BY ORDER OF THE SECRETARY OF THE AIR FORCE

AIR FORCE TACTICS, TECHNIQUES, AND PROCEDURES 3-3.JTAC

17 March 2021

COMBAT FUNDAMENTALS JTAC

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Tactical Doctrine

Combat Fundamentals—JTAC

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PURPOSE: The AFTTP 3-3 series publications are the primary tactical doctrine references for the USAF. This series provides considerations to be used in planning and execution for effective mission accomplishment. These recognized best practices are presented as the foundation of employment and standardization for all USAF weapons systems.

APPLICABILITY: This publication applies to all regular, Air Force Reserve, and Air National Guard personnel. Per AFI 33-360, AFTTP publications are authoritative, but not directive. Deviations require sound judgment and careful consideration. In cases where this publication conflicts with an AFI, the applicable AFI takes precedence. The following definitions from JP 1-02 apply:

> **Tactics**—The employment and ordered arrangement of forces in relation to each other.
>
> **Techniques**—Nonprescriptive ways or methods used to perform missions, functions, or tasks.

Procedures—Standard, detailed steps that prescribe how to perform specific tasks.

SCOPE: This manual addresses basic weapon system tasks. AFTTP 3-3 provides information and guidelines on basic procedures and techniques used for standardization. It presents a solid foundation on which effective tactics can be executed.

FOREIGN MILITARY SALES: Current Foreign Military Sales (FMS) tactics volume program participants and their associated authorized-for-release volumes can be found at **https://intelshare.intelink.gov/sites/561jts/fms**. Refer questions about the FMS tactics manual program to the 561 WPS FMS division at: e-mail: 561jts.fms@us.af.mil or DSN: 682-3811.

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SUMMARY OF CHANGES

Chapter 1

- Minor edits.

Chapter 2

- Updated GPS info with RSR.
- Added PRC-160 and 163 information to table.
- Updated DACAS information.
- Updated Harris SA programming.
- Updated Software information.
- Updated kit configuration.

Chapter 3

- Changed title to Mission Planning.
- Updated verbiage, changing battlefield airman tactical assault kit (BA-TAK) to special warfare assault kit (SWAK/ATAK).
- Updated ALR to mirror information contained in AFTTP 3-3.Integrated Planning and Employment.
- Deleted MCO CoF examples.
- Moved GRG examples from chapter 5.
- Added Marine HAF capabilities/configurations.
- Added SWAK mission planning considerations.
- Updated JFE planning checklist.

Chapter 4

- Minor edits.

Chapter 5

- Added F-35, manned ISR, HAF operations, and AC-130J considerations.
- Updated friendly/target marking TTP.

Chapter 6

- Minor edits.

Chapter 7

- Minor edits.

Chapter 8

- Minor edits.

Attachment 1

- No changes.

Attachment 2

- Minor edits.

Attachment 3

- Removed as an attachment and included it as an embedded file.

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CHAPTER 1
INTRODUCTION

1.1 Purpose.

1.1.1 Statement of Purpose. This volume contains specifics about joint terminal attack controller (JTAC) capabilities and limitations, specific JTAC mission planning responsibilities, and tactics for accomplishing the JTAC mission. In addition, it concentrates on the roles of the JTAC and its team in planning and executing JTAC specific missions. This volume also discusses tested tactics that can be employed. The volume consists of the following chapters and attachments.

- Chapter 1—Introduction.
- **Chapter 2**—Equipment.
- **Chapter 3**—Mission Planning Considerations.
- **Chapter 4**—Weaponeering.
- **Chapter 5**—Close Air Support (CAS) Execution.
- **Chapter 6**—Contested, Degraded, Operationally Limited (CDO).
- **Chapter 7**—Personnel Recovery (PR).
- **Chapter 8**—Environments.
- **Attachment 1**—Glossary of References and Supporting Information.
- **Attachment 2**—Intelligence Support to Joint Terminal Attack Controllers.

1.1.2 Volume Users. Users of this volume should be familiar with the information in AFTTP 3-3.Integrated Planning and Employment (IPE), applicable TOs, and AFIs.

1.2 Tactics Usage and Feedback. The tactics presented in this volume are effective ways to employ as a JTAC. However, they are not the only way to complete the mission. Rather, this volume discusses tested, successful, and approved tactics at the secret, unclassified, and for official use only levels. It serves as the baseline where new tactics can be developed to improve JTAC employment. New ideas are encouraged and may be investigated at the unit level. The tactics improvement proposal (TIP) and unit-level tactics review board (TRB) are the methods for forwarding lessons learned to major commands (MAJCOM). See the squadron weapons officer for more information on TTP reviews.

1.2.1 Tactics Bulletin and Flash Bulletin Process. In between unit-level and MAJCOM TRBs the two methods to get updated tactics information to the field is through a tactics or flash bulletin (TB/FB). Anyone can propose a TB or FB. They can also be generated from approved test reports or TIPs not requiring an operational test. TB and FB topics should be sent to the 561 WPS prior to development to ensure integration of capabilities and to avoid duplicate efforts. For guidance on submission format and contact information to submit a TB, follow the link on the NIPRNET, SIPRNET, or JWICS 561 WPS Intelshare site.

1.2.1.1 TBs are authoritative and serve as official additions to AFTTP between rewrites or revisions in an effort to ensure warfighter TTP remain current. TBs will typically include new or emerging TTP or additional information to augment the existing AFTTP. TBs should not rewrite AFTTP or invalidate the data in the existing AFTTP; in this case, an interim change would be required. Published TBs will list affected AFTTP and should be incorporated in the next AFTTP rewrite for the affected MDS.

1.2.1.2 FBs are informational only, and not official updates to AFTTP 3-1/3-3. Some examples of FBs are observed integration concepts, planning concepts, tactical lessons learned, or TTP confined to a single area of responsibility (AOR) to solve an immediate tactical problem. FBs are often time perishable information that needs to be immediately passed to the warfighter to assist in solving an urgent tactical problem. FBs may be further developed into TBs or incorporated into AFTTP 3-1/3-3 with additional analysis, validation, and vetting.

1.3 General. The JTAC is a joint firepower expert that can be employed at all echelons of a supported maneuver force from Corps all the way down to Company. The primary mission of the JTAC is close air support (CAS). This mission is performed in any environment, weather, and terrain that a maneuver force may be conducting operations with a variety of different forward-firing, free-fall, and precision-guided munitions. Additionally, the JTAC can support a broad spectrum of other taskings (i.e., armed reconnaissance [recce], suppression of enemy air defenses [SEAD], special operations forces [SOF] support, combat search and rescue [CSAR], and air interdiction [AI]).

1.3.1 Close Air Support. CAS is air action against hostile targets, which are in close proximity to friendly forces and require detailed integration of each air mission with the fire and movement of those forces.

1.3.2 Armed Reconnaissance. The primary purpose of recce is to locate and attack targets of opportunity.

1.3.3 Suppression of Enemy Air Defenses. SEAD missions are flown to neutralize, destroy, or temporarily degrade enemy air defenses in a specific area with lethal and nonlethal effects.

1.3.4 Special Operations Forces Support. These missions have specifically trained forces for strategic or tactical targets in pursuit of nationally military, political economic, or psychological objectives. These missions can be executed independently or in conjunction with conventional forces.

1.3.5 Combat Search and Rescue. CSAR missions are designed to locate and recover isolated personnel (IP) during wartime or contingency operations.

1.3.6 Air Interdiction. AI are missions that divert, disrupt, delay, or destroy the enemy's surface military potential before it can be used effectively against friendly forces. Interdiction targets are assigned in the air tasking order (ATO) as specifically identified targets, area targets, or targets of opportunity.

CHAPTER 2

EQUIPMENT

2.1 Purpose. The purpose of this chapter is to outline common JTAC equipment and provide common-use checklists for current operations. The checklists contained in this chapter do not represent the full capability of the equipment itself. The operator should consult the equipment's user manual for detailed instructions that are not outlined in the sections below.

2.1.1 Chapter Overview. This chapter is organized into five sections: global positioning system (GPS), communications, friendly marking, DACAS, and kit configuration. Each section provides an overview of the section, the equipment, a common checklist, and TTP to use the equipment as a JTAC.

SECTION I—GLOBAL POSITIONING SYSTEM

2.2 Global Positioning System. GPS is a satellite-based navigation system made up of at least 24 satellites. GPS works in all-weather conditions, anywhere in the world, 24 hours a day. The GPS satellites circle Earth twice a day in a precise orbit. Each satellite transmits a unique signal and orbital parameters that allow GPS devices to decode/compute the precise location of the satellite. GPS receivers use this information and trilateration to calculate a user's exact location. The GPS receiver measures the distance to each satellite by the amount of time it takes to receive a transmitted signal. With distance measurements from more satellites, the receiver can determine a user's position.

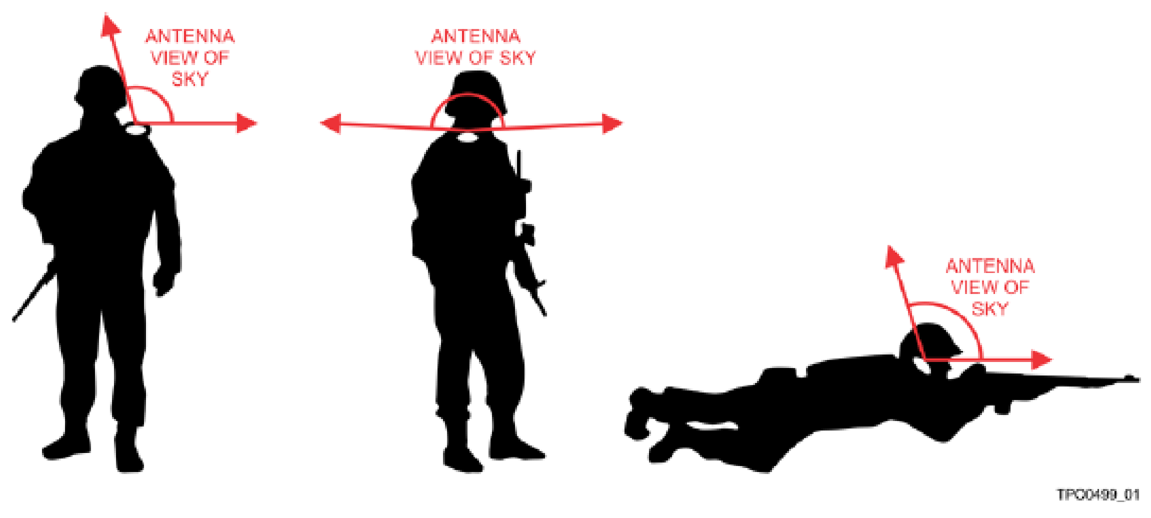
2.2.1 Operating Procedures.

2.2.1.1 Satellite Acquisition/Antenna Positioning. After the remote secure receiver (RSR) is powered and turned on by the host system, the RSR will automatically attempt to acquire and track satellites. For best performance, ensure antenna is provided a clear, unobstructed view of the sky, away from trees or tall buildings. The RSR cannot acquire present position without the antenna having an unobscured view of the sky. **Figure 2.1**, GPS RSR, shows a possible location where the RSR may be worn on the uniform to provide an unobscured view of the sky.

2.2.1.2 (FOUO) When operating in a threat environment; ensure that valid cryptokeys are loaded in the RSR. This protects the RSR from intentionally degraded (spoofing) satellite signals. The RSR requires cryptokeys to take advantage of military signals. Hostile parties may imitate (spoof) GPS signals causing errors in navigation information. Improve operation by ensuring valid cryptokeys are loaded. Accidental jamming may occur when operating the RSR near a source of electromagnetic emissions. Move away from these sources.

2.2.1.3 (FOUO) After turning the RSR off for more than one hour, the RSR will rely on civilian signals for acquisition that may not be available in a jammed environment. The RSR will maintain cryptokeys through power cycles.

Figure 2.1 GPS RSR.



FOUO

2.2.1.4 (FOUO) Zeroize. Used in emergencies to protect mission critical data, zeroize destroys mission critical data (cryptokeys). Failure to zeroize in an emergency could compromise a mission. Unintentional zeroize during a mission could seriously impair RSR operation. Host system provides the means to zeroize. When done with the mission the RSR should be zeroized. Refer to the host system for information on how to zeroize the RSR.

NOTE: (FOUO) Cryptokeys are retained even in the absence of power; there is currently not an interface to check the status of fills other than the GPS showing a green/red indicator.

2.2.1.5 (FOUO) How to load cryptokeys.

- (FOUO) Prior to starting a cryptokey load, the RSR must be powered on. Follow all applicable instructions that come with the key loading device. The key loading device needs to be configured for RS-232 Mode.
- Open the protective cap to gain access to the auxiliary connector.
- (FOUO) Connect the RSR auxiliary cable to the RSR auxiliary I/O connector. Do not connect to the key loading device yet.
- (FOUO) Follow the setup and other instructions provided with the key loading device and connect the RSR auxiliary cable to the key loading device when instructed.
- (FOUO) Once keys are loaded, remove the RSR auxiliary cable from the RSR auxiliary I/O connector.
- Close the protective cap to cover the auxiliary connector.

2.2.2 Cryptokey Entry.

2.2.2.1 Installing cryptokeys does not result in a classified RSR.

2.2.2.2 (FOUO) The user connects a cryptokey loading device that supports DS-101 (e.g., CYZ-10, Single Key Loader [SKL] PYQ-10) to the RSR using the RSR auxiliary cable to start key loading. See **Table 2.1**, GPS Key Loading Instructions Using SKL.

2.2.3 GPS Over the Air Distribution and Rekey. In addition to US defense advanced GPS receiver (DAGR) support as of 2012, over-the-air distribution and rekey (OTAD/OTAR) capability for a limited number of allies will be available in the future. Activation of specific OTAD/OTAR must be requested from USSTRATCOM. OTAD is an additional means to distribute the black cryptovariable monthly (BCVm). It is not meant to completely replace distribution of the electronic or 8-level punched tape. OTAD provides the ability to receive the next BCVm segment simply by turning on the "keyed" selective availability anti spoofing module (SAASM) receiver. To receive the next future segment of the BCVm, receive the complete GPS navigation message in the keyed receiver one time during the month. The process to obtain the complete NAV message takes a minimum 12.5 minutes of air time. At 0000 Z on the day after the OTAD was received, the users will receive notification that the OTAD key was loaded using the same notification method that was used to verify a physical key load. Users are cautioned that physically loading the black key algorithm update parameters (BKAUPD) must still be accomplished annually.

2.2.3.1 Days with Keys. Represents the number of consecutive days for which the RCVR has a valid CVd.

- For group unique variable (GUV) users, valid range is 0 to 2 days because the GUV can acquire, at most, 2 CVds (for today and tomorrow).
- For CV users, (weekly or monthly), valid range is 0 to 84 based on how many have been loaded. When keyed with both CV (m or w) and GUV, the RCVR reports days with keys based on the number of CVs.

2.2.4 PSN-13/Defense Advanced GPS Receiver. The defense advanced GPS receiver (DAGR) is a multipurpose handheld GPS device approved to provide targeting data for JTACs. Some of the capabilities include, but are not limited to, navigation, slant range calculation, fire support calculation, situational awareness (SA), current position, target location/elevation, and building a CAS 9-Line. Additional operational information can be found in AFTTP 3-1.JTAC, paragraph 2.4, and PSN-13 DAGR, *13 DAGR Manual*.

2.2.4.1 DAGR Safety. See **Table 2.2**, DAGR Safety Notes.

2.2.4.2 PSN-13 DAGR Operations. The following tables provide commonly used functions of the DAGR. See **Table 2.3**, Receiving a TOD From a PSN-13 DAGR; **Table 2.4**, Loading COMSEC in PSN-13 DAGR; and **Table 2.5**, Initial DAGR Setup for Normal Operation as a JTAC.

2.2.4.3 If you have moved a large distance since the last time the DAGR was used, initialize the position to allow the DAGR to find itself quicker. See **Table 2.6**, Initializing Own Position, for directions on how to counter a long initialization.

Table 2.1 GPS Key Loading Instructions Using SKL.

Red Operational GUV Key Entry Using the SKL
1. Connect the fill cable to the unit. Connect the opposite end of the cable to the SKL cable (provided with SKL). 2. Turn PWR on. 3. Select Menu twice to access the main menu. 4. Select Receiver Setup, and then select Crypto Fill. 5. Ensure the unit is configured to receive the key in DS-101. 6. On the SKL, highlight red key to be loaded into the unit. 7. On the SKL, press File →Transmit →Load. 8. On the SKL display, select the following settings: a. Protocol = RS-232 b. Baud Rate = 2400 c. Mode = Fill d. Bus address should be grayed out 9. Select OK. 10. Verify short title and select OK. 11. Displays should read "Operation Successful" on SKL.
Black Operational GUV Key Entry Using the SKL
1. Connect the fill cable to unit. Connect the opposite end of the cable to the SKL cable (provided with SKL). 2. Turn on Power. 3. Select Menu twice to access the main menu. 4. Select Receiver Setup, and then select Crypto Fill. 5. Ensure the device is configured to receive the key in DS-101. 6. On the SKL, highlight BKAUPD to be loaded into the device. 7. On the SKL, press File →Transmit →Load. 8. On the SKL display, select the following settings: a. Protocol = RS-232 b. Baud Rate = 2400 c. Mode = Fill d. Bus address should be grayed out 9. Select OK. 10. Verify short title and select OK. 11. Displays should read "Operation Successful" on SKL. 12. On the SKL, highlight the Black Operational GUV key to be loaded into the unit. 13. On the SKL, press File →Transmit →Load 14. On the SKL display, select the following settings: a. Protocol = RS-232 b. Baud Rate = 2400 c. Mode = Fill d. Bus address should be grayed out 15. Select OK. 16. Verify short title and select OK. 17. Displays should read "Operation Successful" on SKL.

Table 2.2 DAGR Safety Notes.

1. If the screen is flashing, the DAGR does not have a fix on satellites and the coordinates should not be trusted for your position or any information created while flashing.
2. If there is any doubt what screen you are in, read the page tab at the top. If it states present position, the coordinates you are reading are yours.
3. The DAGR compass needs to be calibrated when new, or if you move long distances. Go to the Nav pointer page, hit Menu, and select calibrate compass.

Table 2.3 Receiving a TOD From a PSN-13 DAGR.

1. Press **MENU** twice.
2. Highlight **Communications**, press **ENTER**.
3. Highlight **PPS/HQ/SINCGARS**, press **ENTER**.
4. From the PPS/HQ/SINCGARS menu, press **ENTER** to highlight a field.
5. Set COM 1 PPS MODE to **1-PPS UTC**.
6. Set HAVE QUICK MODE to **ON**
7. Connect **DAGR TOD** cable from DAGR J2 to radio connector (-113/VRC-83 remote, -117 GPS, -148/152 side connector).
8. Press **8/TOD** button on radio.
9. When “2t” or “3t” on display changes to “2 tod” or “3 tod,” press **ENT** button.
10. Disconnect **TOD** cable from radio and GPS (do not turn off radio, or you will lose **TOD**).
11. Reconnect cable to radio **REMOTE** connector (GRC-206 only).
LEGEND: HQ—HAVE QUICK SINCGARS—single channel ground and airborne radio system

Table 2.4 Loading COMSEC in PSN-13/DAGR.

1. Press **MENU** twice.
2. Highlight **Receiver Setup**, press **ENTER**.
3. Highlight **Crypto Fill**, press **ENTER**.
4. Press **ENTER** to highlight a field.
5. Select **CV LOADING INTERFACE** field, press **ENTER** and select **DS-102**, press **ENTER**.
6. CV STATUS may indicate No CV Keys Loaded.
7. Connect Fill device to J1 connector (the one with 1 dot).
8. Set Fill device to send the USKAD 103040 first. (***NOTE:*** Load this one before the other 2 parts of the key).
9. Once the Fill device is connected and turned on the Fill will keep going to the DAGR until it is turned off/disconnected.
10. DAGR will indicate "Valid CV Loaded," press **ENTER**.
11. Switch to the next Fill (USKAD 102040), DAGR will indicate "Today's CV Has Been Collected" then "Valid CV Loaded," Press **ENTER**.
12. Observe that the CV status on the DAGR changes to "Have Today's CV Key."
13. Switch to remaining Fill (USKAD 101040), DAGR will indicate "Valid CV Loaded," Press **ENTER**.
14. Turn **OFF** and disconnect **FILL** device.
OVERALL NOTE: * Installing cryptokeys does ***NOT*** create a classified DAGR. **LEGEND:** COMSEC—communication security

Table 2.5 Initial DAGR Setup for Normal Operations as a JTAC.

1. Turn DAGR **ON**.
2. Press **MENU** key twice.
3. Select **RECEIVER SETUP** and press **ENTER**.
4. Highlight **GPS SETUP** and press **ENTER**.
5. Press **ENTER** to highlight fields. Scroll to **OPERATING MODE** and press **ENTER**. Select **CONTINUOUS** and press **ENTER**.
6. Highlight **POWER-ON OPERATING MODE** and press **ENTER**. Select **CONTINUOUS** and press **ENTER**.
7. Highlight **FREQUENCY** and press **ENTER**. Select **L2 PRIMARY** and press **ENTER**.
8. Highlight **SV CODE** and select **MIXED** and press **ENTER** (consult AFTTP 3-1.JTAC for info on changing this setting).
9. Press **MENU** key twice.
10. Select **RECEIVER SETUP** and press **ENTER**.
11. Highlight **POWER SAVER** and press **ENTER**.
12. Press **ENTER** to highlight fields. Scroll to **AUTO-OFF MODE** and press **ENTER.** Select **OFF** and press **ENTER**.
13. Highlight **AUTO-STANDBY MODE** and press **ENTER.** Select **OFF** and press **ENTER**.
14. Click **MENU** button twice.
15. Select **SYSTEM** from the main menu.
16. Select **FUNCTION SET**.
17. Select **ADVACNED** (turns on fire support functions).
18. Press **MENU** twice.
19. Select **DISPLAY SETUP** and press **ENTER**.
20. Select **CUSTOMIZE** and press **ENTER**.
21. Select **TOOL BAR KEYS** and Press **ENTER** (one of the tool bar keys will be highlighted).
22. Highlight **F1** Press **ENTER**.
23. Select **CUSTOMIZE KEY** and press **ENTER**.
24. Scroll to **FS CALC** and press **ENTER**.
25. Select **ACTIVATE** and press **ENTER**.
26. Highlight **F2** Press **ENTER**.
27. Select **CUSTOMIZE KEY** and press **ENTER**.
28. Scroll to **CAS 9LINE** and press **ENTER**.
29. Select **ACTIVATE** and press **ENTER**.
30. Highlight **F3** press **ENTER**.
31. Select **CUSTOMIZE KEY** and press **ENTER**.
32. Scroll to **WP RANGE** and Press **ENTER**.
33. Select **ACTIVATE** and press **ENTER**.
34. Press **QUIT** to return to **TOOL BAR KEYS** menu.
35. Press **MENU** twice and select **DISPLAY SETUP** and press **ENTER**.
36. Press **ENTER** to highlight fields. Set the following for a standard DAGR setup:
GRID/COORD = MGRS-New // RESOLUTION = 1(10-DIGIT) // DATUM = WGD/WGS-84 // POS ERROR = FOM // ELEVATION = FEET // REFERENCE = MSL // GROUND SPEED = ENGLISH // TIME ZONE = ZULU//
ANGLE = DEGREES // NORTH REF = MAGNETIC // MAGVAR TYPE = CALCULATED.
37. Press **MENU** twice and select **SYSTEM** and press **ENTER**.
38. Select **USER PROFILE** and press **ENTER**.
39. Press **ENTER** and highlight desired profile (1 to 10) and press **ENTER**.
40. Name position as required, highlight **SAVE** and press **ENTER**.

Table 2.6 Initializing Own Position for First Time Use.

1. **PRESS** and **HOLD** down **POS PAGE** for 3 seconds.
2. Press **ENTER** to highlight the coordinate box.
3. Press **ENTER** again and a position box will open.
4. Enter your coordinate/grid zone designator for your location press **ENTER**.
5. Press **QUIT**.
OVERALL NOTE: * Allow the DAGR time to find itself.

2.2.4.4 In the middle of a mission, there are times when the aircrew may require a new coordinate format type. See **Table 2.7**, Changing Coordinate Format During Mission, for directions on how to accomplish this task.

Table 2.7 Changing Coordinate Format During Mission.

From the "Present Position" page:
1. Press **MENU** once.
2. Scroll to Select **Coord/Grid** and press **ENTER**.
3. Select format desired (MGRS NEW is the standard) press **ENTER**.

2.2.4.5 The JTAC has the ability to project a waypoint using the advanced functions feature of the DAGR. **Table 2.8**, Projecting a Waypoint, describes the steps to complete this during a mission.

2.2.4.6 The DAGR has the ability to use the digital compass to assist in land and vehicle navigation. **Table 2.9**, DAGR Navigation Setup; **Table 2.10**, Input a Waypoint; **Table 2.11**, Navigate to a Waypoint; and **Table 2.12**, Range Between Waypoint Functions, provide the most common uses for the Waypoint Menu.

2.2.4.6.1 Waypoints, when entered into the DAGR, will have a two-letter identifier in front of the number for how they were entered until the operator renames them. The following list provides the definitions of each two-letter identifier.

- FS means it was created using the Fire Support Mode.
- LR means it was created using a range finder.
- MK means it was created by hitting MARK on the DAGR.
- XXX means it was transferred from a computer.
- WP means it was hand jammed in create New WP feature.

Table 2.8 Projecting A Waypoint.

1. Press **MENU** twice select **APPLICATIONS** press **ENTER**.
2. Select **FIRES SUPPORT** press **ENTER**.
3. Press **ENTER** to highlight **FROM WP** box.
a. If calculating from present position, leave the **FROM WP** box as "**000-Pres Pos**."
b. If calculating from waypoint, press **ENTER** to open **SELECT FROM WP** window, scroll to desired WP press **ENTER**.
4. Scroll and highlight the **AZIMUTH** box press **ENTER** use the arrows to input the desired azimuth and press **ENTER**.
5. Scroll and highlight the **RANGE** box press **ENTER**.
a. Range can be Range or Slant (Slant Range is preferred as it takes into account the difference in elevation).
6. Scroll to **RANGE/SLANT RANGE** to enter distance to calculate press **ENTER** on selection.
7. Scroll and highlight the **TARGET ELEVATION** box and press **ENTER** input data and then press **ENTER**.
8. Scroll and highlight the **STORE AS WP** box and press **ENTER s**elect **STORE AS WP** press **ENTER**.
9. Scroll to the desired **WP NUMBER** and press **ENTER**.
10. Keep stored WP highlighted and press **MENU** once select **EDIT WP NAME** press **ENTER**.
11. Enter the desired name of the WP.
12. Hold down **POS PAGE** button to return to own position screen and exit FS Calc.

Table 2.9 DAGR Navigation Setup.

1. Press **MENU** twice select **NAV** press **ENTER.**
2. Select **NAV Setup** press **ENTER.**
3. Press **ENTER** to highlight the Navigation Method.
OVERALL NOTES: * **Direct to** is the default DAGR navigation. * **Rhumb Line** is an imaginary line on the Earth's surface cutting all meridians at the same azimuth, maintaining a constant heading relative to Grid North/Magnetic North/True North, based on user's preference. * **Great Circle** is the most direct route with changing azimuths (not commonly used due to changing headings).

Table 2.10 Input a Waypoint.

1. Press and hold **ENTER** button.
2. Select **Create New WP** press **ENTER**.
3. Enter Coordinate and scroll down to enter elevation.
4. Once the information is entered press **MENU** select **Save and Exit** to save the WP.
OVERALL NOTE:
* The DAGR should save as WP001 (or whatever you choose to label it as).

Table 2.11 Navigate to a Waypoint.

1. Press and hold **ENTER** button, select **GOTO a WP** press **ENTER**.
2. Scroll through the list and select the desired **WP** press **ENTER**.
OVERALL NOTE:
* The NAV POINTER window will appear with the WP selected from current position

Table 2.12 Range Between Waypoints Functions.

If the normal setup was not followed, follow Steps 1 and 2 to get to the Range Between Waypoints Page.
1. Press **MENU** twice and highlight **WP/ROUTE/ALERTS** and press **ENTER**.
2. Highlight **RANGE BETWEEN WAYPOINTS** and press **ENTER**.
If normal setup was followed, hold down the **F3** key to access the Range Between Waypoints Page.
3. Press the **ENTER** key to highlight **FROM WP** field and press **ENTER** again to select WP from the list. Once selected press **ENTER**.
4. Scroll to **TO WP** field and press **ENTER**. Highlight desired WP and press **ENTER**.
5. Scroll through remaining fields to see calculated data. (Azimuth, Range, Elevation, Slant Range, Elevation Angle).

2.2.4.6.2 In order to see a list of all waypoints in the DAGR, the operator needs to press and hold the ENTER button. From this menu, the operator can select the function they want to use in regards to the waypoints. The list below describes what each selection does.

- GOTO a WP—where the user would go to navigate to a stored waypoint.
- MARK A WP—where the user would go to mark the DAGRs current position.
- Creating New WP—where the user would go to input a new waypoint.
- Listing all WP—allows the user to see all stored waypoints in the DAGR and modify them as appropriate.

2.2.4.6.3 When saving waypoints, use any of the checklists below. The DAGR has the ability to show the waypoints in reference to the user's position on the SIT AWARNESS page. In order to show WPs on this page, the user needs to scroll down to SIT AWARNESS (while in the WP MENU), highlight SIT AWARNESS, press ENTER, select YES, and press ENTER. See Table 2.13, Create a 9-Line Using WPs for the IP and Target; and Table 2.14, Loading a Profile.

Table 2.13 Create a 9-Line Using WPs for the IP and Target.

1. Hold down **F2** key from the POS Page.
2. Highlight **TARGET LOCATION** press **ENTER**.
3. Press **MENU** select **Use WP Position** press **ENTER**.
4. Scroll to the desired WP and press **ENTER**.
5. Highlight **INITIAL POINT** press **MENU**.
6. Select **Use WP Position** press **ENTER**.
7. Scroll to the desired WP and press **ENTER**.
OVERALL NOTES:
* The DAGR will automatically ENTER the heading and distance in the boxes for Line 2 and 3.
* Line 4 will also be filled if the WP provided has an elevation. All other sections will need to be manually inputted.
* If using a LASER for ground based lase, scroll to **MARK** (Line 7), press **ENTER,** select **LASER,** and input the **LTL**. Once the LTL is input, scroll down to the **REMARKS** section and it will display the **LASER SAFETY CONE**.

Table 2.14 Loading a Profile.

1. Press **MENU** twice.
2. Select **SYSTEM** and press **ENTER**.
3. Select **USER PROFILE** and press **ENTER**.
4. Press **ENTER** and highlight desired profile options 1 through 10 press **MENU**.
5. Select **SET AS CURRENT** press **ENTER**.
NOTE:
* Changing profiles may switch user settings, press **ENTER**.

SECTION II—COMMUNICATIONS

2.3 Communications. This section breaks down JTAC communications basics and equipment.

2.3.1 Communication Threats. Compromised tactical communication equipment would jeopardize US and allied missions while placing JTACs at a tremendous disadvantage during conflict. Many nations have, and will continue, to manipulate the electromagnetic (EM) spectrum for strategic, operational, and tactical military advantage. Since the JTAC operates in all portions of the EM spectrum, it is important for each JTAC to understand how it is broken out so that they can take advantage of different TTP.

2.3.1.1 In order to understand basic communications, it is important to first grasp a knowledge of the different bands and frequencies that are available for operations. The operator should then have a working knowledge of antenna theory to exploit gaps in capability based on equipment limitations. By using this document in combination with AFTTP 3-1.JTAC, the operator should be capable of accomplishing this task. **Table 2.15**, International Distress Frequencies, breaks down the various frequencies used for distress signals. **Table 2.16**, Frequency Band Designations, outlines the different frequencies associated with the alphanumeric designation.

2.3.2 Radio Waves. Radio waves travel much like surface water waves. They travel near the earth's surface and also radiate skyward at various angles to the surface. As the radio waves travel, the energy spreads over an ever-increasing surface area. A typical radio wave has two components, a crest (top portion) and a trough (bottom portion). These components travel outward from the transmitter, one after the other, at a consistent speed. The distance between the successive wave crests is called a wavelength and is commonly represented by the Greek lowercase lambda (λ). See **Figure 2.2**, Radio Wave Break Down, for an example.

2.3.2.1 The radio communication circuit describes the process for a transmission to leave one point and reach another point. The first part of this circuit, the radio link, has seven components: transmitter, power supply, transmission lines, transmitting antenna, propagation path, receiving antenna, and the receiver itself. See **Figure 2.3**, Typical Radio Link, for a visual of the communication circuit.

2.3.2.2 The radio operator's objective is to provide the strongest possible signal to the receiving station. The best possible signal is one that provides the greatest signal-to-noise (S/N) ratio at the receiving antenna.

2.3.2.3 Choosing the right antenna and matching its characteristics to the best propagation path are the two most important factors in setting up a communications circuit. The weakest link in the circuit is the wrong propagation path. Refer to Marine Corps Reference Publication (MCRP) 8-10B.11, *Antenna Handbook*, for detailed information on basics of radio communication theory.

Table 2.15 International Distress Frequencies.

Aeronautical/Maritime—Distress	500 kHz, 2182 kHz
Aeronautical/Maritime—Search and Rescue	8364 kHz
Aeronautical—Emergency	121.5 MHz
Maritime—Call and Reply	156.8 MHz
Military Aeronautical—Emergency	243.0 MHz (Guard), 282.8 MHz
Mobile Satellite—Search and Rescue	406.1 MHz

Table 2.16 Frequency Band Designations.

Tri-Service Band (MHz)		Common Band (MHz)	
A	0 to 250	I	100 to 150
B	250 to 500	G	150 to 225
C	500 to 1000	P	225 to 390
D	1000 to 2000	L	390 to 1550
E	2000 to 3000	S	1550 to 3900
F	3000 to 4000	C	3900 to 6200
G	4000 to 5000	X	6200 to 10,900
H	6000 to 8000	K	10,900 to 36,000
I	8000 to 10,000	Q	36,000 to 46,000
J	10,000 to 20,000	V	46,000 to 56,000
K	20,000 to 40,000		
L	40,000 to 60,000		
M	60,000 to 100,000		

Band Frequency		Equipment Use
ELF	< 3 kHz	
VLF	3 kHz to 30 kHz	Teletype, Submarine communications
LF	30 kHz to 300 kHz	LORAN C
MF	300 kHz to 3 MHz	AM radio, LORAN A
HF	3 MHz to 30 MHz	Over The Horizon, Long range communications, CB radio
VHF	30 MHz to 300 MHz	FM radio, AM radio, TV, VOR
UHF	300 MHz to 3 GHz	TV, TACAN, SATCOM
SHF	3 GHz to 30 GHz	AI radar, Target Tracking Radar, SATCOM
EHF	> 30 GHz	Target Tracking Radar, SATCOM, Microwave

LEGEND:
Kilohertz (kHz) = 1,000 cycles per second
Megahertz (MHz) = 1,000,000 cycles per second
Gigahertz (GHz) = 1,000,000,000 cycles per second
SHF—superhigh frequency

Figure 2.2 Radio Wave Break Down.

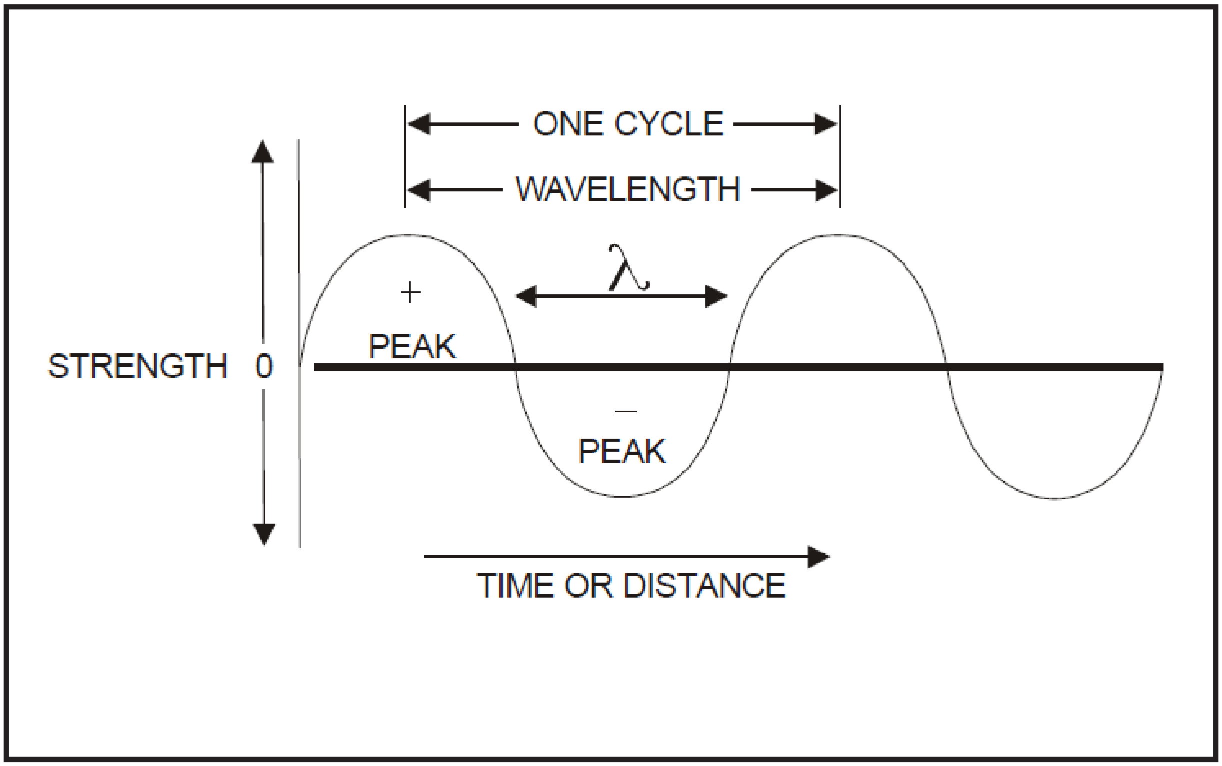
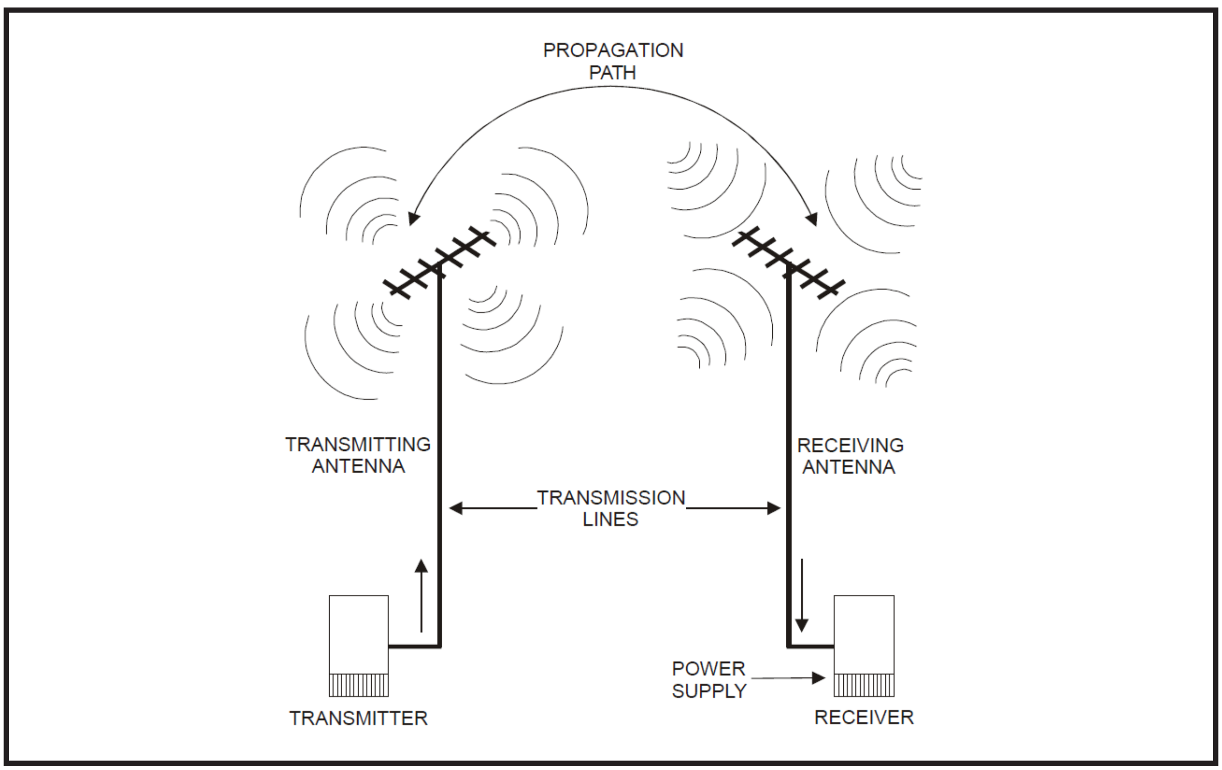


Figure 2.3 Typical Radio Link.



2.3.3 Modulation. Modulation describes how telecommunication technologies alter the periodic waveform of an electronic signal in order for a receiving station to demodulate the waveform to use the signal. The most common example for a JTAC is a voice communication being transmitted through the headset of the JTACs individual radio. The radio turns that signal into an electronic signal in order to transfer it via radio waves to a receiving station. The receiving station then grabs that signal and demodulates it into a form that the receiver can understand, the voice transmission.

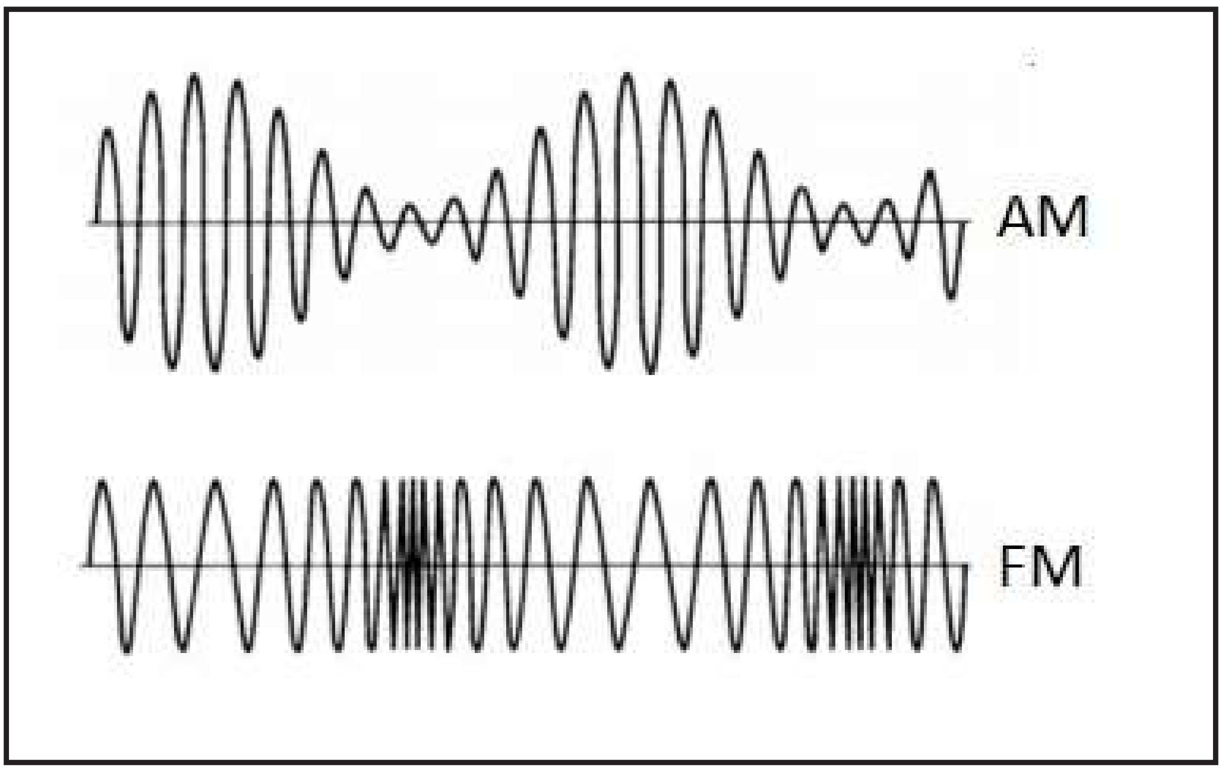
2.3.3.1 Frequency Modulation (FM). The process of varying the frequency of a carrier wave, usually with an audio frequency, in order to convey intelligence. See **Figure 2.4**, Modulation Wave Examples, as a visual for a normal radio wave and a modulated wave.

2.3.3.2 Amplitude Modulation (AM). AM is modulation in which the amplitude of the carrier wave is varied above and below its normal value in accordance with the intelligence of the signal being transmitted. See **Figure 2.4**, Modulation Wave Examples, as a visual for a normal radio wave and a modulated wave.

2.3.3.3 Useful notes on modulation are listed below:

- UHF FM is used for military satellite (MILSAT).
- VHF/UHF AM is most commonly used for line of sight (LOS).
- VHF-low is most commonly used with FM.
- UHF FM has been found to work well for intrateam communications.

Figure 2.4 Modulation Wave Examples.



2.3.4 High Frequency. High frequency (HF) describes the 1.6 to 30 MHz portion of the radio spectrum. HF radios provide tactical elements with stand-alone, terrain independent, robust communications, LOS, beyond-line of sight (BLOS), secure voice, and data communications. HF radios provide long distance, wide area, fixed, on-the-move, ground, and ground-to-air communications. HF radio (terrestrial BLOS) systems require understanding antenna design and capabilities to support local requirements. HF radios are simple, economic, portable, and versatile.

2.3.5 Very-High Frequency. Very-high frequency (VHF) describes the 30 to 300 MHz portion of the radio frequency (RF) spectrum. Works with both FM and AM radios. VHF signals propagate, principally, by LOS. VHF transmitters may be manpack, vehicular, or airframe-mounted units with power ranging from 0.25 watts in a manpack configuration to 120 watts in a multichannel, amplified system. Ground stations use VHF LOS for short range (approximately 25 to 50 miles, directly) or long-haul communications via LOS RETRANS. Uses include short-range, FM, combat radio networks radar; radio navigation; ground-to-air communications; and wideband LOS multichannel systems.

2.3.6 Ultrahigh Frequency. Ultrahigh frequency (UHF) describes the 300 MHz to 3,000 MHz portion of the RF spectrum. This frequency range can provide short-range and long-haul communications. In the UHF band, direct wave is used for transmissions from 15 to 100 miles. Communications are limited to a short distance beyond the horizon. Lack of static and fading in these bands makes LOS reception satisfactory. Directional antennas can focus the beam of RF energy, increasing the signal intensity over long distances. Directional antennas enable satellite transmissions over thousands of miles, depending on altitude, power, and configuration. UHF systems, that play an important role in network-centric warfare, are HQ, Link 16, enhanced position location report system (EPLRS), high capacity line of sight (HCLOS), and situational awareness data link (SADL). These systems provide the joint Service communities with ground-to-air, ship-to-shore, and multinational communications capabilities.

2.3.7 UHF MIL SATCOM. UHF MILSATCOM is the DOD's primary means of BLOS communications-on-the-move for tactical users. Its primary use is command and control (C2) by employing voice and data transmission. UHF MILSATCOM operates in the 225 to 400 MHz frequency range with narrowband MILSATCOM data rates of 64 Kbps and below. Legacy UHF SATCOM operates within 244 to 270 MHz with UHF uplink and downlink limited within the AOR. The next generation Mobile User Objective System (MUOS) Wideband Code Division Multiple Access (WCDMA) operates within 300 to 380 MHz, uses Ka uplink and is capable of global satellite relay communications.

2.3.8 Field-Expedient Antennas. Selecting the right antenna for a radio circuit is very important. When selecting an antenna, first consider the propagation required. Ground wave propagation requires low take-off angle and vertically polarized antennas (e.g., the whip antennas included with all radio sets).

2.3.8.1 Sky wave propagation is more complex. First, the operator needs to determine the distance required to transmit so that the take-off angle can be determined. See **Table 2.17**, Take-Off Angle, to assist in determining take-off angles. Next, the operator needs to determine the required coverage: omnidirectional, bidirectional, or directional.

Table 2.17 Take-Off Angle.

Take-Off Angle (Degrees)	Distance			
	Daytime		Nighttime	
	km	Miles	km	Miles
0	3220	2000	4508	2800
5	2415	1500	3703	2300
10	1932	1200	2898	1800
15	1450	900	2254	1400
20	1127	700	1771	1100
25	966	600	1610	1000
30	725	450	1328	825
35	644	400	1127	700
40	564	350	966	600
45	443	275	805	500
50	403	250	685	425
60	258	160	443	275
70	153	95	290	180
80	80	50	145	90
90	0	0	0	0

2.3.8.2 Before selecting an antenna, examine the available construction materials. At least two supports are needed to erect a horizontal dipole, with a third support in the middle for frequencies of 5 MHz or less. Examine the proposed antenna site to determine if the antenna will fit. If not, select a different antenna. **Table 2.18**, Antenna Selection Matrix, is a good example of an antenna selection chart.

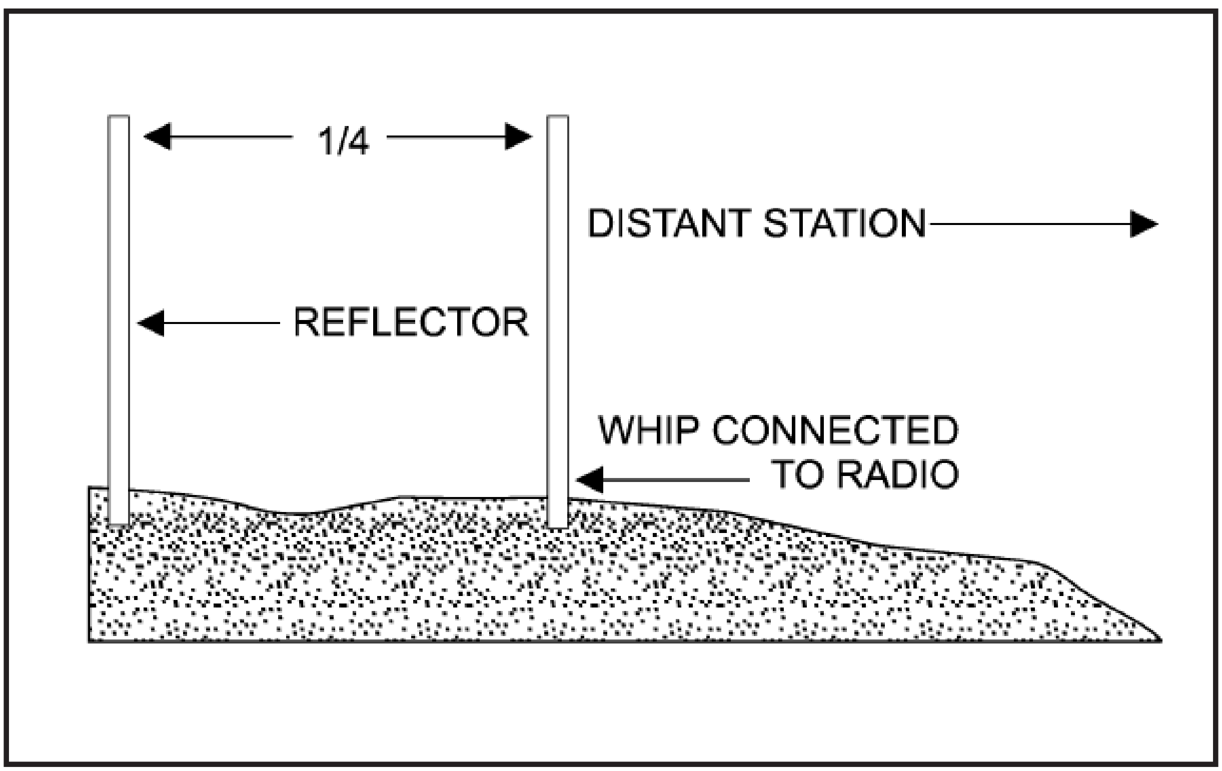
2.3.8.3 The vertical whip is a component of a variety of radio sets. It is available and easy to use on almost all radio circuits; however, it is probably the worst antenna to use on sky wave circuits. Unless the radio circuit involves omnidirectional ground wave propagation, any other antenna would provide better communications (e.g., vertical whips are often used for long-range point-to-point circuits with marginal success). Since the circuit is point-to-point, there is no need to radiate energy in all directions. Radiation in directions other than at the distant station is wasted and serves no useful purpose. Concentrating the omnidirectional radiation at the distant station produces a better received signal and reduces interference around the transmitting antenna. Concentrate radiation in a single direction with a directional antenna. **Figure 2.5**, Vertical Whip Antenna, illustrates the construction of this antenna. In order to cut the antenna to the proper length use the following formula:

Length in Feet = 234/Frequency in MHz

Table 2.18 Antenna Selection Matrix.

	Use				Directivity			Polarization		Bandwidth	
		SKY WAVE									
	GROUND WAVE	Short (500 Miles)	Medium (500 to 1,200 Miles)	Long (1,200 Miles)	Omnidirectional	Bidirectional	Directional	Horizontal	Vertical	Wide	Narrow
Vertical Whip	X				X				X	X	
Half-Wave Dipole		X	X			X		X			X
Inverted Vee	X	X	X			X		X	X		X
Long Wire	X		X	X		X	X		X	X	
Inverted-L	X	X	X		X	X		X	X		X
Sloping Vee	X		X	X			X	X		X	
Sloping Wire	X		X	X		X	X		X	X	
Vertical Half-Rhombic	X		X	X			X		X	X	

Figure 2.5 Vertical Whip Antenna.



2.3.8.4 The horizontal half-wave dipole (doublet) antenna is used on short and medium-length sky wave paths (up to approximately 1,200 miles). Since it is relatively easy to design and construct, the doublet is the most commonly used field expedient wire antenna. It is a very versatile antenna; by adjusting the antenna's height above ground, the maximum gain can vary from medium take-off angles (for medium path-length circuits) to high take-off angles (for short path-length circuits). When the antenna is constructed for medium take-off angle gain (a height of approximately one-half wavelength), the doublet is a bidirectional antenna (i.e., the maximum gain is at right angles to the wire). This is the broadside pattern normally associated with a half-wave dipole antenna.

2.3.8.5 Each wire for the dipole is cut at a half-wavelength for an assign frequency. The separate dipoles are connected to the same center insulator, or preferably a balun, and are fed by a single coaxial cable. **Figure 2.6**, Half-Wave Dipole, illustrates the antenna. The formula used for the antenna length is:

Dipole Length = 468 feet/Frequency in MHz

NOTE: The formula used to determine the height of the antenna at ½ of a wavelength is:

Height in feet = 492 feet/Frequency in MHz

2.3.8.6 The inverted vee, or drooping dipole, is similar to a dipole but uses only a single center support. See **Figure 4.14**, Typical Munitions Dispenser. Like a dipole, it is designed and cut for a specific frequency and has a bandwidth of two percent above or below the design frequency. Because of the inclined sides, the inverted vee antenna produces a combination of horizontal and vertical radiation-vertical off the ends and horizontal broadside to the antenna. All the construction factors for a dipole also apply for the inverted vee. The inverted vee has less gain than a dipole, but using only a single support could make this antenna the preferred antenna in some tactical situations. **Figure 2.7**, Inverted Vee, illustrates the construction of the antenna.

2.3.8.7 A long wire antenna is one that is long compared to a wavelength. A minimum length is one-half wavelength. However, antennas that are at least several wavelengths long are needed to obtain good gain and directional characteristics. Constructing long wire antennas is simple, and there are no critical dimensions or adjustments. A long wire antenna will accept power and radiate it well on any frequency for which its overall length is not less than one-half wavelength. The gain and take-off angle of a long wire antenna depend on the antenna's length. The longer the antenna, the more gain, and the lower the take-off angle. Gain has a simple relationship to length; however, take-off angle is a bit more complicated. A long wire antenna radiates a cone of energy around the tie wire, much like a funnel with the antenna wire passing through the funnel opening. The narrow part of the funnel would be the feed point, and the open part would be toward the distant station. If the funnel were cut in half, the resulting half cone would represent the pattern of the antenna. As the antenna is lengthened, the cone of radiation (funnel) moves closer and closer to the wire.

Figure 2.6 Half-Wave Dipole.

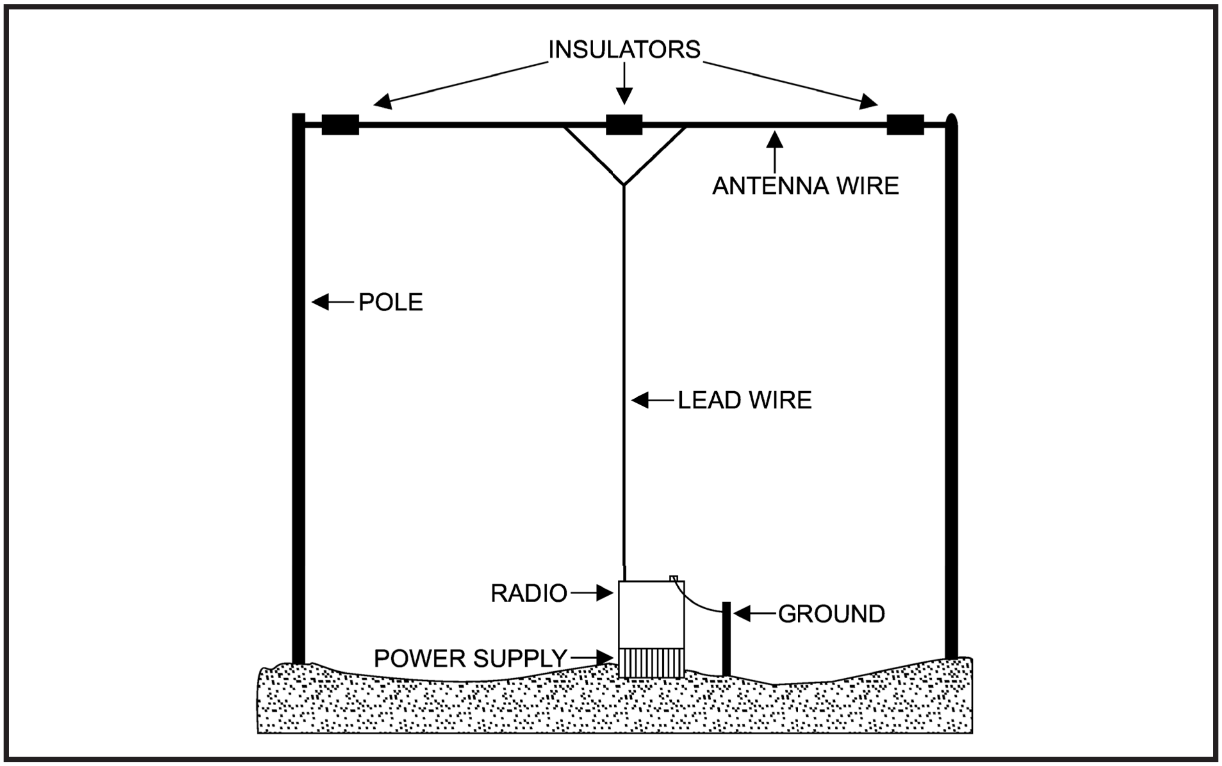
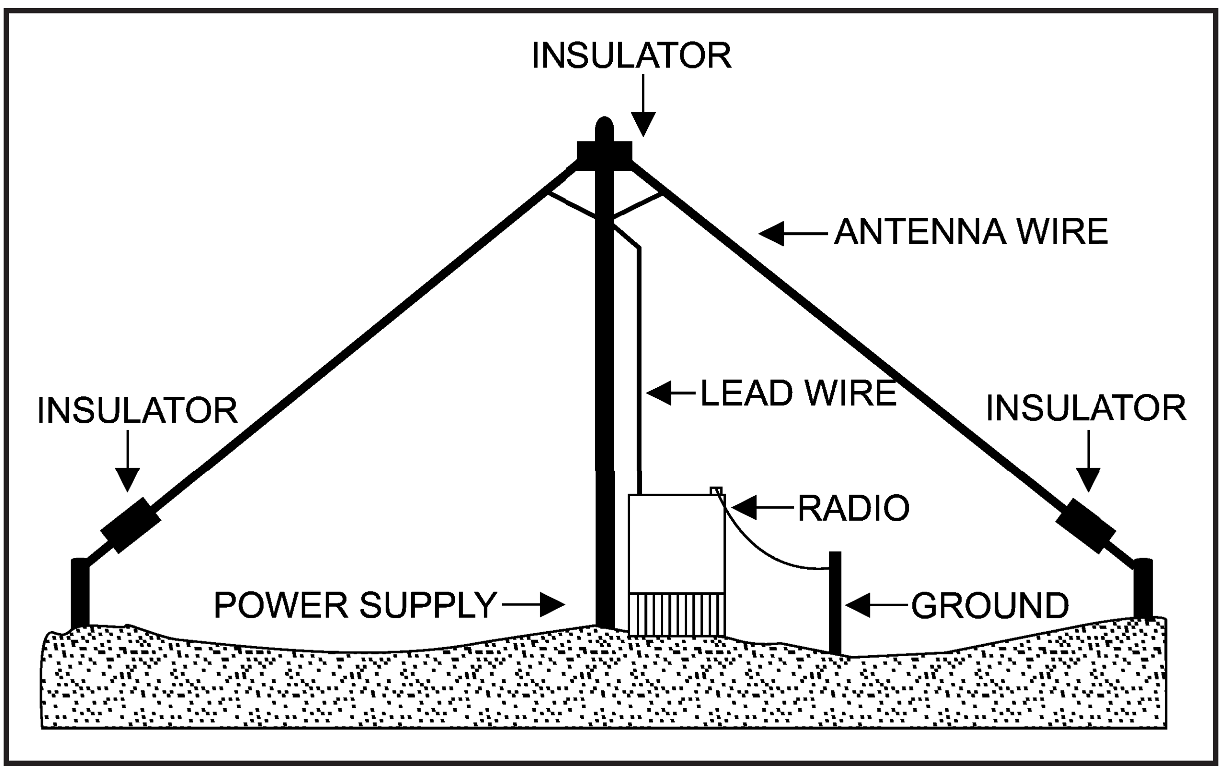


Figure 2.7 Inverted Vee.



2.3.8.8 To make a long wire antenna directional, place a terminating device at the distant station end of the antenna. The terminating device should be a 600-ohm, non-inductive resistor capable of absorbing at least one-half of the transmitter power. Terminating resistors are components of some radio sets but can also be fabricated locally using supply system components (i.e., 100-watt, 106-ohm resistor).

2.3.8.9 Constructing a long wire antenna requires only wire, support poles, insulators, and a terminating resistor (if directionality is desired). The only requirement is that the antenna be strung in as straight a line as the situation permits. The antenna is only 15 to 20 feet above ground, so tall support structures are not required. The antenna is normally fed through a coupler that can match the antenna's 600-ohm impedance. Coaxial cable can be used if a 12 to 1 balun is available to convert the coaxial cable 50-ohm impedance to the required 600 ohms. Vertical radiation plots of this antenna are not presented because of the great variation in the pattern as the length changes. For take-off angles between 5 and 25 feet, use the off-axis graph and the gain versus length graph in **Table 2.19**, Gain Versus Length, to determine the proper antenna length.

2.3.8.10 For more information and antenna construction techniques, refer to MCRP 8-10B.11, *Antenna Handbook*.

Table 2.19 Gain Versus Length.

Frequency Range (MHz)	2.5 to 4.0	3.5 to 6.0	5.0 to 7.0
Horizontal Length (Feet)	150	100	80

2.3.9 JTAC Radios. The following paragraphs provide quick overviews and checklist for commonly used areas of JTAC radios. **Table 2.20**, Tactical Radio Equipment Nomenclature, outlines common radio technical specifications for quick reference.

2.3.9.1 AN/PRC-117G. The AN/PRC-117G Manual is a smaller, lighter, more robust version of the AN/PRC-117F. It is a joint tactical radio system (JTRS)-capable radio, allowing it to be upgraded with new capabilities by downloading approved software. It operates on a single battery, giving it an advertised weight of 12 pounds, which is 35 percent lighter than its predecessor. It covers the frequency ranges of 30 MHz to 2 GHz, while transmitting up to 10 watts in VHF and up to 20 watts in the UHF bandwidths. This radio's capabilities include, but are not limited to, SINCGARS, HAVE QUICK II, VHF/UHF AM and FM, demand assigned multiple access (DAMA)/IW, SATCOM, retransmit, high performance waveform (HPW), Harris advanced networking wideband waveform (ANW2), broadband global area network (BGAN) and soldier radio waveform (SRW). Its secure Internet protocol data rates are up to 5 megabits per second (Mbps). It is certified to carry up to US top secret voice and data. The AN/PRC-117G also has an embedded selective availability anti-spoofing module (SAASM) receiver to display local position and provide automatic position reporting for SA on the battlefield. This radio can be equipped with optional software which allows the user to receive remotely operated video enhanced receiver (ROVER) L-Band signals.

Table 2.20 Tactical Radio Equipment Nomenclature.

System Nomenclature	Frequency Band						Multi-Band Radio	Frequency Range	Power Output	Weight	Select Features, Waveforms and Modes of Operation
	HF 2-30 MHz	VHF 30-3000 MHz		UHF 300-3000 MHz							
	LOS/ BLOS	LOS		LOS		BLOS					
		AM	FM	AM	FM	SATCOM					
AN/PRC-117G (RT-1949)	—	X	X	X	X	X	Yes	30.000 MHz to 2.000 GHz	FM, VHF, UHF 10 Watts SATCOM NB/WB: 10/20 Watts	8 pounds without Batt 12 pounds with Batt	Voice and data radio capable of operating SINCGARS, HQII, VHF/UHF AM and FM, ANW2, MIL-STD-188-181B SATCOM, high-performance waveform SATCOM
AN/PRC-148	—	X	X	X	X	—	Yes	30.000 to 512.000 MHz	5 Watts	1.9 pounds without Batt 2.2 pounds with Batt and Ant.	Voice and data radio capable of operating HQI and II, SINCGARS, ESIP in single channel or FH mode, and analog narrowband capable
AN/PRC-150 [DG1]	X	—	—	—	—	—	No	1.600 to 60.000 MHz	HF: 20 Watts VHF FM: 10 Watts	10 pounds without Batt 18 pounds	Voice and data radio capable of operating HF ALE
AN/PRC-160 [DG2]	X	—	—	—	—	—	No	1.5000 to 59.9999 MHz	HF: 20 Watts VHF FM: 10 Watts	8.7 pounds without Batt 11.87 pounds with Batt	Voice and data radio capable of operating HF ALE NOTE: Adaptive wideband HF is supported in 3G, but NOT supported in 2G ALE or 3G IP config. NOTE: PRC-160 supports freq hopping and OTAR.
AN/PRC-152	—	X	X	X	X	X	Yes	30.000 to 512.000 MHz and 762 to 870 MHz	5 Watts	2.5 pounds with Batt and Ant.	Voice and data radio capable of operating SINCGARS, VHF/UHF LOS in AM and FM, HQII, SATCOM MIL-STD-188-181B
AN/PRC-163	—	X	X	X	X	X	Yes	30.000 to 512.000 MHz SBTW/SA 30 MHz to 2.6 GHz L/S-Band 1.3 to 2.6 GHz	FM, VHF, UHF 5 Watts SATCOM 10 Watts L/S-Band 3.2 Watts	2.75 pounds with Batt	Voice and data radio capable of operating SINCGARS, HQI and II, VHF/UHF AM and FM, SATCOM HPW and IW

2.3.9.1.1 A significant feature of the AN/PRC-117G is its wideband ANW2 (B) capability. ANW2 is a waveform in the 225 MHz to 1999.995 MHz band that allows simultaneous voice and high speed data capabilities. Once configures, an ANW2 network forms automatically. ANW2 networks also have the ability to self-heal as well as relay data between two radios in order to reach BLOS. ANW2 (B) capability allows for more nodes to connect to the network and allows for VOIP calls between PRC-117G radios. ANW2 (C) can extend network ranges from 40 km up to 85 km.

2.3.9.2 The HPW data waveform can securely transmit and receive e-mail and transfer large files over SATCOM and LOS AM/FM nets by adapting to varying channel conditions. HPW ensures error-free data delivery using high-speed, over-the-air data rates up to 64 Kbps on LOS nets and up to 56 Kbps on wideband SATCOM nets.

2.3.9.3 The following tables will help the operator configure the radio for unsecure, secure, and HQ operations: **Table 2.21**, PRC-117G Radio Setup; **Table 2.22**, PRC-117G VHF, UHF line of sight (VULOS) COMSEC Loading; **Table 2.23**, PRC-117G Zeroize Procedures; and **Table 2.24**, PRC-117G VHF, UHF Line of Sight Programming.

Table 2.21 PRC-117G Radio Setup.

1. Attach power supply, Radio and GPS antennas, KDU. 2. Set Radio Switch to **CT or PT**. 3. Clear messages, press **ENT**.

Table 2.22 PRC-117G VHF, UHF Line of Sight (VULOS) COMSEC Loading.

1. Set Radio Switch to **LD**. • Radio Switch must be in **LD BEFORE** connecting/disconnecting fill device.
2. Select **Fill**, press **ENT**.
3. WAVEFORM, press **ENT**.
4. ▲/▼ **VULOS** (other as required), press **ENT**.
5. FILL DEVICE, ▲/▼ **KYK-13**, press **ENT**.
6. Connect FILL device. **If "BAD FILL" Appears:** • Check FILL Device type and FILL Device protocol. • Check Fill cable connections before repeating process. • Ensure O Ring in fill cable is secure. • Clean cable connections. • Attempt to reload radio.
7. CRYPTO MODE, **VINSON** (ANDVT for 5 kHz SATCOM, other as req), press **ENT**. 8. KEY TYPE, **TEK** (KEK as req), press **ENT**. 9. KEY NUMBER, ▲/▼ 01 to 25 (record which Fill was loaded in which position), press **ENT**. 10. CLASSIFICATION, ▲/▼ UNCLASS/CONF/SECRET/ TOP SECRET as required, press **ENT**.
11. LOAD ANOTHER KEY, ▲/▼ YES/NO, press **ENT**.
12. Repeat steps 4 through 13 as required for additional keys.
13. Disconnect FILL device.
14. Set Radio Switch to **PT**.
15. Proceed to **Programming**.
OVERALL NOTE: * Keys are associated with waveform types. You MUST load a HAVE QUICK Key in for CT ops in HAVE QUICK.

Table 2.23 PRC-117G Zeroize Procedures.

Selective Zero
1. Function Switch in **PT/CT**.
2. Press **ZERO** (5 Key).
3. ▲/▼ to select **SELECTIVE ZERO**, press **ENT**.
4. ▲/▼ to select ZEROIZE WAVEFORM, press **ENT** Maintenance Password (**H2445830** or **HARRIS1680** or **A2345678**).
5. ▲/▼ to **VULOS** (other as req), press **ENT**.
6. SELECT TYPE, **TEK**, press **ENT**.
7. SELECT CRYPTO MODE, **VINSON** (other as req), press **ENT**.
8. ZEROIZE VINSON TEK, **TEK 01** as req, press **ENT**.
9. ZEROIZE VINSON TEK XX, ▲/▼ **YES**, press **ENT**.
10. Screen shows ZEROIZE IN PROGRESS then ZEROIZE SUCCESSFUL, press **ENT**.
11. Repeat Steps 6 to 10, as required.
12. Press **CLR** out to main screen.
Zero All
1. Function Switch in **PT/CT**.
2. Press **ZERO** (5 Key).
3. ▲/▼ to select **ZEROIZE ALL**, press **ENT**.
4. ZEROIZE RADIO, ▲/▼ **YES**, press **ENT**.
5. Screen shows ZEROIZE IN PROGRESS then ZEROIZE SUCCESSFUL, press **ENT**.
Panic Zero
1. Set Function Switch to **Z**.
2. Screen displays **PANIC ZEROIZE SUCCESSFUL**.

Table 2.24 PRC-117G VHF, UHF Line of Sight Programming.

1. Set Function Switch to **PT/CT**.
2. **PGM** (8 Key), press **ENTERING PROGRAM MODE**…**WAIT**…
3. ▲/▼ to select **SYSTEM PRESETS**, press **ENT**.
4. ▲/▼ to select **SYSTEM PRESET CONFIG**, press **ENT**.
5. Use keypad to enter preset number, press **ENT**.
6. Use Keypad to enter preset description, press **ENT**.
7. PRESET WAVEFORM, ▲/▼ to select **VULOS**, **ENT**.
8. GENERAL CONFIG, press **ENT**.
9. PRESET NAME, name the net, press **ENT**.
10. PRESET TYPE, **LOS**, press **ENT**.
11. ▼ to **FREQUENCY**, press **ENT**.
12. RX FREQUENCY, enter frequency, press **ENT**.
13. RECEIVE ONLY, YES/**NO**, press **ENT**.
14. TX PREQUENCY, **USE RX FREQUENCY**, press **ENT**.
15. Verify TX FREQUENCY, press **ENT**.
16. ▼ to **COMSEC**, press **ENT**.
17. ▲/▼ to **VINSON** (other as required), press **ENT**.
18. Select appropriate TEK, press **ENT**.
19. ▼ to **TRAFFIC**, press **ENT**.
20. VOICE, press **ENT**.
21. CVSD, press **ENT**.
22. Change MODULATION TYPE, as required.
23. FM DEVIATION, **8.0 kHz**, press **ENT**.
24. ▼ to **TX POWER**, press **ENT**.
25. TX POWER LEVEL ▲/▼ to **HIGH**, press **ENT**.
26. ▼ to **SQUELCH**, press **ENT**.
27. **SQUELCH TYPE**, ▲/▼ to **NOISE** (other as req), **ENT**.
28. ▼ to EXIT, press **ENT**.
29. Repeat 3 to 28 as required for additional nets.
30. Press **CLR** (2 times) Screen displays.

2.4 Frequency Managed Training Net. Loading frequency managed training net (FMT) enables HQII training operations. See Table 2.25, FMTs.

Table 2.25 FMTs.

235.050 / PST 20	267.850 / PST 15	303.275 / PST 10	279.750 / PST 05
225.150 / PST 19	262.450 / PST 14	298.650 / PST 09	
252.925 / PST 18	257.250 / PST 13	293.550 / PST 08	
239.950 / PST 17	314.450 / PST 12	289.050 / PST 07	
271.950 / PST 16	308.750 / PST 11	284.150 / PST 06	

2.4.1 HAVE QUICK. HAVE QUICK (HQ) can be used to conduct electronic counter-countermeasures (ECCM) in a jamming environment. Before setting up the radio for HQ operations, the operator will need three items to ensure the radio will be able to operate HQ—word of the day (WOD), time of day (TOD), and a net number—are the items needed to be programmed into the radio. Below are steps to configure the PRC-117 for HQ operations.

2.4.1.1 WOD. WOD is a transmission security variable that consists of six segments of six digits each. The WOD is loaded into the radio to key the HQ system to the proper hopping pattern, rate, and dwell time.

2.4.1.2 TOD. Syncs the users on the same time, usually GPS time.

2.4.2 HQ Net Numbers. Purpose of net numbers allow entry point in the WOD frequency hopping pattern. Net Numbers assignments will be published in the ATO. See **Table 2.26**, HAVE QUICK Net Numbers; **Table 2.27**, PRC-117G HAVE QUICK Programming; **Table 2.28**, HAVE QUICK WOD; **Table 2.29**, PACAF Training WODs; **Table 2.30**, HAVE QUICK II Secure Programming; **Table 2.31**, HAVE QUICK TOD; **Table 2.32**, PRC-117G SINCGARS Operations; **Table 2.33**, Loading SINCGARS From a PYQ-10 SKL; **Table 2.34**, PRC-117G FM SINCGARS Programming; **Table 2.35**, PRC-117G Change SINCGARS Net ID; **Table 2.36**, PRC-117G SINCGARS TOD; **Table 2.37**, PRC-117G SINCGARS Late Net Entry; **Table 2.38**, UHF/AF SATCOM Voice Secure Programing; **Table 2.39**, PRC-117G SATCOM "PING" Test; and **Table 2.40**, PRC-117G DAMA SATCOM Voice Net Programming.

Table 2.26 HAVE QUICK Net Numbers.

Last Two Characters of the Net Number Determine Mode, as follows:		
00 = HQ I original A and B net structures (Training or Wartime).		
25 = HQ II (Training) or HQ II NATO/Europe nets (Wartime).		
50 = None (Training) or HQ II Non-NATO/Europe nets (Wartime).		
75 = Designated illegal and will generate an alarm.		
Available Net Numbers:		
HQ I Training:	A00.X00	(where X = 0 to 5, for a total of 5)
HQ II Training:	A0X.X25	(where XX = 00 to 15, for a total of 16)
Wartime:	AXX.X00	(where XXX = 000 to 999, for a total of 1,000)
LEGEND: NATO—North Atlantic Treaty Organization		

Table 2.27 PRC-117G HAVE QUICK Programming.

1. Set Function Switch to **PT/CT**.
2. **PGM** (8 Key), press **ENTERING PROGRAM MODE**…**WAIT**…
3. ▲/▼ to select **HAVE QUICK II CONFIG**, press **ENT**.
4. ▲/▼ to select **CONFIGURE MWOD**, press **ENT**.
5. ▲/▼ to select **DEFINE MWOD**, press **ENT**.
6. Use keypad to enter WOD Day of Month, press **ENT**.
7. Use Keypad to enter WOD 20-15, press **ENT**.
8. MWOD DEFINE COMPLETE VALID WOD VALUE, press **ENT**.
9. Repeat Steps 6 to 8 for additional MWODs, press **ENT**.
10. Press **CLR** to CONFIGURE MWOD.
11. ▼ to FMT FREQUENCIES, as required, to define FMT Net Frequencies.
12. Press **CLR**, Screen displays.
LEGEND: MWOD—multiple word of day

Table 2.28 HAVE QUICK WOD.

	1	2	3	4	5	6	7	
20	300.050	300.050	300.050	300.050	300.050	300.050	300.050	20
19	376.125	375.725	375.825	375.925	376.025	375.825	375.925	19
18	376.025	376.125	375.725	375.825	375.925	376.125	375.725	18
17	375.925	376.025	376.125	375.725	375.825	376.025	376.125	17
16	375.825	375.925	376.025	376.125	375.725	375.925	376.025	16
15	375.725	375.825	375.925	376.025	376.125	375.725	375.825	15
14	301.000	302.000	303.000	304.000	305.000	306.000	307.000	14

	8	9	10	11	12	13	14	
20	300.050	300.050	300.050	300.050	300.050	300.050	300.050	20
19	376.025	376.125	375.725	375.925	376.025	376.125	375.725	19
18	375.825	375.925	376.025	375.825	375.925	376.025	376.125	18
17	375.725	375.825	375.925	376.125	375.725	375.825	375.925	17
16	376.125	375.725	375.825	376.025	376.125	375.725	375.825	16
15	375.925	376.025	376.125	375.725	375.825	375.925	376.025	15
14	308.000	309.000	310.000	311.000	312.000	313.000	314.000	14

	15	16	17	18	19	20	21	
20	300.050	300.050	300.050	300.050	300.050	300.050	300.050	20
19	375.825	376.025	376.125	375.725	375.825	375.925	375.925	19
18	375.725	375.925	376.025	376.125	375.725	375.825	376.125	18
17	376.025	375.825	375.925	376.025	376.125	375.725	376.025	17
16	375.925	376.125	375.725	375.825	375.925	376.025	375.825	16
15	376.125	375.725	375.825	375.925	376.025	376.125	375.725	15
14	315.000	316.000	317.000	318.000	319.000	320.000	321.000	14

	22	23	24	25	26	27	28	
20	300.050	300.050	300.050	300.050	300.050	300.050	300.050	20
19	376.025	376.125	375.725	375.825	376.025	376.125	375.725	19
18	375.725	375.825	375.925	376.025	375.825	375.925	376.025	18
17	376.125	375.725	375.825	375.925	376.125	375.725	375.825	17
16	375.925	376.025	376.125	375.725	375.925	376.025	376.125	16
15	375.825	375.925	376.025	376.125	375.725	375.825	375.925	15
14	322.000	323.000	324.000	325.000	326.000	327.000	328.000	14

	29	30	31
20	300.050	300.050	300.050
19	375.825	375.925	376.125
18	376.125	375.725	375.925
17	375.925	376.025	375.825
16	375.725	375.825	376.025
15	376.025	376.125	375.725
14	329.000	330.000	331.000

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Table 2.29 PACAF Training WODs.

DAY	1	2	3	4	5	6	7
CH20	300.050	300.050	300.050	300.050	300.050	300.050	300.050
CH19	341.700	381.100	381.100	341.700	369.700	229.725	364.275
CH18	229.725	369.700	341.700	381.100	381.100	341.700	369.700
CH17	364.275	364.275	229.725	369.700	341.700	381.100	381.100
CH16	369.700	229.725	364.275	364.275	229.725	369.700	341.700
CH15	381.100	341.700	369.700	229.725	364.275	364.275	229.725
CH14	301.000	302.000	303.000	304.000	305.000	306.000	307.000
DAY	8	9	10	11	12	13	14
CH20	300.050	300.050	300.050	300.050	300.050	300.050	300.050
CH19	364.275	229.725	369.700	381.100	341.700	364.275	364.275
CH18	229.725	364.275	364.275	341.700	381.100	381.100	341.700
CH17	341.700	369.700	229.725	369.700	229.725	341.700	381.100
CH16	381.100	381.100	341.700	229.725	369.700	369.700	229.725
CH15	369.700	341.700	381.100	364.275	364.275	229.725	369.700
CH14	308.000	309.000	310.000	311.000	312.000	313.000	314.000
DAY	15	16	17	18	19	20	21
CH20	300.050	300.050	300.050	300.050	300.050	300.050	300.050
CH19	229.725	369.700	369.700	229.725	341.700	381.100	341.700
CH18	364.275	364.275	229.725	369.700	369.700	229.725	229.725
CH17	381.100	341.700	364.275	364.275	229.725	369.700	381.100
CH16	341.700	381.100	381.100	341.700	364.275	364.275	369.700
CH15	369.700	229.725	341.700	381.100	381.100	341.700	364.275
CH14	315.000	316.000	317.000	318.000	319.000	320.000	321.000
DAY	22	23	24	25	26	27	28
CH20	300.050	300.050	300.050	300.050	300.050	300.050	300.050
CH19	381.100	364.275	364.275	369.700	229.725	381.100	341.700
CH18	369.700	341.700	381.100	364.275	364.275	369.700	229.725
CH17	341.700	229.725	369.700	341.700	381.100	364.275	364.275
CH16	229.725	381.100	341.700	229.725	369.700	341.700	381.100
CH15	364.275	369.700	229.725	381.100	341.700	229.725	369.700
CH14	322.000	323.000	324.000	325.000	326.000	327.000	328.000
DAY	29	30	31				
CH20	300.050	300.050	300.050				
CH19	229.725	369.700	229.725				
CH18	381.100	341.700	369.700				
CH17	369.700	229.725	364.275				
CH16	364.275	364.275	381.100				
CH15	341.700	381.100	341.700				
CH14	329.000	330.000	331.000				
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Table 2.30 HAVE QUICK II Secure Programming.

1. Set Function Switch to **PT/CT**.
2. **PGM** (8 Key), press **ENTERING PROGRAM MODE**…**WAIT**…
3. ▲/▼ to select **SYSTEM PRESETS**, press **ENT**.
4. ▲/▼ to select **SYSTEM PRESET CONFIG**, press **ENT**.
5. Use keypad to enter preset number, press **ENT**.
6. Use Keypad to enter preset description, press **ENT**.
7. PRESET WAVEFORM, ▲/▼ to select HAVE QUICK **II**, press **ENT**.
8. GENERAL CONFIG, press **ENT**.
9. PRESET NAME, name the net, press **ENT**.
10. ▼ to **HQ NET CONFIG**, press **ENT**.
11. INITIAL FREQUENCY, enter **TOD** freq, press **ENT**.
12. HOP MODE TYPE, ▲/▼ to **INIT** to **TX/RX TOD** over the air, press **ENT**.
a. ▲/▼ to **HOPPING** to go active immediately after programming, press **ENT**.
13. HQ NET NUMBER, use keypad to enter **NET** number, press **ENT**.
14. RECEIVE ONLY, ▲/▼ to **NO**, press **ENT**.
15. ▼ to **COMSEC**, press **ENT**.
16. ▲/▼ to **VINSON** (other as req), press **ENT**.
17. Select appropriate TEK, press **ENT**.
18. ▼ to **TRAFFIC**, press **ENT**.
19. ▲/▼ to **VOICE**, press **ENT**.
20. ▼ to **TX POWER**, press **ENT**.
21. TX POWER LEVEL ▲/▼ to **HIGH**, press **ENT**.
22. ▼ to **SQUELCH**, press **ENT**.
23. ANALOG SQUELCH LEVEL, ▲/▼ to adjust, press **ENT**.
24. ▼ to EXIT, press **ENT**.
25. Repeat 4 to 23 as required for additional HQ nets.
26. Press **CLR** (2 times) Screen displays, EXITING PROGRAM MODE…WAIT…

Table 2.31 HAVE QUICK TOD.

1. From main screen press the **1/CALL** button. 2. ▲/▼ to **TOD RECEIVE**, press **ENT**. 3. Display will show **TOD RECEIVE AWAITING RECEPTION**. 4. If successful the screen will display the TOD data that was received. T**IMED OUT** is displayed if nothing received within 2 minutes. **ABORTED** if **CLR** was pressed. **FAILED** will be displayed if the TOD was not successful for some reason other than a time-out. **Sending TOD to Another Station** 1. From main screen press the **1/CALL** button. 2. ▲/▼ to **TOD TRANSMIT**, press **ENT**. 3. Display will show **TOD TRANSMIT IN PROGRESS**. **SUCCESSFU**L is displayed if transmission was successful. **ABORTED** if **CLR** was pressed. **FAILED** will be displayed if the TOD was not successful for some reason other than a time-out.

Table 2.32 PRC-117G SINCGARS Operations.

SINCGARS COMSEC/HOPSET Loading
1. Set Radio Switch to **LD**. - Radio Switch must be in **LD** BEFORE connecting/disconnecting fill device. 2. Select **Fill**, press **ENT**. 3. WAVEFORM, press **ENT**. 4. ▲/▼ **SINCGARS**, press **ENT**. 5. FILL DEVICE, ▲/▼ to **SKL PYQ-10**, press **ENT**. 6. FILL PORT TYPE, ▲/▼ to **MODE 2/3**, press **ENT**. 7. INITIATE FILL AT FILL DEVICE. 8. Prepare and Connect SKL. See Loading SINCGARS from a PYQ-10 SKL, below. 9. Disconnect FILL device. 10. CLASSIFICATION, ▲/▼ UNCLASS/CONF/SECRET/-TOP SECRET as required, press **ENT**. 11. Radio displays COMPLETING FILL. 12. Scroll to view #/type of keys installed, press **ENT**. 13. LOAD ANOTHER KEY, ▲/▼ to **NO**, press **ENT**. 14. Set Radio Switch to **PT**. 15. Proceed to **SINCGARS Programming**.
OVERALL NOTE: * TEKs 1 to 5 are loaded into VINSON slots 1 to 5 respectively. HOPSETS are stored in compartment locations 1 to 25. The cold start portion of the loadset is stored in compartment 19 as TSK 19.

Table 2.33 Loading SINCGARS From a PYQ-10 SKL.

1. SKL Power, **ON**.
2. Using stylus, select **CoreLib—**SKL may automatically go to Logon screen.
3. Using stylus, enter User ID and Password, select **OK**.
4. Select **Launch**, select **Launch UAS**, select **OK**.
5. SKL will "check and decrypt database," select **OK**.
6. Select the **Plats** (PLATFORMS) tab.
7. Highlight SINCGARS.
8. Select **LOAD** icon near top right of screen.
9. Select **ICOM Transfer**.
a. If time at bottom of SKL screen matches Zulu time, check **Include Time**.
b. Select **OK**.
10. Connect to Radio, Select **NEXT**.
11. Select **SEND**.
12. SKL displays RELOAD EQUIPMENT, select **NO**.
13. SKL displays OPERATION SUCCESSFUL, select **OK**.
14. Disconnect the device being filled from the SKL.
15. Select **File**, select **Save Database**.
16. Select **File**, select **Exit**.
17. Select **Session**, select **Logout**.
18. Power **OFF**.

Table 2.34 PRC-117G FM SINCGARS Programming.

1. Set Function Switch to **PT/CT**.
2. **PGM** (8 Key), press "ENTERING PROGRAM MODE…WAIT…"
3. ▲/▼ to select **SYSTEM PRESETS**, press **ENT**.
4. ▲/▼ to select **SYSTEM PRESET CONFIG**, press **ENT**.
5. Use keypad to enter preset number, press **ENT**.
6. Use Keypad to enter preset description, press **ENT**.
7. PRESET WAVEFORM, ▲/▼ to select **SINCGARS**, **ENT**.
8. OPMODE, ▲/▼ to select **FREQUENCY HOPPING** (or **SINGLE CHANNEL** as required).
9. GENERAL CONFIG, press **ENT**.
10. PRESET NAME, name the net, press **ENT**.
11. ▲to **TEK01** (other as req), press **ENT**.
12. TX POWER LEVEL, ▲/▼ to **HIGH**, press **ENT**.
13. TRAFFIC MODE, ▲/▼ to **VOICE**, press **ENT**.
14. HOPSET COMPARTMENT, ▲/▼ to desired net ID, as required or update from main screen), press **ENT**.
15. SC FREQ, enter single channel freq, press **ENT**.
16. SC SQUELCH TYPE, ▲/▼ to TONE, press **ENT**.
17. Repeat 4 to 17 as required for additional nets.
18. Press **CLR** (2 times), screen displays EXITING PROGRAM MODE…WAIT…

Table 2.35 PRC-117G Change SINCGARS Net ID.

1. From SINCGARS FH main screen → to highlight **NET ID**.
2. Use keypad to enter new NET ID, press **ENT**.

Table 2.36 PRC-117G SINCGARS TOD.

1. From SINCGARS FH main screen press OPT.
2. ▲/▼ to **SINCGARS OPTIONS**, press **ENT**.
3. ▲/▼ to **SINCGARS GTOD**, press **ENT**.
4. ▲/▼ to **USER ENTRY/GPS SYNCH,** as required, press **ENT**.
a. USER ENTRY requires 2-digit Julian date and Zulu time.
5. Press **CLR** to main screen.

Table 2.37 PRC-117G SINCGARS Late Net Entry.

(If time is within ±1 min of net time).
1. From SINCGARS FH main screen press **0** to view time.
2. Press → to highlight **LNE**.
3. ▲/▼ to ON, press **ENT**.

Table 2.38 UHF/AM SATCOM Voice Secure Programming.

1. Set Function Switch to **PT/CT**.
2. **PGM** (8 Key), press "ENTERING PROGRAM MODE…WAIT…"
3. ▲/▼ to select **SYSTEM PRESETS**, press **ENT**.
4. ▲/▼ to select **SYSTEM PRESET CONFIG**, press **ENT**.
5. Use keypad to enter preset number, press **ENT**.
6. Use Keypad to enter preset description, press **ENT**.
7. PRESET WAVEFORM, ▲/▼ to select **VULOS**, **ENT**.
8. GENERAL CONFIG, press **ENT**.
9. PRESET NAME, name the net, press **ENT**.
10. PRESET TYPE, **SATCOM**, press **ENT**.
11. ▼ to **FREQUENCY**, press **ENT**.
12. Press numbers for desired SATCOM Channel from Comm Plan or Handbook or **999** for user entry, **ENT**.
    a. If selecting channel number from handbook:
        1) Verify RX/TX FREQ match down/uplink frequencies from chart, press **ENT**.
        2) RECEIVE ONLY, YES/**NO**, press **ENT**.
    b. If user entry:
        1) RX FREQUENCY, enter downlink, press **ENT**.
        2) RECEIVE ONLY, YES/**NO**, press **ENT**.
        3) Verify TX FREQ, press **ENT**.
13. ▼ to **COMSEC**, press **ENT**.
14. ▲/▼ to **VINSON** (other as req), press **ENT**.
15. Select appropriate TEK, press **ENT**.
16. ▼ to **TRAFFIC**, press **ENT**.
17. ▲/▼ to VOICE / DATA as req, press **ENT**.
18. CVSD, press **ENT**.
19. If **DATA** ▲/▼ to Select SYNCRSOUS/ASYNCRONOUS, as required.
20. OPTION CODE, verify.
21. FM DEVIATION, **8.0 KHz**, press **ENT**.
22. ▼ to **TX POWER**, press **ENT**.
23. TX POWER LEVEL ▲/▼ to **HIGH**, press **ENT**.
24. ▼ to **SQUELCH**, press **ENT**.
25. SQUELCH TYPE, DISABLED, press **ENT**.
26. FM TRANSMIT TONE, DISABLED, press **ENT**.
27. ▼ to EXIT, press **ENT**.
28. Repeat Steps 4 to 27 as required for additional nets.
29. Press **CLR** (2 times), screen displays, EXITING PROGRAM MODE…WAIT…

Table 2.39 PRC-117G SATCOM "PING" Test.

1. Attach SATCOM antenna to radio, J7.
2. Set antenna to correct azimuth and angle.
3. Set Radio Switch to **CT**.
4. Press **CALL**. START PING TEST, ▲/▼ to select **YES**, press **ENT**.
5. Screen displays PING TEST IN PROGRESS then PING RX STRENGTH: XX%.
6. Adjust antenna to attain highest RX strength possible.
7. To repeat test, press **ENT**.
8. Press **CLR**, to exit to main screen.

Table 2.40 PRC-117G DAMA SATCOM Voice Net Programming (1 of 2).

This example describes how to program a basic DAMA voice preset using ANDVT encryption. Alternative preset programming choices will be noted at each step in the sequence. This will include programming a NET, a PORT_CONFIG, and DESTINATIONS under the DAMA PRESETS menu. All other programming options can typically be left at the default states.

ENTER THE DAMA PRESET MENU

1. Press **PGM**.
    a. Select **DAMA**. Press **ENT**.
    b. Select **PRESETS**. Press **ENT**.

PROGRAMMING THE DAMA NETS PRESET

2. Select **NETS**. Press **ENT**.
    a. Input desired Net Preset number to modify (00-09). Press **ENT**.
3. Select **CHANNEL**. Press **ENT**. NOTE: Input preset information from left to right, top to bottom.
    a. Enter **CHANNEL NUMBER** (3 digit code if known or 999 for manual entry). Press **ENT**.
    b. Select **TRANSMIT CAPABILITY** as **FULL**. Press **ENT**.
    NOTE: EMCON will disable transmit making the radio receive only.
    c. Select **CONSTANT KEY PORT** as **NO**. Press **ENT**.

