Plus, (EPWII+) – A Paveway IV seeker on a PWII bomb body and tail. Introduced as an interim for PWIV, it has the ability to define impact conditions in flight and has a greater launch acceptable range (LAR). Otherwise similar to EPWII, still a 1000-lb class weapon. Carried on the Harrier GR9.
d. Paveway III (PWIII) – Similar to the GBU-24 (BLU-109 warhead). Carried on Harrier and Tornado.
e. Enhanced Paveway III (EPWIII) – Enhanced version of the PWIII with the addition of a GPS guidance kit. EWPIII only carried on Tornado GR4.
f. Paveway IV (PWIV) – Fully programmable in-flight for impact angle, azimuth, fuze settings (impact, delayed, airburst) 500-lb class weapon. Large LAR, for use with Tornado GR4 and Harrier GR9.
g. 540-lb bomb – Unguided freefall weapon similar to US Mk-82. Can be set to retard or freefall before flight. Fuzed with a 960 (standard UK fuze), which can be set to impact, delay, or airburst. Carried on the Harrier GR7/9 only.
h. 1000-lb bomb – Unguided freefall weapon similar to US Mk-83. Can be set to retard or freefall before flight. Fuzed with 960 (standard UK fuze), which can be set to impact, delay, or airburst. Carried on the Harrier GR7/9, Tornado GR4, and Typhoon.
i. CRV-7 Rocket – A mach 4 rocket, similar to the 2.75" used in the US. Pods are designated "Training" (reusable 6-shot pod) and "Operational" (disposable 19-shot pod). Warhead types are kinetic energy penetrator or high explosive semi-armor piercing, with a time delay.
j. Maverick – AGM-65 G2 and JX (IR and CCD variants). Minor differences to the US equivalents. Carried on the Harrier only.
k. Brimstone – Millimeter-wave radar, antiarmor missile. 3 missiles per launcher (one launcher with 3 missiles known as a weapon.) Carried on the Tornado GR4 with 4 weapons and on the Harrier in with 2 or 4 weapons standard. Very low collateral damage weapon.

Table 28. Recommended Target-Weapons Pairings for Ordnance	
Targets	Recommended Ordnance
Armored Vehicles: tanks, APCs, and mobile assault guns	Maverick, Hellfire K, TOW, LGB (GBU-10/12/16), GBU-39, JDAM or GP bomb (with inst. Fuze), CBU-87 CEM, CBU-89 Gator (mine), CBU-97 SFW, CBU-103/104/105 (WCMD), JSOW, 30 mm (AP/HEI), SLAM-ER
Area denial and channelization	CBU-89/104 (mine)
Soft targets: trucks, radar, aircraft parked in open, etc.	Maverick, GP bomb, GBU-39, JDAM, JSOW, Hellfire, TOW, 20/30 mm guns (AP/HEI), 25/40/105 mm gun (AC-130), CBU-87/103 (CEM), 2.75" rockets (w/ M261, M229, M151), SLAM-ER
Personnel: In the open	GP bomb, GBU-39, JDAM, 20/25/30/40/105 mm, CBU-87/103 (CEM) 2.75" rockets (M229, M151, M261, M255E1/WDU-4A/A Flechette)
In fighting / prepared positions	GP bomb, GBU-39, JDAM, 2.75" rockets (w/ M261, M299, M151)
Under light cover	GP bomb, GBU-39, JDAM, 20/25/30/40 mm, 2.75" rockets (w/ M229, M151), CBU-87/103 (CEM)
Under heavy cover (concrete bunker)	GP bomb or JDAM (w/ BLU-109/110), GBU-39, GP bomb with steel nose plug, LGB (GBU-10/24/28), Maverick, (E)GBU-15, AGM-130
Buildings	GP bomb or JDAM, LGB (GBU-10/24/28), Maverick, Enhanced (E)GBU-15, AGM- 130/158, Hellfire M/N, 2.75" rockets (w/ M229, M151), SLAM-ER

Table 28. Recommended Target-Weapons Pairings for Ordnance

Targets	Recommended Ordnance
Artillery, AAA, Rocket Launcher: In the open	CBU-87/97/103/105, JSOW, GP bomb, GBU-39, JDAM, LGB (GBU- 10/12/16/24), Maverick, Hellfire, TOW, (E)GBU-15, AGM-130, 2.75" rockets (w/ M255E1/WDU-4A/A Flechette, M261, M299, M151), 30/ 40 mm gun
In revetment	CBU-97, GP bomb, GBU-39, JDAM, LGB (GBU-10/12/16/24), Maverick, Hellfire, 30 mm, (E)GBU-15, AGM-130, 2.75" rockets (w/ M261, M229, M151)
In covered position	GP bomb, JDAM, LGB (GBU-10/12/16/24), Maverick, Hellfire, (E)GBU- 15, AGM-130, 2.75" rockets (w/ M229, M151)
SAM Site / Surface-to-Surface Missile Site	HARM, CBU-87/97/103/105, JSOW, GBU-39, JDAM, Hellfire, GP bomb, LGB (GBU-10/12/16/24), TOW, (E)GBU-15, AGM-65/130/158, 20/25/30/40/105 mm, 2.75" rockets (w/ M261, M229, M151), SLAM-ER
Moving Targets	Maverick, Hellfire, Laser JDAM, GBU-12/51, 20/30 mm guns (strafe)

AGM – air-to-ground missile HEI – high explosive incendiary
AP – armor piercing JDAM – Joint Direct Attack Munition
CBU – cluster bomb unit JSOW – joint stand-off weapon
CEM – combined effects munition LGB – laser-guided bomb
E – enhanced SFW – sensor-fused weapon
GBU – guided bomb unit SLAM-ER – stand-off land attack missile – expanded range
GP – general purpose TOW – tube-launched, optically tracked, wire guided
HARM – high-speed antiradiation missile WCMD – wind corrected munitions dispenser

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Appendix F: Risk-estimate Distances

Risk-estimate distances allow the supported commander to estimate the risk to friendly troops from friendly attack. When ordnance may be a factor to the safety of friendly troops, aircraft attack heading should be parallel to the friendly forces. This mitigates the risk from long or short deliveries. Risk-estimate distances allow the supported commander to estimate the risk in terms of the percent of friendly casualties that may result from fires against an enemy threat along the forward line of own troops (FLOT). Friendly forces outside the 0.1% probability of incapacitation (PI) distance are still subject to weapons fragments, but at a lower risk. Commanders must carefully weigh the choice of ordnance, accuracy, and proficiency of the aircraft/firing unit in relation to the risk of fratricide. Taking steps to protect friendly soldiers (e.g., prone, behind cover) can reduce the risk. Risk-estimate distances are based on fragmentation and blast patterns.