NOTE: This selection is only present for 25 kHz channels.

NOTE: Selecting YES will disable receive making the radio transmit only.

    d. Select **LOGIN TYPE** as **PREASSIGNED** or **OVER-THE-AIR**. Press **ENT**.

NOTE: This selection is only present for 5 kHz channels.

NOTE: Selecting PREASSIGNED assumes that your base address is already LOGGED IN or that the channel controller has already authorized service.

    e. Select the **DEFAULT CONFIG** (00-09). Press **ENT**.

NOTE: Selects the default port configuration that will be programmed after the DAMA preset configuration.

4. Cursor to **RANGING**. Press **ENT**.
    a. Select **RANGING METHOD** as **ACTIVE**. Press **ENT**.

NOTE: PASSIVE Ranging requires EPHEMERIS DATA. FIXED Ranging is used for maintenance purposes only.

5. Cursor to **ADDR**. Press **ENT**.
    a. Select **BASE_ADDRESS**. Press **ENT**.
    b. Enter **BASE ADDRESS**. Press **ENT**.

NOTE: This is the Terminal Base Address, the address of your radio.

    c. Cursor to **GUARD_LIST**. Press **ENT**.
    d. **ADD**, **REVIEW**, or **DELETE** addresses as required. Press **ENT**.

NOTE: Guard List defines a "network address" or "home channel."

    e. Press **CLR** to exit the GUARD LIST menu. Press **CLR** again to exit the ADDR menu.

6. Cursor to **TRANSEC**. Press **ENT**.
    a. Select **ORDERWIRE ENCRYPTION** as **ON**. Press **ENT**.
    b. Assign SATELLITE TRANSEC (i.e., **TSK 01**) to **KEY LOCATION 0-7**.

NOTE: DAMA Primary Channel Controller (PCC) will expect the TSK to be assigned to a specific KEY LOCATION. By assigning the Satellite TSK to all KEY LOCATIONS (0-7), you can avoid possible key mismatch between the Channel Controller and your radio.

NOTE: HPW and DAMA TRANSEC keys share the same key storage compartments (SATELLITE TSK). Be sure to manage these storage compartments accordingly.

7. Cursor to **POWER**. Press **ENT**.
    a. Select **TRANSMIT POWER**. Press **ENT**.
8. Cursor to **NAME**. Press **ENT**.
    a. **CHANGE NAME**—enter a name for this DAMA NET (up to 12 characters). Press **ENT**.
9. Press **CLR** to exit DAMA NETS PRESET programming menu.

Table 2.40 PRC-117G DAMA SATCOM Voice Net Programming (2 of 2).

PROGRAMMING THE DAMA PORTS_CONFIG PRESET
10. Cursor to **PORT_CONFIGS**. Press **ENT**.
a. Input desired Port Config Preset number to modify (00-09). Press **ENT**.
11. Select **COMSEC**. Press **ENT**.
a. Select **CRYPTO MODE** as **ANDVT**. Press **ENT**.
b. Select **ENCRYPTION KEY** (i.e. **TEK 01**). Press **ENT**.
NOTE: This selection determines which TEK, from the COMSEC loading procedure, will be applied to the preset.
c. Select **TRAINING FRAMES** as **20**. Press **ENT**.
NOTE: Training Frames define the length of crypto preamble used. 6 = 80 ms, 9 = 120 ms (KY-99/99A default), 12 = 160 ms, 15 = 200 ms, 20 = 267 ms (KY-100 default), 30 = 400 ms, and 60 = 800 ms.
d. Select **ANDVT PREAMBLE** as **STANDARD**. Press **ENT**.
NOTE: ENHANCED is selectable for KY-100 interoperability (allows for no FEC for data traffic).
12. Cursor to **DATA/VOC**. Press **ENT**.
a. Select **SYNC/ASYNC SELECT** as **SYNC**. Press **ENT**.
NOTE: This selection does not affect voice operations; it is used to choose the data interface type for certain data presets.
b. Select **BAUD RATE** as **2400**. Press **ENT**.
NOTE: This selection does not affect voice operations; it is used to choose the data rate for certain data presets.
c. Select **DASA OPTION NUM** as **010** (5 kHz SBPSK 2400 bps). Press **ENT**.
NOTE: This selection does not affect voice operations; it is used to choose the data rate or certain data presets.
13. Cursor to **CONFIG_CODE**. Press **ENT**.
a. Select **25 KHZ PORT CFG CODE** as required per the Satellite Access Authorization (SAA).
NOTE: Typically for ANDVT voice operations, this is 060 or 063.
b. Select **5 KHZ PORT CFG CODE** as required per the SAA.
NOTE: Typically for ANDVT voice operations, this is 060 or 063.
14. **CHANGE NAME** - Enter a name for this DAMA PORT_CONFIG (up to 12 characters). Press **ENT**.
15. Press **CLR** to exit DAMA PORT_CONFIGS PRESET programming menu.
PROGRAMMING THE DAMA DESTINATIONS PRESET
16. Cursor to **DESTINATIONS**. Press **ENT**.
a. Input desired Destinations Preset number to modify (00-49). Press **ENT**.
b. Select **5 KHZ**. Press **ENT**.
17. Enter **DESTINATION** address. Press **ENT**
NOTE: This is the address for the station you intend to call for 5 kHz DAMA.
a. Select **25K_AC**. Press **ENT**.
18. **ADD**, **REVIEW**, and **DELETE** addresses as necessary.
NOTE: This is the list of addresses for the stations you intend to call for 25 kHz DAMA.
19. Press **CLR** to exit DAMA DESTINATIONS PRESET menu. Press **PRE** ± or **CLR** to exit DAMA programming and return to operating net.

2.4.3 PRC-152 Overview. The AN/PRC-152A wideband networking radio is a tactical transceiver designed for use by military/agency personnel requiring Type-1 National Security Agency (NSA)-certified secure voice and data communications. The AN/PRC152A is a member of the Harris Falcon III family of products. This radio provides multi-band, multimode operation. This radio enables a wide variety of applications for the user, including ground-to-ground, ground-to-air and tactical satellite (TACSAT) communications. See *PRC-152A Manual*. See **Table 2.41**, PRC-152 Setup; **Table 2.42**, PRC-152 VULOS COMSEC Loading; **Table 2.43**, PRC-152 VULOS Programming; **Table 2.44**, PRC-152 Zeroize Procedures; **Table 2.45**, UHF/AM SATCOM Programming; **Table 2.46**, PRC-152

PING Test; **Table 2.47**, VULOS Troubleshooting; **Table 2.48**, HPW PRC-152/PRC-117G Computer; **Table 2.49**, PRC-152/PRC-117G HPW Computer Setup; and **Table 2.50**, HPW Troubleshooting.

Table 2.41 PRC-152 Setup.

1. Inspect battery connection for corrosion, clean as required.
2. Inspect rubber O Ring on top of battery, if not present do not use.
3. Connect battery/antenna and set function switch to 1.
4. Press **PGM** key, select **RADIO CONFIG**, press **ENT9**.
5. Select **AUDIO CONFIG**, press **ENT**.
6. Radio Speaker, Side PTT, and Audio Side tone **ENABLE/DISABLE** as needed, press **ENT**.
7. Press **CLR** twice.

Table 2.42 PRC-152 VULOS COMSEC Loading.

1. Set Function switch to 1.
2. Set Radio switch to **LD** (radio switch must be on LD before connecting/disconnecting fill device).
3. Select **FILL**, press **ENT**.
4. WAVEFORM FOR KEY, **VULOS** press **ENT**.
5. FILL DEVICE, **SKL**, press **ENT**.
6. Connect Fill device, Select proper key from SKL.
7. Press **ENT** on radio, wait for **Successful** or **Bad Fill** to appear.
8. If Bad Fill appears, check Fill Device type, and Fill Device protocol, check Fill cable connections, and O Ring.
9. Clean all connections and attempt to reload radio.

Table 2.43 PRC-152 VULOS Programming.

1. Set Function switch to 1.
2. Press **PGM**, select **VULOS CONFIG**, press **ENT**.
3. Select PRESET CONFIG, press **ENT**.
4. Select **PRESET NUMBER** 01-99, press **ENT**.
5. Select **GENERAL CONFIG**, press **ENT**.
6. Select **PRESET NAME**, name the net, press **ENT**.
7. Select **ENABLE PRESET**, select **YES**, press **ENT**.
8. Select **PRESET TYPE**, select **LOS**, press **ENT**.
9. Select **Frequency**, press **ENT**.
10. **RX FREQUENCY**, select frequency, press **ENT**, RECEIVE ONLY **YES/NO**, press **ENT**
11. TX FREQUENCY, **USE RX FRQUENCY**, press **ENT**, verify TX FREQUENCY, press **ENT**.
12. Select **COMSEC**, press **ENT**, select **VINSON**, press **ENT**, select proper TEK, press **ENT**.
13. Select **TRAFFIC** press **ENT**, select **VOICE**, press **ENT**, select **ANALOG/CVSD** press **ENT**.
14. OPTION CODE 20/202 press **ENT**, FM DEVIATION **8.0 KHz** press **ENT**.
15. Select **SQUELCH** press **ENT**, select **NOISE or TONE** as appropriate, press **ENT**.
16. ASSIGN TO SYSTEM PRESET, press **ENT**, Select preset number from step 4, press **ENT**.
17. Press **CLR** 4 times, screen will display EXTING PROGRAM MODE…WAIT…

Table 2.44 PRC-152 Zeroize Procedures.

Selective Zeroize:
1. Set Function switch to desire preset.
2. Press **ZERO** (5 Key), select **SELECTIVE ZERO**, press **ENT**.
3. Select WAVEFORM, **VULOS**, press **ENT**.
4. Select type, **TEK**, press **ENT**.
5. Select CRYPTO MODE, **VINSON or ANDVT**, press **ENT**.
6. ZEROIZE VINSON TEK, appropriate FILL, press **ENT**.
7. ZEROIZE VINSON TEK XX, **YES**, press **ENT**.
8. Screen shows ZEROIZE IN PROGRESS then ZEROIZE SUCCESSFUL, press **ENT**.
Zeroize All:
1. Set Function switch to any preset, press **ZERO** (5 Key).
2. Select **ZEROIZE All**, press **ENT**.
3. ZEROIZE RADIO, select **Yes**, press **ENT**.
4. Screen shows ZEROIZE IN PROGRESS then ZEROIZE SUCCESSFUL, press **ENT**.
Panic Zeroize:
1. Set Function Switch to **Z**.
2. Press **VOLUME UP** button.
3. Screen displays PANIC ZEROIZE SUCCESSFUL.

Table 2.45 UHF/AM SATCOM Programming.

1. Press **PGM**, radio will display ENTERING PROGRAM MODE…WAIT… 2. Select **VULOS CONFIG**, press **ENT**. 3. Select **PRESET CONFIG**, press **ENT**, select PRESET NUMBER 01 to 99, press **ENT**. 4. Select **GENERAL CONFIG**, press **ENT**. 5. Select **PRESET NAME**, name the net, press **ENT**. 6. ENABLE PRESET, **YES or NO**, press **ENT**. 7. PRESET TYPE, **SATCOM**, press **ENT** 8. Select **FREQUENCY**, press **ENT**. 9. Press numbers for desired SATCOM Channel or **999** for user entry, press **ENT**. a. If selecting channel number from handbook. (1) Verify RX/TX FREQ match down/uplink frequencies from chart, press **ENT**. (2) RECEIVE ONLY, **YES/NO**, press **ENT**. b. If user entry. (1) RX FREQUENCY, enter downlink, press **ENT**. (2) RECEIVE ONLY, **YES/NO**, press **ENT**. (3) TX FREQUENCY, **EDIT TX FREQ**, press **ENT**. (4) TX FREQUENCY, enter uplink, press **ENT**. 10. Select **COMSEC**, press **ENT**, select **VINSON** (for 25K)/**ANDVT** (for 5K), press **ENT**. 11. Select appropriate TEK, press **ENT**. 12. (If ANDVT) TRAINING FRAMES, **20**, press **ENT**. 13. (If ANDVT) ANDVT RX PRIORITY, **ENABLED**, press **ENT**. 14. Select **TRAFFIC**, press **ENT**. a. If 25 kHz VINSON. (1) Select **VOICE**, press **ENT**. (2) VOICE MODE, CVSD, press **ENT**. (3) OPTION CODE, **132** for CVSD, press **ENT**. (4) FM DEVIATION, **▲/▼** to select 8.0 kHz. b. If 5 kHz ANDVT. (1) **▲/▼** to select **VOICE AND DATA**, press **ENT**. (2) DATA MODE, SYNCHRONOUS, press **ENT**. (3) DATA INVERSION, NONE, press **ENT**. (4) VOICE MODE, **DV 2400** (5K), press **ENT**. (5) LPC CODEBOOK, ENGLISH, press **ENT**. (6) OPTION CODE, **010** for ANDVT Voice, press **ENT**. 15. Select **SQUELCH**, press **ENT**, SQUELCH TYPE **DISABLE**, press **ENT**. 16. FM TRANSMIT TONE, **DISABLED**, press **ENT**. 17. Select **ASSIGN TO SYSTEM PRESET**, press **ENT**. 18. Press preset number from Step 3, press **ENT, press CLR** 4 times.

Table 2.46 PRC-152 PING Test.

1. Set antenna to correct azimuth and angle (see chart in *PRC-152 Handbook*, page 168 to 171).
2. Set Radio switch to CT, fill must be loaded in SATCOM preset.
3. Press **CALL (6 Key)**, START PING TEST, select **YES**, press **ENT**. Screen displays PING TEST IN PROGRESS then PING RX STRENGTH: XX%. Adjust antenna to attain highest RX strength possible.
4. To repeat test, press **ENT**.
5. To exit, press **CLR**.

Table 2.47 VULOS Troubleshooting.

1. On power up screen displays **HUB WARNING CAPACITY EXPIRED**. • Hold Up Battery is dead. • Radio does not maintain programmed presets or crypto without a primary battery installed. • Leave radio on a charged battery to minimize HUB drainage.
2. Default password **A2345678**
3. Programmed preset does not show up when selected. Ensure that preset was assigned to system preset (last step of programming before clearing out).
4. Radio has receive but no transmit. Check to ensure that TRAFFIC (VOICE ON MAIN SCREEN) is set to ANALOG (both TX radio and RX radio must have same setting either ANALOG or CVSD).
5. Radio does not transmit. Check for FM versus AM, improper option code selected. FM OPTION CODE is 201 (ANALOG)/132(CVSD), AM is 200 (ANALOG)/202 (CVSD).
6. No side tone, receive on speaker or will not transmit. Check to ensure Radio Speaker/Side PTT/Side tone is enabled/disabled, as required.
7. With PTT **Disabled** depressing PTT switch will still cause a tone in headset (and speaker if enabled). Radio will not be transmitting.
8. **Right Arrow programming** only works until preset is switched or radio is turned off.
9. SATCOM inoperative. Check to ensure CT is enabled.
LEGEND: CVSD—continuous variable slope delta modulation PTT—push to talk RX—receive TX—transmit

Table 2.48 HPW PRC-152/PRC-117G Computer.

1. Set Function switch to LD.
2. Connect fill device.
3. FILL.
    a. HPW
    b. Select appropriate FILL device
    c. Turn on FILL device and select KG-84 FILL position
    d. PRESS **ENT** TO INITIATE, **ENT**
    e. CRYPTO MODE
        (1) KG-84, **ENT**
        (2) TEK 01 (or 02 to 25, as required)
        (3) CLASSIFICATION, as required
        (4) LOAD ANOTHER KEY, YES
    f. Turn on FILL device and select SATELLITE FILL position
    g. PRESS **ENT** TO INITIATE, **ENT‘**
    h. CRYPTO MODE
        (1) SATELLITE, **ENT**
        (2) TSK 01 (or 02 to 25, as required)
        (3) CLASSIFICATION, as required
        (4) LOAD ANOTHER KEY, NO
    i. Turn off and remove FILL device
4. Function Switch to PT
5. PGM
    a. SYSTEM PRESETS
        (1) SYSTEM PRESET NUMBER 01 (or 02 to 99, as required)
            (a) PRESET DESCRIPTION, HPW (or desired net name)
            (b) PRESET WAVEFORM, HPW
            (c) PRESET NAME, HPW (or desired net name)
            (d) USE CUSTOM FREQUENCY, **NO** (for SAT) **YES** (for LOS)
        (2) CRYPTO KEY
            (a) KG-85 TEK XX from above
        (3) TRANSEC KEY
            (a) SATELLITE TSK XX from above
        (4) HPW BAUD RATE, NB, WB, UFO (to match channel)
        (5) TX POWER LEVEL, LOW/MED/HIGH, as required
        (6) **CLR** to main screen
6. OPT
    a. HPW TOD
        (1) CONFIGURE HPW TOD
            (a) USE SYSTEM CLOCK, **YES/NO**
            (b) If NO, update time/date. All systems must be within 30 seconds for HPW
            (c) **CLR** to OPT screen
    b. TRANSEC VALIDATION, **ENT**
        (1) RUN TRANSEC TEST, **YES**, press **ENT**
        (2) Upon TEST PASSED, **CLR** to OPT screen
    c. DATA MODE, PPP, press **ENT**.
    d. **CLR** to main screen.
7. Function Switch, CT
8. Connect HPW cable number 1051`3-0710-A006 to radio side connector and computer COM1
9. Establish communications on selected frequency

Table 2.49 PRC-152/PRC-117G HPW Computer Setup.

1. Open RF-6760W-HPW.
Note: If NOT building the HPW Network from scratch, proceed to Step 7 for start-up.
2. In WMT screen, right click on Domains/Stations folder.
a. Select Add Station.
(1) Input Station Name (if this is your station/computer check Local Station Box)
(2) Select Message Properties Tab
(a) Number of Retries = 3
(b) Delay between retries =1.
(c) Select **OK**.
b. Right click on the station you just created.
c. Select **Add Radio**.
(1) Input Radio Name.
(2) Select Radio Addresses tab.
(a) Enter assigned HPW address (1-65535).
(b) Select **OK**.
3. Repeat Steps 2a through 2bc for any other stations on network.
4. Right Click on Radio Networks folder.
a. Add Net.
(1) Insert Net Name.
(2) Select Net membership tab.
(a) Add all.
(b) Select **OK**.
5. Select Tools Menu.
a. Select Generate Routes.
(1) Select All Stations.
(2) Ensure both check boxes are checked.
(3) Select **OK**.
6. Select Windows Start Menu.
a. Control Panel.
(1) Network Connections.
(2) Right click Harris Automatic IP Radio.
(a) Properties.
(i) Networking Tab.
(ii) Properties.
(1) Select Use the following IP address.
(2) Enter 10.0.0.2.
(iii) Select **OK** twice.
7. To Connect to the Network Select Actions, then GO (or Select STOP LIGHT Icon).
8. Outlook (or e-mail program) should open automatically.
9. Wait for dialog box that reads Harris Automatic IP Radio Connection (COM1) is now connected.
10. HPW Protocol Status should indicate IDLE.
11. Compose and send mail as required by selecting appropriate station from TO.

Table 2.50 HPW Troubleshooting.

1. Ensure radio settings are correct; COMSEC, NET Info, point-to-point protocol (PPP) settings.
2. Ensure radio times are synchronized within 30 seconds.
3. Ensure function switch is set to CT.
4. Ensure computer settings are correct; Network Connections (10.0.0.2).

2.4.4 PRC-150. The AN/PRC-150 is an advanced HF/VHF FM portable radio that provides reliable tactical communications through US government Type 1 encryption for enhanced secure voice and data performance, reduced size/weight and extended battery life. It operates on two batteries and is compatible with JTRS radios. This radio's capabilities include HF single sideband (SSB), VHF FM, continuous waveform (CW), automated link establishment (ALE), 3G/+, hop, fix, and tactical Internet. Below are procedures for operating the PRC-150. See *PRC-150 Manual*. See **Table 2.51**, PRC-150 ALE Channel Programming; **Table 2.52**, PRC-150 ALE Programming (Channel Group Programming); **Table 2.53**, PRC-150 Automatic Link Establishment Programming (Address Programming); **Table 2.54**, PRC-150 Automatic Link Establishment; **Table 2.55**, Link Quality Analysis; **Table 2.56**, Automatic Message Delay Create TX MSG; **Table 2.57**, ALE Mode System Preset; **Table 2.58**, Select Radio Mode; **Table 2.59**, ALE Operations; and **Table 2.60**, PRC-150 COMSEC Troubleshooting.

NOTE: The following options are mode specific and are only available if the feature is installed in the radio and it is the current operating mode.

Table 2.51 PRC-150 ALE Channel Programming.

1. Press **PGM**.
2. Select. **MODE**, press **ENT**.
3. Select **PRESET**, press **ENT**.
4. Select **CHANNEL**, press **ENT**.
5. Enter desired channel number (000 to 199).
6. Enter desired **RX FREQUENCY**.
7. Enter desired **TX FREQUENCY**, or press **ENTER**.
8. Modulation (**USB**, AME, CW, FM, LSB).
9. AGC Speed (SLOW, **MED**, FAST, DATA, OFF)
10. IF Bandwidth
NOTE: Options are dependent on modulation type selected.
• USB or LSB (2.0 kHz, 2.4 kHz, 2.7 kHz, **3.0 kHz**)
• AME (3.0 kHz Only).
• CW (0.5 kHz, 0.35 kHz, 1.0 kHz, **1.5 kHz**).
11. RX ONLY (YES, **NO**).
12. LIMIT MAX TX POWER, **NO**.
13. ENABLE HAIL TX.
NOTE: Not available for channel 000 (YES, **NO**).
14. Enable SSB Scan (YES, **NO**).
NOTE: Selecting **YES** automatically places current channel in scan list.
15. Repeat Step 5 to 14 for the remaining channels to be programmed.
16. Press **CLR** to main screen.

Table 2.52 PRC-150 ALE Programming (Channel Group Programming).

1. Press **PGM**.
2. Select **MODE**, press **ENT**.
3. Select **ALE**, press **ENT**.
4. Select **CHAN_GROUP**, press **ENT**.
5. **ADD** CHANNEL GROUP, press **ENT**.
6. Enter desired **CHANNEL GROUP NUMBER** (2 digits), press **ENT**.
7. **ADD** CHANNEL, press **ENT**.
8. Enter desired **CHANNELS** for channel group (two digits, one channel for each of the frequencies used for ALE).
9. To modify, review, or delete channel groups, at ADD CHANNEL screen (Step 5**)** ▲/▼ to select **REVIEW** or **DELETE**.
Press **CLR** to main screen.

Table 2.53 PRC-150 Automatic Link Establishment Programming (Address Programming).

1. Press **PGM**.
2. Select **MODE**, press **ENT**.
3. Select **ALE**, press **ENT**.
4. Select **ADDRESS**, press **ENT**.
5. Select **SELF**, press **ENT**.
6. **ADD SELF ADDRESS**, press **ENT**.
NOTE: A three character **SELF ADDRESS** must be entered or ALE will not function (e.g., 123 must be entered first, then enter any address containing 1 to 15 alphanumeric characters.
a. Procedure for this: enter **123**, select the channel group, and then add your **ADDRESS** (e.g., BN01, and make it your **SELF ADDRESS**.
7. Enter your own operational **SELF ADDRESS** (e.g., RAD1).
8. Enter **CHANNEL GROUP** to associate with this address.
9. To review or delete Self Addresses, at Step 6 select **REVIEW** or **DELETE**.
10. Press **CLR** to ADDRESS TYPE.
11. ADDRESS TYPE, ▲/▼ to **INDIVIDUAL**, press **ENT**.
12. **ADD**, press **ENT**.
13. Enter an **INDIVIDUAL ADDRESS** (e.g., RAD2 [other addresses in the net or outside the net you want to be able to talk to])
14. Enter **CHANNEL GROUP** to associate with this address.
15. Select correct **ASSOCIATED SELF** (e.g., RAD1) by pressing up cursor.
16. Repeat 13 to 15 for remaining **INDIVIDUAL ADDRESSES**).
17. To review or delete **INDIVIDUAL ADDRESSES**, at Step 12, select **REVIEW** or **DELETE**.
18. ADDRESS TYPE, ▲/▼ to **NET**, press **ENT**.
19. **ADD**, press **ENT**.
20. Enter a **NET ADDRESS** (e.g., ASOC).
21. Enter **CHANNEL GROUP** to associate with this address.
22. Select appropriate **ASSOCIATED SELF** (e.g., RAD1).
23. **ADD NET MEMBERS** (Ensure all net members are programmed in the **same order** on all radios used).
a. At end of list, press **CLR**.
24. To review or delete Net Addresses, at step **19**, select **REVIEW** or **DELETE**.
25. Press **CLR** to main screen.
LEGEND: ASOC—air support operations center

Table 2.54 PRC-150 Automatic Link Establishment.

1. Press **PGM**.
2. Select **MODE**, press **ENT**.
3. Select **ALE**, press **ENT**.
4. Select **CONFIG**, press **ENT**.
5. MAX SCAN CHANNELS.
NOTE: This is a critical parameter. It must be set to the number of channels that have been programmed into the channel group to be scanned, press ENT.
6. LISTEN BEFORE TX (**OFF**, ON).
7. KEY TO CALL (**OFF**, ON).
8. MAX TUNE TIME, select **15 SECONDS**.
NOTE: This is a critical parameter. It must be set to the worst case tune time for any radio in the network.
9. LINK Time-Out (**OFF**, ON).
10. LINK TO ANY CALLS. (**OFF**, ON**)** When a station transmits the address **ANY**, any ALE-capable radio that receives the transmission will stop scanning and automatically respond to the call.
11. LINK TO ALL CALLS (**OFF**, ON) When a station transmits the address **ALL**, any ALE-capable radio will stop scanning, but will not respond (transmit).
12. LINK-TO-INLINK CALLS (**OFF**, ON).
13. AMD Operation (**ENABLED**, DISABLED).
14. AMD Auto Display (**ENABLED**, DISABLED).
15. Scan Rate (**ASYNC**, 2, 5).
16. LINK PROTECT LEVEL (**OFF**, ON).
17. LINK PROTECT KEY, 000000...**ENT**.
18. Press **CLR** to main screen.

Table 2.55 Link Quality Analysis.

1. Press **PGM**.
2. Select **MODE**, press **ENT**.
3. Select **ALE**, press **ENT**.
4. Select **LQA**, press **ENT**.
5. **EXCH** or **SOUND**, use EXCHANGE to perform a two way link analysis between your radio and another radio or group of radios on all preprogrammed frequencies. Use SOUND as a passive, one-way transmission, from your radio to another radio or group of radios, press **ENT**
6. **ADD**, press **ENT**.
7. **▲/▼** to **INDIVIDUAL/NET**.
8. **▲/▼** to **INDIVIDUAL or NET ADDRESS** (e.g. Joint Air Request Net [JARN]). (other addresses in the net or outside the net you want to be able to talk to).
9. OFFSET TIME **00:00**, press **ENT.**
10. REPEAT INTERVAL **00:00**, press **ENT**.
11. Press **CLR** to main screen.

Table 2.56 Automatic Message Delay Create TX MSG.

1. Press **PGM**.
2. Select **MODE**, press **ENT**.
3. Select **ALE**, press **ENT**.
4. Select **AMD**, press **ENT**.
5. Select **TX_MSG** press **ENT**.
6. TX_MSG, **▲/▼** to **EDIT, REVIEW, DELETE**.
7. Press **ENT** twice.
8. Enter message using KEYPAD.
9. Press **ENT** to save.
10. Press **CLR** to escape.
11. Select RX_MSG.
12. RX_MSG, **▲/▼** to **REVIEW, DELETE, COPY**.
13. Press ENT.
14. Press **CLR** to main screen.

Table 2.57 ALE Mode System Preset.

1. Press **PGM**.
2. Select **MODE**, press **ENT**.
3. Select **PRESET**, press **ENT**.
4. Select **SYSTEM**, press **ENT**.
5. SYSTEM PRESET TO CHANGE, ▲/▼ to desired preset, press **ENT** (on a zeroized radio, system presets are given default names of **SYSPRE1** to **SYSPRE75**).
6. PRESET NAME (Press the alphanumeric keys to enter a name up to nine characters in length), press **ENT**.
7. RADIO MODE, ▲/▼ to **ALE**.
8. ASSOCIATED SELF, ▲/▼ to select **SELF ADDRESS** to associate with this preset.
9. MODEM PRESET, select **OFF** (or ▲/▼ to enter a preconfigured Modem preset), press **ENT**.
10. ENCRYPTION TYPE, ▲/▼ to **TYPE I**, press **ENT**.
11. CRYPTO MODE, ▲/▼ to **KG-84R**, press **ENT**.
12. ENCRYPTION KEY, ▲/▼ to desired FILL (e.g., TEK01), press ENT.
13. PT VOICE MODE, ▲/▼ to **CLR**, press **ENT**.
14. CC/CT VOICE MODE, **DV24,** press **ENT**.
15. ENABLE, ▲/▼ to **YES**, press **ENT**.
16. Press **CLR** to main screen.

Table 2.58 Select Radio Mode.

1. Enter ALE MODE, press **MODE/3** button on KDU until ALE is displayed, press **ENT** or wait and the radio will automatically enter ALE mode.
2. Exit ALE MODE, press **MODE/3** button to select **FIX**.

Table 2.59 ALE Operations.

ALE Scan Operation.
1. Radio will begin scanning when ALE mode is selected.
2. To stop scanning, press **CLR**. To resume scanning, press **CLR** again.
Placing an ALE Call.
1. Press **CALL/1** key.
2. CALL TYPE, ▲/▼ to select.
a. **MANUAL**—allows you to select a specific channel to call on.
b. **AUTOMATIC**—radio will start calling on the channel with the highest LQA score.
3. ADDRESS TYPE, ▲/▼ to select **INDIVIDUAL, NET, GROUP, PHONE, ANY, ALL**.
4. ▲/▼ to select ADDR, as required, press **ENT**.
Terminating an ALE Link.
1. Press **CLR**. Radio will display, **TERMINATE LINK**.
2. ▲/▼ to **YES**, press **ENT**.

Table 2.60 PRC-150 COMSEC Troubleshooting.

1. Press **PGM**.
2. Select **MODE**, press **ENT**.
3. Select **PRESET**, press **ENT**.
4. Select **MANUAL**, press **ENT**.
5. ▲/▼ and **ENT** to CRYPTO MODE.
6. ▲/▼ to **KG-84R**, press **ENT**.
7. ▲/▼ to select appropriate **TEK**.
8. Accept defaults then CLR to main screen.

2.4.5 PRC-160. The AN/PRC-160 is an advanced HF/VHF FM portable radio that provides reliable tactical communications through US government Type 1 encryption for enhanced secure voice and data performance, reduced size/weight and extended battery life. It operates on one battery and is compatible with JTRS radios. This radio's capabilities include HF SSB, VHF FM, CW, amplitude modulation equivalent (AME) automated link establishment (2G/3G ALE), ANDVT, hop, fix, and tactical Internet. **Table 2.61**, PRC-160 Electronic Fill Types; **Table 2.62**, PRC-160 Loading GPS Fill Data and Keys; and **Table 2.63**, PRC-160 Load OTAR TEK/KEK, show procedures for operating the PRC-160. See *PRC-160 Manual*.

NOTE: The following options are mode specific and are only available if the feature is installed in the radio and is the current operating mode.

Table 2.61 PRC-160 Electronic Fill Types.

Fill Type	Quantity	Purpose	Fill Device
TEK	25	Transmission Encryption	Common Fill Device (CFD) or Data Transfer Device (DTD)
KEK	1	OTAR Key unwrapping	DTD
End Cryptographic Unit (ECU) KEK	1	ECU KEK Black Key unwrapping	DTD

Table 2.62 PRC-160 Loading GPS Fill Data and Keys.

1. Move function switch to **[LD]**.
2. Select **FILL**.
3. Select **GPS**. The GPS selection is not available if the **GPS TYPE** is **DISABLED** in **[PGM] > RADIO** > **CONFIG** > **GENERAL CONFIG** > **GPS CONFIG**.
4. Select **DTD (CYZ-10)/KIK-20, KYK-13,** or **KOI-18** from FILL DEVICE screen, and press **[ENT]**.
5. The radio displays **INITIATE FILL AT FILL DEVICE** (DS-101) or **PRESS ENT TO INITIATE FILL** (DA-102).
6. Connect fill device to AUDIO/Fill connector.
7. Perform the following if using AN/CYZ-10 DTD:
a. Use DTD FILL program to initiate loading of required key.
b. With DTD FILL program set to D101 (DS-101), select **ISSUE** as transmit mode in the DTD loading process (**FILL** results in a BAD KEY LOAD). If using DS-102, continue with step e.
c. Select **XMIT** on the DTD.
d. Select **ISSUE**.
e. Select **PUP** and **PDN** until GPS key is displayed. Do not send multiple keys. Press **[ENTR]**.
f. Select **SEND**.
g. Select **SENT TO: DIRECT** and press **[ENTR]**.
h. Observe at **CONNECT TO STATION**, select **SEND**, or press **[ENTR]** if highlighted.
8. Observe when at fill devices other than AN/CYZ-10, prepare to transmit key information and initiate the fill. Do not send multiple keys.
9. Observe at prompt **LOAD ANOTHER KEY**, select **YES** to enter more fill data.
10. Perform Step 3 through 10 again, selecting second GPS key.
11. Observe when both keys are entered, select **NO** when the **LOAD ANOTHER KEY** prompt displays.
12. Disconnect fill device from the AUDIO/Fill connector. Follow screen prompts to close session and log out.
13. Turn function switch from **[LD]** to desired operating position.
14. Verify key loading by selecting **[OPT] > GPS OPTIONS > GPS KEY INFO**.

Table 2.63 PRC-160 Load OTAR TEK/KEK.

1. Move function switch to **[LD]**.
2. Select **FILL** and press **[ENT]** to continue.
3. Select **OTAR KEY** <S> to load OTAR key information from another device.
4. Select **[ENT]** to continue.
5. Observe prompt. Initiate the Fill operation on the COMSEC loading device (NCD using AK transmit process). All other buttons are disabled while this screen is displayed.
6. Select **[CLR]** to abort the operation and display **FILL STORE ABORTED**.
7. Select **[ENT]** to continue and the In Progress screen will be displayed. Press **[CLR]** to abort the OTAR fill and display the notification screen.
8. Observe the number of TEKs and KEKs loaded from the OTAR fill (one or more is required). You may fill up to 15 KEKs at one time.
9. Select **[CLR]** or **[ENT]** to continue to the Notification Screen.
10. Observe OTAR fill procedure completed successfully. If OTAR fill is unsuccessful, the following error notifications may be displayed to the operator: OTAR FILL SET UNAVAILABLE, FILL STORE FAILURE, or FILL STORE ABORTED.
11. Select **[CLR]** or **[ENT]** to exit to the Fill Menu.
12. Disconnect the NCD and turn it off. Do not turn off radio or it will lose TEK and KEK being held in memory.
13. Move the function switch to CT.

2.4.5.1 PRC 160 OTAR Receive and Transmit Mode. Review AN/PRC-160(V) manual, paragraphs 3.11.1.1 and 3.11.1.2 for step-by-step directions.

2.4.5.2 ALL other PRC-160 general operations (ALE, 3G, TQA, HOP, etc.) reference AN/PRC-160(V), Publication 10515-0512-4200, January 2019, Rev D.

2.4.6 AN/PRC-148 JEM. The AN/PRC-148 JTRS enhanced multiband intra/inter team radio (MBITR) (JEM) is a highly portable tactical radio designed to meet the variety of environmental conditions. This radio was designed with inter/intra team communications requirements in mind. It needs a private JOSEKI component (PJC) to operate in Cypher Text (CT) mode. This radio's capabilities include, but are not limited to, AM, FM wideband, FM narrowband, AM beacon, SINCGARS, HQ II, ANDVT, and retransmit. See *PRC-148 Manual*.

2.4.6.1 PRC-148 Radio Info. Battery life for the PRC-148 is eight hours at a 8:1:1 ratio (standby:tx:rx). Classification of the radio is CCI or classification of the highest level of stored data. Frequency range of the PRC-148 is 30 to 512 MHz with the broadband antenna at 30 to 90 MHz, with the whip antenna. The tables below are commonly used operations for the PRC-148. See **Table 2.64**, PRC-148 Setup; **Table 2.65**, PRC-148 Zeroize Procedure; **Table 2.66**, PRC-148 SINCGARS Loading; **Table 2.67**, PRC-148 COSMEC Loading; **Table 2.68**, PRC-148 Set Date and Time; **Table 2.69**, PRC-148 SINCGARS Loading; **Table 2.70**, PRC-148 SINCGARS Programming; **Table 2.71**, PRC-148 Enable/Disable Side Connector; **Table 2.72**, PRC-148 Microphone Level; **Table 2.73**, PRC-148 Narrowband SATCOM Programming; **Table 2.74**, PRC-148

Wide/Narrowband SATCOM (Using in Scan Plan); **Table 2.75**, PRC-148 Power/Squelch Adjustments; **Table 2.76**, PRC-148 Cloning Procedures; and **Table 2.77**, PRC-148 HAVE QUICK II Operations.

Table 2.64 PRC-148 Setup.

Radio Setup:
1. Inspect battery connector for corrosion, clean as required.
2. Inspect top of battery for corrosion, clean as required.
3. Inspect rubber O ring at top of battery.
NOTE: If rubber O ring is missing **DO NOT USE BATTERY**.
4. Connect battery.
5. Connect antenna.
6. Connect handset/headset (if used).
7. Turn on—wait for test to finish.
• ERROR—an operational fault occurred.
• ALARM—crypto fault.
• NOPWR (no power)—check battery.
• UNLCK—unable to lock on a frequency.
• TEMP—radio is overheating.
Lock/Unlock Keypad: ALT+LOCK.
Select Audio Device.
1. Mode, press.
2. Select the top menu item, press **ENT**.
3. ▲/▼ to select INT AUDIO/EXT AUDIO/SIDETONE, press **ENT**.
Backlight On/Off: ALT+LAMP.
View Current Channel Info, press **ENT**.

Table 2.65 PRC-148 Zeroize Procedures.

Zeroize:
1. **ALT+MENU**, press.
2. Select **ZEROIZE**.
a. CLEAR ALL.
b. ZERO COMSEC.
(1) ALL or select individual keys.
c. ZERO TRANSEC.
d. DEFAULTS (resets all radio defaults).
3. **ENT/ESC**, press.
Panic Zeroize:
1. Hold down Mechanical Interlock (beside volume knob). 2. Turn on/off switch counter-clockwise past off position. This will zeroize all COMSEC.

Table 2.66 PRC-148 SINCGARS.

1. **ALT+MENU**, press.
2. Select **KEY FILL**, press **ENT**.
3. Select **MODE 2/3**, press **ENT**.
4. Prepare and attach sending device.
5. Initiate send on sending device.
6. **PTT**, press when prompted. All TEK positions will be filled with the loadset TEK.
7. When **RADIO** and **FILL** device indicate **LOAD COMPLETE** disconnect **FILL** device.
8. **ESC**, press.

Table 2.67 PRC-148 COMSEC Loading.

Accomplish **AFTER** the loadset is loaded. If a loadset is used, ***do not*** load a new TEK into TEK Position 1.
1. **ALT+MENU**, press.
2. Select **KEY FILL**, press **ENT**.
3. Select **COMSEC**, press **ENT**.
4. **ENT**, press. Select position to load (**TEK 1-5** or **KEK**).
5. Prepare and attach sending device.
6. Initiate send on sending device.
7. **PTT**, press when prompted. TEK position will increment when complete.
8. Disconnect sending device.
9. **ESC**, press.

Table 2.68 PRC-148 Set Date and Time.

1. **ALT+MENU**, press.
2. Select **PROGRAM**, press **ENT**.
3. Select **GLOBAL**, press **ENT**.
4. Select **SET CLOCK**, press **ENT**.
5. **DAY**, press **ENT**.
a. Enter last two digits of Julian Date, press **ENT**.
6. **HOURS**, press **ENT**. Enter Zulu hours, press **ENT**.
7. **MINUTES**, press **ENT**. Set minute to 1-minute ahead—at 00 seconds press **ENT**.
8. **ESC**, press.

Table 2.69 PRC-148 SINCGARS Loading.

1. **ALT+MENU**, press.
2. Select **PROGRAM**, press **ENT**.
3. Select **RADIO CONFIG**, press **ENT**.
4. Set channel number to modify using top switch.
5. Select **PLAIN/SECURE**, press **ENT**.
6. Set **Net Name**, press **ENT**.
7. Set **PWR** to 5.0W, press **ENT**.
8. Set MODE to **SINCGARS**, press **ENT**.
9. Set SINCGARS channel, 1 to 6, CUE, MAN, press **ENT**.
10. **ECCM, FH**, press **ENT**.
11. **FX**, set to assigned MANUAL Frequency, press **ENT**.
12. **TEK,** set to 1, press **ENT**.
13. **NETID**, set as assigned, press **ENT**.
14. **ESC** to main screen.

Table 2.70 PRC-148 SINCGARS Programming.

1. **ALT+MENU**, press.
2. Select **PROGRAM**, press **ENT**.
3. Select **RADIO CONFIG**, press **ENT**.
4. Set channel number to modify using top switch.
5. Select **PLAIN/SECURE**, press **ENT**.
6. Set **Net Name**, press **ENT**.
7. Set **PWR** to 5.0W, press **ENT**.
8. Set **MODE** to **SINCGARS**, press **ENT**.
9. Set SINCGARS channel, 1 to 6, CUE, MAN, press ENT.
10. **ECCM, FH**, press **ENT**.
11. **FX**, set to assigned MANUAL Frequency, press **ENT**.
12. **TEK**, set to "**1**," press **ENT**.
13. **NETID**, set as assigned, press **ENT**.
14. **ESC** to main screen.

Table 2.71 PRC-148 Enable/Disable Side Connector.

1. **ALT+MENU**, press.
2. Select **PROGRAM**, press **ENT**.
3. Select **GLOBAL**, press **ENT**.
4. Select **SIDE/MIC LVL**, press **ENT**.
5. Select **SIDE ENABLE/DISABLE**, press **ENT**.
6. Press **ESC**, WAFFLE Icon will show in upper right of screen.

Table 2.72 PRC-148 Microphone Level.

1. **ALT+MENU**, press.
2. Select **PROGRAM**, press **ENT**.
3. Select **GLOBAL**, press **ENT**.
4. Select **SIDE/MIC LVL**, press **ENT**.
5. Select:
a. **MIC LVL LOW** (for THALES accessories).
b. **MIC LVL HIGH** (for all others).
6. Press **ENT**.
7. Press **ESC**.

Table 2.73 PRC-148 Narrowband SATCOM Programming.

1. **ALT+MENU**, press.
2. Select PROGRAM, press **ENT**.
3. Select **RADIO CONFIG**, press **ENT**.
4. Set channel number to modify using top switch.
5. Select **PLAIN/SECURE**, press **ENT**.
6. Set **Net Nam**e, press **ENT**.
7. Set **PWR** to **5.0W**, press **ENT**.
8. Set **MODE** to **ANDVT**, press **ENT**.
9. Set **RX** to downlink frequency, press **ENT**.
10. Set **TX** to uplink frequency, press **ENT**.
11. Set **DELAY** (135MS), press **ENT**.
12. TEK, selected loaded ANDVT TEK, press **ENT**.
13. Set **TFRAME** (training frame) 6, press **ENT**.
14. **ESC** to main screen.

Table 2.74 PRC-148 Wide/Narrowband SATCOM (Using in Scan Plan).

1. **ALT+MENU**, press.
2. Select PROGRAM, press **ENT**.
3. Select RADIO CONFIG, press **ENT**.
4. Set channel number to modify using top switch.
5. Select **PLAIN/SECURE**, press **ENT**.
6. Set Net Name, press **ENT**.
7. Set PWR to **5.0W**, press **ENT**.
8. Set MODE to **BASIC**, press **ENT**.
9. Set **RX** to downlink frequency, press **ENT**.
10. Set **TX** to uplink frequency, press **ENT**.
11. Set Modulation to **FM**, press **ENT**.
12. Set CTCSS R & T to **150.0**, press **ENT**.
13. **TEK**, selected loaded crypto, press **ENT**.
14. **ESC** to main screen.

Table 2.75 PRC-148 Power/Squelch Adjustments.

Adjust Power Output:
1. **PTT**, press + ▲/to **INCR/DECR** power out.
Enable/Disable Squelch:
1. Side Squelch Button, press (below PTT switch).
Adjust Squelch:
1. Side Squelch Button, press and hold.
2. Squelch Adjust screen appears, ▲/▼ to adjust.
3. Press **ENT**.

Table 2.76 PRC-148 Cloning Procedures.

Requires a cloning cable, a source, and a destination radio.
1. Set both radios to internal audio.
2. Enable side connector on both radios.
3. Turn both radios **OFF**.
4. Source Radio, connect the **SEND** end of cloning cable.
5. Destination Radio, connect **RECEIVE** end of cloning cable.
6. Both radios, **ON**.
7. Source Radio, press **PTT**. Wait for completion.
8. Destination Radio, turn **OFF**/disconnect within 15 seconds.
9. Source Radio, disconnect.
10. Source Radio, press **ESC**.
11. Source Radio, **OFF**. COMSEC and TRANSEC are NOT cloned.
LEGEND:
TRANSEC—transmission security

Table 2.77 PRC-148 HAVE QUICK II Operations.

Frequency Hopping Net: 1. ALT +MENU, press ENT 2. Select PROGRAM, press ENT 3. Select CHANNEL, press ENT 4. Select channel number to modify using top switch 5. Select PLAIN/SECURE, press ENT 6. Set Net Name, press ENT 7. Set PWR to 5.0W, Press ENT 8. Set MODE to HQ/HQII, press ENT 9. Set ECCM to FH, press ENT 10. Scroll back up to FX and change Active Net (i.e., A00.0250), press ENT 11. Select TEK and change to appropriate fill location **Load MWOD:** 1. ALT +MENU, press ENT 2. Select KEYFILL, press ENT 3. Select MWODM, press ENT 4. Select OPR DAY, press ENT 5. Enter the current day of the month, press ENT 6. Skip over WOD 7. Select MWOD, press ENT 8. Select a MWOD position (1-6), press ENT 9. Enter MWOD presets 20-18 on page 1 and MWOD presets 17-15 on page 2 from the appropriate WOD sheet 10. Select DAY on page 3, enter the Day of the Month the MWODs will be assigned to. 11. Press ESC to get back to the main menu **Receive TOD** (from another party): 1. ALT +MENU, press ENT 2. Select KEYFILL, press ENT 3. Select TOD, press ENT 4. Select RX TOD, press ENT 5. TODRX will flash in top right corner of screen 6. Once TOD is received, TODRX will disappear 7. If TOD is not received, TODRX will remain in screen until it times out **Receive TOD** (from GPS): 1. **ALT +MENU**, press **ENT** 2. Select **KEYFILL**, press **ENT** 3. Select **TOD**, press **ENT** 4. Select **PLGR TOD**, press **ENT** 5. Connect GPS to radio with **GPS TOD** Cable 6. Press the **PTT** switch to load TOD **Send TOD:** 1. ALT +MENU, press ENT 2. Select KEYFILL, press ENT 3. Select TOD, press ENT 4. Select EMER INIT, press ENT 5. Once EMER INIT was selected, the internal clock was set and you will be returned to the main screen 6. ALT +MENU, press ENT 7. Select KEYFILL, press ENT 8. Select TOD, press ENT 9. Select TX TOD, press ENT 10. Press PTT switch to send TOD **Single Channel Net:** 1. ALT +MENU, press ENT 2. Select PROGRAM, press ENT 3. Select CHANNEL, press ENT 4. Select channel number to modify using top switch 5. Select PLAIN/SECURE, press ENT 6. Set Net Name, press ENT 7. Select PWR to 5.0W, press ENT 8. Select MODE to HQ/HQII, press ENT 9. Select ECCM to SC, press ENT 10. Scroll back up to FX and change frequency (i.e., UHF Freq), press ENT 11. Select TEK and change to appropriate fill location

2.4.7 Generic Crypto Operations. The following outlines normal procedures for crypto loading procedures for various radio systems. Table 2.78, COMSEC Short Titles and Associated Equipment, provides a quick glance at various short titles and their equipment. See Table 2.79, Loading From a PYQ-10 SKL; and Table 2.80, Sending OTAR From PYQ-10 SKL.

Table 2.78 COMSEC Short Titles and Associated Equipment.

Short Title	Associated Equipment
AKAC 1553	Authentication/Encode/Decode (Operational)
KAD 269	HQ training WOD AN/PRC-117G, AN/PRC-148 AN/PRC-152, AN/GRC-206
KTC L500	Authentication/Encode/Decode (Training)
USEAD M4270	Secure Communications AN/PRC-117G, AN/PRC-152 (ANW2 net programming) HAIPE KEY
USKAD G2881	VOICE and DAT// Secure Communications AN/PRC-117G, AN/PRC-148 AN/PRC-152, AN/GRC-206
USKAD 215	ANDVT // Secure Communications AN/PRC-117F/G, AN/PRC-148, AN/PRC-150, PRC-160, AN/PRC-152, AN/GRC-206
USKAD 1019	VINSON // Secure Communications AN/PRC-117F/G, AN/PRC-148, AN/PRC-150, PRC-160, AN/PRC-152, AN/GRC-206
USKAD 101040	GPS // BLACK CRYPTO VARIABLE MONTHLY (BCVm)
USKAD 102040	GPS // BLACK GROUP UNIQUE VARIABLE (BGUV)
USKAD 103040	GPS // BLACK KEY ALGORITHM UPDATE PARAMETER (BKAUPD)
AEAD G12154 880091	MASTER KEY ENCRYPTION KEY (MKEK) // PROTECTS TRAFFIC ENCRYPTION KEYS (TEK) // PROTECTS TRANSMISSION SECURITY KEYS (TSK)
AEAD W88 880091	WATARI KEY // DECRYPTS AN/PRC-161 SOFTWARE AND PROGRAMMABLE LOGIC IMAGES DURING A SOFTWARE DOWNLOAD OPERATION 4

Table 2.79 Loading from a PYQ-10 SKL

1. SKL Power, ON.
2. Using stylus select **CoreLib** SKL may automatically go to Logon screen.
3. Using stylus, enter **User ID** and **Password**, select **OK**.
4. Select **Launch**, select **Launch UAS**, select **OK**.
5. SKL will check and decrypt database, select **OK**.
6. Select the **Keys** tab.
7. Select desired Short Title and Edition, highlight segment to transfer.
8. Select **Load** icon near top right of screen.
9. Protocol **DS-102**, Activate Mode **KYK-13**, select **OK**.
10. Confirm Short Title/Edition/Segment to transfer, select OK.
11. Setup device to be filled the same as if receiving from a KYK-13 and connect to SKL.
12. Follow instructions on SKL, Press **INITIATE** button.
13. SKL displays **Operation Successful**, select **OK**.
14. Disconnect the device being filled from the SKL.
15. Select **File**, select **Save Database**.
16. Select **File**, select **Exit**.
17. Select **Session**, select **Logout**.
18. Power OFF.

Table 2.80 Sending OTAR from PYQ-10 SKL.

1. SKL Power, Steps 1 to 5 above.
2. Select FILE, OTAD, MANUAL REKEY (MK).
3. Select **Generic MK**, press **Next>>**.
4. Perform MK-RV, select **YES**.
5. Generate new, select **NO**.
6. Loadout station TEK, select **NO**.
7. Select desired Short Title and Edition, Segment to send, press **Next>>**.
8. Follow instructions on SKL, Press **FINISH**.
9. SKL displays Operation Successful, select **OK**.
10. Complete Steps 14 to 18 in Table 2.79 above.

2.4.8 AN/GRC-263 Mounted Communications System.

2.4.8.1 MCS Block 1. See Table 2.81, MCS Block 1 Default Password; Table 2.82, MCS Block 1 IP/Network Addresses; Table 2.83, MCS Block 1 System Configuration; Table 2.84, MCS Block 1 IP Configuration in SIR Viewer Software; Table 2.85, MCS Block 1 DAGR Configuration; Table 2.86, MCS Block 1 AN/PRC150(C) Configuration; Table 2.87, MCS Block 1 SKA Configuration; Table 2.88, MCS Block 1 UIDM Software Configuration Procedures; Table 2.89, MCS Block 1 Function Checks; and Table 2.90, MCS Block 1 KD Function Check/Radio Checks.

Table 2.81 MCS Block 1 Default Password.

Title	Password
G3 Laptop - Windows Username Windows Password	jrACP lqaz@WSX3edc$RFV
LAN Router	!QAZ2wsx#4r
LAN Switch	! QAZ2wsx#EDC4rfv
Central Unit	harris
MB and HF Radios	IGOV14725836

Table 2.82 MCS Block 1 IP/Network Addresses.

LAN Router	192.168.69.1
LAN Switch	192.168.69.2
Soldier ISR Receiver (SIR) - TACRover-p	192.168.69.10
Central Unit (CU)	192.168.69.20
UIDM	192.168.69.203
G3 Laptop	192.168.69.7
G3 Laptop (Docking Station)	192.168.69.6
Subnet Mask (All)	255.255.255.128
Default Gateway (All)	192.168.69.1

Table 2.83 MCS Block 1 System Configuration (1 of 2).

1. **SIR Configuration Using Viewer** (if viewer is not available, use instructions in System Configuration Step 2)
    a. Install battery onto the base of the SIR
    b. Install the Viewer cable onto SIR J1 and center composite video connectors
    c. Press the SIR power button
    d. Wait for the Viewer to initialize/load, allowing the status bar at the bottom of the screen to finish loading
    e. Wait for **Menu bar** to appear at the bottom of the Viewer screen
    f. Press the **center/return/lock** button on the SIR
    g. Press the down arrow button on the SIR to select **Options**
    h. Press the right arrow button on the SIR to open the **Options menu**
    i. Press the down arrow button on the SIR to select **Advanced Options**
    j. Press the right arrow button on the SIR to open the **Advanced Options menu** and select **Set IP Address**
    k. Press the center/return/lock button on the SIR to configure the SIR IP Address
    l. Using the SIR keypad, enter the Enter the following IP addresses:
        (1) IP address: field, type [**192.168.69.10**]
        (2) Subnet mask: field, type [**255.255.255.128**]
        (3) Gateway: field, type [**192.168.69.1**]
    m. Press the center/return/lock button on the SIR to input the SIR IP Address

NOTE: The Viewer screen will display, Saving IP Address

    n. After the IP Address is saved, power off the SIR by pressing and holding the SIR power button; restart the SIR to verify the IP Address has been saved

2. **SIR Configuration if Viewer is Not Available** (this step is not necessary if step 1 completed)
    a. Right click the **Network Connection** icon in the System Tray
    b. Click **Open Network and Internet Settings**
    c. Click the **Change adapter options** link on the left
    d. Right click **Ethernet 2** and then click **Properties**
    e. Double click on **Internet Protocol Version 4 (TCP/IPv4)**
    f. Select **Use the following IP address**, and enter as follows:
        (1) IP address: field, type [**192.168.80.2**]
        (2) Subnet mask: field, type [**255.255.255.0**]
        (3) Gateway: field, type [**192.168.80.1**]
    g. Click the **OK** button to close the TCP/IP Settings window
    h. Click yes when the pop-up occurs
    i. Close out all windows
    j. Launch Internet Explorer by clicking on the icon in the quick launch bar, or by clicking Start > All Programs > Internet Explorer
    k. In the URL box, enter the IP address of the SIR [192.168.80.1], and press <Enter>
    l. Click on the Show Advanced Options link
    m. Select the Admin tab
    n. Select the **Network** tab
    o. Change the User IP: to [**192.168.69.10**]; Subnet Mask: [**255.255.255.128**]
    p. Change the Link IP: to [**192.168.70.1**]; Subnet Mask: [**255.255.255.0**]
    q. Change the Default Route: to [**192.168.69.1**]
    r. Click the **Apply Changes** button
    s. Click the **Save** button to save the current IP configuration
    t. Close the Internet Explorer window
    u. Right click the **Network Connection** icon in the System Tray

Table 2.83 MCS Block 1 System Configuration (2 of 2).

v, Click Open Network and Internet Settings w. Click the **Change adapter settings** link on the left x. Right click **Ethernet 2** and then click **Properties** y. Double click on Internet Protocol Version 4 (TCP/IPv4) z. Select **Use the following IP address**, and enter as follows: (1) IP address: field, type [**192.168.69.6**] (2) Subnet mask: field, type [**255.255.255.128**] (3) Gateway: field, type [**192.168.69.1**] aa. Click the **OK** button to close the TCP/IP Settings window bb. Click **YES** when the pop-up occurs cc. Close out all windows dd. Launch **Internet Explorer** by clicking on the icon in the quick launch bar, or by clicking **Start** > **All Programs** > **Internet Explorer** ee. In the **URL box**, enter the IP address of the SIR [**192.168.69.10**], and press **Enter** ff. Verify the GUI reconnects via the updated IP address gg. Click on the Show Advanced Options link hh. Select the Admin tab ii. Select the Network tab jj. Click the Save button kk. Cycle the power on the ISR switch on the PDU

Table 2.84 MCS Block 1 IP Configuration in SIR Viewer Software.

1. **IP Configuration in SIR Viewer Software** (may need to be reset upon restarting viewer or when frequency band is changed. a. **Changing SIR IP Address in Soldier Sight** (1) Open **Media player** (2) Go to **View** (3) Click **Review Connection Details** (4) Change IP from default IP of **192.168.80.1** to **192.168.69.10** (5) Click **OK** b. **Changing SIR IP Address in Flight Lens** (1) Open **Flight Lens** (2) Go to **gear icon** in the top right corner of the application window (3) Click on the **Radio Control** settings (4) Change the IP address from default IP of **192.168.80.1** to **192.168.69.10** (5) Click **OK**

Table 2.85 MCS Block 1 DAGR Configuration.

1. Press and hold the **POWER** key
2. Press the **MENU** key twice on the keypad to display the Main Menu
3. Scroll down and select **System** by pressing the **ENTER** key
4. Scroll down and select **"Select Function Set"** by pressing the **ENTER** key
5. Select **Advanced** by pressing the **ENTER** key
6. Press **MENU** key twice to return to main menu
7. Press the **Down Cursor Control** key on the keypad until the **Receiver Setup** submenu item is selected; press the **ENTER** key
8. Press the **Down Cursor Control** key on the keypad until the **POWER SAVER** page (Figure 1) is selected; press the **ENTER** key
9. On the **POWER SAVER** page press the **ENTER** key on the keypad until the **AUTO-OFF MODE** field is selected; press the **ENTER** key
10. Press the **Down Cursor Control** key until the **Off** option is selected; press the **ENTER** key
11. Press the **Down Cursor Control** key until the **AUTO-STANDBY MODE** field is selected Press the **ENTER** key
12. Press the **Down Cursor Control** key until the **Off** option is selected; press the **ENTER** key
13. Press and hold the **POS/PAGE** button to return the Home Screen
14. Press **MENU** button twice to open the main menu
15. Scroll down and select **System** by pressing the **ENTER** button
16. Scroll down and select **"Select Function Set"** by pressing the **ENTER** button
17. Select **Advanced** by pressing the **ENTER** button
18. Press **MENU** button twice to return to main menu
19. Scroll up and select **COMMUNICATIONS** by pressing the **ENTER** Button
20. Scroll down and select **COM PORT SETUP** by pressing the **ENTER** button
21. Press **Down Arrow Button** once to scroll down to next page
22. Press **ENTER** to highlight **COM PORT 1**
23. Press the **Down Arrow Button** to highlight **IN PROTOCOL**
24. Press the **ENTER** button and select **NMEA** to change **IN PROTOCOL** to **NMEA**
25. Press the **Right Arrow** Button to highlight **OUT PROTOCOL**
26. Press the **ENTER** button and select **NMEA** to change **OUT PROTOCOL** to **NMEA**
27. Navigate to and highlight **IN BAUD**
28. Press **ENTER** button and select **4800** to change **IN BAUD** to **4800**
29. Navigate to and highlight **OUT BAUD**
30. Press **ENTER** button and select **4800** to change **OUT BAUD** to **4800**
31. Press **Down Arrow Button** twice to scroll down to next page
32. Navigate to and highlight **NMEA INTERVAL**
33. Press **ENTER** button and change **NMEA INTERVAL** from **2** to **1**
34. Press **Down Arrow Button** once to scroll down to **NMEA Sentences**
35. Under **NMEA Sentences**, the first box on the left is **"RMC,"** ***DO NOT*** change this
NOTE: You will add the following values to **NMEA Sentences**; **GSV**, **GGA**, **GSA**, **GLL**
36. Navigate to the second box and press **ENTER** button, select **GSV**
37. Navigate to the third box and press **ENTER** button, select **GGA**
38. Navigate to the fourth box and press **ENTER** button, select **GSA**
39. Navigate to the fifth box and press **ENTER** button, select **GLL**.
40. Press and hold the **POS/PAGE** button to return to the Home Screen

Table 2.86 MCS Block 1 AN/PRC150(C) Configuration.

1. Press the **PGM/8** button on the PRC-150 to bring up the Program Menu
2. Press the **Right Arrow button** to highlight the **CONFIG** option
3. Press the **ENT** button to enter the Config Menu
4. Press the **Right Arrow button** to highlight the **PORTS** option
5. Press the ENT button to enter the Ports Menu
6. Press the Right Arrow button to highlight the ASCII option
7. Press the ENT button to enter the ASCII Menu
8. Press the Up/Down arrow buttons to scroll and set to 9600
9. Press the ENT button 6 times to complete and return to the ASCII Menu
10. Press the **PGM/8** button on the PRC-150 to exit the Program Menu
11. Press the **PGM/8** button to bring up the Program Menu
12. Press the **Right Arrow button** to highlight the **CONFIG** option
13. Press the **ENT** button to enter the Config Menu
14. Press the **Right Arrow button** to highlight the **GPS** option (it will be on the second screen)
15. Press the **ENT** button to enter the GPS Menu
16. Press the Up/Down arrow buttons to scroll and set to EXT GARMIN GPS V (R)
17. Press the ENT button to complete and return to the GPS Menu
18. Press the **PGM/8** button to exit the Program Menu

Table 2.87 MCS Block 1 SKA Configuration.

1. From the Ruggedized Laptop's desktop, double click the **[SKA]** icon
2. The Harris RF-7800I SKA3 window displays; if no shortcut is present, go to **Windows Icon**, scroll to **SKA** program, double click to open, right click to save short cut
3. When the SKA first starts, no intercom elements are displayed
4. Right click on any white background area and select [**Add Central Unit**].
5. The New Central Unit dialog box is displayed
6. In the **[Name:]** field, enter CU name **(PEITTS_M1145_rev 7)**
7. In the **[Password:]** field, enter current password **(harris)**
8. In the **[IP Address:]** field, enter current IP Address **(192.168.69.20)**
9. In the **[Inactivity timeout:]** field, leave as default **(2s)**
10. Click **[OK]**, green icon will appear

Table 2.88 MCS Block 1 UIDM Software Configuration Procedures.

1. In the System Tray of the Windows operating system task bar, left-click on the IDM icon (it may be necessary to select **Show hidden icons**, represented by an up arrow)
2. The **PCIDM Control Panel** window appears
3. Right-click the top row and select PCIDM IP Settings
4. In the **IP Address field**, type **192.168.69.203**
5. In the **Net Mask** field, type **255.255.255.128**
6. Select the **OK** button
7. To the left of **UIDM V2 R2**, verify that the circle is green; serial Number will be displayed along with IP address, Net Mask, and status will state "Ready"
8. Select the **X** button to close the **PCIDM Control Panel** window

Table 2.89 MCS Block 1 Function Checks (1 of 2).

1. LAN connectivity function check a. Login to the laptop (CTRL/ATL/DELETE) b. Open command prompt from start menu c. Verify connection to UIDM (1) Ensure PCIDM icon in System Tray is green; if/when green, click icon (2) Within PCIDM Control Panel, verify circle to the left of UIDM V2 R2 is green (3) Serial Number, IP Address, and Net Mask should be displayed (4) Status should read “Ready” (5) Type “ping 192,168.69.203” in command prompt (a) Verify 4 sent, 4 received, and 0 lost d. Verify connection to CU (1) From the laptop’s desktop, double click the **[SKA]** icon to open SKA application (2) The Harris RF-7800I SKA3 window displays (3) In the upper left-hand corner, under the **Central Unit tab**, the name of the CU will be displayed (4) Verify the Central Unit icon is green with a white checkmark (5) Under the **Details tab**, the IP address of the CU will be displayed (6) Type in command prompt “ping 192,168.69.20” (a) Verify 4 sent, 4 received, and 0 lost e. Verify connection to SIR (1) Launch Internet Explorer by clicking on the icon in the quick launch bar, or by clicking **Start** > **(Under Common Utilities)> Internet Explorer** (2) In the URL box, enter the IP address of the SIR [**192.168.69.10**], and press **Enter** (3) The TAC-e Graphical User Interface (GUI) will open up. Verify GUI Status is green (4) Click on the **Show Advanced Options** link (5) Select the **Admin** tab (6) Select the **BIT** tab (7) Click on the **Run IBIT** button (a) After IBIT runs, the IBIT Status changes to Pass and all will illuminate green (8) Click on the **Video Test** button (a) The button will go from **Off** to **On** and will illuminate green (9) Click the **[-]** symbol in the upper right-hand corner of the Admin – Internet Explorer window to minimize (10) Launch Media Player by clicking on the icon on the desktop, or by clicking **Start** > **SoldierSight ™ Suite** > **Media Player** (11) Media Player launches and test video displays within 10 seconds. (12) In command prompt, type “ping 192,168.69.10” (a) Verify 4 sent, 4 received, and 0 lost

Table 2.89 MCS Block 1 Function Checks (2 of 2).

2. **KD Function Check/Radio Checks** a. Confirm KDs are receiving position data from DAGR (1) From KD main menu, push "9" to verify GPS displays on all 4 KDs (2) Push C to get to the main menu b. Confirm ability to remote into each radio / confirm position data from radio receiver (1) Push and hold "1" to remote into radio 1 (2) Push "2" (Options), scroll by pressing "4" to "Advanced," then push "8" to scroll to "GPS Display" (3) Verify GPS data displays (LAT/LONG) (4) Push "C" to return to main menu (5) Repeat for radios 2, 3, and 4 c. Confirm intercom/conference function between at least 2 KDs (1) Ensure appropriate "Microphone" setting is selected for both J2 and J3 ports (from KD main menu, press "X" button, scroll to "Microphone," then select correct source; press "C" to return to main menu) (2) Ensure all radios are inactive (NOT Highlighted) on main menu of KDs (3) Push "C" to access submenu on each KD (4) Push "9" to activate conference mode on each KD (5) Talk into microphone on handset/headset to confirm comms (d. Perform radio checks in each available frequency band (1) Suggest VHF/AM on Radio 1, VHF/FM on Radio 2, UHF on Radio 3, and HF on Radio 4 (2) Sequentially select radio for transmission by highlighting on main KD menu 3. **Remote Operations (KD only)** a. Configure remote KD and laptop for remote operations b. Repeat Function Checks Steps 1 and 2

Table 2.90 MCS Block 1 KD Function Check/Radio Checks.

1. Confirm KDs are receiving position data from DAGR
a. From KD main menu, push "9" to verify GPS displays on all 4 KDs
b. Push C to get to the main menu
2. Confirm ability to remote into each radio / confirm position data from radio receiver
a. Push and hold "1" to remote into radio 1
b. Push "2" (Options), scroll by pressing "4" to "Advanced," then push "8" to scroll to "GPS Display"
c. Verify GPS data displays (LAT/LONG)
d. Push "C" to return to main menu
e. Repeat for radios 2, 3, and 4
3. Confirm intercom/conference function between at least 2 KDs
a. Ensure appropriate "Microphone" setting is selected for both J2 and J3 ports (from KD main menu, press "X" button, scroll to "Microphone," then select correct source; press "C" to return to main menu)
b. Ensure all radios are inactive (NOT Highlighted) on main menu of KDs
c. Push "C" to access submenu on each KD
d. Push "9" to activate conference mode on each KD
e. Talk into microphone on handset/headset to confirm comms (
4. Perform radio checks in each available frequency band
a. Suggest VHF/AM on Radio 1, VHF/FM on Radio 2, UHF on Radio 3, and HF on Radio 4
b. Sequentially select radio for transmission by highlighting on main KD menu

2.4.8.2 MCS Block 2 System Configuration. See **Table 2.91**, MCS Block 2 Default Password; **Table 2.92**, MCS Block 2 IP/Network Addresses; **Table 2.93**, MCS Block 2 Power on Procedures; **Table 2.94**, MCS Block 2 SIR Configuration; **Table 2.95**, MCS Block 2 IP Configuration in SIR Software; **Table 2.95**, MCS Block 2 AN/PRC160 Configuration; **Table 2.97**, MCS Block 2 PRC-117G Enable External Keyline; **Table 2.98**, MCS Block 2 PRC-160 Enable External Keyline; **Table 2.99**, MCS Block 2 SKA Configuration; **Table 2.100**, MCS Block 2 UIDM Software Configuration Procedures; **Table 2.101**, MCS Block 2 Function Checks; and **Table 2.102**, MCS Block 2 Shutdown Procedures.

Table 2.91 MCS Block 2 Default Password.

Title	Password
G3 Laptop - Windows Username Windows Password	Tactical Air Control Party (TACP) lqaz@WSX3edc$RFV
LAN Router	!QAZ2wsx#EDC4rfv
Central Unit	harris
MB and HF Radios	IGOV14725836
TacROVER-e GUI - Username	admin
TacROVER-e Hardware	1234

Table 2.92 MCS Block 2 IP/Network Addresses.

LAN Switch	192.168.69.1
Soldier ISR Receiver - TacROVER-e	192.168.69.10
Central Unit	192.168.69.20
UIDM	192.168.69.203
Power Supply	192.168.69.30
G5 Laptop	192.168.69.7
G5 Laptop (Docking Station)	192.168.69.6
Subnet Mask (All)	255.255.255.128
Default Gateway (All)	192.168.69.1

Table 2.93 MCS Block 2 Power on Procedures.

1. Connect MCS Block 2 to AC or DC external power, if available through SEP
2. Turn on either the **AC** breaker (top right) or the **EXT DC** breaker (bottom left), depending on availability of external power source, by flipping the switch UP
3. If external power is unavailable, turn on the **Vehicle DC** breaker (bottom left) by flipping the switch UP
4. Set the MCS power bypass switch to the **ON** position
5. Ensure ISR switch is set to **L/S/C**, SATCOM radio switch is set to **RT3**, SATCOM antenna switch is set to **SAT**
6. Switch PDU master power switch to **ON**, then switch PDU power for all components except for UIDM to **ON**
7. Turn the Function switch on all radios to the desired more; push the **2** button on each to light the display
8. Turn on TacROVER-e by pressing and holding button on top; push **COV** button to light the display and verify power to the receiver (only perform this step if Operator is in an environment where light emission is appropriate)
9. Turn on laptop via button on front left of device
10. Turn on DAGR by pressing the **PWR** button, if not already powered on
11. Press **OK** on all KDs to light displays and verify power

Table 2.94 MCS Block 2 SIR Configuration.

1. Power on the TacROVER-e
2. Enter the default password: 1234 and press **OK**
3. Press the **Up Arrow button** and note the current IP address.
4. Use these steps to change the Laptop's IP address to the same subnet as the current address of the TacROVER-e
5. On the Taskbar of the Laptop, click the **Network Connection** icon
6. Click **Open Network and Internet Settings**
7. Click the **Change adapter options** link
8. Double click **Local Area Connection**
9. Click the **Properties** button on lower left
10. Double click **Internet Protocol Version 4 (TCP/IPv4)**
11. Use the following IP addresses: a. IP address field, type **192.168.80.2** b. Subnet mask field, type **255.255.255.0** c. Leave Default gateway field blank
12. Click the **OK** button and exit all windows to the desktop
13. From the Taskbar, click the **Internet Explorer** icon
14. In the Address/Search bar type the IP address **192.168.80.1** a. The L3 Technologies GUI window displays. Log in using: Username: (**admin**) Password: (**L3tacrover**) and click **Submit**
15. Click **User Interface**
16. Click **Show Advanced Options**
17. Select the **Admin** tab
18. Select the **Network** tab
19. Change User IP to **192.168.69.10**
NOTE: This address must be on the same subnet as the laptops desired IP address
20. Change the Default Route to **192.168.69.129**
21. Click the **Apply Changes** to apply all entries a. The TacROVER-e address changes to **192.168.69.10**
22. Click the **Save** button to save the current IP
23. Click the **X** in the upper right-hand corner of the Admin—Internet Explorer window to exit
24. Repeat Steps 4 to 11 with the following values: a. In the IP address, type **192.168.69.07** b. In the Subnet mask field, type **255.255.255.128**

Table 2.95 MCS Block 2 IP Configuration in SIR Software.

Changing SIR IP Address in Flight Lens
1. Open **Flight Lens**
2. Go to **gear icon** in the top right corner of the application window
3. Click on the **Radio Control** settings
4. Change the IP address from default IP of **192.168.80.1** to **192.168.69.10**
5. Click **OK**

Table 2.96 MCS Block 2 AN/PRC160 Configuration.

1. Press the **PGM/8** button on the PRC-150 to bring up the Program Menu
2. Press the **Right Arrow button** to highlight the **CONFIG** option
3. Press the **ENT** button to enter the **Config Menu**
4. Press the **Right Arrow button** to highlight the **PORTS** option
5. Press the **ENT** button to enter the **Ports Menu**
6. Press the **Right Arrow button** to highlight the **ASCII** option
7. Press the **ENT** button to enter the **ASCII Menu**
8. Press the **Up/Down arrow buttons** to scroll and set to **9600**
9. Press the **ENT** button 6 times to complete and return to the **ASCII Menu**
10. Press the **PGM/8** button on the PRC-150 to exit the **Program Menu**
11. Press the **PGM/8** button to bring up the **Program Menu**
12. Press the **Right Arrow button** to highlight the **CONFIG** option
13. Press the **ENT** button to enter the **Config Menu**
14. Press the **Right Arrow button** to highlight the **GPS** option (it will be on the second screen)
15. Press the **ENT** button to enter the **GPS Menu**
16. Press the **Up/Down arrow buttons** to scroll and set to **EXT GARMIN GPS V (R)**
17. Press the **ENT** button to complete and return to the **GPS Menu**
18. Press the **PGM/8** button to exit the **Program Menu**

Table 2.97 MCS Block 2 PRC-117G Enable External Keyline.

From the face of the radio

1. Press the **PGM/8** button on the PRC-117G to bring up the Program Menu
2. Press the **ENT** button to enter the Program Menu
3. Press the **Right Arrow button** to highlight the **RADIO CONFIG** option
4. Press the **ENT** button to enter the **RADIO CONFIG** Menu
5. Press the **Right Arrow button** to highlight the **GENERAL CONFIG** option
6. Press the **ENT** button to enter the **GENERAL CONFIG** Menu
7. Press the **Right Arrow button** to highlight the **ENABLE** option
8. Press the **ENT** button to **ENABLE KEYLINE**

From the Keypad Display Unit (KDU)

1. Press and hold button **4 (PRC-117G Radio)**
2. Press button **2 (Options)**
3. Use the **Up/Down arrow buttons (Button 8)** to scroll to **Advanced**
4. Press **OK**
5. Use the **Up/Down arrow buttons (Button 8)** to scroll to **External Keyline**
6. Press OK
7. Select **Enable** by pressing **OK**
8. Press **C** three times to return to **Main Menu Screen**

Table 2.98 MCS Block 2 PRC-160 Enable External Keyline.

From the Keypad Display Unit (KDU)

1. Press and hold button **4 (PRC-160 Radio)**
2. Press button **2 (Options)**
3. Use the **Up/Down arrow buttons (Button 8)** to scroll to **Advanced**
4. Press **OK**
5. Use the **Up/Down arrow buttons (Button 8)** to scroll to **External Keyline**
6. Press OK
7. Select **Enable** by pressing **OK**
8. Press **C** three times to return to **Main Menu Screen**

Table 2.99 MCS Block 2 SKA Configuration.

From the Ruggedized Laptop's desktop, double click the **SKA** icon
NOTE 1: The Harris RF-7800I SKA3 window displays; if no shortcut is present, go to **Windows Icon**, scroll to **SKA** program, double click to open, right click to save short cut
NOTE 2: When the SKA first starts, no intercom elements are displayed
1. Right click on the white background and select **Add Central Unit**.
2. The New Central Unit dialog box is displayed
3. In the **Name:** field, enter CU name **(PEITTS_M1145_rev 7)**
4. In the **Password:** field, enter current password **(harris)**
5. In the **IP Address:** field, enter current IP Address **(192.168.69.20)**
6. In the **Inactivity timeout:** field, leave as default **(2s)**
7. Click **OK**, green icon will appear

Table 2.100 MCS Block 2 UIDM Software Configuration Procedures.

1. In the System Tray of the Windows operating system task bar, left-click on the **PCIDM** icon (it may be necessary to select **Show hidden icons**, represented by an up arrow)
2. The **PCIDM Control Panel** window appears
3. Right-click the top row and select **PCIDM IP Settings**
4. In the **IP Address field**, type **192.168.69.203**
5. In the **Net Mask** field, type **255.255.255.128**
6. Select the **OK** button
7. To the left of **UIDM V2 R2**, verify that the circle is green; serial Number will be displayed along with IP address, Net Mask, and status will state "Ready"
8. Select the **X** button to close the **PCIDM Control Panel** window

Table 2.101 MCS Block 2 Function Checks (1 of 2).

1. LAN connectivity function check
    a. Login to the laptop by pressing **CTRL/ATL/DELETE**
    b. Open command prompt from **start** menu
    c. Verify connection to UIDM
        (1) Ensure **PCIDM icon** in System Tray is green; if/when green, click icon
        (2) Within **PCIDM Control Panel**, verify circle to the left of UIDM V2 R2 is green
        (3) Serial Number, IP Address, and Net Mask should be displayed
        (4) **Status** should read "Ready"
        (5) Type **ping 192,168.69.203** in command prompt
        (6) Verify 4 sent, 4 received, and 0 lost
    d. Verify connection to CU
        (1) From the laptop's desktop, double click the **SKA** icon to open SKA application
        (2) The Harris RF-7800I SKA3 window displays
        (3) In the upper left-hand corner, under the
        (4) **Central Unit tab**, the name of the CU will be displayed
        (5) Verify the Central Unit icon is green with a white checkmark
        (6) Under the
        (7) **Details tab**, the IP address of the CU will be displayed
        (8) Type in command prompt
        (9) Ping 192,168.69.20
        (10) Verify 4 sent, 4 received, and 0 lost
    e. Verify connection to TacROVER-e
        (1) Launch Internet Explorer by clicking on the icon in the quick launch bar, or by clicking **Start** > **(Under Common Utilities)> Internet Explorer**
        (2) In the URL box, enter the IP address of the SIR **192.168.69.10**, and press **Enter**
        (3) The TacROVER-e Graphical User Interface (GUI) will open up. Verify GUI Status is green
        (4) Click on the **Show Advanced Options** link
        (5) Select the **Admin** tab
        (6) Select the **BIT** tab
        (7) Click on the **Run IBIT** button
        (8) After IBIT runs, the IBIT Status changes to Pass and all will illuminate green
        (9) Click on the **Video Test** button
        (10) The button will go from **Off** to **On** and will illuminate green
        (11) Click the **[-]** symbol in the upper right-hand corner of the Admin – Internet Explorer window to minimize
        (12) Launch Media Player by clicking on the icon on the desktop, or by clicking **Start** > **Flight Lens** > **Media Player**
        (13) Go to the task bar at the top of the screen, click **View**
        (14) Navigate to **Connection Details**
        (15) Type IP address **192.168.69.10**, press **OK** to close the dialog box
        (16) Media Player launches and test video displays within 10 seconds
        (17) In command prompt, type **ping 192,168.69.10**
        (18) Verify 4 sent, 4 received, and 0 lost

Table 2.101 MCS Block 2 Function Checks (2 of 2).

2. KD Function Check/Radio Checks
   a. Configure KDs
      (1) Connect Headset or Handset to ports on KDs
      (2) Push **X** button on each KD connected to Peltor or H250s and scroll to **Microphone**
      (3) Select appropriate device
      (4) Push **C** to return to main menu
   b. Confirm KDs are receiving position data from DAGR
      (1) From KD main menu, push **9** to verify GPS displays on all 4 KDs
      (2) Push **C** to get to the main menu
   c. Confirm ability to remote into each radio / confirm position data from radio receiver
      (1) Push and hold **1** to remote into radio 1
      (2) Push **2** (Options), scroll by pressing **4** to **Advanced**, then push **8** to scroll to GPS Display
      (3) Verify GPS data displays (LAT/LONG)
      (4) Push **C** to return to main menu
      (5) Repeat for radios 2, 3, and 4
   d. Confirm intercom/conference function between at least 2 KDs
      (1) Ensure all radios are inactive (NOT Highlighted) on main menu of KDs
      (2) Push **C** to access submenu on each KD
      (3) Push **9** to activate conference mode on each KD
      (4) Talk into microphone on handset/headset to confirm comms
   e. Perform radio checks in each available frequency band
      (1) Suggest VHF/AM on Radio 1, VHF/FM on Radio 2, UHF on Radio 3, and HF on Radio 4
      (2) Sequentially select radio for transmission by highlighting on main KD menu
3. Remote Operations
   a. Remove 1 of 2 rear KDs; disconnect J1 connection and ground cable, then back out each of two thumb screws to release KD
   b. Connect KD cable reel to SEP connector
   c. Connect other end of KD cable reel to J1 on remoted KD
   d. Connect H250 to remoted KD J2 port
   e. Remove laptop from the docking station
   f. Connect fiber reel to the SEP connector
   g. Connect the other end of the fiber reel to the media converter
   h. Connect wire W7307 to the media converter
   i. Connect the other end of wire W7307 to the Ethernet and USB port on the laptop
   j. Repeat Function Checks Steps 1 and 2
   k. Once Function Checks are complete, replace KD and Laptop on their mounts, disconnect Cable reels from the SEP, Reel Cables back in, and stow media converter in the On The Move bag.

Table 2.102 MCS Block 2 Shutdown Procedures.

1. Turn rotary switch on all radios to OFF
2. Switch PDU power for all components to OFF
3. Switch PDU master power switch to OFF
4. Turn off laptop from Start Menu
5. Open all 3 circuit breakers on back of power supply
6. Disconnect external power to MCS, if used
7. Turn power bypass switch to OFF

SECTION III—FRIENDLY MARKING

2.5 Friendly Marking.

2.5.1 Friendly Marking With Beacons. Beacons are often a forgotten tool that can be used for marking friendly positions relatively accurately, and with little effort from the aircrew or JTAC. Some aircraft (i.e., B-1s), can receive beacon codes up to 70 NM away from the source. Accuracy is directly dependent upon distance of the acquiring radar from the source. In the case of the B-1, accuracy is about 100 feet per nautical mile away (i.e., 10 NM away = about 1,000 feet accuracy). It is vital to preplan beacon settings prior to the mission, since beacons have many settings and will only work when they are interrogated by radar. These settings show different returns on the display of the interrogating radar, and a setting that produces at least three returns gives the aircrew the best chance of acquiring the beacon. The SMP-1000/2000 will not emit until they detect a signal from radar in the correct frequency range. If unable during mission planning, pass the beacon code during the AO update and work coordination over the net.

2.5.1.1 Multiple considerations should be taken when using the SMP-1000/2000. For further details, refer to AFTTP 3-1.JTAC, paragraph 2.3.2, Beacon Fratricide Mitigation. **Table 2.103**, SMP-1000/2000 Compatibility Chart, shows that the aircraft can see the mark from the JTAC.

2.5.2 Strobes. There are various types of personal strobe lights available for the JTAC to use. Careful consideration in the selection of which strobe to use should take into account the enemy's capability inside of the light spectrum. **Figure 2.8**, The Light Spectrum, depicts the spectrum. JTACs should consult intelligence personnel to get a current enemy capability briefing, as it relates to this spectrum, in order to select the appropriate strobe type (e.g., short wave infrared [SWIR], medium wave infrared [MWIR], and near infrared [NIR]). Additionally, the JTAC should see **Figure 2.8**, The Light Spectrum, for a reference on what pieces of equipment are compatible in different areas of the spectrum.

Table 2.103 SMP-1000/2000 Compatibility Chart.

Aircraft	PPN-19	SST-181XE	SMP-1000	SMP-2000
F-15	X	X	X	X
F-16	X	X	X	X
F/A-18	(1)			(1)
B-1B	X	X	X	X
B-52	X	X	X	X
AC-130	X	X	X	X
MC-130	X			X
MH-53	X			X
C-130	X	X	X	X
C-17	(2)			
C-5	X	X	X	X

NOTES:

(1) The F/A-18 APG-65 radar is beacon compatible, not all F/A-18s have the new radar installed.

(2) Not compatible with all beacon codes.

2.6 Target Marking.

2.6.1 Lasers. Laser capabilities are degraded by ice, fog, blowing/falling snow, and other environmental conditions. The most common result is refraction off snow and ice particles (the human eye sees farther in these conditions). When clear, cold, and dry, lasers are most accurate. There is an increased eye hazard from refraction off snow or ice-wear laser eye protection to reduce this risk. False signals are possible with laser target designators due to refraction or bouncing of laser off snow- or ice-covered targets.

2.6.1.1 There are various effects that the JTAC can reduce as it relates to laser energy when targeting. The most common issues with JTAC usage with a laser are-the podium effect (**Figure 2.9**, Podium Effect), the spillover effect (**Figure 2.10**, Spillover Effect), and spot jitter.

2.6.1.1.1 The podium effect is caused by an object blocking the laser energy from the intended target. To reduce this effect, a JTAC needs to place the aircraft and/or weapons attack azimuth, so that it can see the laser reflection throughout the flight time of the weapon.

2.6.1.1.2 The flashlight effect, also known as spillover, is the result of a low-grazing angle from the designator to the target combined with a large beam divergence. The best way to reduce this effect is to increase the angle, so that the target end of the designation is more concentrated, as depicted in **Figure 2.10**, Spillover Effect.

Figure 2.8 The Light Spectrum.

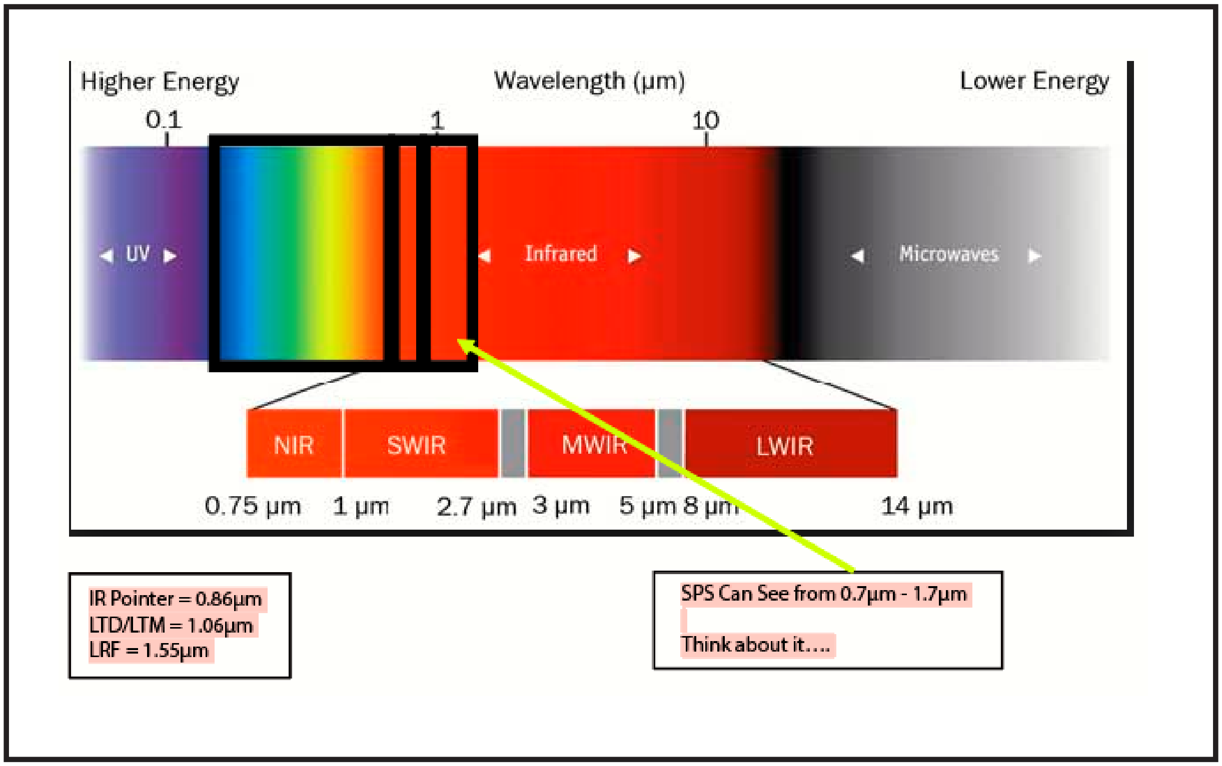


Figure 2.9 Podium Effect.

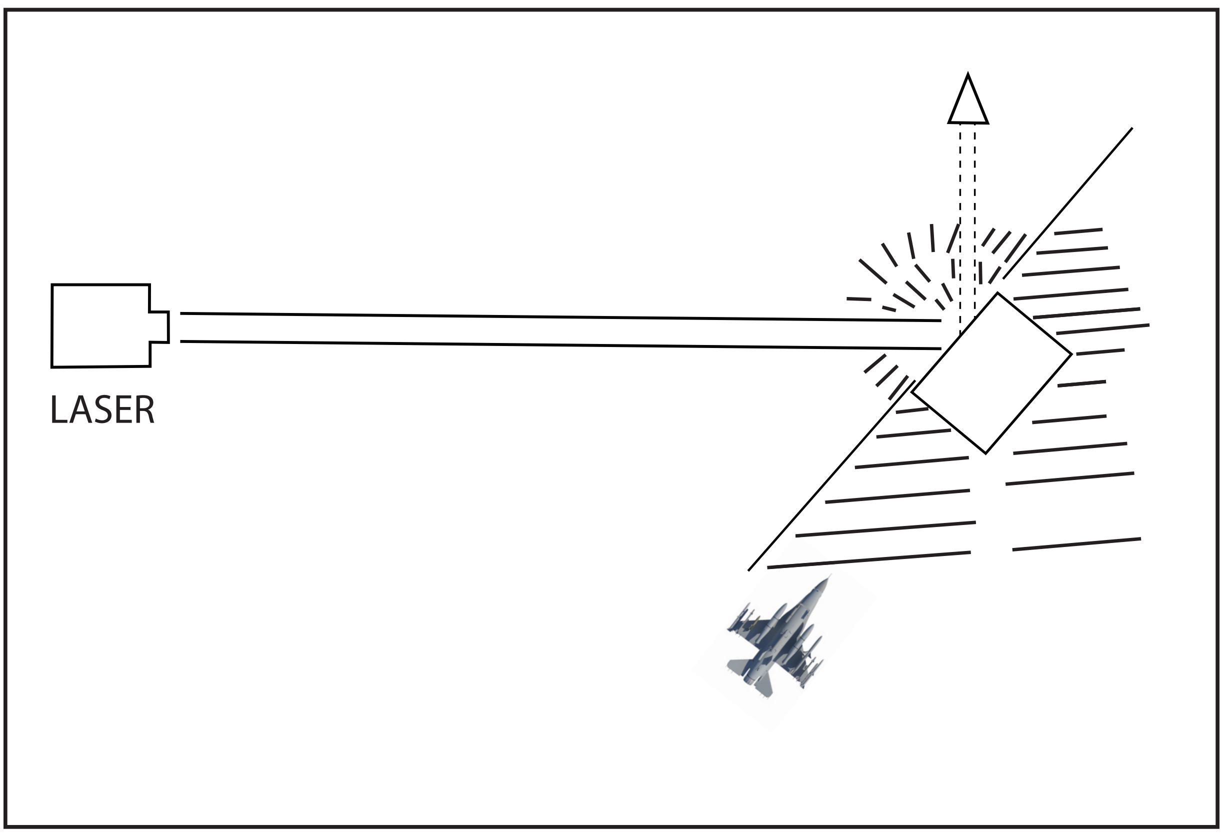
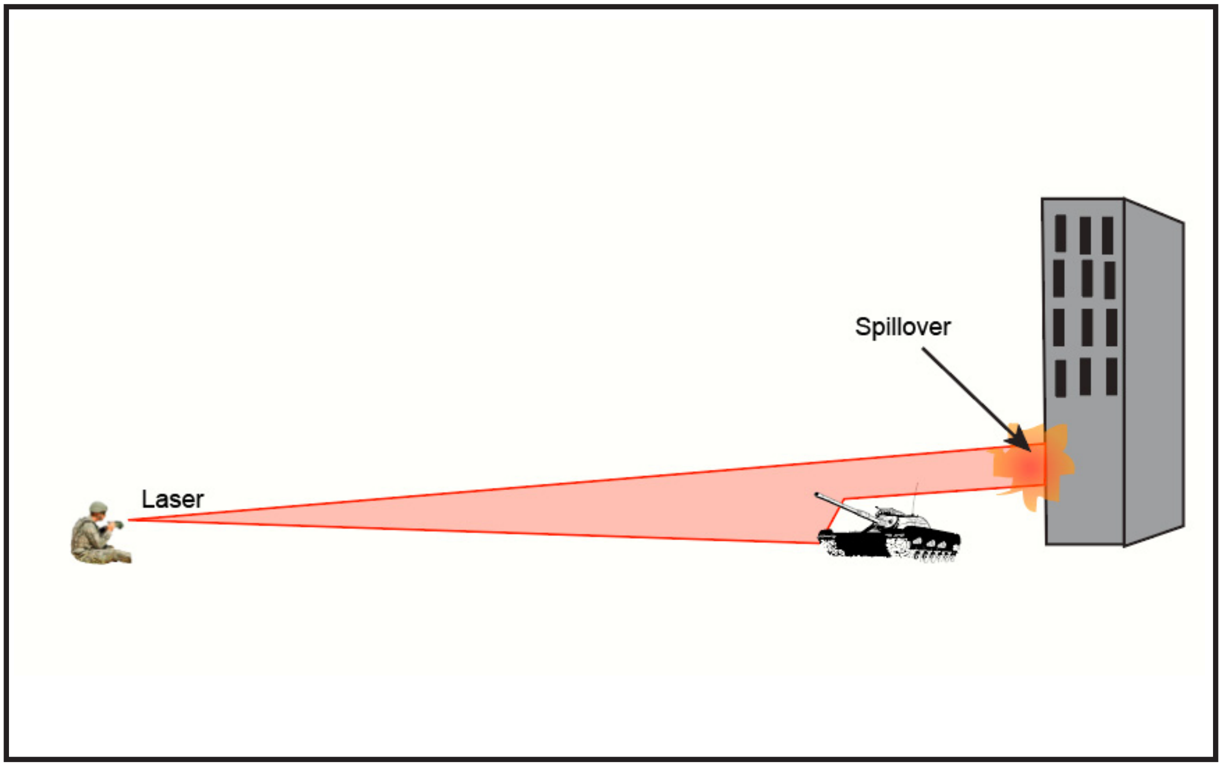


Figure 2.10 Spillover Effect.