Warning: 0.1% probability of incapacitation numbers are for combat use only during "danger close" situations and are not minimum safe distances for peacetime training.

1. Danger Close

a. In CAS, artillery, mortar, and naval gunfire support fires, danger close is the term included in the method of engagement segment of a call for fire which indicates that friendly forces are within close proximity of the target. The close proximity distance is determined by the weapon and ammunition fired. Danger close is not the same as minimum safe distance (MSD) or risk-estimate distance, but allows the observer/controller to inform the FDC of the close proximity to friendly forces. Aircraft ordnance delivery inside 0.1% PI distances will be considered danger close. This is simply a warning and not a restriction to the maneuver commander and the FDC to take proper precautions.

b. The supported commander must accept responsibility for the risk to friendly forces when targets are inside 0.1% PI distance. The supported commander will pass his/her initials to terminal controllers to pass to attacking aircraft, indicating acceptance of the risk inherent in ordnance delivery inside the 0.1% PI distance. The supported commander may pre-brief danger close authorization to his/her JTAC / JFO / FO or Flight Lead / AMC. A call for fire constitutes consent to danger close from the ground commander when pre-briefed.

c. Risk-estimate distances are defined as the distance in meters or feet from the intended center of impact at which a specific degree of risk and vulnerability will not be exceeded. The risk is usually expressed as the probability of incapacitation, which is the probability that a soldier will suffer an incapacitating injury. Percent PI value is less than or equal to 1 chance in 1,000.

2. Surface-to-surface Risk-estimate Distances

a. Danger close is usually 600 meters for canon and mortars and 750 meters for naval gunfire. The creeping method of adjusting surface-to-surface fires (no adjustment greater than 100 meters) will be used during danger close missions.

b. Cannon risk-estimates were calculated using the following assumptions.

(1) Gun Target Line is perpendicular to the FLOT.

(2) An observer has adjusted the fires onto the target. Unadjusted FFE fires may entail greater risk.

(3) The friendly troops are standing unprotected in the open, in winter clothing and helmet, and on a line perpendicular to the line of fire.

Note: Friendly forces outside the PI distance may still be subject to weapons fragments, but at a lower risk. Commanders and fire supporters must carefully weigh the choice of ordnance and the accuracy and proficiency of the firing unit in relation to the risk of fratricide. Taking steps to protect friendly Soldiers (e.g. prone, behind cover) can reduce the risk.

Table 29. Mortar Risk-estimate Distances

Item / System	Description	0.1% PI (meters/feet)			10% PI (meters/feet)		
		1/3 Rng	2/3 Rng	Max Rng	1/3 Rng	2/3 Rng	Max Rng
M224	60mm mortar	100m/ 328’	150m/ 492’	175m/ 574’	60m/ 197’	65m/ 213’	65m/ 213’
M252	81 mm mortar	165m/ 541’	185m/ 607’	230m/ 755’	75m/ 246’	80m/ 262’	80m/ 262’
M120/ M121	120 mm mortar	150m/ 492’	300m/ 984’	400m/ 1312’	100m/ 328’	100m/ 328’	100m/ 328’

Table 30. Cannon Risk-estimate Distances

Item / System	Description	0.1% PI (meters/feet)			10% PI (meters/feet)		
		1/3 Rng	2/3 Rng	Max Rng	1/3 Rng	2/3 Rng	Max Rng
M102/ M119	105mm Howitzer HE	175m/ 574’	200m/ 656’	275m/ 902’	85m/ 279’	85m/ 279’	90m/ 295’
M109/ M198/ M777	155mm Howitzer HE	200m/ 656’	280m/ 919’	450m/ 1476’	100m/ 328’	100m/ 328’	125m/ 410’
M109/ M198/ M777	155mm Howitzer DPICM	280m/ 919’	300m/ 984’	475m/ 1558’	150m/ 492’	180m/ 591’	200m/ 656’

Table 31. Naval Gunfire Risk-estimate Distances							
Item/ System	Description	0.1% PI (meters/feet)			10% PI (meters/feet)		
		1/3 Rng	2/3 Rng	Max Rng	1/3 Rng	2/3 Rng	Max Rng
Mk-45	5" / 54 gun	450m/ 1476'	450m/ 1476'	600m/ 1969'	210m/ 689'	225m/ 738'	250m/ 820'

Table 32. Tomahawk Land Attack Missile Risk-estimate Distances			
Item/ System	Description	0.1% PI (meters/feet)	10% PI (meters/feet)
TLAM	1000-lb unitary warhead	200m / 656'	80m / 263'
Note: TLAM risk-estimate distances are not range dependent.			

3. Air-to-surface Risk-estimate Distances

Users must fully understand the assumptions used to develop these risk-estimate distances. All values were calculated using the Joint Munitions Effectiveness Manual Weaponeering System (JWS) version 1.1 software dated 31 Oct 2006 classified SECRET//NOFORN from the Joint Technical Coordinating Group for Munitions Effectiveness.
The classified assumptions and conditions used to develop the risk-estimate table are available on the ALSA classified website, http://www.acc.af.smil.mil/alsa/jfire. Combining the online assumptions and/or conditions with the risk-estimate numbers makes both sets of numbers classified. The following risk-estimate table depicts a "worst-probable" scenario.

Table 33. Fixed-wing Risk-estimate Distances			
Weapon	Description	0.1% PI (m/ft)	10% PI (m/ft)
Mk-82 LD contact	500-lb bomb	245 m / 804'	105m / 345'
Mk-82 LD[1] airburst	500-lb bomb	300 m / 984'	135m / 443'
Mk-82 HD contact	500-lb bomb/ retarded	230 m / 755'	130m / 427'
Mk-82 HD[1] airburst	500-lb bomb	280 m / 919'	155m / 509'
Mk-83 LD contact	1000-lb bomb	305 m / 1001'	120m / 394'
Mk-83 LD[1] airburst	1000-lb bomb	340 m / 1116'	145m / 476'
Mk-83 HD contact	1000-lb bomb/ retarded	265 m / 869'	160m / 525'
Mk-83 HD[1] airburst	1000-lb bomb/ retarded	315 m / 1034'	175m / 574'
Mk-84 LD[1] contact	2000-lb bomb	315 m / 1034'	110m / 361'

Table 33. Fixed-wing Risk-estimate Distances			
Weapon	Description	0.1% PI (m/ft)	10% PI (m/ft)
Mk-84 LD[1] airburst	2000-lb bomb	380 m / 1247’	140m / 459’
Mk-84 HD contact	2000-lb bomb/ retarded	270 m / 886’	165m / 541’
Mk-84 HD[1] airburst	2000-lb bomb/ retarded	355 m / 1165’	180m / 591’
CBU-87[2], CBU-89[2]	CEM or GATOR	265 m / 869’	180m / 591’
CBU-103/104 (WCMD)	CEM or GATOR	155 m / 509’	90m / 295’
CBU-99[2]/100[2], Mk-20[2]	Rockeye	230 m / 755’	140m / 459’
GBU-12	500-lb LGB	170 m / 558’	50m / 164’
GBU-51 contact	500-lb LCDB LGB	100 m / 328’	35m / 115’
GBU-16	1000-lb LGB	195 m / 640’	75m / 246’
GBU-10/24	2000-lb LGB	250 m / 820’	70m / 230’
GBU-38 contact	500-lb JDAM	185 m / 607’	55m / 180’
GBU-38 airburst	500-lb JDAM	230 m / 755’	80m / 263’
GBU-38(v)4 contact	500-lb LCDB JDAM	100 m / 328’	35m / 115’
GBU-32 contact	1000-lb JDAM	210 m / 689’	75m / 246’
GBU-32 airburst	1000-lb JDAM	275 m / 902’	100m / 328’
GBU-31 contact	2000-lb JDAM	265 m / 869’	80m / 263’
GBU-31 airburst	2000-lb JDAM	305 m / 1001’	105m / 345’
GBU-39 contact	250-lb SDB	135 m / 443’	35m / 115’
GBU-39 airburst (7’)	250-lb SDB	160 m / 525’	40m / 131’
GBU-39 airburst (14’)	250-lb SDB	180 m / 591’	55m / 181’
AGM-130	2000-lb TV guided	220m / 722’	70m / 230’
AGM-154	JSOW	170m / 558’	100m / 328’
AGM-158A	JASSM	210m / 689’	55m / 181’
AGM-65	Maverick (All)	95m / 312’	35m / 115’
M151, M229, M261[3]	2.75” Rockets med alt	365m / 1198’	190m / 623’
	2.75” Rockets low alt	225m / 738’	115m / 377’
Zuni – Contact[3]	5” Rockets low alt	290m / 951’	125m / 410’
M61A1	20 mm gatling	60m / 197’	35m / 115’
GAU-12	25 mm gatling	55m / 181’	30m / 98’
GPU-5A, M230A1	30 mm gatling / chain	40m / 131’	25m / 82’
GAU-8 (A-10)	30 mm gatling	65m / 213’	40m / 131’

Table 33. Fixed-wing Risk-estimate Distances			
Weapon	Description	0.1% PI (m/ft)	10% PI (m/ft)
AC-130	25 mm	65m / 213'	35m / 115'
	30 mm Mk 44	100m / 328'	45m / 148'
	40 mm	75m / 246'	25m / 82'
	105 mm cannon	165m / 541'	65m / 213'
AGM-114 K	Hellfire	110m / 361'	40m / 131'
AGM-114 K2A	Hellfire	110m / 361'	50m / 164'
AGM-114 M	Hellfire	125m / 410'	40m / 131'
AGM-114 N	Hellfire	120m / 394'	40m / 131'
PW II / EPW2[4]	UK PI Values	235m / 771'	---
PW III / EPW3[4]	UK PI Values	305m / 1001'	---
AGM-65[4]	UK PI Values	130m / 427'	---
UK 540-lb bomb[4]	UK PI Values	200m / 656'	---
UK 1000-lb bomb[4]	UK PI Value	240m / 787'	---
CRV-7 – Single Rocket[4]	UK PI Value	105m / 345'	---
CRV-7 – Op Pod[4]	UK PI Value	125m / 410'	---

See classified ALSA website for munitions profiles and assumptions.
[1] Airburst fuzing (DSU-33).
[4] Not recommended for use with troops in contact.
[3] Fixed-wing only. See Table 34 for rotary-wing numbers.
[4] UK – United Kingdom values shown for reference. No UK 10% PI available.
AGM – air-to-ground missile HD = high drag / air inflatable retarder (AIR)
alt – altitude LD – low drag
CBU – cluster bomb unit PW – Paveway
EPW – enhanced Paveway WCMD – wind corrected munitions dispenser
GBU – guided bomb unit

Warning: 0.1% / 10% Probability of Incapacitation numbers are for combat use only during danger close situations and are not minimum safe distances for peacetime training.

Warning: The risk-estimate distances listed in Tables 33 and 34 are highly generalized and are valid only for the conditions specified in the assumptions spreadsheet on the ALSA classified website http://www.acc.af.smil.mil/alsa/jfire. Any change to these assumptions may significantly increase the risk-estimate distances.

Table 34. Rotary-wing Risk-estimate Distances			
Airframe / Weapon	Firing Range	0.1% PI (meters/feet)	10% PI (meters/feet)
0.50 cal[1]	300m	20m / 66’	15m / 49’
	500m	35m / 115’	25m / 82’
Cobra / 20 mm (M56)	300m	75m / 246’	30m / 98’
	800m	85m / 279’	50m / 164’
Apache / 30 mm (M789)	500m	70m / 230’	25m / 82’
	1000m	75m / 246’	30m / 98’
2.75” Rockets			
M-151	300m	140m / 459’	60m / 197’
	800m	160m / 525’	80m / 263’
	1000m	180m / 591’	90m / 295’
	2000m[2]	300m / 984’	155m / 509’
	3000m[2]	405m / 1329’	210m / 689’
M-229	300m	145m / 476’	70m / 230’
	800m	165m / 542’	90m / 296’
	1000m	185m / 607’	100m / 328’
	2000m[2]	305m / 1001’	165m / 542’
	3000m[2]	410m / 1346’	220m / 722’
Hellfire Variants[3]			
AGM-114 K2A	All Ranges	110m / 361’	50m / 164’
AGM-114 M		125m / 410’	40m / 131’
AGM-114 N		120m / 394’	40m / 131’
BGM-71 TOW Anti-Tank	All Ranges	N/A	N/A