2.6.1.1.3 Spot jitter is a result of the JTAC not having a steady base while employing the laser. For a laser target designator (LTD), using a tripod and a remote firing cable can negate spot jitter. If using a handheld laser marker (HLM) the JTAC should attempt to steady the device on a stable surface such as a ledge or vehicle while firing the LTM. Additionally, if using an infrared zoom laser illuminator/designator (IZLID) or other infrared (IR) marking device, the JTAC can use the same TTP described above or place the IZLID on the helmet for a steady base as well as bring the device closer to the chest.

2.6.2 Handheld Laser Marker/LA-16/U. The HLM is a lightweight, handheld coded laser marker that allows for target handoff to LST-equipped aircraft. The HLM's 1,064 NM marking laser is capable of emitting a user-selected NATO band I/II pulse repetition frequency (PRF) through a simple interface. Additionally, the HLM features two MI-STD-1913 rails for hosting optical sights, laser aiming devices, flashlights or other fielded equipment such as a mini red dot sight (MRDS) for rapid target acquisition. See **Table 2.104**, HLM Technical Specifications, for details on the system and the HLM Manual.

2.6.2.1 The HLM should not be used for conducting terminal guidance operations (TGO). However, they are very helpful when conducting difficult talk-ons in areas such as rock formations, ridgelines, and creek beds. The HLM has significantly less power when compared to LTDs, limiting the ability to mark targets at long ranges. Operators must take note of the lack of power and the increased chance of spot jitter when used off-hand versus from a stable platform.

Table 2.104 HLM Technical Specifications.

Weight and Dimensions	
Weight (with Battery)	2.5 lbs/1.1 kg
Dimensions (L x W x H)	9.25 x 1.75 x 6.25 in/23.5 x 4.4 x 15.9 cm
Power/Performance	
Battery	Rechargeable, lithium nano-phosphate battery
Battery Life	10 to 20 minutes lasing time
Operating Temperature	14°F (-40°C) to (70°C) 158°F
Water Immersion	1 m of water for 2 hours
System Lasers	
Output Power	<60 mJ
Beam Divergence	≤1 mil
Wavelength	1,064 NM

2.6.2.2 **Figure 2.11**, HLM Overview, shows the various buttons and equipment on the HLM. This button terminology will be used in the checklist below for various operations with the system. See **Table 2.105**, Prepare HLM for use With SWIR Imager (Preferred Setup).

Figure 2.11 HLM Overview.

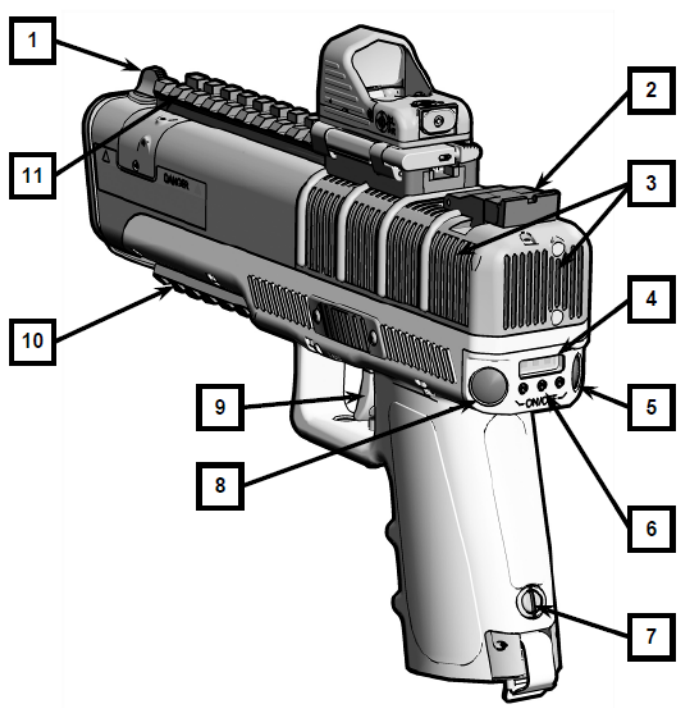


Table 2.105 Prepare HLM for use With SWIR Imager (Preferred Setup).

1. Check battery level and ensure it is full by pressing the battery test button on the battery.
2. Insert battery into magazine well of HLM.
3. Ensure SPS is securely mounted on the top-rail.
Align HLM and SWIR Imager:
4. Choose a target downrange clear of personnel and ensure all personnel are wearing laser eye protection.
5. Power on SWIR device (see SPS section).
6. Power on HLM by pressing **MODE** and **ENTER** for > 2s release, when ON is displayed.
7. Observe target downrange through SWIR imager, while simultaneously shooting a target.
8. Observe where the reflection shows in the SWIR imager and move the reticle to overlay the observed spot.
Enter a PRF Code into the HLM:
9. Power on the HLM.
10. Press the **MODE** button until <CODE> is displayed and press **ENTER**.
11. Press the **MODE** button until the digit displayed is correct then press **ENTER**.
12. Continue until the desired PRF is displayed. The HLM will display <CODE>.
13. Hold down the **MODE** or **ENTER** button to exit the menu.
Dim LED Display:
14. Press the **ENTER** key, while the unit is in Ready Mode (LED indicator is flashing green and/or PRF is displayed).
15. Continue Step 1 until desired brightness is reached.

2.6.3 Type-163 Laser Target Designator. The Type-163 is a NATO compliant laser target designator with programmable PRF codes and ranging functionality. It is an improved version of the special operations laser marker (SOFLAM) in both battery life, size, and weight. The JTAC can rapidly deploy this LTD in a variety of CAS scenarios. The following section provides specifications and common checklists and TTP for the LTD. See **Table 2.106**, Type-163 LTD Technical Specifications, for a detailed list of the LTD's capabilities. **Figure 2.12**, Type-163 LTD Overview, provides visual depiction of the system itself. See **Figure 2.13**, Type 163 Battery Pack; **Table 2.107**, Battery Pack Installation and Removal; **Table 2.108**, Type-163 Setup for Initial Use; **Table 2.109**, Type-163 PRF Code Presets; and **Table 2.110**, Adjust Display Brightness. See **Table 2.111**, Type-163 LTD Error Messages, for a list of typical messages and the meanings.

Table 2.106 Type-163 LTD Technical Specifications.

Weight And Dimensions	
Weight (with Battery)	5.3 lbs/2.4 kg
Dimensions (L x W x H)	9.25 x 1.75 x 6.25 in/23.5 x 4.4 x 15.9 cm
Power/Performance	
Battery	Rechargeable, lithium battery
Battery Life	
Operating Temperature	-30°C - +50°C
System Lasers	
Output Power	≥70 mJ
Beam Divergence	≤ 0.3 mil
Non-Ocular Hazard Distance	28.1 km

Figure 2.12 Type-163 LTD Overview.

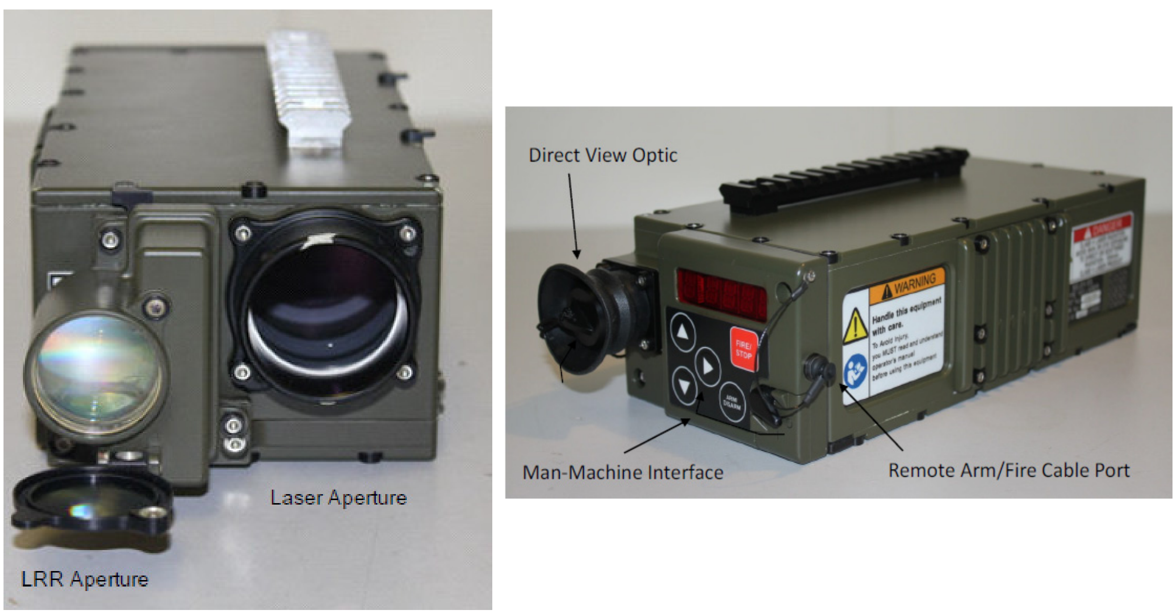


Figure 2.13 Type-163 Battery Pack.

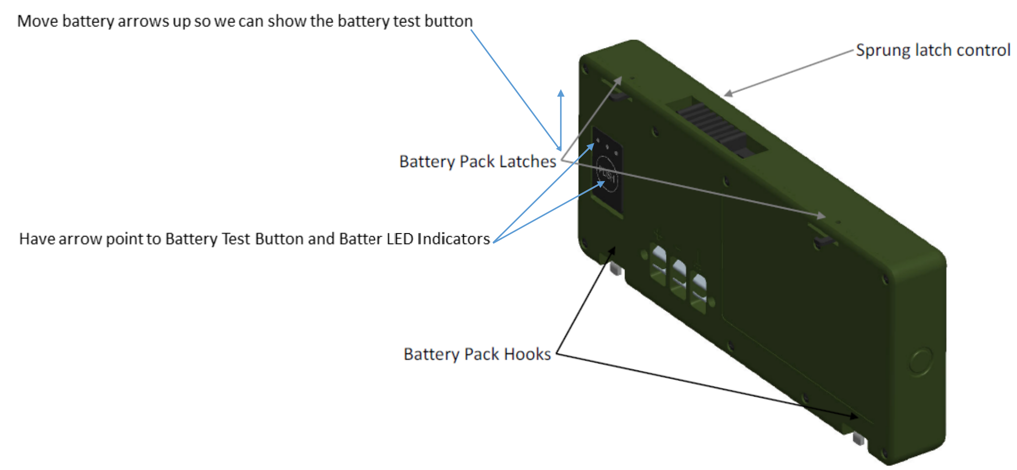


Table 2.107 Battery Pack Installation and Removal.

1. Check battery pack power by pressing the test button on the side of the battery. a. RED LED ON – Capacity <25%, Orange LED ON – Capacity >25% and <75%, Green LED ON – Capacity >75%.
2. Ensure Power Switch on LTD is set to OFF.
3. Locate the battery pack hooks and insert them into the receptacles at the bottom of the LTD.
4. Rotate the battery pack towards the device and secure to the top of device using the spring tension assembly.
5. Remove the battery in reverse order.

Table 2.108 Type-163 Setup for Initial Use.

1. Attach the tripod to the LTD.
2. Extend legs on the tripod and adjust height for the user.
3. Place battery pack on the LTD.
4. Ensure LTD is pointed towards the target area and lens cap is on.
5. Set the power switch to **ON**.
6. Press the right arrow key.
7. Press the **UP** cursor to display “1.”
8. Press the right arrow to move to the next digit of the PRF.
9. Continue Steps 7 and 8 until the desired PRF is displayed.
10. Press the right arrow key to complete code.
11. When ready to fire press the ARM button and ensure the “A” is displayed as the first digit and remove the lens cap.
12. Hold down the fire button until complete with targeting.

Table 2.109 Type-163 PRF Code Presets.

1. Press and hold the Down cursor for >5s.
2. Preset 1 will be displayed with a “1” in the first digit of the LCD screen and the PRF in digit 2 to 5 spot.
3. Press the right cursor to manipulate the PRF. Use the up and down arrow keys to change the numbers.
4. Press the right arrow when appropriate, **PRF** is entered.
5. Toggle the first digit using the up and down key to change preset 2 to 5.

Table 2.110 Adjust Display Brightness.

1. Press and hold the right cursor for >2s.
2. “-BRGT” will be shown.
3. Press up or down arrow keys until desired brightness is displayed.
4. Press right cursor when complete.

Table 2.111 Type-163 LTD Error Messages.

Error	Meaning
BATT	Alternating with the laser code, the battery pack is discharged and needs to be replaced.
ENRG	Output energy is below the specified output. Laser will operate, but power should be recycled to confirm or clear the fault.
TEMP	Over Temperature, Laser will continue to operate but should be removed and the laser allowed to cool.(1)
BITE	Over Temperature, Laser will continue to operate but should be removed and the laser allowed to cool.(1)
LASE	Fault in the laser, recycle power on the laser to confirm or clear the fault.
COMM	Fault in the laser, recycle power on the laser to confirm or clear the fault.
MMIE	Fault in the laser, recycle power on the laser to confirm or clear the fault.(1)
NOTE: (1) If the fault persists, return laser to Selex ES for investigation.	

2.6.4 PLRF25C/PLRF25C BT. The PLRF25C is an upgraded version of the PLRF15C. The enhancements include a smaller form factor in addition to an increased range at greater than 4,000 meters. The technical specification are outlined in **Table 2.112**, PLRF-25C Technical Specifications. See **Table 2.113**, PLRF 25C Bluetooth Pairing Instructions for ATAK. **Figure 2.15**, PLRF-25C, shows what the system looks like. See *PLRF-25C Manual*. The reticle pattern is a standard mil-dot reticle and is depicted in **Figure 2.16**, PLRF-25C Reticle Pattern.

2.6.4.1 General Operations. The entire PLRF-25C is operated by a single button. Various button patterns allow the user to cycle through different functions of the PLRF-25C in order to use it for JTAC missions. The most common uses are outlined below for a JTAC with the corresponding button pushes in a quick reference guide format. However, for further information consult the *PLRF25C User Manual*.

2.6.4.2 The JTAC can use the Bluetooth feature of the PLRF-25C in order to integrate systems with the ATAK software. **Table 2.114**, PLRF 25C Bluetooth Pairing, shows the steps to pair the PLRF 25C with an android device.

2.6.4.3 The PLRF-25C has several different range finding functions that can be used by the JTAC. Two of those functions are outlined below for quick reference. **Figure 2.16**, PLRF-25C Single Target Measurement, shows how the PLRF-25C can be sued to find the range, azimuth and inclination for a single target. **Figure 2.17**, PLRF-25C Distance Between Two Objects, shows how the PLRF-25C can be used to find the range between two points.

2.6.4.4 **Table 2.115**, PLRF-25C Normal Setup, provides a best practice for PLRF-25C setup for a JTAC.

Table 2.112 PLRF-25C Technical Specifications.

Magnification	6x
Field of View	6° / 106 mil
Magnetic Compass (azimuth and inclination)	
Azimuth Units	360° / 6400 mil / 6300 mil / 6000 mil
Azimuth Accuracy	±10 mil / ±0.6°
Inclination Angle	± 3 mil / ± 0.2°
Max Inclination and Bank Angle	± 45°
Declination Adjustable	± 179.9°
Range Finder	
Laser Wavelength	1,550 NM
Laser Type	Class 1
Range Performance	5 m to >4,000 m (*2,500 m w/15 km vis. on a 2.3 x 2.3 m target size)
Accuracy	±2 m (>50 m to <1,500 m)
	±5 m (<50 m / >1,500 m)
Power Supply	1 x 3V lithium battery, type CR123A
Battery Capacity (20°C)	>3,000 measurements
Operational Temperature Range	-35°C to +63°C / -31°F to +145°F
Weight With Battery and Eye Cup	500 or 1.1 lbs
Dimensions With Eye Cup	Length 131 mm/5.2 in, Width 88 mm/3.5 in, Height 56 mm / 2.2 in
Tripod Interface	¼ thread
Data Interface	RS232 or Bluetooth

Table 2.113 PLRF 25C Bluetooth Pairing Instructions for ATAK.

First Time PLRF Pair: NOTE: Only need to perform this when a specific EUD and PLRF have never been paired to each other before. Needs to be accomplished each time you connect the PLRF to a different EUD.

1. ATAK EUD Settings
   a. Ensure EUD's Bluetooth is turned on
   b. Open ATAK and go into settings from drop down menu on top right corner of screen.
   c. Depending on ATAK version
      (1) 3.6 or Earlier—select network preferences. Then ensure Bluetooth support box is checked
      (2) 3.6 or later—Enter Bluetooth preferences. Ensure Bluetooth Support is checked
      (3) You can also edit the BT pairing search time each time ATAK is open
   d. Open Bluetooth Settings on EUD and be ready to Scan/Search and connect to PLRF once configured
2. PLRF Settings
   a. Press PLRF 6 times to get to "Settings"
   b. Scroll through settings past "CONFIG" to "interface"
   c. Long Press to select "INTERFACE" scroll through "PC" and "BT 2.0" and stop on "BT 4.0" long press on "4.0" until PLRF reads "STORED"
   d. Press PLRF 6 times to enter "settings"
   e. Scroll through settings passed "INTERFACE" until "BT-Config," then long press on "BT CONFIG"
   f. Long press on "PAIR" and observe it read "PAIRING" with reticle circling
3. EUD
   a. Search EUD Bluetooth scan for PLRF and pair the devices, ensuring serial number of PLRF and PLRF's BT name serial number match
   b. Once paired, quit and then restart ATAK
   c. When ATAK starts back p up it should state it is searching for or has connected to a LRF device
   d. Once connected. LRF a target of interest beyond 30 meters—your self-location icon must be present on the ATAK map as it is measuring from your position
   e. Ensure PLRF compass calibration has been completed to ensure LRF icon accuracy

-COMPLETE-
All future pairings between the two devices should only require you to turn on PLRF and ensure EUD Bluetooth is on. They should automatically Pair.
Troubleshooting: If unsuccessful during subsequent pairings, restart ATAK keeping an eye out for ATAK prompt during startup that it is searching for and has connected to LRF device. If that does not work, turn PLRF pairing mode on under 6x Presses in settings then connect devices using EUD Bluetooth settings. If still failing to pair, repeat all steps listed in initial pair instructions.

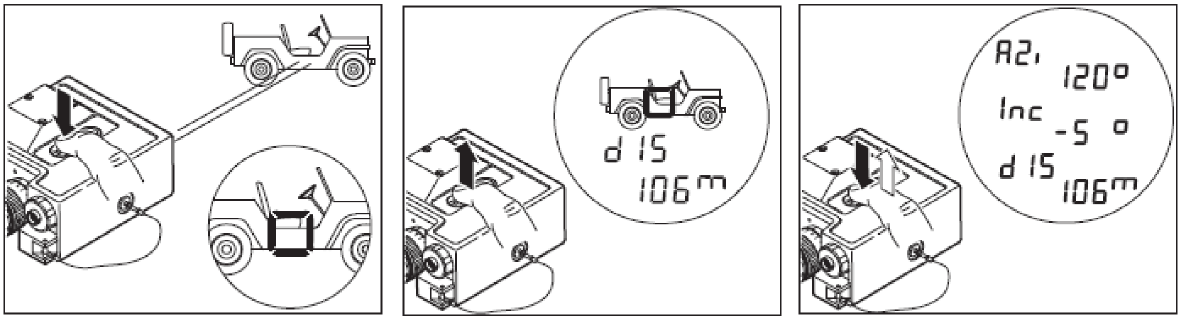
Figure 2.14 PLRF-25C.

Figure 2.15 PLFR-25C Reticle Pattern.

Table 2.114 PLRF-25C Bluetooth Pairing.

Step	Description
1	Take the PLRF and activate the Pairing Mode by storing the Interface Setting “BT” (see PLRF25C user’s manual) “PAIRING” is displayed in the field of view
2	On the Android device, go to the setting menu Select the Bluetooth Settings Make sure that the Bluetooth is turned on Click on “Scan” to make the available devices visible
3	Click on the PLRD device you want to pair with (e.g. PLRF25C BT S/N 11-0004) If a PIN is requested, enter “0” (zero) and click on “OK” **REMARK:** Depending on the BT module configuration, it might not be necessary to enter a PIN.
4	The paring is successful if the device is shown in the list “Paired Devices”
5	Start the App “VTX LRF Data Viewer Click on “Accept” Click on the menu button to see the menu Click on “Bluetooth”
6	Click on the PLRF you want to connect with “SUCCESS” is displayed in the field of view of the PLRF25C BT for a short instant On the Android device, the PLRF is shown under “Connected device” for a short instant Leave the Bluetooth settings menu by clicking on the “back button”

Figure 2.16 PLRF-25C Single Target Measurement.

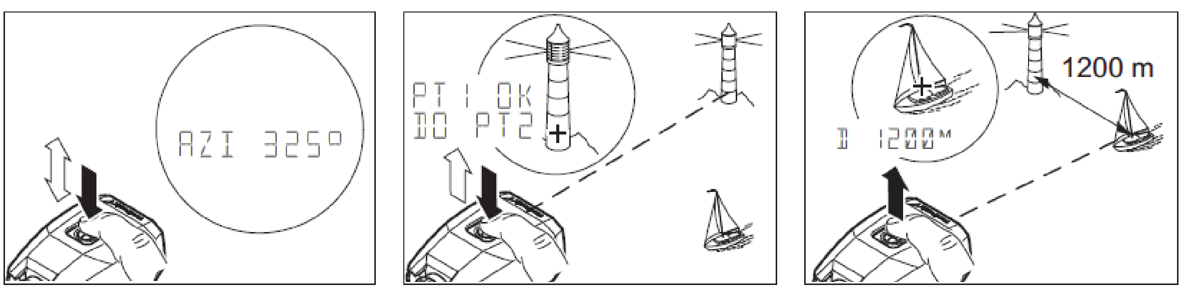


Press and hold the distance key.
Sight the object with the aiming mark

Hold the instrument steady as you release the key.
"dIS" appears briefly followed by the slope distance.
"- - - -" is displayed when no distance could be detected.

While the display is on, press and hold the distance key to get the azimuth "AZi". Do the same again to get the inclination "Inc". Repeat above step to obtain the distance "dIS" again.

Figure 2.17 PLRF-25C Distance Between Two Objects.



Click the button one time then immediately press and hold it down. The azimuth appears and is updated continuously. Sight the first object with the aiming mark.

Release the button to measure the first point. PT 1 OK followed by DO PT2 is displayed. Immediately press and hold down the button again. Sight the second point.

Release the button to measure the second point. The distance D between the two points is displayed.

Table 2.115 PLRF-25C Normal Setup.

1. Place fresh CR-123A battery in battery compartment.	
2. Quick Press Range Button 6x times to enter settings menu. 3. Select CONFIG and long-hold > 2s to enter submenu. • Ensure 3 DIS is OFF. • Ensure ERET is OFF. • Ensure NVIS mode is OFF.	These settings are for normal day-time usage. In a low-light setting the ERET is useful to illuminate the reticle. If in an environment with heavy foliage the 3 DIS feature should be considered.
4. Select UNITS and long hold > 2s to enter submenu. • Ensure METER is selected. • Ensure 360° is selected.	If using the PLRF-25C for FIRES corrections the user should select 6400 MIL instead of 360°.
5. Perform 12-point Calibration before the mission. • Quick Press range button 4x times to enter the calibration menu. • Select 12PT CAL and long-hold >2s to select. • Follow instructions for the 12 pt calibration. • If BAD is displayed perform the calibration until GOOD is displayed.	This calibration should be done after every battery change and after a peripheral is either connected or disconnected from the PLRF.
6. Range a target: • Place reticle on the target. • Quick press range button.	If more information is needed for the target (e.g., azimuth, elev, etc.). Use **Figure 2.16**, PLRF-25C Single Target Measurement, for directions on how to display different data.
7. Range between targets. • Place reticle on Target 1. • Quick press the range button and then hold the range button until azimuth is displayed. • Release the button followed by a press and hold immediately (PT 1, OK should be displayed). • Move reticle to Target 2 and release the button (D is displaying the distance between the two points measured).	

2.6.5 PLRF-15C. The PLRF-15C is still in use by some TACP units. The technical specifications are outlined in **Table 2.116**, PLRF-15C Technical Specifications. **Figure 2.18**, PLRF-15C, shows what the system looks like. See PLRF-15C Manual.

2.6.5.1 The reticle pattern is a standard mil-dot reticle and is depicted in **Figure 2.19**, PLRF-15C Reticle Pattern.

2.6.5.2 General Operations. The entire PLRF-15C is operated by a two button setup. Various button patterns allow the user to cycle through different functions in order to use it for JTAC missions. The most common uses are outlined below for a JTAC with the corresponding button pushes in a quick reference guide format. However, for further information consult the *PLRF15C User Manual*.

2.6.5.3 The PLRF-15C has several different range finding functions that can be used by the JTAC. Two of those functions are outlined below for quick reference. **Figure 2.20**, PLRF-15C Single Target Measurement, shows how the PLRF-15C can be used to find the range, azimuth and inclination for a single target. **Figure 2.21**, PLRF-15C Distance Between Two Objects, shows how the PLRF-15C can be used to find the range between two points.

2.6.5.4 **Table 2.117**, PLRF-15C Normal Setup, provides a best practice for PLRF-15C setup for a JTAC.

Table 2.116 PLRF-15C Technical Specifications.

Magnification	6x
Field of View	6° / 106 mil
Magnetic Compass (Azimuth and Inclination)	
Azimuth Units	360° / 6400 mil
Azimuth Accuracy	±10 mil / ±0.6°
Inclination Angle	± 3 mil / ± 0.2°
Max Inclination and Bank Angle	± 45°
Declination Adjustable	± 179.9°
Range Finder	
Laser Wavelength	1,550 NM
Laser Type	Class 1
Range Performance	5 m to >3,000 m (*2,500 m w/ 15 km vis on a 2.3 x 2.3 m target size)
Accuracy	±2 m (>50 m to <1,500 m)
	±5 m (<50 m / >1,500 m)
Power Supply	2 x 3V lithium battery, type CR123A
Battery Capacity (20°C)	> 5,000 measurements
Operational Temperature Range	-35°C to +63°C / -31°F to +145°F
Weight With Battery and Eye Cup	< 670 g or 1.5 lbs
Dimensions With Eyecup	Length 125 mm / 5.0 in, Width 101 mm / 4.0 in, Height 65 mm / 2.6 in
Tripod Interface	1/4 thread
Data Interface	RS232 or Bluetooth

Figure 2.18 PLRF-15C.

Figure 2.19 PLRF-15C Reticle Pattern.

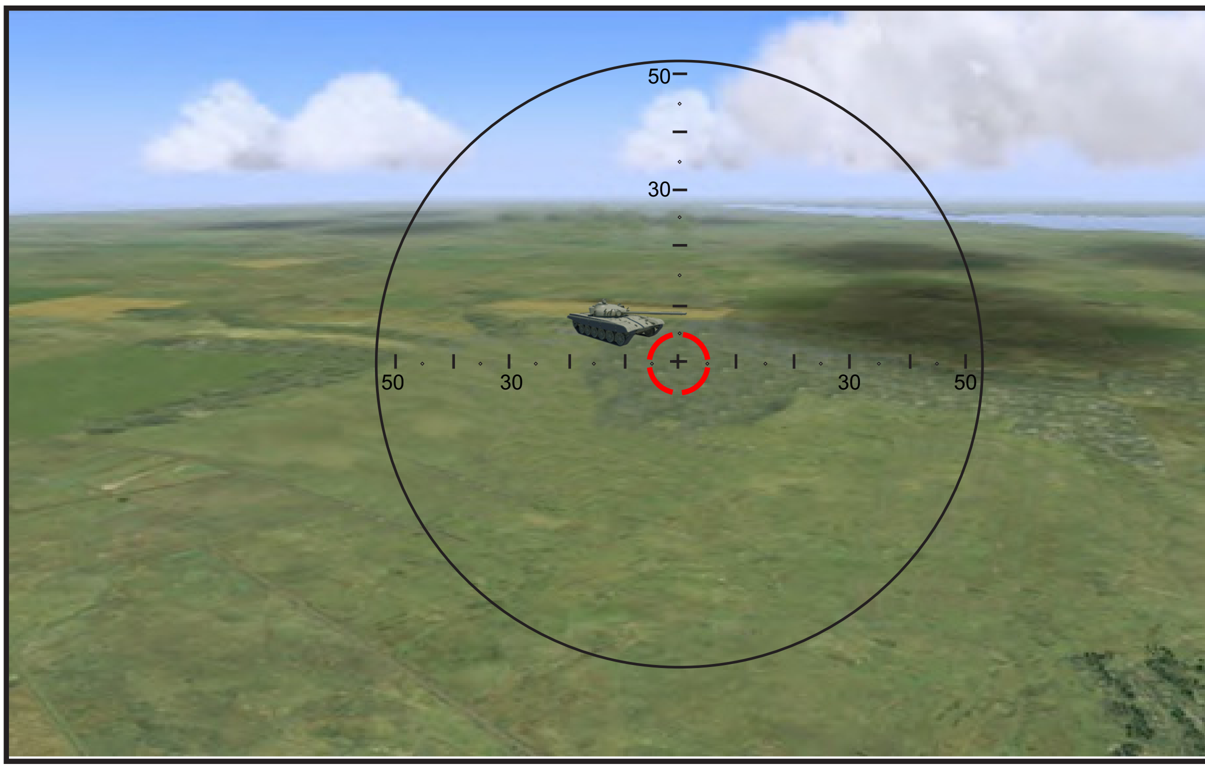
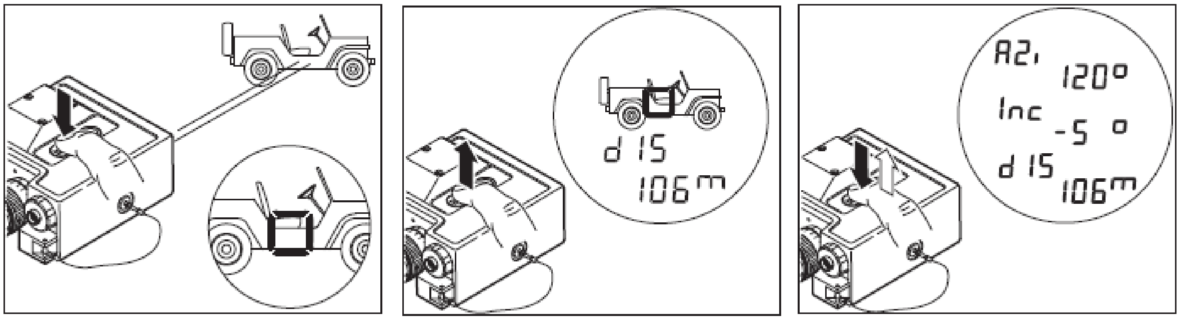


Figure 2.20 PLRF-15C Single Target Measurement.

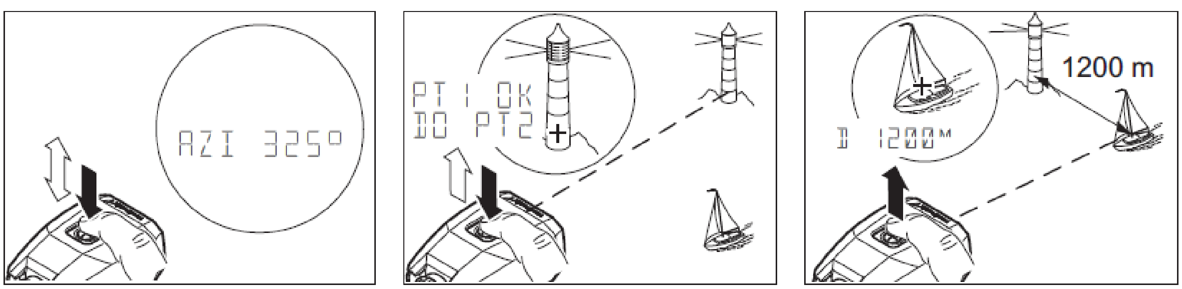


Press and hold the distance key.
Sight the object with the aiming mark

Hold the instrument steady as you release the key.
"dIS" appears briefly followed by the slope distance.
"- - - -" is displayed when no distance could be detected.

While the display is on, press and hold the distance key to get the azimuth "AZi". Do the same again to get the inclination "Inc". Repeat above step to obtain the distance "dIS" again.

Figure 2.21 PLRF-15C Distance Between Two Objects.



Click the button one time then immediately press and hold it down. The azimuth appears and is updated continuously. Sight the first object with the aiming mark.

Release the button to measure the first point. PT1 OK followed by DO PT2 is displayed. Immediately press and hold down the button again. Sight the second point.

Release the button to measure the second point. The distance D between the two points is displayed.

Table 2.117 PLRF-15C Normal Setup.

1. Place fresh CR-123A batteries in battery compartment.	
2. Quick Press azimuth key 5x times to select the type of units. • Click the key until MEtEr appears. • Press the azimuth key 5x times to store the setting. 3. Quick press azimuth key 5x times to select the type of units. • Click the key until 360° appears. • Press the azimuth key 5x times to select the type of units.	If using the PLRF-25C for Fires corrections, the user should select 6400 Mil instead of 360°.
4. Perform 12-point Calibration before the mission. • Quick Press range button 4x times to enter the calibration menu. • Select 12 PT CAL and long-hold >2s to select. • Follow instructions for the 12 pt calibration. • If "bAdC" appears reattempt the calibration until "good" is displayed.	This calibration should be done after every battery change and after a peripheral is either connected or disconnected from the PLRF.
5. Range a target: • Place reticle on the target. • Quick press range button.	If more information is needed for the target (e.g., azimuth, elev, etc.), use **Figure 2.20**, PLRF-15C Single Target Measurement, for directions on how to display different data.
6. Range between targets. • Press and hold the distance button. • Place reticle on target 1 click the azimuth button > 0.5s ("1-P" should be displayed). • Sight he second target and release the distance key. • "dIS" appears briefly and displays the distance between the two targets.	

2.6.6 Short Wave Infrared Pocket Scope. The SWIR pocket scope (SPS) system is a battery powered SWIR imaging device, providing a high resolution video during day and nighttime operations. This section will provide an overview on the SPS and the SPS + Multimode Tracker (SPS+MMT). Both systems have similar capabilities however, the SPS+MMT provides the operator an advanced function of laser tracking and decoding of up to 3-pulsed laser sources with NATO PRF codes. For more information on detailed specifications and additional functions of the SPS, refer to the *SPS User Manual*.

2.6.6.1 (FOUO) The visible spectrum extends from wavelengths of 0.4 microns (μm) (violet) to 0.7 microns (deep red). Traditional IR (i.e., that emitted by an IZLID), is 0.86 μm. Night vision devices (NVD) can see this non-coded IR between 0.7 to 0.9 μm.

Sensing in the SWIR range-wavelengths from 0.9 to 1.7 µm was made practical by the development of Indium Gallium Arsenide (InGaAs) sensors and are now being provided to JTAC. These sensors, more commonly referred to as SWIR devices, are capable of seeing coded laser (SWIR) energy not detectable by NVDs in both day and night conditions. They also can see through haze, dust, and smoke without significant degradation.

2.6.6.2 SWIR Advantages. InGaAs sensors detect longer wavelengths, those in the SWIR band that are not visible to the naked eye or NVD. SWIR light interacts with objects similarly to visible light, reflecting off objects it strikes, even creating shadows and contrast that can be seen through a SWIR sensor. Images from an InGaAs camera, although not in color, are comparable to visible-light images in resolution and detail. This resolution makes objects easy to recognize and yields one of the tactical advantages of SWIR, namely, object or individual discrimination. Another advantage of SWIR cameras is that they work in very dark, as well as extremely bright conditions, unlike NVD.

2.6.6.3 (FOUO) The majority of aircraft targeting pods can operate in two modes: Training mode and Combat mode. For training purposes, the pods use an eyesafe laser beam to avoid accidental damage to the eyes. This mode usually operates around 1.57 µm and 40 mJ of output power. In Combat mode, the pods use a 1.06-micron LTD which ranges from 100 mJ to 150 mJ of output power. The beam divergences of these aircraft-based lasers are far less than ground-based laser systems, around 0.165 mrad.

2.6.6.4 SWIR sensors (i.e., the SPS and SPS+MMT), give the JTAC the ability to view coded laser energy. This coded laser energy can come from ground-based lasers, any laser-equipped observer on the ground, or from an airborne-based laser. JTACs and joint fires observers equipped with SWIR are able to correlate and confirm targets more efficiently, during daytime operations and with less risk of compromise, during night time operations. Refer to AFTTP 3-1.JTAC, Chapter 5, for specific scenarios using this technology. **Table 2.118**, SPS Technical Specifications, provides a baseline data set on the SPS and SPS+MMT.

2.6.6.5 **Figure 2.22**, SPS Overview, provides an overview of the button functions on the SPS and SPS+MMT. The systems are similar in design and buttonology even though there are slight differences in the overall dimensions of the system.

2.6.6.6 **Table 2.119**, SPS Menu Operations, covers step-by-step procedures for commonly used functions of the SPS. Use **Figure 2.22**, SPS Overview, for reference on the buttonology in **Table 2.119**, SPS Menu Operations.

Table 2.118 SPS Technical Specifications.

Description	SPS	SPS+MMT
Weight	1 lb (with batteries)	< 1.5 lbs (with batteries)
Dimensions	6.0 x 2.6 x 3.0 in (LxWxH)	6.0 x 3.0 x 2.8 in (LxWxH)
Power Source	2 x CR-123A batteries	
Battery Life	> 2 hours at room temp	
Resolution	640 x 500 pixels	
Light Spectral Sensitivity	0.7 to 1.7 µm	
Video Frame rate	60 Hz maximum	
External Video Output	RS170	
FOR OFFICIAL USE ONLY		

Figure 2.22 SPS Overview.

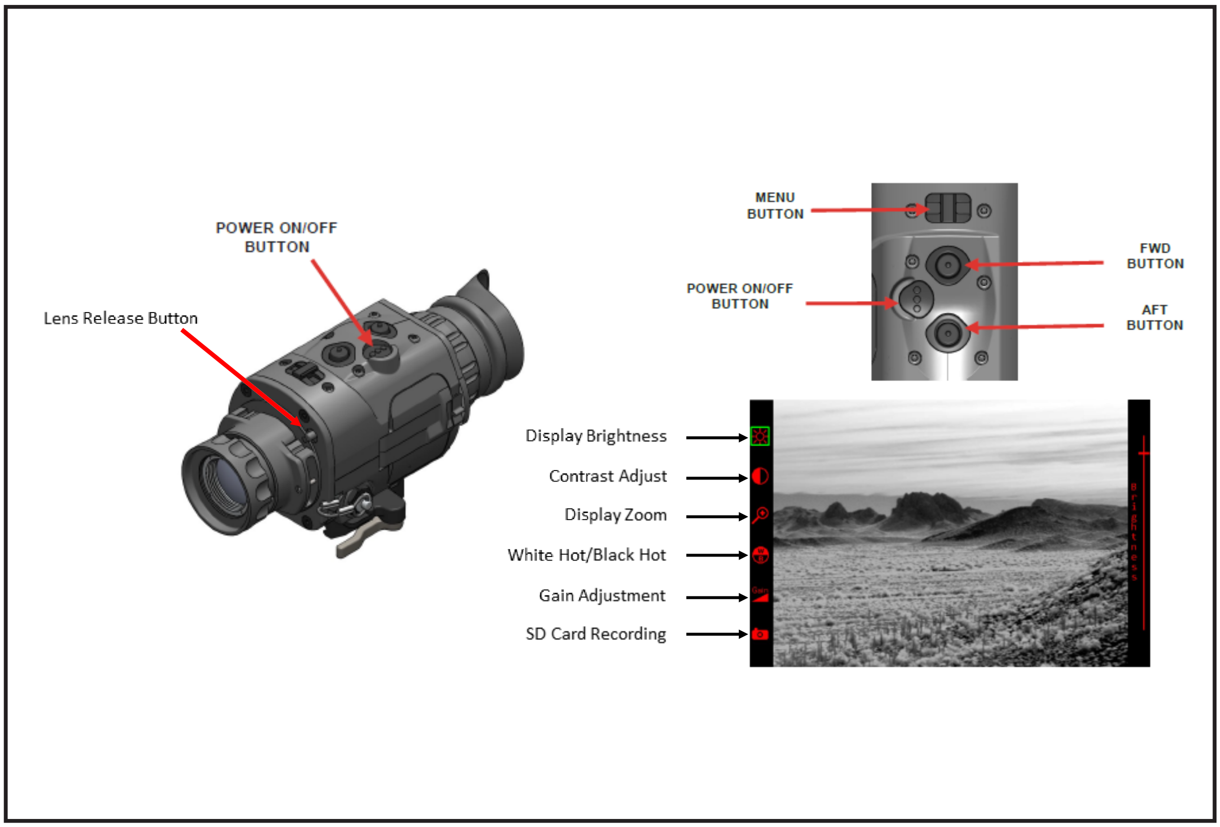


Table 2.119 SPS Menu Operations.

Turn-On SPS
1. Press and hold the Power On/Off button for approx. 3s.
Select Startup Configuration
1. Press FWD or AFT Button to select appropriate configuration. (See **Figure 2.24**, SPS Startup Configuration Screen.)
Access Main Menu for User Setup
1. Press and release either the FWD, AFT, or MENU Button. 2. Press the MENU button to cycle through the Main Menu Functions. 3. Use FWD and AFT buttons to adjust each setting. (See **Figure 2.22**, SPS Overview, bottom right picture, for a visual on this screen.)
SPS Hot Key Functions
1. Start/Stop Video Recording. • Press FWD and MENU together. 2. Enable/Disable Reticle. • Press FWD and AFT together. 3. Field Calibration. • Press AFT an MENU together.
SPS Reticle Boresight for use With LTD/LTM
1. Press FWD and AFT button to enable reticle. 2. Press MENU button to access reticle options. 3. Press FWD and AFT button until “Reticle Elevation” or “Reticle Windage” is selected. 4. Use FWD or AFT buttons to adjust the reticle center point position. 5. Fire LTD/LTM and observe where the reflection is on the imager. REPEAT STEPS 4 and 5 until reticle is lined up with the reflected energy. 6. Press and release the MENU button to exit reticle options menu. (See **Figure 2.23**, SPS Reticle Adjustment, for a visual of this screen.)
SPS Lens Change
1. Press lens detach button and twist lens counter clockwise 1/4 turn. 2. Pull lens out of receptacle keeping the internal components protected. 3. Place new lens into receptacle and ensure it is fully seated before twisting. 4. Twist lens 1/4 turn clockwise until locked in place. 5. Enter configuration menu and select the appropriate lens.

Figure 2.23 SPS Reticle Adjustment.

Figure 2.24 SPS Startup Configuration Screen.

SECTION IV—DACAS

2.7 DACAS. DACAS covers a variety of areas that allow the JTAC to interface with aircrew and sensors with minimal human interface required. This area of the JTAC community is still being developed daily and the current TTP and checklists included/embedded along with the hardware will evolve as this document continues to age. JTAC kits, aircraft weapons systems, gateway, and tactical data link (TDL) software/hardware has enabled greater interoperability among aircrew and JTACs, resulting in increased demand for a digitally-aided close air support DACAS TTP document for the joint warfighter. It is a direct result of a collaborative effort between the Joint Staff J6; DDC51; Joint Fires Division, who sponsored the DACAS Joint Test; and the Joint Test and Evaluation (JT&E) Program under the auspices of the Director, Operational Test and Evaluation, Office of the Secretary of Defense. This DACAS TTP document has been tested, vetted, and analyzed by warfighters, weapons schools, and test squadrons of various Services. The material is intended to inform, complement, and advance CAS doctrine and is approved usage of TTP to serve in conjunction with DACAS Joint TTP 2018 Final Release available on the 561st portal at **https://intelshare.intelink.gov/sites/561jts/ rewrite/sitepages/home.aspx** under the AFTTP and Weapon Systems tab →JTAC tab →JTAC announcements.

2.7.1 What is DACAS.

2.7.1.1 DACAS is CAS operations that are augmented by machine-to-machine (M2M) exchange of SA and/or targeting messages that can include CAS briefs, friendly, threat, target locations, battle damage assessment (BDA), clearance of fires, and C2. DACAS employs data link(s) to exchange text and/or visual cuing information to enhance SA of the battlefield, minimize transcription error, make correlation easier, and potentially decrease the kill-chain time line.

2.7.1.2 Digital systems in aircraft and ground kits provide several benefits that aide in the conduct of CAS planning and execution. Although voice transmissions remain the principal means of communication during CAS execution, technological advances have allowed for greater use of digital messages to expedite communications and target acquisition, quickly build SA through the use of digital reference points, enhance target correlation, and shorten the kill-chain time line in certain circumstances "Digital reference point" is a generic term for any digital point (e.g., target point, markpoint, or sensor point).

2.7.2 Communications Pathways. Digital aides for CAS execution use line of sight (LOS), extended line of sight (ELOS), and beyond line of sight (BLOS) communication systems. When combined, LOS, ELOS, and BLOS digital capabilities provide aircrew greater SA of the battlefield layout (locations of JTACs, friendly attribute points, hostile attribute points, and targets) earlier in the CAS mission profile through extended ranges.

2.7.2.1 Line of Sight Communications. LOS communications are those that directly connect two or more independent users through point-to-point RF communications without an intermediary C2 node.

2.7.2.2 Extended Line of Sight Communications. ELOS communications, such as Link 16 and situation awareness data link (SADL), are those that connect the JTAC/JFO and aircraft using a relay platform. ELOS communications require CAS participants to identify the information exchange requirements to relay. A major advantage is the elimination of the LOS requirement between CAS participants. However, CAS participants must coordinate with the network planner and frequency spectrum managers for planning reliable relayed communications.

2.7.2.3 Beyond Line of Sight Communications. BLOS communications allow multiple participants to communicate without being within the line of sight of each other. High frequency (HF) or SATCOM are examples of BLOS communications that can provide direct connectivity between two participants whose radios are not within the line of sight of each other.

2.7.3 Tactical Data Links. A data link is the means of connecting one location to another for the purpose of transmitting and receiving digital information. A TDL used by the US or NATO armed forces is regulated by a military standard (MIL-STD), or Standard NATO Agreement (STANAG), in order to standardize communication. All military C2 systems use standardized TDLs to transmit, relay, and receive tactical data, ensuring interoperability. The three most common DACAS TDLs used for information exchange are Combat Network Radio (CNR) using variable message format (VMF) (MIL-STD-6017); SADL (MIL-STD-6016 and -6017); and Link 16 (MIL-STD-6016).

2.7.3.1 Combat Net Radio. CNR is a standard that enables digital communication over a variety of RF waveforms and wired networks with common message formatting and network access methods. CNR is a key enabling technology for the tactical exchange of K-Series (VMF), J-Series, and other joint and coalition messaging protocols. The greatest benefit of CNR is that digital messaging can be transmitted and received over voice RF, which means that a ground user does not require an additional radio to employ CNR. When coupled with VMF, CNR is considered a TDL and is commonly referred to as VMF over CNR.

2.7.3.2 Variable Message Format. VMF is a message protocol described in MIL-STD-6017. The VMF message set can be transmitted and received over a wide variety of networks, but is most commonly implemented in DACAS using the CNR standard on single-channel voice UHF. A benefit of using VMF for DACAS is that the message set was designed to support common CAS information exchanges such as the on-station report (OSR), standardized 9-Line, and the aircraft target designation to assist in correlation. VMF is also referred to as K-Series messages.

2.7.3.3 Situation Awareness Data Link. SADL is a TDL that has been customized from the US Army's Enhanced Position Location Reporting System (EPLRS) to meet US Air Force mission requirements. SADL provides air-to-air (A-A), air-to-ground (A-G), and gateway (GW) data communications that are robust, secure, jam-resistant, and contention-free.

2.7.3.4 Link 16 (tactical digital information link—joint). Link 16 is a communication, navigation, and identification (ID) system supporting near real-time information exchange between tactical communications systems and is governed by MIL-STD-6016. It is a frequency-hopping, jam-resistant network that allows participants to share the battlespace picture, greatly enhancing SA. Link 16 is the fastest, most reliable, and most widely employed TDL on air platforms. With the advent of the PRC-161 handheld Link 16 radio, Link 16 networks are now accessible by JTACs and TACP.

2.7.4 Network Tactical. Network-Tactical (Net-T) is a hub and spoke, high bandwidth network that leverages video downlink (VDL) and uplink frequencies to pass digital messages between aircraft advanced targeting pods/sensor enhanced pods and ground/surface video receivers. The aircraft sensor pod acts as a central hub of the network with the ground/surface users as the spokes. Airborne pods typically provide streaming video and metadata from various onboard sensors via downlink. Using the network, users are able to share messages such as digital reference points and video in order to enhance SA to all users on the network.

2.7.5 Advanced Networking Wideband Waveform. ANW2 is a self-healing Internet protocol (IP) networking waveform. When nodes move in and out of range, they are automatically added to, or removed from, the network. ANW2 can facilitate transmission of video or image, chat, SA and mapping data, text messaging, and e-mail. ANW2 is not a true mobile ad hoc network (MANET) because it requires planning, but ANW2's operational behavior is used for DACAS as an option for achieving the benefits of a MANET for ground networks because of its wide bandwidths and ability to combine multiple ANW2 sub-networks for sharing SA.

2.7.6 Gateways. GW is a generic term for a network node designed to provide interoperability by interfacing between incompatible systems or networks. GWs have two functions: data forwarding and/or message translation. Data forwarding moves data from one network to another and can occur between similar or dissimilar networks. Additionally, moving data between networks may or may not require message translation. GW message translation, dictated by MIL-STD-6020, *Data Forwarding Between Tactical Data Links*, can allow dissimilar or incompatible systems to communicate with each other by translating one message format to another. GWs provide data/information sharing and battlespace visualization between isolated network environments.

2.7.7 Ground Kits. Ground kits are designed to facilitate mission planning, execution, and integration of many peripheral devices including, but not limited to, VDL, laser range finders, GPS, and radios. Software enables users to build SA, acquire targets, and expedite communications through the use of various digital message sets and map/imagery capabilities. These kits can connect across various TDLs (VMF over CNR, SADL, Link 16, or ANW2) that reach both the CAS aircraft and EAs. Services and US Special Operations Command (USSOCOM) have adopted different digital ground systems with unique interfaces; however, the overall functionality is similar. Kit configuration example will be in the Hardware **paragraph 2.9.1.1**.

2.7.8 Data Links. There are several different types of data link networks that are available to the JTAC. **Table 2.120**, Common Networks, shows various information about common TDL networks available.

Table 2.120 Common Networks.

Common DACAS Networks	Message Type	Waveform	Frequency Range(s)
VMF over CNR	K-Series (VMF)	UHF/VHF	49 to 952 MHz Single Channel
Link 16 RF	J-Series	UHF	960 to 1215 MHz Frequency Hopping
SADL	J-Series	UHF	420 to 450 MHz Frequency Hopping
ANW2	K-Series (VMF), J-Series, or Cursor on Target (CoT)	UHF or L Band	225 to 400 MHz (UHF) or 1350 to 1800 MHz (L) Frequency Hopping
Net-T	CoT	UHF (L or S Band): Uplink SHF (C Band): Downlink	L Band: 1 to 2 GHz S Band: 2 to 4 GHz C Band: 4 to 8 GHz Single Channel

2.7.9 Situational Awareness Waveform. SA waveform is available on the PRC-152A and the PRC-117G. This specific function of the radio allows for the automatic display of the location of ground forces when the user transmits a normal voice transmission. This data is sent as a data packet on the preamble of the transmission in a 128-bit field over an encrypted, non-hopping UHF/VHF LOS voice net. It DOES NOT work with unencrypted nets.

2.7.9.1 The SA waveform data packet contains the following: combat identifier (CID), position, track, and speed of the transmitting station. This adds the capability of the aircraft to receive, interpret, and display this information to the pilot on their multifunction color display (MFCD) and in the helmet mounted cuing system (HMCS).

2.7.9.2 When SA waveform is being used, the receiving aircraft can see a list of reporting stations and can modify the stations by using their CID and inputting something that s more familiar (i.e., a call sign). An example of this is provided in **Figure 2.25**, A-10 JTAC Control Page.

2.7.9.2.1 The PRC-117G and PRC-152A can send and receive position information to PRC-117F, PRC-117G, and PRC-152 radios over line of sight and SATCOM frequencies.

2.7.9.2.2 The setup for SA Waveform is provided in **Table 2.121**, PRC-152A and PRC-117G SA Waveform Setup. This checklist can be used for both the PRC-152A and PRC-117G.

Figure 2.25 A-10 JTAC Control Page.

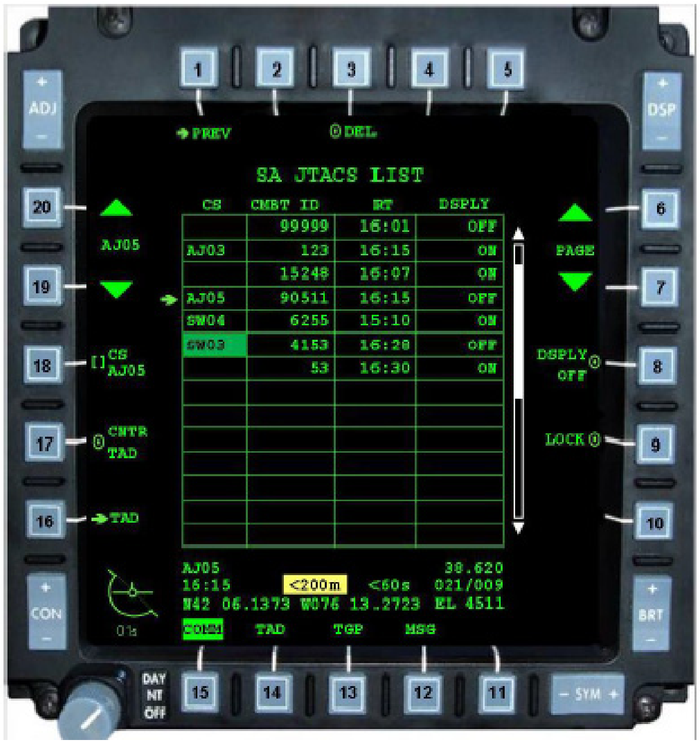


Table 2.121 PRC-152A and PRC-117G SA Waveform Setup.

1. Power on radio.

SA Waveform Setup

2. Press 8/PGM select RADIO CONFIG select GENERAL CONFIG select SA CONFIG.
3. Input CID (IAW unit SOP and/or SPINS).
4. Input SA name/URN (first letter of call sign) (last letter of call sign) (call sign number) (e.g., KY03).
5. Select REPORT FORMAT and select CID.
6. Select SA RX/TX. **Input the following:**
    a. SA TX Mode—Auto -- Will see "SA FOR VOICE TX ONLY" 30-511.995
    b. SA Receive—ON
    c. SA Packet Type—Cursor on Target (CoT)
    d. CoT Expiration—00010
    e. SA Dest IP Address—PPP Per
    f. SA Port (11001)—Old
    g. Local SA Report—ON

GPS Setup

7. Press 8/PGM select RADIO CONFIG select GENERAL CONFIG select GPS CONFIG. **Input the following:**
    a. GPS Type—Internal
    b. GPS Sleep Cycle—Disabled
    c. Position
    d. Format—MGRS-NEW
    e. Linear Units—Statute
    f. Elevation Basis—Mean Sea Level
    g. Angular Units—Degrees Magnetic
    h. Grid Digit—8
    i. Group (Common) Name—WGD-WGS-84

152A Port Setup

8. Press 8/PGM select RADIO CONFIG select GENERAL CONFIG select DATA PORT CONFIG.
9. Select HW CONFIG change to USB.

ATAK Setup

10. You can use either the PPP (HPW) cable or the Smartronix RDA cable to communicate SA information to a computer.
11. Connect the Radio to OCS BDAT System
12. Start ATAK.
13. Select SETTINGS select RADIO CONTROLS select Gear Box
14. Select BDAT PRC-152 Cable.
15. Change Harris SA to ON.

GPS Tracking: 7 (OPT) →Radio Information →GPS Options

16. Data Auto Switch: Off
17. Data Mode: PPP
18. GPS Status
19. Ensure GPS is tracking
20. Requires a minimum of 4 satellites

SA Transmit 7(OPT) →SA Options →SA Transmit →Enable

NOTES:
* Load Crypto on radio Open and Follow Harris SA radio programming steps.
*Harris SA only works in CT mode. Ensure phone times Zulu are the same. Open radio control/Harris SA, select BDAT PRC-152A cable. Turn on Harris SA in ATAK radio control.

2.7.10 (FOUO) PRC-161/Handheld Link 16 (HHL16). The HHL16 is a software programmable digital-radio device that provides a single-channel Link 16 waveform compliant capability and a selective availability anti-spoofing module (SAASM) GPS receiver within a handheld form factor. The radio offers access to both air and ground (friendly and enemy) situational data and can provide secure, reliable target data and position location, identification, and status information to the network. The radio is also J-voice capable for direct voice communications with other Link 16 users. **Table 2.122**, HHL16 Technical Specifications, provides details on the system. See **Figure 2.26**, HHL16 Overview, for a visual of the system connections and physical features. Refer to the *PRC-161 Basics Manual*.

2.7.10.1 **Figure 2.27**, HHL16 Characteristics; **Figure 2.28**, HHL16 Key Pad; **Figure 2.29**, HHL16 Menu Tree; **Figure 2.30**, HHL16 Faceplate Break Down; and **Figure 2.31**, HHL16 Symbology, should be referenced when using the operations checklists listed in the tables below.

2.7.10.2 To accomplish RED key loading of the PRC-161 use **Table 2.123**, HHL16 Key Loading Procedures. The table walks through the procedures of building "platform" in the SKL and then how to load that into a PRC-161.

NOTE: The SKL must be configured with the appropriate Link 16 Crypto-Mod Platform and Equipment sections in order to send the correct Key-Tags to the BATS-D radio.

NOTE: SKL software version 9.0 and higher is needed.

Table 2.122 HHL16 Technical Specifications.

Dimensions (weather HxD)	2.6 x 8.4 x 1.7 in or 6.6 x 21.3 x 4.3 cm
Weight (with battery)	2.19 lbs
Frequency Range	969 to 1206 MHz
Transmission Range	20 to 50 NM
Battery Life (normal operations)	5 to 6 hrs
Operating Temperature	-31° to +60°C or -23.8° to +140°F
Immersion	≤ 2 m
Data interfaces	Ethernet/USB/Net Warrior/APEX Hub
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Figure 2.26 HHL 16 Overview.

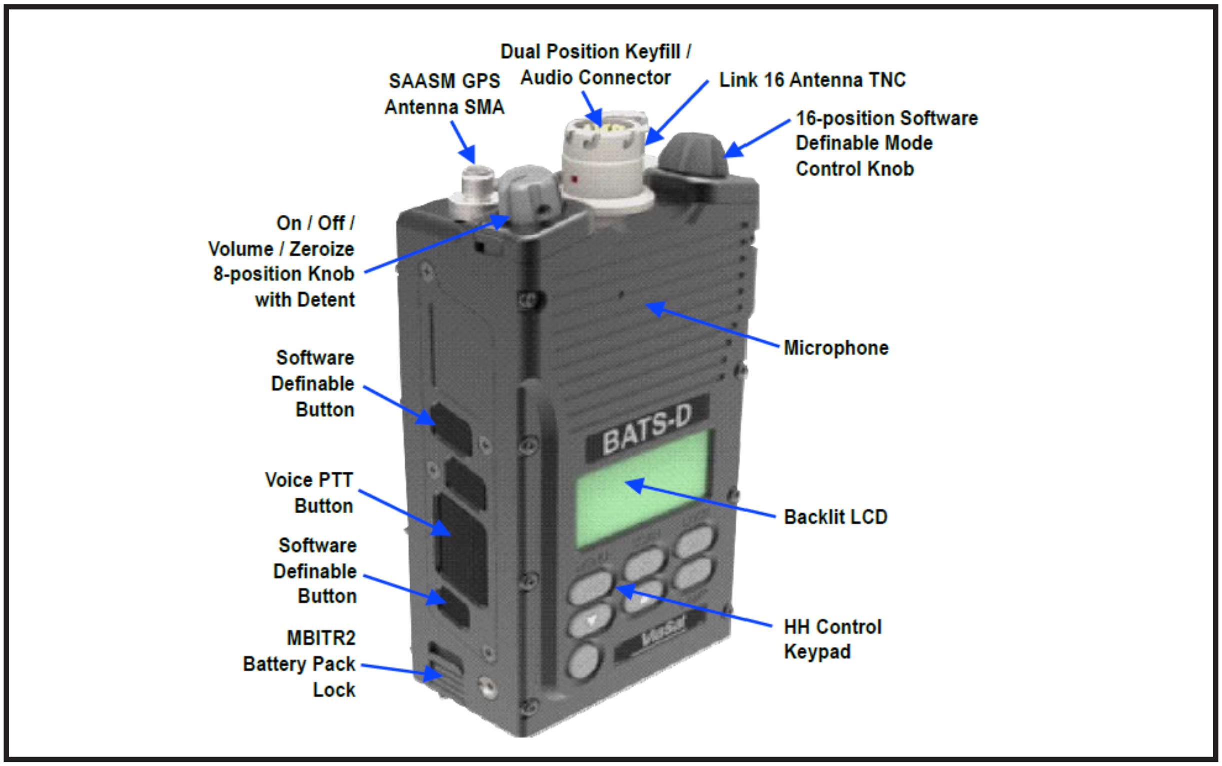


Figure 2.27 HHL16 Characteristics.

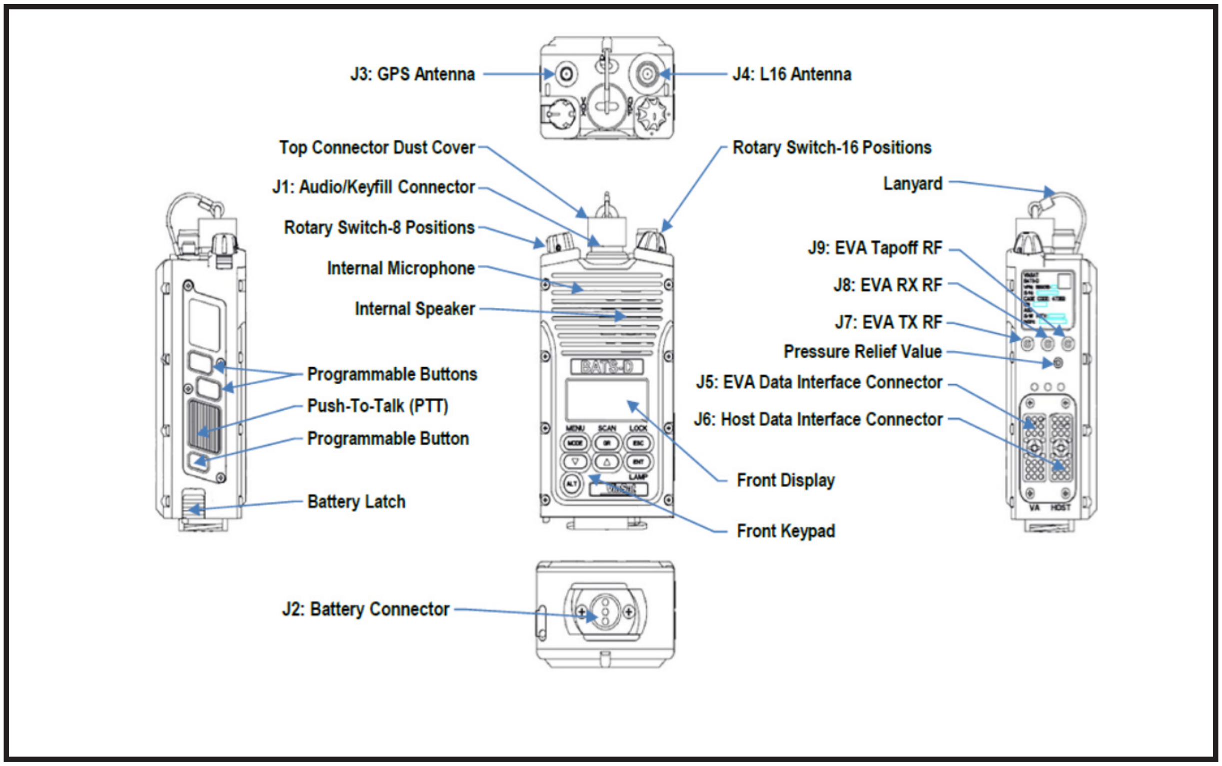


Figure 2.28 HHL16 Key Pad.

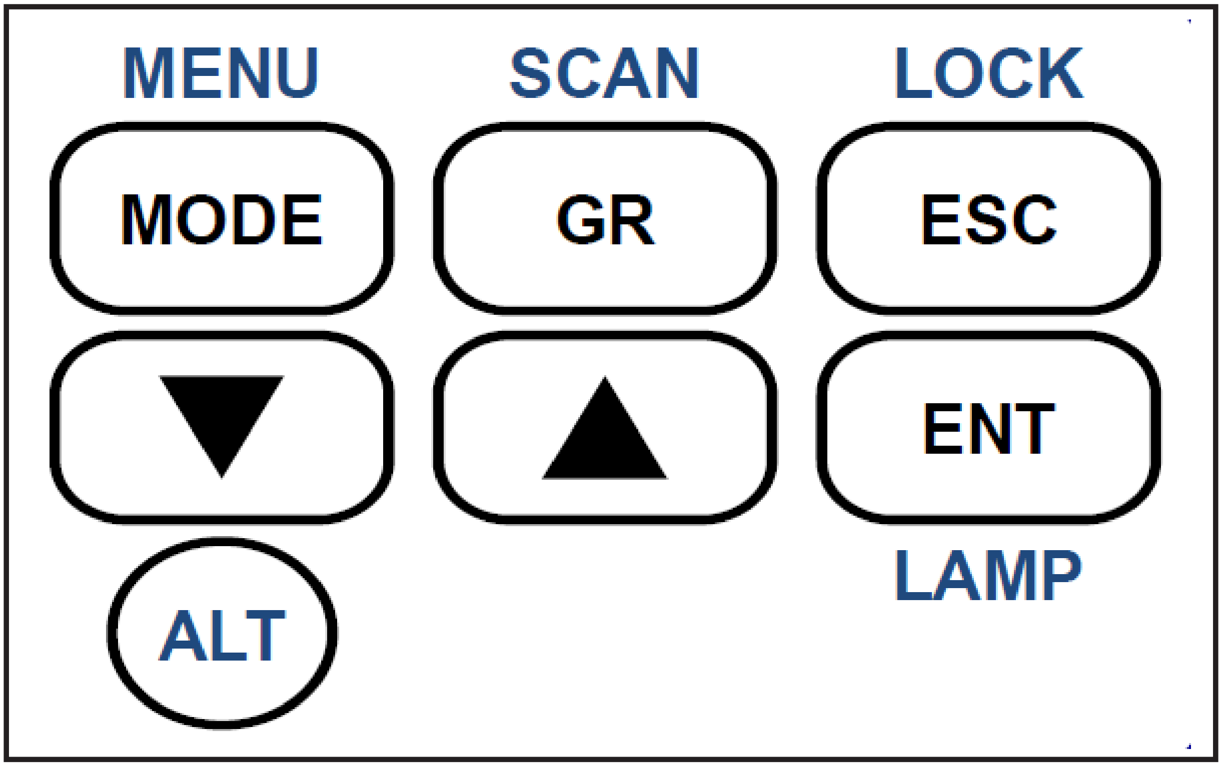


Figure 2.29 HHL16 Menu Tree.

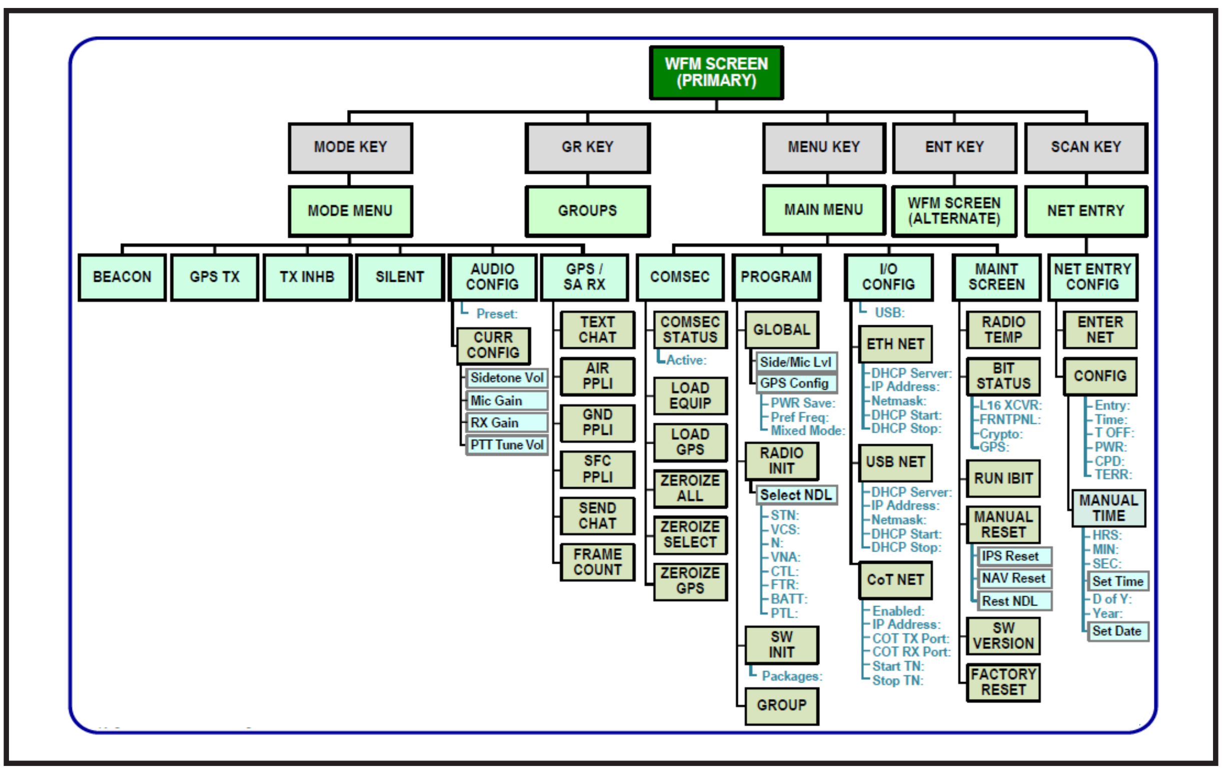


Figure 2.30 HHL16 Faceplate Break Down.

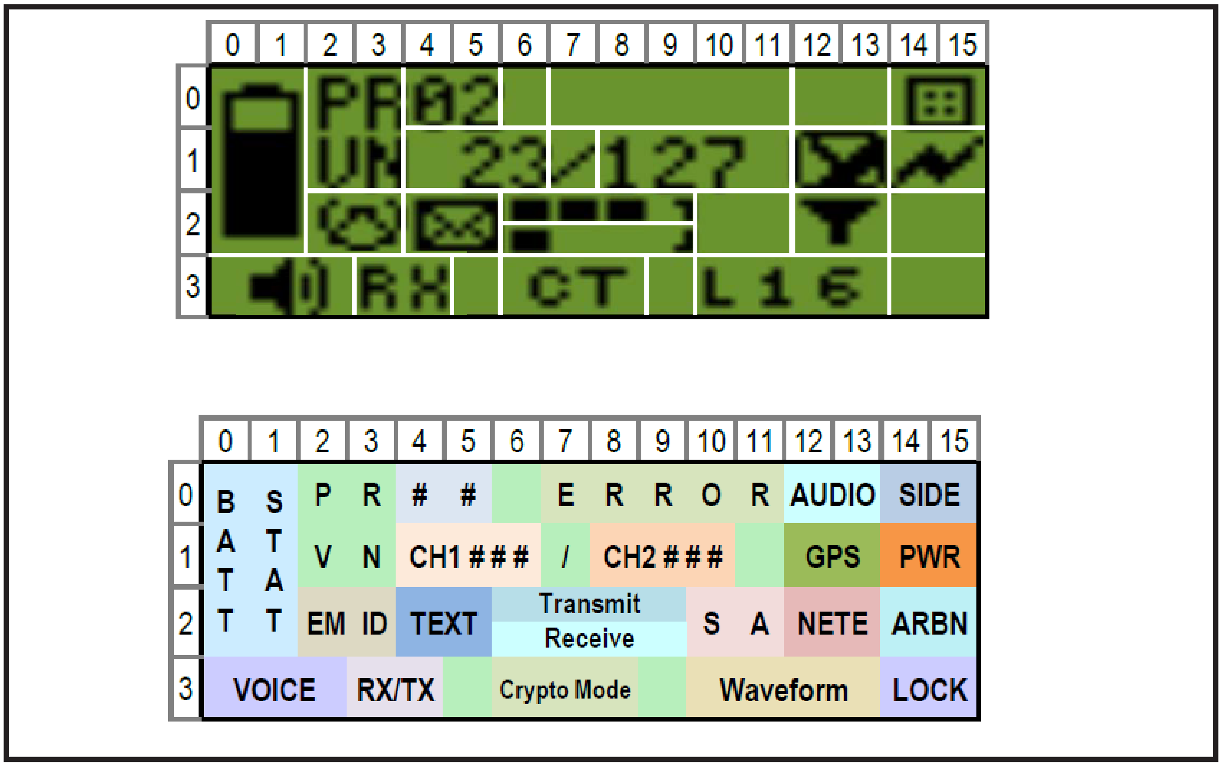


Figure 2.31 HHL16 Symbology.

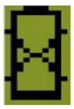
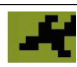
Icon	Title	Meaning
	BATT STAT	Battery Status indicator, showing reaming percentage(100%, 75%, 50%, 25%, 10%). Battery Status Indicator flashing means Low battery. Make sure the battery is precisely aligned with the bottom of radio and wait 5 seconds. If still flashing replace with fully charged battery.
	BATT STAT	Battery Status Error, unable to read battery level. Likely a Battery Eliminator or nonstandard battery in use. Also seen during first 3 seconds after stat-up, while battery is being read.
	AUDIO	External Audio Path selected (EXT or TOP audio).
	SIDE	Side Connector Enabled, recommended this be disabled before use in water.
	GPS	GPS Lock, present when GPS acquired enough satellites.
	SASSM GPS	SAASM GPS lock, present when GPS acquired enough satellites.
	PWR LV	SW Transmit Mode enabled.
	EMER	Emergency Beacon ON (IFF Emergency in PPLI).
	CHAT	Tet Message(i.e., J28.2 awaiting reply). Pressing ENT will switch to a screen where chat can be viewed, and quick-response selected.
SA	SAMODE	SA Mode indicates that J-Messages are lowing to the Side Connector either vie Cot or JREAP-C.
	NETENT	Net entry in progress.
	NETENT	In Sync, presence indicates radio is in Coarse Sync (flashing) or Fine Sync (solid). Absence indicates radio Start Net Entry not started.
	ARBN	Airborne Platforms Present, indicates radio recently received a J2.2 with "airborne" flag.
	VOC	Voice Active, presence indicates L16 voice being received or transmitted. See RX/TX.
RX	RX/TX	Receiving L16 Voice, PTT wil be ignored.
TX	RX/TX	Transmitting L16 Voice, PTT is depressed.
PT	PT/CT	Pain Text, indicates Comm Mode 4 operations.
CT	PT/CT	Cypher Text, indicates Comm mode 1 operations (default).
M2	PT/CT	Cypher Text, indicates Comm mode 2 operation.
	LOCK	Presence indicates keypad 7 channel knob are nonfunctional. To unlock, press ALT+ESC.

Table 2.123 HHL16 Key Loading Procedures.

1. Power up SKL.
2. Log into SKL.

Create Equipment

3. From the main screen of the SKL, select the **Eqs Tab** and navigate to File>Add Equipment.

Input the Following:

- Equipment Name—HHL16
- Equipment Type—Link 16CM
- Distribution Path—<blank>
- MIDS JTRS—Checked

4. Select **OK.**

Assign Keys

5. Assign appropriate keys. See **Table 2.78**, COMSEC Short Titles and Associated Equipment.
6. To assign, the proper Key-Tags, from the **Eqs tab**, select the appropriate equipment and navigate to File>Assign>Key Tags.
7. Select the Edition of the Keys that you want to load.
8. Select **NEXT.**
9. Select the LINK 16CM R001 segment by placing a check in the box.
10. Select **FINISH.**

Create Platform

11. From the main screen of the SKL, select the **Plats Tab** and navigate to File>Add Platform.

Input the Following:

- Platform Name—HHL16
- Distribution Path—<blank>
- Bussed—Not Checked
- MIDS JTRS—Checked
- Bus Address—255

12. Select **OK.**

Assign Equipment to Platform

13. From the main screen of the SKL, select the **Plats Tab** and the select the **HHL16 Platform** and navigate to File>Assign>Equipment.
14. Select LINK 16CM HHL16.
15. Select **OK.**

Loading Keys from the SKL

16. Connect SKL to PRC-161 with fill cable.
17. Ensure that the PRC-161 is fully booted.
18. Ensure that the PRC-161 is in "internal audio."
    - A quick way to determine that the radio is not set to internal audio is the headset icon on the front panel.
    - To confirm "internal audio," from the home screen on the radio front panel, select "**mode.**" This will display audio selection. To change the audio selection, highlight the top selection in the mode menu and press enter **(ENT).** Use the up/down arrows to navigate to "internal audio" **(INT AUDIO)** and press enter **(ENT).** Then use the **ESC** key and escape out to the home screen.
19. From the main screen of the SKL, select the **Platform Tab** and select the upper level HHL16 platform.
20. Click on the "**LOAD**" icon in the upper right-hand corner of the screen.
21. Choose "**NO**" when prompted to "Perform equipment date and time load."
22. On the "**Load ECU Wizard**—**Connect To**" screen, Verify the following:
    - Equipment Type—LINK 16CM
    - Equipment Name—HHL16
    - Bus Address—255
23. Select **NEXT.**
24. On the SKL "**Load ECU Wizard – Profiles**" screen.
25. Connect SKL to LINK 16CM fill port.
26. Prepare LINK 16CM to receive date.
27. Select **Send** on SKL.
28. The PRC-161 should display "**Key Fill.**"
29. On the SKL "MIDS JTRS Equipment Results" screen—verify the number of keys were loaded in the "**Success**" window and that the "**Fail**" window is displaying **0**.
30. Disconnect fill cable from PRC-16.
31. Reboot PRC-161.
32. PRC-161 is ready for use.

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2.7.11 Soldier ISR Receiver. The SIR is a lightweight, batter powered portable receiver designed to display video and telemetry data from a wide variety of surveillance equipment, including manned and unmanned aircraft. The unit provides ISR video imagery (when connected to a video display) in a small package.

2.7.11.1 The primary purpose of the system is to provide live aerial imagery to mobile ground personnel. The system receives imager in L, S, C, and Ku-bands providing compatibility with many different types of existing platforms. See **Table 2.124**, Frequency Band Asset Breakdown.

Table 2.124 Frequency Band Asset Breakdown.

Frequency Band	Aircraft
C-band Digital (5.250 to 5.850 GHz)	Litening Pod (US/NATO), Sniper Pod (US/NATO), ATFLIR Pod, Project Liberty, C-130, Army and Air Force Predator Variants, some P3 (US, Canadian), French (SEM, Mirage2000, Rafael, Heron, Harfang), Upgrades (Italian and Swedish Helos), Upgrades (French Helos: Lynx, Panther, Cougar)
C-band Analog (4.400 to 4.950 GHz)	Legacy (Litening Pod, Sniper Pod, Predator, Shadow, Hunter), UK EH101, Italian Helos
L-band Digital (1.625 to 1.850 GHz)	Raven DDL, ScanEagle, FBI, Border Patrol, Police
L-band Analog (1.625 to 1.850 GHz)	Raven A, Raven B, Tern, Viking, Legacy ScanEagle
S-band Digital (2.200 to 2.500 GHz)	Scan Eagle, Integrator, FBI, Border Patrol, RC-26, Police
S-band Analog (2.200 to 2.500 GHz)	Legacy ScanEagle
Ku-band Digital (14.40 to 14.83 and 15.15 to 15.35 GHz)	P-3C AIP, P-8, Sharp pod, FireScout, C-130, Apache, Guardrail RC-12, LEMV, EMARSS, PTDS, A-160, Blue Devil 1 Gorgon Stare, P3 (US, Australian, German), Upgrades (Shadow, Hunter, Kiowa, UH-60)
OVERALL NOTE: * Not an inclusive list	
LEGEND: DDL—digital down link	

2.7.11.2 The receiver is capable of triple data encryption standard (DES) and advanced encryption standard (AES) decryption. This allows the operator to receive encrypted or unencrypted video for display using National Television Standards Committee (NTSC) compatible displays. Video may also be displayed and recorded on a computer connected to the receiver via Ethernet.

2.7.11.3 **Figure 2.32**, SIR Overview, provides a visual for the physical features of the system, while **Figure 2.33**, L/S/C-band Antenna Propagation, and **Figure 2.34**, Ku-band Antenna Propagation, show the two antenna options available for the dismounted user and the propagation patterns for the radio. For added information, see **Table 2.125**, SIR Setup with ATAK.

Figure 2.32 SIR Overview.

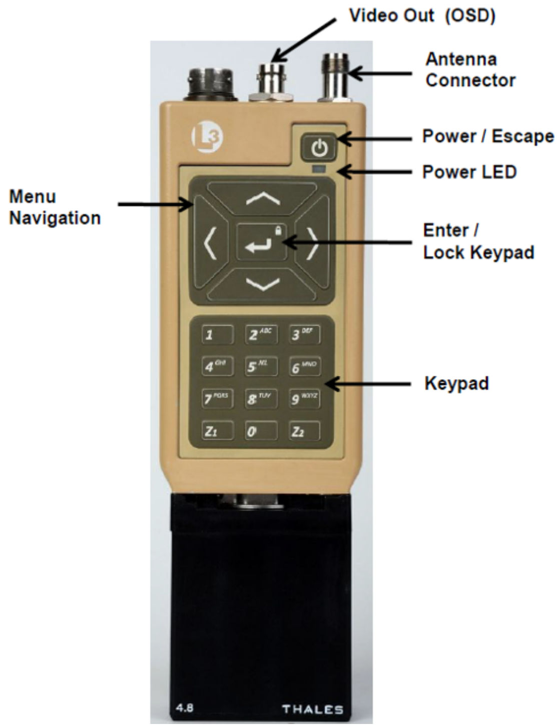
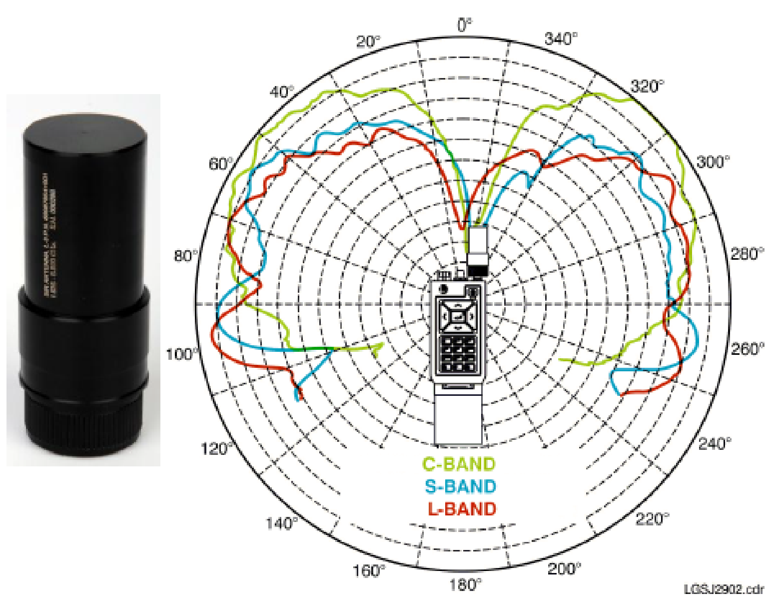
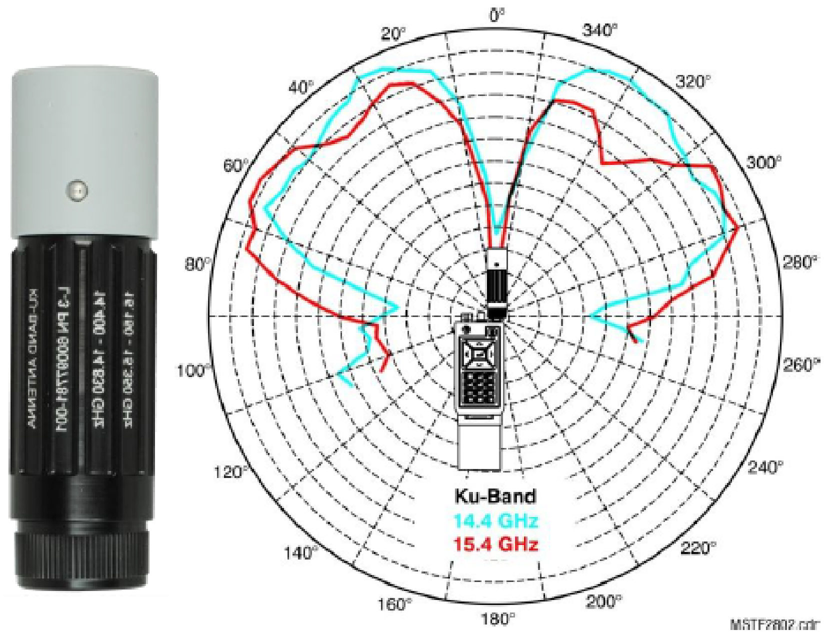


Figure 2.33 SIR L/S/C-Band Antenna Propagation.



Antenna for L, S, and C bands

Figure 2.34 SIR Ku-Band Antenna Propagation.



Antenna for Ku band

Table 2.125 SIR Setup With ATAK.

1. Connect SIR via BDAT cable to APEX hub and Place in SIR pouch on individual kit. 2. Power on SIR. 3. Ensure SIR is mapped appropriately IAW current firmware. 4. Open ATAK on EUD. 5. Select RADIO CONTROL slide tab to ON. 6. Select “Blue Play button” once green status symbol states connected. 7. Input frequency into GUI. 8. Select “Video Player” (shows in split screen). If video is playing the device is configured appropriately.
OVERALL NOTE: * If meta-data is not showing, request that aircraft transmit data (if capable).
LEGEND: EUD—end user device

2.7.12 Variable Message Format. See Table 2.126, VMF K-Series Message Descriptions, and Table 2.127, VMF J-Series Message Descriptions.

Table 2.126 VMF K-Series Message Descriptions.

Number	Message Type	Description
K01.1	Free Text	Provide information that does not fall into a structured format.
K01.2	Unit Reference Query/Response	Request or distribute the data associated with a URN.
K02.27	CAS Request	Request immediate or preplanned CAS.
K02.28	CAS BDA Report	Report BDA after the completion of a CAS mission.
K02.31	Mission Request Rejection	Inform a requester that a planned or immediate CAS mission(s) is rejected.
K02.32	CAS Request Acceptance	Inform command and control agencies that a CAS mission request has been accepted for a planned or immediate mission.
K02.33	CAS Aircrew Briefing	Provide aircrew all essential information for a CAS mission.
K02.34	Aircraft On-Station (AOS)/On-Station Report (OSR)	Pilot or flight leader to notify the control agency that he and his flight have arrived at the prescribed control station.
K02.35	Aircraft Departing Initial Point (DPIP)	Pilot or flight leader to notify the control agency that he and his flight are departing the initial point to complete the assigned air support mission.
K02.57	Aircraft Attack Position and Target Designation (APTD)	Provide aircraft location, target location, and aircraft system status to the JTAC/Forward Air Controller (Airborne) (FAC[A]).
K02.58	CAS Aircraft Final Attack Control	Provide the ability to conduct final attack (terminal) control and the CAS aircraft to respond to an abort code mismatch.
K02.59	Request for K02.57 Aircraft APTD	Provide the FAC with means to schedule, start, and stop CAS aircraft APTD reporting message.
K04.1	Observation Report	Provides aircrew with a ground designated point of interest.
K04.17	Image Transfer	Bidirectional image collaboration.
K05.1	Positions Report	Provide friendly unit locations data.

Table 2.127 J-Series Message Descriptions.

Number	Message Type	Description
J2.0	Indirect Interface Unit PPLI	Provides forwarded participation status, ID and positional information from other data links such as VMF over CNR.
J2.2	Air PPLI	Provides network participation status, ID, position and relative navigation information about an aircraft.
J2.5	Land Point PPLI	Provides network participation status, ID, position, and relative navigation information about a stationary ground unit.
J2.6	Land Track PPLI	Provides network participation status, ID, position and relative navigation information about a mobile ground unit.
J3.5	Land Point/Track	Provides tactical surveillance information on land points and tracks.
J10.6	Pairing	Provides a means to indicate a pairing between friendly track and another track or point.
J12.0	Mission Assignment	Assigns missions, designated targets, and provides target information to non-C2 JU platforms. Provision is made for the non-C2 JU platforms to acknowledge the message through receipt/compliance action.
J12.4	Control Unit Change	Initiates control procedures with a new controlling unit or to effect a change of controlling unit in response to a controlling unit change order or by a C2 JU to initiate control by own unit.
J12.6 (SID X)	Target Sorting	Used to enable non-C2 JUs to exchange targets and targeting information among themselves; pass sensor data to C2 JUs and among non-C2 JUs; pass non-C2 JU engagement status information between non-C2 JUs and from non-C2 JUs to C2 JUs; and provide control among non-C2 JUs. SID 4 - New Sensor Target Report SID 9 - Mark Point SID 10 - Lock On
J13.2	Air Platform and System Status	Provides the current status of an air platform to include ordnance load, fuel, operational status, and onboard systems' status.
J28.2(0)	Text Message	Provides the means to convey alphanumeric text information via data link.

2.7.13 Tactical Rover e. The TACe provides encrypted digital and analog video with aircraft and sensor positional data directly to the dismounted user for real-time situational awareness. TACe supports external interfaces, allowing interoperability with display devices, wearable EUDs and power sources.

2.7.13.1 The system receives images in L, S, C, and Ku-bands providing compatibility with many different types of existing platforms. See **Table 2.128**, Frequency Band Asset Breakdown; **Figure 2.35**, TACe and TACe Computer Setup; **Table 2.129**, Digital Waveform Breakdown; **Table 2.130**, TACe Setup Guide; and **Table 2.131**, TACe Troubleshooting Procedures; **Table 2.132**, TACe Computer Setup Guide; **Table 2.133**, Rover 6 Setup Guide; and **Table 2.134**, MCS Block 2 DAGR Configuration.

Table 2.128 Frequency Band Asset Breakdown.

Frequency Band	Aircraft
C-band Digital (5.250 to 5.850 GHz)	Litening Pod (US/NATO), Sniper Pod (US/NATO), ATFLIR Pod, Project Liberty, C-130, Army and Air Force Predator Variants, some P3 (US, Canadian), French (SEM, Mirage2000, Rafael, Heron, Harfang), Upgrades (Italian and Swedish Helos), Upgrades (French Helos: Lynx, Panther, Cougar)
C-band Analog (4.400 to 4.950 GHz)	Legacy (Litening Pod, Sniper Pod, Predator, Shadow, Hunter), UK EH101, Italian Helos
L-band Digital (1.625 to 1.850 GHz)	Raven DDL, ScanEagle, FBI, Border Patrol, Police
L-band Analog (1.625 to 1.850 GHz)	Raven A, Raven B, Tern, Viking, Legacy ScanEagle
S-band Digital (2.200 to 2.500 GHz)	Scan Eagle, Integrator, FBI, Border Patrol, RC-26, Police
S-band Analog (2.200 to 2.500 GHz)	Legacy ScanEagle
Ku-band Digital (14.40 to 14.83 and 15.15 to 15.35 GHz)	P-3C AIP, P-8, Sharp pod, FireScout, C-130, Apache, Guardrail RC-12, LEMV, EMARSS, PTDS, A-160, Blue Devil 1 Gorgon Stare, P3 (US, Australian, German), Upgrades (Shadow, Hunter, Kiowa, UH-60)
OVERALL NOTE: * Not an inclusive list	

Figure 2.35 TACe and TACe Computer Setup.

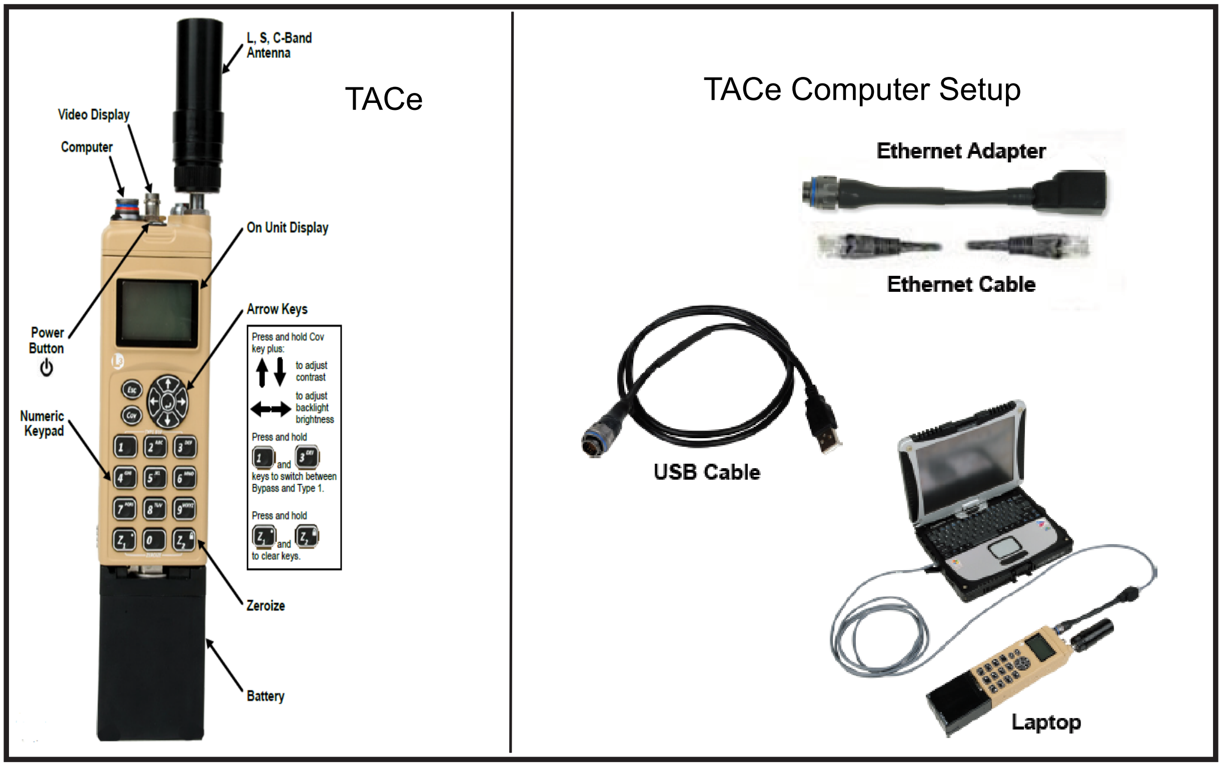


Table 2.129 Digital Waveform Breakdown.