Rocket / gun assumptions: Running / diving fire with 5-20 degree dive angle fired parallel to FLOT; 10 or 20 round gun burst or 2 round rocket burst; forward flight.
[1]Non-exploding round (ball-type ammunition)
[2]2000m and 3000m 2.75” rocket values for use by US Army aviation only.
[3]AGM-114 A/B/C/D/L/K variants will have risk-estimate distances smaller than the variants listed above.
AGM – air-to-ground missile
cal – caliber
TOW – tube-launched, optically tracked, wire guided

Appendix G:General Information

1. Conversion Tables

Use the following table to calculate the number of minutes : seconds that it will take an aircraft to go from the IP to the target at various ground speeds. Ground speed (GS) is airspeed adjusted for winds at altitude. Table 36 converts meters to feet for use on 9-Line briefings.

Table 35. Speed and Time Conversions

GS (kts)	nm/ min	8 nm	9 nm	10 nm	11 nm	12 nm	13 nm	14 nm	15 nm
60	1	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00
80	1.3	6:00	6:45	7:30	8:15	9:00	9:45	10:30	11:15
90	1.5	5:20	6:00	6:40	7:20	8:00	8:40	9:20	10:00
110	1.8	4:22	4:55	5:28	6:00	6:33	7:05	7:38	8:11
120	2	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30
150	2.5	3:12	3:36	4:00	4:24	4:48	5:12	5:36	6:00
270	4.5	1:47	2:00	2:13	2:27	2:40	2:53	3:07	3:20
300	5	1:36	1:48	2:00	2:12	2:24	2:36	2:48	3:00
330	5.5	1:28	1:39	1:50	2:00	2:11	2:23	2:33	2:44
360	6	1:20	1:30	1:40	1:50	2:00	2:10	2:20	2:30
420	7	1:09	1:17	1:26	1:34	1:43	1:51	2:00	2:09
450	7.5	1:04	1:12	1:20	1:28	1:36	1:44	1:52	2:00
480	8	1:00	1:08	1:15	1:23	1:30	1:38	1:45	1:53
510	8.5	0:57	1:04	1:11	1:18	1:25	1:32	1:39	1:46
540	9	0:53	1:00	1:07	1:13	1:20	1:27	1:33	1:40

Aircraft Run-in Speeds

Aircraft	GS (kts)	Aircraft	A/S (kts)
AH-1	60-120	AH-64	60-120
MH-60	60-120	AH-6	60-90
OH-58	60-90	A-10	270-350
B-1	480-540	AV-8B	420-480
B-2	400-460	F-15E/F-16	480-540
B-52	380-440	F/A-18	480-520

Table 36. Distance Conversion Table (1 meter = 3.28 feet)					
Meters	Feet	Meters	Feet	Meters	Feet
25	82	525	1722	1025	3362
50	164	550	1804	1050	3444
75	246	575	1886	1075	3526
100	328	600	1968	1100	3608
125	410	625	2050	1125	3690
150	492	650	2132	1150	3772
175	574	675	2214	1175	3852
200	656	700	2296	1200	3936
225	738	725	2378	1225	4018
250	820	750	2460	1250	4100
275	902	775	2542	1275	4182
300	984	800	2624	1300	4264
325	1066	825	2706	1325	4346
350	1148	850	2788	1350	4428
375	1230	875	2870	1375	4510
400	1312	900	2952	1400	4592
425	1394	925	3034	1425	4674
450	1476	950	3116	1450	4756
475	1558	975	3198	1475	4838
500	1640	1000	3280	1500	4920
Notes: 1 statute mile (5280 feet) = 1610 m 1 nautical mile (6076 feet) = 1852 m					

2. Minimum Safe Distances

Warning: The numbers presented here are intended for use on training missions at air-to-surface ranges where minimum safe distances have not been established. Users must adhere to all local range procedures, Service directives, and abide by any MSDs established at those ranges, even if they are more restrictive than the ones published here. The MSDs provided are not intended to allow personnel to deviate from any published guidance and are only authorized for use in the absence of Service directives. They are only authorized for aircrew and JTACs that are conducting CAS training IAW the established TTP in JP 3-09.3. JTACs will wear Service mandated gear (including eye protection) when operating at these MSDs.

a. General Information

(1) Applicability – This table establishes minimum distances that ground JTAC / TACP personnel may be safely located in relation to the target / impact area of standard munitions. The area within the limits

established by this table is designated the danger area. Minimum safe distances are from the target / impact area, and for a ground function only (no airburst munitions.) Additionally, range features can affect weapon impact points, and must be factored into planning (e.g., high terrain short of the intended target may intersect weapon flyout trajectories, causing short impacts). Only the weapons listed may use the distances contained in the table and aircrew will adhere to specific remarks for a weapon if they are listed. Only the following aircraft may utilize the MSD table: A-10, AC-130, AV-8B, B-1, B-2, B-52, F-15E, F-16, F/A-18, AH-1, UH-1.

(2) Parameters Assumptions – Aircraft attack parameters must be at or below 15,000 feet AGL for level or diving deliveries, and at or below 20,000 feet AGL, 540 knots true air speed (KTAS) for level LGBs. For GBU-31/32/38/39 munitions from a bomb on coordinate mode, altitude and release airspeeds are limited by range regulation parameters and weapon battery life. B-1, B-2, and B-52 must reference Note 5, and AC-130 must reference Note 6.

(3) Multiple Deliveries – Ripple / string / stick deliveries must be less than 500 feet total length, with a maximum of 6 weapons. For IAMs deliveries, a 250 foot maximum impact distance from the primary target location will be used for all pattern-managed drops.

(4) Ammo / Bullet Numbers – For AC-130 operations, ammo numbers are taken from AFI 11-2AC-130v3. Ricochet fan numbers are SAFE RANGE-derived for 20mm and 30mm (extrapolated for 25mm) fighter strafe passes: single drop fighter strafe min safe distance numbers are Joint Munitions Effectiveness Manual- (JMEM-) derived. Helicopter ricochet fans are SAFE RANGE-derived and MSD numbers are JMEM-derived.

(5) Rocket Deliveries – Fixed-wing parameters: at or below 15,000 AGL, 540 KTAS, 15-degrees of dive, 8000 ft slant range. Rotary-wing parameters: running / diving fire with 5-20 degree dive angle, 2 round burst, forward flight.

(6) Not all munitions / platforms currently available in the inventory have MSD values associated with them. This is a limitation of the JWS software used to calculate the MSDs. As JFIRE is revised in the future, expect MSDs for those munitions / platforms to become available.

Table 37. Minimum Safe Distances for Ground Parties (Training Use Only: Live Fire)

Weapon	MSD (meters/ft)	Ricochet Fan (Deg/Meters/Feet)	Notes
Guided Munitions – All Platforms			
GBU-10 (2,000-lb LGB)	1800m/5904’		1, 4
GBU-12 (500-lb LGB)	1000m/3280’		1, 4
GBU-16 (1000-lb LGB)	1000m/3280’		1, 4
GBU-51 (500-lb LCDB LGB)	N/A		1, 4
GBU-10/12/16/51 Inert	500m/1640’		1, 4

Table 37. Minimum Safe Distances for Ground Parties (Training Use Only: Live Fire)			
Weapon	MSD (meters/ft)	Ricochet Fan (Deg/Meters/Feet)	Notes
Guided Munitions – All Platforms			
GBU-31 (2000-lb JDAM)	1800m/5904’		1
GBU-32 (1000-lb JDAM)	1000m/3280’		1
GBU-38 (500-lb JDAM)	1200m/3936’		1
GBU-38(v)4 (500-lb LCDB JDAM)	N/A		1
GBU-39 (250-lb SDB)	N/A		1
GBU-31/32/38 Inert	500m/1640’		1
GBU-39 Inert	N/A		1
Fighters / Helicopters			
Mk-82 LD/HD (500-lb)	1200m/3936’		
Mk-83 (1000-lb)	1000m/3280’		
Mk-84 LD/HD (2000-lb)	1800m/5904’		
Mk-82/83/84 Inert	500m/1640’		
CBU-87/103	1700m/5576’		3
CBU-99[4]/100[4], Mk-20[4]	N/A		
BDU-33/38/45/50/56	500m/1640’		
Mk-76	500m/1640’		
LGTR I	500m/1640’		1,4
AGM-65G (WDU-24)	1300m/4264’		1
2.75” Rockets WP or HE	700m/2296’	60°/3100m/10168’	2
2.75” Rockets Inert	500m/1640’	60°/1800m/5904’	2
20 mm (Fighter)	500m/1640’	60°/2700m/8856’	2
25 mm/30 mm (Fighter)	500m/1640’	60°/2600m/8528’	2
7.62 mm (Helo)	500m/1640’	All Headings	2
.50 cal/20 mm/30 mm (Helo)	500m/1640’	N/A	2
AC-130			
25 mm	500m/1640’ 400m/1312’	60°/2000m/6560’	6
30 mm	N/A	N/A	6
40 mm	500m/1640’ 300m/984’	None	6
105 mm	650m/2132’ 600m/1968’	60°/700m/2296’	6
Med Alt Bombers – GP Bombs (Live or Inert)			
B-1: Mk-82	1200m/3936’		5
B-1: Mk-84	1800m/5904’		5
B-52: Mk-82	3000m/9840		5
B-52: Mk-84	3500m/11480’		5

Table 37. Minimum Safe Distances for Ground Parties (Training Use Only: Live Fire)			
Weapon	MSD (meters)	Ricochet Fan (Deg/Meters/Feet)	Notes
Other Munitions			
AGM-130 (2000-lb TV guided)	N/A		
AGM-154 (JSOW)	N/A		
AGM-158A (JASSM)	N/A		
Zuni (5" Rockets)	N/A	N/A	
AGM-114 K Hellfire	N/A		
AGM-114 K2A Hellfire	N/A		
AGM-114 M Hellfire	N/A		
AGM-114 N Hellfire	N/A		
AGM – air-to-ground missile JSOW – joint stand-off weapon, BDU – bomb dummy unit LCDB – low collateral damage bomb cal – caliber LD – low drag CBU – cluster bomb unit LGB – laser guided bomb GBU – guided bomb unit LGTR – laser guided training round HD – high drag SDB – small diameter bomb HE – high explosive WP – white phosphorous JASSM – joint air-to-surface stand-off missile JDAM – Joint Direct Attack Munition			

b. Notes

(1) Guided Weapon Hazard Areas – Hazard areas for guided weapons (AGM-65, LGBs, and JDAMs) are highly dependent upon launch conditions and in some cases coordinate accuracies. Coordinate quality (TLE) and passage presents a significant risk to ground personnel for coordinate-dependent weapons release in a bomb on coordinate mode. Extreme caution must be taken to prevent mishaps. Weapon malfunctions (such as fin failures) are not included, with the assumption that malfunctioning weapons have the same probability of impacting any point within the hazard area.

(a) JTACs may tactically derive coordinates, but these coordinates must be cross-checked and confirmed using all available means to include target coordinates listed in range supplements, if applicable. Likewise, aircraft may tactically derive coordinates (via TGP, SAR radar, etc.) for actual employment with bomb on coordinate weapons. Aircraft-derived coordinates must also be cross-checked and confirmed as well.

(b) Guided weapons distances are not platform-specific. Minimum distances apply to all delivery platforms, however, release parameters must be IAW the parameter assumptions detailed above.

(2) Bullet / Rocket Ricochet Fans – The ricochet fan will be dependent upon many variables, such as bullet / rocket weight and shape, impact angle, speed, etc. Thus, the ricochet fan must be applied to each target so that

ground personnel are not within the ricochet fan. The aircraft flight path / firing direction will bisect the ricochet fan—a 60 degree fan will be drawn 30 degrees right and 30 degrees left of the flight path / firing direction.

(3) CBU-87/103 – Data is for intact canister and is based on a 209' x 183' pattern size. Delivery assumptions are for 4 canisters or less, 75 feet spacing, 1200 feet height of function, 2000 revolutions per minute spin. For patterns that exceed these parameters, the MSD must be expanded to include the larger pattern. Distances indicated must be added to the radius of the calculated bomblet pattern. CBU-87/103 data is for fighters only and is restricted to fighter employment only.

(4) Environmental Factors for Laser-Guided Weapons – Data assumes environmental conditions are conducive to seeker / weapon acquisition, and reflected laser energy is sufficient to guide the weapon to the target.