			Digital Waveforms						
			DDL	Tactical	CDL	Legacy Digital (455)	466ER	VNW	FM Analog
Supported Features	Frequency Band	UHF		X			X	X	
		L	X	X			X	X	X
		S	X	X			X	X	X
		C		X		X	X	X	X
		Ku		X	X		X	X	

Table 2.130 TACe Setup Guide.

1. Antenna: Connect antenna to receiver. **NOTE:** Antenna sides receive best signal. 2. Battery: Attach a Thales PRC-148 or Harris PRC-152 battery. 3. Power On: Press the Power button. Display appears in less than 5 seconds. 4. Operation using External Video Display: a. Connect External Video Display. b. Enter password and press Enter. (Password: 1234) c. Press and hold the desired preset number 0 through 9, or use keypad to enter frequency (exclude the decimal), then press Enter. **NOTE:** Ku and UHF frequencies require optional antennas. If video is playing, the device is configured properly. 5. Power Off: Press and hold the Power button for 5 seconds to power down the radio. Press the Power button briefly and Enter to confirm power save mode.
OVERALL NOTE: * If meta data is not showing, request that aircraft transmit digital or Tx data (if capable).
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Table 2.131 TACe Troubleshooting Procedures.

1. Receiver Will Not Power On: If no L3 logo is displayed check connection to the battery. 2. No Video: Check for signal strength and status screen from the Alerts menu to ensure proper frequency, data rate, and waveform are selected. If low signal check antenna connection. 3. No Video From Platform: • The transmitting source is transmitting a signal but it may not have available video on it. Ensure the transmitting source is transmitting video properly. 4. Incorrect Key Stored, Verify Keys: Verify the correct cryptokey is selected. 5. Manual Key Selection Required: When operating in VNW or DDL the crypto key must be manually selected. 6. Video Breaks Up: When digital signals are weak, the display may break up into “blocky” images; that is, it displays tiles of broken, unrelated images. When analog signals are weak, the display may show a series of white lines. Check the antenna position. Ensure antenna is not obstructed. 7. Built In Test: The receiver uses built in testing to monitor the status and health of the system. On the OSD, the BIT status is shown on the menu. If error occurs the status of built in test (BIT) is displayed in the Admin under the BIT tab. Temperature BIT failure occurs if the receiver exceeds 90° C (194° F) and will need to be cooled below 75° C (176° F) which is maximum external ambient operating temperature. 8. Antenna Bit Failure: this message is displayed when the attached antenna is the incorrect antenna for the entered frequency or when the correct antenna needs to be attached for the entered frequency. 9. Invalid Antenna: This message indicates that the wrong antenna is connected. The current frequency entered is in Ku-Band and the L, S, C Band antenna is connected. Change either the frequency or the antenna. 10. Hardware BIT Failure: Hardware BIT Failure This warning appears when there is a hardware issue with the device that may hinder normal operations. Restore factory defaults if able. 11. Video Message Freeze: If the radio is not responsive to button pushes, or if there is an error message on the video output that does not disappear after pushing the correct buttons, try the following steps in order: a. Push the Esc button several times. b. Power down the radio and power back on. c. Restore to factory defaults.
OVERALL NOTE: * There are no serviceable parts within the receiver. If a BIT test fails and undesired operation is experienced, then the system must be returned for repair.
FOUO

Table 2.132 TACe Computer Setup Guide.

1. Antenna: Connect antenna to receiver. **NOTE:** Antenna sides receive best signal. 2. Battery: Attach a Thales PRC-148 or Harris PRC-152 battery. 3. Power On: Press the Power button. Display appears in less than 5 seconds. 4. Operation using Computer: a. Ethernet Cable Connection (1) Connect Ethernet adapter and Ethernet cable to computer and receiver (as shown). (2) Open Internet browser and type "ROVER.com." **NOTE:** Ku and UHF frequencies require optional antennas. (3) Set the frequency and select Reconnect. (4) Use SoldierSight media player to view video. (Installation CD included in kit) • Troubleshooting: Type 192.168.80.1 if ROVER.com does not work. • Troubleshooting: Set computer to obtain IP address automatically in the network settings found in Control Panel. (5) If video is playing the device is configured appropriately. b. USB Cable Connection (1) Connect USB cable to computer and receiver. (2) Install driver on the computer (Driver CD included in kit). 5. Power Off: Press and hold the Power button for 5 seconds to power down the radio. Press the Power button briefly and Enter to confirm power save mode **(Password: 1234)**
OVERALL NOTE: * If meta-data is not showing, request that aircraft transmit digital or Tx data (if capable).
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Table 2.133 ROVER 6 Setup Guide.

1. Connect the ROVER™ 6 Transceiver to a viable power source. Power source could be either a BA-5590 battery (or equivalent) or one of the battery eliminators.
2. Connect the RED I/O cable (40012005-000 or 60103908-000) to the RED I/O transceiver port (J5) and then to the Ethernet port on the laptop computer.
a. The RED I/O cable also contains a bypass switch. When operating using Type 1 encryption make sure the switch is 'Secure;' all other operating scenarios will have the switch as 'Bypass.'
3. Select the appropriate antenna to use for your band of operation, refer to the User Manual for part number and antenna detail.
4. Connect antenna using a supplied RF cable to either 'RCV 1' (J7) or 'RCV 2' (J6) on the transceiver.
5. Power on the ROVER™ 6 Transceiver (front panel power switch) and laptop. The transceiver PWR indicator LED will turn green to acknowledge power is on.
6. Wait for the ROVER™ 6 to fully boot up (approximately two minutes) then connect to the transceiver GUI by entering https://192.168.80.1 or 'ui' into the URL of Internet Explorer (or equivalent web browser). Log into the GUI using supplied username and password (Password: 1234).
7. Select the Rx tab on the GUI. Set up the GUI parameters to match the operational scenario (e.g., frequency, waveform, data rate). Once the settings are correct, activate the receiver by toggling 'Standby' to 'On.' Ku Omni, CLS Omni, and ECLS antennas require the LNA voltage to be set to Auto Mode.
OVERALL NOTE: * Additional Quick Start Up labels and procedures can be referenced from L3 Technologies Quick Start Guide.
FOUO

Table 2.134 MCS Block 2 DAGR Configuration.

1. Press and hold the **POWER** key
2. Press the **MENU** key twice on the keypad to display the Main Menu
3. Scroll down and select **System** by pressing the **ENTER** key
4. Scroll down and select "**Select Function Set**" by pressing the **ENTER** key
5. Select **Advanced** by pressing the **ENTER** key
6. Press **MENU** key twice to return to main menu
7. Press the **Down Cursor Control** key on the keypad until the **Receiver Setup** submenu item is selected; press the **Enter** key
8. Press the **Down Cursor Control** key on the keypad until the **POWER SAVER** page is selected; press the **Enter** key
9. On the **POWER SAVER** page press the **Enter** key on the keypad until the **AUTO-OFF MODE** field is selected; press the **Enter** key
10. Press the **Down Cursor Control** key until the **Off** option is selected; press the **Enter** key
11. Press the **Down Cursor Control** key until the **AUTO-STANDBY MODE** field is selected Press the **Enter** key
12. Press the **Down Cursor Control** key until the **Off** option is selected; press the **Enter** key
13. Press and hold the **POS/PAGE** button to return the Home Screen
14. Press **MENU** button twice to open the main menu
15. Scroll down and select **System** by pressing the **ENTER** button
16. Scroll down and select "**Select Function Set**" by pressing the **ENTER** button
17. Select **Advanced** by pressing the **ENTER** button
18. Press **MENU** button twice to return to main menu
19. Scroll up and select **COMMUNICATIONS** by pressing the **ENTER** Button
20. Scroll down and select **COM PORT SETUP** by pressing the **ENTER** button
21. Press **Down Arrow Button** once to scroll down to next page
22. Press **ENTER** to highlight **COM PORT 1**
23. Press the **Down Arrow Button** to highlight **IN PROTOCOL**
24. Press the **ENTER** button and select **NMEA** to change **IN PROTOCOL** to **NMEA**
25. Press the **Right Arrow Button** to highlight **OUT PROTOCOL**
26. Press the **ENTER** button and select **NMEA** to change **OUT PROTOCOL** to **NMEA**
27. Navigate to and highlight IN BAUD
28. Press **ENTER** button and select **4800** to change **IN BAUD** to **4800**
29. Navigate to and highlight OUT BAUD
30. Press **ENTER** button and select **4800** to change **OUT BAUD** to **4800**
31. Press **Down Arrow Button** twice to scroll down to next page
32. Navigate to and highlight NMEA INTERVAL
33. Press **ENTER** button and change **NMEA INTERVAL** from **2** to **1**
34. Press **Down Arrow Button** once to scroll down to **NMEA Sentences**
35. Under **NMEA Sentences**, the first box on the left is "**RMC,**" ***DO NOT*** change this
NOTE: You will add the following values to **NMEA Sentences**; ***GSV, GGA, GSA, GLL***
36. Navigate to the second box and press **ENTER** button, select **GSV**
37. Navigate to the third box and press **ENTER** button, select **GGA**
38. Navigate to the fourth box and press **ENTER** button, select **GSA**
39. Navigate to the fifth box and press **ENTER** button, select **GLL**
40. Press and hold the **POS/PAGE** button to return the Home Screen

2.8 Software.

2.8.1 Android Tactical Assault Kit. This system allows for precision targeting, navigation, and generalized situational awareness.

2.8.1.1 Digital Terrain Elevation Data (DTED). DTED is used to give the user terrain elevation associated with each point on the digital map. This allows for elevation data to auto fill when the user creates a 9-Line. It also allows the user to use the HEATMAP tool and the VIEWSHED tool. The addition of the CONTOUR tool in newer TAK versions will allow for the overlay of DTED-correlated contour lines to augment imagery sources. Know that DTED is similar to maps/imagery in that DTED level 1 is a larger data file than DTED level 0, for the same size geographic region. To conserve memory on the EUD, a beneficial TTP is to download DTED level 0 for the entire AO, but download DTED level 0, 1, 2 for your specific objective area. DTED should be saved to the EUD's internal memory in the ATAK/DTED folder in My Files.

2.8.1.2 Map Tool. When saving maps/imagery for use in ATAK, JTACs should use the EUD microSD card as the primary data storage repository. This aids the overall performance of the EUD and increases the capacity for higher fidelity imagery. Users should exercise caution when attempting to use various microSD cards with classified, security controlled EUDs. The microSD card encryption/decryption process does not allow users to employ an imagery library concept where each microSD card is tied to one geographic area. The microSD card must be encrypted and decrypted by the same EUD that originally authored the encryption, and if the microSD card is ejected and used on a stand-alone computer for data transfer, the EUD security program must decrypt each individual file added to the microSD card before the card is available for use. This process may take several hours or days depending on the volume of data added. It is not recommended to eject the microSD card for any reason. Users should make every effort to determine the geographic area they will need imagery and DTED for and create readily exportable file sets on a stand-alone system. This allows the EUD to be tailored to perform reliably and ensure that there is sufficient storage space to maintain reference guides, still imagery, and other mission specific products. There are three methods in which users can obtain high-quality imagery; the TAK-TICS imagery resource site, the sources listed in the ATAK online imagery tab, and through a process known as "air-gapping," whereby units who maintain a stand-alone laptop or tablet may use the device as an imagery library in order to pair the EUD to the device and drag/drop files directly into the ATAK imagery folders. Users should make every effort to use NGA-derived imagery and maps. For detailed guides on NGA resources go to **https://pki.geo.nga.mil**.

2.8.1.3 ATAK Compatible Maps.

- Pre-existing FalconView or other digital maps.
- Intel Shops.
- NGA digital maps.
- DigitalGlobe maps.
- ATAK "Mobile" Map tool.
- Portable Reference Imagery (PRI).

2.8.1.4 As ATAK software is continually evolving, the following task can be referenced for the most up-to-date training at **https://takmaps.com**. Scroll over FAQ and Training at the top of the page, select either Training Videos or ATAK Interactive Training Tool.

- Initial setup.
- Map manager.
- Import manager.
- Radial menu and action bar (to include 9-Line functions).
- Fires tool.
- Bloodhound tool.
- Mission package tool.
- Elevation tool (with DTED loaded).

2.8.2 Harris Computer Programming Application. The Harris computer programming application (CPA) is a software tool that allows a JTAC to build an entire network configuration for their team and quickly disseminate it while still being capable of individualizing specific radio functions for multiple team members. Once a user completes the build in the software program, they can share it with other users in various ways (i.e., stand-alone computer plug-in, e-mail, and over the air re-key with a radio). The software can be accessed from the Harris premier website at **https://tcpremier.harris.com**. The user will have to register for an account in order to be able to access the information, download firmware, courseware, and the CPA.

2.8.2.1 The following figures and tables walk the user through a basic setup in Harris CPA. If there are any questions regarding specifics of the CPA, consult the “help” section of the software itself. See **Table 2.135**, Harris Computer Programming Application, and **Figure 2.36**, Harris CPA Startup Screen through **Figure 2.44**, Harris CPA Finished Plan.

Table 2.135 Harris CPA Programming.

1. Open the CPA application on your desktop. See **Figure 2.36**, Harris CPA Startup Screen.
Add a Frequency
2. Click **CREATE NETWORK** and Select your desired network type. See **Figure 2.37**, Harris CPA Add Frequency.
3. Use **PROPERTIES** Slide out on the right of the screen to input details. See **Figure 2.38**, Harris CPA Net Setup.
• Repeat Step 2 and 3 for each desired frequency on the communications card for the mission.
NOTE: See **Figure 2.39**, Harris CPA HQII FMT Entry and **Figure 2.40**, Harris CPA HQII WOD Entry for HAVE QUICK specifics.
Add a Radio
4. Select dropdown on **ADD NEW RADIO** and select desired radio type. See **Figure 2.41**, Harris CPA Add a Radio.
5. Use **PROPERTIES** Slide out on the right of the screen to input details. See **Figure 2.42**, Harris CPA 152A General Setup. **Figure 2.43**, Harris CPA 152A Standard Properties Setup, shows a detail of the different options and inputs for the 152A.
• Repeat Step 4 and 5 for each radio type and repeat radio types when there are individual differences (e.g., lapel mic vs H-250).
NOTE: You will have to add each radio to each frequency. The easiest way to do this is to click on each frequency tab and then click the **EXISTING** button and select **ADD ALL**.
Setup Preset List
NOTE: Each radio can be programmed differently in regards to the preset list. Use the following steps for each station.
6. Select desired radio from the navigator menu on the left side of the screen. See **Figure 2.44**, Harris CPA Finished Plan.
7. Scroll to **PRESET LIST** and enter the desired preset order by changing the numbers to the right of the preset name (e.g., if Strike is number 9 in the list and you want it to be number 1, select number 9 and replace it with number 1).
Program Radios
NOTE: Once all of the frequencies and radios are built into the CPA the user needs to save the file so that it can be shared and loaded.
8. Connect your radio to your computer with the KDU to USB cable.
6. Select **NAVIGATION** tab from the bottom left of the screen and highlight all stations on the left menu.
7. Select **PROGRAM** from the main toolbar.
8. Check the box **CREATE MULTI-STATION FILE**.
9. Click **GENERATE MISSION PLAN**.
10. Change radio to **LD**.
11. Scroll to software.
12. Select **LOAD MISSION PLAN** and find your mission plan. Select **LOAD**.
13. Return to PT/CT.
14. Press the **MODE** key and select activate mission plan. Scroll to your plan and press enter.
Your plan is now loaded and activated for use.

Figure 2.36 Harris CPA Startup Screen.

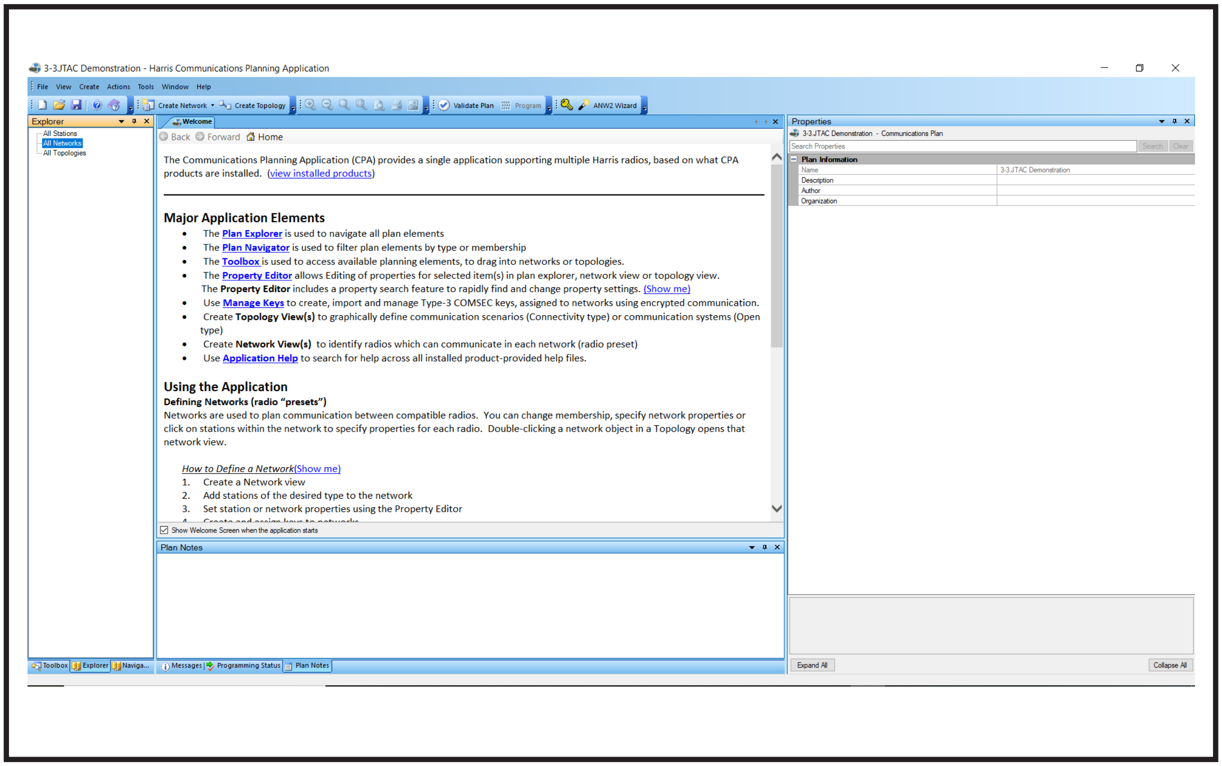


Figure 2.37 Harris CPA Add a Frequency.

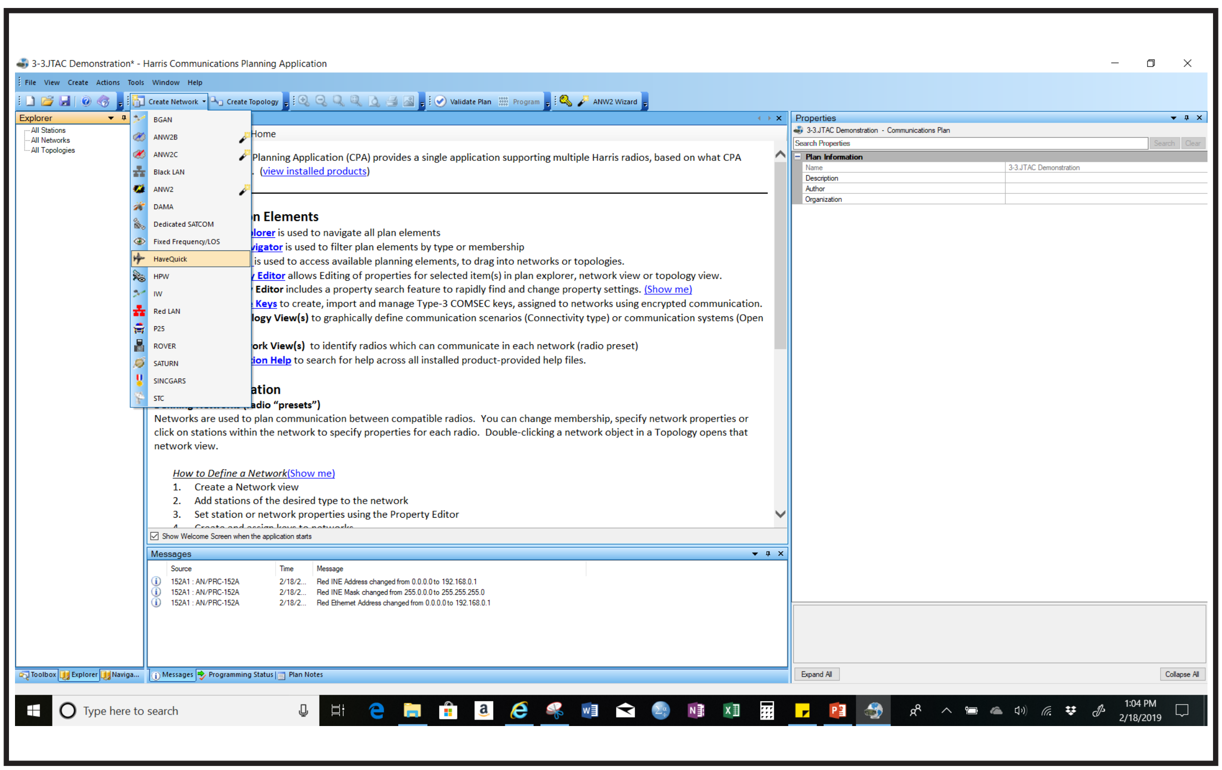


Figure 2.38 Harris CPA Net Setup.

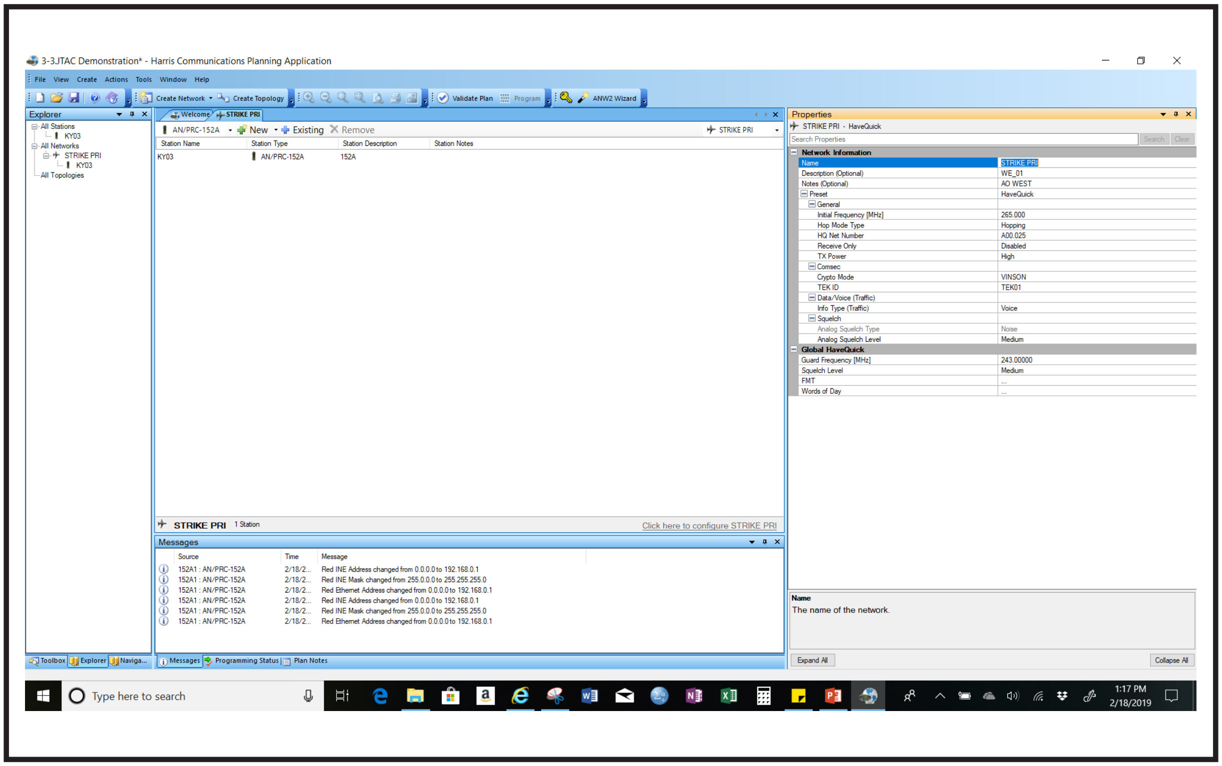


Figure 2.39 Harris CPA HQII FMT Entry.

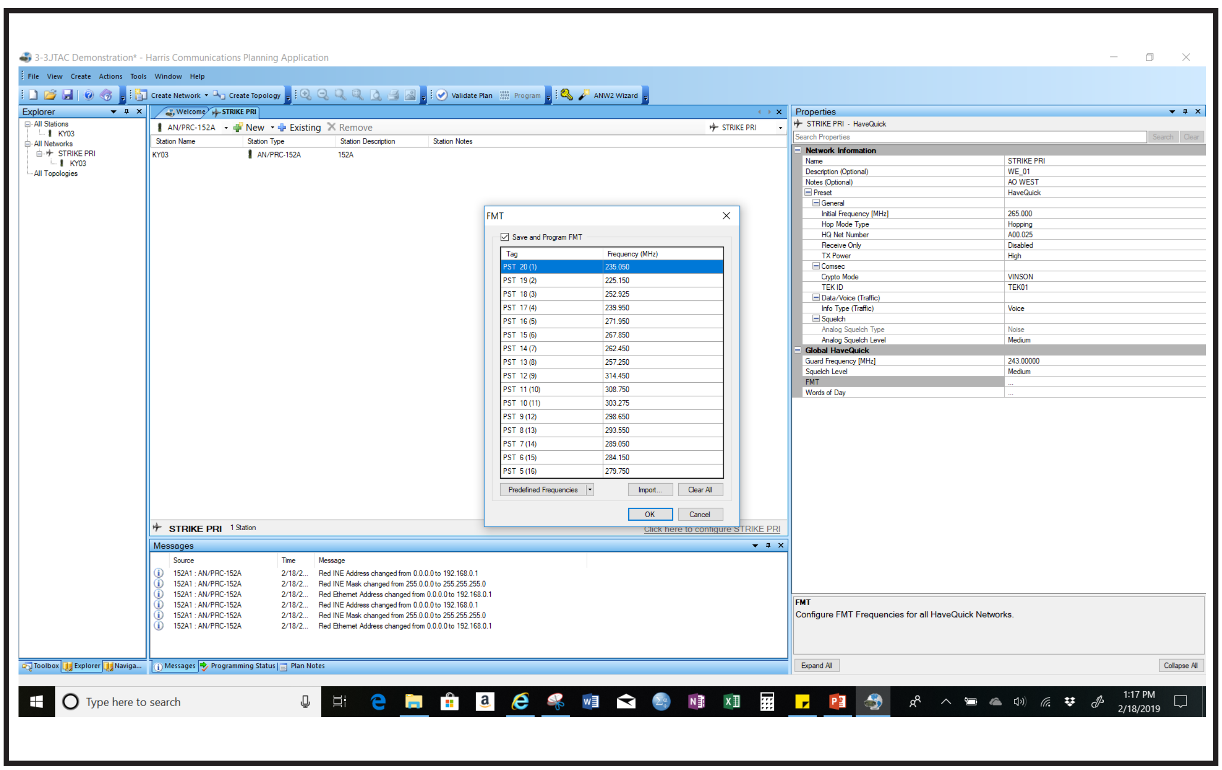


Figure 2.40 Harris CPA HQII WOD Entry.

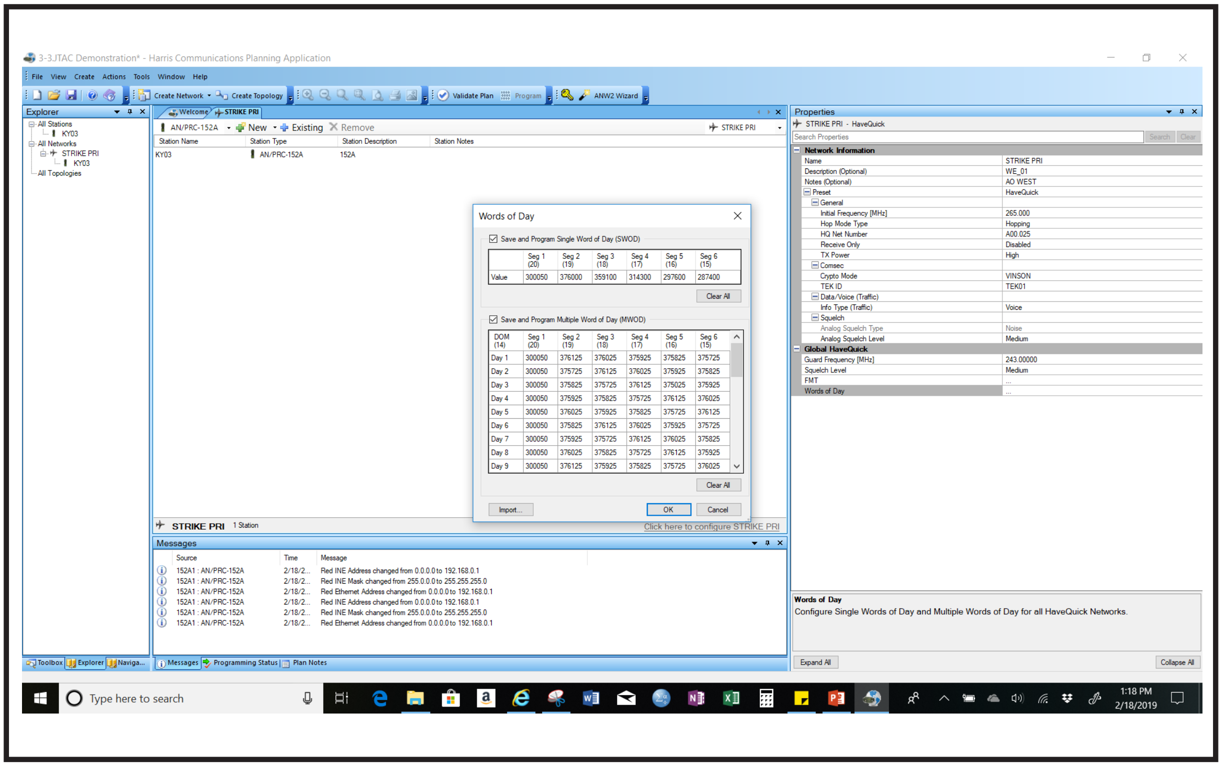


Figure 2.41 Harris CPA Add a Radio.

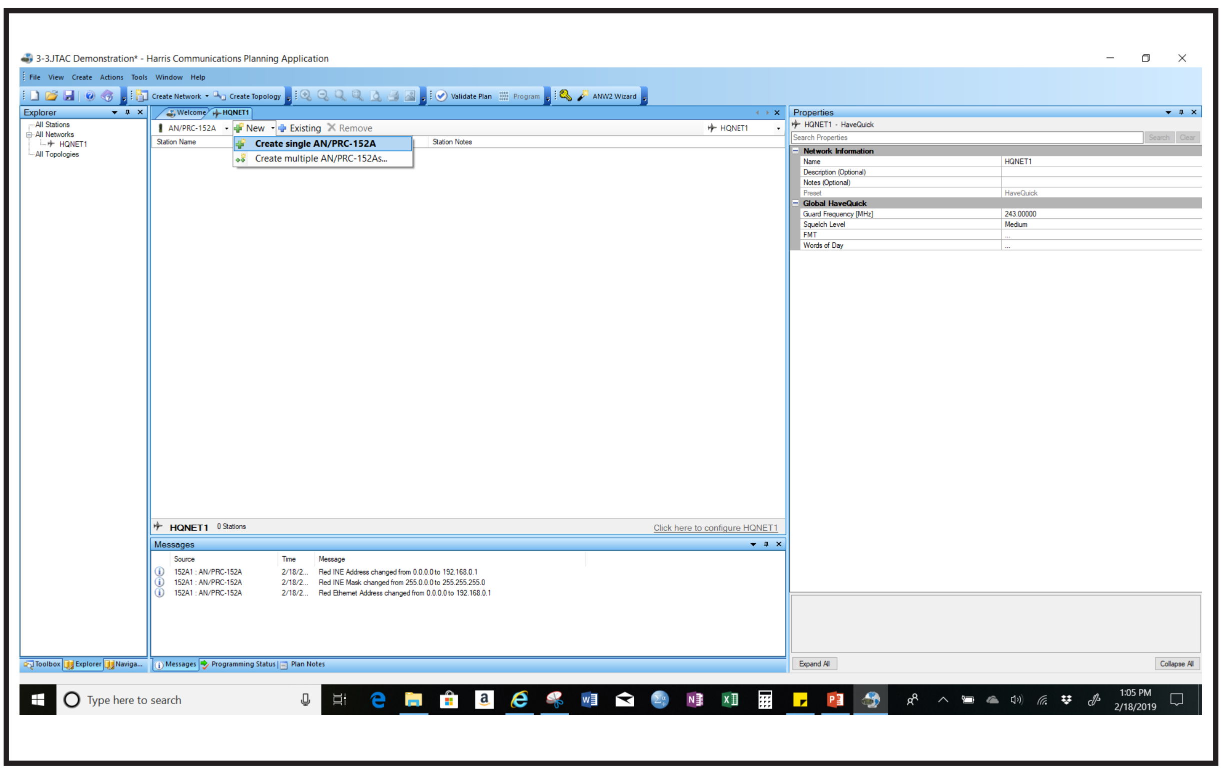


Figure 2.42 Harris CPA 152A General Setup.

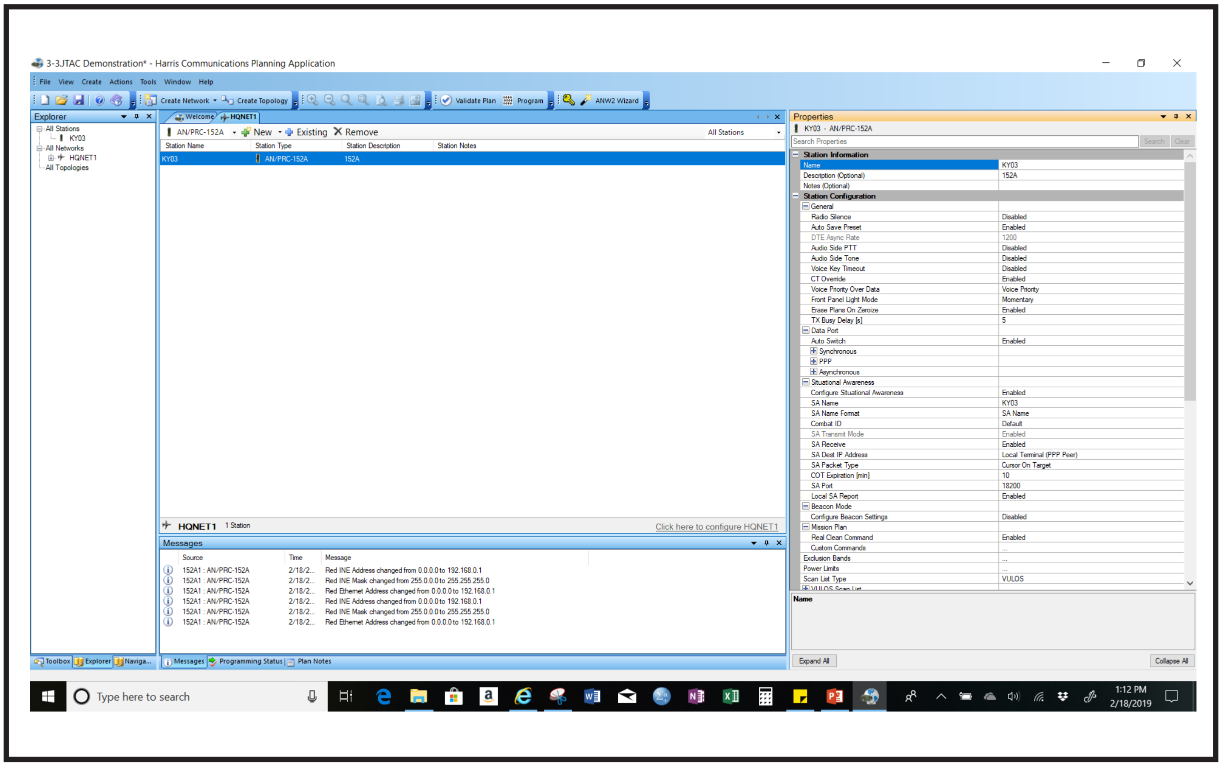


Figure 2.43 Harris CPA 152A Standard Properties Setup.

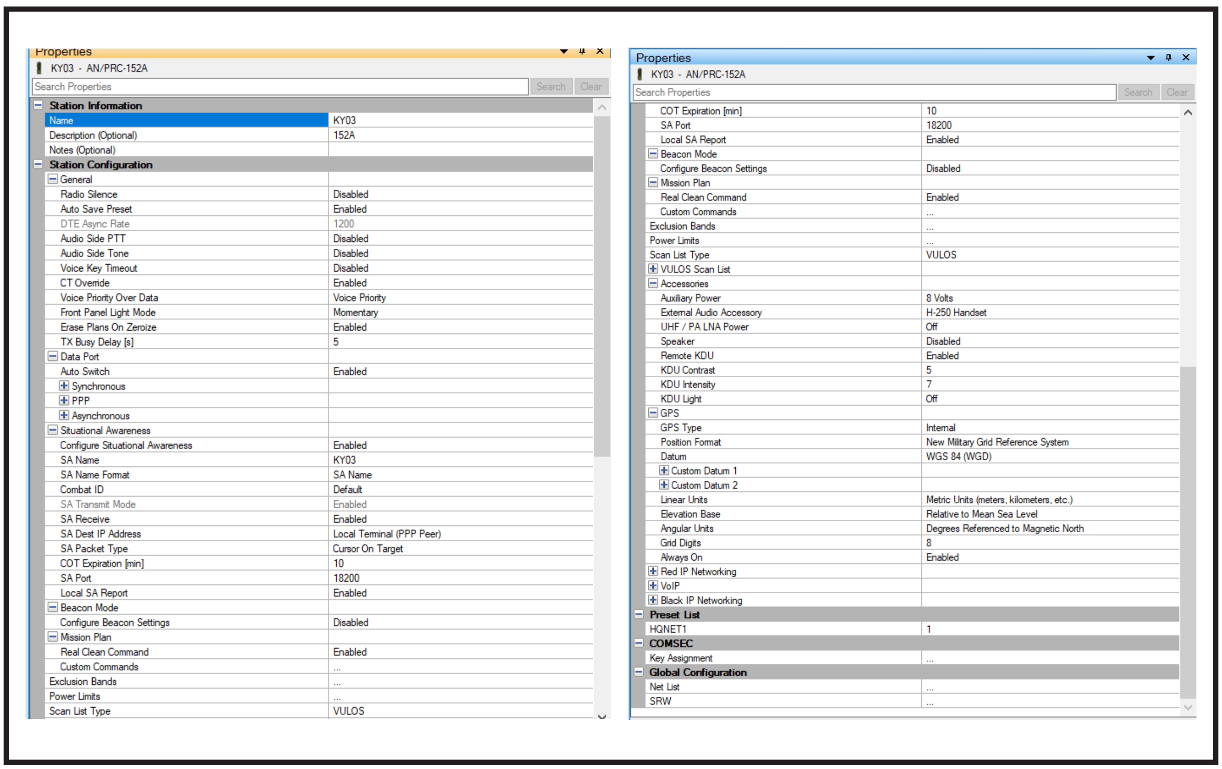
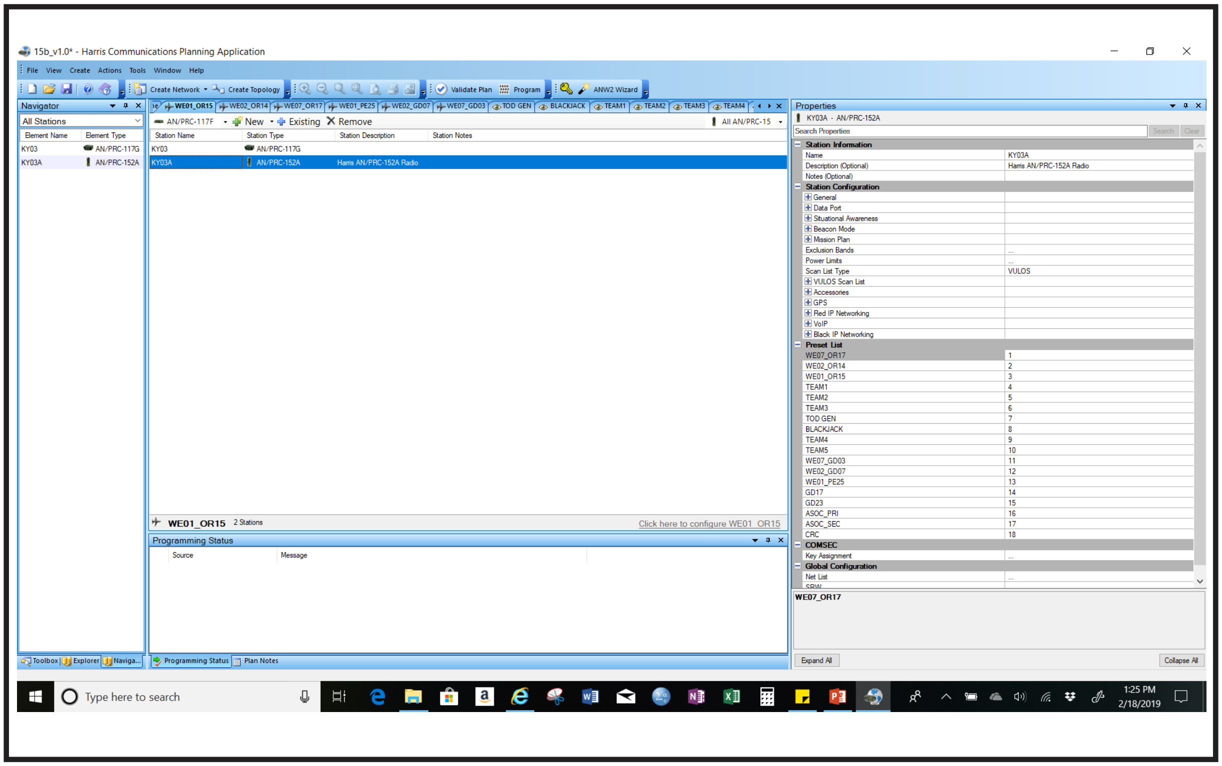


Figure 2.44 Harris CPA Finished Plan.



SECTION V—KIT CONFIGURATION

2.9 Kit Configurations.

2.9.1 Intra-Team Radio Placement. Small form factor intra-team radios should be rigged to the kit securely and in such a position that allows it to be readily manipulated with regard to channel switches, power and volume knobs, and user-defined buttons without reliance on team-mates. If placed out of reach, users must ensure remote access to these radios are routed appropriately, reliably, and secured to prevent cuts or snagging. Examples include using a KDU or the BDAT system on ATAK to remote the digital interface as to negate the need to manually adjust settings internal to the radio like volume or switching frequencies. Users should attempt to use both concepts when configuring the kit for use in the event that remote systems fail or become damaged.

2.9.1.1 Operator Control System (OCS) Equipment Basics. While there are several body-worn peripheral-hub network systems available for use, the OCS kit fielded by Black Diamond Technologies is the most widely proliferated. This kit uses smart hub technology which allows operators to integrate a multitude of peripherals or accessories for use with properly configured ATAK-equipped EUDs. The intent of using the system is to harvest the unique capabilities of the operator chosen peripherals and display them on a streamlined moving-map resource to allow users access to relevant information in a greatly expedited manner. This systems also allows users to tailor the configuration of the system to best perform within the operational environment. See **Figure 2.45**, Kit Configuration.

Figure 2.45 Kit Configuration.

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2.9.1.2 EUD Configuration and Training. EUD initial configuration and software training is conducted by MAJCOM-approved special program office (SPO) and provides critical DACAS training to the subordinate units. Courseware should be requested directly through the Air Force Special Warfare (AFSPECWAR) Body-Worn Kit SPO. Users should not modify software or hardware configurations as they will degrade or disrupt tested and verified operations.

2.9.1.3 OCS Kit Setup and Tactical Performance. Users should integrate the OCS kit in a manner that does not impede donning and doffing, while simultaneously allowing the user to manipulate radios and other peripherals without significant penalty to tactical mobility and performance. In order to facilitate these concepts, users should route cables using specialized channels built into body armor to prevent damage to the cables, while ensuring that any emergency doffing systems can be engaged without failure. If no specialized channels exist, users should secure cables on the interior side of the cummerbund and/or up and over the opposite side of the emergency doffing pull cable. Kit setup should ensure that radios and other peripherals do not preclude the user from proper engagement of weapons systems and firing positions.

CHAPTER 3

MISSION PLANNING

3.1 Planning Principles. This chapter is designed to improve CAS mission planning and should be used in conjunction with JP 3-09.3, *Close Air Support*, Chapter III, "Planning and Requesting," and Chapter IV, "Preparation." This chapter will familiarize the JTAC with how Army counterparts are organized and employed. This chapter also allows the JTAC to successfully prepare for a mission and bridge the gap between what is provided in an operations order (OPORD)/concept of operations (CONOP), and the required mission information prior to aircraft check-in.

3.2 Army Force Structure. The Army brigade combat team (BCT) is the Army's primary combined arms, close combat force. BCTs often operate as part of a division or joint task force. The division or joint task force acts as a tactical headquarters that can control up to six BCTs in high-or mid-intensity combat operations. The tactical headquarters assigns the BCT its mission, area of operations, and supporting elements. The headquarters coordinates the BCT's actions with other BCTs in the formation. The BCT might be required to detach subordinate elements to other brigades attached or assigned to the division or task force. Usually, this tactical headquarters assigns augmentation elements to the BCT. Field artillery, maneuver enhancement, sustainment, and combat aviation brigades can all support BCT operations. See **Figure 3.1**, Army Force Structure, for a graphic depiction of the Army force structure.

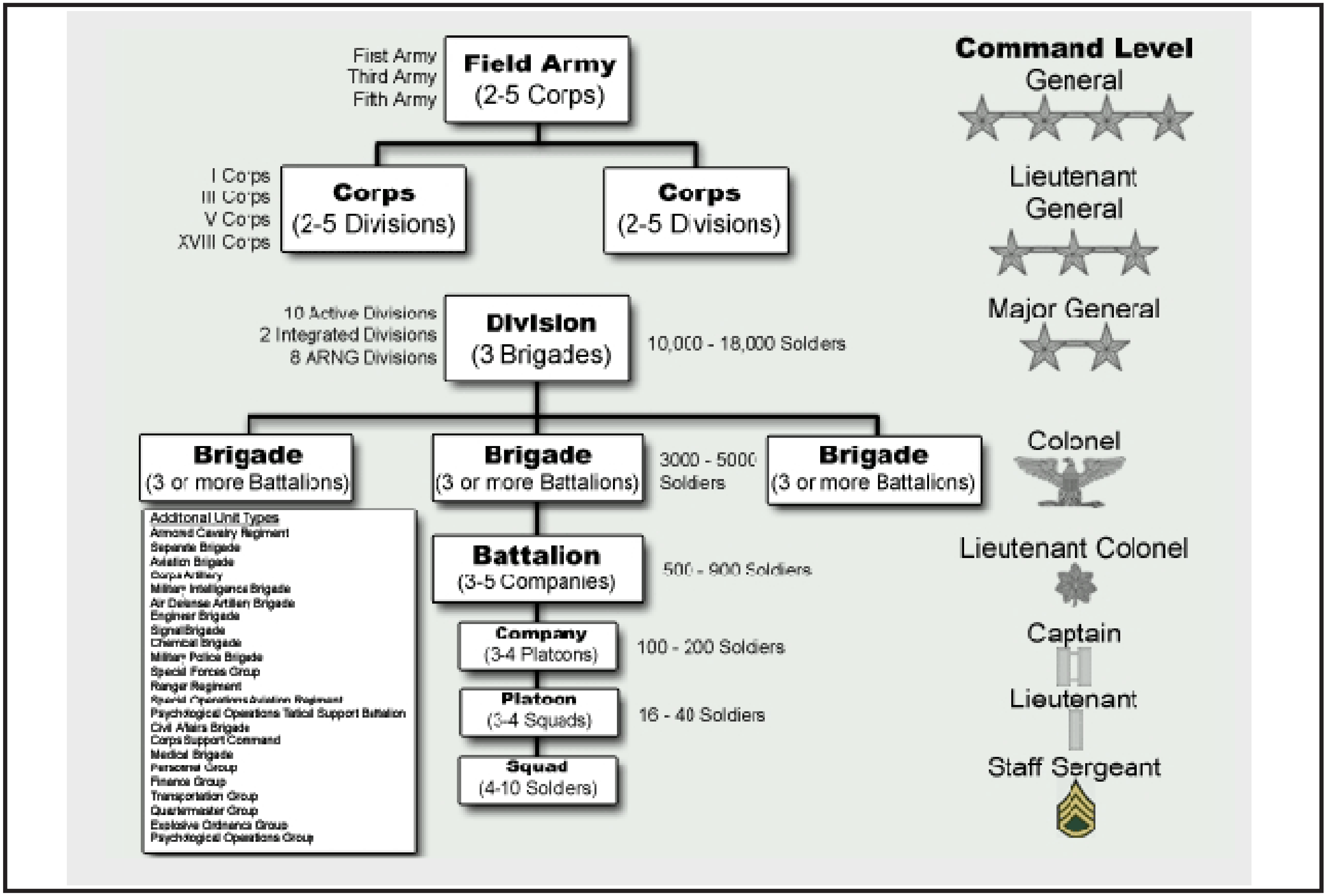
3.2.1 Corps. A corps includes 20,000 to 45,000 soldiers and is made up of two to five divisions. It is normally commanded by a lieutenant general, who is assisted by a command sergeant major and an extensive corps staff. The corps provide the framework for modern multi-national operations.

3.2.2 Division. A division, with 10,000 to 16,000 soldiers, usually consists of three brigade-sized elements and is commanded by a major general, who is assisted by two brigadier generals. It can conduct major tactical operations and sustained battlefield operations and engagements. Divisions are numbered and are assigned missions based on structures. Divisions perform major tactical operations for the corps and can conduct sustained battles and engagements.

3.2.3 Brigade. A brigade includes 1,500 to 3,200 soldiers, and a brigade headquarters commands the tactical operation of two to five combat battalions. Brigades normally are employed on independent or semi-independent operations, and normally are commanded by a colonel with a command sergeant major as senior noncommissioned officer (NCO). In some cases, a brigadier general may assume command. Armored cavalry, ranger and special forces units in this size range are called regiments or groups instead of brigades.

3.2.4 Battalion. This encompasses four to six companies and between 300 and 1,000 soldiers. A battalion normally is commanded by a lieutenant colonel, and a command sergeant major serves as principal NCO assistant. A battalion can conduct independent operations, if they are of limited scope and duration, and operates its own administration. An armored or air cavalry unit of equivalent size is known as a squadron.

Figure 3.1 Army Force Structure.



3.2.5 Company. A company contains three to five platoons and a total of 60 to 200 soldiers. A company is commanded by a captain with a first sergeant as the commander's principal NCO assistant. If the element is an artillery unit, it is called a battery rather than a company. If the company is armored or air cavalry, it is called a troop. A company is a tactical sized unit and can perform a battlefield function on its own.

3.2.6 Platoon. Normally, a platoon includes 16 to 44 soldiers and is led by a lieutenant with an NCO as second in command. A platoon usually consists of three to four squads or sections.

3.2.7 Squad/Section. A squad is the smallest element in the Army structure. Typically, a squad is made up of four to 10 soldiers and normally is commanded by a sergeant or staff sergeant. Some units have two squads that make up a section, commanded by a staff sergeant.

3.2.8 Fire Team. A Fire Teams is comprised of two Riflemen (one being the team leader—a grenadier, and an automatic rifleman) and is led by a sergeant. When a small recon or special missions is required, the Fire Team is called.

3.3 Infantry Brigade Combat Team Purpose. The infantry brigade combat team (IBCT) is an expeditionary, combined arms formation optimized for dismounted operations in complex terrain-a geographical area consisting of an urban center larger than a village and/or of two or more types of restrictive terrain or environmental conditions occupying the same space. The IBCT can conduct entry operations by ground, airland, air assault, or amphibious assault (via surface and vertical) into austere areas of operations with little or no advanced notice. Airborne IBCTs can conduct vertical envelopment by parachute assault. The IBCT's dismounted capability in complex terrain separates it from other functional brigades and BCTs.

3.4 Stryker Brigade Combat Team Purpose. The Stryker brigade combat team (SBCT) is an expeditionary combined arms force organized around mounted infantry. Due to the rapid strategic deployments and mobility, SBCT units operate effectively in most terrain and weather conditions. The role of the SBCT is to close with the enemy by means of fire/movement; to destroy/capture enemy forces; repel enemy attacks by fire, close combat, and counterattack; to control land areas, including populations and resources. The SBCT can gain the initiative early—seize/retain key terrain (any locality, or area); seizure/retention of which affords a marked advantage to either combatant, and conduct massed fire, fire from a number of weapons directed at a single point/small area; to stop the enemy.

3.5 Armored Brigade Combat Team Purpose. The armored brigade combat team's (ABCT) role is to close with the enemy using fire and movement to destroy or capture enemy forces, to repel enemy attacks by fire, to engage in close combat, and to counterattack to control land areas, including populations and resources. The ABCT organizes to concentrate overwhelming combat power. Mobility, protection, and firepower enable the ABCT to conduct offensive tasks with great precision and speed. The ABCT performs complementary missions to the IBCT and SBCT. The ABCT conducts sustained and large-scale actions within the foundations of unified land operations. The ABCT can fight without additional combat power, but can be task-organized to meet the precise needs of its missions. The ABCT conducts expeditionary deployments and integrates the Army's efforts with unified action partners.

3.6 Army Special Operations Forces Force Structure. Special operations task forces (SOTF) are scalable organizations built around the nucleus of an Army Special Force (SF) group (joint capable), SF battalion or Ranger regiment. Army special operations force (ARSOF) units normally establish the core of a SOTF with the commander and staff and respective subordinate units. See **Figure 3.2**, ARSOF Force Structure for an example of a notional SOTF organization.

3.6.1 ARSOF Purpose. SOF conduct core activities using unique capabilities under conditions in which other forces are not trained or equipped to operate. ARSOFs are organized, trained, and equipped specifically to accomplish the core activities and tasks shown in **Table 3.1**, ARSOF Core Activities.

3.7 Basic Modified Table of Organization and Equipment. The Army table of organizations and equipment (TOE) is the document that describes the wartime mission, capabilities, organizational structure, and mission essential personnel and equipment requirements for military units. It portrays the doctrinal modernization path (MODPATH) of a unit over time from the least modernized configuration to the most modernized. Understanding how to read a TOE will allow enablers and those not doctrinally aligned with a specific maneuver element understand the force capabilities available. ***NOTE:*** TOE updates occur every three years in an effort to project the most current warfighting capabilities of Army units. For the most current information, visit **https://fmsweb.fms.army.mil**. See **Figure 3.3**, Basic Army MTOE Example, for an example Army modified table of organization and equipment (MTOE) depicting an IBCT.

3.8 Map Symbols. A military symbol is a graphic representation of a unit, equipment, installation, activity, control measure, or tactical task relevant to military operations that is used during the planning process to represent a common operational picture on a map, display, or overlay. Military symbols fall into two categories: framed, which includes unit equipment, installation, and activity symbols; and unframed, which includes control measures and tactical symbols.

3.8.1 How to Read a Framed Military Map Symbol. **Figure 3.4**, How to Read an Objective Symbol, and **Figure 3.5**, Echelon Amplifiers, show the fundamentals of how to read a framed military map symbol and represents the foundation of understanding what each symbol represents and how to read what unit is depicted.

3.9 Course of Action Sketch. In addition to understanding how to read a framed symbol, it is also important to understand the symbols that make up friendly force actions when depicted on a map. When combined, framed military map symbols along with friendly tactical mission task symbols make up the basis of a course of action sketch.

Figure 3.2 ARSOF Force Structure.

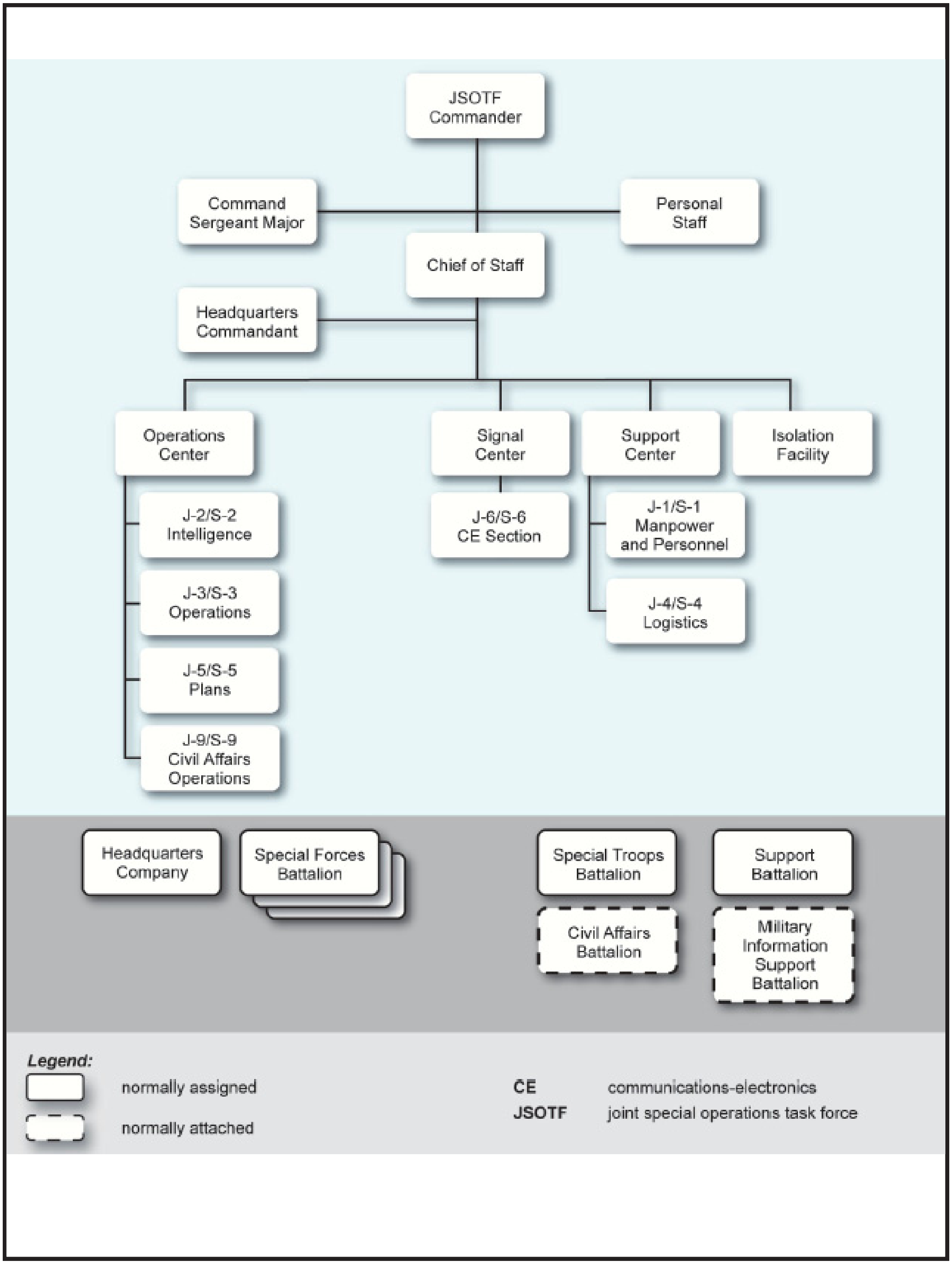
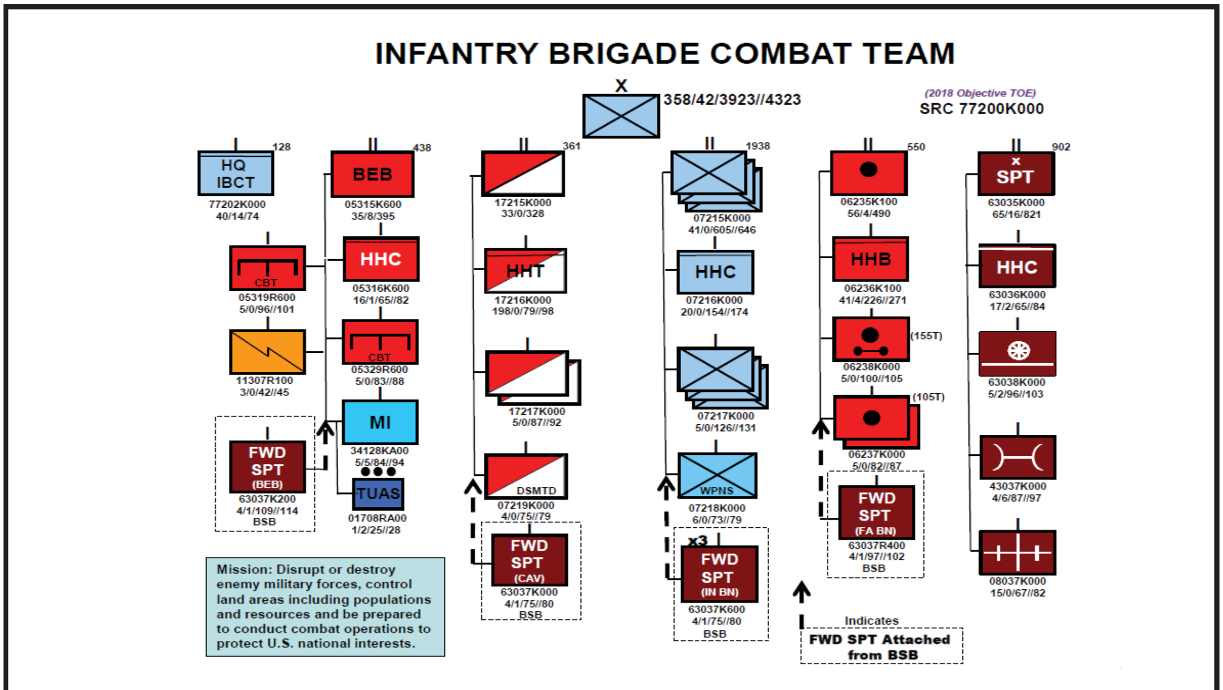


Table 3.1 ARSOF Core Activities.

- Unconventional warfare
- Foreign internal defense
- Counterinsurgency
- Counterterrorism
- Countering weapons of mass destruction
- Security force assistance
- Direct action
- Special reconnaissance
- Military information support operations
- Civil Affairs operations
- Preparation of the environment
- Hostage rescue and recovery
- Foreign humanitarian assistance

Figure 3.3 Basic Army MTOE Example.



FOR OFFICIAL USE ONLY

Figure 3.4 How to Read an Objective Symbol.

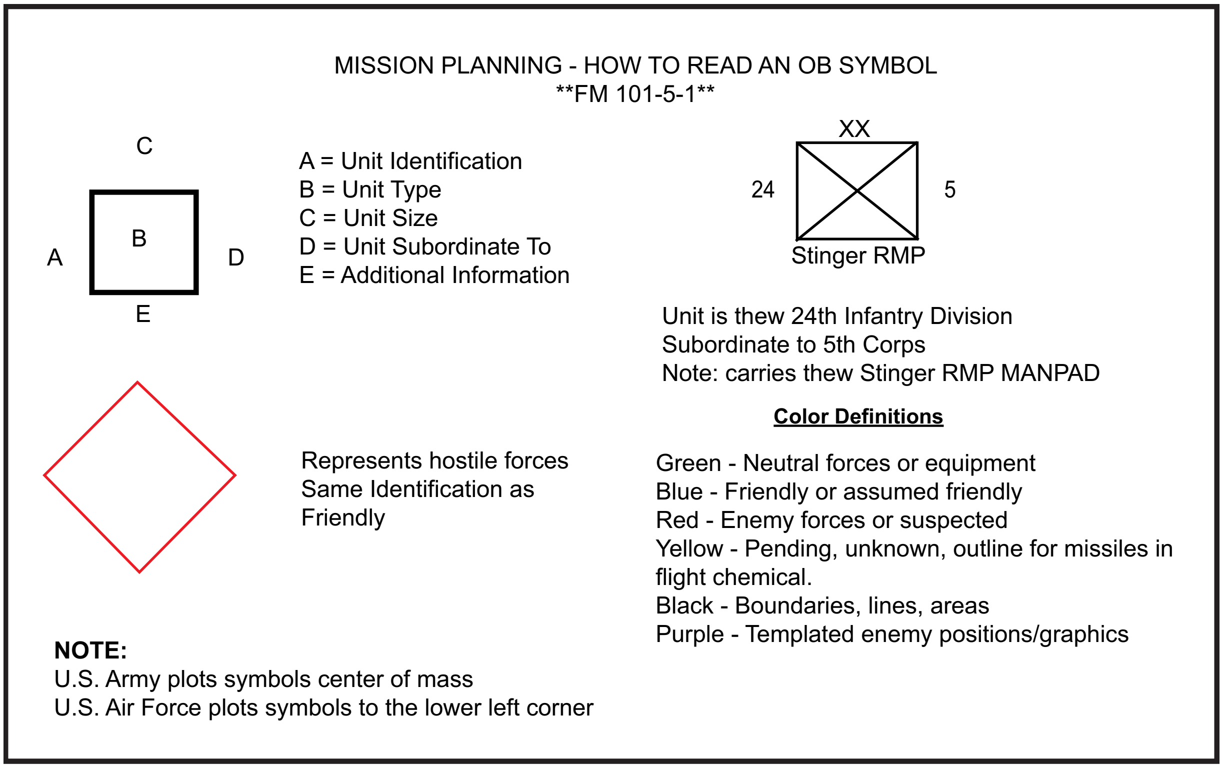


Figure 3.5 Echelon Amplifiers.

Echelon	*Echelon*	*Example of amplifier with friendly unit frame*
Team or crew ***Note:*** This is the smallest echelon and should not be confused with company team brigade combat team in the next paragraph.	Ø	
Squad	●	
Section	● ●	
Platoon or detachment	● ● ●	
Company, battery, or troop	I	
Battalion or squadron	II	
Regiment or group	III	
Brigade	X	
Division	XX	
Corps	XXX	
Theater army	XXXX	
Army group ***Note:*** Used in North Atlantic Treaty Organization or multinational operations.	XXXXX	

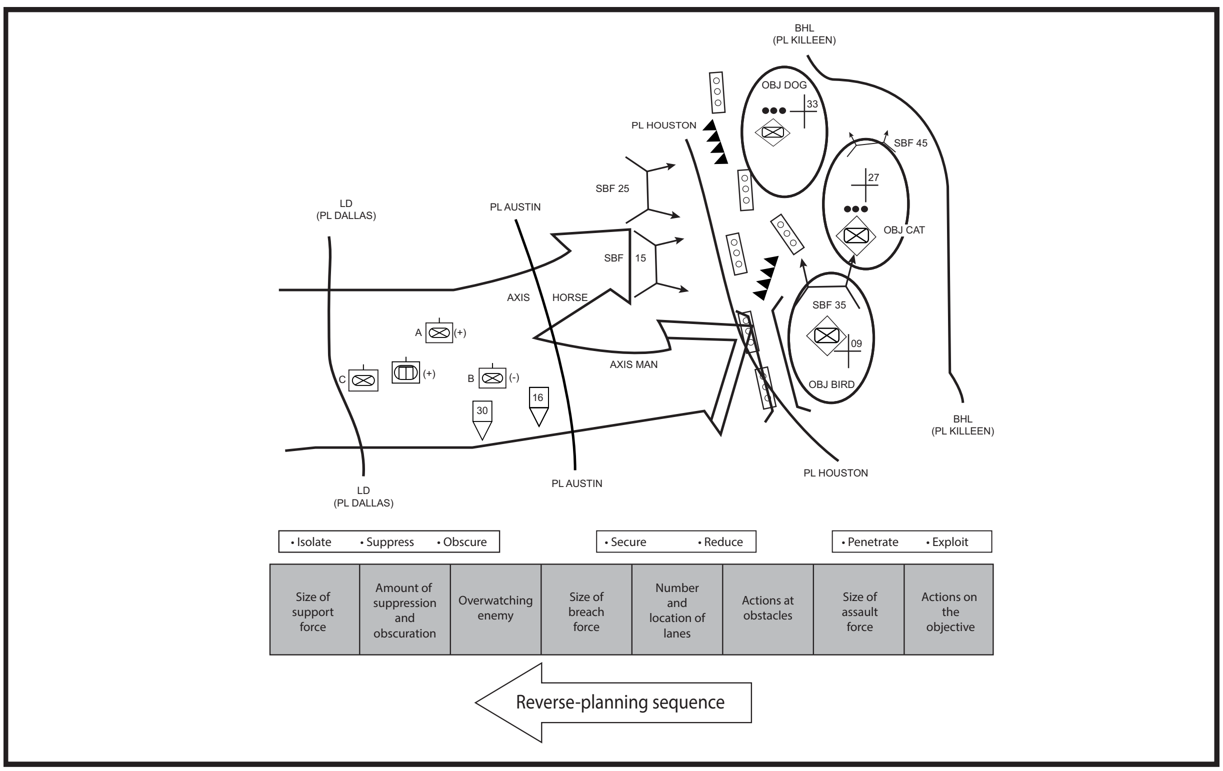
Function	*Symbol*	*Function*	*Symbol*
Air defense		Field artillery	
Armor		Infantry	
Armored reconnaissance (cavalry) Note: Reconnaissance (calvalry) unit that is both amoredf and tracked)		Air assault infantry	
Antitank		Airborne infantry	
Attack helicopter	A	Light infantry	
Air reconnaissance (cavalry)		Mechanized infantry ***Note:*** Infantry unit that is both armored and tracked.	
Assault or lift helicopter		Medium infantry (Stryker)	
Combined arms		Mountain infantry	
Engineer		Reconnaissance (cavalry or scout)	

3.9.1 Course of Action. A course of action (COA) is a scheme developed to accomplish a mission. It constitutes a broad potential solution to an identified problem. A course of action statement clearly portrays how the unit will accomplish the mission. At a minimum, the course of action sketch includes the array of generic forces and control measures, such as the following.

- Unit and subordinate unit boundaries.
- Unit movement formations, but not subordinate unit formations.
- Line of departure or line of contact and phase lines, if used.
- Reconnaissance and security graphics.
- Ground and air axes of advance.
- Assembly areas, battle positions, strong points, engagement areas, and objectives. Obstacle control measures and tactical mission graphics.
- Fire support coordination (FSC) and airspace control measures (ACM).
- Main effort.
- Location of command posts and critical information systems nodes.
- Enemy locations, known or templated.
- Population concentrations.

NOTE: When developing the course of action sketch, it is common for the unit conducting operations to use the reverse planning process as depicted in **Figure 3.6**, Course of Action Sketch and Reverse Planning Diagram (FM 3-21.21).

Figure 3.6 Course of Action Sketch and Reverse Planning Diagram (FM 3-21.21).



3.9.2 Tactical Mission Tasks/Tactical Mission Tasks Effects on the Enemy. A tactical mission task is a specific activity performed by a unit while executing a form of tactical operation or form of maneuver. A tactical mission task may be expressed as either an action by a friendly force or effects on an enemy force. The tactical mission tasks describe the results or effects the commander wants to achieve (ADRP 1-02). See **Figure 3.7**, Tactical Mission Tasks, and **Figure 3.8**, Tactical Mission Tasks Effects on the Enemy, for examples of tactical mission task and the effects on the enemy.

3.10 Military Decision Making Process. The military decision making process (MDMP) is an iterative planning methodology to understand the situation and mission, develop a course of action, and produce an operation plan or order. MDMP helps leaders apply thoroughness, clarity, sound judgment, logic, and professional knowledge to understand situations, develop options to solve problems, and reach decisions. This process helps commanders, staffs, and others think critically and creatively while planning. This section is not intended to be inclusive when speaking specifically to MDMP rather it is intended to identify key inputs/outputs that the JTAC will need to be aware of during this process. For an inclusive look at the MDMP, refer to FM 6-0, *Mission Command: Mission Command and Control of Army Forces*. JTACs should use **Figure 3.9**, JTAC MDMP Planning Matrix, in planning when identifying key deliverables from the ALO/JTAC perspective.

3.10.1 Step 1—Receipt of Mission. Commanders initiate MDMP upon receipt or in anticipation of a mission. The purpose of this step is to alert all participants of the pending planning requirements, determine the amount of time available for planning and preparation, and decide on a planning approach, including guidance on design and how to abbreviate MDMP, if required. The last task upon receipt of mission is to issue a warning order (WARNO) to subordinate and supporting units. This order provides the minimum essential information to allow subordinate units to begin planning. At a minimum, include-the type of operation, the general location of the operation, the initial time line, and any movement or reconnaissance to initiate.

3.10.1.1 During MDMP, JTACs must consider not only the individual participation level (which will vary based on the echelon that is being supported), but also any deliverables that would be expected from them. During the receipt of mission phase, senior members must be on alert notification and ensure they are aware of when the warning order will be issued. They must attend and participate in all applicable meetings with the most current information relating to the mission to include, but not limited to air order of battle, apportionment, SPINS, rules of engagement (ROE), and OPORD. They must be able to articulate CAS specific documents and provide input to the ground commander's initial guidance.

3.10.1.1.1 Air Tasking Order (ATO). A method used to task and disseminate to components, subordinate units, and command and control agencies projected sorties, capabilities and/or forces to targets and specific missions.

Figure 3.7 Tactical Mission Tasks.

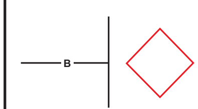
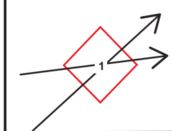
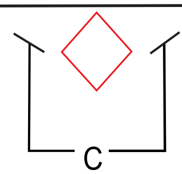
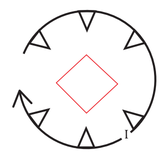
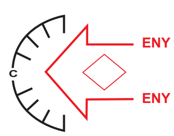
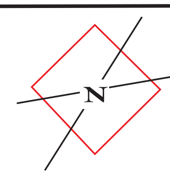
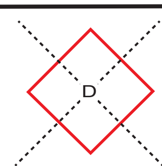
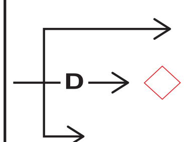
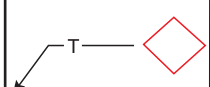
Function	***Symbol***	***Function***	***Symbol***
Block is a tactical mission task that denies the enemy access to an area or prevents his advance in a direction or along an avenue of approach.		Interdict is a tactical mission task where the commander prevents, disrupts, or delays the enemy's use of an area or route.	
Canalize is a tactical mission task in which the commander restricts enemy movement to a narrow zone by exploiting terrain coupled with the use of obstacles, fires, or friendly maneuver.		**Isolate** is a tactical mission task that requires a unit to seal off—both physically and psychologically—an enemy from his sources of support, deny him freedom of movement, and prevent him from having contact with other enemy forces.	
Contain is a tactical mission task that requires the commander to stop, hold, or surround enemy forces or to cause them to center their activity on a given front and prevent them from withdrawing any part of their forces for use elsewhere.		**Neutralize** is a tactical mission task that results in rendering enemy personnel or materiel incapable of interfering with a particular operation.	
Destroy is a tactical mission task that physically renders an enemy force combat-ineffective until it is reconstituted. Alternatively, to destroy a combat system is to damage it so badly that it cannot perform any function or be restored to a usable condition without being entirely rebuilt.		**Suppress** is a tactical mission task that results in the temporary degradation of the performance of a force or weapon system below the level needed to accomplish its mission.	
Disrupt is a tactical mission task in which a commander integrates direct and indirect fires, terrain, and obstacles to upset an enemy's formation or tempo, interrupt his timetable, or cause his forces to commit prematurely or attack in a piecemeal fashion.		**Turn** is a tactical mission task that involves forcing an enemy element from one avenue of approach or movement corridor to another.	
Fix is a tactical mission task where a commander prevents the enemy from moving any part of his force from a specific location for a specific period.			

Figure 3.8 Tactical Mission Tasks Effects on the Enemy.

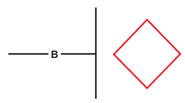
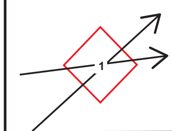
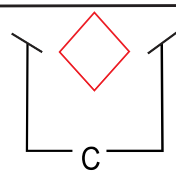
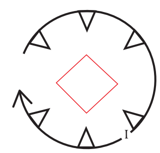
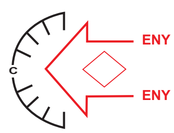
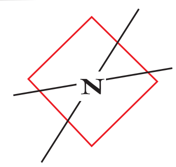
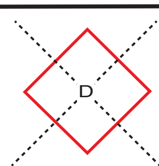
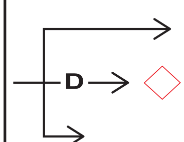
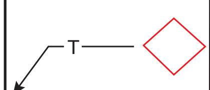
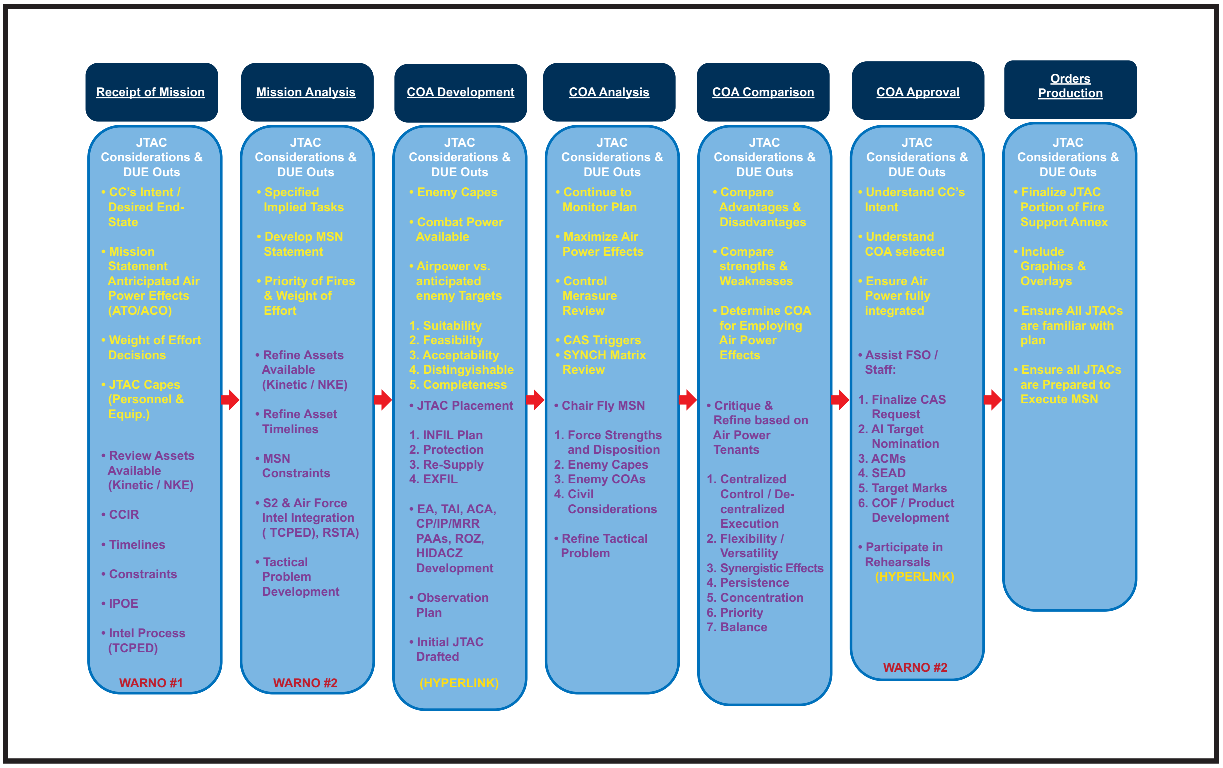
Function	*Symbol*	*Function*	*Symbol*
Block is a tactical mission task that denies the enemy access to an area or prevents his advance in a direction or along an avenue of approach.		Interdict is a tactical mission task where the commander prevents, disrupts, or delays the enemy's use of an area or route.	
Canalize is a tactical mission task in which the commander restricts enemy movement to a narrow zone by exploiting terrain coupled with the use of obstacles, fires, or friendly maneuver.		**Isolate** is a tactical mission task that requires a unit to seal off—both physically and psychologically—an enemy from his sources of support, deny him freedom of movement, and prevent him from having contact with other enemy forces.	
Contain is a tactical mission task that requires the commander to stop, hold, or surround enemy forces or to cause them to center their activity on a given front and prevent them from withdrawing any part of their forces for use elsewhere.		**Neutralize** is a tactical mission task that results in rendering enemy personnel or materiel incapable of interfering with a particular operation.	
Destroy is a tactical mission task that physically renders an enemy force combat-ineffective until it is reconstituted. Alternatively, to destroy a combat system is to damage it so badly that it cannot perform any function or be restored to a usable condition without being entirely rebuilt.		**Suppress** is a tactical mission task that results in the temporary degradation of the performance of a force or weapon system below the level needed to accomplish its mission.	
Disrupt is a tactical mission task in which a commander integrates direct and indirect fires, terrain, and obstacles to upset an enemy's formation or tempo, interrupt his timetable, or cause his forces to commit prematurely or attack in a piecemeal fashion.		**Turn** is a tactical mission task that involves forcing an enemy element from one avenue of approach or movement corridor to another.	
Fix is a tactical mission task where a commander prevents the enemy from moving any part of his force from a specific location for a specific period.			

Figure 3.9 JTAC MDMP Planning Matrix.



3.10.1.1.2 Airspace Control Order (ACO). The ACO Provides the details of the approved requests for coordination measures such as airspace coordinating measures (ACM), air defense measures, and fire support coordination measures (FSCM). It is published either as part of the ATO or as a separate document. The ACO defines and establishes airspace for military operations as coordinated by the airspace control authority (ACA).

3.10.1.1.3 Special Instructions/Rules of Engagement. The SPINS may have information about the commander's intent, objectives, ground scheme of maneuver, radio frequencies, code words, airspace info, routing, coordinating instructions, and standard conventional loads (SCL). Ensure all mission preparation falls within parameters of current SPINS and local ROE.

3.10.1.1.4 OPORD. An operation order is a directive issued by a commander to subordinate commanders for the purpose of effecting the coordinated execution of an operation (IAW JP 5-0, *Joint Operation Planning*). Commanders issue OPORDs to direct the execution of long-term operations as well as the execution of discrete short-term operations within the framework of a long-range OPORD.

3.10.1.2 Air Liaison Officer (ALO)/JTAC deliverables include an estimate of what aerospace combat capabilities will be available to support the operation and how to employ these assets appropriately, as well as the capabilities of the JTAC assigned personnel/equipment that will be supporting the operation. At the end of the receipt of mission phase all members of the staff should be familiar with the commander's initial guidance. This includes a thorough understanding of mission time, resources available, authorized movements, any intelligence requirements that need to be satisfied, planning times, locations and any other information requirements that still need to be fulfilled.

3.10.1.2.1 This phase will conclude with the issuing of the first WARNO which will include the type of operation, general location of the operation, initial time line, and any movement or reconnaissance to initiate.

3.10.2 Step 2—Mission Analysis. Commanders (supported by staffs and informed by subordinate and adjacent commanders and by other partners) gather, analyze, and synthesize information to orient themselves on the current conditions of the operational environment. The commander and staff conduct mission analysis to better understand the situation and problem, and identify what-the command must accomplish, when and where-it must be done, and most importantly why-the purpose of the operation.

3.10.2.1 During the mission analysis phase, JTACs must begin to consider the specified, implied, and mission essential tasks. This is done by first considering the commander's initial assessment of the operation and intent, and by considering the concepts of mission, enemy, terrain, troops, time, and civil considerations (METT-TC). Similar to the mission analysis phase, the JTAC must assist other staff officers in developing the overall mission statement and continue to anticipate what aerospace power effects will be required for contributing to the fight based on higher headquarters (HHQ) priority of fires, facts and assumptions, as well as weight of effort decisions.

3.10.2.1.1 JTAC deliverables include a review of assets available to include both kinetic and non-kinetic effects (NKE), risk assessments, commander's critical information requirements (CCIR), ground force time lines and how air assets fit within those time lines, and finally any constraints.

3.10.2.1.1.1 Commander's Critical Information Requirements. Elements of information the commander identifies as being critical to timely decision making. CCIRs help focus information management and help the commander assess the operational environment (OE), validate (or refute) assumptions, identify accomplishment of intermediate objectives, and identify decision points during operations. The CCIR list is normally short so that the staff can focus its efforts and allocate scarce resources.

3.10.2.1.1.2 CAS Decision Points (CDP). Once CCIRs have been communicated, the ALO/JTAC should articulate how these requirements will influence the utilization of joint fires assets. Decisions will be made on where and how to prioritize assets, in order to achieve the GFCs intent throughout all phases of the operation, as well as aid in identifying triggers/criteria for appropriation. Understanding when the ground force commander (GFC) will make key decision points will allow for the appropriate application of joint fires assets both in planning and execution, ultimately resulting in the ability of the GFC to orient forces appropriately.

3.10.2.1.1.3 Priority Information Requirements (PIR). PIRs focus on the adversary and the OE and are tied to commander's decision points. They drive the collection of information by all elements of a command request for national-level intelligence support and requirements for additional intelligence capabilities. All staff sections can recommend potential PIRs believed to meet the commander's guidance. However, the intelligence section has overall staff responsibility for consolidating PIR nominations/providing staff recommendation to the commander.

3.10.2.1.1.4 Friendly Force Information Requirements (FFIR). FFIRs focus on information the commander must have to assess the status of the friendly force and supporting capabilities. All staff sections can recommend potential FFIRs they believe meet the commander's guidance. Commander-approved FFIRs are automatically CCIRs.

3.10.2.1.2 Understanding how NKE (i.e., intelligence surveillance and reconnaissance [ISR]), can answer the CCIR, and other information requirements essential to accomplishing the mission is critical, during this phase. Since the mission analysis phase relies heavily on questions being answered through a variety of intelligence disciplines, JTACs should work closely with both Army and Air Force intelligence sections to determine these requirements, during the initial intelligence preparation of the operational environment (IPOE). Additionally, they should understand what assets are best suited to answer any preliminary questions proposed. **Table 3.2**, Intelligence Disciplines, and **Figure 3.10**, Model for Gaining Intelligence, outline the different intelligence disciplines, as well as model for how intelligence can be gathered.

3.10.2.1.3 A key component of the mission analysis phase is the JTAC's ability to integrate and liaise both with the standard staff functions, as well as with special staff members, that may be assigned only on a temporary basis or until mission completion (i.e., different liaison officers [LNO]). Understanding/knowing how the intelligence cycle works, and how it can be leveraged at the tactical level is extremely important and will form the basis of mission analysis success.

3.10.2.1.4 One important note to consider is that although many of the assets used to gain intelligence across the intelligence disciplines are used to achieve strategic and operational level effects, JTACs should know and understand how to gain access to products. Access is sometimes the most difficult barrier to overcome; however, understanding the joint ISR process will assist them in getting what they need to meet the ground commander's intent.

3.10.3 Task, Collect, Process, Exploit, and Disseminate. In order to integrate with and use the Intel section of any component, it is essential to understand the joint ISR process. This will aid a JTAC in injecting knowledge and expertise to best meet the ground commander's objectives. ***NOTE:*** Typically, targets will fall into one of two general categories: deliberate, and dynamic. **Figure 3.11**, Joint ISR Process: Deliberate Targeting, outlines the task, collect, process, exploit, and disseminate (TCPED) process graphically and demonstrates that it is a continuous process starting and finishing as required.

Table 3.2 Intelligence Disciplines.

GEOINT—Geospatial Intelligence
- Imagery
- IMINT—imagery Intelligence
- Geospatial information

HUMINT—Human Intelligence
- Debriefings
- Interrogation operations
- Source operations

SIGINT—Signals intelligence
- COMINT—communications intelligence
- ELINT—electronic intelligence
    - Technical ELINT
    - Operational ELINT
- FISINT—foreign instrumentation signals intelligence

MASINT—Measurement and Signature Intelligence
- Electromagnetic data
- Radar data
- Radio frequency data
- Geophysical data
- Materials data
- Nuclear radiation data

OSINT—Open-Source Intelligence
- Academia
- Interagency
- Newspapers/periodicals
- Due diligence
- Media broadcasts
- Internet
- Alternative collections

TECHINT—Technical Intelligence
- Weapon system intelligence
- Scientific intelligence

CI—Counterintelligence

Applications
- Biometrics-enabled intelligence
- Forensics-enabled intelligence
- Document and media exploitation
- Identify intelligence

Figure 3.10 Model for Gaining Intelligence.

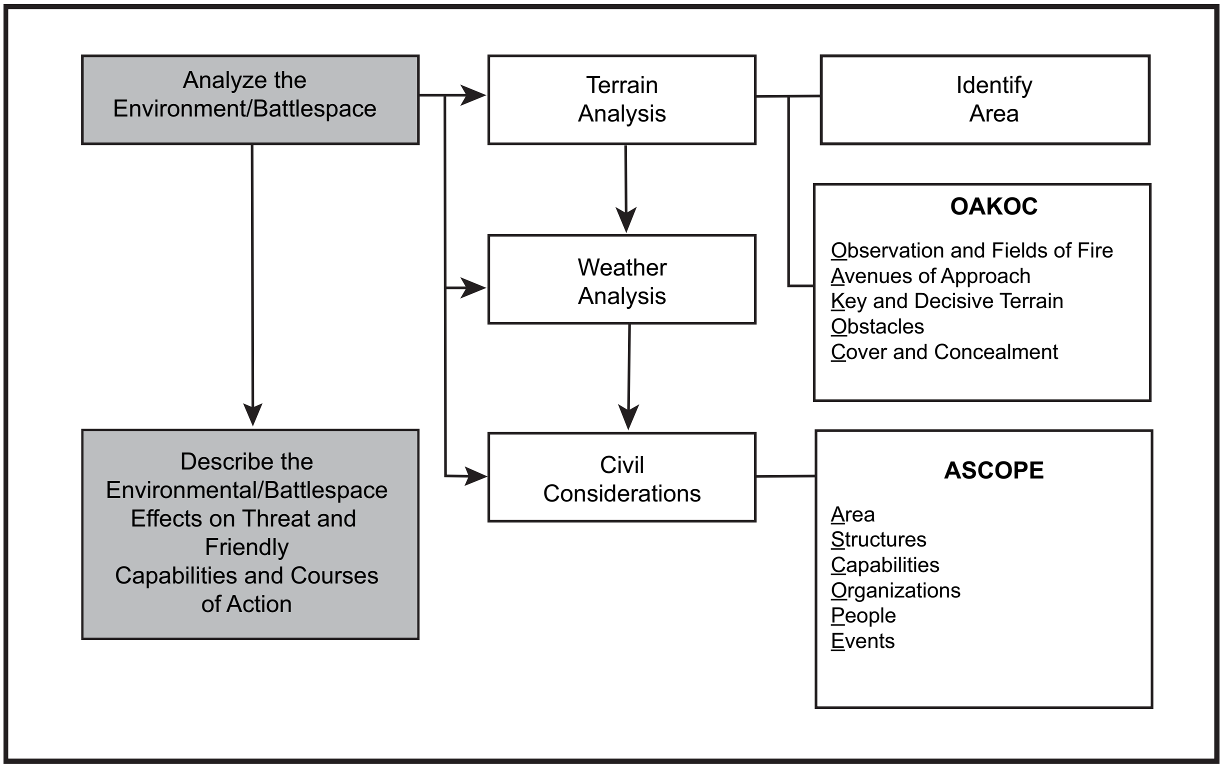
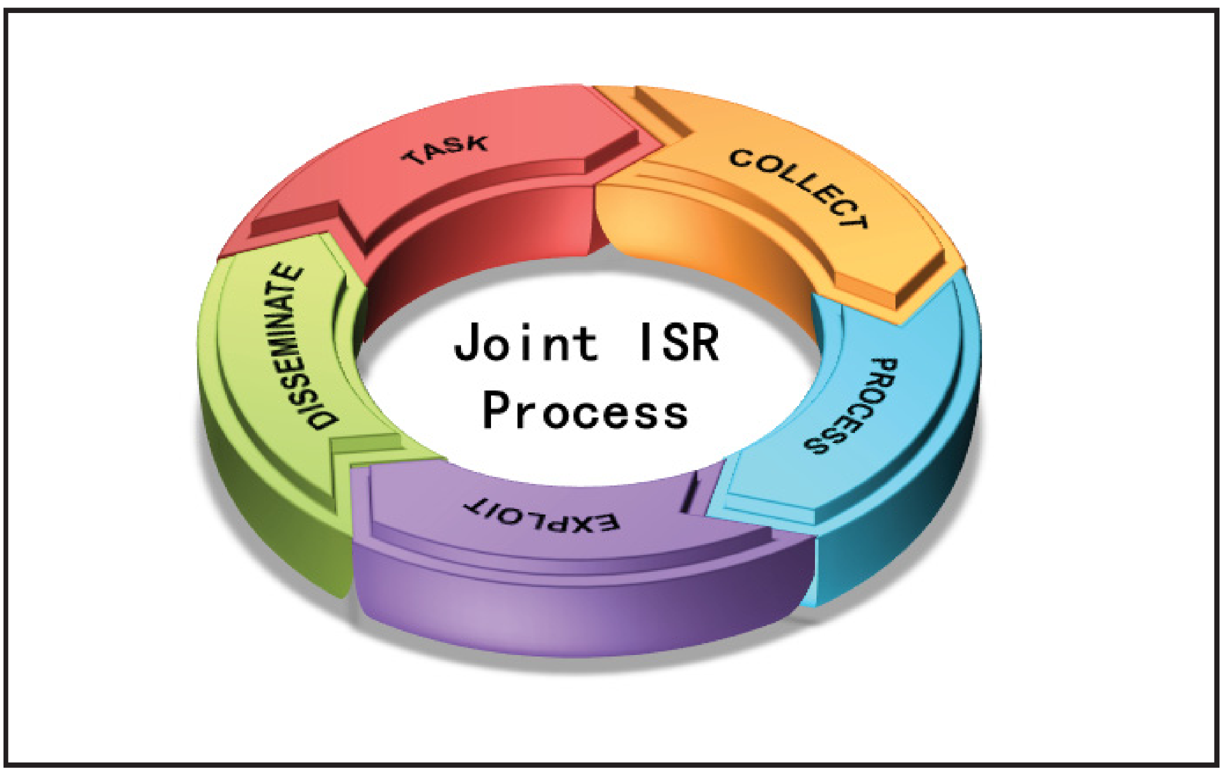


Figure 3.11 Joint ISR Process: Deliberate Targeting.



3.10.3.1 Tasking and Planning. During this phase, requirements and priorities for ISR collection are set based on the number and type of ISR assets available, and the desired end state. Since capabilities are often times limited and vary based on the supported unit-level, it is important to understand and plan for which categories of intelligence are most desired and which will achieve the commander's end state. A standard methodology in determining ISR requirements is by simply using the Five Ws.

3.10.3.2 Collection. The second step includes all the different activities, mainly research, that involves the collection of data to satisfy the requirements that were defined. The collection can be done either via technical or human means and involves gathering data from a variety of sources. In the military and intelligence community the sources normally used are people, objects, emanations, and records. These sources span the different collection disciplines outlined previously in **Table 3.1**, ARSOF Core Activities. Once collected, information is correlated and forwarded for processing and production.

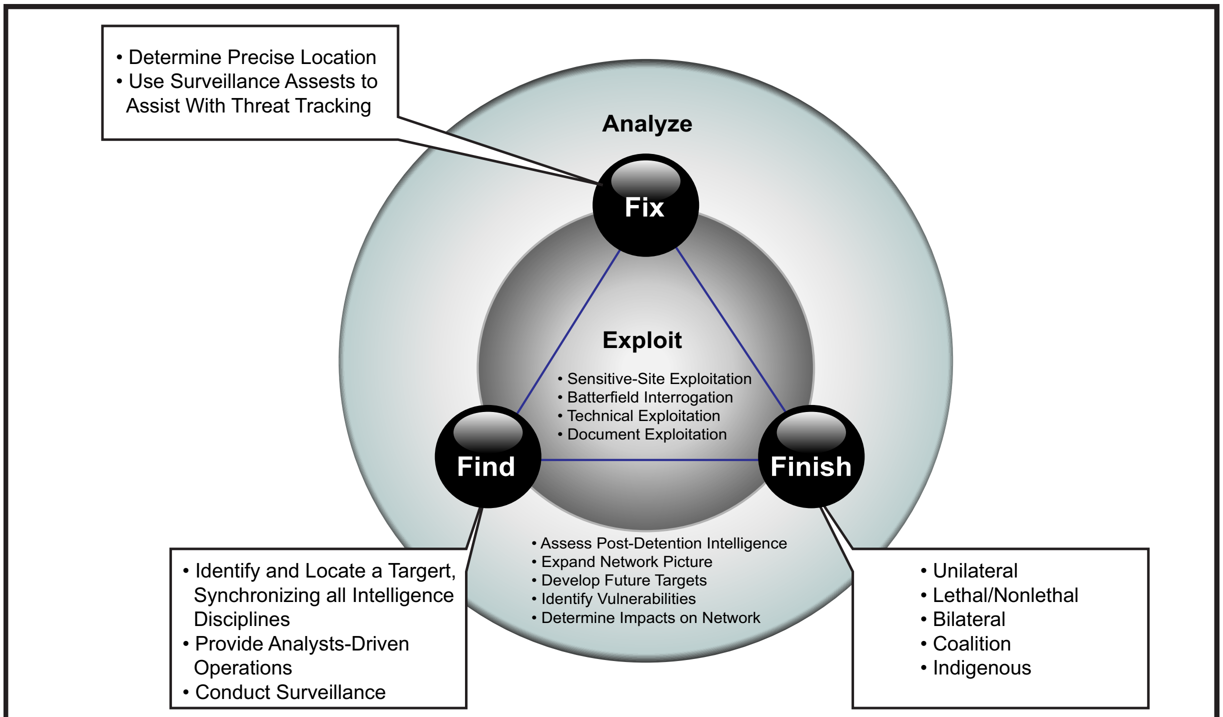
3.10.3.3 Processing and Exploitation. The third step is where the collected raw data starts to be interpreted, translated and converted into a form suitable for the consumers of the intelligence. This raw data eventually becomes information. Depending on the source of the information whether it be airborne ISR or some other means will determine the time it takes for a product to processed or exploited. JTACs should be aware that if they require a specific type of product with additional information added to it the turn-around time will be much longer. However, there will be situations where a simple image will suffice reducing the time from collect to dissemination.

3.10.3.4 Analysis and Production. The refinement of the information that was produced in the previous step is where analysis and production occurs. The fusion of the different information that was processed from the different intelligence disciplines. The analysis consists of facts, findings and forecasts that describe the element of study and allow the estimation and anticipation of events and outcomes. The analysis should be objective, timely, and most importantly accurate. To produce intelligence objectively, the analysts apply four basic types of reasoning. Induction, deduction, abduction and the scientific method. Furthermore, because bias and misperceptions can influence the analysis the analyst should be aware of the different analytical pitfalls. The outcome is value-added actionable information tailored to a specific need.

3.10.3.5 Dissemination and Integration. Essentially, this step consists of delivering the finished product to the consumers who requested the information. This can be done using a wide range of formats in a manual or automated manner.

3.10.4 Dynamic Targeting. Find, Fix, Track, Target, Engage, and Assess (F2T2EA)/Find, Fix, Finish, Exploit, and Analyze (F3EA). Dynamic targeting involves the prosecution of targets that fall into several different categories. This includes time sensitive targets (TST), component critical targets (CCT), ATO scheduled targets whose status has changed in some manner, and emerging targets that the commander deems worthy of targeting during mission execution (JP 3-60 Annex, *Targeting*). **Figure 3.12**, F3EA Process, depicts the F3EA process.

Figure 3.12 F3EA Process.



Find, fix, finish, exploit, and analyze process

3.10.4.1 TST—target or target sets of such high importance to the accomplishment of the mission and objectives, or one that presents such a significant strategic or operational threat to friendly forces or allies, that the commander dedicates intelligence collection, attack assets, and is willing to divert assets away from other targets in order to engage it.

3.10.4.2 Component critical target (CCT)—targets that are considered crucial for success of friendly component commanders' missions, but are not JFC-approved TSTs. Component commanders may nominate targets to the JFC for consideration as TSTs. If not approved as TSTs by the JFC, these CCT may still require dynamic execution with cross-component coordination and assistance in a time-compressed fashion.

3.10.4.2.1 Regardless of the type, dynamic targeting involves the F2T2EA, and applies equally to the application of military capabilities to achieve lethal/non-lethal effects. The decision to employ a capability is based on availability, desired effects, potential consequences, and commander's guidance.

3.10.4.3 Find—involves detection of an emerging target, which various aspects of its characterization will result in it being binned into one of the dynamic targeting categories listed above. The find phase requires clearly designated guidance from commanders, especially concerning target priorities, and the focused ISR collection plan based on IPOE, to include named areas of interest (NAI) and target areas of interest (TAI). Emerging targets usually require further ISR and analysis to develop and confirm. Commanders should not task sensors without an idea of what they may collect. They should anticipate results, not request unfocused detection. The result of the find phase is a potential target that is nominated for further investigation and development in the fix phase.

3.10.4.4 Fix—positively identifies an emerging target as worthy of engagement and determines its position and other data with sufficient fidelity to permit engagement. When the emerging target is detected, sensors are focused upon it to confirm its identity and precise location. This may require implementing a sensor network or diverting ISR assets from other uses to examine it. Target location and other information should be refined enough to permit engagement in accordance with ROE. An estimation of the target's window of vulnerability frames the timeliness required for prosecution and may affect the prioritization of assets and the associated risk assessment. If a target is detected by the aircraft or system that may engage it (e.g., by an armed remotely piloted aircraft, or platform with an advanced targeting pod); this may result in the find and fix phases being completed near-simultaneously, without the need for additional assets.

3.10.4.5 Track—takes a confirmed target and its location, maintaining a continuous track. Sensors should be coordinated to maintain situational awareness and track continuity on targets. Windows of vulnerability should be updated when warranted. This phase may require reprioritization of ISR assets, just as the fix phase may, in order to maintain situational awareness. The track phase results in track continuity and refining the target identification.

3.10.4.6 Target—takes an identified, classified, located, and prioritized target; determines the desired effect and targeting solution against it; and obtains required approval to engage. The selection of assets for a specific target may be based on many factors, such as the location and operational status of ISR and strike assets, support asset availability, weather conditions, ROE, target range, the number and type of missions in progress, available fuel and munitions, the adversary threat, and the accuracy of targeting acquisition data.

3.10.4.7 Engage—identification of the target as hostile is confirmed and engagement is ordered and transmitted to the pilot, aircrew, or operator of the selected weapon system. The engagement orders should be sent to, received by, and understood by the operator of the weapons system. The engagement should be monitored and managed by the engaging component (for the air component, by the air and space operations center [AOC]). The desired result of this phase is successful action against the target.

3.10.4.8 Assess—predetermined assessment requests are measured against actions and desired effects on the target. ISR assets collect information about the engagement according to the collection plan (as modified during dynamic targeting) and attempt to determine whether desired effects and objectives were achieved. In cases of the most fleeting targets, quick assessment may be required in order to make expeditious reattack recommendations.

3.10.4.8.1 JTACs need to understand their role in the F2T2EA process and must always consider the ground force commander's intent and the second and third order effects of striking a target during an operation. They should also understand how the intended target will be struck and whether any additional requirements will need to be met aside from just passing a CAS brief. Coordination with HHQs is crucial when targets are nominated within their AO that are outside of the planning purview. Crucial to any engagement however, is accurate and timely reports regarding to battle damage assessment (BDA) or bomb hit assessment (BHA).

3.10.4.8.2 BDA should be a timely and accurate estimate of damage or degradation resulting from the application of military force, lethal or nonlethal, against a target. BDA is primarily an intelligence responsibility with required inputs and coordination from operations. The purpose of BDA is to determine the effects of target engagement at the target element level, target level, and target system level in order to support reattack recommendations and development of follow-on targets.

3.10.4.8.3 The most critical ingredient for effective BDA is a comprehensive understanding of the supported commander's objectives and how they relate to a specific target. For BDA to be meaningful, the commander's objectives must be observable, measurable, and obtainable. The commander should provide a comprehensive plan, together with intelligence architecture, to support BDA. This plan must synchronize ISR resources and reporting to effectively/efficiently support timely BDA.

3.10.4.8.4 JTACs play a crucial role in BDA reporting because of the ability to control and employ both kinetic and NKE effects on the battlefield. Key to successful BDA reporting is an accurate assessment of what effect was achieved. JTACs should never assume a target was destroyed, delayed, or degraded without knowing specifically what effect was achieved. This may require leveraging other intelligence assets besides CAS specific sensors to determine the specific outcome of either kinetic effects or NKE.

3.10.4.8.5 Bomb Hit Assessment. BHA is an assessment of the military force applied in terms of the weapon system and munitions effectiveness to determine and recommend any required changes to the methodology, tactics, weapon systems, munitions, fusing, and/or delivery parameters to increase force effectiveness. BHA is conducted concurrently and interactively with BDA assessments. BHA answers the question, "Did the systems (i.e., bomb or jamming) employed perform as expected?"

3.10.5 NKE Planning. JTACs should be aware that NKE can have a tremendous impact on the enemy and should be capable of employing these assets across many spectrums/environments. For a more in-depth look at planning and requesting NKE, refer to AFTTP 3-1.JTAC, Electronic Attack Planning and Requesting, Cyberspace Effects and Considerations.

3.10.6 Air Support Operations Center and JAGIC. Another key component that JTACs will have to liaise with during the mission analysis phase will be the air support operation center (ASOC)/Joint air-to-ground integration center (JAGIC). Although not an unfamiliar term to most, the ASOC will be the focal point for gaining insight into the planning and requesting of CAS specific assets and other entities that can be used to support the mission. It is also important to understand the JAGIC and its functions.

3.10.6.1 At the conclusion of this phase JTACs should issue their own WARNO to subordinate JTACs and ensure all participants have read and understand the overall mission statement and their role in the mission. This could be as simple as the JTAC going out on the mission to the JTAC remaining back at HHQ ensuring proper airspace planning has been accomplished incorporating joint fires assets, ensuring freedom of maneuver for all players, submitting requests for assets, and maintaining the vital link between other staff members and accounting for any changes to the plan. JTACs should consult **Table 3.3**, Deliberate Mission Planning Coordination Checklist, and **Table 3.4**, Dynamic MPCC, when planning for each mission depending on the type; deliberate versus dynamic.

3.10.7 Acceptable Level of Risk. ALR is a key aspect of operational limitations. Typically defined in the air operations directive (AOD) or theater SPINS, ALR defines the risk the air component commander is willing to embrace in order to achieve mission success. In most cases, ALR is delivered with some degree of vagueness. The mission commander and package leads determine what threat picture meets or exceed the stated ALR. ALR will vary by mission type and may vary by phase of mission. Since aircraft flight leads are not permitted to violate ALR restrictions, JTACs will often be required to suppress or kill threats prior to attacking the ground force commanders' priority targets. CAS operations will almost always be conducted at ALR low or moderate, see **Table 3.5**, Example ALR.

3.10.8 Step 3—Course of Action Development. COA development is one of the most crucial phases of MDMP and is one of the most time consuming processes that requires critical thinking from the JTAC perspective. An assessment of not only enemy capabilities, but also how aerospace assets are going to be employed will be done during this phase. JTACs must analyze combat power available and weigh individual effectiveness of joint fires platforms against anticipated targets and enemy surface forces. Options should be generated which will be used to develop possible COAs to include: suitability, feasibility, acceptability, distinguishability, and completeness. Typically, there are six steps to the COA Development process—analyze relative combat power, generate options, array initial forces, develop the scheme of maneuver, assign headquarters, and prepare COA statements and sketches.

3.10.8.1 JTACs must continue to refine the best opportunities to use joint fires assets in the most productive manner to include the placement of subordinate JTACs. Things to consider when doing this is what JTAC will be assigned to the main command post, assault command post, and the forward placement of JTACs. They must also assist in the development of engagement areas (EA), TAIs, triggers, objective areas, obstacle plan, movement plan, airspace coordination areas (ACA), contact points (CP), initial points (IP), minimum risk routes (MRR) selections, artillery proposed area of artillery (PAA), restricted operating zones (ROZ), and high density airspace control zones (HIDACZ). A request to update SCLs can also be requested based on specific weapons effects needed. The request process for this will be theatre specific.

3.10.8.2 JTACs should also understand the process of how relative combat power is assessed in order to (IOT) determine the amount of joint fires needed to achieve the GFC's intent. By analyzing force ratios and determining and comparing each force's strengths and weaknesses as a function of combat power, planners can gain insight into the following:

- Friendly capabilities that pertain to the operation.
- The types of operations possible from both friendly and enemy perspectives.
- How and where the enemy may be vulnerable.
- How and where friendly forces are vulnerable.
- Additional resources needed to execute the mission.
- How to allocate existing resources.

Table 3.3 Deliberate Mission Planning Coordination Checklist (1 of 4).

<table>
<tr><th colspan="3">S-2/ISRLO/Allocation or Collection Manager</th></tr>
<tr><td colspan="2">LRS Teams</td><td></td></tr>
<tr><td colspan="2">Unit, size, location, call sign, frequency, capabilities</td><td>Weather</td></tr>
<tr><td colspan="2">Availability of ISR</td><td>Ceiling/visibility, surface winds, twilight hours/ illumination/thermal</td></tr>
<tr><td colspan="2">Platform, call sign, frequency, playtime, ordnance, codes, lost-link route. Develop what phase for the JTAC to take control (if needed). Develop a sensor plan. Develop a squirter, mover, sparkle plan by phase.</td><td>Atmosphere</td></tr>
<tr><td colspan="2">National/strategic ISR available?</td><td>Surface-to-air threats (known/suspected)</td></tr>
<tr><td colspan="2">NAIs/TAIs?</td><td>Refer to AFTTP 3-1.Threat Guide</td></tr>
<tr><td colspan="2">Enemy Order of Battle</td><td>Shot doctrine, reload time, reload capability</td></tr>
<tr><td colspan="2">SALT: type of unit and enemy support assets</td><td>Autonomous or integrated</td></tr>
<tr><td colspan="2">Protection</td><td>Status of IADS: degraded or operational</td></tr>
<tr><td colspan="2">Capabilities (CDO)</td><td>Typical spacing/employment</td></tr>
<tr><td colspan="2">Assessed vulnerabilities</td><td>Frequency movements</td></tr>
<tr><td colspan="2">MLCOA/MDCOA develop contingencies</td><td>Air-to-air threats</td></tr>
<tr><td colspan="2">OCOKA analysis</td><td>Assessed air-to-air threat</td></tr>
<tr><td colspan="2">Identify and confirm observation and fields of fire</td><td>CDE/historical or cultural sites</td></tr>
<tr><td colspan="2">Identify and confirm cover and concealment</td><td>Request CDE reference chart (also refer to AFTTP 3-1.JTAC, Chapter 4, “Weaponeering.”</td></tr>
<tr><td colspan="2">Identify and confirm obstacles (natural and man-made)</td><td>Civilian/noncombatant activity</td></tr>
<tr><td colspan="2">Identify and confirm key or decisive terrain</td><td>BDA/SSE/EEI requirements</td></tr>
<tr><td colspan="2">Identify and confirm avenues of approach</td><td>Review or develop GRG/graphics complete</td></tr>
<tr><th colspan="3">S-6</th></tr>
<tr><td colspan="2">Crypto needs (LOS, SAT, SINCGARS, SADL, ANW2, DAGR, FBCB2</td><td>Provide JTACT developed CAS/fires PACE plan</td></tr>
<tr><td colspan="2">Request or fill Army COMM PACE Plan</td><td>JRFL protect and guarded frequency list</td></tr>
<tr><th>EWO</th><th>Call Sign</th><th>Frequency</th></tr>
<tr><td colspan="2" rowspan="4">Availability of assets. Verify a request has been submitted (if not, fill out an ERF with the EWO to submit).
Platform, call sign, frequency, capabilities, on-station time, effects provided (deny/disrupt/collect/deceive locate)</td><td>Nonlethal SEAD (known threat location provided/standoff distance.</td></tr>
<tr><td>Effects deconfliction</td></tr>
<tr><td>Friendly communication frequencies have been listed</td></tr>
<tr><td>Review JPEL/request RAPPER cards</td></tr>
</table>

Table 3.3 Deliberate Mission Planning Coordination Checklist (2 of 4).

SPACELO		
Effects on communications (HF/SATCOM)		Effects on GPS. Enemy jamming/ atmospherics/countermeasures
ADA/ADAM		
Weapon status		Location of ADA weapons and radars
Provide number/type/ALT/route/CP/IPs/TOT/Mode/Code (if not published)		Confirmed published, if not, provide to EWO/HARM shooters
FSE	**Call Sign**	**Frequency**
Surface-to-surface fires		Preplanned CAS requests (submitted)
Call sign frequency		FSCMs
Direct or general support? Priority of fires?		(FSCL, CFL, RFA, NFA, RFL)
Location/composition/status		Observer plan
Ammo type/number (RAP/Excal/DPICM/FASCAM RAM/ADAM)		PACE, observer line-up information
Rates of fire, suppression rounds/amount of guns		Location of counter-fire radars
TOT time line delays (fire to shot radio delay, etc.)		Provide to EWO/HARM shooters
Higher asset availability (surface missiles, larger artillery)		Counter-fire
Preplanned TGTs/TRPs		Friendly displacement plan/down time
JFOs (1st SGT or PLT SGT)		Counter-fire radar response time/grid category
Location, frequency, call sign		Request target list worksheet
Equipment, training, experience		Request No-Strike list
Aviation/LNO/S-3 AIR/BAE	**Call Sign**	**Frequency**
ACAs		Gas planning
Coordinating altitude/level		TOT
MRRs/ROZs		FARP/FARRP location and security
SUAS procedures/deconfliction		Refueling times? With/without rearming?
Attack rotary-wing assets		Response time and routes
Platform call sign, frequency, capabilities		Gaps in coverage? (Consider FW tanker times)
How is RW tasked to support? Develop task and purpose		MEDEVAC/CASEVAC
On-station time, ordnance, VDL/laser codes		Platform, call sign, frequency, capabilities
Request or develop CPs/BPs/HAs. Confirm holding levels/response times		Response time and routes/holding levels and times
Assault zones and lift		Times to medical facilities/trauma levels
LZ/PZ/DZ locations. Develop hasty HLZs. Confirm holding levels and response times		Able to support a MASCAL

Table 3.3 Deliberate Mission Planning Coordination Checklist (3 of 4).

Aviation/LNO/S-3 AIR/BAE	Call Sign	Frequency
Brief Cherry/Ice criteria/escort		Brown/white-out contingency plans
Supporting assets/surveys, etc.		RWs ICS plug-in capable/available
Exfil/evac aircraft brief		
ACL/payload planning (See "THE 7" below)		
HLZ Party Plan		
ALO	**Call Sign**	**Frequency**
Available A/C/requests/JAGIC coord		Verify GLO coordination/products have been accomplished
Number/type/POS/ALT/MSN Number/ORD/VDL/laser		FAC(A) coordination
Follow-on CAS requests		Are they available to attend mission planning or rehearsal?
Number/type/POS/ALT/MSN Number/ORD/VDL/laser		Mission assigned FAC(A) or just FAC(A) qualified?
Cross boundary airspace coordination		What are the FAC(A) assigned duties?
1972 submitted (IMM/preplanned)		DACAS
ATO/ACO availability		JU number/mission planner/Link 16/ SADL/VMF
Confirm requests in ATO/ACAs in ACO		Tanker availability/tracks location
SPINS ALR (low, medium, high), confirm for mission		Air-to-air support
Review overall, weekly, daily SPINS (have the discussion with the ALO about ALR/airspace problems)		OCA/Defensive Counter Air (DCA)/SEAD/CAPS
1 SGT/PL SGT - "The 7"	**Call Sign**	**Frequency**
"Trip Ticket"		SOPs/develop MEDEVAC/CASEVAC plan/HLZs
Load Plan		IFAK/Medical configurations
Bump Plan		Smoke SOPs
Assault Marking Plan		IR strobe/sparkle SOPs
		Review HLZ plans and markings
S-3		
Call Sign		**Frequency**
Requests GGC CCIRs/scheme of maneuver/commands call sign and frequency		QRF
Time or event driven operation		Unit, call sign, frequency, capabilities
What phase or time will FEBA/FLOT change		Response time, infil platform
Min force by phase and effect needed (sensors/kinetic/NKE)		Cross boundary fires

Table 3.3 Deliberate Mission Planning Coordination Checklist (4 of 4).

S-3	
Call Sign	**Frequency**
Confirm priority unit	Battlespace owner (BSO) coord
Exfil criteria/follow-on missions possibilities	Commands call sign/frequency
Last cover and concealment/fallbacks/VDO/ORP	Approval process
Friendly positions not briefed or planned to change from OPORD	Adjacent unit missions
Unit, call sign, frequency, capabilities	How do they effect the AOS mission?
Ground DF capability?	Preparation of battlefield/engineers/EOD
Other friendly forces (OGA/SOF)	Obstacles/minefields
Unit, call sign, frequency, capabilities	Time to clear/emplace obstacles/bridges or runway repairs
In support of the mission? (If not, how does their mission effect ours?)	Route status, IED threat, RCP SALT
Ground Force Commander Tactical Risk Assessment (TRA)	
Reconfirm CCIRs	Airborne sparkle status
State mission objectives/intent	Integration of Fires
State intent for CAS	The use of kinetic marks/illumination
Identify unit with priority of fire	Friendly battle tracking plan Suppressive/containment fires
Provide the best joint fires solution/options to tactical problems identified during mission coordination. Identify potential friction points and how they can be mitigated or resolved. The list to the right are a few examples of friction areas.	Ordnance restrictions (how to mitigate weapons effects) CBU/DPICM/FASCAM use FAC(A) delegation How the ATO fragged FAC(A) is employed How a non-ATO fragged FAC(A) can be used Reactive fire power safety/risk mitigation Reactive HARMs safety/risk mitigation ROE/CDE considerations/mitigation
LEGEND: A/C—aircraft ACL—aircraft load DCA—Defensive Counter Air DPICM—dual purpose improved conventional munition EOD—explosive ordnance disposal FARP—forward area refuel point FARRP—forward arming and refueling point FASCAM—family of scatterable mines	FCB2—Force XXII Battle Command Brigade and Below FEBA—forward edge of the battle area IFAC—individual first aid kit JPEL—Joint Prioritized Effects List JRFL—Joint Restricted Frequency List ORP—objective rally point SSE—sensitive site exploitation SUAS—small unmanned aircraft system

Table 3.4 Dynamic MPCC (1 of 2).

S-2/ISRLO/Allocation or Collection Manager		
Availability of ISR		Surface-to-air threats (known/suspected)
Platform, call sign, frequency, playtime, ordnance, codes, lost-link route		
Enemy order of battle		Capabilities (CDO)
SALT: Type of unit and enemy support assets		Protection
MILCOA/MDCOA develop contingencies		Assessed vulnerabilities
FSE	**Call Sign**	**Frequency**
Surface-to-surface fires	Call sign, frequency	FSCMs
Direct or general support? Priority of fires?		FSCL, CFL, RFA, NFA, RFL
Location/composition/status		Observer plan
Ammo type/number (RAP/Excal/DPICM/FASCAM RAM/ADAM)		PACE, observer line-up
Higher asset availability (surface missiles, larger artillery)		Location of counter-fire radars
Preplanned TGTs/TRPs		Counter-fire
JFOs (1st SGT or PLT SGT)		Request Target List Worksheet
Location, frequency, call sign		Request No-Strike List
ALO	**Call Sign**	**Frequency**
Available A/C/requests/JAGIC coord		ATO/ACO availability
Number/type/POS/ALT/MSN Number/ORD/VDL/laser		Confirm requests in ATO, ACAs
Cross boundary airspace coordination		Review overall, weekly, daily
1972 submitted (IMM/preplanned)		
Aviation/LNO/S-3 Air/BAE	**Call Sign**	**Frequency**
ACAs		
Attack rotary-wing assets	Platform call sign, frequency	MEDEVAC/CASEVAC
S-3		
ALO	**Call Sign**	**Frequency**
Requests GFC CCIRs/scheme of maneuver/commands call sign and frequency		QRF
Time or event driven operations		Unit, call sign, frequency, capabilities
What phase or time will FEBA/FLOT change		Response time, infil platform
Min force by phase and effect needed (sensors/kinetic/NKE)		Cross boundary fires
Confirm priority units		Battlespace owner (BOS) coord
Exfil criteria/follow-on mission possibilities		Commands call sign, frequency
Last cover and concealment/fallbacks/VDO/ORP		Approval process
Friendly positions not briefed or planned to change from OPORD		Adjacent unit missions

Table 3.4 Dynamic MPCC (2 of 2).

S-3		
ALO	**Call Sign**	**Frequency**
Unit, call sign, frequency, capabilities		How do they effect the AOS mission?
Ground DF capability?		Preparation of battlefield/engineers/EOD
Other friendly forces (OGA/SOF)		Obstacles/minefields
Unit, call sign, frequency, capabilities		Time to clear/emplace obstacles/bridge or runway repairs
In support of the mission? (If not, how does their mission effect ours?)		Route status, IED threat, RCP SALT
Ground Force Commander Tactical Risk Assessment (TRA)		
Reconfirm CCIRs		Airborne sparkle status
State mission objectives/intent		Integration of Fires
State intent for CAS		The use of kinetic marks/illumination
Identify unit with priority of fire		Friendly battle tracking plan Suppressive/containment fires
Provide the best joint fires solutions/options to tactical problems		Ordnance restrictions (hot to mitigate weapons effects)
Provide the best joint fires solutions/options to tactical problems identified during mission coordination. Identify potential friction points and how they can be mitigated or resolved.		FAC(A) delegation
ROE/CDE considerations/mitigations		How the ATO fragged FAC(A) is employed

Table 3.5 Example ALR.

ALR Level	Definition	Tactics, Techniques, and Procedures
Low	ALR Low is a tool for extended contingencies where there is a remote potential for aircraft loss or damage and/or injury to forces due to hostile actions.	Avoid a known factor threat by anchoring off of a specific IP.
Moderate	ALR Moderate is a tool for a protracted interdiction campaign where there is a remote to highly improbable chance for aircraft loss or damage and/or injury to forces due to hostile actions. Loss rates must be managed to ensure the campaign/capability is sustainable over several months.	Factor threat neutralized by HIMARs prior to A/C entering WEZs with confirmed BHA with high confidence that no other factor threats in the area.
Significant	ALR Significant is used when there is a highly improbable to roughly even chance for aircraft loss or damage and/or injury to forces due to hostile actions. It is used when the CFACC is willing to accept substantial losses to achieve an objective, but wants to ensure that additional assets can be brought into theater via time-phased force deployment data (TPFDD) flow or allow a full tasking order cycle to execute before the initial unit is rendered combat ineffective. The CFACC also has the option to slow the operations tempo or reduce ALR in subsequent ATOs before the unit is rendered unfit for combat.	Factor threat suppressed by artillery while A/C enters the WEZ.
High	ALR High is used when there is a probable chance for aircraft loss or damage and/or injury to forces due to hostile actions. It is used when the CFACC is willing to accept major losses to achieve an objective, but wants to ensure that combat power can be sustained throughout the ATO day or tasking order period. This allows the mission commander or COD to realistically "abort" the operation and reduce some losses before force annihilation occurs, or preserve some combat power so the unit can be withdrawn and eventually reconstituted. This implies that disadvantageous engagements are acceptable so long as the probability of success remains reasonable.	Approving a strike on a strategic target within a WEZ with disruption.
Extreme	ALR Extreme is used when there is a highly probable to nearly certain chance for aircraft loss or damage and/or injury to forces due to hostile actions. It is used when the CFACC is willing to accept any losses to achieve an objective, to include accepting force annihilation within a single sortie. An example of this loss rate is the WWII Doolittle Raider strike, where all 16 aircraft were lost, although most crew survived. It is important to note that even if ALR Extreme is authorized, mission commanders are responsible for committing forces only if some probability of success exists.	Approving a strike on a strategic target within a WEZ without disruption.

LEGEND:
HIMAR—high mobility artillery rocket system

3.10.8.3 After determining the decisive/shaping operations and related tasks and purposes, planners determine the relative combat power required to accomplish each task. For Historical minimum planning ratios, see **Table 3.6**, Historical Minimum Planning Ratios.

Table 3.6 Historical Minimum Planning Ratios.

Friendly Mission	Position	Friendly: Enemy
Delay		1:6
Defend	Prepared or fortified	1:3
Defend	Hasty	1:2.5
Attack	Prepared or fortified	3:1
Attack	Hasty	2.5:1
Counterattack	Flank	1:1

3.10.8.4 Deliverables include the JTAC portion of the observation plan, employment plan, communications plan, and evaluation of JTAC personnel and equipment capabilities and limitations. A thorough risk assessment should be accomplished during this phase as well. JTACs should also prepare the initial Joint Theatre Air Request (JTAR) and make sure that personnel supporting the mission have current maps and overlays. If JTACs are to be deployed forward, HHQ should consider the appropriate insertion plan, force protection, destination, resupply plan, and extraction plan. See **Figure 3.13**, DD Form 1972 How To, for how to fill out a JTAR, **Figure 3.14**, Sample Request Number, for a Sample Request Number, and **Figure 3.15**, Sample DD Form 1972 JTAR, for a Sample DD Form 1972.

NOTE: The table should be read as follows: Klaxon this is Exterminator 17, Request Number FXEBG01, Line 2, immediate, circle Charlie, write ONE. Line 3, circle Alpha, write 25, circle Echo, write ZSU 23-4/S-60, circle India, write REINFORCED. Line 4, circle Alpha, write 39S MK 43800 38400, circle Echo write 3805, circle Foxtrot, write FTWABMB, circle Golf, write Q7015, circle Hotel, write 35503. Line 5, circle Charlie, write 191730ZFEB14, circle Delta, write 192030ZFEB14. Line 6, circle Alpha, write BEST, circle Charlie write F-Kill.

3.10.9 Observation Point. When considering observation point (OP) locations and placement of forward observers and/or JTACs planners should consider purpose, location, observer call sign, triggers, communications, and any additional remarks (PLOTCR).

3.10.9.1 Purpose—identify what is the intended purpose of placing a JTAC or joint forward observer (JFO) in a particular location; does doing so enhances the friendly force's ability to accomplish a specific task/requirement to meet the GFC's intent.

3.10.9.2 Location—where is the most suitable location for the JTAC/JFO to be placed that will allow for clear line of sight (LOS) to anticipated enemy avenues of approach as well as facilitate LOS and/or beyond-line-of-sight (BLOS) communications; consider most likely avenues of approach for the enemy, as well as the most likely course of action (MLCOA) and most dangerous course of action (MDCOA).

Figure 3.13 DD Form 1972 How To (1 of 4).

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			

Line 1 – UNIT CALLED: This line identifies the HHQ (typically the ASOC) who will be receiving the air support request. This call sign designation is typically dictated by theater level SPINS.

THIS IS: This is the JTAC/Fires Element who authored the request. Call-signs again are dictated by theater level SPINS and denotes where the request is coming from.

REQUEST NUMBER: Alphanumeric identifier that denotes the type of request being sent, the unit sending the request, the day for which the request is for as well as the request number sequence. For example a request ending in 01 denotes the first request of the day for the unit requesting support. This number will typically go from 01-99. For immediate requests the alphanumeric identifier may change slightly and will be SPINS directed

SENT: Indicates the time at which the request was authored and who transmitted the request.

LINE 2- PREPLANNED: Requests submission is made within the ATO cycle and meets pre-planned criteria i.e. outside of 72 hours; sent via supported units fires channels. If it does not fall within the 72 hour planning cycle it would be sent as an immediate directly through ASOC channels.

PRECEDENCE: Stated numerically in descending order of importance, as determined by the requesting unit.

PRIORITY: For pre-planned requests, requester will indicate the priority level; 1- Emergency, 2- Priority, 3- Routine. For Immediate requests enter the priority in Block C. A precedence entry (1-3) is not required for immediate requests since it is assumed that all immediate requests are precedence 1. When multiple Immediate requests are sent a precedence number can be used. In doing so follow these rules when assigning numbers: 1 (Emergency) - Targets require immediate action and supersede all other categories of mission priority; 2 (Priority) - Targets that require immediate action and supersede routine targets; 3 (Routine) – Targets of opportunity – do not demand urgency in execution

Line 3- Target Is / Number Of: This section describes the type, size, and mobility of the targets to be attacked. It is necessary to specify, even if the estimate is not exact. Otherwise planners cannot accurately determine what ordnance and aircraft to support.

3.10.9.3 Observer—ensure all supporting assets have received the call sign and placement of the JTAC/JFO pushed forward.

3.10.9.4 Triggers—identify what triggers, if any, have been identified that would cause the forward JTAC/JFO to either control a specific asset or request additional assets to support. Ensure that any contracts are clearly articulated to supporting assets during the rehearsal.

3.10.9.5 Communications—ensure that a communications plan has been developed for the forward JTAC/JFO, as well as any specific HHQ reporting criteria. Planners should consider LOS, as well as BLOS communications.

3.10.9.6 Remarks—any additional data that planners would deem necessary and is pertinent to all applicable supporting elements/assets.

NOTE: If JTACs are not going to be deployed forward, a reliable communications plan should include frequency, net ID and call sign for all adjacent units and locations. Digital systems such as Link 16 should be leveraged. This will enable JTACs to communicate directly with these elements.

Figure 3.13 DD Form 1972 How To (2 of 4).

					CHECKED
4.	TARGET LOCATION IS				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				

Line 4 – TARGET LOCATION IS: Locates the target by using MGRS prescribed for that area of concern.

BLOCK A – Location of either a point target, or the starting point of a sequence of targets i.e. Routes, area targets etc.
BLOCK B – When used together with BLOCK A it provides from A to B coordinates.
BLOCK C – When used in conjunction with A & B it provides a route.
BLOCK D – When used together with A through C, provides the location of either a route or an area target.
BLOCK E – Target elevation in feet MSL
BLOCK F – Provides the sheet number for the map being utilized.
BLOCK G – Provides the series number of the map being utilized.
BLOCK H – Provides the chart number of the map being utilized.

Line 5 – TARGET TIME/DATE: Indicates the time/date when the air strike is requested

BLOCK A – As soon as possible; requester does not specify a specific time rather the earliest an asset is available.
BLOCK B – The target is to be attacked before, but not later than the time indicated.
BLOCK C – Indicates the time at which the target is to be attacked
BLOCK D – Denotes end of period of time in which support such as airborne alert or column cover is required. When used, NLT and AT are not necessary .

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.

BLOCK A – Indicates the ordnance needed to achieve a desired result.
BLOCK B – Destroy
BLOCK C – Neutralize
BLOCK D – Harass/Interdict

Line 7 – FINAL CONTROL: Identifies the final controller (JTAC, FAC-A) who will conduct the briefing and control the release of ordnance.

BLOCK A – Transmit the type of terminal control.
BLOCK B – Call-sign of the terminal controller.
BLOCK C – Recommended TAD frequency.
BLOCK D – 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 final control.

8. REMARKS

T-E-F-A-C-H-R

Line 8 – REMARKS: Allows the requestor to pass other information that is not already included elsewhere in the request. When submitting a JTAR, the JTAC or requesting agency will provide a current situation update to the ASOC/DASC. In most situations, theater specific SPINS will dictate what will be included in the REMARKS section. In the absence of specific instructions the requestor can include the CAS brief to be utilized for the attack, or a situation update utilizing either T-T-F-A-C-O-R-L-H or T-E-F-A-C-H-R. In either case the JTAC should take extra steps to be as detailed as possible especially when the request meets the pre-planned cycle described earlier.

Figure 3.13 DD Form 1972 How To (3 of 4).

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)

Line 9 – NSFS: If utilized place any Naval fire support coordination information in this block.
Line 10 – ARTY: If utilized place any Artillery support coordination information in this block.
Line 11 – AIO/G-2/G-3: Air Intelligence Officer, G-2, G-3, or other service equivalent coordination information.
Line 12 – REQUEST: Indicates whether the request has been approved or denied.
Line 13 – BY: Indicates the individual who either approved or denied the request.
Line 14 – REASON FOR DISAPPROVAL: Indicates to the requester why the request was denied.
Line 15 – RESTRICTIVE FIRE/AIR PLAN: The ACA establishes airspace that is reasonably safe from friendly surface-delivered fires. The ACA provides a warning to aircrew of the parameters of surface-delivered fire in a specific area. A plan number or code name is issued when 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 and end points of the ACA's centerline.
Line 18 – WIDTH (Meters): Defines ACA width on either side from the centerline.
Line 19 – ALTITUDE/VERTEX: ACA altitude given in feet MSL.

Figure 3.13 DD Form 1972 How To (4 of 4).

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)/TAC(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 4/LOCATION	
LINE 2/MSN NUMBER		LINE 5/TOT	
LINE 3/REQ NUMBER		LINE 6/RESULTS	
		REMARKS	*TRANSMIT AS APPROPRIATE

Line 20 – MISSION NUMBER: Mission number of the aircraft/platform supporting the request.
Line 21 – CALLSIGN: Callsign of the aircraft/platform supporting the request
Line 22 – NO. AND TYPE OF AIRCRAFT: Self Explanatory.
Line 23 – ORDNANCE: Type of ordnance either by code 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 – CONTROL POINT (Coords): The farthest limit of the attack aircraft's route of flight prior to control by JTAC/FAC-A.
Line 27 – ISINITIAL CONTACT: Indicates the initial control agency the flight is to contact.
Line 28 – JTAC/FAC-A/TAC-A CALLSIGN/FREQ: Callsign and frequency of the final control agency.
Line 29 – AIRSPACE COORDINATION AREA: Refer to lines 15 through 19 for this data.
Line 30 – TARGET DESCRIPTION: Self explanatory.
Line 31 – TARGET COORD/ELEV: Self explanatory.
Line 32 – BDA REPORT: This optional space is used to record BDA for each mission.

Figure 3.14 Sample Request Number.

1st Character:	
1	CAS Immediate
2	CAS Preplanned
3	Interdiction
4	Reece Immediate
5	Other (EW, MC-130, etc)
6	Airlift Immediate
7	Airlift Preplanned
8	Recce Preplanned

3rd & 4th Character:
Zulu day for TOT

5th & 6th Character:
Request sequence number (01-99)

2nd Character:		
A	82 Abn	(14ASOS)
B	3 ID	(15 ASOS)
C	101 Abn	(19ASOS)
D	10 Mtn	(20ASOS)
E	4/10 Mtn	(DET 1, 20ASOS)
F	3 SFG	
G	5 SFG	
H	7 SFG	
I	75 RGR	
J	160 SOAR	
K	18 Corps TACP	
L	18 Corps AVN Bde	
M	Other 18 ASOG TACPs	
N	As Assigned	
O	As Assigned	
P	As Assigned	
Q	As Assigned	
R	As Assigned	
S	As Assigned	
T	Army Component Cmd	
U	Air Force Component Cmd	
V	Navy Component Cmd	
W	Marine Component Cmd	
X	Special Ops Component Cmd	
Y	Spare	
Z	Spare	

7th Character:

Mandatory (A-Z) designator for further ID

A	1st Bde
B	2nd Bde
C	3rd Bde
D	AVN Bde
E	1 Bn/ 1st Bde
F	2 Bn/ 1st Bde
G	3 Bn/ 1st Bde
H	Avn BN/Sq
I	2 Bn/ 2nd Bde
J	3 Bn/ 2nd Bde
K	1 Bn/ 3rd Bde
L	2 Bn/ 3rd Bde
M	3 Bn/ 3rd Bde
N	1 Bn/ 2nd Bde
O	Armor Bn (Separate)
P	Main CP
Q	TAC/ACP
R	Rear
S	Other Bde
T	1 Bn/75 Rgr Regt
U	2 Bn/75 Rgr Regt
V	3 Bn/75 Rgr Regt
W,X,Y	Spares
Z	7th Character filler
Z	7th Character filler

Bde/Bn can be used interchangeably with Regt/Sq

Figure 3.15 Sample DD Form 1972 JTAR.

JOINT TACTICAL AIR STRIKE REQUEST — See Joint Pub 3-09 for instructions for preparation

SECTION I - MISSION REQUEST — DATE 13032014

1. UNIT CALLED	THIS IS	REQUEST NUMBER	SENT	
KLAXON	EXTERMINATOR 17	FXEBG01	TIME 2000	BY SSGT DOE

2.			RECEIVED	
PREPLANNED: / IMMEDIATE: X	A. PRECEDENCE / C. PRIORITY 1	B. PRIORITY:	TIME	BY

3. TARGET IS / NUMBER OF

A. PERS IN OPEN 25	B. PERS DUG IN	C. WPNS/MG/RR/AT	D. MORTARS/ARTY
E. AAA/ADA ZSU-23-4 / S-60	F. RKTS/MISSILES	G. ARMOR	H. VEHICLES
I. BLDG REINFORCED	J. BRIDGES	K. PILLBOXS/BUNKERS	L. SUPPLIES/EQUIP
M. CENTER (CP/COM)	N. AREA	O. ROUTE	P. MOVING N S E W

Q. REMARKS:

4. TARGET LOCATION IS — CHECK BY:

A. 39S MK 43800 38400 (COORDINATES)	B. (COORDINATES)	C. (COORDINATES)	D. (COORDINATES)
E. ELEVATION 3805	F. SHEET NO. FTWABMB	G. SERIES Q7015	H. CHART NO. 35503

5. TARGET TIME/DATE

A. ASAP	B. NLT	C. AT: 191730ZFEB14	D. TO: 192030ZFEB14

6. DESIRED ORDNANCE/RESULTS

A. ORDNANCE BEST	B. DESTROY	C. NEUTRALIZE F-KILL	D. HARASS/INTERDICT

7. FINAL CONTROL

A. JTAC/TYPE CONTROL: 1/2/3 B. CALL SIGN: ER 69 C. FREQ: PLUM 45

D. CONTROL POINT: 39S MK 15100 25400

8. REMARKS: (Situation Update -#, Situation update, Airspace Update, Map Datum;) Reference JPUB 3-09.3 Fig. A-3

T: ZSU 23-4/ S-60 IVO TGT LOC.
E: ENEMY FIGHTERS STRONG POINT IN URBAN TOWN IN DEFENSIVE POSTURE
F: B Co CONDUCTS CLEARANCE OF ENEMY FORCES IVO GOTHAM CITY
A: D Co ESTABLISH MFP AT 39S MK 431 370
C: EXTERMINATOR 69
H: POSSIBLE CIVILIAN AIR TRAFFIC TO THE WEST
R: NFA HOSPITAL (39S MK 43725 38001)

SECTION II - COORDINATION

9. NSFS	10 ARTY	11 AIO/G2/G3
12. REQUEST ☐ APPROVED ☐ DISAPPROVED	13. BY	14. REASON FOR DISSAPPROVAL

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 B. TO
18. WIDTH (METERS)
19. ALTITUDE/VERTEX — A. (MAX VERTEX) B. (MINIMUM)

SECTION III - MISSION DATA

20 MISSION NUMBER	21 CALL SIGN	22 NO. & TYPE AIRCRAFT	23 ORDNANCE
24 EST/ACT TAKEOFF	25 EST TOT	26 CONT PT (COORDS)	27 INITIAL CONTACT
28 FAC/TAC(A) CALLSIGN/FREQ	29 ACA	30 TGT DESCRIPTION	31 TGT COORDINATION/ELEV*

32. BATTLE DAMAGE ASSESSMENT (BDA) REPORT (USMTF INFLTREP)

LINE 1/CALLSIGN LINE 4/LOCATION *TRANSMIT AS APPROPRIATE
LINE 2/MSN NUMBER LINE 5/TOT
LINE 3/REQ NUMBER LINE 6/RESULTS
REMARKS

3.10.9.7 Forward Air Controller-Airborne (FAC[A]) Planning Integration. Once it has been identified that a FAC(A) will be tasked to support the JTAC's mission, the JTAC should begin integrating the FAC(A) into the planning process as early as possible, so the FAC(A) has the highest amount of SA. Integrating FAC(A) into MDMP can pay huge dividends specifically during certain phases of the planning process. During COA development the FAC(A) can provide additional expertise when developing ACMs and FSCMs in order to meet the GFC's intent as well as helping develop the fire support plan.

3.10.9.8 During the COA Analysis phase, FAC(A)s can help refine specific fire support tasks (FST), more specifically the method in which each FST will be achieved. During COA Comparison a FAC(A) can be leveraged to provide airpower specific information as well as additional recommendations for the employment of airpower effects. The FAC(A) can also point out any strengths and weaknesses of each COA from an air component perspective.

3.10.9.9 Every effort should be made to include the FAC(A) into any rehearsals that occur, but when the environment precludes doing so, JTACs should at least contact the supporting FAC(A) prior to and discuss any contracts or inputs the FAC(A) may have. The overall goal of including a FAC(A) into the planning process is to reduce the workload of the JTAC, as well as increase SA of the entire CAS team.

3.10.10 Step 4—COA Analysis. During the course of analysis phase JTACs should continue to monitor the overall plan and ensure that it maximizes the use of joint fires assets. All resources, not just CAS, should be considered and effective control measures should be implemented to ensure the successful employment and integration of these assets. Things such as air interdiction (AI) and strike coordination and reconnaissance (SCAR) should also be considered. JTACs should be able to answer key questions during this phase to include; are all-aspects of airpower reflected in the synchronization matrix, have triggers for CAS been identified, and does each course of action analysis include within it the utilization of aerospace assets. JTACs should be able to visualize the flow of the operation given the forces strengths and disposition, enemy capabilities and possible COAs, civil considerations, and aspects of the situation.

3.10.10.1 AI and CAS. The primary USAF missions the Army considers fires are air interdiction and close air support. Although the target sets for these missions are often similar, the clearances, authorities, and ROE required for these missions are very different. Due to the difference in control, authority, and ROE it is critical that aircrew understand what type of mission (CAS or AI) they are being tasked to execute. Because the JTAC and or air support operations center (ASOC) often controls both CAS and AI, it is critical that individuals understand the differences in these missions.

3.10.10.1.1 Interdiction. Interdiction is defined as actions to divert, disrupt, delay, or destroy an enemy's surface capabilities before it can be used effectively against friendly forces, or to otherwise achieve objectives. Interdiction also can be used to prevent an adversary from achieving a variety of objectives affecting the US populace, economy, or national interests.

3.10.10.1.2 Strike Coordination and Reconnaissance. SCAR is air interdiction in a specific volume of assigned airspace to find and destroy enemy targets. The ASOC or AOC will assign aircraft to patrol an area and hunt for targets on the ROE-approved target list. SCAR is normally used against a mobile enemy. Because it is interdiction, it does not require detailed integration or final control. However, the tasking agency can provide target cuing updates as well as NAI, and TAI updates based on additional ISR. SCAR operations in areas short of the fire support coordination line (FSCL) or within a ground commander's AO should monitor the ASOC for updates and further tasking. For additional discussion on SCAR, see AFTTP (I) 3-27.72, *SCAR*.

3.10.11 Step 5—COA Comparison. COA comparison starts with all staff members analyzing and evaluating the advantages and disadvantages of each COA from their perspectives. Using the evaluation criteria developed before the wargame, the staff outlines each COA, highlighting its advantages and disadvantages. Comparing the strengths and weaknesses of the COAs identifies advantages and disadvantages with respect to each other. JTACs provide accurate USAF data into the army decision matrix and assists with assessing the best means for employing airpower effects that were considered earlier, and those that have been requested. JTACs should be able to determine strengths and weaknesses associated with each COA from the air component perspective. They should be prepared to compare, critique, and refine the plan based on the tenants of airpower; centralized control/decentralized execution, flexibility/versatility, synergistic effects, persistence, concentration, priority, and balance.

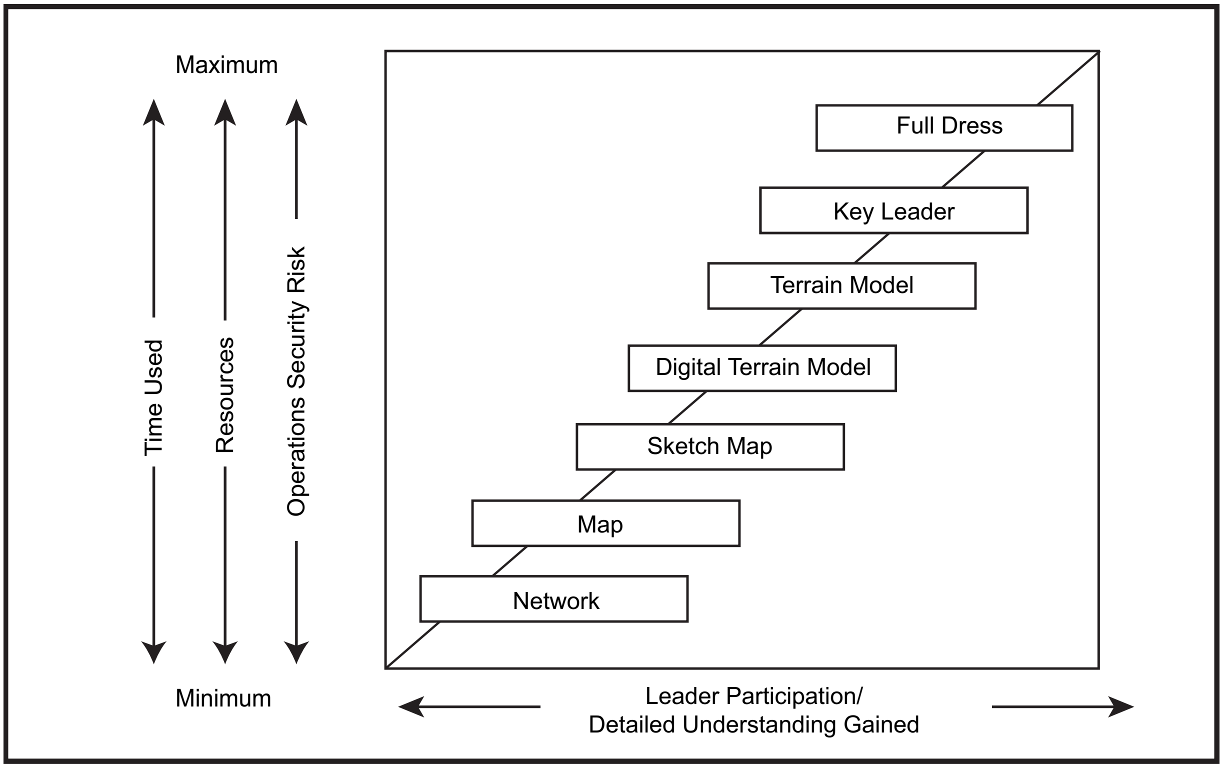
3.10.11.1 During the COA comparison phase, Army staff members conduct detailed wargaming, when time allows, to analyze what effect the proposed COA will have on the enemy. Key to successful wargaming will be the identification of contingencies that will force decisive points for CAS. Consider when and where airpower resources can be used to overcome contingencies and fill in any gaps that organic assets cannot. Understand what the triggers are as well as how each asset will be employed in detail.

3.10.12 Step 6—COA Approval. Once the commander decides on which COA best achieves the objectives that have been laid out, JTACs must review the final COA and again ensure that aerospace forces have been effectively and efficiently integrated. They should assist the fire support officer (FSO) as well as other operations and intelligence staff in preparing CAS requests, AI target nominations, airspace control measure nominations, SEAD plan, target marks, as well as any other products. It is during this step that JTACs will also participate in rehearsals. Participation is paramount to ensure that air assets are being projected correctly and that they are integrated into the ground scheme of maneuver. JTACs must also ensure that all members understand the role that airpower will play in the mission.

3.10.12.1 Rehearsals allow leaders and other key players to practice key aspects of the mission/operation, and afford them the ability to orient themselves to the environment in which the operation will take place. This aspect of planning helps build a lasting mental picture of the sequence of key actions. Key to successful rehearsals is the understanding of the commander's intent, concept of operation, and desired end state.

3.10.12.1.1 The rehearsal type will dictate the flow in which individuals will speak; however, the JTAC/ALO will typically follow the FSO once complete with the fire support plan. JTAC/ALO should provide data pertaining to CAS aircraft on-station times, number and type of aircraft supporting the operation/mission, standard conventional load (SCL), where subordinate JTACs will be located on the battlefield, triggers for the successful integration on CAS into the scheme of maneuver, as well as airspace deconfliction plans. The overall intent is to visualize when and where CAS effects will be integrated to ensure synchronization with all affected units. See **Figure 3.16**, Rehearsal Types.

Figure 3.16 Rehearsal Types.



3.10.12.1.2 Although there will be situations where time will not allow for certain rehearsals to occur, it is important to use each to the max extent possible in an effort to build a solid idea of how the mission will unfold while identifying potential friction points where more guidance may be needed. For the purpose of this chapter, those rehearsals that require more time and planning will be referred to as deliberate planning rehearsals. Dynamic rehearsals are those rehearsals that take place when less time is allowed.

3.10.13 Combined Arms Rehearsal. Normally, conducted by a maneuver unit HHQ and performed after subordinate units have issued their OPORD. This ensures subordinate units' plans are synchronized with those of the other units in the organization, all subordinate commanders' plans will properly achieve the intent of the higher commander.

3.10.14 Fire Support Rehearsal. Ensures the synchronization of the fire support effort with the maneuver plan to include inputs from the ALO/JTAC. Fire support rehearsals focus on the execution of fire support tasks, the fire support execution matrix, the effectiveness of FSCMs, and the timing and synchronization of all fire support efforts with each other and with the maneuver operation. Fire support rehearsals serve to refine fire support, ensure understanding by all fire support personnel, and prove the feasibility of executing fire support. A fire support rehearsal may be used to prepare for a combined arms rehearsal or it may be used after a combined arms rehearsal to refine and reinforce key fire support tasks.

3.10.14.1 During the fire support rehearsal, the ALO/JTAC will be expected to brief air allocation by planning or targeting cycle or phase. They will brief task and purpose of CAS desired effects on the target, target description; on-station time(s), number and type(s) of aircraft, SCL, CPs and IPs, ACMs and friendly markings. The brigade FSO and assistant brigade FSO add SEAD and marking of targets and defer to the battalion fire direction officer for delivery system and number of rounds by type. JTACs should confirm the observation plan and positioning of forward JTAC/JFO (control type, triggers and communications plan primary and alternate communications frequencies including call signs, brevity codes, and nets).

NOTE: For a further discussion on fire support rehearsal, refer to ATP 3-09.42, *Fire Support for the Brigade Combat Team*.

3.10.15 Full Dress. This produces the most detailed understanding of the mission, done on terrain that is similar to where the mission will actually occur both in low light and good light conditions. Gives an opportunity for all supporting assets such as aviation crews and the JTAC to come together and run through the plan. ***NOTE:*** Aviation units will conduct a similar type of rehearsal organic to the unit known as the Air Mission Brief (AMB). This type of rehearsal is the most complex and highest demand for time.

3.10.16 Key Leader. Performed throughout the MDMP; allows the commander to clarify intent early, and allows the commander to identify problems in the concept of operations, identify problems in subordinate commander's concept, and learn how subordinates intend to accomplish the mission.

3.10.17 Terrain Model. Most popular, takes less time and few resources than a full dress rehearsal. An accurately constructed terrain model is built to help subordinate leaders visualize the commander's intent and CONOP.

3.10.18 Sketch Map. Can be done in almost any environment day or night. Procedures are the same as the Terrain Model example except a sketch map of the objective area is used in lieu of the terrain model.

3.10.19 Support Rehearsal. Synchronizes each warfighting function with the overall operation. This rehearsal supports the operation so units can accomplish the mission.

3.10.20 Dynamic Rehearsals. There will be instances when one or more of the deliberate rehearsal types cannot be accomplished due to the amount of time before mission start. In these instances, rehearsal planning should include (at a minimum) the following.

- Insertion.
- Infiltration (INFIL).
- Actions on the Objective.
- Exfiltration (EXFIL).
- Extraction.

3.10.20.1 During each of the seven phases, JTACs should consider CAS and ISR sensor planning considerations, ensure that areas are covered with the appropriate sensor, and/or asset to maximize not only sensor coverage, but also to make sure the right asset is tasked to the right mission. In certain situations, overlapping sensor coverage and firepower may be needed to ensure the safety of ground elements. Other things to consider are the method in which the JTAC will get to the fight and how they will get back.

NOTE: See **Chapter 5**, "Close Air Support Execution," for specifics on helicopter assault force (HAF) and ground assault force (GAF) execution principles.

3.10.20.2 When speaking specifically to actions on the objective, JTACs must have a thorough understanding of the CONOP and understand how to employ joint fires assets during this phase. JTACs must be adamantly familiar with the ground scheme of maneuver, but they must also understand and rehearse specific unit SOP (i.e., react to contact, react to indirect fire etc.). At a minimum, a JTAC should produce a concept of fires (CoF) and forward this to any supported unit. The CoF will establish the baseline of information a pilot or supported unit needs to successfully integrate sensors/capabilities into the operation.

3.10.21 Step 7—Orders Production. Orders are typically published in an OPORD format. JTACs must prepare and finalize the portion of the Fire Support Annex during this phase and include any graphics or air overlays. They must also ensure that HHQ and subordinate JTACs are familiar with the plan and are prepared to execute. **Figure 3.17**, Sample OPORD, outlines the information in an OPORD.

3.10.21.1 Product Development/CoF. TACs should be familiar with the appropriate request procedures for operation-specific mission support products. Although procedures will vary depending on supported/supporting unit guidelines, the JTAC's first step should be to request HHQ developed products before developing their own. JTACs should coordinate with the Intel section as soon as receipt of mission occurs to select the appropriate level of imagery needed to build air-specific products. The JTAC then develops air products and passes this onto the operations section.

3.10.21.1.1 CoF Basics. The concept of fires should serve as the baseline of information needed for supported assets to be integrated into an operation. At a minimum, a CoF should include the communications plan as seen from the JTAC perspective, the players expected to participate in this specific mission with associated call signs, initial A/C stack plan, and any specific ACMs or FSCMs that will be used throughout the operation. In some situations, and depending on the complexity of the mission, multiple PACE plans may be warranted. JTACs should leverage all available capabilities to include digital means and use this whenever possible.

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Figure 3.17 Sample OPORD (1 of 3).

Copy ## of ## copies
Issuing headquarters
Place of issue
Date-time group of signature
Message reference number

OPERATION PLAN/ORDER [number] [(code name)] [(classification of title)]
(U) References:
(U) Time Zone Used Throughout the OPLAN/OPORD:
(U) Task Organization:
1. (U) Situation.
a. (U) Area of Interest.
b. (U) Area of Operations.
(1) (U) Terrain.
(2) (U) Weather.
c. (U) Enemy Forces.
d. (U) Friendly Forces.
(1) (U) Higher Headquarters' Mission and Intent.
(a) (U) [Higher Headquarters Two Levels Up]. {Identify the actual unit}
1 (U) Mission.
2 (U) Commander's Intent.
(b) (U) [Higher Headquarters]. {Identify the actual unit}
1 (U) Mission.
2 (U) Commander's Intent.
(2) (U) Missions of Adjacent Units.
e. (U) Interagency, Intergovernmental, and Nongovernmental Organizations.
f. (U) Civil Considerations.
g. (U) Attachments and Detachments.
h. (U) Assumptions.
2. (U) Mission.
3. (U) Execution.
a. (U) Commander's Intent.
b. (U) Concept of Operations.
c. (U) Scheme of Movement and Maneuver.
(1) (U) Scheme of Mobility/Countermobility.
(2) (U) Scheme of Battlefield Obscuration.
(3) (U) Scheme of Intelligence, Surveillance, and Reconnaissance.
d. (U) Scheme of Intelligence.
e. (U) Scheme of Fires.
f. (U) Scheme of Protection.
g. (U) Stability Operations.
h. (U) Assessment.
i. (U) Tasks to Subordinate Units.
j. (U) Coordinating Instructions.
(1) (U) Time or condition when the OPORD becomes effective.
(2) (U) Commander's Critical Information Requirements.
(3) (U) Essential Elements of Friendly Information.
(4) (U) Fire Support Coordination Measures.
(5) (U) Airspace Coordinating Measures.
(6) (U) Rules of Engagement.
(7) (U) Risk Reduction Control Measures.
(8) (U) Personnel Recovery Coordination Measures.
(9) (U) Environmental Considerations.
(10) (U) Information Themes and Messages.
(11) (U) Other Coordinating Instructions.

Figure 3.17 Sample OPORD (2 of 3).

OPERATION PLAN/ORDER [number] [(code name)]—[issuing headquarters] [(classification of title)]

4. (U) Sustainment.
a. (U) Logistics.
b. (U) Personnel.
c. (U) Health System Support.
5. (U) Command and Control.
a. (U) Command.
(1) (U) Location of Commander.
(2) (U) Succession of Command.
(3) (U) Liaison Requirements.
b. (U) Control.
(1) (U) Command Posts.
(2) (U) Reports.
c. (U) Signal.

The commander or authorized representative signs the original copy. If the representative signs the original, add the phrase "For the Commander." The signed copy is the historical copy and remains in the headquarters' files. (FM 5-0)

ACKNOWLEDGE:

[Commander's Last Name]
[Commander's Rank]

OFFICIAL:

Use only if the commander does not sign the original order. If the commander signs the original, no further authentication is required. (FM 5-0)

[Authenticator's Last Name]
[Authenticator's Rank]

ANNEXES:

A – Task Organization
B – Intelligence
C – Operations
D – Fires
E – Protection
F – Sustainment
G – Engineer
H – Signal
I – not used
J – Public Affairs
K – Civil Affairs Operations
L – Intelligence, Surveillance, and Reconnaissance
M – Assessment
N – Space Operations
O – not used
P – Host-Nation Support
Q – not used
R – Reports
S – Special Technical Operations
T – not used
U – Inspector General
V – Interagency Coordination
W – not used
X – not used
Y – not used
Z – Distribution

DISTRIBUTION: Furnish distribution copies either for action or for information. List in detail those who are to receive the plan or order. Refer to Annex Z (Distribution) if lengthy.

Figure 3.17 Sample OPORD (3 of 3).

BASE ORDER. The base OPORD consists of five primary paragraphs: 1) Situation, 2) Mission, 3) Execution, 4) Sustainment, and 5) Command and Control. The OPORD contains the following annexes:

ANNEX A – TASK ORGANIZATION (S-5]or S-3)
ANNEX B – INTELLIGENCE (S-2)
- Appendix 1 – Intelligence Estimate
  - Tab A – Terrain (Engineer Coordinator)
  - Tab B – Weather (Staff Weather Officer)
  - Tab C – Civil Considerations
  - Tab D – Intelligence Preparation of the Battlefield Products
- Appendix 2 – Intelligence, Surveillance, and Reconnaissance Synchronization Matrix
- Appendix 3 – Counterintelligence
- Appendix 4 – Signals Intelligence
- Appendix 5 – Human Intelligence
- Appendix 6 – Geospatial Intelligence
- Appendix 7 – Imagery Intelligence
- Appendix 8 – Measurement and Signature Intelligence
- Appendix 9 – Open Source Intelligence
- Appendix 10 – Technical Intelligence
- Appendix 11 – Soldier Surveillance and Reconnaissance

ANNEX C – OPERATIONS (S-5 or S-3)
- Appendix 1 – Design Concept
- Appendix 2 – Operation Overlay
- Appendix 3 – Decision Support Products
  - Tab A – Execution Matrix
  - Tab B – Decision Support Template and Matrix
- Appendix 4 – Gap Crossing Operations
- Appendix 5 – Air Assault Operations
- Appendix 6 – Airborne Operations
- Appendix 7 – Amphibious Operations
- Appendix 8 – Special Operations (S-3)
- Appendix 9 – Battlefield Obscuration (CBRN Officer)
- Appendix 10 – Information Engagement (S-7)
- Appendix 11 – Airspace Command and Control (S-3 or Airspace Command and Control Officer)
- Appendix 12 – Rules of Engagement (Staff Judge Advocate)
  - Tab A – No Strike List (S-3 with Staff Judge Advocate)
  - Tab B – Restricted Target List (S-3 with Staff Judge Advocate)
- Appendix 13 – Military Deception (S-5)
- Appendix 14 – Law and Order Operations (Provost Marshal)
  - Tab A – Police Engagement
  - Tab B – Law Enforcement
- Appendix 15 – Internment and Resettlement Operations (Provost Marshal)

ANNEX D – Fires (Chief of Fires)
- Appendix 1 – Fire Support Overlay
- Appendix 2 – Fire Support Execution Matrix
- Appendix 3 – Targeting
  - Tab A – Target Selection Standards
  - Tab B – Target Synchronization Matrix
  - Tab C – Attack Guidance Matrix
  - Tab D – Target List Work Sheets
  - Tab E – Battle Damage Assessment (S-2)
- Appendix 4 – Field Artillery Support
- Appendix 5 – Air Support
- Appendix 6 – Naval Fire Support
- Appendix 7 – Command and Control Warfare (Electronic Warfare Officer)
  - Tab A – Electronic Attack
  - Tab B – Electronic Warfare Support
  - Tab C – Computer Network Attack
  - Tab D – Computer Network Exploitation

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3.10.21.2.1 CoF Basics. The concept of fires should serve as the baseline of information needed for supported assets to be integrated into an operation. At a minimum, a CoF should include the communications plan as seen from the JTAC perspective, the players expected to participate in this specific mission with associated call signs, initial A/C stack plan, and any specific ACMs or FSCMs that will be used throughout the operation. In some situations, and depending on the complexity of the mission, multiple PACE plans may be warranted. JTACs should leverage all available capabilities to include digital means and use this whenever possible.

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3.10.21.3.1 CoF Basics. The concept of fires should serve as the baseline of information needed for supported assets to be integrated into an operation. At a minimum, a CoF should include the communications plan as seen from the JTAC perspective, the players expected to participate in this specific mission with associated call signs, initial A/C stack plan, and any specific ACMs or FSCMs that will be used throughout the operation. In some situations, and depending on the complexity of the mission, multiple PACE plans may be warranted. JTACs should leverage all available capabilities to include digital means and use this whenever possible.

3.10.21.3.1.1 If it makes sense and room allows, the CoF can also include a labeled situation update using the target, enemy, friendly, artillery, control, hazards, and restrictions (TEFACHR) format. It can also include time lines, key grids, contracts, comm-out procedures, associated GRGs (see **paragraph 3.10.21.3.1.2**, and **Figure 3.18**, Gridded Reference Graphics), sensor plans (see **Figure 3.19**, Sensor Tasking Graphic, for an example), or preplanned attack briefs. **Figure 3.20**, Direct Action/Counterinsurgency COF Example, is an example CoF tailored for a specific mission type.

3.10.21.3.1.2 GRG Development. GRGs should only be developed and used when applicable, i.e., urban environment. GRGs will vary slightly and will be driven by the mission set and environment. Labeling of buildings or other items in the GRGs may be driven by the unit the JTAC is supporting. If not, groups of buildings can be labeled in clusters in two ways: 100 series (Macro) with individual building numbers within the series or a group of buildings labeled 100 to 199, 300 to 350, etc. Also of note, ATAK/special warfare assault kit (SWAK) has a GRG Builder plug-in to build graphics with the EUD.

Figure 3.18 Gridded Reference Graphics (1 of 4).

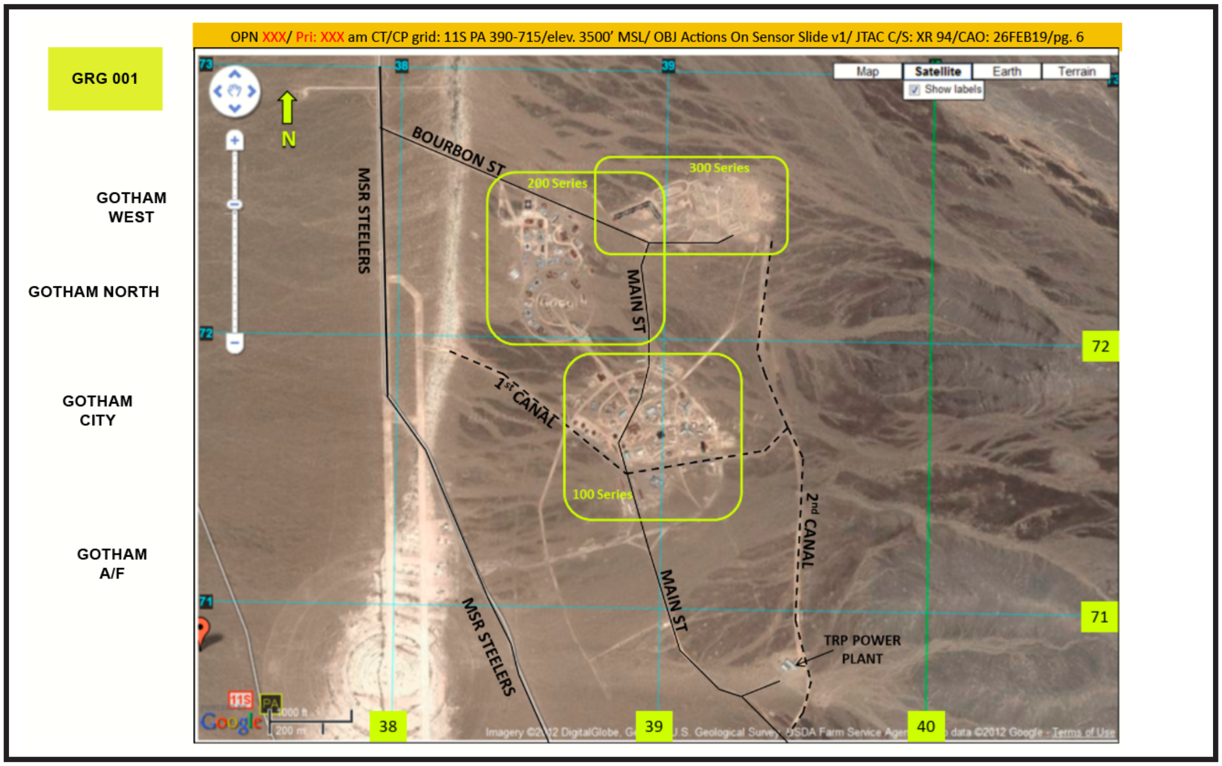


Figure 3.18 Gridded Reference Graphics (2 of 4).

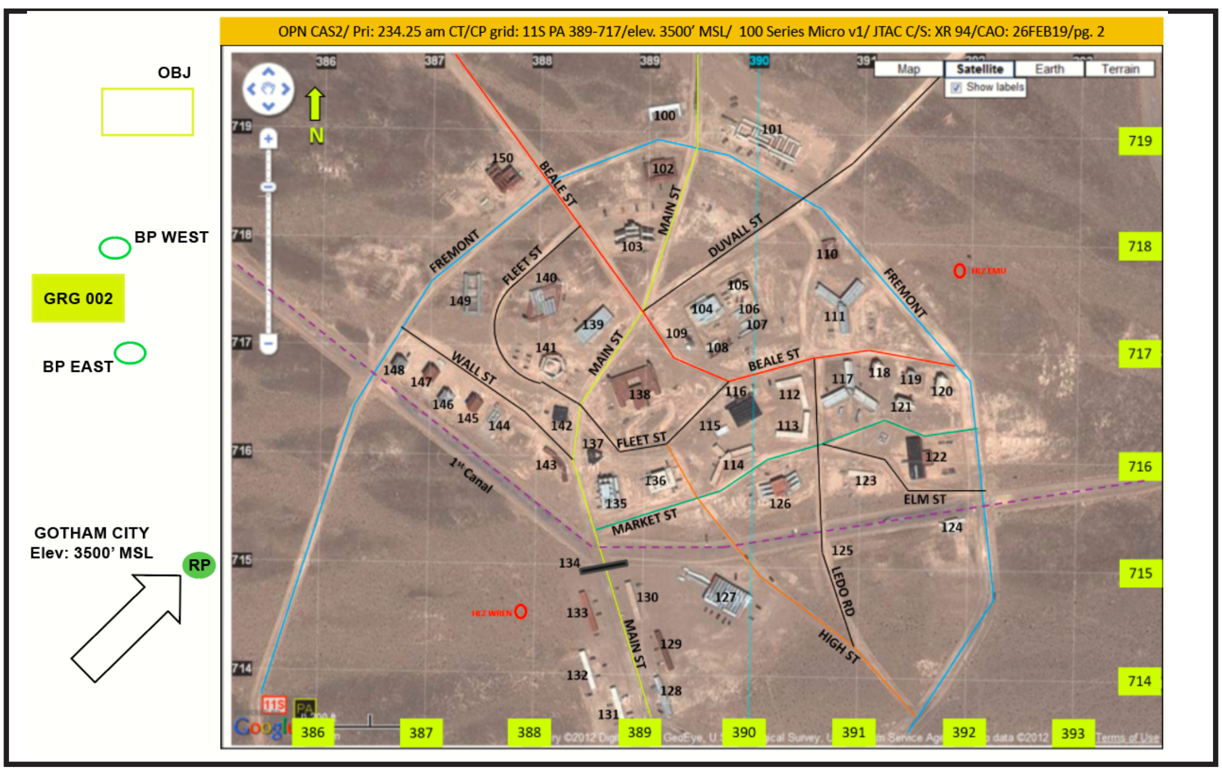


Figure 3.18 Gridded Reference Graphics (3 of 4).

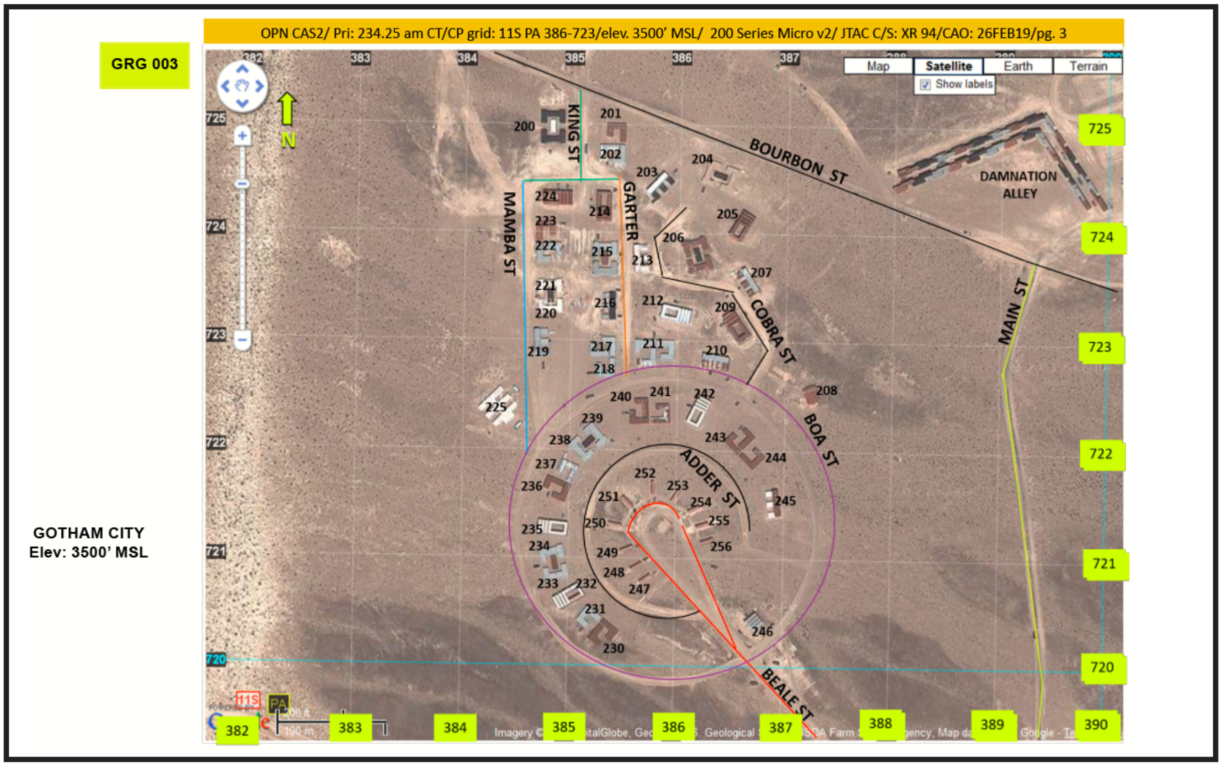


Figure 3.18 Gridded Reference Graphics (4 of 4).

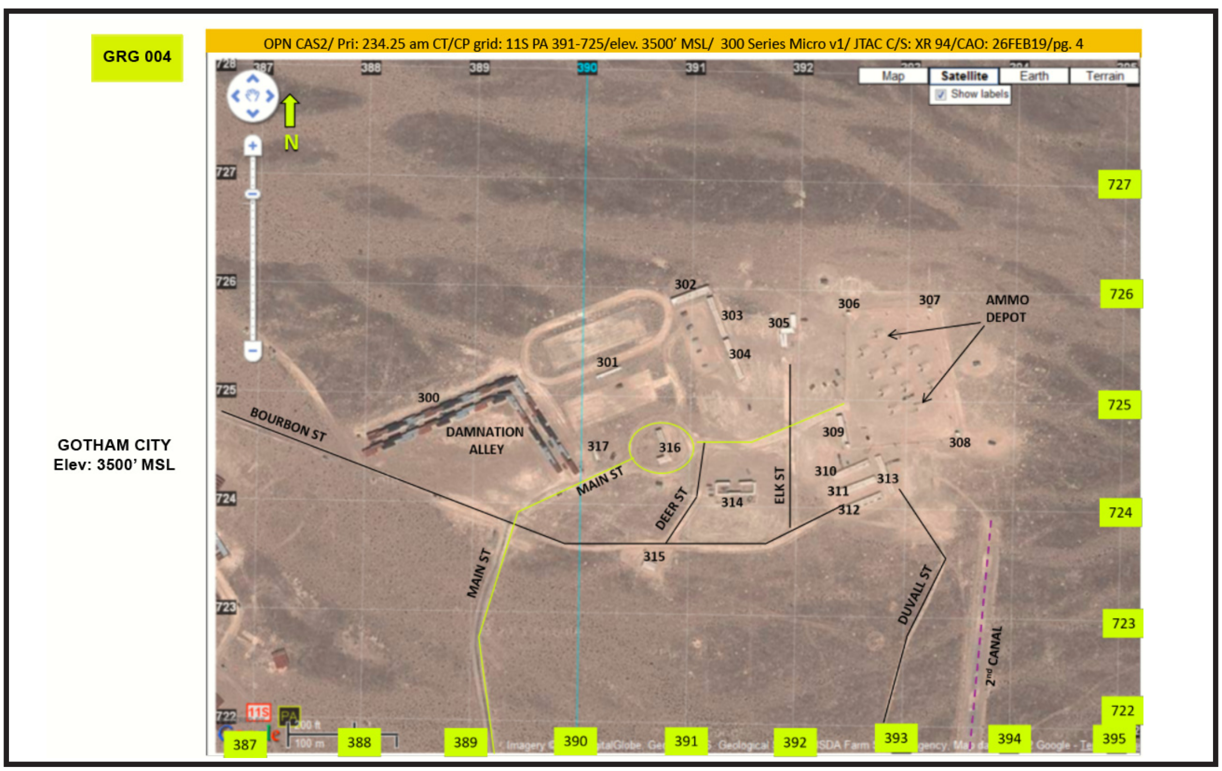


Figure 3.19 Sensor Tasking Graphic.

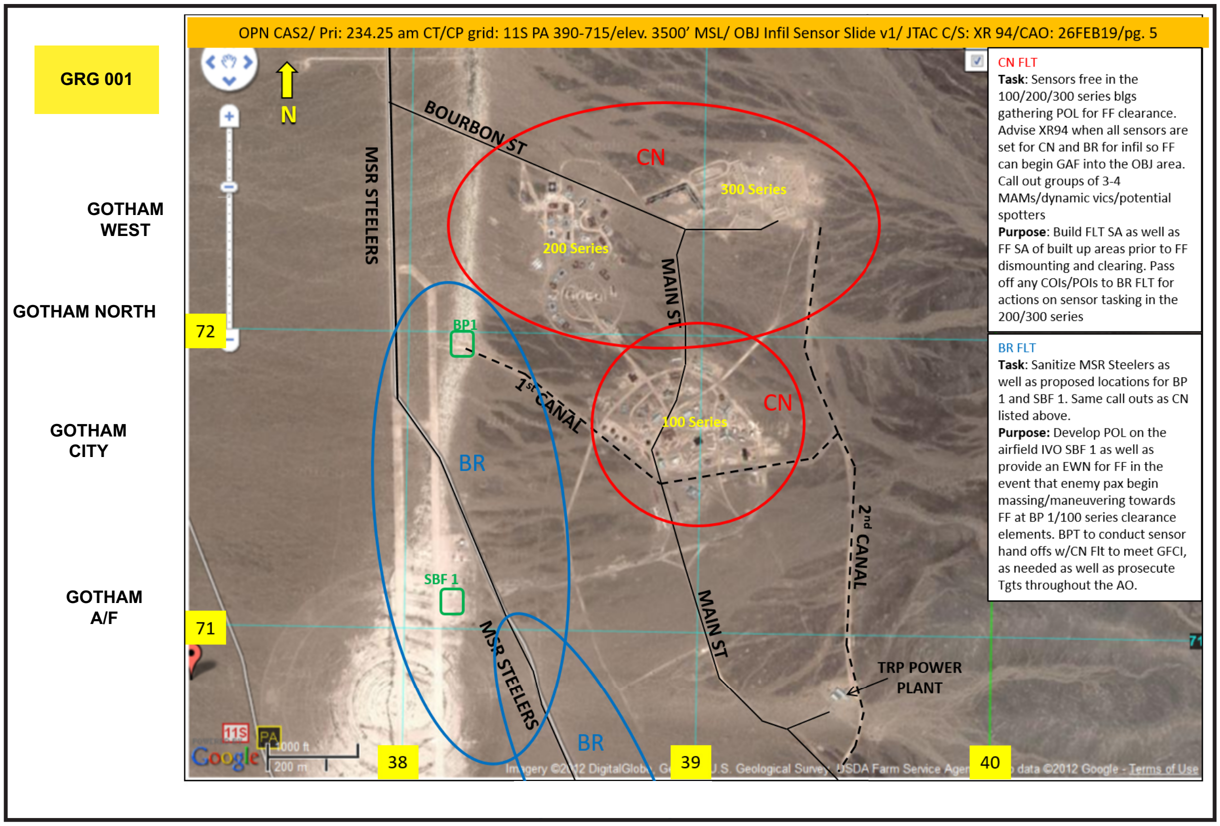


Figure 3.20 Direct Action/Counter Insurgency CoF Example.

OBJ GOLDEN DOVE V 1.0
11S PA 391 726 / 3,485 FT MSL

CALLSIGNS	
CRC	AIREDALE
JAGIC (ASOC)	KLAXON
GFC	TROJAN
GFC JTAC	EXTERMINATOR 91
JFO	N/A
ISR	SNAKE
FW	HOG / GUNN
RW	AVENGER
LIFT	BLACKCAT

COMM GRID	
FIRES-P	GD08 234.250 AM
FIRES-A (HQ II)	WE07 A00.625
FIRES-C	GN15 140.975 AM
ASSAULT	32.330 FM
CRC	PE04 238.800 AM
CRC SEC	143.375 AM
JAGIC (ASOC)	GD04 341.925 AM
JAGIC SEC	139.400 AM

TIMELINE (HAF)	LOCAL
STEP TO AF	1845
LOAD A/C	1915
W/U	1945
W/D	2020
TOT	2000
EXFIL	2130

HLZ	
NUTCRACKER	11S PA 3878 7348
EAGLE	11S PA 4171 7235

BPs / HAs	
BP Bud	11S PA 360 700
BP Coors	11S PA 420 700
BP Stella	11S PA 420 770
BP Heineken	11S PA 340 790
HA South (2x3)	11S PA 404 600
HA North (2x3)	11S PA 400 900

COMM OUT: XR ROPE A/C, STEADY SPARKLE TGT, A/C MATCH SPARKLE, XR PULSE SPARKLE FOR CLEARANCE

SITUATION UPDATE 91A	
THREAT	SMALL ARMS / MANPADS UP TO SA-7 / ZPU-2, 4 POSS
ENEMY SITUATION	HVI +1 BLDG 302 / 305 / 4-5 TECHS / 20+ ARMED PAX / POSSIBLE REINFORCEMENTS FROM CENTRAL
FRIENDLY	22x EAGLES / 2x ELEMENTS CLEAR S-N
ARTILLERY	N/A
CLEARANCE AUTHORITY	XR91 / VDL,GRG,CAT IV, IR SPARKLE, TRACER
HAZARDS	UPDATE WX / AVN- POWERLINES / UPDATE PER HLZ
REMARKS/RESTRICTIONS	NFA BLDG 141, 200 / 600M RFA FOB Hammer / MIN CDE TO GOTHAM

OPERATION WILL FALL UNDER NTTR ROE

BLOCK	ASSET	CALLSIGN	POS	TOS(LOCAL)	REMARKS
FL 220 - 230	U-28	SNAKE	OH	2000	
FL 180-210	A-10	GUNN	OH	2000	
FL 090- 170	A-10	HG	OH	2000	
SFC – 4K A	AH-64	AVENGER	OH	UTC	
SFC-500 A	UH-60	BLACKCAT	CREECH	UTC	CASEVAC

ALL PLAYERS CONTACT KLAXON ON GD04 PRIOR TO CHECK-IN. CHECK-OFF WITH EXTERMINATOR ON FIRES PRIOR TO RTB. INABILITY TO ESTABLISH OR MAINTAIN CLEAR COMMS WITH TAC(A) AND/OR EXTERMINATOR WILL RESULT IN REMOVAL FROM A/S DUE TO REDUCED SA AND SAFETY OF FLIGHT CONCERNS.

CAPABILITIES	LASER	VDL	JU#
ISR			
HOG			
GUN			
AVENGER			

A/C COORDINATION

LIFT COORDINATION
INFIL FROM NELLIS: 70 KM // 20 MIN
FROM CREECH: 30 KM // 15 MIN
CP 1: 11S PA 446 716
CP 2: 11S PA 319 691
CP 3: 11S PA 325 725

CHERRY CRITERIA:
1x GUN TRUCK WITHIN 500M OF HLZ
10x ARMED PAX WITHIN 500M OF HLZ

CHALK 1:
11x EAGLES
CHALK 2:
11x EAGLES

KEY CALLS DURING INFIL
H-10 HLZ UPDATE / INITIAL SENSOR
H-6 CHERRY / ICE CALL
H-3 SHIFT SENSORS TO PRI TASK
H- TGT UPDATE

GAMEPLAN/9LINE Z
Type III, BOT
1-3. OH
4. EL. 3,409 FT
5. GUN TRUCK
6. HLZ NUTCRACKER
7. No Mark
8. XR91 WILL UPDATE
9. EGRESS OH
R/R
FAH: E-W
ALL EFFECTS INSIDE 500M NUTCRACKER
GFCI – NEUTRALIZE VEH ON HLZ

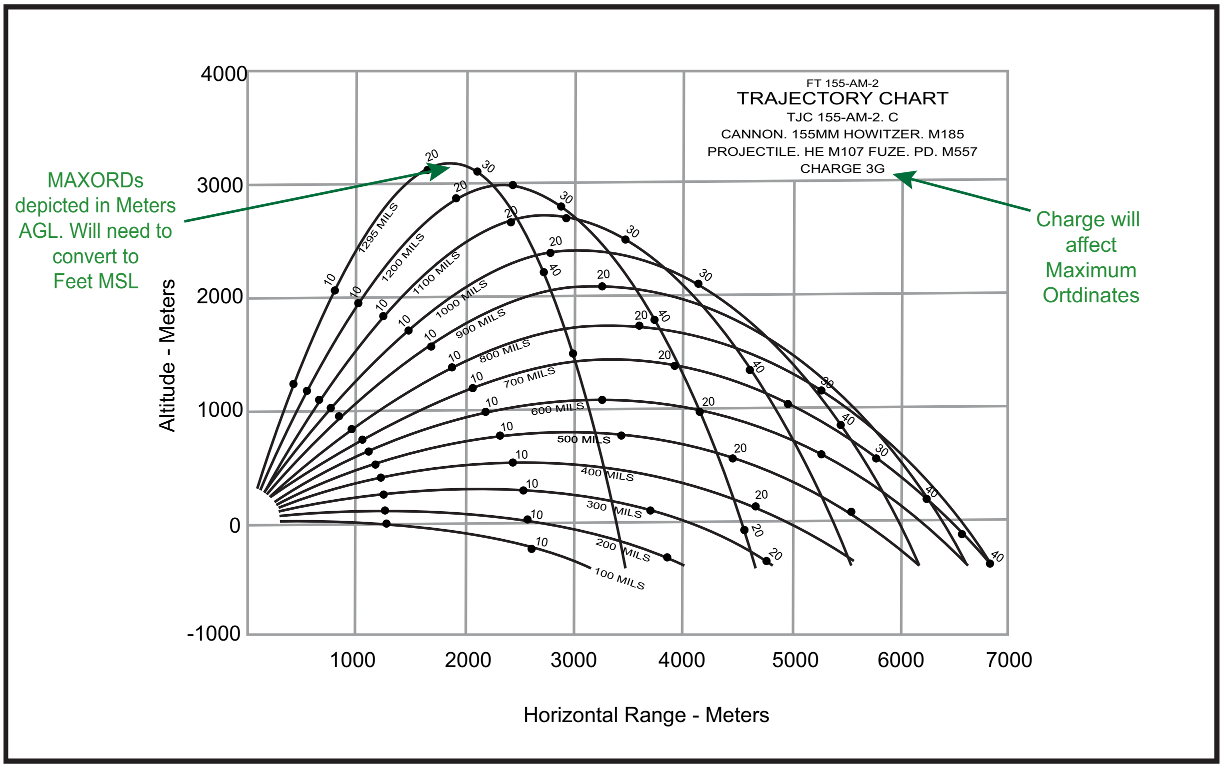
GAMEPLAN/9LINE Y
Type III, BOT
1-3. OH
4. EL. 3,495 FT
5. GUN TRUCK
6. HLZ EAGLE
7. No Mark
8. XR91 WILL UPDATE
9. EGRESS OH
R/R
FAH: E-W
ALL EFFECTS INSIDE 500M EAGLE
GFCI – NEUTRALIZE VEH ON HLZ

3.10.22 Surface-to-Surface Fires Planning Considerations and FSCMs. Field artillery firing data is determined by use of various firing tables and equipment. These tables contain the fire control information (FCI) under standard conditions and data correcting for nonstandard conditions. These tables and equipment include the tabular firing tables (TFT), graphical firing tables, and graphical site tables. TFTs are the basic source of firing data. They present fire control information in a tabular format. The data listed is based on standard conditions.

3.10.22.1 TFTs are based on test firings and computer simulations of a weapon and its ammunition correlated to a set of conditions that are defined and accepted as standard. These standard conditions are points of departure. Corrections are used to compensate for variables in the weather-weapon-ammunition combination that are known to exist at a given instant and location. TFTs are developed for weapons ranging from crew-served to heavy artillery.

3.10.22.2 TFT charts for both mortars and artillery are updated as necessary when changes are required. In order to effectively plan for the use of artillery and mortars, JTACs need to ensure they are using the most current data during planning. Updated TFTs can be accessed through Publications Management Application (PMA) at **https://picac2as2.pica.army.mil/PMA/**. **Figure 3.21**, Sample TFT Trajectory Chart, shows an example trajectory chart that would be included in the TFT.

Figure 3.21 Sample TFT Trajectory Chart.



3.10.23 Airspace Control and Implementation. Airspace control in the combat zone is a process used to increase combat effectiveness by promoting the safe, efficient, and flexible use of airspace. Airspace control is provided to reduce the risk of friendly fire, enhance air defense operations, and permit greater flexibility of operations. Effective airspace control should maximize combat effectiveness without unduly restricting combat operations. Airspace control does not infringe on the authority vested in commanders to approve, disapprove, or deny combat operations.