(5) Medium Altitude Bombers (B-1, B-2, B-52)

(a) Guided Weapons – Bombers must adhere to Note 1 above for guided weapon employment. The maximum pattern distance for IAM weapons deliveries using pattern management tactics will not exceed 250 feet from the intended target passed from the JTAC.

(b) GP Bombs – Medium altitude bombers conducting aircraft computed Mk-82/Mk-84 deliveries are limited to 30,000 feet AGL and below, airspeeds not exceeding 540 KTAS, and maximum stick length of 500 feet and 6 weapons. Weapon releases above that altitude will not meet weapon accuracies used in the MSD calculations and should not be employed with this table.

(c) Cross-wind Limits – A 50 knot direct cross-wind was assumed in the calculations. Weapons should not be delivered using the table numbers when the cross-wind component exceeds 50 knots at release.

(d) B-2 deliveries are restricted to GBU-31/38 only.

(6) AC-130 Parameters and Restrictions

(a) When radar is the primary fire control sensor, fire no closer to ground party than 650m for 105mm TP/HE, 500m for 40mm HEI and 25mm TP/HEI. When IR or TV is the primary fire control sensor and the system has been tweaked (min 750m away from friendlies) fire no closer to ground parties than 600m for 105mm HE, 400m for 105mm TP, 300m for 40mm HEI, and 400m for 25mm TP/HEI.

(b) For ricochet risk mitigation with TP ammunition, the AC-130 will use no-fire zones if ground party is within 700m for 105mm TP and 2000m for 25mm TP. No-fire zones are relative to ground party location from target and are based on aircraft heading, not gun-to-target line. To compute the no-fire aircraft headings, take the heading from friendly position to the target and subtract 60 degrees to define the beginning of the no-fire zone. Then subtract an additional 60 degrees to define the end of the no-fire zone.

(7) Source Data – Assumptions, calculations, etc. for the MSD table can be requested via email: acc.a3tw@langley.af.smil.mil or phone DSN 574-5896, HQ ACC/A3TW.

3. Surface-to-air Threat Capabilities

Table 38. Surface-to-air Missile Threat Capabilities					
System	Max Eff Rng (kM)	Max Eff Rng (NM)	Altitude (feet)	Guidance / Guidance Radar	Remarks
SA-2	55	29.7	328-98.4K	Rdr (Fan Song)	Rear area defense
SA-3	28	15.1	66-65.6K	Rdr (Low Blow)	Area defense, 2/4 rail launcher
SA-4	50	27	492-82K	Rdr (Pat Hand)	Point defense. Mobile
SA-5	300	162	984-131.2K	Rdr (Square Pair)	Hi speed, hi alt, HVAA threat
SA-6	25	13.5	98-49.2K	Rdr (Straight Flush)	Tracked vehicle, 3 msl launcher
SA-7	4.2	2.3	164-7.5K	IR	MANPAD. Tail only.
SA-8	15	8.1	82-16.4K	Rdr (Land Roll)	6 wheel vehicle
SA-9	4.2	2.3	98-11.5K	IR (Flat Box A acq rdr)	Clear WX, BRDM-2 w/4 msl canisters
SA-10	150	81	33-88.6K	Rdr (Flap Lid or Tombstone)	Cruise missile defense
SA-11	35	18.9	98-72.2K	Rdr (Snow Drift/Tube Arm)	Tracked vehicle, 4 msl launcher
SA-12A	75	40.5	82-82K	Rdr (Grill Pan)	Hi-performance, anti-ARM
SA-12B	200	108	82K-98.4K	Rdr (Grill Pan)	Standoff jamming aircraft threat
SA-13	5	2.7	82-9.8K	IR (Snap Shot)	Tracked vehicle, SA-9 follow on
SA-14	5	2.7	50-9.8K	IR	MANPAD. All aspect
SA-15	12	6.5	33-32.8K	Rdr (Scrum Half)	Mobile, SA-8 follow on

Table 38. Surface-to-air Missile Threat Capabilities					
System	Max Eff Rng (kM)	Max Eff Rng (NM)	Altitude (feet)	Guidance / Guidance Radar	Remarks
SA-16	5	2.7	33-9.8K	IR	MANPAD. Improved SA-14
SA-17	45	24.3	98-52.5K	Rdr (Chairback)	Mobile, SA-11 follow on
SA-18	5	2.7	33-9.8K	IR	MANPAD. SA-16 follow on
SA-19	20	10.8	15-32.8K	Rdr (Hot Shot)	Mobile. Mounted on 2S6
Stinger Basic	4	2.2	0-9.8K	IR	MANPAD effective against low alt, hi speed
Roland II	15	8.1	33-19.7K	Optical or Rdr	Tracked vehicle, 2 msl launcher
Crotale / Shahine	15	8.1	50-16.4K	Rdr	Wheeled vehicle, 4 msl launcher

acq – acquisition
alt – altitude
ARM – antiradiation missile
BRDM – Boyevaya Razvedyvatelnaya Dozornaya Mashina
HVAA – high value airborne asset
IR – infrared
MANPAD – man-portable air defense
msl – missile
Rdr – radar

Table 39. Antiaircraft Artillery Threat Capabilities					
System	Barrel x Cal	Tac Rng (km / feet)	Max Vert / Hor (feet)	Control / Guidance	Remarks
M38/M46	1 x 12.7	1.0 / 3.3K	13.8K / 25.8K	Optical	Tripod mounted heavy MG
ZPU-1/2/4	½/4 x 14.5	1.4 / 4.6K	15.1K / 20.7K	Optical	Towed or APC mounted
ZU-23	2 x 23	2.0 / 6.6K	16.7K / 23K	Optical or Mech	Towed or APC mounted
ZSU 23-4	4 x 23	2.5 / 8.2K	16.4K / 23K	Opt / Rdr (Gun Dish or Dog Ear)	Tracked vehicle
ZSU 57-2	2 x 57	4.0 / 13.1K	30.8K / 39.4K	Optical	Tracked Vehicle
M53/M59	2 x 30	3.0 / 9.8K	20.7K / 31.8K	Optical	Large 8 wheel vehicle
S-60/ Type 59	1 x 57	6.5 / 21.3K	30.8K / 39.4K	Opt / Rdr (Fire Can or Flap Wheel)	4 wheel towed
M-1985	2 x 57	4.0 / 13.1K	28.9K / 39.4K	Opt / Rdr (Fire Can or Flap Wheel)	Tracked vehicle (N. Korea)
KS-12A, M1939/1944	1 x 85	10.2 / 33.5K	33.5K / 50.9K	Opt / Rdr (Fire Can)	4 wheel towed
KS-19/ KS-1A	1 x 100	13.7 / 45 K	49.2K / 68.9K	Opt / Rdr (Fire Can, Whiff, Flap Wheel,)	Towed
2S6	4 x 30	4.0 / 13.1K	20.3K / 27.2K	Opt / Rdr (Hot Shot)	Tracked w/ 8 x SA-19
Type 80	1 x 57	5.5 / 18K	28.9K / 39.4K	Opt / Mech	Tracked Vehicle
Twin 37	2 x 37	4.0 / 13.1	22K / 26.2K	Opt / Rdr / Mech	Tracked T-69 chassis
APC – armored personnel carrier Mech – mechanical MG – machine gun Opt – optical Rdr – radar					