3.10.23.1 Formal Airspace Control. All airspace in a campaign is owned by the joint force commander and is further delegated down to other agencies or individuals. Below the coordination level, airspace control is delegated down to the joint force land component commander (JFLCC) to facilitate rotary-wing operations. The joint forces air component commander (JFACC) is responsible for the control of airspace above the coordination level long and short of the FSCL. Long of the FSCL, missions (i.e., AI and the submission of AI, and SCAR), are executed and are considered the deep fight. Airspace long of the FSCL is also the responsibility of the JFACC.

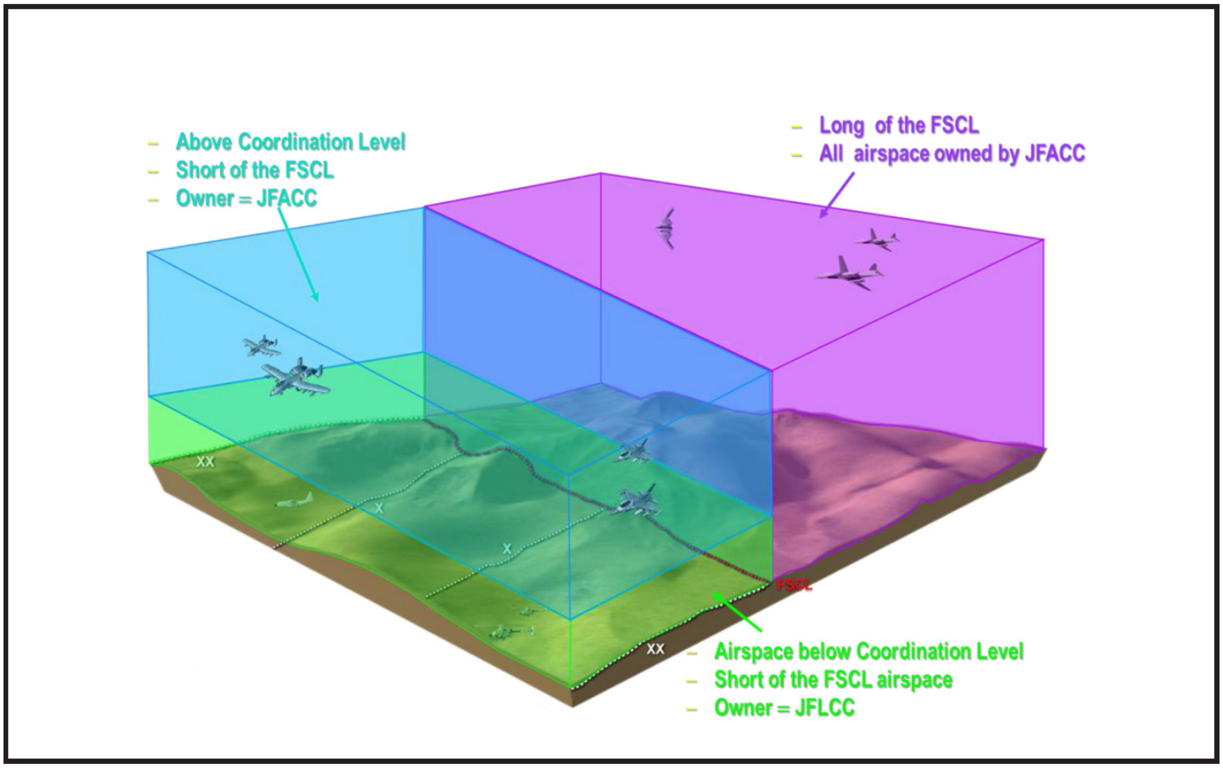
3.10.23.1.1 Above the coordination level and short of the FSCL, airspace control is delegated down, by the JFACC, to the ASOC and its aligned Army division. It is further subdivided, as necessary, to the division's corresponding brigades. The altitude that separates the ASOC's airspace facilitating CAS operations from all other operations, such as air refueling, is controlled by other tactical command and control (TAC-C2) systems such as Airborne Early Warning and Control System (AWACS) or the control and reporting center (CRC), will be determined by the airspace control authority at the AOC. Formal ACAs are disseminated in the ACO and/or SPINS. **Figure 3.22**, Airspace Model, shows an example doctrine airspace model.

3.10.23.2 Informal Airspace Control. Informal ACAs can be established using multiple separation techniques and may be established by any ground commander. Since they do not require as much prior coordination, informal ACAs are much easier to put into effect than formal ones. Inbound aircraft may be briefed the ACA lateral and vertical boundaries, or they may be given just holding instructions that keep them within the ACA. Examples include altitude separation, lateral separation, timing, or a combination.

3.10.23.3 Airspace Coordination Area (ACA). An ACA is defined as a three-dimensional block of airspace in a target area, established by the appropriate commander, in which friendly aircraft are reasonably safe from friendly surface fires. It is an ACM put in place to ensure that CAS operations can be integrated without interrupting the US Army's indirect fire plans.

3.10.23.3.1 For JTACs operating at the brigade level, it is important to have a baseline airspace plan to integrate CAS with field artillery to mass effects for the GFC. This baseline plan will depend heavily on the ACA. ACAs should cover aircraft ingress, egress, holding areas, should be easily identifiable from the air (when possible), and allow for the simultaneous employment of artillery/mortars and CAS.

Figure 3.22 Airspace Model.



3.10.23.3.2 When determining the dimensions of an ACA, JTACs and planners should coordinate with the ASOC to determine the maximum altitude. It is crucial to consider assets that may need to use the airspace above the ACA to execute missions (i.e., air refueling, SCAR, and AI).

3.10.23.3.3 When determining the minimum altitude of an ACA, JTACs should consider the maximum ordinate (MAX ORD) of artillery and mortars. This will require close coordination with the fire support element (FSE) to determine where organic fires will be used. Lateral limits of an ACA will be calculated based off of brigade boundaries and other FSCMs. **Figure 3.23**, BCT ACA, and **Figure 3.24**, Battalion ACA, depict an example of a BCT ACA as well as a Battalion ACA.

3.10.23.3.4 When building ACAs, JTAC should also consider the aircraft that will be supporting a mission, understanding that different platforms may require more room to operate. Although this may not always be feasible and the tactical situation will dictate the dimensions of an ACA, JTACs should use **Figure 3.25**, Holding Airspace Considerations, as a rule of thumb for aircraft turning radius.

3.10.23.3.5 When speaking specifically to the employment of airspace, JTACs need to familiarize themselves with not only the ASOC, but also the division level JAGIC.

Figure 3.23 BCT ACA.

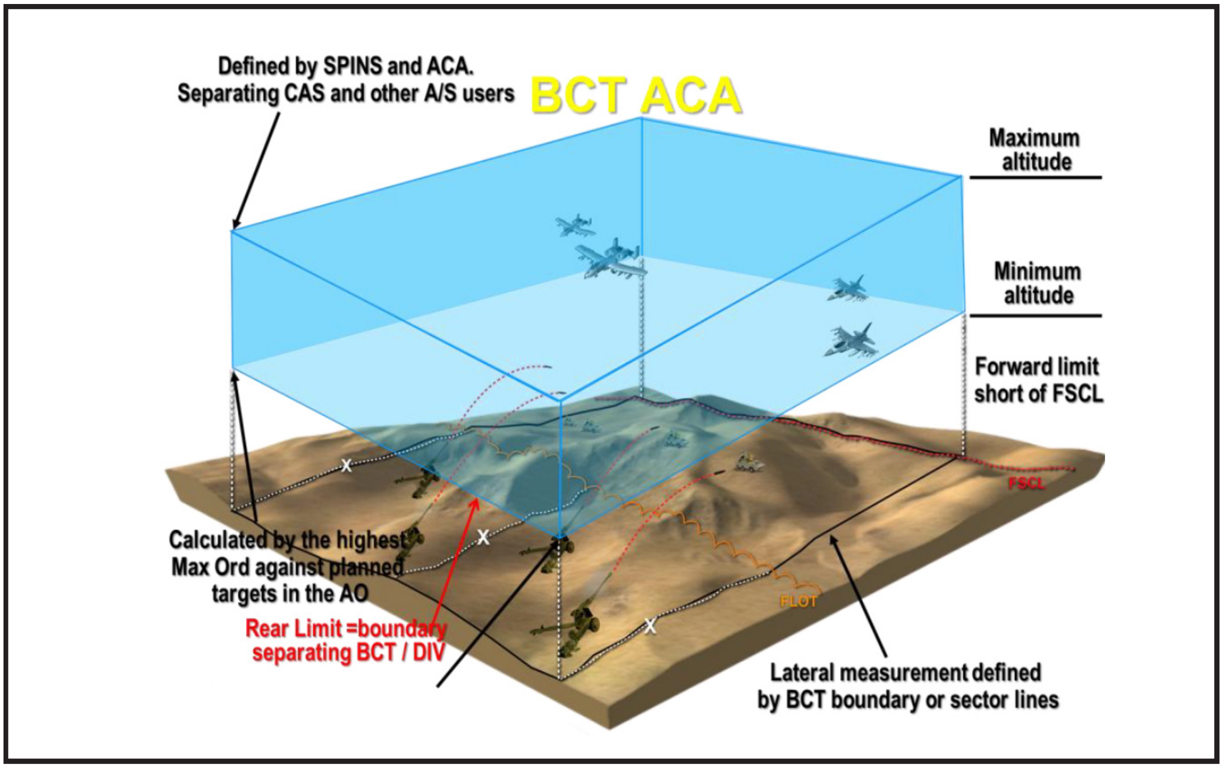


Figure 3.24 Battalion ACA.

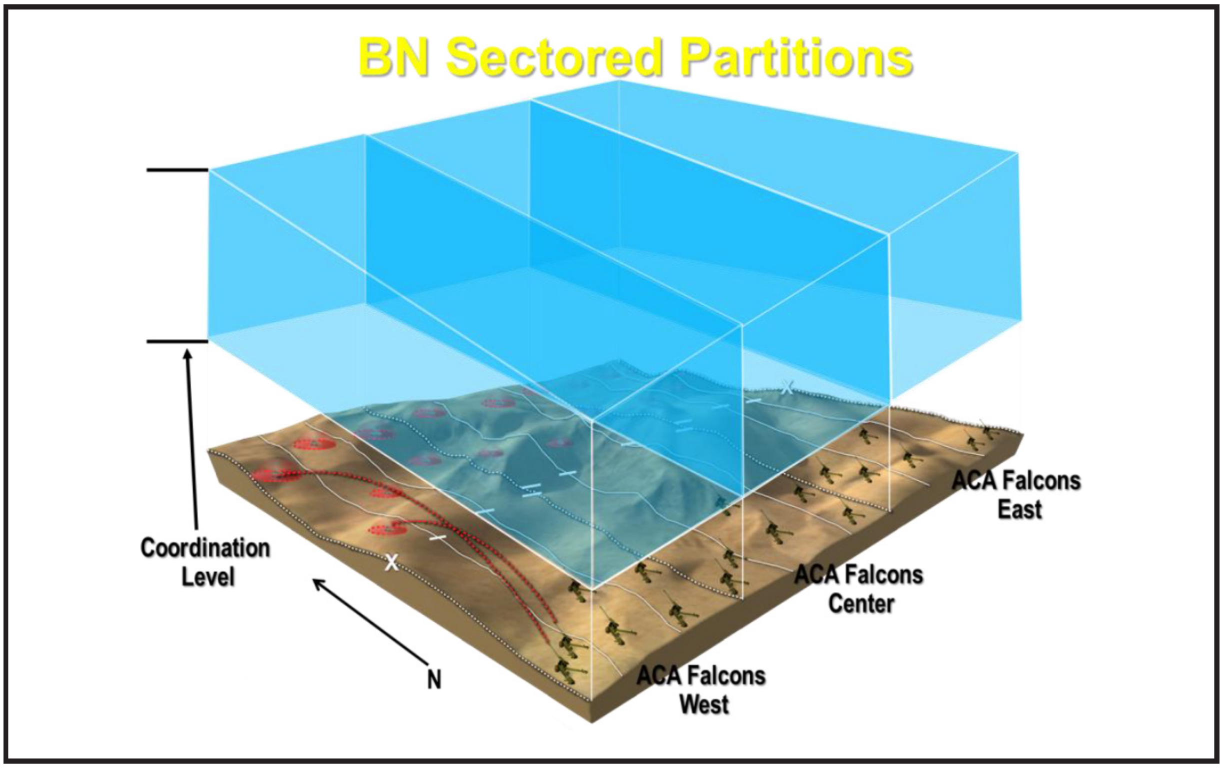
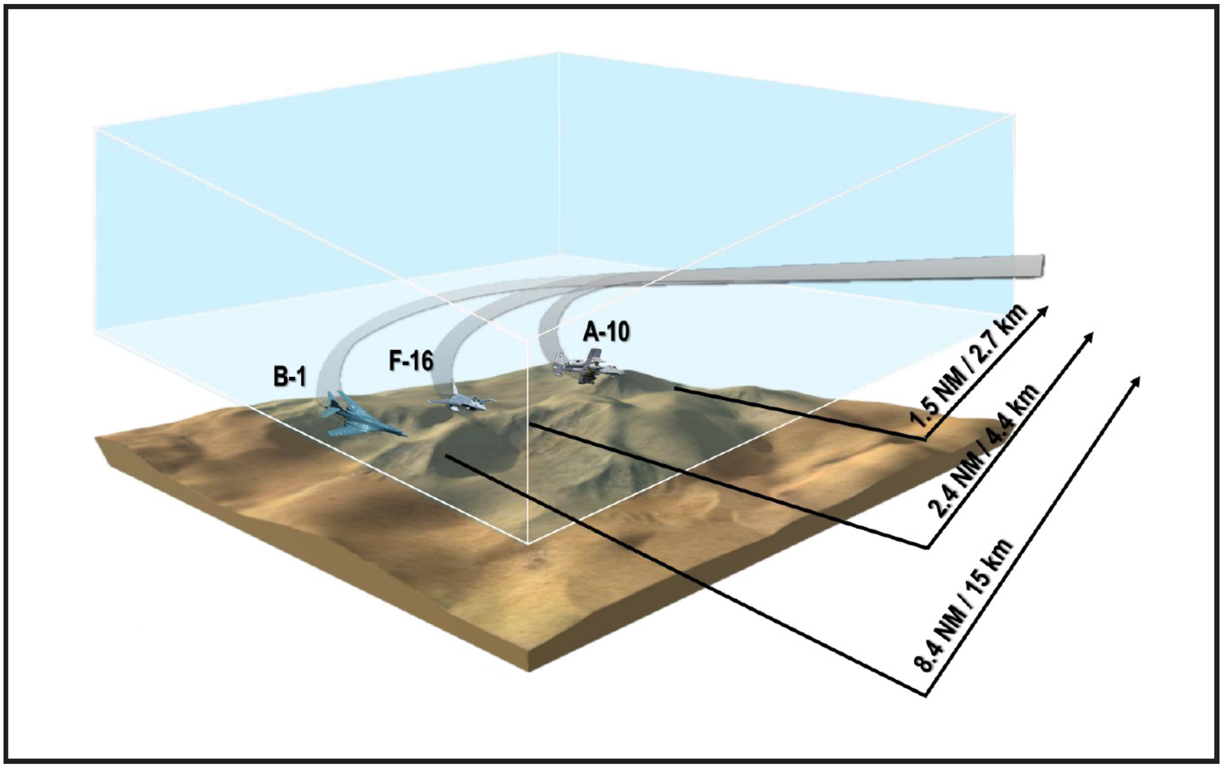


Figure 3.25 Holding Airspace Considerations.



3.10.24 JAGIC. The JAGIC is designed to fully support and enable division-level current operations through the rapid execution and clearance of fires and airspace. It is a modular and scalable center designed to integrate and synchronize fires and airspace control in the division area of operations in accordance with guidance received from the division commander and the JFACC and airspace control authority. It is physically located in the division current operations integration cell (COIC).

3.10.24.1 JAGIC Functions. Specific functions of the JAGIC include-fires, airspace control, interdiction coordination, friendly force identification, and information collection. All JAGIC functions are in support of current operations. As part of the COIC, the JAGIC is not resourced to conduct planning. However, individuals working in the JAGIC may sometimes be required to conduct planning and preparation tasks in addition to JAGIC responsibilities. For more detailed information pertaining to the JAGIC functions, organization, and responsibilities, refer to ATP 3-91.1, AFTTP 3-2.86, *The Joint Air Ground Integration Center* (**https://intelshare.intelink.gov/sites/alsacenter/SiteCollectionDocuments/ jagic_2014.pdf**).

3.10.24.1.1 Airspace Control. The JAGIC enables the execution and assessment of airspace control in accordance with the airspace control plan and ACO. The JAGIC improves the effectiveness of airspace control by co-locating division and ASOC airspace personnel to enable shared understanding and collaborative integration of airspace users. This allows the division to respond effectively during operations with appropriate flexible and timely actions.

3.10.24.1.2 Interdiction Coordination. The JAGIC coordinates attacks on emerging high-payoff targets, both short of and beyond the FSCL, if enabled with prior theater air control system coordination. Additionally, the JAGIC provides the AOC with updates of ongoing and future interdiction operations, including integration and coordination of AI and SCAR operations short of and beyond the FSCL within the ground commander's area of operations.

3.10.24.1.3 Fires. The fires function integrates division fires with other complementary and reinforcing functions for achieving air-ground integration. In the JAGIC, fires cell personnel rapidly and efficiently respond to requests for joint fires by coordinating with the necessary air and ground forces to enable the delivery of joint fires in a timely manner. Additionally, the JAGIC integrates division-level Army tactical air mobility division (AMD) systems in accordance with the area air defense plan, enabling direct coordination with area air defense commander, C2 nodes, and division aviation liaisons in the COIC. Division AMD personnel are responsible for establishing, integrating, and maintaining necessary AMD voice and data communications network architecture as defined in ATP 3-01.50.

3.10.25 Surface-to-Air Threat Planning Considerations. Strategic and tactical surface to air missile systems are designed to use either radar or infrared as the primary sensor during aircraft engagement. Guidance for these systems can be broken into four general categories; command guidance, semiactive homing, ground-aided inertial, and seeker-aided ground guidance/track via missile. JTAC should use the information below for planning purposes. However, for more information pertaining to specific threats reference, See AFTTP 3-1.Threat Guide, as well as **Chapter 6**, "Contested, Degraded, Operationally Limited."

3.10.25.1 Command Guidance. Missile commands are generated externally and uplinked to the missile. The missile itself has no seeker and requires both the missile and the target be tracked to determine the necessary intercept commands.

3.10.25.2 Semiactive Homing. The target is illuminated by an external source. A receiver in the missile uses the reflected radiation from the target to generate internal guidance commands, thus homing on the target.

3.10.25.3 Ground-Aided Inertial. The missile receives uplinked target locations data. The missile uses this information, in conjunction with its internal navigation system to generate its own guidance commands.

3.10.25.4 Seeker-Aided Ground Guidance/Track-Via-Missile. The target is illuminated by the ground-based radar and the missile receives reflected energy from the target. Unlike conventional semiactive homing, the missile does not generate its own guidance. Instead, the missile transmits raw engagement data to the ground based fire control system in order to generate an uplink guidance command. Track-via-missile is similar; however, additional processing is done onboard the missile prior to transmitting the engagement data to the ground-based fire control system.

3.10.26 Reference Threat Systems. When referencing threat systems, JTACs should also consider whether a particular threat is templated, reported, or located. Understanding this classification method will give JTACs the ability to force package Air Force and other joint fires assets effectively.

3.10.26.1 Templated. This term represents what a particular unit is capable of having based on the ground order of battle. It is reserved for instances when a threat is known to exist with a particular enemy formation, but has not been located (e.g., "HAWG, ZOMBIE HAS A COMPANY SIZED ELEMENT OF ARMOR MOVING NORTH TO SOUTH IN THE DOG-BONE LAKE. THERE ARE TEMPLATED SA-8S AND ZSU 23-4S COLLOCATED, ADVISE WHEN READY FOR 9-LINE").

3.10.26.2 Report. This is an indication to the aircrew that someone or something has reported that a threat is present in an area. The timeliness of this reporting dictates whether or not the aircrew honors the reported threat. A general rule of thumb is that reporting within 30 minutes should be honored, and the threat should be treated as located. If the information is older than 30 minutes the threat should be treated as unlocated until additional correlation is complete (e.g., "HAWG, ZOMBIE, THERE IS A REPORTED SA-8 IN THE AREA. LAST KNOWN LOCATION AT 12S NV 1999 5647 REPORTED AT 0030Z").

3.10.26.3 Located. This is an advisory call to aircrew to emphasize that someone or something sees the threat at the reported location. This can come from multiple sources including ground personnel. This term should be reserved to explain to the aircrew that they have high confidence in the actual location of the threat mentioned (e.g., "HAWG, ZOMBIE, WE HAVE A LOCATED SA-15 AT 12S NV 5884 9933").

3.11 Joint Operations. As a JTAC operating across numerous different domains and mission sets it is extremely important to consider the many different operations in which they could support. The important thing to consider is that no matter what type of operation the JTAC is supporting, there exists seven different phases of any operation that the JTAC must consider when participating in mission planning. Some of which will require more effort and time resulting in added requirements to ensure the safety of friendly elements. The five different phases of operations that a JTAC must consider are insertion, infiltration, actions on objective, exfiltration, and extraction.

NOTE: The list below is intended to guide the JTAC in the planning of specific type of operation. While it includes many important planning considerations, the list is not intended to be inclusive. The list begins with-the movement to insertion, with the assumption that IPOE/product overlays are readily available/displayed either on a map or by some other means (i.e., SWAK). It is also assumed that commander's guidance has been issued and all key players understand the desired end state for the mission. This facilitates the transition into COA development, where this checklist is intended to be used.

3.11.1 Personnel Recovery. For Personnel Recovery planning considerations see **Chapter 7**, "Personnel Recovery."

3.11.2 Weaponeering. For Weaponeering planning considerations see **Chapter 4**, "Weaponeering."

3.12 Helicopter Assault Force Planning Considerations. When considering helicopter assault force (HAF) operations, the JTAC should treat it as any other operation; however, there are a few key components of the mission where extra emphasis must be placed. Specifically, the JTAC must consider certain phases of the operation that are typically overlooked due the vulnerability of ground forces, as well as the vulnerability of rotary-wing (RW) aircraft.

3.12.1 Landing on the "X". Landing on the "X" implies that the assault force will be landing as close to the actual objective (OBJ) building or area as possible. Generally, this means the force will land within 300 meters from the objective (based on effective small arms range).

3.12.2 Landing on the "Y". Landing on the "Y" implies that the assault force will be landing near the OBJ, but will still be offset from the actual OBJ location by a given distance. Planning ranges generally consider the enemies ability to employ heavy weapons where the aircraft will land within 300 meters of the objective but less than 1,000 meters. This keeps the assault force outside of heavy weapons range.

3.12.3 Deliberate Offset. A deliberate offset infiltration will place the assault force a good distance away from the actual OBJ. This implies that the force conducting the mission will have to travel a greater distance on foot to reach the objective. It allows the assault force the greatest element of surprise, and in some cases the best protection. Landing distances are typically greater than 1,000 meters from the objective.

3.13 HAF Operation. A JTAC involved in a HAF operation must have a keen understanding of the many tools, capabilities, tactics, and limitations for both the aircraft and ground forces involved. Different situations will dictate different methods and applications; however, one must have a good baseline knowledge of how to effectively conduct JTAC operations within this environment.

3.13.1 HAF Advantages.

- Mobility—can rapidly cover long distances.
- Agility—can insert ground forces into areas that may not be accessible via foot or vehicle.
- Firepower—can bring considerable firepower to bear using mounted weapon systems.
- Adaptability—can rapidly adjust to changes in intelligence, terrain, tasking, and other factors to continue the mission.

3.13.2 HAF Disadvantages.

- Security—helicopters represent a bigger target to enemy ground fire as well as threat systems.
- Noise—large noise signature.
- Adaptability—loiter/on station time heavily dependent on available fuel, forward air refuel points (FARP).
- Availability—depending on the ground unit location, RW resources may not be available. Maximum cargo load of aircraft will vary depending on the type of RW aircraft tasked to support a mission.

3.13.3 Coordination With Aircrew. JTACs must allow ample time prior to a HAF to plan with respective RW aircrews. More often than not, the GFC will look to the JTAC as the controlling authority for all air players. Furthermore, a JTAC must be intimately familiar with the air movement table prior to PZ posture. Knowing where all air players will be, number of aircraft involved, and execution times are all very important. Coordination is the key element to a JTAC's success in any HAF operation. Planning considerations include but are not limited to the following.

- Frequency programming and radio use for JTAC within helicopter.
- Loading and staging plans of aligned ground unit (also known as PZ operations).
- Times and locations for hot load and/or cold load rehearsals.
- MEDEVAC call sign, frequency and ingress/egress plan.
- FARP locations.
- Terrain flight modes.

3.13.4 Flight Route Planning. A specific in route flight altitude is not designated and is usually below the coordinating level. Factors affecting flight altitude include enemy, terrain, navigation, weather, flight distance, need for surprise, and pilot fatigue. Pilots may use one, or a combination of all three terrain flight modes as dictated by the mission variables.

3.13.4.1 Nap-of-the-earth flight is conducted at varying airspeeds as close to the earth's surface as vegetation and obstacles permit. It is a weaving flightpath that remains oriented along the general axis of movement and takes advantage of terrain masking. This is a general flight mode and may likely be in close proximity to the enemy.

3.13.4.2 Contour flight is conducted at low altitudes, conforming to the earth's contours. It is characterized by relatively constant airspeeds and varying altitudes as dictated by terrain and obstacles.

3.13.4.3 Low-level flight is conducted at constant altitudes and airspeed dictated by threat avoidance. Its intent is to facilitate speed and ease of movement, while minimizing detection. This mode of flight is used when there is a low-threat level.

3.13.4.4 Route options should be briefed to CAS aircraft for situational awareness. Knowing where and when RW aircraft will ingress/egress the target area will expedite CAS attacks and Shows of Force. Considerations include, but not limited to the following.

- In-route airspeed.
- Time, distance, and heading information for primary and alternate air routes.
- Expected start point (SP) crossing time on ingress and egress.
- Enemy air defense artillery locations within the AO.
- Available assets to deliver SEAD fires.
- Locations, frequencies, and call signs of friendly artillery.
- Airspace deconfliction measures.
- Coordinate with intelligence surveillance and reconnaissance liaison officer (ISRLO) and/or aligned S2 for any remotely piloted aircraft (RPA) support.

- Identify who will be giving the Cherry/Ice call for the planned LZ and what the criteria is.
- LZ/PZ environmental considerations.

3.13.5 Equipment Preparation. Equipment preparation is essential to the success of any HAF operation. The equipment a JTAC brings on a HAF should be based on the mission-set. An excess of equipment and/or the wrong equipment will significantly hinder a JTAC's operational ability. It is important for a JTAC to know what is appropriate, and to pack only those items necessary for the operation.

3.13.6 Individual Planning Considerations.

3.13.6.1 Know the mission—knowing the mission and the intent of the GFC will aid in preparing equipment. Due to the nature of a HAF, minimal gear is preferred. This is especially true, during operations such as fast rope insertion and extraction system/special purpose insertion and extraction system (FRIES/SPIES) and rappelling operations.

3.13.6.2 Noise control—use of a headset during HAF operations is the most preferred method of negating the ambient noise produced by helicopter rotor blades.

3.13.6.3 Antenna location—antenna type and placement should always be considered for each HAF mission. Type and placement depends on what model helicopter will be used, mission requirements, and method of insertion/extraction.

3.13.6.4 Maintain control of gear—each maneuver unit will have own SOPs for entering and exiting helicopters. Each of these techniques is dependent on which model helicopter is being used and the terrain of the LZ/PZ. Whichever method is being used, maintain positive control of all equipment. Tie down NVDs.

3.13.7 HAF Aircraft—CH-47 Chinook. The CH-47F is the Army's only heavy-lift cargo helicopter supporting critical combat and non-combat operations. The CH-47F aircraft has a suite of improved features such as an upgraded digital cockpit featuring the Common Avionics Architecture System (CAAS), a new monolithic airframe with vibration reduction, and the Digital Automatic Flight Control System (DAFCS), which provides coupled controllability for operations in adverse environments (reduced visibility, brownout, high winds). The CH-47F's common cockpit enables multi-Service digital compatibility and interoperability for improved situational awareness, mission performance, and survivability, as well as future growth potential. **Figure 3.26**, CH-47 Combat Troop Capacity, shows the cargo bay of a CH-47 aircraft which can carry 31 combat troops.

3.13.7.1 Communications:

3.13.7.1.1 The CH-47F features the AN/ARC-231 Airborne Communication System, which includes two UHF/VHF AM/FM radios. Capable of lower VHF through SATCOM frequency ranges.

3.13.7.1.2 The CH-47F is also equipped with two AN/ARC-201 single channel ground-to-air radio system (SINCGARS), one AN/ARC-220 HF radio, and one L-Band Blue Force Tracker (BFT) transceiver.

3.13.7.1.3 Access to comms—JTAC access to the CH-47F communications suite can be made at a number of locations throughout the aircraft.

Figure 3.26 CH-47 Combat Troop Capacity.

NOTE: See **Figure 3.27**, CH-47/UH-60 Radio Control Configuration, and **Figure 3.28**, CH-47/UH-60 Audio Nexus Cable, for CH-47 radio configuration, as well as an example audio nexus port connector.

NOTE: Audio/Nexus cables are routed differently depending on the model helicopter and unit-specific SOP.

3.13.8 HAF Aircraft—UH-60 Blackhawk. UH-60M Black Hawk is a medium-lift; RW helicopter designed/manufactured to meet evolving warfighting needs. The UH-60M has multimission capabilities, features new airframe, advanced digital avionics, and a powerful propulsion system. It can be used to perform tactical transport, utility, combat search-and-rescue, airborne assault, command-and-control, medical evacuation, aerial sustainment. It offers improved situational awareness and greater survivability. See **Figure 3.29**, UH-60 Configuration, for an example UH-60 seating configuration.

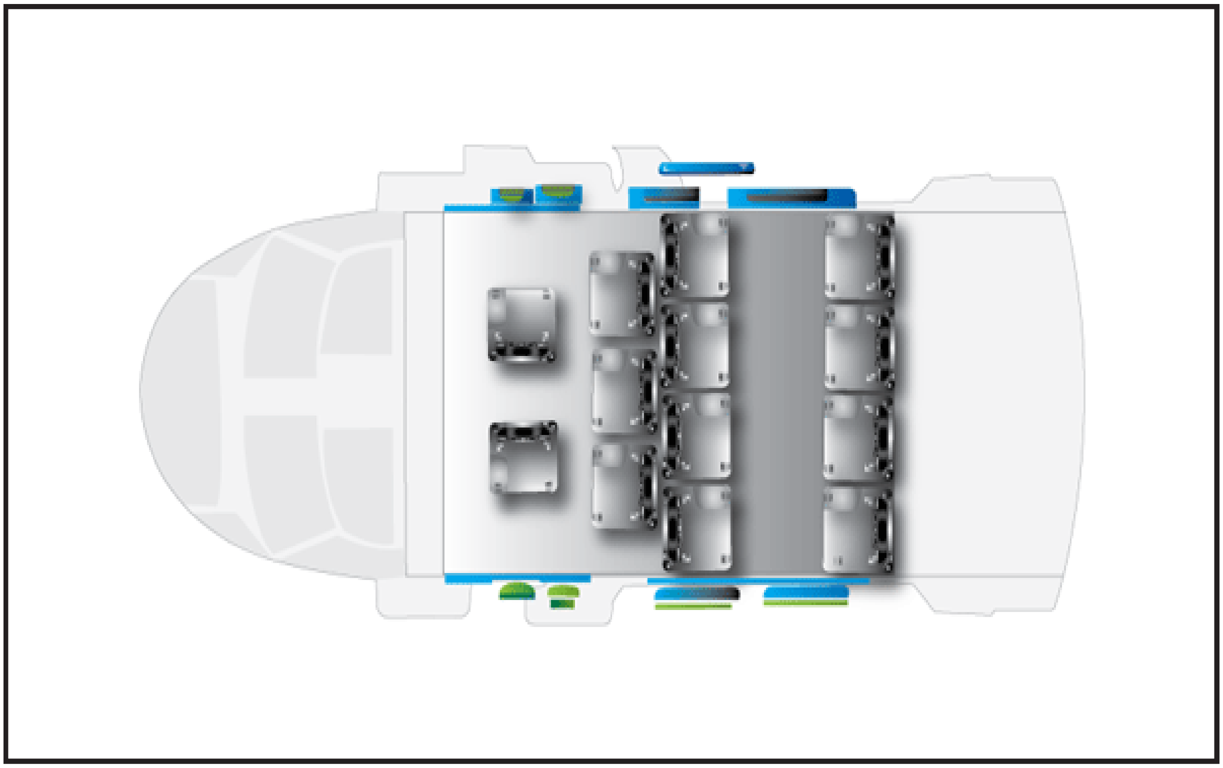
3.13.8.1 Communications:

- AN/ARC-186: Provides two-way voice VHF-AM/FM communications.
- AN/ARC-164(V): (HAVE QUICK II) provides two-way voice UHF-AM communications. It provides an anti-jam frequency-hopping capability.
- AN/ARC-201: (SINCGARS) provides two-way voice VHF-FM communications. It provides an anti-jam frequency-hopping capability.
- AN/ARC-220: HF radio provides long-range, two-way voice and text messaging communications capabilities between other AN/ARC 220-equipped aircraft or AN/ARC-100-equipped aircraft.

Figure 3.27 CH-47/UH-60 Radio Control Configuration.

Figure 3.28 CH-47/UH-60 Audio Nexus Cable.

Figure 3.29 UH-60 Configuration.



NOTE: The UH-60M communication system contains the Joint Tactical Radio System and Joint Alternate Communications Suite (JACS) that includes the following.

- Two AN/ARC-231 multiband radios, FM-SATCOM.
- Two AN/ARC-201D (SINCGARS).

NOTE: See Figure 3.27, CH-47/UH-60 Radio Control Configuration, for an example UH-60 radio Control panel/configuration.

3.13.9 HAF Aircraft—V-22 Osprey.

3.13.9.1 The V-22 Osprey is designed to be operated by a crew of two, pilot and copilot, situated side-by-side in the cockpit. Each crew member is considered redundant (for system survivability) in that each has a complete set of controls necessary to fly the aircraft. Incapacitation of both crew members would result in aircraft attrition. Each crew member is seated in an armored bucket seat.

3.13.9.1.1 Communications:

3.13.9.1.1.1 The V-22 can accommodate up to four MIL-STD-1553B-compatible radios. The MV-22 uses to ARC-210 radios. The CV-22 replaces the ARC-210s with DCS 2000s.

3.13.9.1.1.2 Audio communications for crew members on the aircraft, as well as a connection for the ground crew. The intercommunication system (AN/AIC-30) includes seven stations: pilot, copilot, jump seat, troop commander, forward and aft cabin, and an external station for ground operations or maintenance support.

3.13.10 HAF Aircraft—CH-53 Super Stallion.

3.13.10.1 CH-53 Super Stallion, the Marine Corps' heavy lift helicopter, is one of the few helicopters in the world configured with three gas turbine engines and in-flight refueling. The CH-53E is a larger version of the CH-53 Sea Stallion, and the largest helicopter in the US military inventory The Air Force version, equipped with sophisticated electronic countermeasures systems, is used for long-range delivery and resupply of special operations forces and combat rescue missions.

3.13.10.1.1 Communications:

3.13.10.1.1.1 The CH-53 provides an external troop antenna and an antenna jack connector that interfaces with the antenna. Planners should pay close attention to the distance required to communicate, and consideration should be given to using a radio signal amplifier for manpack radios. An aircraft at 10,000 feet and 5 miles away can easily have a slant range to the intended receiver on the ground that exceeds the power output of the carry-on radio alone. If data communications are not required for a mission, it is also possible to configure an additional radio in the cabin for voice communications by "sharing" the aircraft SATCOM antenna with a PRC-117F or G radio (the PRC-117G is capable of voice or data sharing under this setup). This "sharing" may be accomplished by hooking up the radios to the aircraft helosat antenna. This capability does not change fit, form, or function of the aircraft's communication system, and is currently authorized and described in detail in the CH-53 NATOPS.

3.13.11 HAF Aircraft—UH-1Y Huey.

3.13.11.1 The UH-1Y Huey has many mission requirements, including C2, escort, reconnaissance, troop transport, medical evacuation, and close air support. Typically, detachments of two to four Hueys have been deployed with detachments of four to eight Cobras. The Y-model upgrades pilot avionics to a glass cockpit, adds further safety modifications, and provides the UH-1 with a modern FLIR system. However, the biggest improvement is an increase in engine power. By replacing the engines and the two-bladed rotor system with four composite blades, the Y-model returns the Huey to the utility role for which it was designed. See **Table 3.7**, Typical UH-1Y Capabilities and Configurations.

3.13.11.1.1 Communications:

3.13.11.1.1.1 Communications suite includes the US Navy standard AN/ARC-210 radio, UHF/VHF communications, COMSEC, an APX-100(V) identification, friend or foe (IFF), a satellite communications interface with a high power amplifier and tactical data modem.

3.13.11.2 Daytime Considerations:

3.13.11.2.1 Due to the amount of ambient light, daytime HAFs are far more vulnerable to enemy actions. As a JTAC, focus should be on integrating CAS into the operation in order to reduce the chance of enemy interdiction.

3.13.11.2.2 Pre-coordination with aircrew/aligned ground unit.

3.13.11.2.3 Hot LZ/PZ.

3.13.11.2.4 Ensure knowledge of the aligned ground unit's SOP for a hot LZ/PZ.

Table 3.7 Typical UH-1Y Capabilities and Configurations.

Mission	Equipment	Passengers	Endurance	Ordnance
C&C [1,2]	3x ARC-210 Sensor DAS	5	2+30	GAU-21 600 GAU-17 3000
Troop Lift[1,2,3]	Sensor DAS	6 to 10	2+00	GAU-21 600 GAU-17 3000 M-240D 600
CASEVAC[1,2,4,5]	3 Man Litter Kit Sensor DAS	7	2+00	GAU-21 600 GAU-17 3000
Fast Rope[2,6]	2 Gantries Sensor DAS	8	2+00	GAU-21 600 GAU-17 3000
FAC(A)[1,2]	Sensor DAS	—	2+00	11 Smoke rockets 7 HE rockets GAU-21 600 M-240D 500
Escort/RW CAS[1,2]	Sensor DAS	—	2+00	14 HE rockets GAU-21 600 GAU-17 3000

OVERALL NOTE:

*All endurance numbers and passengers are based on full internal fuel only.

NOTES:

(1) One crew chief and one aerial observer included as aircrew.

(2) Fuel endurance and passenger/ordnance loads may be less because of temperature, altitude considerations, and density.

(3) Aircraft can be configured for maximum of 10 crash-worthy seats.

(4) Passenger includes one corpsman.

(5) Aircraft can be configured for maximum of six litter patients.

(6) Passenger includes one helicopter rope suspension technique (HRST) master.

3.13.11.3 Enemy Actions. There are four types of enemy activity that can be employed to oppose landing operations. The enemy may employ a combination of these activities.

- Near Ambush: enemy force within reasonable assaulting distance (50 meters) of the LZ.
- Far Ambush: enemy force outside assaulting distance range within audio, visual of LZ, and capable of effective organic firepower.
- Indirect fire: delivered by distant mortars, artillery, or rockets, but directed by an enemy that can see the LZ.
- Mines/obstacles: anti-landing mines, booby traps, and barriers.

NOTE: Overall, mitigating these types of enemy activities will be up to the air assault task force commander (AATFC). However, JTACs must consider which fire support assets they will have and plan accordingly to help mitigate potential enemy action. Pre-assault fires (if used) on or near the LZ should also be planned in detail, and can be used to mitigate potential enemy action.

3.13.11.4 Night Time Considerations. The lack of light during night HAF operations greatly decreases SA for all involved. JTACs must know what equipment, techniques, and aircraft capabilities can be used to overcome this disadvantage.

- Discuss with the GFC and determine if covert or overt flares are required.
- Request specifics on DD Form 1972.
- Coordinate employment techniques with both RW and FW aircrews.
- Discuss the approval for kinetic marks with the GFC.

3.13.11.5 Noise Abatement:

3.13.11.5.1 Discuss with the GFC what the intent is and ensure CAS platforms have an understanding of that intent prior to checking on station.

3.13.11.5.2 Marking targets (from ground and from aircraft).

3.13.11.5.3 Ensure all players, both ground party and aircraft (RW/FW), understand SOPs and equipment that will be used for target marking. With the many moving parts of an HAF operation, a friendly laser, strobe, tracer round or flare could be confusing or worse be considered hostile to someone not aware of its intent.

3.13.11.6 PZ/LZ Marking Techniques:

3.13.11.6.1 Unless it is briefed and fully understood, do not use the same mark for both the PZ/LZ and target. This is a dangerous practice and should be avoided at all cost.

3.13.11.6.2 Coordinate with both RW and FW aircrews prior to each operation regarding which method of marking will be used (i.e., laser, strobe, buzzsaw, flare, static IR chemical stick, and whether it will be covert or overt).

3.14 Ground Assault Force Operations. JTACs may be called upon to infiltrate and operate anywhere in the world over a variety of terrain—from high, rugged mountains to low-lying deserts of deep sand. The capability to travel long distances, unassisted, in otherwise inaccessible areas provides the JFC with a viable long-range capability in support of the following mission areas.

- Direct action (DA).
- Combat search and rescue (CSAR).
- Humanitarian relief operations (HUMRO).
- Combat search and rescue (CSAR).
- Precautionary/pre-positioned personnel recovery (PR).
- Nonconventional assisted recovery (NAR).
- Unconventional assisted recovery (UAR).
- Foreign internal defense (FID).
- Building partnership capacity (BPC).

3.14.1 Preparation. In order to prepare for such roles, teams must develop the following capabilities: operate, navigate, and communicate over long distances; operate effectively and continually in a hostile environment that may severely limit or prevent air support; navigate and operate in rugged terrain—both on and off-road; and make on-site repairs to all equipment using only the skills of the team members and onboard tools and parts.

3.14.2 GAF Advantages.

- Safety—can mitigate risks to aircraft by inserting safe distances from threats and proceeding overland to the target area.
- Mobility—can rapidly cover long distances, reducing reliance on aircraft for operational support.
- Compatibility—can work with US and foreign mechanized troops without additional vehicle assets.
- Air Mobility—can use a variety of aircraft for airland or airdrop operations.
- Endurance—can remain in the field for extended periods without resupply. Endurance is further enhanced with resupply.
- Firepower—can bring considerable firepower to bear using vehicle-mounted weapon systems.
- Adaptability—can rapidly adjust to changes in intelligence, terrain, time available, tasking, and other factors to continue the mission.

3.14.3 GAF Disadvantages.

- Maintenance—personnel must be skilled in maintenance and repair (to include depot-level maintenance procedures) and require additional tools and parts to sustain extended operations.
- Training—personnel require additional training in mounted planning, tactics, driving, navigational techniques and route planning, maintenance and repair, and vehicle camouflage.

- Security—the profile, tracks, and noise of vehicles increase the possibility of detection.
- Medical Treatment—treatment in/on vehicles during extended operations involves unique challenges and planning considerations.

3.14.4 GAF Principles. Aggressive—the positioning of the vehicle, weapons systems, and personnel should dominate the environment and remove any doubt that the team is capable of inflicting lethal force. The team must remain ready to engage threats with weapons systems and, if necessary, with the vehicles.

3.14.5 Unpredictable. Predictability makes the team vulnerable to attack. The mounted team should vary routes, departure times, and vehicle intervals and speeds. The team must never appear to be lost or stop for extended periods in populated areas. Cross-country travel is inherently unpredictable and should be used to the maximum extent possible. Planning should include identification of primary routes, alternate routes, rally points, and laager (camouflaged defensive encampment) sites.

3.14.6 Agile. Rely on stealth, speed, and adaptability to accomplish the mission and protect personnel and equipment. Vehicle speed should be proportionate to the terrain, mission, and driver skill/experience. Drivers must become proficient at maneuvering the vehicle through or around obstacles, vehicles, and pedestrians. Teams must be prepared to rapidly change course and react to contingencies with well-rehearsed SOPs and immediate action drills. Cross-country driving requires specialized skills and intimate knowledge of the vehicle's capabilities and limitations.

3.14.7 Situational Awareness. Maintain 360-degree security during movement. All personnel should be briefed on the mission and the primary and alternate routes. A well-rehearsed communications plan aids in dissemination of critical information and helps orchestrate movement and reaction to threats or contacts. Personnel must become proficient in three-dimensional (depth, width, and elevation) threat-scanning. Careful observation of individual movements and behavior of the local population help the team detect potential threats.

3.14.8 Other Considerations.

- Key terrain should be occupied at all times if possible.
- Stay undetected if able.
- Pace is dictated by threat, just like a foot patrol.
- Keep engine noise down, specifically when off road or approaching a vehicle drop off (VDO).
- Stop often and scan horizon. When able, use ISR, but do not rely on it.
- Crew must maintain good noise discipline. Talk quietly/shut doors quietly.
- Navigator must maintain awareness of convoy's location, threats, danger crossings, alternate routes, keep convoy informed and use good light discipline.
- Use appropriate optics to scan forward of the patrol (thermal devices).

- Continuous scanning for threats, improvised explosive device (IED), and routes that limit options or funnel convoy into an area.
- Smallest element possible makes contact with the enemy; this allows remaining vehicles to maneuver/flank the enemy.

3.14.9 Threats to Convoys. Although mounted vehicle operations may face threats that are common to all elements within a theater of operations, they also encounter unique threats that may otherwise be avoided or minimized by aircraft or a dismounted force. Threats posed to vehicle teams fall under two broad categories according to the type of movement—those conducting convoys or urban movements, and those conducting off-road movements. Teams must recognize, plan, and rehearse actions to counter all potential threats. Certain threats exist that are more likely to be encountered by off-road movements.

3.14.10 Additional Convoy Planning Considerations: Communication Plan. A redundant communication plan should be developed and implemented. Teams must conduct a communications test on all systems used. If possible, communications systems should be tested in an environment similar to that of the AO.

3.14.11 Dress Rehearsals. Team leadership must allow for time to conduct full dress rehearsals. These rehearsals should include vehicle formations, navigation techniques, communications plans, reaction drills, personnel and equipment recovery drills, and the destruction of left-behind vehicles. Live-fire maneuvers should be conducted on an appropriate range. Vehicle hide site techniques, security techniques during movement and halts, and link-up or passage of lines with US or foreign units should be practiced. The configuration of personnel, weapons, and equipment for each vehicle must be established and rehearsed.

3.14.12 CAS in Joint Forcible Entry Operations. The inherent uncertain and dynamic nature of a joint forcible entry (JFE) creates a unique tactical problem in regards to AO ownership. Thus, the plan addressing succession of command roles and responsibilities must be understood by all JTACs. Any JTAC, at any level in the chain of command, must be able to conduct the roles and responsibilities of all higher echelons until that higher echelon is established and is able to assume command.

3.14.12.1 The JTAC communications plan must be well planned due to the large volume of information. Ground frequencies should be used for requesting aircraft from the JTACs higher echelon. The communications plan must be resilient, with special attention being paid toward the development and deconfliction of ground strike nets. The JTAC strike frequencies should be kept clear of unnecessary communications, unless absolutely necessary. To facilitate expeditious CAS, consider using multiple Strike nets, either one per JTAC or one per geographic area (one for JTACs on the east side of the objective and one for JTACs in the west).

3.14.12.2 Brigade and battalion JTACs must coordinate with supported ground commanders to allow delegation of release authority to the lowest possible level.

3.14.12.3 Once again the inherent uncertainty of a JFE comes into play. This allows for attacks to be conducted even if communications with higher echelons have not been established. See **Table 3.8**, JFE Planning Checklist, for JFE planning checklist.

Table 3.8 JFE Planning Checklist (1 of 2).

Forcible Entry Phase I	Preparation and Deployment
An accurate time phased force deployment (TPFDD) is developed.	• Who is deploying to support the JFE and when?
The JFC assigns complementary and/or deconflicted missions to components.	• What is your surrounding AO?
Command relationships/comms plans are delineated/created.	• Frequencies assigned for JTAC ground and strike nets. • Comms flow coordinated with higher echelons/what comms go through what nets/CAS request process at all levels.
Rehearsals are conducted.	• MDMP phases and scheme of maneuver rehearsals are conducted.
The intelligence effort for components is prioritized.	• How can battalion air liaison officer (BALO) help here?
Initial air apportionment decisions are made.	• Crucial to our ops.
Targeting guidance is disseminated.	• Priority of fires. • Priority target list.
Determine the arrival sequence of forces.	• How are follow-on forces arriving? • When and in what strength?
Integration and/or synchronization with other (if any) operations is completed.	• Other forces pushing into your AO? • Deconfliction of airspace as force push toward JFE objective.
MILDEC operations are executed.	• Integrating airpower into deception.
Advanced force operations (i.e., countermine, air superiority, space and cyberspace superiority, SOF operations) conducted.	• Prepping the objective for JFE. Understanding SOF maneuver crucial for deconfliction of pre-assault fires.
Sustainment activities and requirements are planned.	• How are we getting batteries, fills for radios, food, and water?
Fire support and airspace coordination measures are created and disseminated.	• ROZ, keypad, keyhole in keypads/CPs, IPs/plan deconfliction from airland/subordinate JTAC roles/disseminate all products to CAS team (strike A/C and JTACs)/AO ownership plan.
ISR assets in the assault are positioned and report their information.	• Gather needed intel for planning.

Table 3.8 JFE Planning Checklist (2 of 2).

Forcible Entry Phase II	Assault
Air apportionment is reassessed and revised.	• Check ATO.
H-hour (specific time an operation begins) synchronization is completed among components.	• If H-hour changes, ensure your CAS aircraft, ACA start times, and pre-assault fires are rolled to new H-hour.
Fire support coordination and airspace coordination measures are activated.	
Pre H-hour activities and/or staging are completed.	• Final brief with all JTACs. • Comms check conducted. • Board A/C, pre-assault fires take place.
Forcible Entry Phase III	**Stabilization of the Lodgment**
Terrain management issues are addressed.	• Comms issues addressed.
Clear airfield of hazards.	
Runways, aprons, taxiways, and parking areas are repaired and maintained to support continuous air landed operations.	
Airspace control is coordinated.	• Deconflict CAS from airland operations.
Medical evacuation is provided.	• Deconflict CAS from MEDEVAC operations.
TPFDD flow is managed.	• Reevaluate who and what is showing up in your AO to build combat power.
Forcible Entry Phase IV	**Introduction of Follow-On Forces**
Force sequencing is continuously adjusted.	
Operations are transitioned to follow-on forces.	• Handover JTAC duties to follow-on JTAC.
Reconstitution and/or redeployment of assault forces.	
Joint security operations issues addressed.	
Forcible Entry Phase V	**Termination or Transition Operations**
Achievement of operation or campaign objectives.	• Reconstitute and redeploy the joint force.
Achievement of operational objectives.	• The forcible entry operation establishes the condition for follow-on operations.

3.14.13 Communications Planning and Interoperability. JTACs need to ensure they have the ability to communicate across many different spectrums and different levels; from the lowest maneuver element all the way to HHQ. JTACs inherently assume an increased responsibility when it comes to communications because of the ability to talk across many different spectrums, both voice and digital.

3.14.13.1 Maximum power output for handhelds usually does not exceed 5 watts compared to 20 watts for a manpack radio. Emerging handhelds have increased output for BLOS data burst, but not for LOS voice.

3.14.13.2 Antennas are another component in a radio's capability or limitation. The antennas that come with handheld radios are either multiband antennas capable of transmitting signals from 30 to 512 MHz LOS or a tape antenna for VHF-low only. The wide range of frequency capability on a multiband antenna potentially comes at a reduction in signal strength in each frequency range compared to an antenna built specifically for only one frequency range. Many other factors may affect the radio's capability, often degrading its capability: the amount of metal on the operator's kit, terrain, weather, or routing of the antenna in the kit.

3.14.14 Long Range LOS and BLOS Communications. Manpack radios provide full VHF to UHF frequency range, frequency hopping, SATCOM, and data capabilities while providing up to 20 watts of transmission power, making it the radio of choice when degradation of communication from terrain or environment could limit the ability to pass critical information. For instance, in the higher-latitude forest environment during winter, the handheld radio will be less effective, especially for SATCOM. This is due to terrain that can interrupt the signal, cloud cover, and more potential atmospheric conditions between the operator and MILSAT satellites. See **Chapter 2**, "Equipment," for set up of JTAC Equipment.

3.14.14.1 When participating in any operation JTACs should first consider friction points and areas where Tactical Problems may develop when employing joint fires assets. In doing such, JTACs should come to the planning table with solutions to potential problems using experiences and checklists. The key to success in mission planning is not necessarily the question to be asked per any given checklist, but more importantly the solution to the tactical problem as seen from the JTAC's perspective.

3.14.14.2 JTACs first begin to identify tactical problems and friction points during the mission brief. Similar to rehearsals mission briefs can follow many different formats and the amount of information presented will be dictated not only by the type of operation, but also the time available. Mission briefs should be conducted with as many players as possible, but when operations tempo precludes having all of the supporting assets present, it can be done amongst JTACs. In either case JTACs should consider the below items when developing the mission brief and tactical problems.

3.14.14.2.1 IPOE. The supported unit's intelligence section should create/provide the IPOE brief to aid planners in mission analysis. Briefs should focus on enemy and environmental situations to include enemy tactics (MLCOA and MDCOA), civilian and political atmospherics, weather, and types of terrain within the AO. JTACs should use this information to determine where and when CAS would be most effective; delivering a decisive blow to the enemy.

3.14.14.2.2 Essential Elements of Information (EEI). Information regarding the enemy or environment that affects the commander's planning.

3.14.14.2.3 Essential Elements of Friendly Information (EEFI): Key elements of information as it pertains to friendly scheme of maneuver, and cross boundary operations, other JTACs operating in the AO.

3.14.14.2.4 Specified and Implied Tasks. JTACs must understand the difference between specified and implied task as it pertains to the mission they are supporting in order to effectively achieve the ground commander's intent. Specified tasks are those items that can be found in the OPORD, CONOP, or fragmentary order (FRAGO); however specified task can also be issued verbally. Implied tasks are those things that need to be accomplished, but are not necessarily published in a formal order. Differentiating between specified and implied tasks will assist the JTAC in developing CAS mission objectives that tie in closely with the Army mission objectives.

3.14.14.2.5 Review Available Assets. Understanding the capabilities and limitations of the assets supporting a mission will not only enable the JTAC to use allocated assets to the max extent possible, but it will also help cue them into what assets may still need to be requested.

3.14.14.2.6 Identify Limitations. Limitations typically fall into two general categories; resource limitations or limitations imposed by the physical characteristics of the operational environment (i.e., enemy strengths). When developing tactical problems, JTACs will typically focus on this one area, understanding own personal limitations, the limitations of supporting assets, and the limitations that the environment in which they are operating imposes on them (i.e., non-permissive, CDO, etc.). Although it is impossible to come up with all of the limitations to a mission, understanding the greatest points of friction the JTAC can begin to develop contracts and game plans to overcome tactical problems.

3.15 DA-CAS Planning Considerations. Digital CAS systems are tools used to transfer target and situational awareness information between the JTAC, tactical operations center (TOC), ASOC, FAC-A, CAS aircraft, and fire support systems. When used properly, they can reduce the time required to prosecute targets, build situational awareness, and assist in preventing fratricide. Also, digital communications provide an alternative means of communication in an environment where the electromagnetic spectrum is degraded. These tools and tactics are similar to traditional marks in that they aid CAS aircrew in rapidly acquiring the target or friendly locations. Data links tend to fall into two general categories: LOS and BLOS.

3.15.1 Link 16 Tactical Data Link. Link 16 is the predominant tactical data link (TDL) used in USAF, joint and coalition operations. It is a high capacity, secure, jam-resistant communications system that supports a wide variety of information exchanges. These exchanges include air/surface/subsurface/land/space surveillance tracks, command and control directives, participant position reports, platform status, electronic warfare, imagery, network enabled weapons, engagement coordination, integrated fire control, and fighter target reports.

3.15.2 Situational Awareness Data Link. Situational awareness data link (SADL) is a high capacity, secure, jam-resistant communications system that is an AF derivative of the Army's Enhanced Position Location Reporting System (EPLRS) networking technology. It supports a wide variety of information exchanges along with the ability to exchange friendly ground force positions and CAS mission data with the ground EPLRS network. A configured Gateway is required for integration with Link 16 networks.

3.15.3 Joint Interface Control Officer. The most complex TDL environments are real world operations under the responsibility of a JFC and conducted IAW an OPLAN and/or OPORD. Complex TDL networks can also occur in large-scale joint exercises. These complex multi-TDL network operations will fall under the management of a joint interface control officer (JICO) managing a joint interface control cell. The information pertaining to link architecture, specific roles, participants, track number blocks, and other network specific identifiers will be contained within the operational tasking data link (OPTASKLINK).

3.16 ATAK Planning Considerations. It is important to understand that ATAK software is continually evolving, reference **https://takmaps.com** for the most up-to-date training. Scroll over to FAQ and Training at the top of the page, select either Training Videos or ATAK Interactive Training Tool, also see **Chapter 2**, "Equipment." For SWAK specific training, reference the TACP Resources website at **https://tacp.af.mil/resources/index.html?date=9/2/2020**.

3.16.1 ATAK Imagery Request Process. If planning on using ATAK during the mission, make sure to put the specific imagery for the area operating in on the EUD. The following details the processes to upload imagery to the SWAK.

3.16.1.1 ATAK Point Mensuration Tool (PMT) using portable reference images (PRI) process.

3.16.1.1.1 PRI gives the JTAC a near mensuration tool capability and provides them with up to CAT I, UNCLASSIFIED imagery for use in ATAK. The process to download PRI images can be found in the steps below. The assumption is that the user already has a TAKMAPS account and can log-in to the TAK-TICS site.

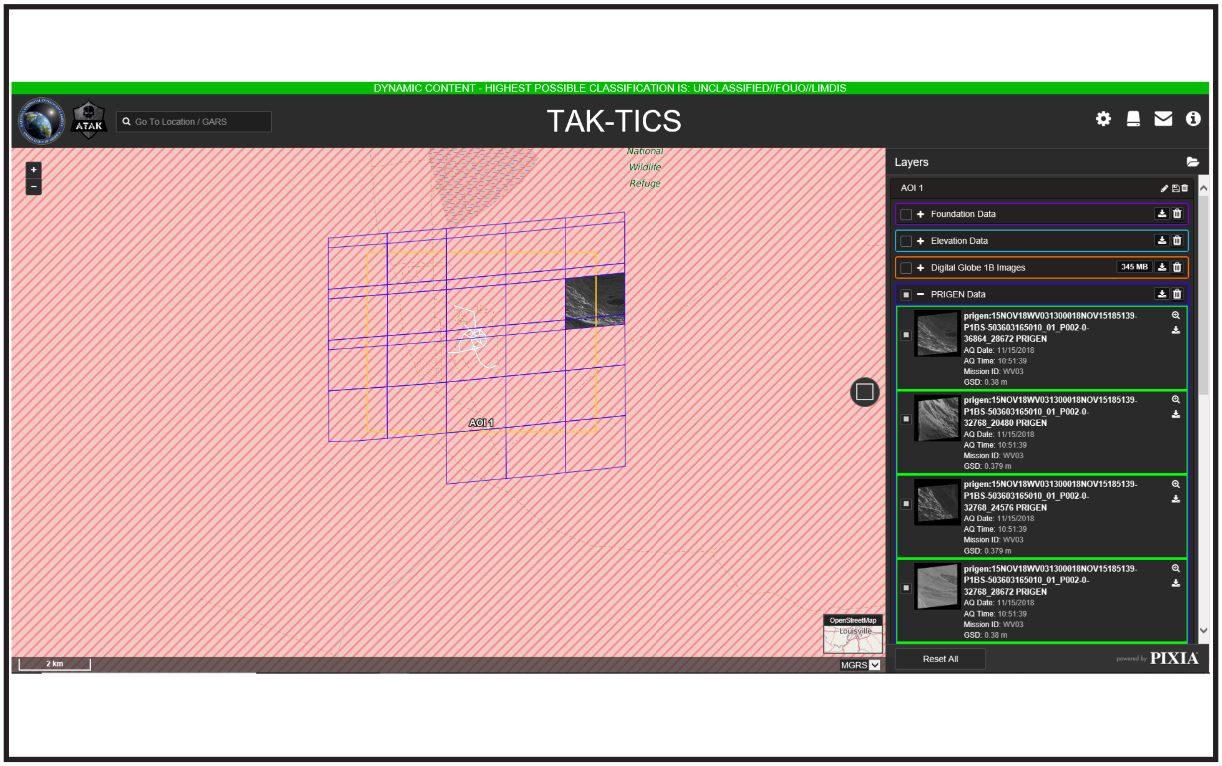
3.16.1.2 Once the user is logged into the TAK Maps website (**https://takmaps.com**), navigate to 'downloads' and select 'TAK-TICS.' Once the new page loads, scroll to the bottom of the page and click on the 'TAK-TICS Website' button to open TAK-TICS.

3.16.1.3 Once TAK-TICS loads click "accept" on the Terms of Use to begin using the site.

3.16.1.4 In order to download imagery and PRI the user must navigate to their desired area on the screen and draw a box to create an "AOI." Follow the on screen prompts to do this.

3.16.1.5 When the "AOI" is created, TAK-TICS displays a "layers" section on the right side of the screen. This section includes all of the map data that is available for the specific AOI. The user should follow unit file structure/naming SOP in order to download the desired imagery, maps, charts, and DTED information. The PRI imagery can be found under the "PRIGEN Data" submenu of the "layers" section. See **Figure 3.30**. TAK-TICS PRIGEN Data Screenshot.

Figure 3.30 TAK-TICS PRIGEN Data Screenshot.



3.16.1.6 Once imagery has been downloaded and transferred to the stand-alone mission planning computer use the following steps to import the PRI into ATAK.

3.16.1.7 Start by inserting the EUDs SD card into the computer.

3.16.1.8 Open File Explorer, access the SD card, open the ATAK folder on the SD card and create a new folder named "GRG."

3.16.1.9 Drag and drop the PRI images that were downloaded into the "GRG" folder that was just created on the SD card.

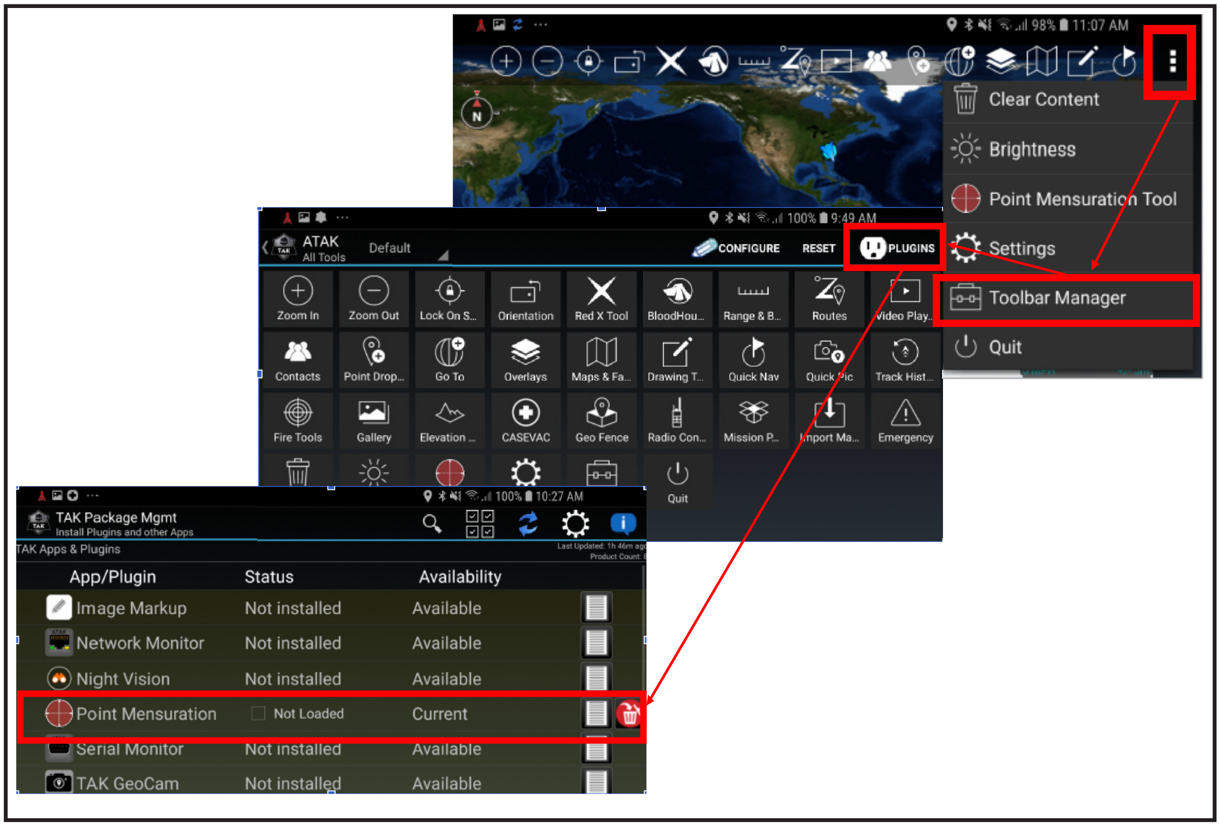
3.16.1.10 Images loaded into the created "GRG" folder on the SD card will be displayed in the Overlay Manager tool under the GRG sub-item. These images will automatically load when zooming in on ATAK. If clicking on the entries in the GRG list, SWAK will automatically zoom to the image.

3.16.1.11 SWAK PMT is a plugin for ATAK. Plugins can be found and installed using the TAK Package Management screen, see Figure 3.31. ATAK Point Mensuration Tool Install Screens.

3.16.1.12 Navigate to the TAK package management screen by selecting the Options Menu, Toolbar Manager, and then select plug-ins from the top right corner.

3.16.1.13 Once the user has the TAK Package Management screen populated find the "Point Mensuration Tool" and select install. Once installed, the tool can be used to modify points for near-mensuration.

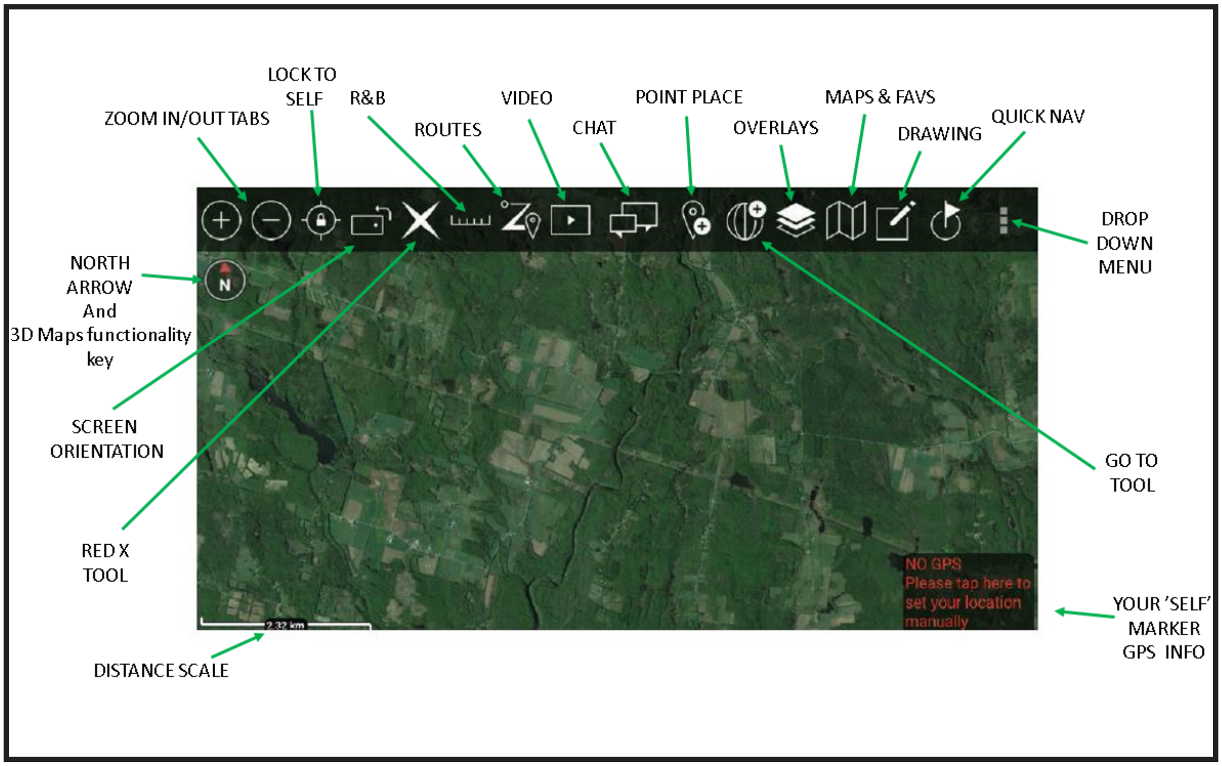
Figure 3.31 ATAK Point Mensuration Tool Install Screen.



3.16.1.14 During mission planning, it is recommended to customize the Action Bar on your EUD that is most advantageous for execution. See **Figure 3.32**, ATAK Fighting Screen for an example action bar and the associated functions.

3.17 Postmission Debrief. One of the most overlooked portions of the mission is the postmission debrief or after action report. Debriefs are just as crucial as the planning and execution of the mission. Some could argue that capturing the lessons learned during the mission debrief are even more important because it can contribute directly to future mission success. Although time will not always allow for a full comprehensive debrief with all supporting players present, a debrief should still occur in some fashion. Generally speaking, a debrief should be broken down into three components or parts: truth data gathering, reconstruction/debrief focus point (DFP) development, and lessons learned presentation.

Figure 3.32 ATAK Fighting Screen.



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CHAPTER 4

WEAPONEERING

4.1 Introduction. Weaponeering is the process of estimating the quantity of a specific weapon required, kinetic or non-kinetic, to achieve a specific level of damage to a given target, considering target vulnerability, weapon effects, munition delivery errors, damage criteria, probability of kill, and weapon reliability. The purpose of this chapter is to give the JTAC a look into the process of translating ground force commander's intent (GFCI) to desired weapons effects (DWE), then weaponeering to achieve DWE. This process includes pairing effects from non-kinetic, air-to-surface, surface-to-surface, and sea-to-surface weapons with targets that JTACs have and/or will find in the current and future combat mission arenas. This chapter will provide the JTAC with the requisite knowledge on how to weaponeer a specific target during the preplanning or tactical engagements. It will provide examples of weaponeering software and examine the tactical weaponeering process in detail. It lists TTP, identifies basic rules of thumb for weapon to target pairing for common CAS platforms, common loadouts, and common target types found on current and future battlefields.

4.2 JTAC Weaponeering Process. The JTAC weaponeering process starts with target nomination and associated GFCI for the target set. The JTAC must take the GFCI and translate that into DWE, expressed using defined terms that are expanded in **paragraph 4.3**, Common Definitions. The pairing of weapons to meet DWE generally happens in one of two venues: preplanned weaponeering or tactical weaponeering. The JTAC can easily determine which process to follow purely based off the time available to meet DWE. JTACs should make the following considerations: fratricide mitigation, collateral damage estimate (CDE), target location error (TLE), contested, degraded, operationally limited (CDO), available weapons/effects, and weapons conservation plans. Finally, the JTAC checks the weapons effects solution to ensure GFCI is being met for the target set and holistically the CAS mission. See **Figure 4.1**, Weaponeering Process.

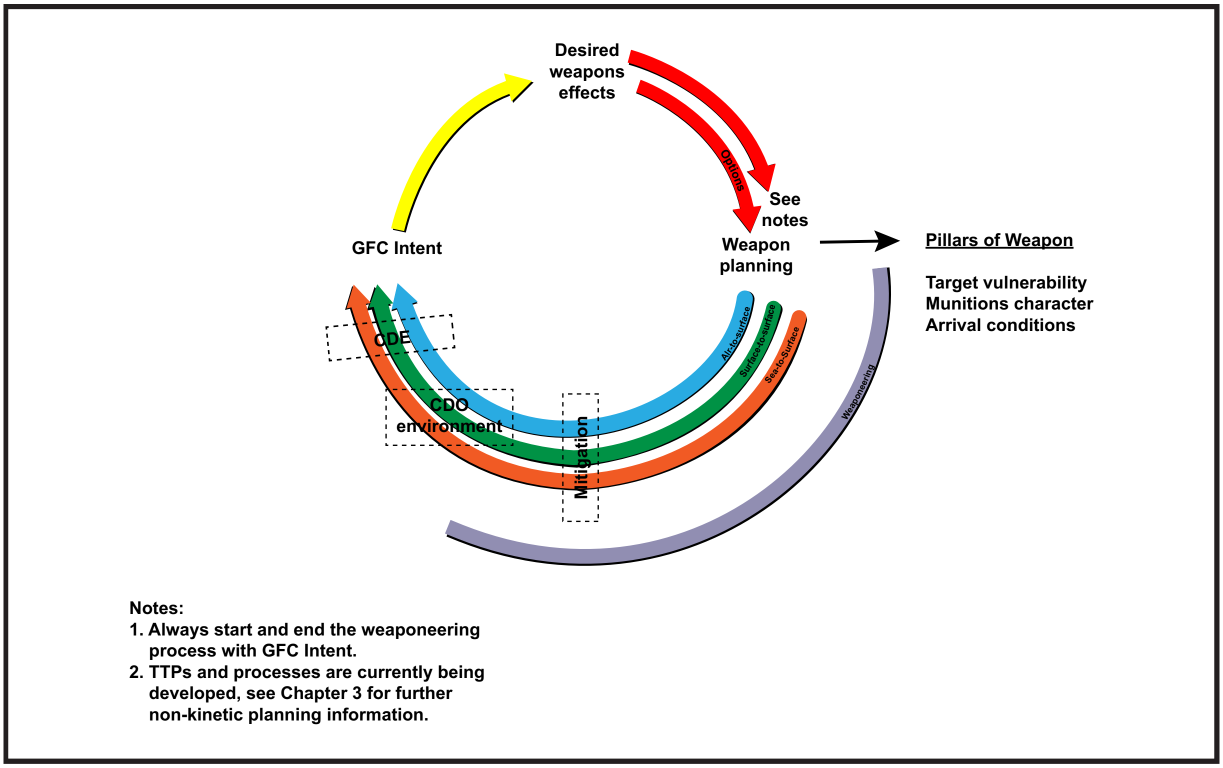
4.2.1 Effects. Options to achieve DWE are broken down into two sections, non-kinetic and kinetic effects.

4.2.1.1 Non-kinetic effects (NKE) include; electronic optical (EO), electronic warfare (EW), cyber and space. TTP and processes for employment are under development. See **Chapter 3**, "Mission Planning Considerations," for specifics on mission planning considerations.

4.2.1.2 Kinetic effects are separated in three delivery types.

4.2.1.2.1 Air-to-Surface. This includes fixed-wing (FW) and rotary-wing (RW) aircraft weapons. FW employment is the focus of this publication. For air-to-surface weapons common descriptive and procedural information reference TO 1-1M-34, *Aircrew Weapons Delivery Manual (Nonnuclear) Standard Volume*.

Figure 4.1 Weaponeering Process.



4.2.1.2.2 Surface-to-Surface. Discussion of indirect systems of the 120 mm or greater, and missile systems are considered for the weaponeering process, due to specific capabilities and guided munitions. For specifics on surface-to-surface weapons systems, refer to the following FMs for the respective systems: MCIP 3-16.0, *Tactics, Techniques, and Procedures for Lightweight 155*, and ATP 3-09.50/MCWP 3-1.6.23, *The Field Artillery Cannon Battery*.

4.2.1.2.3 Sea-to-Surface. Tomahawk Land Attack Missiles (TLAM) and 5 inch guns.

4.2.2 Weaponeering Considerations. JTACs should take the following considerations during both preplanned and tactical weaponeering—mitigation, CDE, TLE, and CDO conditions. Available weapons/effects and weapons conservation plans all affect weaponeering decisions.

4.2.2.1 Fratricide mitigation, due to proximity or tactical situation of the friendly element, is a driving force for weapons/effects selection. Depending on the GFCI for target engagement, the JTAC has options of selecting weapons (i.e., strafe or advanced precision kill weapon system [APKWS]), which generate a small weapons effects footprint rather than a guided bomb unit (GBU), or general purpose bomb. Fuzing also should be considered as an option, due to change in the propagation of effects of blast or frag when a weapon is airbursted, impact fuzed on the surface, or delayed into the ground or a building to mitigate effects.

4.2.2.2 Risk estimate distance (RED) is an estimate of the risk of friendly casualties that may result from weapons effects near friendly forces expressed as a probability of incapacitation (PI). The PI in combat, which drives danger close distances, is 0.1 percent.

A 0.1 percent PI represents a one in 1,000 chance of each individual becoming incapacitated due to a weapon impact within the referenced distance. A 0.1 percent PI should not be interpreted as one in every 1,000 troops will become incapacitated.

4.2.2.3 CDO conditions constrain the type of weapons that can be employed for various reasons.

4.2.2.4 Circular error probable (CEP) is an expression of either ballistic weapon dispersion or guided weapon expected accuracy performance. CEP is a reflection of a weapon's accuracy, not the coordinate's accuracy. Classified CEP data are found in joint munitions effectiveness manuals (JMEM) or from air-to-ground weapons system evaluation program (WSEP) data. CEP is a statistical prediction based on historical results and presented relative to a desired point of impact (DPI). Specifically, CEP is the circle around the target that predicts where any single bomb has a statistical chance of hitting (normally 50 percent). CEP is not necessarily suitable for predicting where most of the weapons will hit. For example, if a bomb has a CEP of 30 feet, each bomb of that type has a 50 percent chance of landing within 30 feet of the DPI. Likewise a CEP of 30 feet predicts that 50 percent of the bombs dropped will land outside of 30 feet of the DPI. CEP (weapon accuracy) is calculated separately from TLE (coordinate accuracy), and when combined, they affect field performance of a weapon delivery. See **Figure 4.2**, Circular Error Probable.

4.2.2.5 Target location error (TLE) is defined as the difference between a set of target coordinates generated by a tool/system and the actual location of the target. To provide targeting information effectively to CAS or surface-to-surface platforms using coordinate-dependent munitions, the JTAC must understand how different situations and equipment can provide varied levels of TLE. In order to facilitate communication of targeting accuracy, TLE is characterized into six categories, and range from most accurate category (CAT) grid, (CAT I) to least accurate (CAT VI). TLE is expressed in several components: circular error (CE), vertical error (VE), and spherical error (SE). TLE categories, however, are expressed in CE only, because this shows the error of the system in the horizontal plane, and thus portrays the system's capability most accurately with weapons dropped at near 90-degree impact angles; this is common in CAS. If executing significantly different weapons profiles (such as low-impact-angle deliveries), and SE numbers are available for the system generating the coordinates, consider using SE numbers for planning purposes if significantly different from CE. See **Figure 4.3**, Target Location Error Illustration. TLE values typically are expressed as distances, which correspond to a 90 percent chance that the actual target will be within the stated distance. For example, coordinates with a TLE90 (CE) of 5 meters means that there is a 90 percent chance that the coordinates are within 5 meters of the actual target in the horizontal plane. A TLE of 5 meters is a very accurate TLE and would be considered CAT I coordinates. A TLE of 400 meters is a very inaccurate TLE and is considered CAT VI coordinates. See **Table 4.1**, Target Location Error.

Figure 4.2 Circular Error Probable.

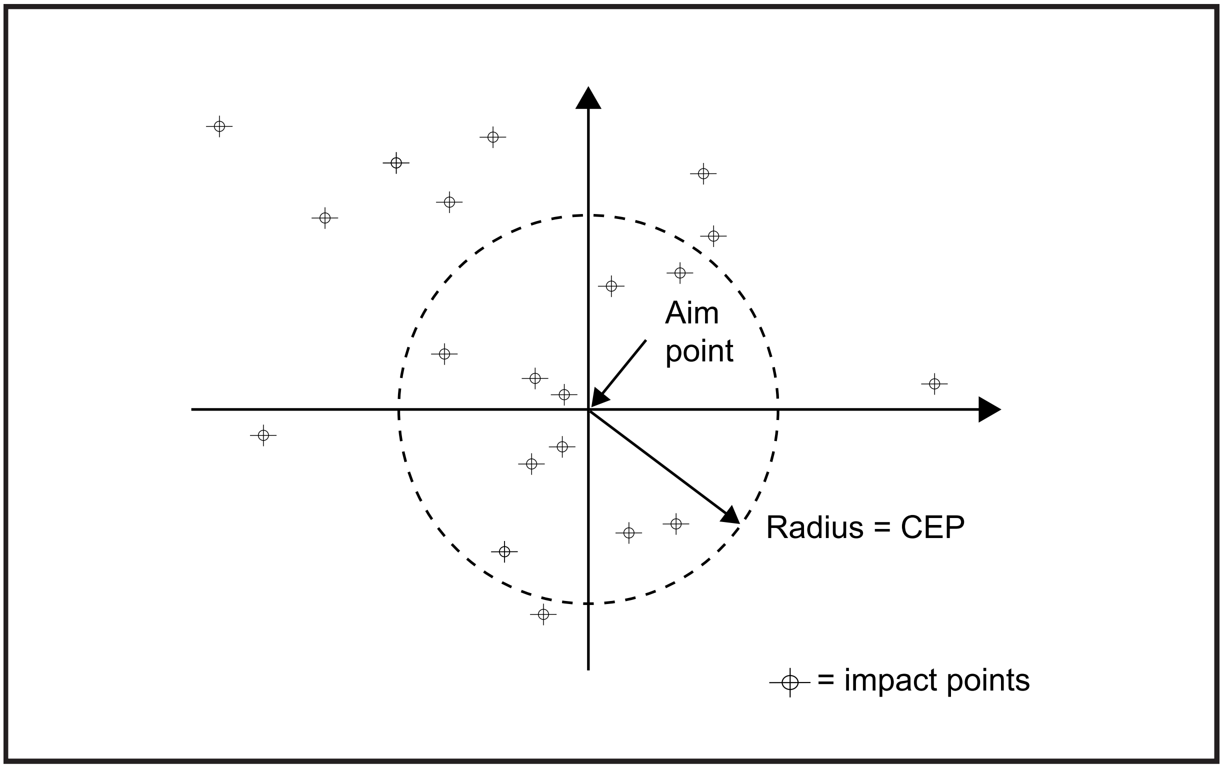


Figure 4.3 Target Location Error.

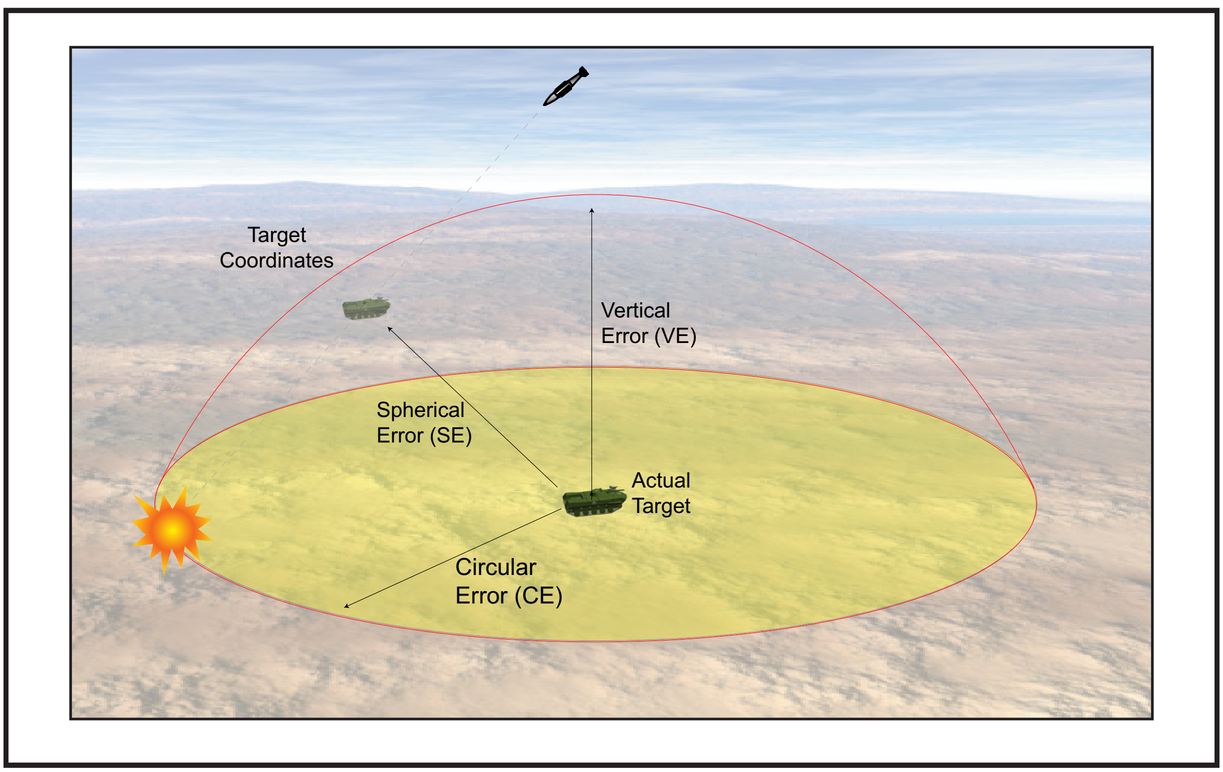


Table 4.1 Target Location Error.

Category of Data	TLE (meters)	TLE (feet)
CAT I	0 to 6	0 to 20
CAT II	7 to 15	21 to 50
CAT III	16 to 30	51 to 100
CAT IV	31 to 91	101 to 300
CAT V	92 to 305	301 to 1,000
CAT VI	30 meters plus	1,001 feet plus

4.2.2.6 CDE and civilian casualties (CIVCAS) mitigation has become a primary concern for the ground force commanders in specific theatres. JTACs should select effects/weapons to achieve the DWE that minimize collateral damage. Examples of weapon target pairing are detailed in **paragraph 4.8**, weapon target pairing, and **Table 4.3**, Weapon Target Pairing.

4.2.2.7 Available weapons of CAS aircraft on station may not provide the exact capabilities or effects desired. JTACs must then combine effects from weapons or other effects capabilities to achieve DWE.

4.2.2.8 Weapons conservation plans are critical to ensuring JTACs are able to achieve GFCI during decisive engagements. This may drive a less than desirable weaponeering solution for a present target due to requirement to save specific weapons for a higher priority target that is still being developed.

4.3 Common Definitions. The JTAC acts as the principle liaison between the GFC, air assets, and DWE in the CAS weaponeering process. Therefore, they must be familiar with JMEM terms and definitions. The supported commander may not be familiar with these definitions and the JTAC will translate the GFCI into DWE using the below terms.

4.3.1 Catastrophic Kill (K-Kill). Surface damage that is non-repairable or beyond economic feasibility to repair. For buildings or hardened structures, K-Kill is defined as damage that causes collapse of the entire building or structure or defeat of every critical component in the target.

4.3.2 Communications Kill. Structural or component damage such that the facility cannot receive or transmit any type of communication.

4.3.3 Destruction. To deny access to and irreparably damage the operation of a target.

4.3.4 Firepower Kill (F-Kill). Damage or effects that render the target immediately incapable of firing its primary armament and duration is indeterminate. Time-out of action-kill levels may be defined.

4.3.5 Functional Kill. Damage that produces loss of a facility or any key component or combination of components in a target that prevents it from performing its designated function/functions.

4.3.6 Gun Kill (G-Kill). Damage to the target such that its ability to use its armament is lost and damage is not repairable by the crew on the battlefield.

4.3.7 Incapacitation Kill. Damage sufficient to prevent personnel from providing the critical functions required by the assigned job before a given time has elapsed. The different time criterion are listed below.

- 12-Hour Supply—incapacitation that will render personnel unable to perform in a supplying role within 12 hours of wounding.
- 30-Second Assault—incapacitation that will render personnel unable to perform in an assaulting role within 30 seconds of wounding.
- 30-Second Defense—incapacitation that will render personnel unable to perform in a defending role within 30 seconds of wounding.
- 30-Second Total Warfighting—incapacitation that will render personnel unable to perform total warfighting capabilities within 30 seconds of wounding.
- 5-Minute Assault—incapacitation that will render personnel unable to perform in an assaulting role within 5 minutes of wounding.

4.3.8 Mobility Kill (M-Kill). Damage sufficient to render a vehicle incapable of executing controlled movement within the time interval being assessed and duration is indeterminate. The time-to-failure kill levels are:

- M (0) Kill—damage that prevents controlled movement immediately and is not field repairable by the crew.
- M (5 to 40) Kill—damage that prevents controlled movement within 5 to 40 minutes and is not field repairable by the crew.

4.3.9 Passenger or Personnel Kill. Damage sufficient to cause the incapacitation of the transported personnel aboard a combat vehicle. Crew members are excluded.

4.3.10 Structural Kill. Occurs when sufficient structural damage has been inflicted to a building or a hardened structure to make it unusable. Generally, it is assumed that a structural kill is achieved when more than 50 percent of the structural component volume or usable floor space of the target is removed.

4.3.11 FD. Fractional damage; the average fraction damage (kills/incapacitations) done to an area target after being attacked by N volleys or passes.

- FD-Expected fraction of the target covered by the pattern in deflection.
- P_D-Probability of damage; the probability (chance) of damage (kill or incapacitation) to a unitary target or a target site after being attacked by N volleys or passes.

NOTE: When using P_D, it is important to know that it will vary depending on the individual target, as well as local guidance.

4.3.12 Joint P_D Definitions.

4.3.12.1 Harassment. 0.05 to 0.10 P_D to personnel, equipment, or structures.

4.3.12.2 Neutralization. 0.30 to 0.50 P_D to personnel, equipment, or structures. Renders a unit unable to perform essential aspects of its mission.

4.3.12.3 Destruction. 0.50 to 0.70 P_D represents irrecoverable damage to personnel, equipment, or structures. This level of damage is considered infeasible for large units (i.e., brigades or divisions).

4.3.12.4 0.70 to 0.80 P_D for most high priority point targets. Higher probabilities may be appropriate for targets (i.e., SAM sites), where success is essential in order to conduct a number of other strikes.

4.3.12.5 Sortie requirements increase exponentially if high P_D requirements are specified. To achieve a P_D is 0.15 on a large target set, a single sortie may suffice. However, on that same target set, it may take an average of eight sorties to achieve a 0.70 desired P_D, and 15 sorties for a 0.90 P_D.

4.4 Weaponeering Tools. Advances in computer software allow JTACs to perform weaponeering with great detail. These include; Joint Munitions Effectiveness Manual Weaponeering System (JWS), Precision Strike Suite for Special Operations Forces (PSS-SOF), Digital Imagery Exploitation Engine (DIEE), and Integrated Munitions Effects Assessment (IMEA). PSS-SOF is used to create targetable coordinates up to CAT 1. DIEE is used for CDE product development. IMEA is used for tunnels, bunkers, and hardened facilities that require a detailed model for weaponeering. JWS is used for generic targets that do not require a detailed model (i.e., trucks, tanks, and aircraft). For the purposes of this publication, JWS will be used as the example. See AFTTP 3-1.JTAC, Attachment 3, "*How to Weaponeer Point Targets in JWS*," for a step-by-step guide to weaponeering an area and point target in JWS 2.2.

4.5 Preplanned Weaponeering.

4.5.1 Assumptions. Targeting officers and JTACs take into account several assumptions when conducting preplanned weaponeering.

- Desired weapons for the target set will be available in quantity and type requested/required.
- Targets will be stationary and predictable based on current/real time intelligence sources.
- CDO constraints have been factored into weaponeering and employment tactics to achieve DWE with the assigned sorties.

4.5.2 Tools. In general, the targeting officer or JTAC is responsible for basic information (i.e., target coordinate/location), outline target on intelligence agency produced imagery, supported operation and desired effect. These will be used by upper echelons during the formal processes. However, the JTAC may elect to use some of the tools mentioned in **paragraph 4.4**, Weaponeering Tools, in order to assist the upper echelons' formal weaponeering process.

4.5.3 CDE. Formal processes include the use of PSS-SOF, RainDrop, and DIEE completed by certified personnel to create a product that is approved by the appropriate authorities.

4.5.4 Completed Target Packets. After formal approval, scheduled/deliberate targets are serviced by air interdiction (AI) strike packages listed on the air tasking order (ATO) or other component weapons systems. It is important for the JTAC to be aware of these scheduled missions. They must also have access to the target packet if there is a need to reroll CAS aircraft to service joint desired point of impact(s) (JDPI) with the correct weaponeering in the case of weapon failure to function or mission aircraft aborts.

4.5.5 Target Packet Review. JTACs should review completed target packets to check the generated weapons solutions ability to achieve GFCI.

4.6 Basic Air-to-Surface CAS Weapons and Effects. Refer to TO 1-1M-34, *Aircrew Weapons Delivery Manual (Nonnuclear) Standard Volume* and the Weapons File, for more in-depth information.

4.6.1 Weapons Effects. Most weapons are designed and built to create one or more of five weapons effects: blast, fragmentation, penetration, cratering, and incendiary.

4.6.1.1 Blast. Blast destroys objects through a sudden and violent overpressure due to the expansion of gasses. Blast causes the physical effect of damaging structures or causing internal injuries. However, the shock wave rapidly loses energy as it moves away from the point of detonation. Significant damage from blast will be confined to less than 100 feet from the detonation point for most conventional weapons. Blast is not the primary effect against most tactical targets but is very useful against buildings. The overpressure within the structure will take down the walls and have good effects against individuals contained within. Typical targets for blast weapons include buildings, bridges, and ships. See **Figure 4.4**, Blast, Effects on a House.

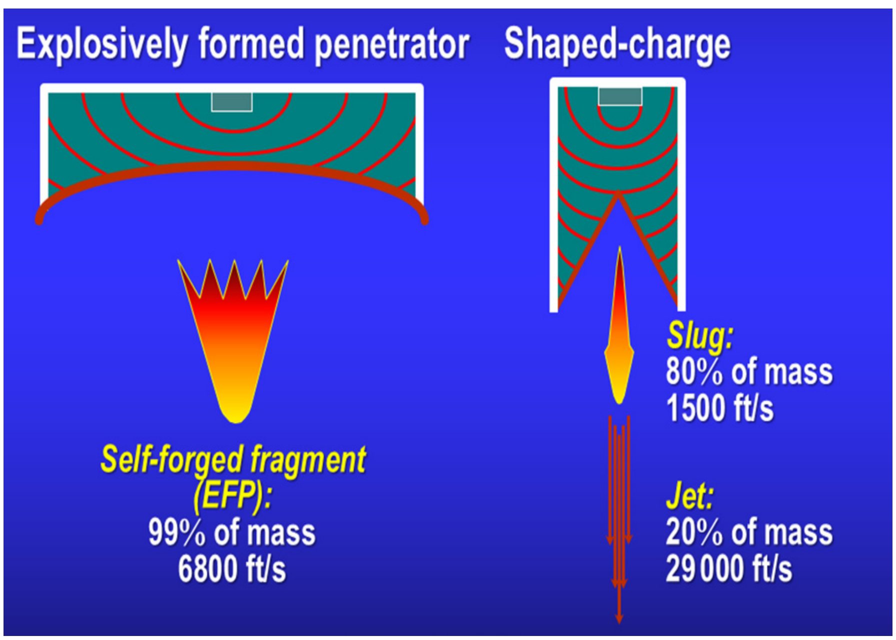
Figure 4.4 Blast Effects on a House.

4.6.1.2 Fragmentation. The fragmentation effect is from high-velocity pieces of the bomb casing or surrounding target structure that are propelled outward from the explosion. Fragmentation perforates target structures and normally will provide the longest destructive reach from the point of detonation. For this reason, the fragmentation weapons effect is generally considered the most useful weapons effect against most CAS targets. Typical targets include light armor, aircraft, radar, and troops. Some weapons function differently, thus the fragmentation patterns are different across various weapons. Additionally, the impact angle of the weapon will significantly change the fragmentation pattern. See **paragraph 4.7.1**, Fragmentation, for further discussion on impact angle effects on fragmentation pattern.

4.6.1.3 Penetration weapons use shaped-charge or kinetic-energy penetration warheads specifically designed to breach protective coverings (i.e., armored vehicles, steel reinforced concrete and earth or rock). The penetration weapons effect is the desired effect against armor targets such as tanks as well as reinforced structures such as hardened aircraft shelters or bunkers. Basic blast and fragmentation from common conventional weapons have little effect against armored targets unless a direct hit against a vulnerable area is achieved. Ultimately, penetration results in subsequent effects of blast and incendiary inside the vehicle or structure targeted.

4.6.1.3.1 There are two types of armor piercing munitions: explosively formed penetrator and shaped-charge, see **Figure 4.5**, Explosively Formed Penetrator and Shaped-Charge Example.

Figure 4.5 Explosively Formed Penetrator and Shaped-Charge Example.

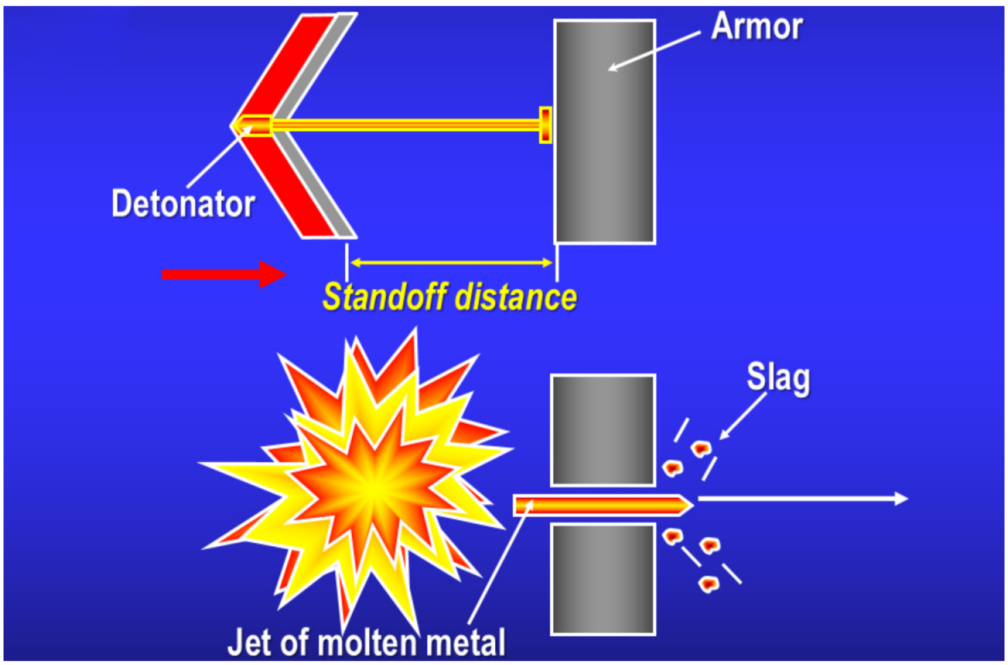


4.6.1.3.1.1 Explosively Formed Penetrators. Self-forged fragments formed by HE into high-velocity, high density penetrators. They rely on mass and velocity to penetrate.

4.6.1.3.1.2 Shaped-Charge. The warheads shape the explosive fill with a hollow cavity usually formed by a metal liner. The hollow cavity causes the gaseous products formed from the explosion to focus the energy of the detonation, causing an intense localized force (hypervelocity jet) in the direction of the hollow section. This explosion is capable of generating a hypervelocity jet of 15,000 to 20,000 feet per second (fps), which literally pushes the armor material aside.

NOTE: Shaped-charge warheads must detonate at a proper standoff distance from target to generate the jet. See **Figure 4.6**, Shape-Charge Formation.

Figure 4.6 Shape-Charge Formation.



4.6.1.4 Cratering. The cratering effect is achieved by delaying fuze function until the weapon becomes buried in the target. Cratering effects are normally intended for runways or critical road passages and in CAS may be used to achieve a desired tactical effect (i.e., delay or harass). See **Figure 4.7**, Cratering Examples.

4.6.1.5 Incendiary. Incendiary effects are achieved by intense heat, causing surrounding material to burn or melt. Nearly all weapon detonations produce some incendiary effects from heat generated by the detonation. While current weapon inventories have very few purely incendiary weapons (i.e., MK 77s), incendiary effects often are incorporated into attack plans as a secondary weapons effect. See **Figure 4.8**, Firebomb Example.

Figure 4.7 Cratering Examples.

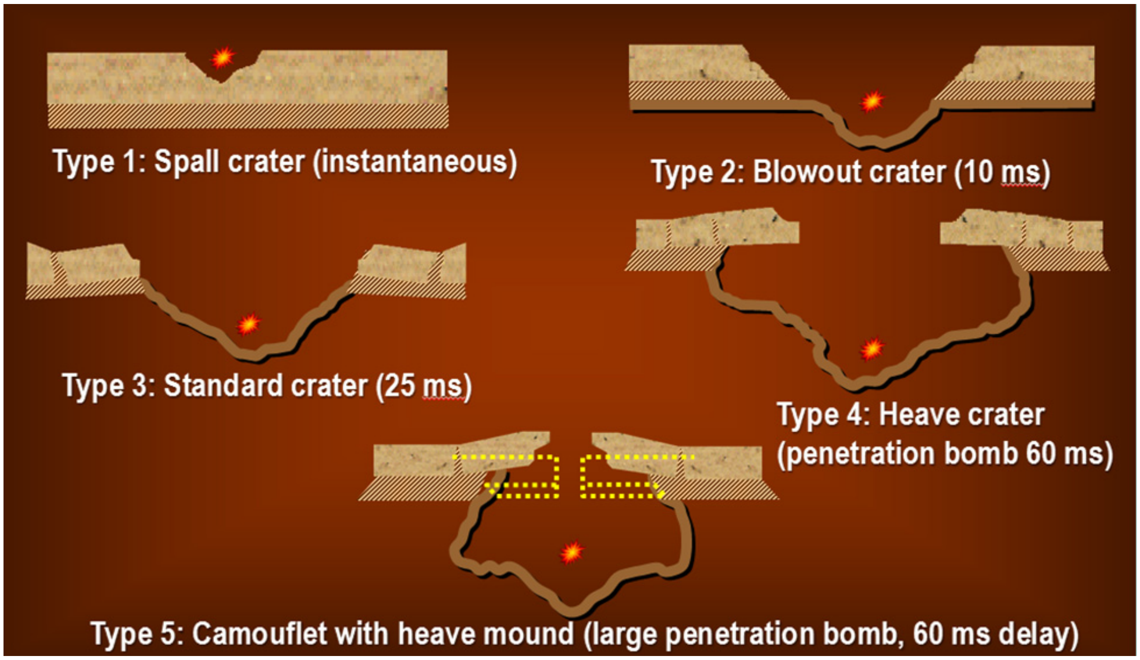
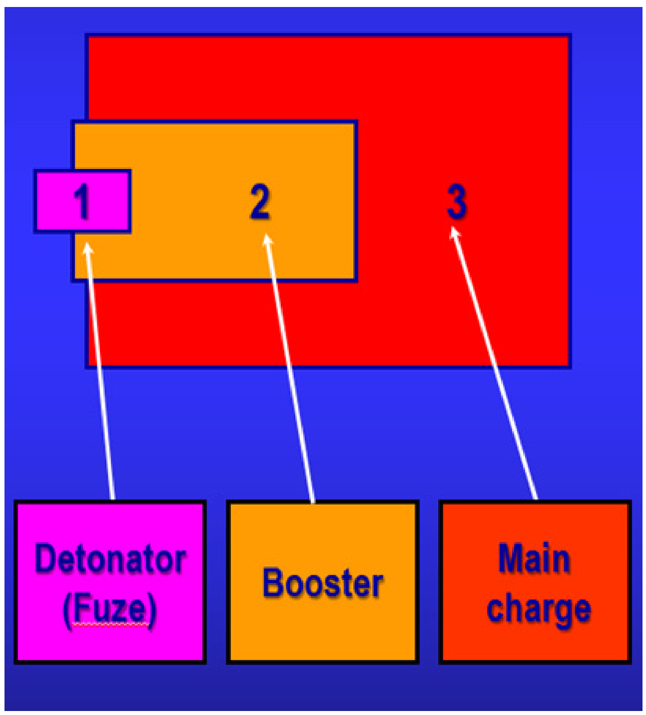


Figure 4.8 Firebomb Example.

4.6.2 Explosive Train, Fuzes, Sensors, Nose Plugs, and Explosive Fillers.

4.6.2.1 Explosive Train. The explosion generated by a munition is actually a series of chain-reactions that occur near-simultaneously. These chain-reactions are called the explosive train because they happen in a sequential order. The train starts with the bomb's firing mechanism, or fuze. When the fuze is initiated, it ignites a small quantity of a sensitive explosive material, called the booster. As the booster explodes, it sets off the main charge which consists of an insensitive explosive material. The combination of a small amount of sensitive material used in the booster along with the much larger quantity of insensitive material found in the main charge allow a bomb to retain a significant amount of potential energy while making it relatively safe to store, handle, and transport. As an added safety measure, the fuze is usually not stored with the bomb itself, but rather is installed prior to use. See Figure 4.9, The Explosive Train.

Figure 4.9 The Explosive Train.



4.6.2.2 Fuzes. A fuze in function is a device that causes the detonation of an explosive charge at the proper time after certain conditions are met, known as the methods of function. Prior to the conditions being met, the fuze must be armed by one of the methods of arming.

4.6.2.2.1 Methods of Arming. These methods of arming are to facilitate safe transportation and handling of US bombs. A fuze is kept unarmed and the explosive train out of alignment until the weapon is employed. The four different methods of arming are vane, pin, inertia, and electric.

4.6.2.2.1.1 Vane. The arming vane (small propeller) is rotated by airflow as the bomb falls after weapon release. A specified number of rotations arms the fuse.

4.6.2.2.1.2 Pin. A pin is withdrawn or ejected by a spring action at weapons release, arming the fuze.

4.6.2.2.1.3 Inertia. When the fins or ballutes employ there is an abrupt change in the velocity of the falling bomb, which arms the fuze.

4.6.2.2.1.4 Electric. A time-delay circuit powered by a thermal battery is activated by extraction of the arming lanyard upon bomb release, which arms the fuze.

4.6.2.2.2 Methods of Function. A fuze is triggered in a variety of different ways including input from various sensors.

4.6.2.2.2.1 Impact. An impact fuze is designed to function on or after impact. Impact fuzes can be delayed in order to allow the bomb to penetrate before exploding.

4.6.2.2.2.2 Proximity. A proximity fuze contains a miniature Doppler radar which senses the bomb's height above the ground. Once it reaches a predetermined height, the bomb explodes.

4.6.2.2.2.3 Time. A mechanical or electrical timer begins to count down once the bomb is released from the aircraft. The bomb explodes after the preset time has expired.

4.6.2.2.2.4 Acoustic. Acoustic fuzes are commonly used by the US Navy in underwater mines and torpedoes. They are victim-triggered devices which use a hydrophone to sense audible disturbances caused by passing ships. The fuze is tuned to a specific set of characteristics to ensure that the weapon only explodes at the passage of a target within range.

4.6.2.2.2.5 Hydrostatic. A victim-triggered fuze designed to function underwater. The fuze detects changes in water pressure caused by passing ships and submarines or an increase in depth and explodes once a set water pressure threshold is exceeded. Hydrostatic fuzes are commonly used in aquatic mining operations.

4.6.2.2.2.6 Magnetic. A magnetic fuze is a victim-triggered fuze commonly used in mines. The bomb explodes when the magnetic equilibrium of the fuze is upset by the proximity of a metallic object like a tank or submarine.

4.6.2.2.2.7 Seismic. Seismic fuzes are victim-triggered devices used in mining operations. They are activated by the vibration of the weapons caused by the passage of a ship or land vehicle.

4.6.2.2.3 Fuze Positioning. Fuzes can be installed in the nose of the bomb, the tail of the bomb, or both for flexibility and redundancy.

4.6.2.2.3.1 Nose Position. A nose-installed fuze usually functions on impact with the target. They are used in bombs, rockets, projectiles and some guided missiles. Nose fuzes deflect sidewall fragmentation away from the nose of the bomb.

4.6.2.2.3.2 Tail Position. A tail fuze may be an inertia fuze initiated by the deceleration of the bomb on impact. A tail fuze directs fragmentation away from the tail of the bomb. A tail fuze is preferred for penetration weapons as the location at the rear of the bomb makes them more survivable than a nose-installed fuze.

4.6.2.2.3.3 Both. To increase flexibility and reduce dud rates, bombs may have both a nose and tail fuze installed at the same time. For example, a bomb that has an impact-only tail fuze can be augmented with a proximity nose fuze to give the weapon additional functionality creating a more versatile weapon.

4.6.2.2.4 Fuze Types: Mechanical and Electrical.

4.6.2.2.4.1 Mechanical Fuzes are hard set prior to launch of the aircraft.

4.6.2.2.4.1.1 M904. A mechanical vane-armed, impact-functioning nose fuze used in MK 80 series of GP bombs. There are nine possible preselected arming delay options and six preselected delay settings; instantaneous, 0.01, 0.025, 0.05, 0.1, or 0.25 second.

4.6.2.2.4.1.2 M905. A mechanical vane-armed, impact-functioning tail fuze used in MK 80 series of GP bombs as well as in the GBU-10 and GBU-12. It is essentially a tail-mounted version of the M904 and shares the same delay settings of instantaneous, 0.01, 0.025, 0.05, 0.1, or 0.25 second.

4.6.2.2.4.2 Electrical Fuzes. An electrical fuze is armed by an electrical pulse applied to the capacitors in the fuze by the delivery aircraft as the bomb is released from the aircraft.

4.6.2.2.4.2.1 FMU-139. A nose or tail-mounted electronic impact or impact-delay fuze used in GP and laser-guided bombs. The four timing delay options of instantaneous, 10, 25, and 60 milliseconds are set at weapon assembly and cannot be altered in flight. The complexity of the timing settings of this fuze, when used in conjunction with other fuzes, can cause higher than expected dud rates.

4.6.2.2.4.2.2 FMU-143. An electronically armed tail fuse designed for penetrator warheads. It has time delay settings of 0.030, 0.060, and 0.120 seconds.

4.6.2.2.4.2.3 FMU-152A/B. An advanced multi-arm; multi-delay fuze, proximity sensor compatible, that provides arming and fuzing functions for general purpose and penetrating warheads. Commonly used with joint direct attack munition (JDAM) weapons, it allows for cockpit-selectable airburst, impact and delay options of 5, 15, 25, 35, 45, 60, 90, 180, and 240 milliseconds.

4.6.2.2.4.2.4 FMU-167/B. A smart fuze with multi-arm, multi delay, and multi-void sensing capability. Designed for use with hardened-target penetrator warheads (HTPW), the FMU-167/B was built to detect the voids or empty space in-between the floors/ceilings in a multi-story building in order to detonate on a specific level. An accelerometer or impact switch detects impacts with a floor and the fuze counts the void in-between the next floor impact. The fuze can track up to 50 voids and detonates with a minimum of 50 percent of the warhead in the target void. A time delay initiated after the initial impact ensures the warhead will detonate as a failsafe to the void-counting function. See **Figure 4.10**, Void Sensing Fuze.

4.6.2.3 Sensors. Though some fuzes, most common in the cluster bomb units (CBU) have integrated sensor and fuze mechanizes (i.e., FZU-39/B or FMU-140), specific sensors are built to provide the initiation stimulus for fuzes to function.

4.6.2.3.1 DSU-33. The DSU-33 is a proximity sensor that works in conjunction with a fuse (typically the FMU-139 or FMU-152) to provide a height-of-burst capability to add flexibility to the weapon. The sensor activates 1.8 seconds after release and transmits a radar signal towards the ground. Upon receiving the reflection of its energy, the DSU-33 calculates its height-above-ground by comparison of the Doppler signal differential amplitudes. When these amplitudes meet the established requirements of the sensor (i.e., the specified height-above-target), the DSU-33 sends an electrical signal to the fuse, detonating the bomb. The sensor provides a height-of-burst of 20 feet with an error of 6 feet.

4.6.2.4 Nose Plugs. There are two basic nose plugs used in general purpose bomb bodies, the ogive nose plug and the solid nose plug.

4.6.2.4.1 OGIVE. The ogive nose plug is the most commonly fitted GP nose plug. It provides a pointed arch. A support cup is installed in the nose well and capped with the ogive nose plug to provide a solid structure to the bomb.

4.6.2.4.2 MXU-735. Is a solid nose plug designed to provide better penetration of hard targets, without the likelihood of nose plug shearing during oblique impact. The MXU-735 replaces the ogive nose plug and support cup. See **Figure 4.11**, OGIVE and MXU-735.

4.6.2.5 Explosive Fillers. Approximately 50 percent of a general purpose bomb's weight is explosive filler. The four most common types of explosive material used by US forces today are listed below.

4.6.2.5.1 Trinitrotoluene (TNT). TNT is one of the most commonly used explosives for military and industrial applications. It is valued because of its insensitivity to shock and friction, which reduces the risk of accidental detonation. TNT melts at 80 degrees Celsius (176 degrees Fahrenheit), far below the temperature at which it will spontaneously detonate, allowing it to be poured as well as safely combined with other explosives. TNT neither absorbs nor dissolves in water, which allows it to be used effectively in wet environments. Additionally, it is stable compared to other high explosives. The explosive yield of TNT is considered to be standard measure of strength of bombs and other explosives.

4.6.2.5.2 Tritonal. A mixture of 80 percent TNT and 20 percent aluminum powder. It serves as the shock-insensitive filler in penetrating bombs. The aluminum improves the total heat output and hence impulse of the TNT—the length of time during which the blast wave is positive. Tritonal is approximately 18 percent more powerful than TNT alone.

Figure 4.10 Void Sensing Fuze.

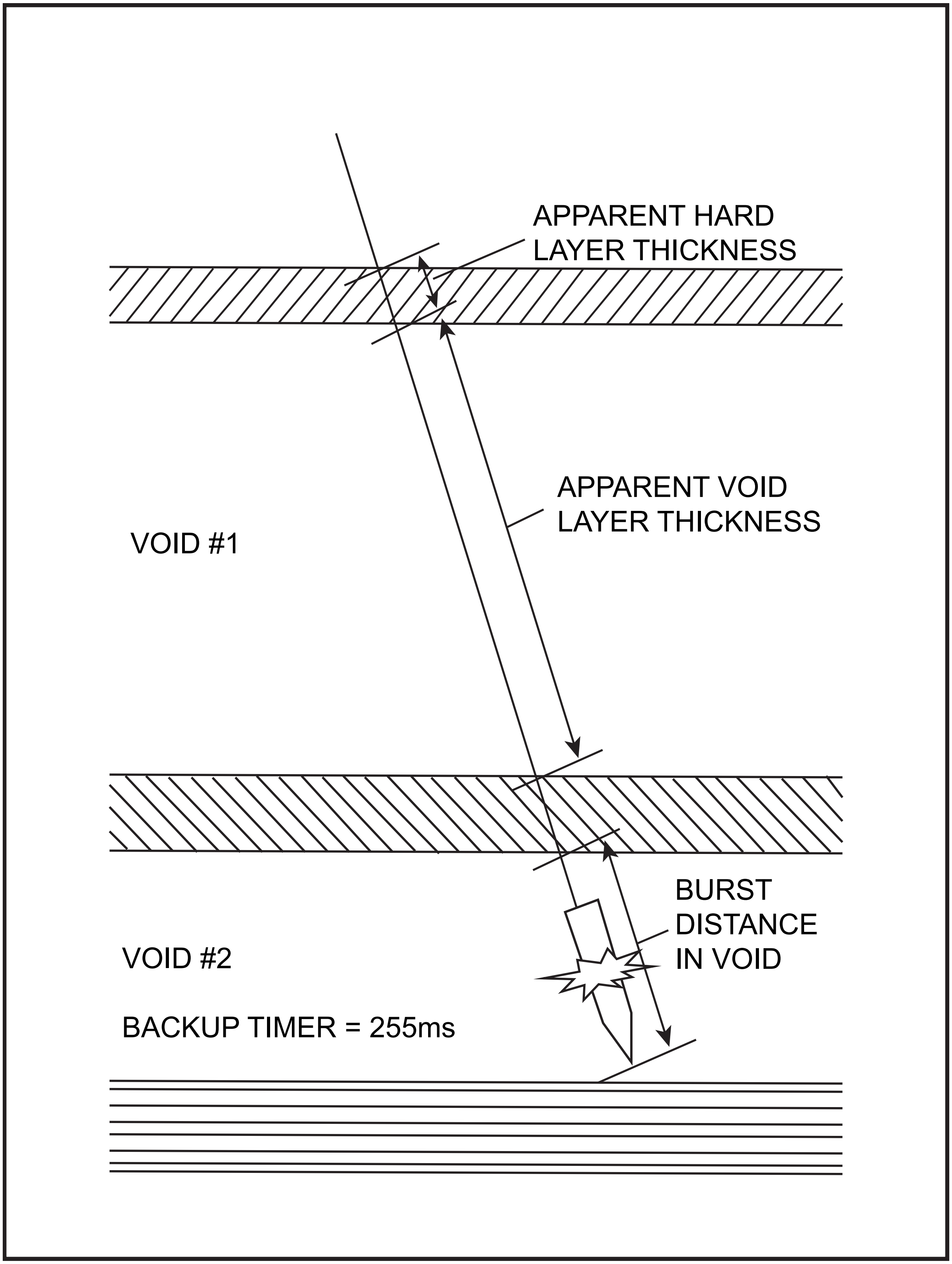
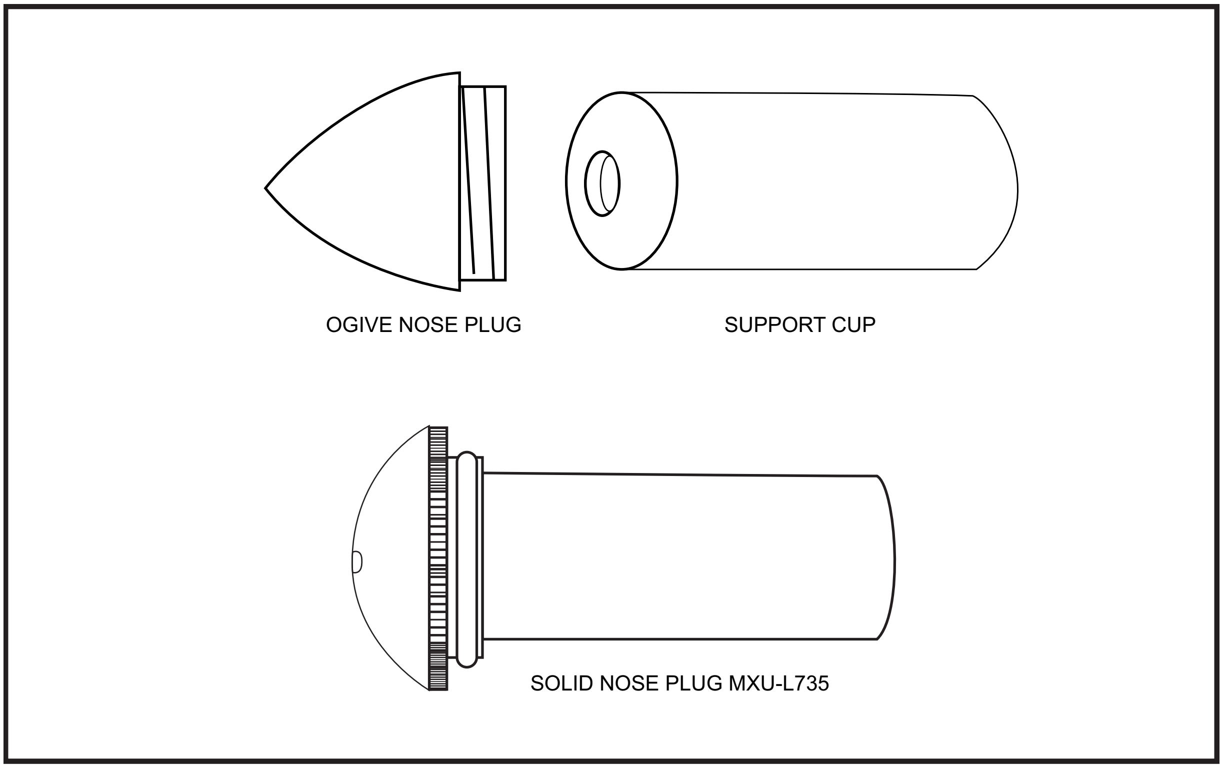


Figure 4.11 OGIVE and MXU-735.



4.6.2.5.3 H-6. A castable military explosive compound. It is a widely used main charge filling for underwater blast weapons such as mines, depth charges, torpedoes, and mine disposal charges.

4.6.2.5.4 PBX. Explosive components bound together by a polymeric binder, forming a rubbery composition, which is less susceptible to shock and other stimuli.

4.6.3 Bomb Body Characteristics, Unguided and Guided Bomb Body Components.

4.6.3.1 Bomb Body Characteristics. A bomb body is the casing that contains the explosive filler. Bomb bodies vary in size, weight, and thickness of casing.

4.6.3.1.1 General Purpose (GP). GP bomb bodies are made from cast steel and are aerodynamic in shape in order to facilitate predictable bomb fall characteristics and reduce CEP. See **Figure 4.12**, General Purpose Bomb Body.

4.6.3.1.2 Harden Penetrator. Penetration bombs are shaped to use kinetic energy to penetrate through protective coverings of structures, or earth and concrete bunkers, to deliver the weapon to the desired location of the explosive effect. Harden penetrators, like the BLU-109, are not dropped as stand-alone free-fall bombs and are always equipped with either a laser guidance or JDAM kit. A GBU-31v3 is an example of a bomb which uses this bomb body. See **Figure 4.13**, MK 84 vs BLU-109 Comparison.

Figure 4.12 General Purpose Bomb Body.

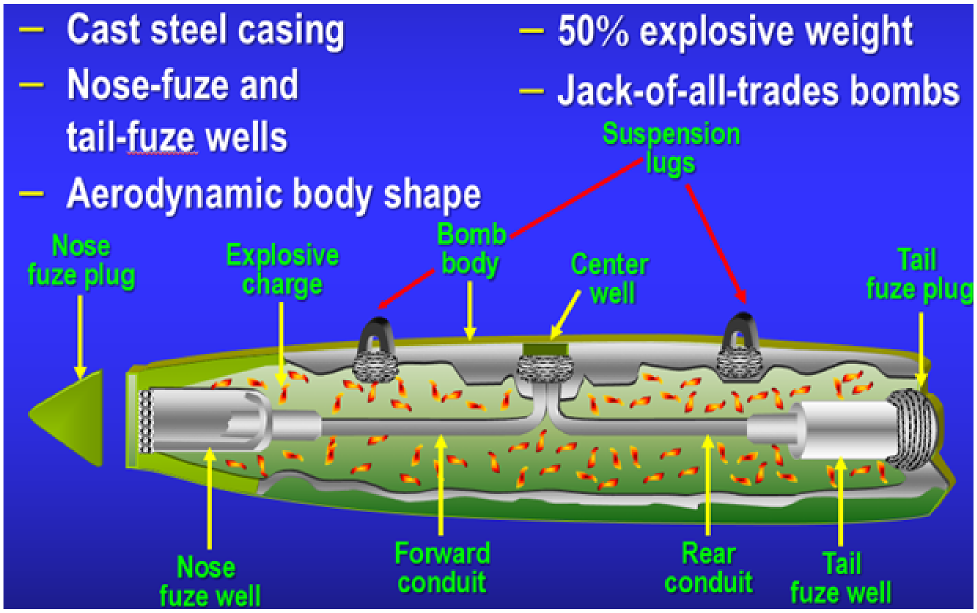
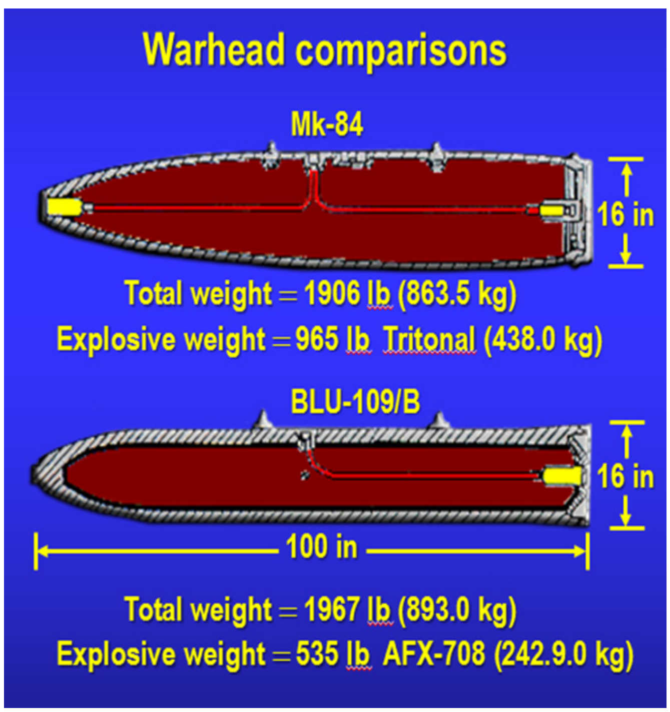


Figure 4.13 MK 84 vs BLU-109 Comparison.



4.6.3.1.3 Cluster Bomb Body. Cluster bomb bodies contain no explosive materials themselves but rather are dispensers, typically the SUU-64/65 that open to release bomblets at predetermined altitudes. Typically, the dispensers are augmented with a wind corrected munitions dispenser (WCMD) tailkit to improve accuracy. See **Figure 4.14**, Typical Munitions Dispenser.

4.6.3.2 Unguided Bomb Body Tail Section Components. Free-fall bombs are stabilized in flight by rear-mounted fin or parachute assemblies. These mechanisms keep the bomb from tumbling during descent and allow the bomb to fall in a definitive curve to the target. High-drag assemblies give an attacking aircraft the capability to drop a bomb at low altitudes, while still achieving a safe-escape distance prior to the bomb's explosion.

4.6.3.2.1 BSU-33. BSU-33 conical fin assembly is steel, conical in shape, and has four fins to provide stability. The conical fin may be used with all MK 80 (series) bombs. The basic difference between the types of conical fins is physical size. The larger the bomb, the larger the fin. See **Figure 4.15**, BSU-33 Tailfin Assemble.

4.6.3.2.2 Snakeye Fin Assemblies. These allow aircraft to drop a bomb in retarded, unretarded, or in-flight selection mode. In the retarded mode, the fins open after the weapon is released from the aircraft. This high-drag mode allows low altitude employment. In the unretarded mode of delivery, the weapon is released from the aircraft and the fins remain in the closed position. The most frequently used mode for delivery is the in-flight selection mode which allows for the pilot to select either retarded or unretarded mode. See **Figure 4.16**, Snakeye Fin Assemble.

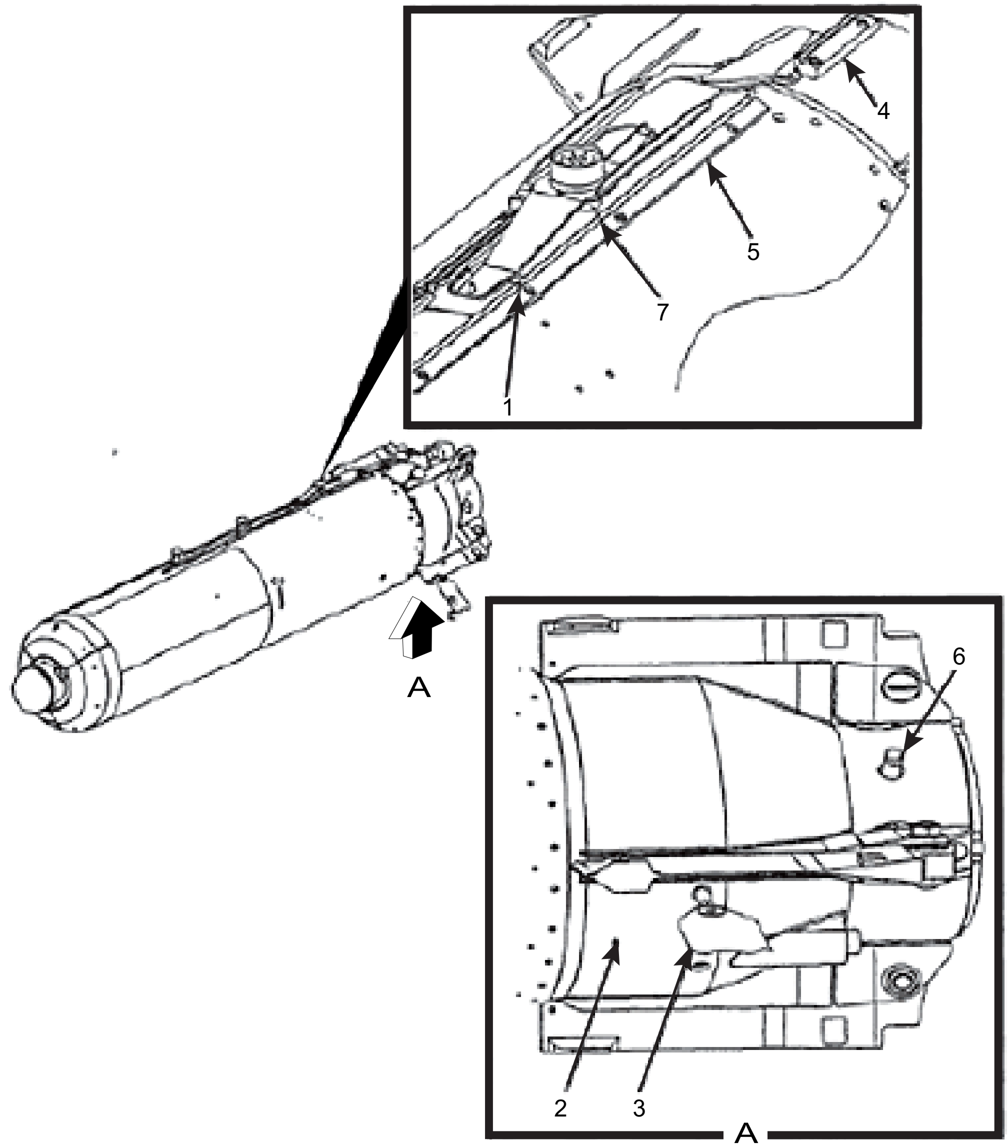
4.6.3.2.3 BSU-85/B. An air-inflatable retarder used on the MK 83 designed for very low altitudes. It can be dropped in either high-drag (retarded) or low-drag (unretarded) mode.

4.6.3.2.4 BSU-86/B. An air-inflatable retarder used with general-purpose bombs, MK 82 Mods, or the practice bomb BDU-45/B. The fin provides a retarded (high-drag) or unretarded (low-drag) bomb delivery capability for the aircraft. See **Figure 4.17**, Air-Inflatable Retarder Examples.

4.6.3.3 Guided Bomb Body Components.

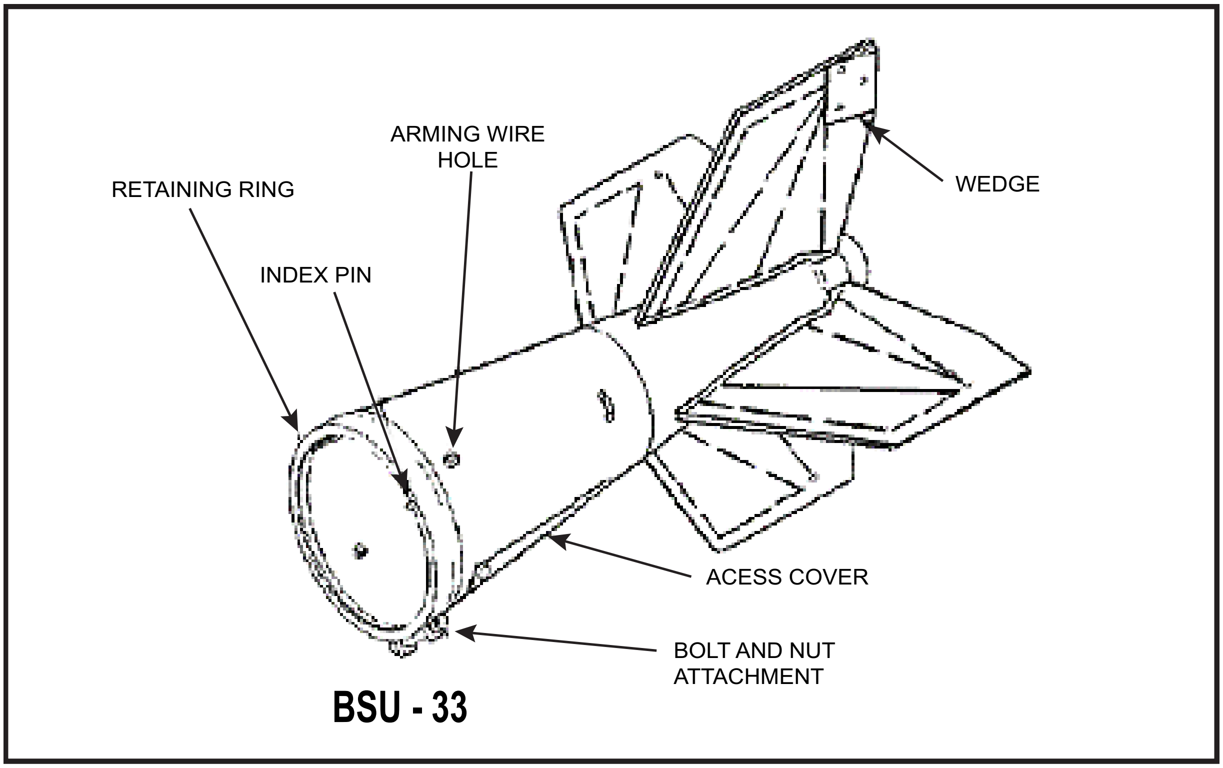
4.6.3.3.1 JDAM/Laser JDAM (LJDAM) Series. Each tail assembly consist of a tail fairing, tail actuator subsystem (TAS), wire harness, guidance control unit (GCU), GPS antenna, three movable control fins, and one fixed control fin. The assembly is designed to allow the bomb to steer itself towards the target.

Figure 4.14 Typical Munitions Dispenser.



LEGEND:
1. UMBILICAL CONNECTOR AND BRACKET
2. TAIL KIT
3. FIN RELEASE SAFING PIN
4. AFT RELEASE LANYARD CONDUIT
5. FWD FIN RELEASE LANYARD CONDUIT
6. PIN PULLER
7. MODIFICATION PAD (RED CAP)

Figure 4.15 BSU-33 Tailfin Assemble.



4.6.3.3.1.1 JDAM. The GBU-31, GBU-32, GBU-38, and GBU-39 are the most commonly used coordinate seeking precision guided munitions (PGM). With the exception of the purpose built GBU-39, joint direct attack munitions (JDAM) are GP and harden penetrator bombs that have had a GPS kit installed. The kit consists of tail assembly and a set of midbody strakes. The GBU-39 has a longer range compared to the GBU-31/32/38, due to the glide capability. See **Figure 4.18**, GBU-39 Free Flight. JDAM kits installed on GP and harden penetrator bomb bodies rely on the altitude and inertial energy imparted by employing aircraft for range. See **Figure 4.19**, GBU-38 Example, and **Figure 4.20**, JDAM Weapon-Flight Phase. After release, the JDAM guides to the target using GPS aided inertial navigation system (INS) after signal acquisition. The JDAM provides adverse weather capability.

Figure 4.16 Snakeye Fin Assemble.

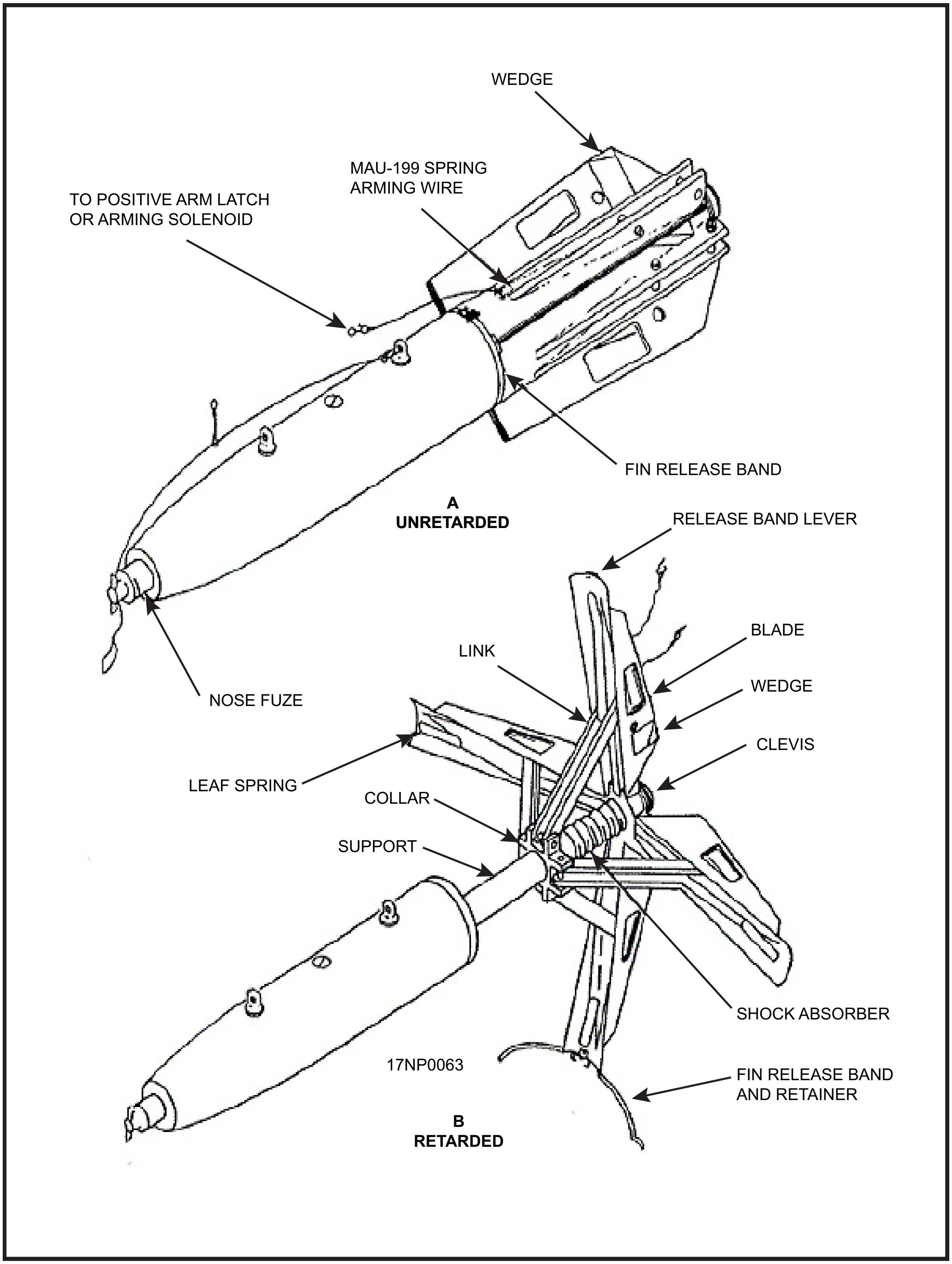


Figure 4.17 Air-Inflatable Retarder Examples.

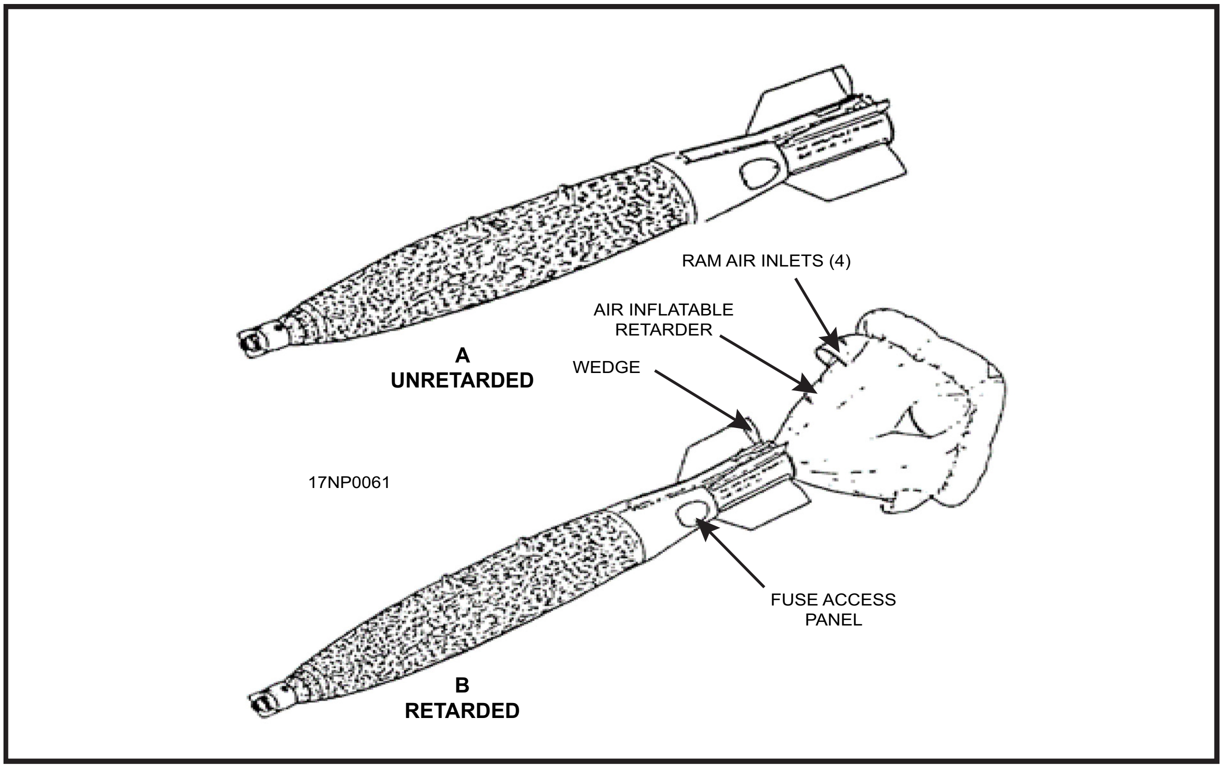


Figure 4.18 GBU-39 Free Flight.

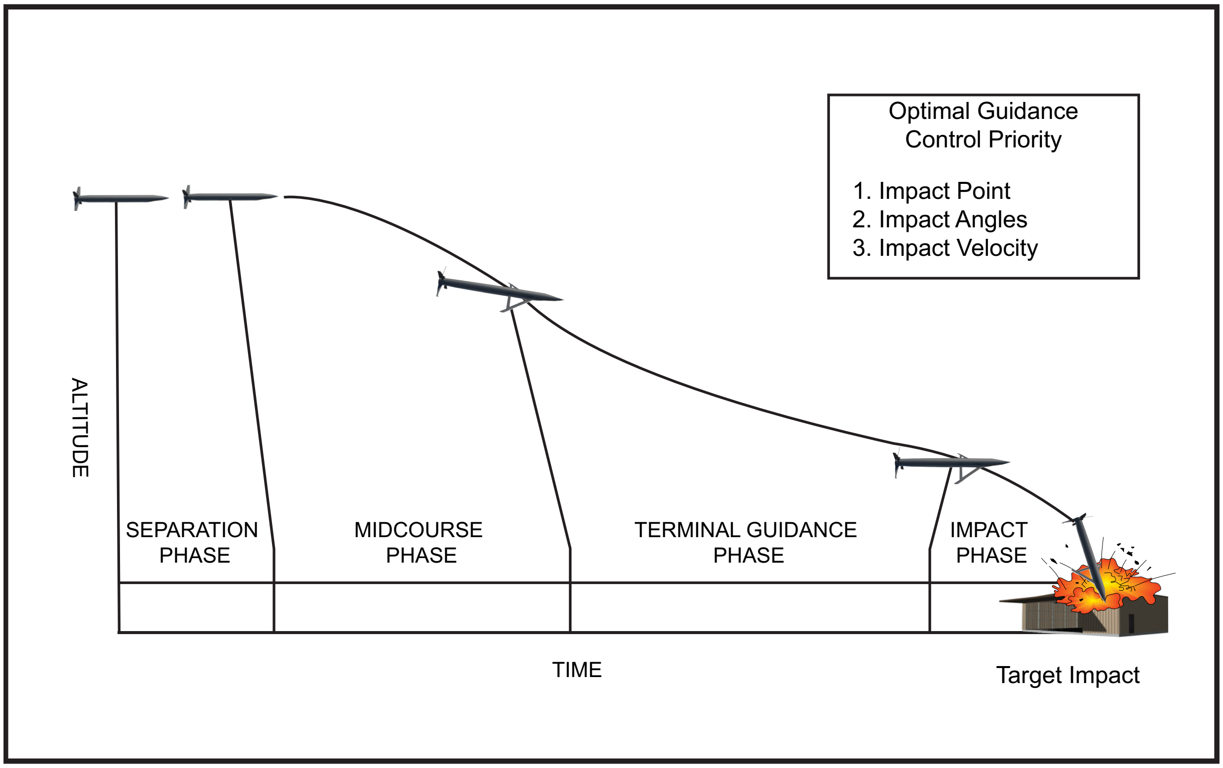


Figure 4.19 GBU-38 Example.

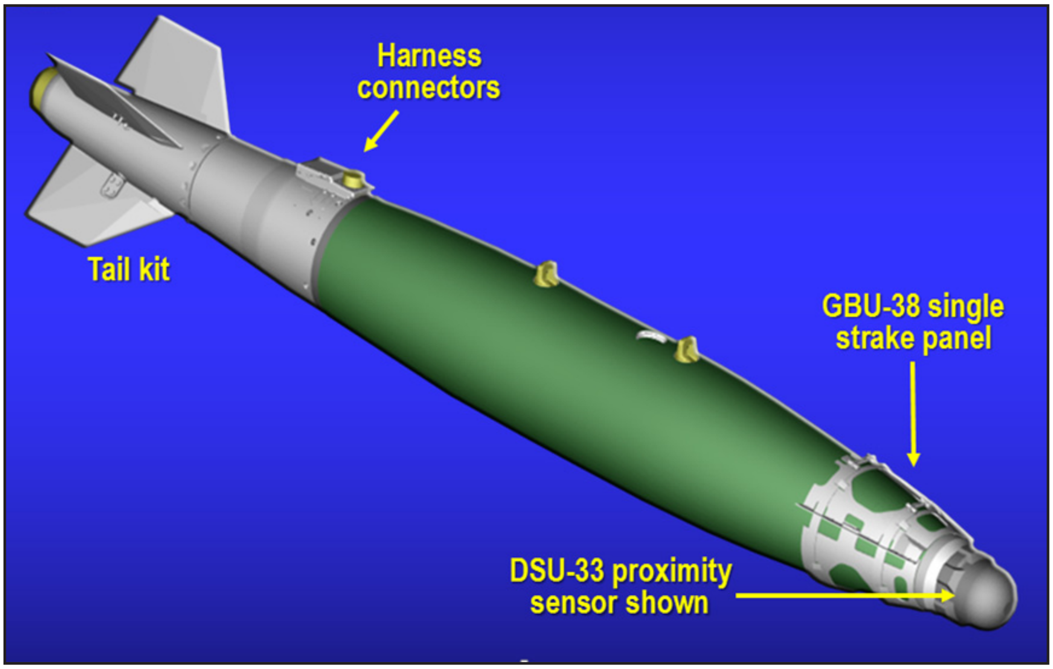
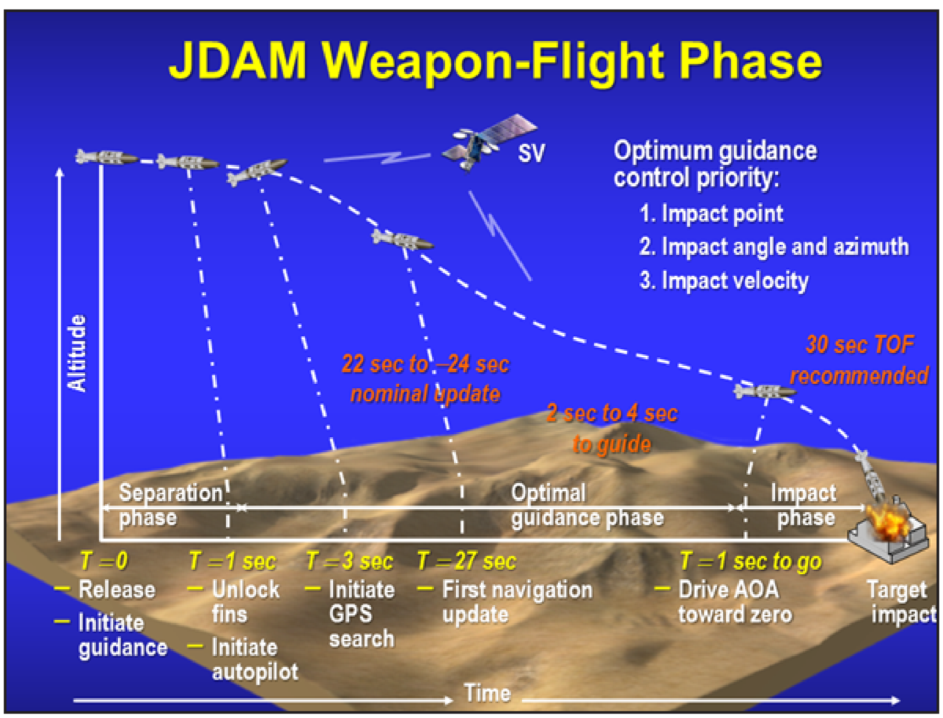


Figure 4.20 JDAM Weapon-Flight Phase.



4.6.3.3.1.2 LJDAM. The GBU-54 is an example of an LJDAM. The weapon functions by using a processor to update coordinates and determine the aerodynamic lead required to intercept the spot. See **Figure 4.21**, GBU-54 Laser JDAM. After release, LJDAM initially guides to a target using baseline GPS-aided INS guidance. The detector acquires and tracks a laser spot. After laser energy is acquired, the laser sensor provides azimuth and elevation angle measurements to the LJDAM guidance set. The LJDAM guidance set uses these angle measurements, along with estimates of the target-velocity vector, to continually update the original target coordinates provided at release. After transitioning to the terminal laser guidance mode, LJDAM will continuously guide to the most recent valid estimated target position that has been updated by tracking the laser energy. During the terminal phase LJDAM transitions to proportional guidance and guides to the preplanned, or updated, target coordinates including a correction for the target velocity, if applicable. If laser energy is never acquired, LJDAM will still transition to terminal laser guidance and guide to the target coordinates provided by the aircraft handover. See **Figure 4.22**, LJDAM Free-Flight Time Line.

Figure 4.21 GBU-54 Laser JDAM.

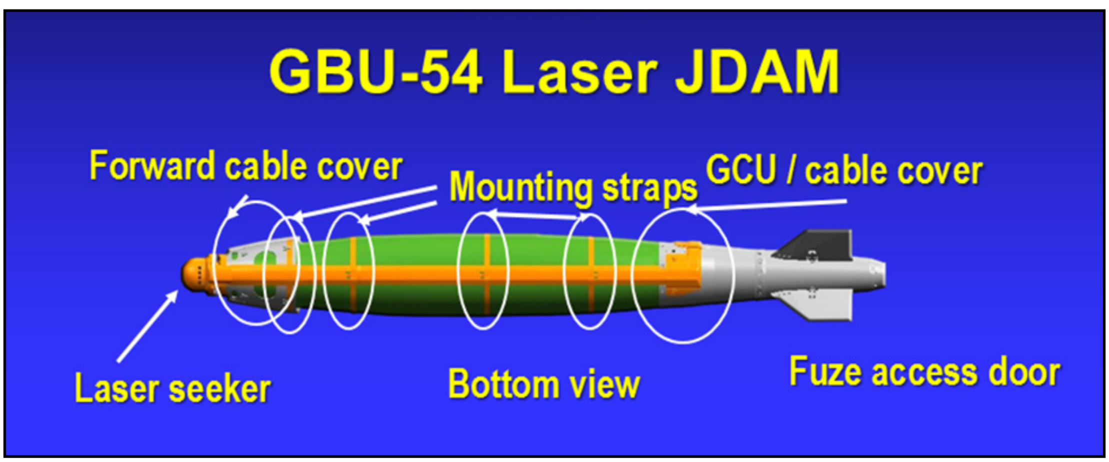
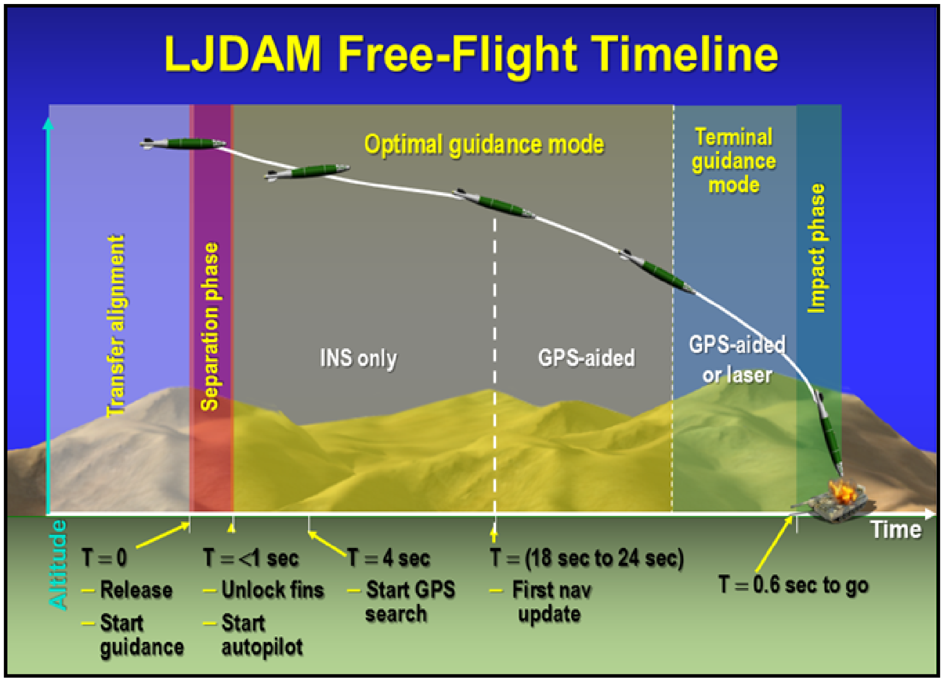


Figure 4.22 LJDAM Free-Flight Time Line.

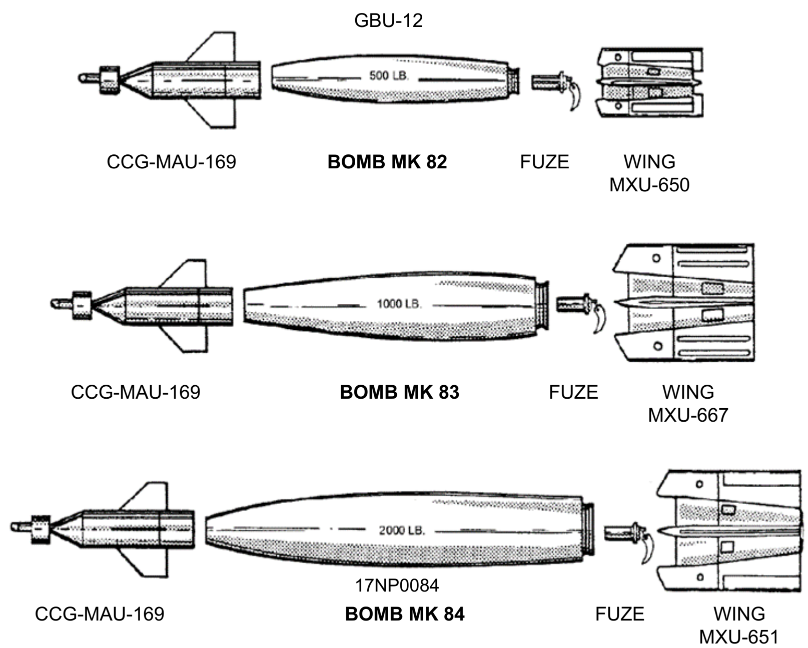


4.6.3.3.2 Laser-Guided Bombs (LGB). All LGB weapons consist of a computer control group (CCG), a warhead (bomb body with fuzes), and an air foil group (AFG). The Paveway II and Enhanced Paveway II series weapons are the common LGBs.

4.6.3.3.2.1 Paveway II. A Paveway II (PW II) LGB is a maneuverable, free-fall weapon that guides to a spot of laser energy reflected off of the target. The LGB is delivered like a normal GP warhead and the semiactive guidance corrects for many of the normal errors inherent in any delivery system. Laser designation for the weapon is provided by an airborne or ground laser designator. GBU-10 (MK 84), GBU-12 (MK 82), and GBU-51 (BLU-126/B low collateral [LOCO] bomb body) are the most common. See **Figure 4.23**, Paveway II Examples.

4.6.3.3.2.2 Enhanced Paveway II. The Enhanced Paveway II Enhanced Computer Control Group (ECCG) kit provides dual mode GPS/semiactive laser guidance. The ECCG contains a height of burst (HOB) sensor enabling airburst fusing options, and an improved anti-jam, selective availability anti-spoofing module (SAASM) compliant GPS receiver. Common LGBs include the British E-PWII (2,000 pounds class weapon), Paveway IV (500 pounds class weapon), and US and NATO GBU-49 (500 pounds class weapon).

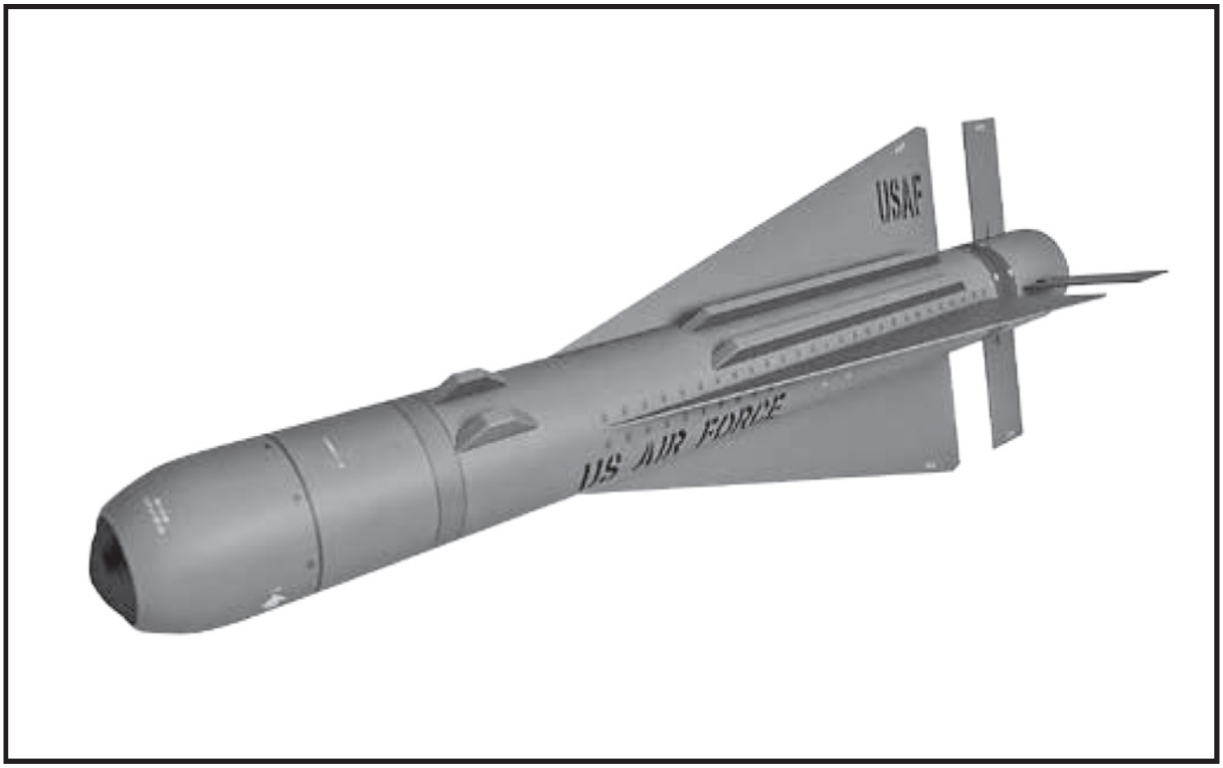
Figure 4.23 Paveway II Examples.



4.6.4 Air-to-Ground Missiles.

4.6.4.1 AGM-65 Maverick Missile. The Maverick is a rocket propelled air-to-ground missile (AGM). It is a launch-and-leave munition (except for the "AGM-65L" Laser Maverick), relying on automatic self-guidance. The Air Force has procured seven models: the EO AGM-65A, B, H2, and K2, the infrared (IR) AGM-65D and G/G2, and the Laser AGM-65L. The USAF AGM-65L guidance command section (GCS) is identical to the Navy AGM-65E2 GCS. The AGM-65A, B, D and H2 models use a 125 pound, shaped charge warhead optimized for use against armored vehicles, bunkers, boats, radar vans, and small hard targets. The AGM-65G/G2, K2, and L use a 300 pound kinetic energy penetrator, blast/fragmentation warhead that is effective against unusually shaped targets (i.e., hangars, bridges, and ships), and small tactical targets (i.e., tanks and bunkers). See Figure 4.24, AGM-65 MAVERICK Missile.

Figure 4.24 AGM-65 Maverick Missile.



4.6.4.2 AGM-114 Hellfire Missile. The Hellfire missile is a rocket-propelled, laser-guided, supersonic weapon designed to defeat individual hardpoint targets. Most AGM-114s (K, K2, R, and R2) have a shape charge warhead designed for armor or penetration effects. The AGM-114M/N have a blast-fragmentation/thermobaric warhead. AGM-114P/R2/R9E/R9H have integrated blast fragmentation sleeves to address a wider variety of target sets. See **Table 4.2**, AGM-114 Models Quick Reference, for a break out of the different models. See **Figure 4.25**, AGM-114 Hellfire Missile, for visual reference.

4.6.5 Forward-Firing Cannons and Rockets.

4.6.5.1 Forward-Firing Cannons. US and NATO countries employ various caliber rounds for both RW and FW aircraft.

4.6.5.2 RW Cannons include 7.62 mm, 0.50 caliber, 20 mm and 30 mm. Rounds include ball, armor piercing (AP), armor piercing incendiary (API), armor piercing incendiary tracer (APIT), saboted light armor penetrator (SLAP), high-explosive incendiary (HEI), and high-explosive dual purpose (HEDP).

4.6.5.3 FW Cannons include 20 mm, 25 mm, 27 mm, and 30 mm. Rounds include API, high-explosive (HE), HEI, semi-armor piercing high-explosive incendiary (SAPHEI), and high-explosive incendiary tracer (HEIT).

Table 4.2 AGM-114 Models Quick Reference.

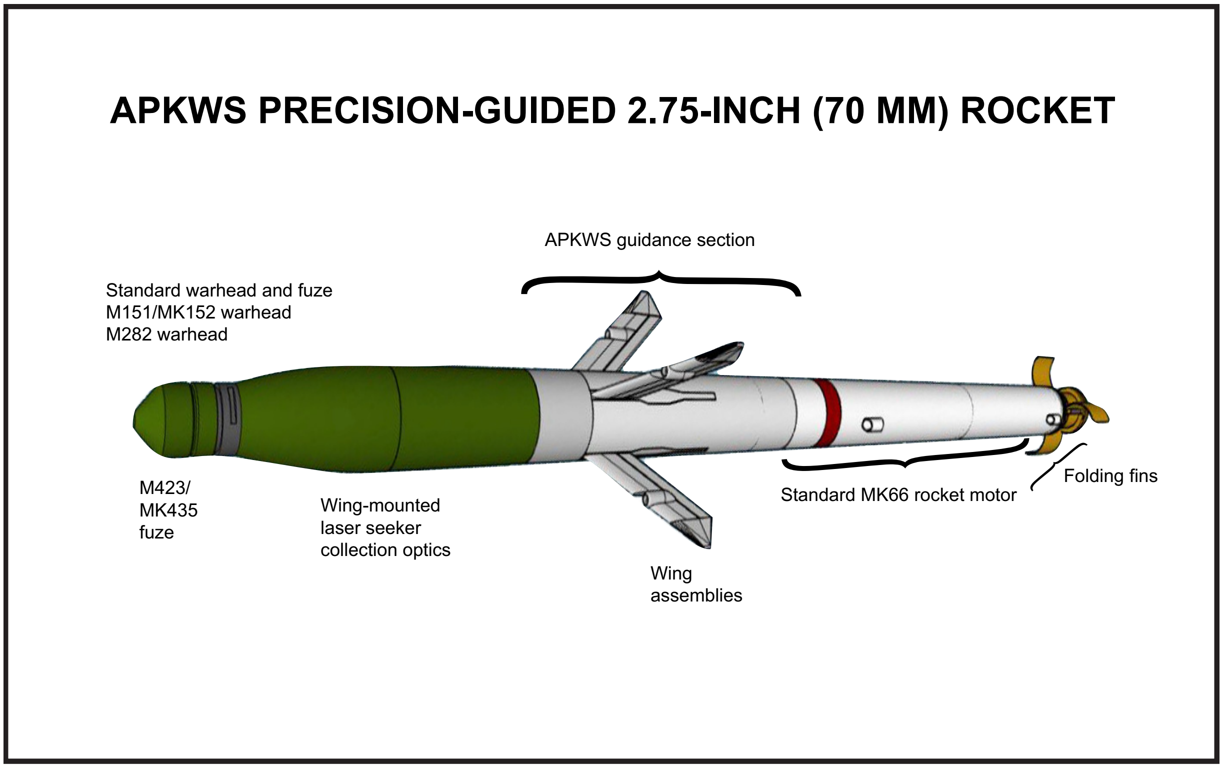
AGM-114 Model	Warhead/Effects	Fuzing Option	Preferred Target Sets
K/K2	Conical Shaped Charge/Blast Fragmentation	Impact	Armor, Radars, Static soft targets, Moving targets, Personnel, Targets in Revetments
N	Thermobaric/Blast	Impact/Delay	Radars, Personnel, Personnel in hardened positions
P	Dual Shaped Charge Frag Sleeve/Blast Fragmentation	Impact	Armor, Static soft targets, Moving vehicles, Personnel, Personnel in hardened positions
R	Conical Shaped Charge/Blast Fragmentation	Impact	Armor, Radars, Static soft targets, Moving targets, Personnel, Targets in Revetments
R2	Conical Shaped Charge Frag Sleeve/Blast Fragmentation	Impact/HOB	Armor, Static soft targets, Moving vehicles
R9E	Dual Shaped Charge Frag Sleeve/Blast Fragmentation	Impact/HOB	Static soft targets, Moving vehicles
R9H	Dual Shaped Charge Frag Sleeve/Blast Fragmentation	Impact/HOB	Static soft targets, Moving vehicles

Figure 4.25 AGM-114 Hellfire Missile.

4.6.5.4 Rockets. Both 2.75 inch and 5 inch rockets are still in use. The Navy and Marines are the primary user of the 5 inch rockets for RW and FW aircraft. All branches use the 2.75 inch rocket. Munitions include Flechette, HE, HE multi-purpose submunition (MPSM), IR illumination, illumination, multi-purpose penetrator (MPP), red phosphorous smoke, and white phosphorous (WP).

4.6.5.4.1 Guided Rockets. AGR-20/APKWS is a guidance kit used with the 2.75 inch rocket system that is connected between the warhead and rocket motor providing laser guidance capability. It is used by both FW and RW aircraft. The laser code range for this weapon is 1111-1488. Tests have shown the weapon will impact 1 foot low when the laser is aimed center mass of the target. If the laser return from the target is lost (podium effect, clutter, etc.), APKWS has the ability to see the laser source rather than the target reflection due to its increased field of regard. For risk estimate distance (RED) calculations use Table 87, RW Risk Estimate Distances, from AFTTP 3-2.6, *JFIRE*. Based on test data from Air National Guard Air Force Reserve Command Test Center (AATC) it is not currently recommended for ground base laser operations as joint laser safety procedures do not apply to this weapon. See **Figure 4.26**, AGR-20/APKWS.

Figure 4.26 AGR-20/APKWS.



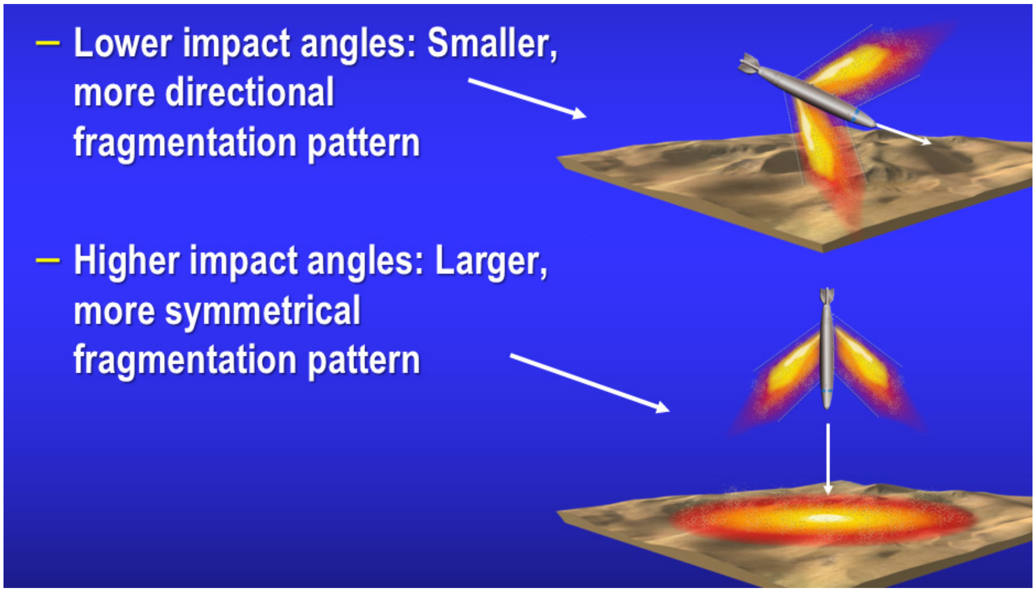
4.6.6 Direct Fire Air-to-Surface Cannons. These include 25 mm, 30 mm, 40 mm, and 105 mm cannons employed by various models of the AC-130. 25 mm rounds are HEI. 30 mm rounds include API and HEI. 40 mm rounds include armor piercing tracer (APT), and high-explosive incendiary-plugged (HEI-P). 105 mm rounds include-HE, HE/high fragmentation, and WP.

4.7 Weapon Employment Considerations. Having an understanding of the capabilities and limitations of air-to-ground munitions will aid the JTAC and aircrew to choose the appropriate weapon in achieving the supported commander's intent for the tactical situation. Below is a brief and not inclusive guide for employing air-to-ground munitions. For more information, refer to AFTTP 3-1.JTAC, 2018 Weapons File, and AFTTP 3-2.6, *JFIRE*.

4.7.1 Fragmentation. Most weapons rely on a near-vertical impact angle to uniformly disperse fragmentation. See **Figure 4.27**, Impact Angle Effects on Bomb Fragmentation Pattern.

4.7.2 Laser Considerations. An understanding of laser pitfalls and how to avoid them (i.e., beam divergence, reflection, scatter, spillover, entrapment, podium effect, and jitter), will enhance weapon accuracy. For a more in-depth explanation, Refer to AFTTP 3-1.JTAC, Chapter 2, "Equipment."

Figure 4.27 Impact Angle Effects on Bomb Fragmentation Pattern.

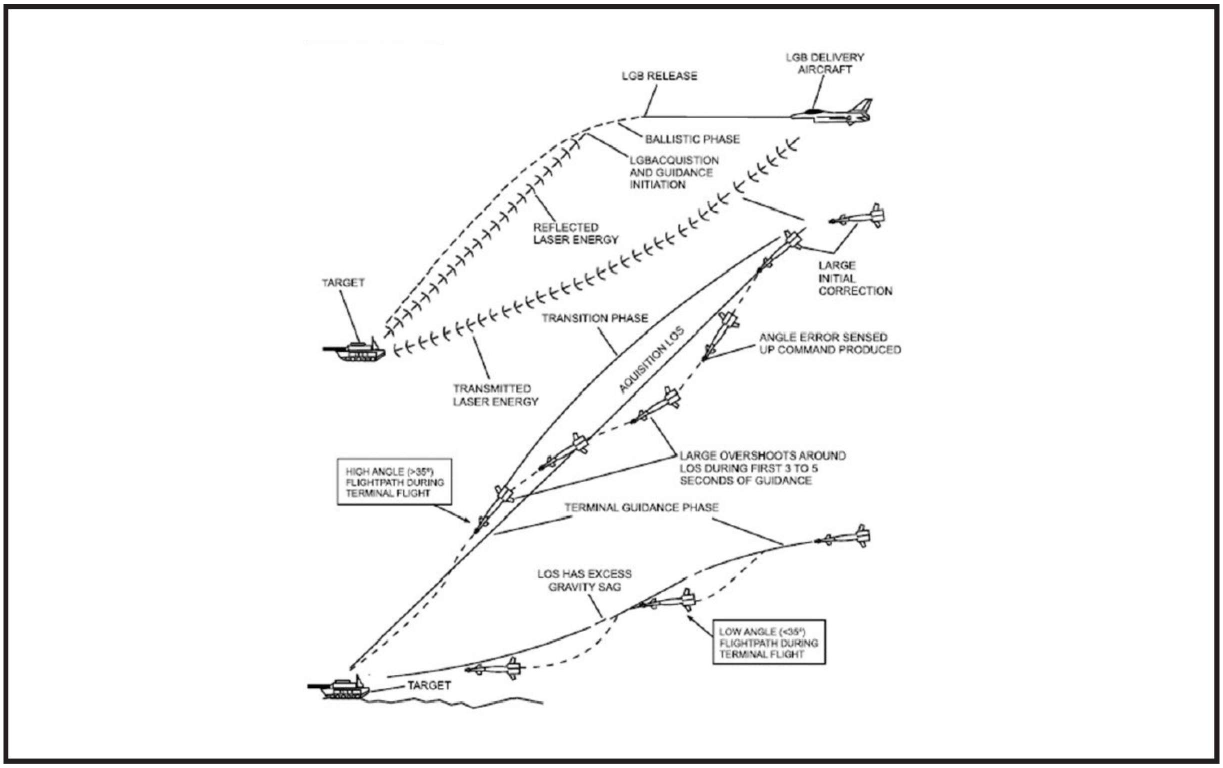


4.7.3 Precision Guided Munitions. Precision guided munitions (PGM) or GPS/initially guided weapons (JDAM) will normally impact targets with a near-vertical impact angle (90 degrees). However, there are situations where a near-vertical impact is undesirable (i.e., hitting the bottom floor entrance of a large 10-story building and no other munitions available to adequately neutralize a threat). In this situation, a JDAM vertically impacting through the top of the roof would not penetrate far enough, nor detonate at the desired level to achieve the intended results. Have a conversation with the aircrew, and develop a game plan that uses the appropriate aircraft run-in and modified impact angle to achieve the desired effects. In these situations, the correct target elevation is paramount.

4.7.4 Laser-Guided Bombs. LGBs are better for dynamic targets and have the ability to adjust the point of impact after release; however, the Paveway II series guidance packages rely heavily on aircraft speed, altitude, heading, and release angle to accurately guide on the desired point of impact and are susceptible to weather/smoke visibility degradation. LGBs generally impact at shallower angles. See Figure 4.28, LGB Flightpath, and often fall short of targets. Strong surface winds may degrade accuracy as well. Additionally, the shallow impact angle of LGBs will affect the fragmentation pattern of the weapon (less uniform); therefore, adjustments to the laser spot aimpoint may be necessary to achieve desired weapon effects.

4.7.4.1 Smoke on the battlefield from previous weapon impacts or munitions can occlude laser energy, and degrade weapons accuracy. As a rule of thumb, if using a mix of weapon types near-simultaneously (i.e., LGBs, PGMs, and unguided), have laser-guided weapons impact prior to other weapons as to not obstruct the laser spot from the target.

Figure 4.28 LGB Flightpath.



4.7.5 Forward-Firing Weapons (AGM 114, AGM-65, AGR-20, and 2.75 Inch Unguided Rockets). For most moving targets with forward-firing weapons, rear-aspect shots are optimal to achieve accurate impacts.

4.7.5.1 AGM-114 Hellfire on Personnel. On personnel, the AGM-114 should be set to lock on after launch (LOAL) with a near vertical impact angle to uniformly disperse fragmentation and a HOB setting to achieve the most lethal results. Knowing the proper variants of AGM-114 will aid in appropriate target pairing.

4.7.5.2 AGM-65 Maverick. AGM-65s provide excellent standoff range and are highly effective against enemy targets; JTACs must know the different munition variants of AGM-65s (unitary versus shaped-charge). Unitary charge (high explosive) variants are effective on a wide array of targets; however, will not be effective on heavy armor. For general knowledge and planning purposes, if a Laser-Maverick loses laser, or malfunctions during terminal guidance, it will normally impact far of the target.

4.7.5.3 AGR-20/APKWS/2.75 Inch (Unguided) Rockets on Personnel. Rockets must be employed in close proximity and usually at a dive angle to effectively impact targets. Due to the direct flightpath and shallow impact angle of rockets, the majority of the blast/frag is dispersed forward; therefore, placing the rocket aimpoint to the rear of personnel will aid in lethality.

NOTE: For SAFETY (due to the seeker sensitivity), DO NOT ground base lase for the APKWS until procedures with an associated safety cone are published.

4.7.6 Gun Strafe. Low-angle strafe versus high-angle strafe. The tactical situation will dictate strafe tactics for attack aircraft. In permissive situations where collateral objects, civilians, or friendlies are of concern, a high-angle strafe pass can often mitigate hazards associated with skip range and ricochet fans. In a non-permissive environment, low angle strafe may be the appropriate technique to avoid enemy surface to air threats. For more specific information on skip range and ricochet fans applicable to the target practice (TP) rounds, refer to AFTTP 3-2.6, *JFIRE*. Other types of rounds (i.e., API, and HEI) do not perform the same as a TP round, but target back drop for round fragmentation and ricochets should always be taken into in account when weaponeering and selecting final attack headings. The risk of fragmentation and ricochets should be discussed with the ground commander during weapons selection.

4.7.7 Unguided Bombs. In contested/degraded operations or in periods when bomb guidance kits are limited or unavailable, unguided weapons may be the only option for air-to-ground munitions. When using unguided bombs, additional attention is required during the aircraft run-in/terminal control, and the flightpath of the aircraft and the bomb should be completely deconflicted from friendlies. Techniques such as bracketing and time-separation should be used to adjust and correct from initial impact points to achieve effective weapons effects on target sets.

4.7.8 Wind Corrected Munitions Dispenser. The WCMD tailkit is typically installed on the CBU-87, CBU-89, and CBU-97; changing designators to the CBU-103, 104, and 105 respectively. This provides increased accuracy for the weapons by correcting for the expected target area winds, velocity, and vector, during the munitions decent. Provided that the target set is static or dynamic in a predictable direction and speed, WCMD's decreased CEP allows the JTAC/aircrew to weaponeer more conservatively. Without WCMD, kits on CBUs have an increased CEP due to uncorrected wind factors playing a significant role on the munitions descent trajectory. JTACs should consider bracketing the target set with CBUs that do not have WCMD kits.

4.7.9 AC-130 Gunship Direct Fire Cannons. Gunship targeting sensors and cannons require calibration or tweaking, prior to on-station time to boresight the cannons to the targeting sensors. Without this process being accomplished, the CEP can be significantly affected. JTACs should request the status of the AC-130 cannon boresight on check-in, then during weaponeering take this into account. If the GFC's intent involves precision engagement upon check-in, an engagement with a cannon that has not been boresighted should be avoided. To maximize accuracy, AC-130 crews should try to tweak at expected employment altitude. AC-130 can enter combat without a tweak, but the first several rounds from each gun will not be as accurate until a ***combat tweak*** is performed. Subsequent fire missions' accuracy is then improved to the expected accuracy.

4.7.10 Weather/Environmental Considerations. Weather factors including clouds, rain, mist, snow, smoke, and wind drive a JTAC to select all-weather weapons. GPS guided weapons are preferred and will correct for all of these factors. Surface wind readings should be taken by the JTAC and reported to the employing aircraft when unguided bomb, rockets or LGBs are to be employed. LGB engagements must allow for the primary and/or alternate target designator to maintain LOS during the guidance phase, approximately the last 8 seconds of LGB flight. Environmental factors that preclude successful LGB guidance can be overcome by employing forward-firing or direct fire weapons on moving targets or bracketing a fixed or static target with unguided weapons.

4.7.11 Target Activity. Target activity can be broken down into three general categories, fixed, static, and dynamic. Weaponeering should consider the nature of the target and possible activity. Fixed—the target is at a known location, and does not have the capability of moving. Static—the target is at a known location, but is inherently capable of moving. Dynamic—the target is located, but moving and the location is constantly changing. For fixed targets, weaponeering should address DWE as the primary consideration because the options for weapons selection is broad (i.e., unguided and GPS guided weapons can be a valid solution). For static targets, weaponeering should address the target's ability to become dynamic thus laser-guided, forward-firing, and direct firing weapons are preferred. The GFC's priority for all targets is essential to grasp prior to selecting a solution. For dynamic targets, laser-guided, forward-firing, or direct fire weapons are preferred, but not necessarily always required. Unguided or GPS weapons can be used if the target's direction and speed is known and a location for engagement can be predicted (i.e., a bomb box), which requires a substantial volume of weapons to be expended thus not preferred, unless sufficient quantities are available. The most preferred weapon for a dynamic is a powered laser-guided weapon (i.e., AGM-65 or AGM-114).

4.8 Weapon/Target Pairing. JTACs must be familiar with weapons capabilities and limitations in order to affect intended targets in various environments and scenarios. Consider the type of aircraft, aiming system, delivery mode, threat, and required time to employ to select the most appropriate weapon for the tactical situation. **Table 4.3**, Recommended Weapon-Target Pairings, provides a general reference for weapon-target pairing. For more in-depth descriptions of weapons and capabilities, refer to AFTTP(I) 3-2.6, *J-FIRE*; 2018 Weapons File; TO 1-1M-34, *Aircrew Weapons Delivery Manual*; and AFTTP 3-1.JTAC.

4.9 Weapons Conservation Plan. JTACs must use assets appropriately in order to effectively manage and employ weapons, while striving to conserve weapons for future targets. Thought should be put in to how to conserve or employ certain weapons based on capability, and/or based on aircraft capabilities, limitations, and remaining time on station in order to anticipate future target sets. Although not a primary concern, fuel conservation may drive tactics as assets may be limited. Certain aircraft are more susceptible to weight and drag, and altitude, increasing fuel consumption decreasing on-station or vul times.

4.9.1 Example Weapons Conservation Plan. Multiple aircraft are on station armed with air-to-ground munitions, including a remotely piloted aircraft (RPA) (long-loiter time) with Hellfires and a PGM, and fastmovers (short-loiter time) with PGMs and guided rockets and collateral damage is not of concern. On stationary targets, it makes sense to use the weapons of the fastmovers first since on-station time is limited. Also, moving target capable PGMs like GBU-54s, should be conserved for dynamic targets that may present themselves in the future. Judicious employment and tactical patience are paramount in managing firepower.

Table 4.3 Recommended Weapon—Target Pairings (1 of 2).

Targets	Recommended Ordnance Options[1]	
Radars	SDB JDAM AGM-88 Hellfire (M/N-4/R)	Brimstone Maverick AGR-20/APKWS JASSM/JSOW
Soft targets, static vehicles, aircraft in open	Hellfire (all variants) Maverick Brimstone Griffin LJDAM[2] AGR-20/APKWS	DMLGB[2] LGB[2] JDAM[2] FW: 20 to 40 mm SAPHEI RW 7.62 to 30 mm SAPHEI
Moving vehicles	Hellfire (all variants) Maverick Brimstone Griffin LJDAM[2] DMLGB[2]	LGB[2] FW 20 to 40 mm SAPHEI RW 7.62 to 30 mm SAPHEI AGR-20/APKWS
Armored vehicles: tanks, armored personnel carriers	Hellfire K/K2A/L/P4A/R/R2 Maverick Brimstone LJDAM[2]	DMLGB[2] CBU-87/97/103/105 FW: 30 mm API
Personnel: Individual/small group	LJDAM[2] DMLGB[2] LGB[2] SDB Brimstone	Griffin AGR-20 Hellfire (M/N4/R) RW 7.62 to 30 mm HEI FW 20 to 40 mm HEI
Personnel: Large group	LJDAM[2] DMLGB[2] LGB[2]	CBU GP[2] JDAM[2]
Buildings[3]	JDAM[2] DMLGB[2] LJDAM[2]	LGB[2] SDB GP[2]
Artillery Fixed AAA in Open	LJDAM[2] DMLGB[2] LGB[2] JDAM[2] Hellfire (all variants)	Brimstone Maverick GP FW: 20 to -40 mm SAPHEI RW: 20 to 30 mm SAPHEI
Hardened position—Targets in Revetments	JDAM[2] LJDAM[2] DMLGB[2] Maverick	Hellfire M/N4/R Hellfire K/K2A/P4A Brimstone FW: 20 to 40 mm SAPHEI
Self-propelled SAM and AAA	LJDAM[2] DMLGB[2] LGB[2] Brimstone	JDAM[2] Maverick Hellfire (all variants) SDB

Table 4.3 Recommended Weapon—Target Pairings (2 of 2).

Targets	Recommended Ordnance Options[1]
NOTES: [1] Consider the type of aircraft, aiming system, delivery mode, threat, and required time to employ to select the most appropriate weapon for the tactical situation. [2] All LGBs, DMLGBs, LJDAMs, JDAMs, and GPs (except SDB [GBU-39]) are assumed to use 500-pound class, or higher, bomb bodies. [3] Building construction type can vary greatly among structures. Material composition and construction techniques will directly impact weapon effectiveness. **LEGEND:** AAA—antiaircraft artillery DMLGB—dual-mode laser-guided bomb GP—general purpose INST—instantaneous JDAM-ER–-JDAM Extended Range mm—millimeter	

4.10 Collateral Damage Mitigation Techniques and Considerations.

4.10.1 Collateral Damage. Collateral damage is the unintentional or incidental injury or damage to persons or objects that would not be lawful military targets in the circumstances ruling at the time. Refer to CJCSI 3160.01C, *No Strike and the Collateral Damage Estimation Methodology*, for a full understanding of the collateral damage estimation (CDE) process. Actual CDE calls will be conducted by an aircrew (informal, usually dynamic targets), or by a certified analyst/weaponeer (formal, usually deliberate targets). The expertise of a JTAC and knowledge of weapons effects can greatly influence targeting outcomes and the approval of strikes from the supported commander or target engagement authority (TEA).

4.10.1.1 In accordance with the principle of proportionality, the right to engage in attacks against military objectives must not be exercised in an unreasonable or excessive way. Therefore, when prosecuting attacks against military objectives (i.e., persons and objects that may be made the object of attack), due regard must be exercised to reduce the risk of incidental harm to the civilian population and other persons and objects that may not be made the object of attack. In particular, the principle of proportionality requires taking feasible precautions in planning and conducting attacks to reduce the risk of harm to civilians and other persons and objects protected from being made the object of attack, including by trying to ensure the targeting and engagement of only military objectives. The principle of proportionality also requires refraining from attacks in which the expected loss of civilian life, injury to civilians, and damage to civilian property incidental to attacks would be excessive in relation to the concrete and direct military advantage expected to be gained. The US military must uphold these obligations through the conscientious use of force in the accomplishment of assigned military missions. The US Government places a high value on preserving civilian and noncombatant lives and property. Failure to comply with US international legal obligations would be considered a law of war violation. In such cases, the US could be subject to global criticism, which could adversely affect military objectives, alliances, partnerships, or national goals.

4.10.2 CDE Considerations. In offensive operations, (i.e., not self-defense), collateral damage methodology must be considered for the above-mentioned reasons. Even in self-defense situations, proportionality should be applied. For example, you have multiple assets overhead with weapons ranging from GBU-31s down to AGM 114s, and your target is a single enemy Sniper in a four-story building shooting from the top floor window. In this situation, your choice of weapon should be an AGM-114, as the target is the Sniper, not the building. The GBU-31 would be legal to use in this self-defense scenario, and it would have certainly neutralized the threat of the Sniper; however, the overwhelming effects of the GBU-31 could have destroyed the entire building, while also damaging adjacent structures, and possibly result in civilian casualties. Choosing the weapon with the smallest damaging effects that will effectively neutralize/destroy the intended target should always be the first consideration in limiting unintended objects or persons.