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Appendix H: (SECRET) Electronic Attack / Call for Electronic Fires (See ALSA classified website.)

For Appendix H: Electronic Attack / Call for Electronic Fires, see the ALSA classified website http://www.acc.af.smil.mil/alsa/jfire.

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Glossary

PART I – ABBREVIATIONS AND ACRONYMS

A

AAA	antiaircraft artillery
A/A	air-to-air
A/C	aircraft
A/S	air-to-surface
ACA	airspace coordination area
ACM	airspace coordinating measure
ACO	airspace control order
acq	acquisition
ADA	air defense artillery
AFDDEC	Air Force Doctrine Development and Education Center
AFI	Air Force instruction
AFTTP(I)	Air Force tactics, techniques, and procedures (interservice)
AGL	above ground level
AGM	air-to-ground missile
AIO	air intelligence officer
AIR	air inflatable retarder
ALLTV	all light level television
ALO	air liaison officer
ALSA	Air Land Sea Application Center
alt	alternate
AM	amplitude modulation
AMC	air mission commander
ANDVT	advanced narrowband digital voice terminal
AO	area of operations
AP	armor piercing
APC	armored personnel carrier
API	armor piercing incendiary
APICM	antipersonnel improved conventional munition
ARM	antiradiation missile
ARTY	artillery
ASAP	as soon as possible
ASOC	air support operations center
ASR	air support request
AT	antitank
ATACMS	Army Tactical Missile System
ATAS	air-to-air Stinger
ATFLIR	advanced targeting forward-looking infrared
ATO	air tasking order
AUP	advanced unitary penetrator
AWACS	Airborne Warning and Control System

B

BCL	battlefield coordination line (USMC)

BCT	brigade combat team
BDA	battle damage assessment
BDE	brigade
BDU	bomb dummy unit
BLU	bomb live unit
BN	battalion
BOC	bomb on coordinate
BOT	bomb on target
BP	battle position
BRDM	Boyevaya Razvedyvatelnaya Dozornaya Mashina (armored reconnaissance vehicle)

C

C2	command and control
CA	combat assessment
cal	caliber
CAS	close air support
CASEVAC	casualty evacuation
CAT	category
CBRN	chemical, biological, radiological, and nuclear
CBU	cluster bomb unit
CCA	close combat attack
CCD	charge-coupled device
CDE	collateral damage estimation
CDS	container delivery system
CEM	combined effects munition
CFF	call for fire
CFL	coordinated fire line
CGRS	common geographic reference system
CJCSI	Chairman of the Joint Chiefs of Staff instruction
CO	company
COLT	combat observation and lasing team
COMM	commercial
COTS	commercial off-the-shelf
CP	contact point
CPHD	copperhead
CRC	control and reporting center
C/S	call sign
CSAR	combat search and rescue

D

DASC	direct air support center (USMC)
DASC(A)	direct air support center (airborne)
DD	Department of Defense (form)
DIV	division
DMLGB	dual-mode laser-guided bomb
DPICM	dual purpose improved conventional munition
DS	direct support
DSN	Defense Switched Network
DTV	day television

DVO	direct view optics
DZ	drop zone

E

E	enhanced
EA	electronic attack
EARF	electronic attack request form
Eff	effective
EGM-84	Earth Gravitational Model 1984
EM	electromagnetic
EO	electro-optical
EPW	Enhanced Paveway
ER	extended range
EST	estimated
ET	electronic time
EW	electronic warfare

F

FA	field artillery
FAC(A)	forward air controller (airborne)
FDC	fire direction center
FEBA	forward edge of the battle area
FEZ	fighter engagement zone
FFA	free fire area
FFE	fire for effect
FIST	fire support team
FLIR	forward-looking infrared
FLOT	forward line of own troops
FM	field manual (USA)
FO	forward observer
FOV	field of view
FRAG	fragmentation
FREQ	frequency
FSC	fire support coordinator (USMC), fire support cell (USA)
FSCC	fire support coordination center
FSCL	fire support coordination line
FSCM	fire support coordination measure
FSCOORD	fire support coordinator (USA)
FSE	fire support element
FSO	fire support officer
FT/ft	feet
FW	fixed-wing

G

GARS	Global Area Reference System
GBU	guided bomb unit
GEOTRANS	geographic translators
GMLRS	Guided Multiple Launch Rocket System
Gnd	ground
GP	general purpose
GPS	global positioning system

GRG	gridded reference graphic
GS	ground speed
GSM	global system for mobile communications
GTL	gun-target line

H

HAE	height above ellipsoid
HARM	high-speed antiradiation missile
HC	hexachloroethane
HD	high drag
HE	high explosive
HEDP	high explosive dual purpose
HEI	high explosive incendiary
HEI-P	high explosive incendiary-plugged
HF	high frequency
HHQ	higher headquarters
HIDACZ	high-intensity airspace control zone
HIMARS	High Mobility Artillery Rocket System
HMCS	helmet mounted cueing system
HOB	height of burst
HPW	high performance waveform
HQ	headquarters
HQ I/II	have quick I or II
HTS	HARM targeting system
HVAA	high value airborne asset

I

IAM	inertially aided munition
IAW	in accordance with
ICM	improved conventional munition
ICOM	integrated communications security
ID	identification
IDM	improved data modem
IDN	Initial Distribution Number
IDT	interflight data transfer
IED	improvised explosive device
IFF	identification, friend or foe
ILLUM	illumination
INMARSAT	international maritime satellite
INS	inertial navigation system
IP	initial point
IR	infrared
IRC	internet relay chat
ISR	intelligence, surveillance, and reconnaissance
IZLID	infrared zoom laser illuminator designator

J

JAAT	joint air attack team
JASSM	joint air-to-surface stand-off missile
JCA	jamming control authority
JDAM	Joint Direct Attack Munition

JFO	joint fires observer
JMEM	Joint Munitions Effectiveness Manual
JOC	joint operations center
JP	joint publication
JRFL	joint restricted frequency list
JSOW	joint stand-off weapon
JSTARS	Joint Surveillance Target Attack Radar System
JTAC	joint terminal attack controller
JTAR	joint tactical air strike request
JTIDS	Joint Tactical Information Distrubution System
JWS	Joint Munitions Effectiveness Manual Weaponeering System

K

K	thousand
kHz	kilohertz
km	kilometer
KTAS	knots true air speed

L

LANTIRN	low-altitude navigation and targeting infrared for night
LAR	launch acceptable range
LAT	latitude
lb	pound
LCDB	low collateral damage bomb
LD	low drag
LGB	laser-guided bomb
LGTR	laser-guided training round
LIA	laser illuminator assembly
LJDAM	laser-guided Joint Direct Attack Munition
LLLTV	low-light level television
LOC	line of communications
LONG	longitude
LOS	line of sight
LST	laser spot tracker
LTD	laser target designator
LTL	laser target line
LTM	laser target marker (commonly referred to as IR marker or IR pointer)
LZ	landing zone

M

m	meter(s)
MAGTF	Marine Air-Ground Task Force
MANPAD	man-portable air defense
MAX	maximum
MCCDC	Marine Corps Combat Development Command
MCPDS	Marine Corps Publication Distribution System
MCRP	Marine Corps reference publication
mech	mechanical
MEZ	missile engagement zone
MFOM	Multiple Launch Rocket System family of munitions

MG	machine gun
MGRS	military grid reference system
MHz	megahertz
mils	miliradian
MILSTRIP	Military Standard Requisition and Issue Procedure
MIN	minimum
min	minute
MLRS	Multiple Launch Rocket System
mm	millimeter
MMW	millimeter wave
MOF	multioptional fuze
MPSM	multi-purpose submunition
MRR	minimum-risk route
MSD	minimum safe distance
MSL	mean sea level
MT	mechanical time
MTADS	multisensor towed array detection system
MTSQ	mechanical time superquick
MTTP	multi-Service tactics, techniques, and procedures
MVR	maneuver

N

NAI	named area of interest
NATO	North Atlantic Treaty Organization
NAVSUP	Navy supplement
NFA	no-fire area
NFTL	no-fire target list
NGF	naval gun fire
NLT	no later than
NM/nm	nautical mile
NSFS	naval surface fire support
NTS	night targeting system
NTTP	Navy tactics, techniques, and procedures
NVG	night vision goggle
NWDC	Navy Warfare Development Command

O

OP	observation post, orbit point
OPR	office of primary responsibility
opt	optical
OTL	observer target line
ORD	ordinate

P, Q

P	proximity
PA	position area
PCN	publication control number
PD	point detonating
PI	probability of incapacitation
PLS	personal locator system
PLT	platoon

PRF	pulse repetition frequency
pri	priority
PW	Paveway

R

RAP	rocket-assisted projectile
Rdr	radar
recce	reconnaissance
RED	risk-estimate distance
REF	reference(s)
req'd	required
RF	radio frequency
RFA	restrictive fire area
RFL	restrictive fire line
rng	range
rnds	rounds
ROA	restricted operations area
ROE	rules of engagement
ROVER	remotely operated video enhanced receiver
ROZ	restricted operations zone
RP	red phosphorous
RREMS	refinements, record as target, end of mission, and surveillance
RW	rotary-wing

S

S-2	Intelligence
S-3	Operations
SADL	situation awareness data link
SALT	size, activity, location, time
SALUTE	size, activity, location, uniform, time, and equipment
SAM	surface-to-air missile
SAR	synthetic aperture radar
SATCOM	satellite communications
SCAT-MINE	scatterable mines
SCDL	surveillance control data-link
SDB	small diameter bomb
SEAD	suppression of enemy air defenses
sec	second
SFW	sensor-fused weapon
SINCGARS	single-channel ground and airborne radio system
SLAM	stand-off land attack missile
SLAM-ER	stand-off land attack missile – expanded range
SOF	special operations forces
SPINS	special instructions

T

TAC	tactical
TAC(A)	tactical air coordinator (airborne)
TACP	tactical air control party
TAD	tactical air direction
TADS	target acquisition and designation system

TAI	target area of interest
TAOC	tactical air operations center (USMC)
TD	time delay
TFLIR	targeting forward-looking infrared
TFR	terrain following radar
TGL	target to gun line
TGO	terminal guidance operations
TGP	targeting pod
TGT	target
TIALD	thermal imaging airborne laser designator
TIS	thermal imaging system
TISS	thermal imaging sensor system
TLAM	Tomahawk land attack missile
TLDHS	target location designation handoff system
TLE	target location error
TOC	tactical operations center
TOF	time of flight
TOT	time on target
TOW	tube-launched, optically tracked, wire guided
TP	target practice
TPT	target practice tracer
TPL	target precedence list
TRADOC	United States Army Training and Doctrine Command
TRAP	tactical recovery of aircraft and personnel (USMC)
TRP	target reference point
TSS	target sensing system
TTP	tactics, techniques, and procedures
TTT	time to target
TV	television
TVS	television sensor

U

UA	unmanned aircraft
UAS	unmanned aircraft system
UHF	ultrahigh frequency
UK	United Kingdom
US	United States
USA	United States Army
USAF	United States Air Force
USMC	United States Marine Corps
USN	United States Navy
UTM	universal transverse mercator

V

VFR	visual flight rules
VDL	video downlink
VHF	very high frequency
VIS	visibility
VMF	variable message format
VSAT	very small aperture terminal

VT	variable time

W, X, Y, Z

WCMD	wind corrected munitions dispenser
WGS 84	World Geodetic System 1984
WP	white phosphorous
wpn	weapon
WSO	weapon system operator
WX	weather

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FM 3-09.32
MCRP 3-16.6A
NTTP 3-09.2
AFTTP(I) 3-2.6

17 Dec 2007

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