4.10.3 CDE Mitigation Techniques. In addition to choosing a weapon with a smaller dominant warhead effect (i.e., lower yield or low collateral), the following methods are basic weaponeering techniques that a JTAC can apply to limit/mitigate collateral damage to nearby objects, buildings, or persons that are not the intended targets. See **Table 4.4**, CDE Mitigation Considerations.

4.10.3.1 Delay Fuze/Warhead Burial. Delay fuzing for complete warhead burial prior to detonation mitigates warhead fragmentation and thus reduces the risk of collateral damage. However, warhead burial prior to detonation can produce a significant secondary debris hazard from the material ejected (ejecta) from the resulting crater. In order to successfully employ this method, delay fuze settings must be set to achieve either complete warhead burial below grade, or complete burial within a target structure prior to detonation to mitigate the primary fragmentation effects of the warheads. The benchmark for achieving complete bomb burial or mitigation is the selection of a specified (in milliseconds) delayed fuzing. Warhead burial reduces the risk of serious or lethal injury to unprotected civilians and noncombatants near the target.

4.10.3.2 Variable Time (VT)/Proximity (PX)/Airburst Fuze. Fuzing for an air detonation is an effective technique for mitigating the blast effects of warheads and reducing collateral risk to structures. However, the technique presents increased risk to unprotected civilian or noncombatant personnel as the fragmentation pattern is optimized. The blast dissipates rapidly in open-air detonations, which reduces the risk of blast effects on the collateral structure. VT/PX fuzing prevents the warhead from penetrating into the structure and injuring the civilians and noncombatants inside. Take caution when employing this mitigation technique to consider the increased potential fragmentation hazards to noncombatant personnel inside the collateral structure, due to openings (e.g., windows and doors) in the collateral structure.

Table 4.4 CDE Mitigation Considerations.

Consideration	Delay Fuzing/ Warhead Burial(1)	VT/PX/ Airburst Fuzing(2)	Shielding(3)	Delivery Heading(4)	Aimpoint Offset(5)
Fragmentation	X	NA	X	X	X
Blast	X	X	X	NA	X
Debris	NA	X	X	NA	X
Penetration	NA	X	NA	NA	NA
Thermal	X	NA	X	NA	NA
Delivery Error	NA	NA	NA	X	NA

NOTES:

(1) Delay fuzing that achieves 100 percent warhead burial in the ground or internal detonation within a target structure provides the best mitigation for fragmentation and blast and may minimize thermal effects. Consider thermal effects when planning attacks on targets that present a high thermal sensitivity (e.g., wood structures or gas tanks).

(2) Variable time/proximity/airburst fuzing that achieves an above-ground/air-burst detonation mitigates lethal blast and effects and eliminates penetration effects.

(3) The presence of other structures, walls, vegetation, and terrain features may achieve the shielding of collateral structures from fragmentation.

(4) Delivery heading can mitigate fragmentation effects and minimize risk of delivery error. Testing demonstrated that most fragmentation effects occur toward the front half of blast and fragmentation warheads.

(5) Aim point offset may mitigate fragmentation, blast, and debris effects when using PGMs. In some cases, applying aim point offset allows employment of larger warheads that create the desired effect and mitigate collateral damage.

4.10.3.3 Delivery Heading Mitigation (Unguided Weapons Only). Limiting the delivery heading of warheads mitigates the risk of collateral effects caused by range delivery error and predominant lethal effects. Weapon testing revealed that the majority of lethal effects occur in the forward quadrants of warhead detonation along the delivery heading (between 270 and 90 degrees relative to warhead detonation). The lethal effects include both fragmentation and secondary debris from the target. Therefore, consider delivery-heading mitigation. Delivery heading mitigation may be impractical at the point of execution due to threats or other conditions in the target area. In these cases, command policies, ROE, and target sensitivity will dictate the decision to forgo the delivery-heading recommendation, reassessing the weapon-target pair, or abort the mission.

4.10.3.4 Shielding. Shielding mitigates warhead effects since the presence of vegetation, terrain features, and intervening structures (e.g., buildings and walls) may shield collateral concerns from fragmentation, blast, debris, and thermal effects. Shielding occurs when the entity or significant terrain feature capable of shielding a warhead's effects is located between the intended aimpoint and a collateral object.

4.10.3.5 Aimpoint Offset. Depending on a target's size, orientation, and composition, one may have to alter or move the aimpoint to still meet the desired effect. Be sure to take into consideration collateral hazards, effects, and the added risk while still achieving the DWE.

CHAPTER 5

CLOSE AIR SUPPORT EXECUTION

5.1 Introduction. Close air support (CAS) execution is an ever evolving process that requires joint terminal attack controllers (JTAC) to be familiar with various platforms, missions, and the employment of kinetic/non-kinetic effects (NKE) in today's battlefield. Decades of TTP have been tested in combat with varying degrees of success. This chapter provides tested TTP and best practices observed, while executing CAS missions, and is not intended to cover all CAS factors that are included in other documents. For a detailed explanation of the CAS execution process, refer to Joint Publication 3-09.3, *Close Air Support*.

5.2 CAS Execution Template. Following the 12-step execution template is critical as a guide for safe/hasty mission success. However, through the complexity of CAS, the execution process can be effectively tailored for any given tactical situation. See **Figure 5.1**, CAS Execution Template.

5.2.1 Routing/Safety of Flight. The JTAC/FAC(A) will immediately give procedural routing/safety of flight (R/SoF) to inbound aircraft in order to establish them in a safe hold. In an environment where spoofing of the strike frequency is a threat, the JTAC/FAC(A) should take care not to give any data that states where other aircraft in the current stack are holding, or where known threat and targets are located, until the entity that is checking in has been authenticated. ***NOTE:*** **DO NOT** delay routing and safety of flight to conduct aircraft authentication. The JTAC/FAC(A) should immediately advise inbound aircraft about safety of flight factors in the battlespace. CAS aircraft will remain at the contact point and altitude as directed by command and control (C2) until approved into the area of operations (AO) by the JTAC. If a situation delays the full routing process, the JTAC will, at a minimum, give maintain instructions for a safe hold area in order to establish control of the aircraft (e.g., "VIPER 31, MAINTAIN CHEVY-FORD FL 180 TO 200"). See **Table 5.1**, Routing/Safety of Flight Calls Examples.

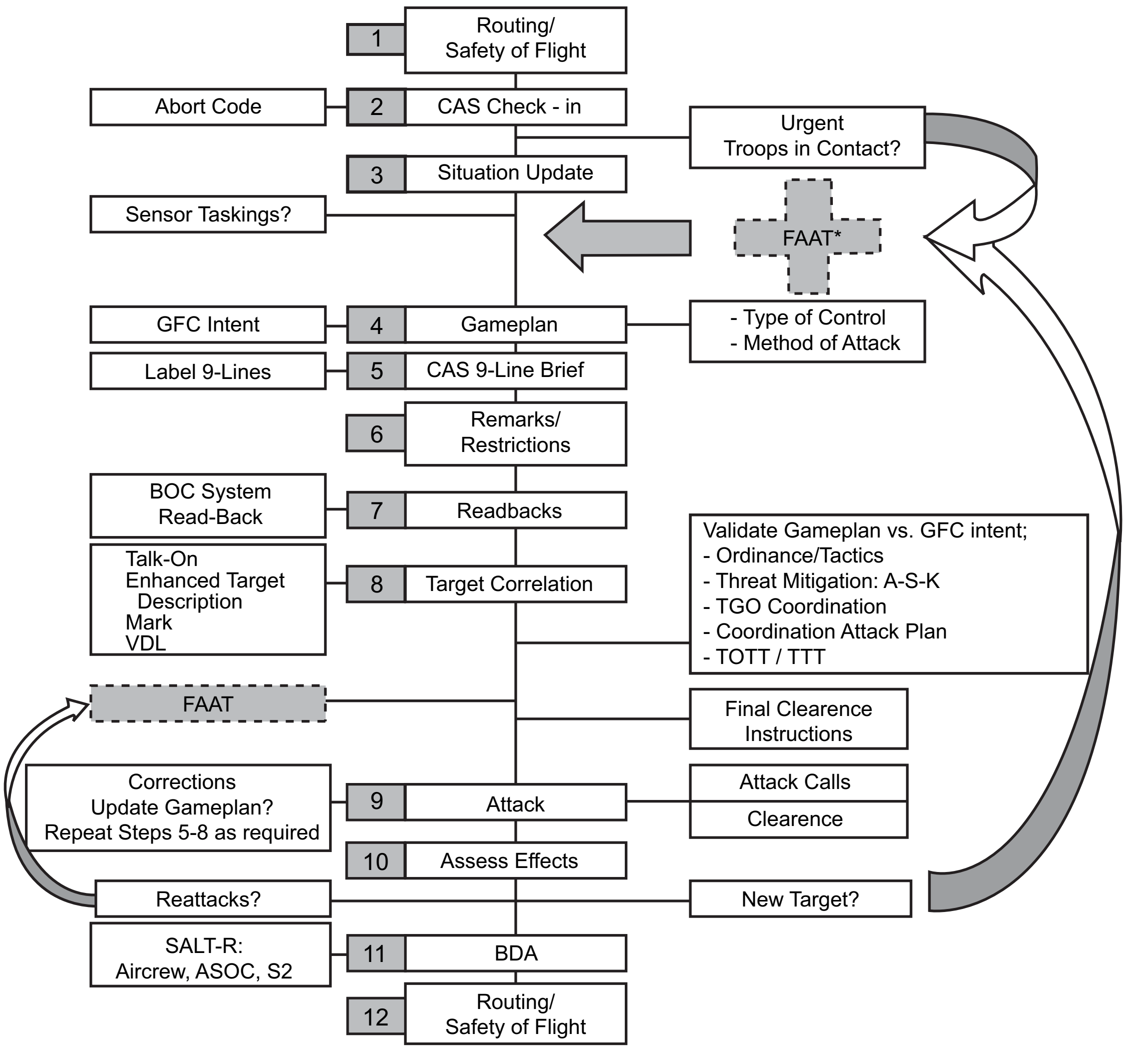
5.2.1.1 If unsure of aircraft's current position and altitude, the JTAC should request aircraft to "STATE POSITION AND ALTITUDE," prior to giving R/SoF instructions in order to avoid potential conflicts. As soon as the tactical situation allows, the JTAC should pass a full R/SoF brief that includes the following information:

- Factor threats that may immediately affect CAS aircraft.
- Three-dimensional directions from current position to intended holding point.
- Other aircraft on station by call sign and location.
- Deconflict aircraft from other assets, surface fires, and known hazards.
- Any other safety of flight issues (e.g., significant weather/terrain).

EXAMPLE: No Other Aircraft on Station: "HAWG 31, PROCEED CHEVY-FORD HOLD 13 BLOCK 15, YOU ARE THE ONLY AIRCRAFT ON STATION."

EXAMPLE: Full R/SoF: "RAZOR 57 PROCEED IP MAZDA AT FLT LEVEL 250, AT MAZDA, DESCEND AND HOLD 16 BLOCK 18, EAST-WEST LEGS, REPORT ESTABLISHED; YOU HAVE LATCH 65 FLIGHT AT CHEVY-DODGE 13 BLOCK 15, WILDCARD 73 IN TEZ CUPS, AND VENOM 15 IN HOLDING AREA BETTY 2K AGL AND BELOW; HOLD YOUR CHECK-IN, ATTACKS IN PROGRESS."

Figure 5.1 CAS Execution Template.



***FAAT: Friendlies, Artillery, Airspace, and Threats.** FAAT represents the minimum essential elements of the situation update. When using FAAT as an abbrreviated situation update for time sensitive situations. JTAC/FAC(A) should pass a full situation update as soon as conditions permit. FAAT also represents a recurring battle tracking reconciliation before beginning a new 9-Line.

Legend:

A-S-K - Avoid, Suppress, Kill
ASOC - Air Support Operations Center
BDA - Battle Damage Assessment
BOC - Bomb on Coordinate
CAS - Close Air Support
FAC(A) - Forward Air Controller (Airborne)
GFC - Ground Force Commander
JTAC - Joint Terminal Attack Controller
SALT R - Size, Activity, Location, Time, Remarks
TGO - Terminal, Guidance Operations
TOT - Time On Target
TTT - Time To Target
VDL - Video Downlink

Table 5.1 Example Routing/Safety of Flight Calls.

Example Routing Calls	
"PROCEED XXXX and REPORT ESTABLISHED."	Call for aircrew to proceed to a location/elevation and verbally report when established.
"MAINTAIN XXXX."	Directive call for aircrew to hold at the specified location/altitude.
"REPORT PASSING XXXX."	Call for aircrew to verbally report passing the specified altitude.

EXAMPLE: "DUDE 41 PROCEED IP BUD TO COORS MAINTAIN 19 BLOCK 20, THERE IS A ZSU-23-4 IN VICITINTY OF COMPOUND 34, YOU ARE THE ONLY AIRCRAFT ON STATION."

EXAMPLE: "DEUCE 23 PROCEED HA BETTY, STAY BELOW 2K AGL EN ROUTE, PAA 12 IS HOT, GTL THREE FOUR ZERO, MAX ORD 12K MSL. YOU ARE THE ONLY AIR ON STATION, SEND CHECK-IN WHEN ABLE."

5.2.1.2 Authentication should occur after R/SoF is given. If the JTAC is in an environment where spoofing is expected they should give the minimum information that allows the aircraft to get to a safe hold without giving any other information on other aircraft or artillery statuses in the AO.

5.2.2 Airspace Control. Quality airspace control should maximize combat effectiveness without unduly restricting combat operations. JTACs/FAC(A)s and fire support personnel should strive to use separation techniques that require the least amount of coordination without adversely affecting the ability to complete the mission safely.

5.2.2.1 Aircraft Deconfliction. Multi-asset, multiship airspace deconfliction is one of the most complicated tasks for a JTAC to conduct. Each aircraft has unique requirements for holding, fuel consumption rates, performance characteristics, attack parameters, and target identification requirements that will affect airspace use. This is amplified by threats and weather in the target area. A complete understanding of aircraft capabilities, aircraft weapons, operational airspace, ground force maneuver and threat ranges are needed to manage a complex multiship close air support mission effectively. Building a solid aircraft deconfliction plan prior to aircraft arriving on station will expedite CAS attacks while reducing ordnance delivery times. The four types of deconfliction are altitude, lateral, timing, and combination.

5.2.2.1.1 Altitude blocks are three-dimensional stacks of airspace where aircraft are free to operate, separated by vertical buffer zones. Peacetime training rules dictate a minimum buffer zone of 1,000 feet between formations of aircraft. This rule can also be applied to combat operations. In addition to the buffer zone between formations, flights of aircraft also require a block altitude to maneuver. During day CAS operations a two-ship formation will require at least a 1,000-foot block and a four-ship will require 2,000 feet. During night operations expect these minimums to double. More airspace provides more flexibility, but try to balance the altitude requirements between the separate formations. If one flight has a 5,000-foot altitude block, then it may push other flights higher than preferred and influence ability to observe the target or pushing them lower, potentially into the threat envelope. Also, if only two formations are on station, then provide at or above or at or below altitudes. See **Figure 5.2**, Altitude Blocks.

5.2.2.1.2 UAS altitude separation can allow for a minimum of 500-foot separation between other UAS. Lost-link procedures should be known by the JTAC in order to appropriately deconflict the stack in the event that a UAS encounters lost-link.

5.2.2.1.3 Lateral. Clearly defined areas where aircraft may operate in all locations at all altitudes. The lateral block does not have to be defined on all sides; a single line will suffice to provide clear separation between assets. As more aircraft arrive, additional deconfliction areas must be created to delineate holding and attack zones. JTACs have multiple options to use when creating lateral zones. The terrain, man-made features (e.g., roads, buildings, and power lines), and threat/weather considerations all will factor into the lateral deconfliction plan. As a general rule, JTACs should choose a method that pilots can reference visually. Grid lines from a 1:50 map can be used but may increase pilot workload. Another technique is to sector aircraft in cardinal directions off the intended CAS target. For the JTAC to optimize allocated airspace it is recommended to consult with the assets that are allocated. See **Figure 5.3**, Lateral Deconfliction.

5.2.2.1.4 Timing. In certain tactical situations (i.e., aircraft flying low altitude tactics or artillery integration), timing separation is the preferred option. Timing will deconflict aircraft from each other and from weapon frag patterns. It is an effective method to deconflict aircraft in the immediate target vicinity during the terminal phase of attacks. JTACs will have to employ other techniques to provide positive deconfliction during holding, ingress, and egress. Using timing with aircraft at medium-altitudes, JTACs may use plain English, based off visual cues (e.g., "VIPER 11, PLAN TO EMPLOY YOUR BOMBS 1 MINUTE AFTER HAWG 12'S IMPACT"). This example illustrates a key point for timing deconfliction; the timing is based off weapons impact. As a rule of thumb, plan on a minimum of 1-minute of separation between all aircraft at low altitude to allow for weapons frag to clear.

5.2.2.1.5 Combination. Hybrids of the above three types of deconfliction also can be used. Tactical considerations will drive JTACs to use a combination of the above options. The most common combination is a laterally defined altitude block that creates holding airspace and is set up to allow multiple follow-on aircraft into the area. The lateral sector may be defined in reference to terrain, man-made objects, or the target itself. The vertical limits can be adjusted based on weather, terrain, and aircraft capabilities. Some low-altitude combinations include running the aircraft back and forth from multiple IPs with timing separation in the target area, assigning different offsets from IP-to-target with separate final attack headings, and having the aircraft egress the target area in different directions.

Figure 5.2 Altitude Blocks.

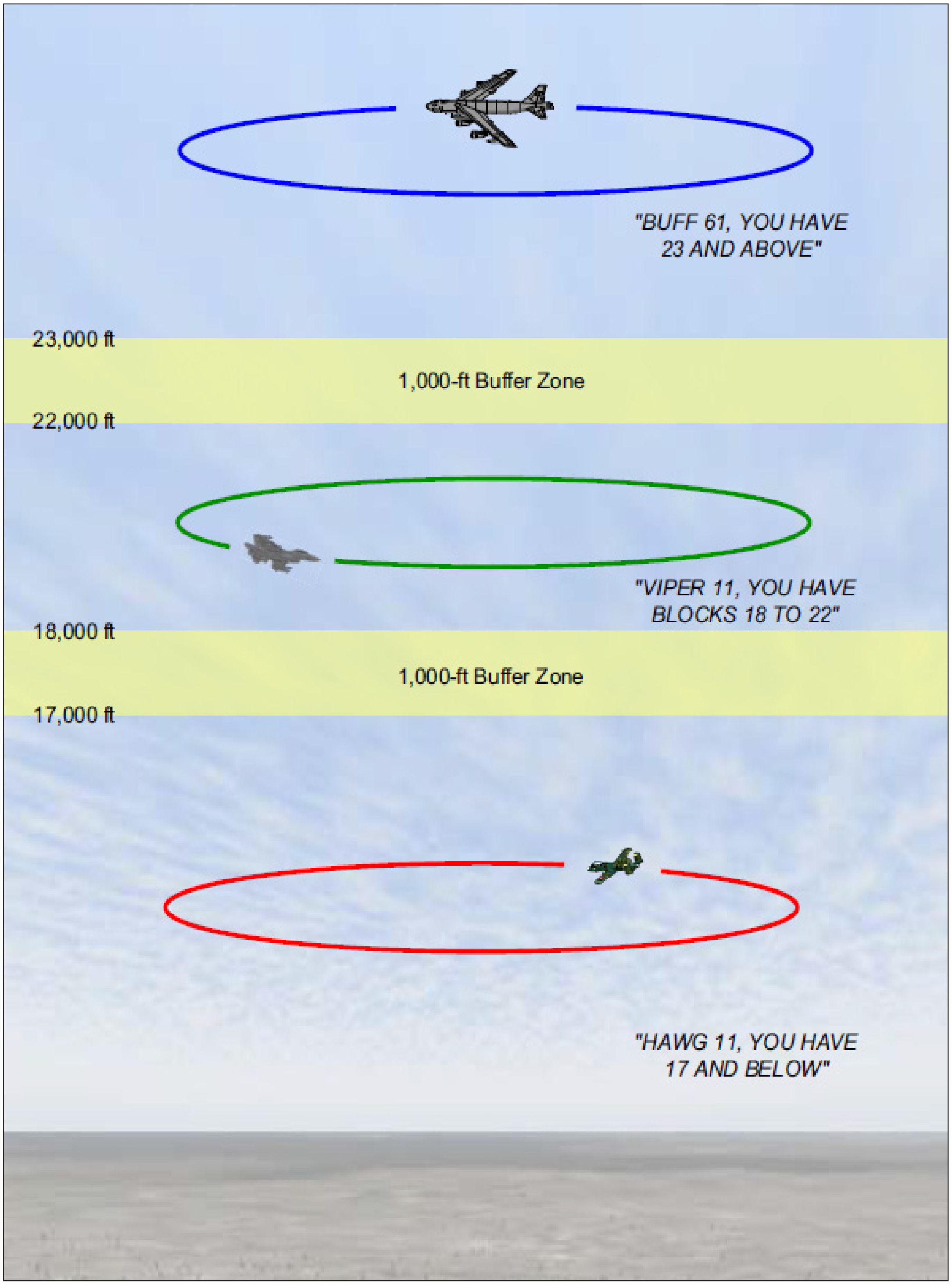
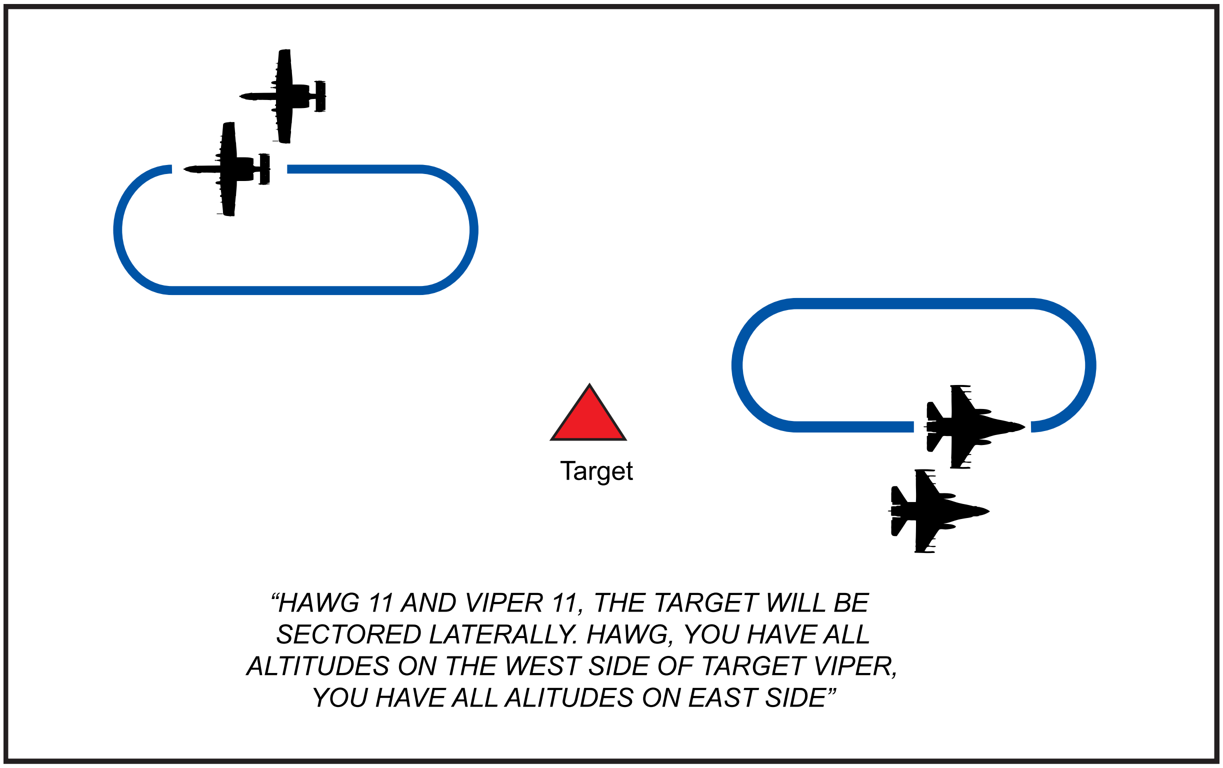


Figure 5.3 Lateral Deconfliction.



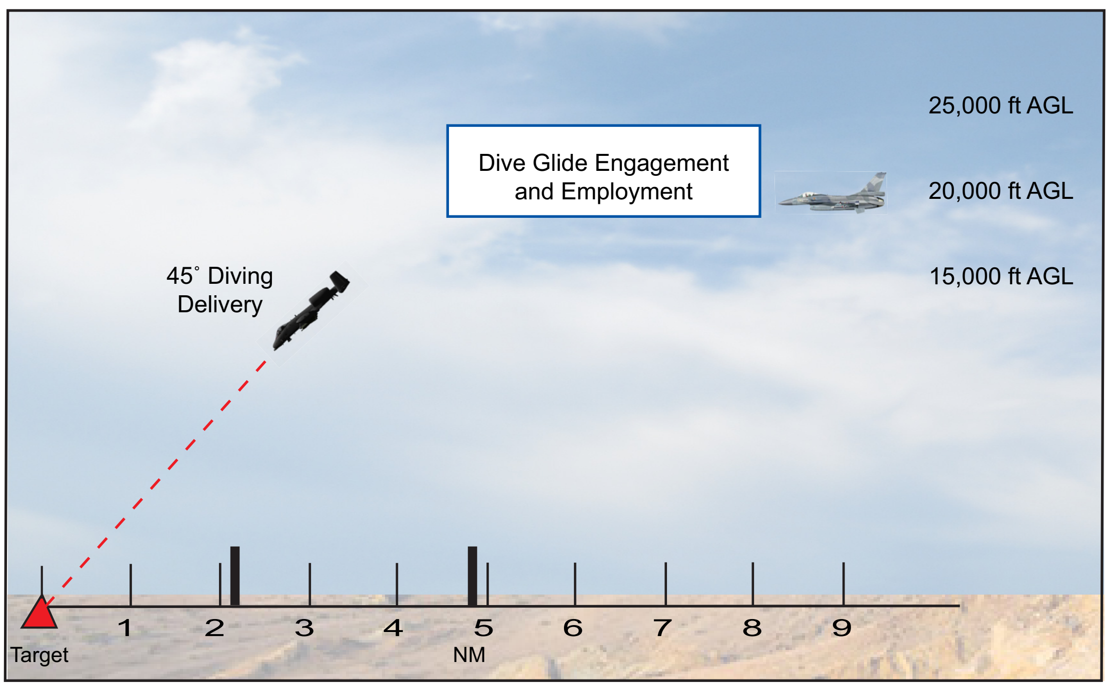
5.2.2.2 Aircraft Airspace Considerations. Every aircraft has varying performance factors in regards to the employment of weapons. JTACs must be familiar with each weapons platform to decide the optimal deconfliction option. For medium-altitude CAS, the block 8,000 feet AGL to 15,000 feet AGL is the best compromise among aircraft engine performance, fuel consumption, and threat vulnerability. Fighter aircraft typically need an IP 5 to 15 NM from the target area for holds and attack run-ins, while bomber aircraft need an IP 15 to 20 NM. During low-altitude employment, expect only fighter aircraft, and use lateral or timing deconfliction to sequence them into the target area. See **Table 5.2**, Aircraft Considerations for Deconfliction of Airspace.

Table 5.2 Aircraft Considerations for Deconfliction of Airspace.

Type	Speed (NM/min)	Turn Radius (NM)	Optimal Airspace (NM)	Typical Holding Altitude (Feet)	Typical Employment Altitude (Feet)
Slow (A-10, AV-8)	4 to 5	3 to 5	10	15,000 to 25,000	15,000 to 25,000 or Below 1,500 feet AGL
Fast (F-16, F-15E, F-35, F/A-18)	7 to 9	4 to 6	15	15,000 to 25,000	5,000 to 25,000
B-1	7 to 9	7 to 9	20 to 25	12,000 to 25,000	12,000 to 25,000
B-52	6 to 8	4 to 15	30+	30,000+	30,000+

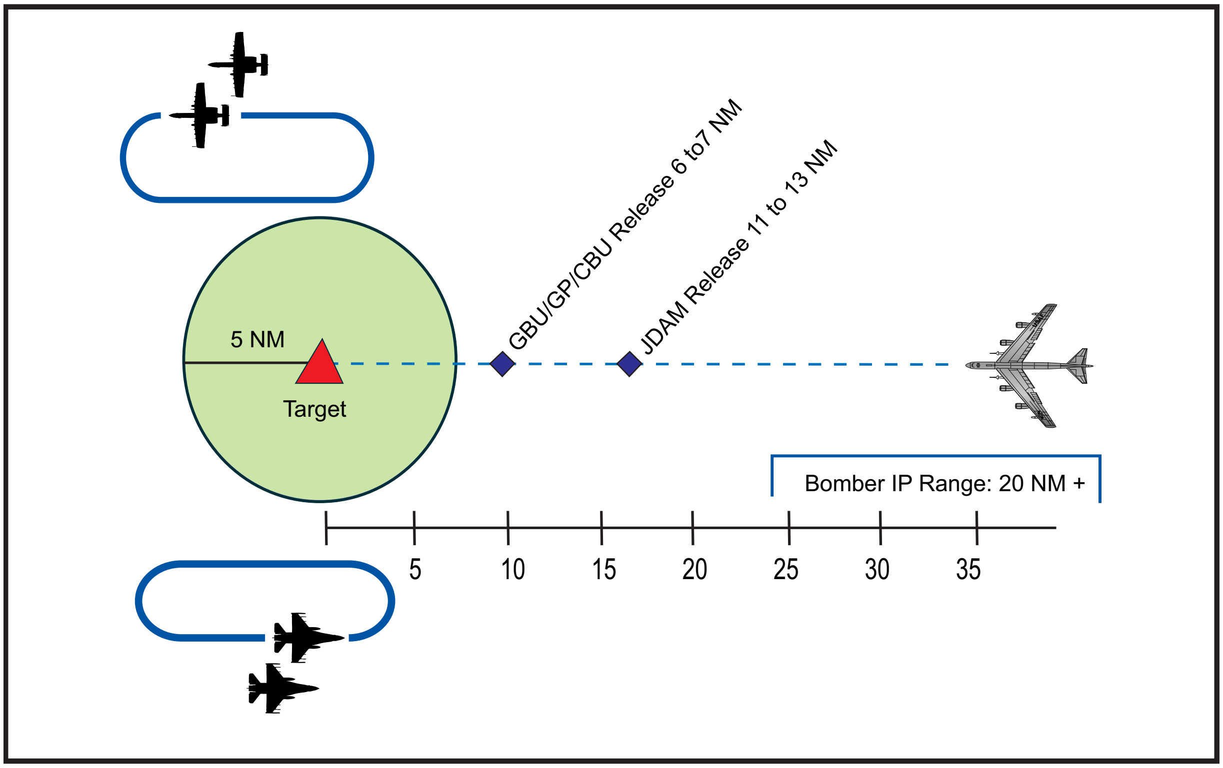
5.2.2.2.1 Fighter Considerations. Diving deliveries will typically work inside a 5-NM tactical employment zone (TEZ). These deliveries apply with rockets, guns, and free-fall general-purpose bombs. If the aircraft is performing a dive-glide delivery using an LGB or JDAM, it still can employ within 5 NM if required for deconfliction, but it also can stand off the target. Releasing above 30,000 feet AGL, the aircraft on a level delivery may release ordnance as far away as 10 NM from the target. It is important to remember that the time of flight of each weapon may vary, so the JTAC needs to compensate for longer drop times. A free-fall bomb released from a dive (near 10,000 feet AGL) will fall for approximately 15 to 20 seconds. A wingman shooter may intend to employ ordnance immediately after Lead's release, or they may wait for JTAC correction before commencing own attack. A dive-glide LGB from 20,000 feet AGL lased by the attacking aircraft may not impact the target for 45 seconds or more following a weapons release. These attacks are not typically done in a "shooter-shooter" formation. See Figure 5.4, Fighter Considerations.

Figure 5.4 Fighter Airspace Considerations.



5.2.2.2.2 Bomber Considerations. Bomber aircraft will not perform diving deliveries. Bombers release munitions from high-altitude level passes, which will affect airspace below the holding altitude. JTACs should choose a specific IP for bomber aircraft due to hold requirements and deconflict all assets in relation to bomber IP-to-target run-ins. Fighters can self-deconflict from bombers if aware of the IP-to-target run-in. Launch acceptability region (LAR) should be taken into consideration when fighters could be affected by the employment of a bomber and his bomb-fail line. The JTAC can aid in conveying this information by using a "Hot Radial," a "TEZ," or other methods of lateral deconfliction described later in this chapter. See Figure 5.11, ROZ/TEZ Use (later in this chapter). Bombers may also need to assist in coordinating own holding airspace with higher level C2 agencies due to the limited airspace available to a JTAC operating at the tactical level. JTACs should advise the bomber aircrew if a different authority owns the holding airspace. See **Figure 5.5**, Bomber Airspace Considerations.

Figure 5.5 Bomber Airspace Considerations.



5.2.2.2.3 Fifth Generation Fighter Considerations (F-35 R/SoF). The F-35 acoustic signature can be heard inside of 10 NM from all altitudes. If acoustic signature is critical during a CAS mission, JTACs and aircrew need to maintain strict awareness holding instructions of distance from the target area. A 5 NM Wheel optimizes electro-optical targeting system (EOTS) masking issues with the ability to identify larger tactical-sized targets. While the 5 NM Wheel minimizes the masking issues, it will not allow for the identification of weapons or the tracking of individuals on the ground. For high altitude holding considerations, an offset will be flown at 10,000 feet height above target (HAT) minimum out to 10 NM away from a target area with perpendicular 5 to 10 NM legs. See **Figure 5.6**, F-35 Offset Wheel. The advantage of this type of Wheel is that it is a simple pattern to fly, especially within the hold and minimal masking is produced. A Figure Eight hold (see **Figure 5.7**, F-35 Offset Figure Eight) at the same distance and minimum altitude will allow for the F-35 to place the target area 45 degrees of nose on the turn. It is not recommended to hold F-35s lower than medium altitude. During a low offset parallel hold, the F-35 can maintain less than 10,000 feet HAT, but will not be able to acquire the target area during the outbound leg due to the gimble. See **Figure 5.8**, F-35 Low Offset Parallel Hold.

Figure 5.6 F-35 Offset Wheel.

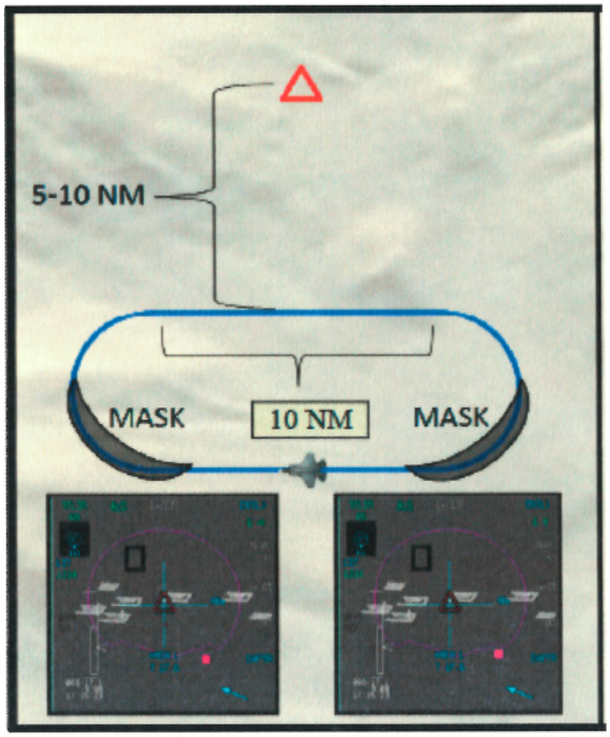


Figure 5.7 F-35 Offset Figure Eight.

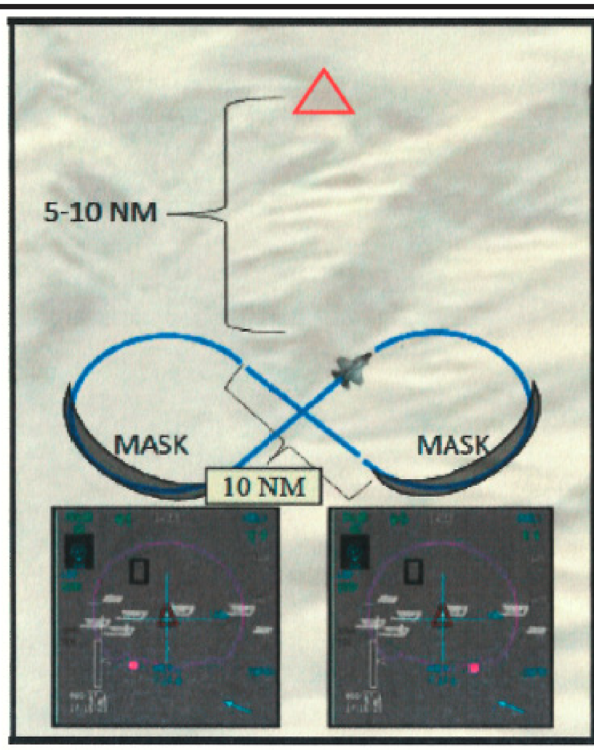
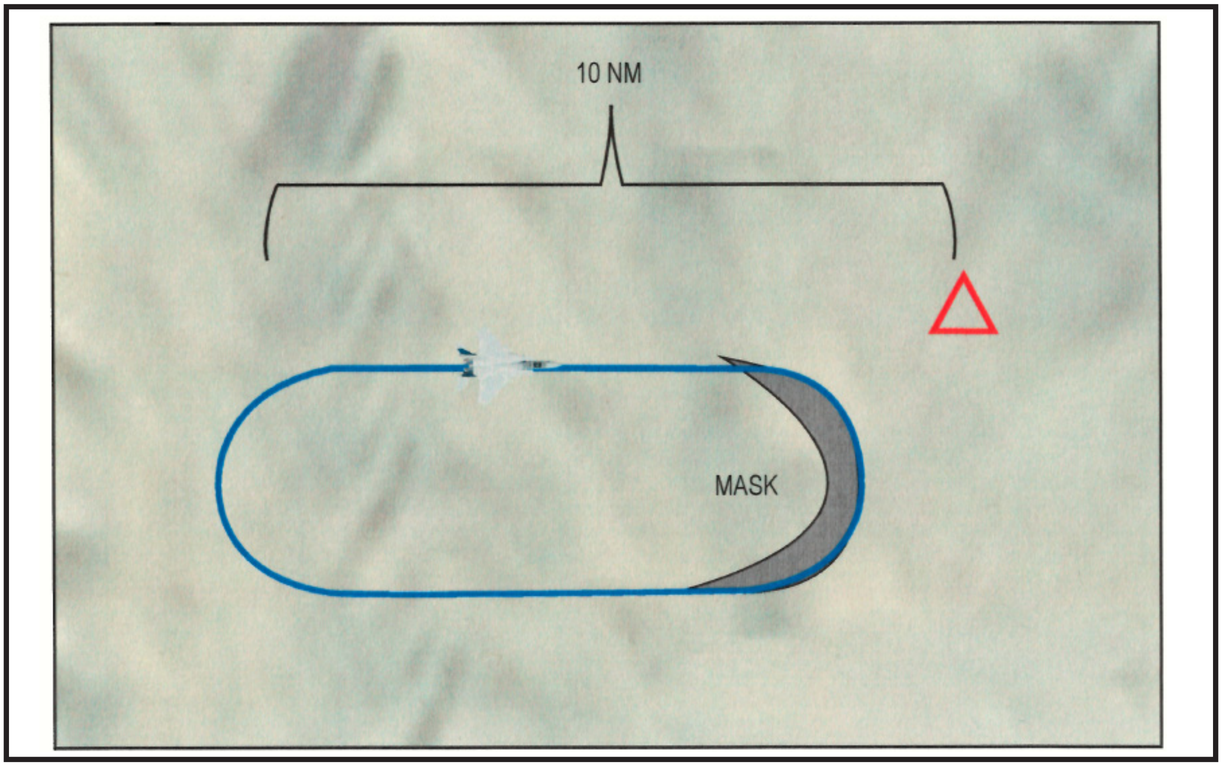


Figure 5.8 F-35 Low Offset Parallel Hold.



5.2.2.2.4 F-35 employment considerations with CAS execution. The following describes how to use an F-35 during the CAS execution template and planning considerations. The F-35 roles consist of, but are not limited to, SEAD/DEAD, AI, offensive counterair (OCA) and CAS. The F-35 has three main variants that are organic to each particular service. F-35A conventional take-off and landing (CTOL) is used with the USAF and uses airfields. F-35B short take-off and vertical landing (STOVL) is used by USMC which has a smaller internal weapons bay and internal fuel capacity. F-35C carrier variant (CV) is used by the USN and has the greatest fuel capacity. The grid that the JTAC provides for line 6 during BOC attacks can be expected to be read back from the navigational system while working with the F-35. Grids/coordinates are input into the navigational system and not the weapon itself.

5.2.2.2.5 F-35 Convoy Escort Considerations. To provide optimum support to a convoy, use a two-ship to the maximum extent possible. The best results were attained when the flight assumed a defensive sensor posture, with one aircraft maintaining situational awareness on the vehicle convoy while the other scanned the convoy's route for threats. From medium altitude (15,000 to 20,000 feet HAT), a single F-35 can scan effectively out to 200 meters in lead of the convoy and still be able to maintain visual with the lead vehicle by selecting wide field of view (WFOV). Beyond 200 meters, there is an increased chance of losing contact with the convoy. Therefore, an increased visual scan outside the cockpit may be required. Effective route reconnaissance requires the use of narrow field of view (NFOV).

5.2.2.2.6 Additional Considerations. Current versions of the F-35 do not have SATCOM capability. The F-35 has two UHF and VHF LOS radios. F-35 operates in 30 to 400 MHz AM/FM band. F-35s have the capability to use HQII and SINCGARS during CAS operations. The primary and alternate radios are operated through the generated waveform computer which allows for the F-35 to monitor two frequencies. The tertiary radio is not HQII or secure communications capable. Digitally it operates in VMF for CAS mission execution but is Link 16 capable.

5.2.2.2.7 Manned ISR Considerations and TAC(A) responsibilities. The U-28 is a versatile platform that provides the JTAC with unique TAC(A) capabilities. Long loiter times combined with an enhanced ability to maintain high situational awareness provides the JTAC an opportunity to delegate duties and alleviate task saturation. JTACs delegating TAC(A) responsibilities to the U-28 should be as detailed as necessary. It is critical for the TAC(A) and the JTAC to establish clear lines of responsibility during premission planning and operation execution. JTACs will use the TAC(A) as a relay for Brief, Stack, Mark and/or Sensor when using responsibilities. For more information on TAC(A) implied, specified, and delegated tasks, reference AFTTP 3-1.U-28, Chapter 5.

5.2.2.3 Airspace Control Measures. CPs/IPs/HAs/BPs and the keyhole template enhance the JTAC's capability of maintaining situational awareness of designated airspace. Location selection should be based on enemy capabilities, target orientation, friendly positions, weather, aircraft capabilities, and FSCMs.

5.2.2.3.1 CPs and IPs should be visually significant geographic points whenever possible, in order for aircrew to visually acquire, in the event of a degraded navigation system or GPS-denied environment. IPs are normally located 5 to 15 NM from the target for FW aircraft. High-altitude aircraft may require IPs in excess of 20 NM from the target. When coordinating the use of stand-off munitions, IP ranges may need to be extended to ensure appropriate weapon delivery parameters. In some cases, stand-off CAS platforms may need to apply required terminal deconfliction parameters to the weapon instead of the aircraft. In this case, the aircrew should communicate an appropriate stand-off IP to the JTAC, ensuring that the weapon will remain deconflicted throughout its entire route of flight.

5.2.2.3.2 Holding areas (HA) and battle positions (BP) are 1 to 5 km for RW aircraft. Standard holding distances (kilometer) and HA dimensions (3 x 3 km) and BP dimensions (2 x 2 km) are implied in the assignment of the keyhole position and does not need to be specified by the JTAC, unless nonstandard dimensions are required.

5.2.2.3.3 Keyhole Template. The keyhole template is an efficient method for establishing an IP/BP in the absence of control points or when the control point location does not sufficiently support target engagements. When using the keyhole template with FW assets, distance represents nautical miles from the echo point, and closest allowable hold range to the echo point. See **Figure 5.9**, Keyhole IP Use. When using the keyhole template with RW assets, distance represents kilometer to the center of the BP. Stack owners may direct CAS aircraft to loiter around the echo point outside a specified distance using the term "MAINTAIN ECHO (DISTANCE)" (e.g., "MAINTAIN ECHO 5"). Additionally, JTACs can direct a multi-point hold with keyhole by stating the dual position and distance (e.g., hold B-C, 5 NM) however, when passing the 9-Line for attacks the JTAC should only use a single position for Lines 1 to 3. See **Figure 5.10**, Keyhole Template.

5.2.2.3.3.1 Echo Point Establishment. Echo point selection should be based on the best deconfliction and hasty prosecution measures in a given target area that is easily identifiable for the aircrew via visual and/or digital means. Some options include a geographically definable point from which assets can offset or even a centroid off the target area (i.e., an objective building). Target location should only be used against a static target that is not expected to move during the entirety of the CAS mission (e.g., a building). Any time the Echo point is changed, the JTAC must ensure all aircraft are aware and are safely deconflicted during the new hold adjustment.

5.2.2.3.4 Anchor Point Versus Echo Point. An anchor point is an offset from a known location, with a distance and/or direction the JTAC intends for the aircraft to hold (e.g., pushing an aircraft to an IP, then telling the IP to anchor south in E to W legs). An echo point is a known location on the battlefield (preferably something not dynamic or mobile) that can be used for keyhole holding requirements.

Figure 5.9 Keyhole IP Use.

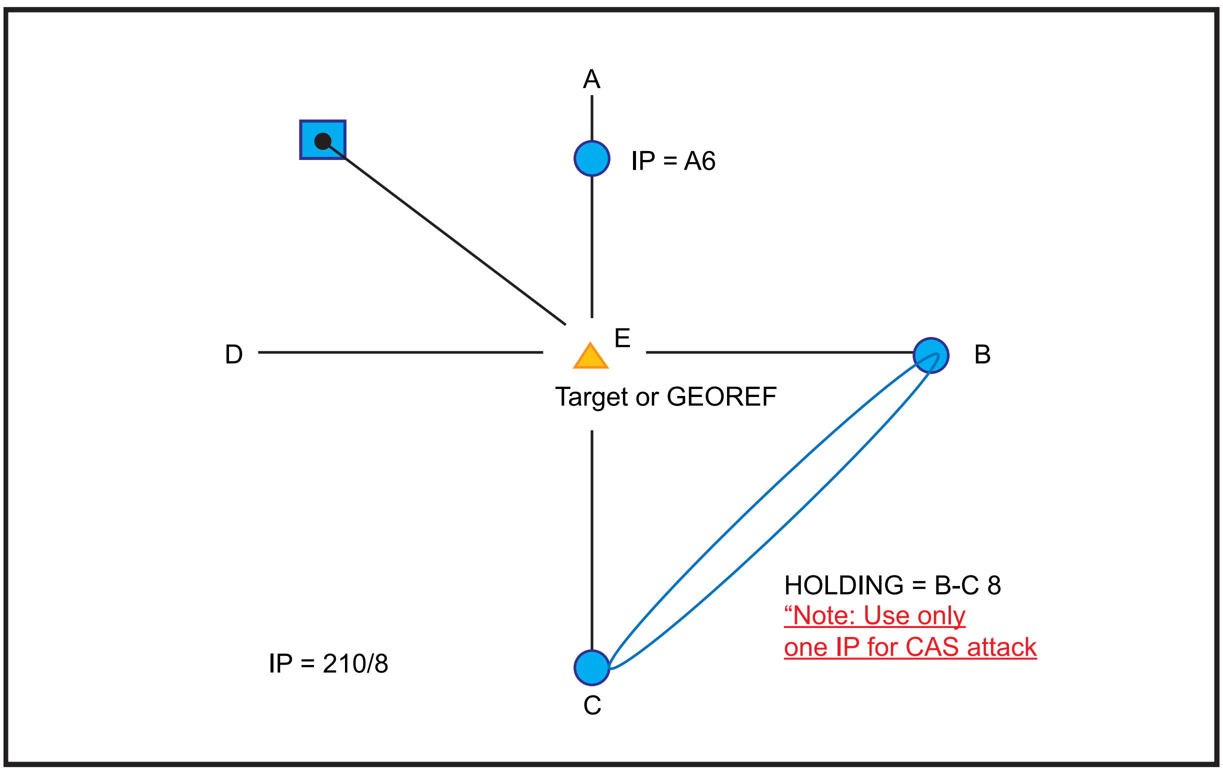
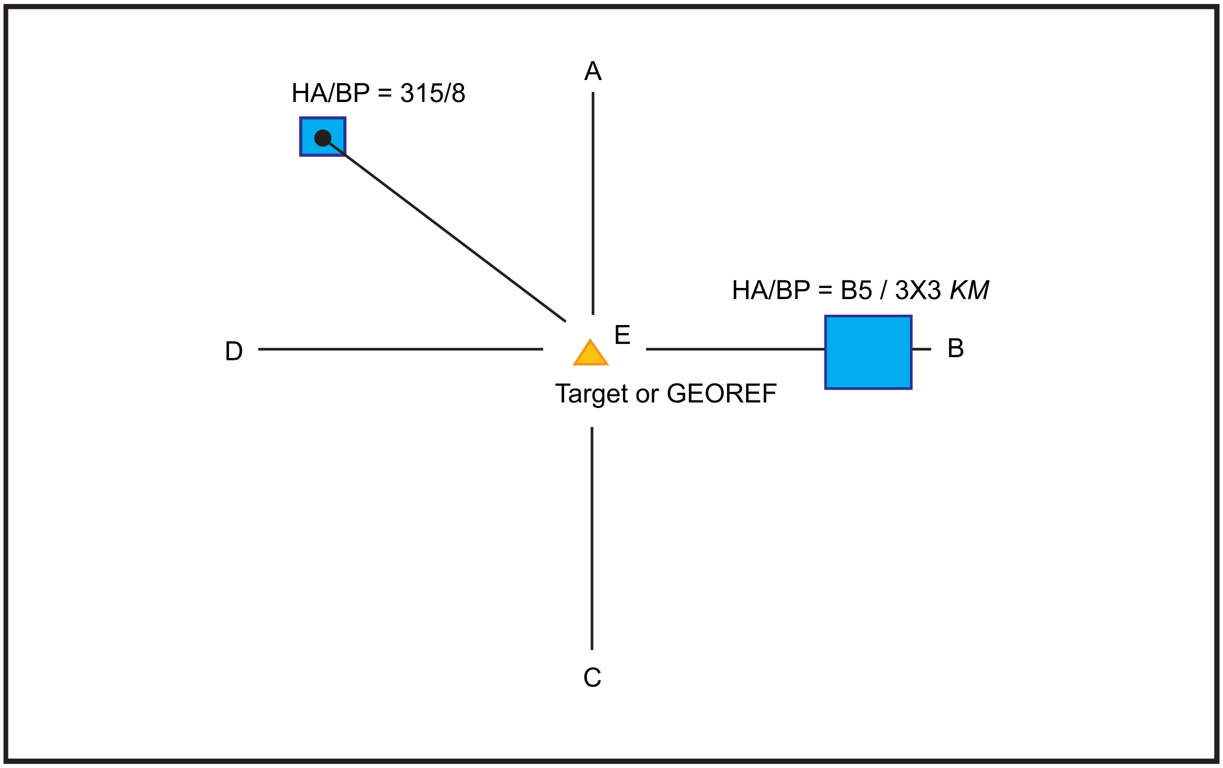


Figure 5.10 FW Keyhole Template.



5.2.2.3.5 Procedural Control of CP/IP Movement. JTACs must ensure when moving aircraft between CPs/IPs, that the transiting aircraft and the established aircraft are altitude and/or laterally deconflicted prior to and during aircraft transition.

5.2.2.3.6 Aircraft Audible Considerations. When the ground commander desires to maintain an element of surprise, the JTAC should take audible considerations into account. It is important the JTAC provides holding instructions to aircraft that maximize noise abatement. There are many factors that play into the mitigation of audible signature such as terrain, time of day, and wind conditions. It is imperative that the JTAC identifies this factor early in mission planning in order to maximize the ground commander's intent. See **Chapter 3**, "JTAC Mission Planning," for additional considerations with noise abatement.

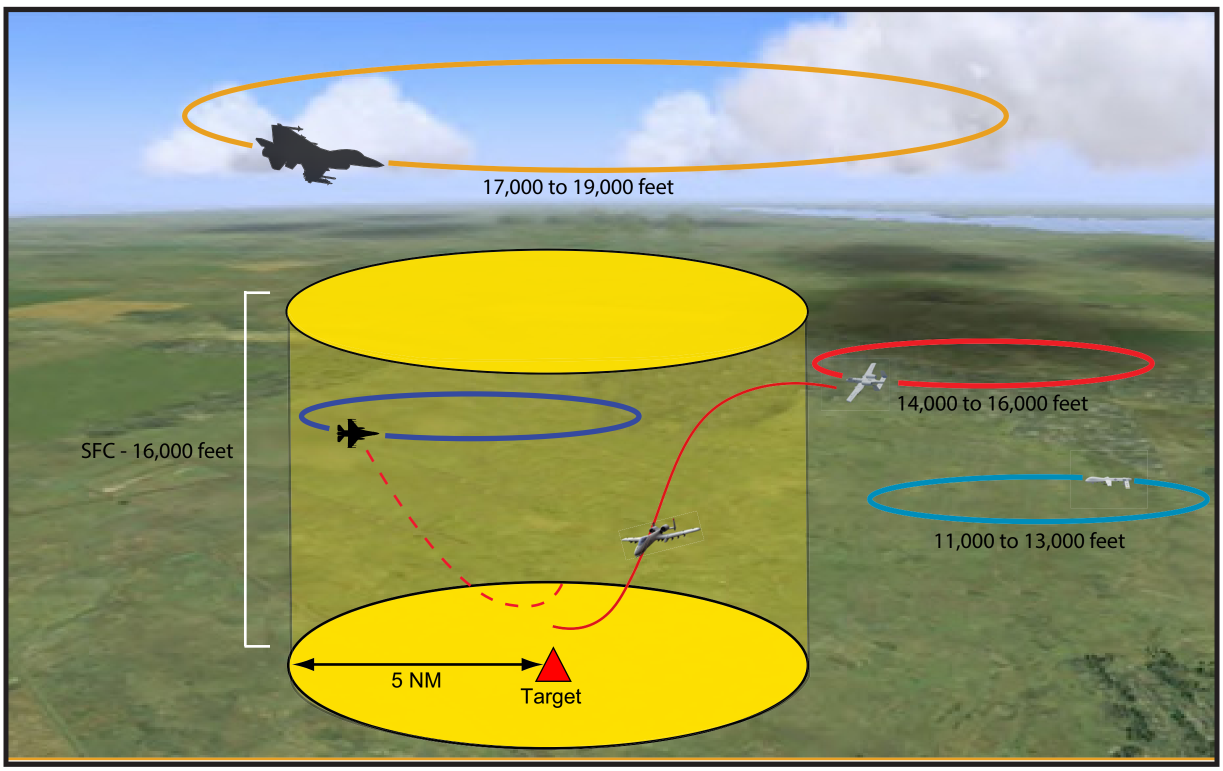
5.2.2.4 Airspace Coordination Areas (ACA). ACAs are defined as 3-dimensional blocks of airspace in which aircraft are reasonably safe from friendly surface-to-surface fires.

5.2.2.4.1 A restricted operations zone (ROZ) is airspace with defined dimensions created in response to specific operational situations or requirements within which the operation of one or more airspace users is restricted. The JTAC or C2 agency will establish the dimensions and location of the ROZ. An established call sign and frequency to contact for entry and exit should be provided, as well. See **Figure 5.11**, ROZ/TEZ Use.

EXAMPLE: "ROZ SQUIRRELLY ESTABLISHED PA 546 364, 5 NM/SFC-FL200, EXTERMINATOR 26 IS CONTROLLER, CONTACT ON WHITE 17 FOR ENTRY. ASSETS APPROVED IN: HAWG AT 13 BLOCK 15 AND VIPER 16 BLOCK 18. CALL WHEN ENTERING AND CLEAR."

5.2.2.4.2 Tactical Engagement Zones (TEZ). The center point and radius of a TEZ is dependent on aircraft capabilities, but 3 to 5 NM is a common size. Only one flight will be in the TEZ at a time. While in the TEZ, there is freedom to maneuver at all altitudes for weapons release. After dropping ordnance, flights will depart the TEZ at the assigned altitude and call "CLEAR." This allows another set of fighters to enter the TEZ expeditiously and prosecute targets. If planning to employ a TEZ, all supporting aircraft must fully understand its dimensions and know how to enter and exit. The JTAC is the CAS team member primarily responsible for activating the TEZ, allowing aircraft to move into a TEZ, and providing final control. However, other CAS aircraft may recommend establishment of TEZ if synergistic effects cannot be achieved due to airspace and/or mission complexity. The center point of the TEZ is not necessarily centered on the objective or target. The TEZ typically includes an upper and lower cylinder. See **Figure 5.11**, ROZ/TEZ Use. It is imperative that a JTAC closes the TEZ when attacks are complete in order to open up the rest of the airspace to other aircraft in the AO.

Figure 5.11 ROZ/TEZ Use.

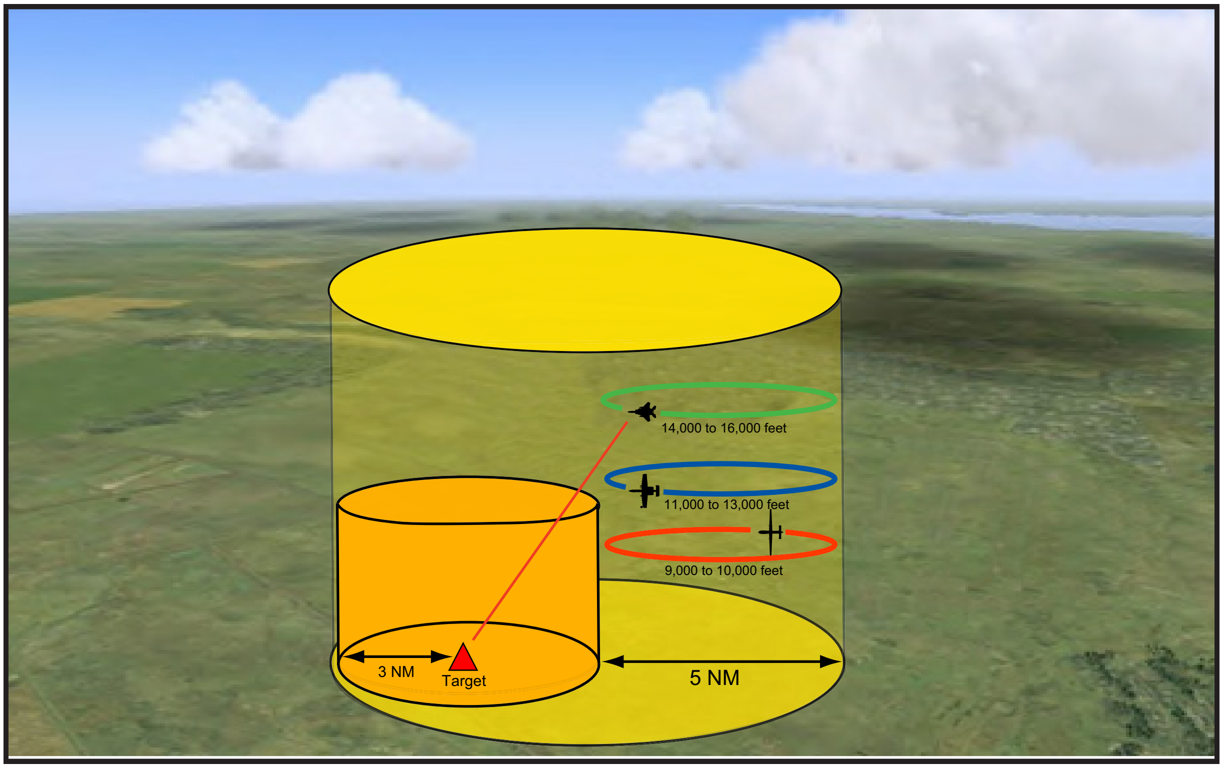


EXAMPLE: TEZ Communications: "MUDHEN, HAWG, AND VIPER, THERE IS A 5-NM TEZ ESTABLISHED AROUND THE TARGET SURFACE TO TWENTY THOUSAND. CALL WHEN ENTERING AND CLEAR. YOU HAVE ALL ALTITUDES WITHIN THE TEZ, BUT

DEPART AT YOUR ASSIGNED BLOCK. SEQUENCE OF ATTACKS WILL BE MUDHEN, HAWG, AND THEN VIPER." (After attacks) "MUDHEN FLIGHT IS CLEAR." HAWG FLIGHT ENTERING TEZ."

5.2.2.4.3 ROZ/TEZ Integration. It is possible to open a TEZ inside the JTAC's established ROZ to expedite attacks. Both the standard ROZ and TEZ techniques are used when this is required. See Figure 5.12, ROZ/TEZ Integration.

Figure 5.12 ROZ/TEZ Integration.



5.2.2.5 Hot Radial. A hot radial is used to clear the minimum amount of airspace for an attacking aircraft's weapons employment. The radial will be established at the target location and be opposite of the planned final attack heading (from the surface up to the top altitude of the attacking assets' airspace block). Non-attacking assets deconflict laterally/vertically, while remaining in assigned altitude block. The hot radial is intended for level deliveries only, and the JTAC closes the informal ACA once attack is done.

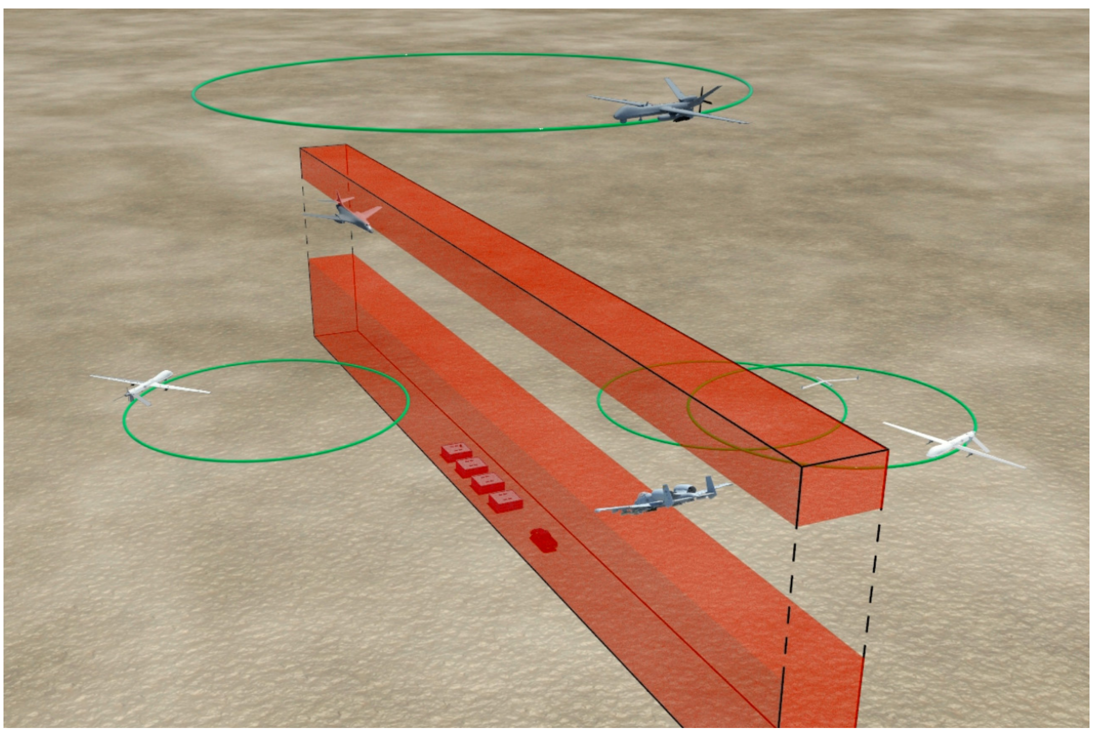
EXAMPLE: Hot Radial Communications: "HOT RADIAL, PS 123 456, 195 DEG ±20, 5 NM/SFC-160, ALL PLAYERS CALL DECONFLICTED." (Once deconflicted) "GREYEAGLE, HAWG, REAPER CLEAR."

5.2.2.6 Bowling Alley. In areas of highly congested airspace, a good informal ACA technique for hasty target prosecution is the bowling alley. The JTAC establishes the following; the target as the center point, a direction, a max altitude, and will direct all non-attacking aircraft to call deconflicted once clear 1 NM either side or above the bowling alley. The attacking aircraft can remain in the altitude block for bomb employment, while aircraft executing forward-firing weapons attack can be approved from the block down to surface. All aircraft outside would confirm deconflicted before JTAC approves attacks, and must provide deconfliction for multiple attacking assets. The bowling alley is closed once attacks are complete. See **Figure 5.13**, Bowling Alley.

EXAMPLE: Bowling Alley Communications: "BOWLING ALLEY ACTIVE LA 579 264, NORTH TO SOUTH, SURFACE TO FL180. BONE APPROVED IN 16 TO 18, HOG APPROVED IN SFC-15. ALL OTHERS CALL DECONFLICTED." (All others call established on strike) "BONE/HAWG, SAY READY 9-LINE AND COORDINATED ATTACK GAME PLAN."

5.2.2.7 Authentication. When operating on a net that is not secure, a JTAC may be unsure of a contacting agencies identity, and additional measures should be taken to ensure operational security. The JTAC should pass R/SoF information, with a minimum of a safe hold, while omitting the locations of other aircraft on station or battlefield information. The JTAC should then authenticate the entity with standard measures designated within the SPINS. It is then the JTAC's responsibility to fully brief the confirmed friendly on the current air picture prior to receiving the CAS check-in.

Figure 5.13 Bowling Alley.



5.2.2.7.1 Authentication Types. The following procedures may still apply during degraded situations. There are several authentication methods (i.e., triad [three letters], RAMROD, and alternative means). JTACs should be familiar with specific theater SOP and be prepared for all authentication methods. For procedures, see **Table 5.3**, RAMROD Challenge/Response Example, and **Figure 5.14**, Triad Numeral Cipher Authentication.

Table 5.3 RAMROD Challenge/Response Example.

RAMROD Challenge/Response Example										
RAMROD										
	0	1	2	3	4	5	6	7	8	9
EXAMPLE	F	O	R	M	I	D	A	B	L	E
	0	1	2	3	4	5	6	7	8	9
Step 1: You receive the challenge letters "M,D."										
RAMROD										
	0	1	2	3	4	5	6	7	8	9
EXAMPLE	F	O	R	M	I	D	A	B	L	E
	0	1	2	3	4	5	6	7	8	9
Step 2: The correct reply will be "I."										

5.2.2.7.2 Alternate Authentication Methods. The JTAC may be placed into a situation where RAMROD or an authentication table is not available. In these cases, an alternate authentication method may be used. The tactical situation and judgment of the JTAC will determine if alternate authentication methods are sufficient to proceed with the mission. An alternate method could be a commonly recognizable statement, much like a challenge and reply that would be known by both the JTAC and the aircrew (e.g., "WHO WON THE SUPER BOWL THIS YEAR?).

5.2.3 CAS Aircraft Check-In. Aircraft check-in procedures are essential for establishing the required flow of information between the CAS aircrews and control agency. Controlling agencies should update all CAS assets on the current situation in route to the target. If aircraft are on the ATO and the JTAC has a copy of the ATO, the CAS asset may check-in as fragged and subsequent transmissions may be minimized. This briefing may be shortened for brevity or security (as fragged or with exceptions). JTACs and CAS aircrew should strive to minimize multiple unnecessary check-ins.

5.2.3.1 CAS Check-In Format. The mnemonic MNPOPCA is useful for remembering the order of check in. See **Table 5.4**, Close Air Support Check-In Briefing.

5.2.3.2 Abbreviated Check-In. There may be situations in which the JTAC requires an abbreviated check-in due to an attack in progress or a developing situation requiring immediate fires. The JTAC will pass routing/safety of flight and should state what information is needed from the check-in in order to accomplish current attack. (e.g., "HOLD YOUR CHECK-IN" or "CONFIRM AS FRAGGED, AGR-20 AVAILABLE.") This should lead to an abbreviated situation update and immediately into a CAS brief to deal with the current situation, when required. See **Table 5.5**, FAATS Update.

Figure 5.14 Triad Numeral Cipher Authentication.

TRIAD NUMERAL CIPHER

	ABCD	EFG	HIJ	KLM	NO	PQR	ST	UV	WX	YZ
	0	1	2	3	4	5	6	7	8	9
A	YLTE	BNF	PKI	CDO	UW	GAH	VX	OS	RM	JZ
B	DHTI	YRA	LBW	KFE	NC	GXJ	PM	UO	VQ	ZS
C	IZUP	XDS	AQN	JHO	KF	RMY	WV	BE	CT	LG
D	QWCR	IBV	PGA	HDF	EL	YTM	SO	XJ	NU	ZK
E	QZTK	PHW	OVA	YES	NU	RXB	FI	CM	GJ	LD
F	AVRC	ULF	XHJ	SQK	DO	PMN	WZ	GE	YB	YI
G	PHWG	DUO	QVL	KRN	AJ	MCS	F1	EX	TY	BZ

Step 1-Choose three letters at random. "B,L, T"
Step 2- Continue across the "B" set line until you locate the second letter challenge "L"

TRIAD NUMERAL CIPHER

	ABCD	EFG	HIJ	KLM	NO	PQR	ST	UV	WX	YZ
	0	1	2	3	4	5	6	7	8	9
A	YLTE	BNF	PKI	CDO	UW	GAH	VX	OS	RM	JZ
B	DHTI	YRA	LBW	KFE	NC	GXJ	PM	UO	VQ	ZS
C	IZUP	XDS	AQN	JHO	KF	RMY	WV	BE	CT	LG
D	QWCR	IBV	PGA	HDF	EL	YTM	SO	XJ	NU	ZK
E	QZTK	PHW	OVA	YES	NU	RXB	FI	CM	GJ	LD
F	AVRC	ULF	XHJ	SQK	DO	PMN	WZ	GE	YB	YI
G	PHWG	DUO	QVL	KRN	AJ	MCS	F1	EX	TY	BZ

Step 3- Directly below "L" is the letter "A", now go to the line indicated by that letter.

TRIAD NUMERAL CIPHER

	ABCD	EFG	HIJ	KLM	NO	PQR	ST	UV	WX	YZ
	0	1	2	3	4	5	6	7	8	9
A	YLTE	BNF	PKI	CDO	UW	GAH	VX	OS	RM	JZ
B	DHTI	YRA	LBW	KFE	NC	GXJ	PM	UO	VQ	ZS
C	IZUP	XDS	AQN	JHO	KF	RMY	WV	BE	CT	LG
D	QWCR	IBV	PGA	HDF	EL	YTM	SO	XJ	NU	ZK
E	QZTK	PHW	OVA	YES	NU	RXB	FI	CM	GJ	LD
F	AVRC	ULF	XHJ	SQK	DO	PMN	WZ	GE	YB	YI
G	PHWG	DUO	QVL	KRN	AJ	MCS	F1	EX	TY	BZ

Step 4- Continue across "A" line until you find the third letter of the challenge, the letter directly below the third letter is your response, which is "T"

Table 5.4 Close Air Support Check-In Briefing.

Aircrew: "____________________, **this is**____________________**.**"	
Mission number: "______________________________**.**"	
Number and type of aircraft: "______________________________**.**"	
Position and altitude: "______________________________**.**"	
Ordnance: "______________________________**.**"	
Playtime or time on station: "______________________________**.**"	
Capabilities: "______________________________**.**" (FAC(A), type of sensors, Link 16, VDL code, SITREPs on board, map version or GRGs, UAS lost link procedures/route).	
Abort code: "______________________________**.**"	
LEGEND: FAC(A)—forward air controller (airborne) GRG—gridded reference graphic	SITREP—situation report UAS—unmanned aircraft system VDL—video downlink

Table 5.5 FAATS Update.

Situation Update Example 3		
Situation Update Line	**Close Air Support Situation Update**	**Battlefield Handover**
Friendly	• General friendly situation and scheme of maneuver. • Use geographic references, phase lines, and checkpoints. Technique is to use general terms: "ALL FRIENDLIES ARE EAST OF THE 94 EASTING." • Friendly grids should not be passed if it can be avoided. If necessary, use no more than 6 digits. • Should include all friendlies that may be a factor during time on station (TOS), not just the JTAC. • Include all CAS assets, ordnance, and TOS remaining for BHO.	
Artillery	• Indirect fire assets that may be a factor during TOS, may include general direction of fire.	• Firing unit location, call sign, and frequency status.
Airspace	• Aircraft on station, call sign, and frequency. • Available airspace and desired IP and HA.	
Threats	• General locations of surface-to-air fires may also be passed. • Time of last observed surface-to-air fires may also be passed.	
Sensors	• Intent for aircraft sensors: Offensive, Neutral, or Defensive.	

5.2.3.2.1 The JTAC should obtain the full check-in when the situation allows.

5.2.3.3 Army Attack Aviation Check-In. Upon check-in, the air mission commander will pass an Army Aviation Air-to-Ground Check-in Brief. See Table 5.6, Army Aviation Air-to-Ground Check-In Brief.

5.2.3.4 Abort Code. If secure communications are in use, an abort code is not required. If not stated, "ABORT, ABORT, ABORT" is considered the standard to abort, commonly referred to as aborts in-the-clear. If communications are not secure, or are required to be switched from secure to unsecure, then an abort code should be passed based on SPINS/SOP for the area (e.g., authentication matrix, Ramrod). The JTAC should confirm the abort code was copied correctly by reading it back to the aircrew.

Table 5.6 Army Aviation Air-to-Ground Check-In Brief.

Aircraft: "________________________, **this is** ____________________."
(ground unit) (aircraft call sign)
Aircraft Team: "____."
(composition and location)
Munitions Available: "____."
(rockets/guns/missiles)
Night Vision (if applicable): "________________________________."
(capability and type)
Station Time: "____."
(minutes)

EXAMPLE: Abort Code Confirmation—Aircraft: "ABORT CODE ALPHA, DELTA, CHARLIE." JTAC: "COPY ABORT CODE ALPHA, DELTA, CHARLIE."

5.2.4 Situation Update. The situation update is a missionized brief used to increase all players' SA. The brief must be based on the JTAC's expectations of the use of the fires assets. Arriving aircraft should provide the JTAC with factor threat information, if known. Ideally, the situation update should answer the following key questions: What is the tactical situation? What is the commander's intent for CAS? What is the battlefield environment?

5.2.4.1 Standard Situation Update. The length and depth of the situation update must be balanced with the need to pass game plans and CAS briefs in order to create timely and desired effects with the necessary SA for aircrew to successfully accomplish the attack. Not all elements must be passed to all aircraft. See Table 5.7, CAS Situation Update Example.

5.2.4.2 Abbreviated Situation Update. Friendly, artillery, airspace, threats, and sensors (FAATS) allows the JTAC to pass minimum essential elements of the situation update. It can be used when the tactical situation dictates a condensed CAS cadence to facilitate hasty fires on the battlefield. When using FAATS as an abbreviated situation update for time sensitive situations, JTAC should pass a full situation update as soon as conditions permit. FAATS can also be used as a recurring battle tracking tool before beginning a new request for fire support. See Table 5.5, FAATS Update.

Table 5.7 CAS Situation Update Example.

Situation Update Line	CAS Situation Update	Battlefield Handover (BHO)
Threat	General locations of surface-to-air threats not already covered. Time of last observed surface-to-air fires may be passed also.	
Enemy Situation	Give the general enemy disposition. Avoid giving a list of grids. Specific targets and locations will be addressed in CAS briefs.	Give the general enemy disposition. Include supported commander's targeting priorities. Include target location grids (this may require breaking up the transmission). Provide a GFC attack guidance matrix and target priority list.
Friendly	Give the general friendly situation and scheme of maneuver. Use geographic references, phase lines, checkpoints, etc. The technique is to use general terms: "all friendlies are east of the 94 easting." Passing of friendly grids should be avoided if the tactical situation allows. Include all friendlies that may be factors during time on station (TOS), not just the JTAC. Include all CAS assets, ordnance, and TOS remaining for the BHO.	
Artillery	List indirect fire assets that may be factors during TOS. This may include general direction of fire.	Determine the firing unit's location, call sign, frequency, and status.
Clearance Authority	Omit it if the speaker has control. Clarify roles if there is potential for confusion due to multiple voices on tactical air direction. For example, "Broadsword 11 has control and is located in the combat operations center, my JFO call sign, Mustang, is located with Charlie Company and is up this net." Define who has which elements of brief, stack, mark, and control.	
Hazards	Towers, Min Safe Altitude, **Weather (including surface winds)**.	
Remarks and Restrictions	Remarks and restrictions may include the following: JTAC capabilities (laser, infrared, and video downlink, etc.). Intent for aircraft (CAS, and multisensory imagery reconnaissance, etc.). Factor ACM/FSCMs for execution. Provide any restrictions to ordnance.	Updates to preplan ACM/FSCM/MCMs. Appropriate elements of brief, stack, mark, and control. Radio calls that will be required by the controller. Other remarks.

5.2.4.3 Situation Update Code (SUC). Situation updates should be given alphanumeric identifiers that enable JTACs and C2 agencies to distinguish the most up-to-date information for a given call sign (e.g., 93A, 93B, and 93C). The JTAC should pass the SUC to the appropriate C2 element. The C2 element can then pass the SUC to CAS aircraft, allowing for increased SA upon check-in. Changes to the situation update may be passed by the JTAC as aircraft check on station. When able, JTACs should pass a current SUC to outbound aircraft for relay to the appropriate C2 agency for passage to follow on aircraft proceeding to the AO.

EXAMPLE: Exterminator 93 passes SUC-93A to the ASOC in 1972 remarks. ASOC will pass SUC-93A to aircraft as they proceed to support Exterminator 93. Any successive updates would be passed to the aircraft as SUC-93(B, and C). As the aircraft completes the mission and received BDA, the JTAC passes or confirms most updated SUC with the aircraft and requests passage to the ASOC as required for limited communication situations.

5.2.5 Sensor Management. Though not a traditional step in the CAS execution template, JTACs often have multiple sensors in the CAS stack. JTACs should brief a sensor plan that tasks appropriate capabilities with an area and specifies reporting instructions for the aircrew to the JTAC. The sensor management plan should be passed at the end of the situation update and be refined throughout the mission. See **Figure 5.18**, Sensor Management Example, for sensor management techniques later in this chapter.

5.2.6 Game Plan. Although the minimum information required for the game plan includes the type of control and method of attack; the game plan can also include the "T, M, O, I" format which assists in systematic CAS cadence:

- Select Type of Terminal Attack Control.
- Select Method of Attack.
- State requested ordnance, if required.
- State the GFCI for CAS. (USMC aircraft will expect an interval instead of intent).
- Additional information (any deviations from the expected CAS Brief format [e.g., expect 10 digit grids in Line 6], and expect multiple factor friendly locations).

5.2.6.1 Suppressive Bomb-on-Coordinate Attack Execution. When the GFC's first priority is suppression, JTACs may use BOC attacks with the most accurate grid possible. JTACs should ensure that they are in position to assess weapons impact (or have other observers in position) in order to provide immediate reattack corrections for a BOT attack using the same 9-Line. Corrections may be passed with a cardinal direction and distance from the impact or via distinct terrain (e.g., ***South, down the hill, 100 meters***). The following is a communications flow example for suppressive BOC—the JTAC pulls a grid with pocket laser range finder (PLRF)/DAGR to a mountain top enemy location across a valley. JTAC passes a BOC 9-Line for the first attack, passes corrections post splash, gets tally from aircraft, and then approved immediate reattack. See **Table 5.8**, Suppressive BOC Examples.

5.2.6.2 Additional Game Plan Info. If the JTAC is planning on using more than one element/asset (coordinated attack, third party contributor, SEAD) in a CAS attack, and should issue an overall game plan prior to issuing the coordination info to individual elements in remarks/restrictions. Using this method also assists in the creation of targeting information, battlefield situational awareness, and attack integration for similar and dissimilar assets. Any other information that can prepare the supporting asset to attack should be included.

Table 5.8 Suppressive BOC Examples.

Militia (JTAC): "HAWG 31, THIS WILL BE A TYPE 2, BOC, GBU-38s, INTENT IS TO PROVIDE IMMEDIATE SUPPRESSION. (9-LINE)."
Hawg: "HAWG 31, FROM MY SYSTEM" (readbacks complete).
Militia: "PUSH IMMEDIATE."
Hawg: "HAWG 31 IN FROM THE SOUTH."
Militia: "HAWG 31 CLEARED HOT."
Hawg: "HAWG 31 WEAPONS AWAY, 34 SECONDS...HAWG 31 SPLASH."
Militia: "HAWG 31, APPROVED IMMEDIATE REATTACK, BOT, SHIFT 100 METERS SOUTH DOWN RIDGELINE."
Hawg: "HAWG 31 TALLY TARGET…HAWG 31 IS IN FROM THE SOUTH."

5.2.7 CAS Brief. For information about completing a 9-Line, refer to JP 3-09.3, *Close Air Support*. JTACs/FAC(A)s will use a standardized briefing to pass information rapidly. The TTP below outline standard practices for USAF JTACs in regards to the 9-Line itself.

5.2.7.1 Recce 9-Lines. Specific tactical situations require aircraft to conduct reconnaissance missions. 9-Line passage for unconfirmed targets or arrays may be used in order to expedite target selection and execution. JTACs must use this technique sparingly and consider all planning functions pertaining to staff coordination. Line 5 will typically include well-defined descriptions using either size, activity, disposition (SAD); number, type, orientation (NTO); or size, orientation, composition (SOC), to provide aircrew with the most information available.

5.2.7.2 Lines 1 to 3. These lines are situation dependent as to what and how they are briefed. Controllers must weigh the pros and cons of providing accurate navigational data vs the timeliness of generating it. The following are examples that can be used:

5.2.7.2.1 "1 TO 3 FROM THE HOLD" can be used when several aircraft on station that are receiving the same 9-Line, but are located at separate IPs or hold points, or if ingress and egress will be covered in-depth with a coordinated attack plan.

5.2.7.2.2 "1 TO 3 PER <insert deconfliction owner here>" can be used when an aircrew owns the airspace deconfliction over a target area.

5.2.7.2.3 "BRAVO 8, OFFSET RIGHT, ELEVATION (LINE 4)" is an example of an acceptable way to address lines 1 to 3 when precise navigation data is not needed or when using the keyhole template. Offsets are also a way to allow an aircraft freedom of maneuver on either side of the IP-to-target Run-in. This technique is usually used for artillery deconfliction but could also be used for a sectored coordinated attack.

5.2.7.3 Initial Point. IPs will be determined either by the JTAC or be predetermined points established for the theater of operations in the ACO or SPINS. See **paragraph 5.2.1**, Routing/Safety of Flight.

5.2.7.4 Heading is given in degrees magnetic from the IP to the target. The aircraft will use this heading as a reference to confirm the target location. A JTAC can give an offset direction for the aircraft to follow when transiting from IP-to-target. An offset can be given to keep aircraft away from known ground threats, surface fire, or hazards. Additionally, offsets can be used to help aircraft in target acquisition or to help the JTAC acquire aircraft when on final.

5.2.7.5 Distance is given from the IP to the target. The distance is measured in nautical miles and should be accurate to the tenth of a NM. For helicopters the distance is measured in meters from the center of the BP to the target to the nearest 100 meters.

5.2.7.6 Target Elevation is given in feet, mean sea level (MSL), and should be as accurate as possible. Elevation may be estimated in BOT situations where additional coordination is required for correlation (e.g., correlation prior to the CAS Brief). There are occasions where assets may request an elevation format other than MSL (i.e., height above ellipsoid [HAE]). In these situations the asset should be specific in the format they request, and the JTAC should state specifically the elevation type when reading Line 4 (e.g., "THREE SIX FIVE FEET HEIGHT ABOVE ELLIPSOID").

5.2.7.7 Target Description must be specific enough for the aircrew to recognize the target and have enough detail to distinguish it from other formations on the battlefield. There are two formats that are effective in target description. When engaging maneuver echelons or personnel the SAD or NTO formats are most preferred. When describing stationary targets such as buildings, SOC offers the better format to aid with aircrew tactics and weapon selection. See **Table 5.9**, Maneuver Format Example, and **Table 5.10**, Building Format Example.

Table 5.9 Maneuver Format Example.

1. Size: number and type of target (dismounted PAX, trucks, and BRDMs).
2. Activity: stationary, moving, defending, etc.
3. Disposition: relative to a terrain feature or formation geometry/orientation.
1. Number: size of enemy element.
2. Type: description of target makeup (tents, T-80s, Hilux w/DSHKA, etc.).
3. Orientation: Spacing, movement, alignment, and offset from known features.

Table 5.10 Building Format Example.

(1) Size: number of stories for the building.
(2) Orientation: building orientation in cardinal direction/headings.
(3) Composition: best estimation of the buildings structural makeup.
OVERALL NOTE:
* "Building" can be included in Line 5 while the rest of this data can be included in the remarks section in order to make the best weaponeering decision.

5.2.7.7.1 Urgency and available data will greatly impact the level of detail provided in the target description. JTACs must not go overboard and keep the data clear and concise.

5.2.7.8 Target Location. The JTAC can give the target location in several ways (e.g., grid coordinates [MGRS], latitude and longitude, offsets, or visual description). In instances where accuracy of the target location is a factor the JTAC should include in the game plan the length of coordinates to expect/source derived, and the coordinate string should be commensurate with the accuracy of the equipment used (e.g., "TARGET INFO PULLED FROM ATAK, EXPECT 10 DIGIT GRID").

5.2.7.8.1 The grid coordinate passed is an informal message to the pilot about the accuracy of the target location. For example, if the JTAC passes a 10-digit grid the pilot does not expect an elaborate talk-on and should be staring at the target with available sensors. In contrast, a 6-digit grid would give the CAS aircrew a "heads-up" to expect an elaborate talk-on or a recce tasking.

5.2.7.8.2 Offsets or Visual Descriptions. A JTAC can give the target location using an offset from a known location or by giving a visual description from a prominent reference point. It is highly recommended to establish a reference point prior to the 9-Line transmission in order to maximize the aircrew's situation awareness. An additional technique is to label a target set that has been identified prior to 9L passage, i.e., an aircraft identifies a column of vehicles moving south bound in a TAI or engagement area (EA) (e.g., XR23-HAWG, "Label vehicles target set Bravo, call ready 9L 23Alpha."

5.2.7.8.2.1 Relative to Navigational Aid/Visual Description Examples.

- "NORTH 100 M FROM TRP OR BUILDING #."
- "300 M WEST FROM MY PPLI."
- "EAST 200 M FROM 9-LINE ALPHA."

5.2.7.8.3 The conspicuous reference technique may be used when operating in an urban environment or when using CAS to support a convoy. An additional technique is to use your position as the known reference point by having the aircrew call, VISUAL. From your position, pass the aircrew a bearing and range to the target much like a call for fire (CFF). The reference point used for the offset method must be established prior to passing the 9-Line.

5.2.7.8.3.1 Visual Description From a Conspicuous Reference Point Examples:

- "WEST 850 M FROM SPARTAN 11 LOCATION."
- "WEST 50 M FROM MY SMOKE, SMOKE IS BLOWING EAST."

5.2.7.9 Mark Type. Describe the type of mark the JTAC will use (e.g., smoke, laser, direct/indirect fire, IR, or "No Mark") to mark the target. Often times the JTAC states "NO MARK" in Line 7, when they actually have marks available that will assist in correlation. A preferred technique is for the JTAC to give the best target mark capability available in Line 7 (e.g., if the JTAC has 40 mm smoke available and is in range of the target they should state "SMOKE" in Line-7. Additionally, if the JTAC has a handheld laser marker (HLM) available they should state "LASER MARK" in Line-7, as it is available to use to assist in correlation on the target. When using laser to mark a target, remember that certain enemy systems are equipped with passive laser detection. Recommended techniques in this example would be using delayed laze or shift.

5.2.7.9.1 Terminal Guidance via Ground Based Laser Considerations. The JTAC is responsible for effective planning of a terminal guidance attack. There should be uninterrupted laser-to-target line of sight, and special examination should be made when origin point and target are at the same elevation, due to possible obscuration. Only stationary targets are recommended due to the difficulty of tracking a moving targets with a ground base laser. The JTAC must be aware with the laser equipment capabilities and assess effective distances, as the reflected laser energy may be insufficient for seeker acquisition at long ranges. With smaller targets there is a high probability of laser spot spillover, which can be mitigated by aiming at the base of the target. The following are recommended laser techniques.

- Center spot on target. For vertically developed targets place 1/3 down from top.
- Keep spot jitter to a minimum by stabilizing with a tripod or on a solid surface. The last 8 seconds are most critical for LGBs.
- Sort downwind targets first to mitigate obscurants caused by weapons impact.
- Avoid laser entrapment by not aiming in mouths of caves or open windows.

5.2.7.10 Friendlies. Closest friendly position and activity is passed in cardinal direction and distance from the target followed by current movement status (e.g., "SOUTHWEST 700 METERS, STATIC"). Appropriate activity explanations are CLOSING, OPENING, or STATIC (e.g., "NORTH 400 METERS, OPENING" or "NORTH 400 METERS, CLOSING"). These additions to Line-8 give CAS aircrew the extra situational awareness on friendly movement, during the attack. Additional affected friendly positions will be briefed in remarks. If the friendly position is marked, identify the type of mark.

5.2.7.11 Egress. The word egress will always be stated when briefing this line. Careful consideration should be made towards passing egress instructions that allow for quick reattack if needed and vector the aircraft away from additional threats in the target area and/or unknown enemy areas, and should always be deliberate. Egress instructions can be given as a cardinal direction or by using control points, "EGRESS SOUTH TO IP CHARLIE." In rare instances where no specific egress instructions are required, the JTAC can brief "EGRESS AS REQUIRED" or "EGRESS AT PILOT'S DISCRETION."

5.2.8 Remarks/Restrictions. The following information should be included, if not already briefed. A recommended mnemonic for the REMARKS section is "AT LEAST."

- A—additional factor friendlies.
- T—target sort.
- L—lasers (e.g., PTL, LTL).
- E—effects desired/weapons selection.
- A—artillery data (GTL, MAXORD).
- S—SEAD plan/availability.
- T—threats (factor for attack).

5.2.8.1 Final attack restrictions; protect friendlies, allows max flexibility, and allows safe laser operations. The JTAC should ensure that they specify whether the restriction applies to the attacking aircraft or the weapon itself (e.g., 360CW090, East to West, keep all attacks parallel with road and all effects to the east of the road).

5.2.8.2 Restrictions Considerations. JTACs should understand restrictions are tailored to the applicable tactical situation and not be unnecessarily over restrictive. When the JTAC has specific restrictions, they are passed in the remarks/restrictions. A restriction can be in conjunction with an ACM or a FSCM (i.e., with lateral separation) (e.g., "NO FLIGHT NORTH OF THE RIVER" or "KEEP ALL ORDNANCE WEST OF THE HARDBALL ROAD"). The JTAC must also remember to receive readbacks for all restrictions.

5.2.8.3 Type 3 Considerations. Type 3 controls allow a JTAC to attack a specific target set or target area while allowing the attacking aircraft freedom of maneuver and flexibility while achieving the GFC intent. While permissive in nature, the key to an effective Type 3 control are the parameters (restrictions) given to achieve a specific intent. The mnemonic DAMIT can help the JTAC define appropriate parameters for the attacking aircraft. This technique allows the JTAC to be as permissive or restrictive as the tactical situation allows.

- Dimensions—giving an attacking aircraft an assigned area in which effects are employed.
- Attrition—specifies a GFC's desired enemy attrition to meet force ratio considerations.
- Munitions—identifies the approved munitions to be expended with in the engagement.
- Intent—clearly defines the GFC intent for that specific engagement.
- Time—allocates an appropriate amount of time for the engagement.

5.2.8.3.1 The JTAC can effectively restrict Type 3 controls by making exceptions to the engagement. Exceptions may include the retention of specific weapons for use later in the fight or approval on certain type of targets. Additionally, geographical restrictions may be pertinent within the parameters, depending on the tactical situation. Once all information has been passed and the JTAC/aircraft finalizes correlation, there is no requirement to delay clearance.

EXAMPLE: Type 3 Restrictions: (JTAC) "HAWG 31, REMARKS RESTRICTIONS TO FOLLOW…KEEP ALL EFFECTS WITHIN EA BOULDER, NO HIGH CDE WEAPONS NORTH OF MSR GREEN. PRIORITIZE SPARTY, TANKS, AND THEN MECHANIZED INFANTRY. RETAIN 2X GBU-54 AND 250 RDS 30 MM EACH AIRCRAFT. APPROVED TOATTACK FROM XX: 35-XX: 45, CALL BACK WITH BDA." (Conducts readbacks/correlation) "HAWG 31, CLEARED TO ENGAGE."

5.2.8.4 Final Attack Heading/Final Attack Direction (FAH/FAD). The JTAC has the option to give a final attack heading or final attack cardinal direction. FAHs are given for a number of reasons which may include: mitigation of fratricide, mitigation of CDE, when a laser safety cone is used, aid JTAC in acquiring the aircraft, or to facilitate deconfliction for FSCMs. In some situations there will be no FAH/FAD restriction required, such as when the attacking asset is the only aircraft on-station and the nearest factor friendlies are

5 km away. If the tactical situation dictates, all final attack headings or directions may be approved by the JTAC and must be read back by the aircrew (e.g., “ALL FINAL ATTACK DIRECTIONS APPROVED”).

5.2.8.4.1 FAH Considerations. FAHs can be given as an assigned magnetic heading (e.g., “FINAL ATTACK HEADING 230”). JTACs should, whenever possible, give the FAH as an attack cone. This allows more flexibility for the aircrew (e.g., “FINAL ATTACK HEADING 210 CLOCKWISE 260, OR 230 ± 30”). In some cases, it may be better to omit a FAH and simply give a restriction for the final attack (e.g., “KEEP ALL ATTACKS PARALLEL TO THE RUNWAY” or “KEEP ALL EFFECTS NORTH OF MSR BLACK”). JTACs should have a valid reason for using a specific FAH or small cones and not overly restrict aircraft. Briefing restrictive FAHs may affect the timeliness of the attack adversely.

5.2.8.4.1.1 In addition to aircraft FAH the JTAC may also give the aircrew a weapons FAH. This TTP is used with aircraft that are capable of high off-boresight shots with weapons. If this TTP is used it is acceptable to omit the aircraft FAH with the assumption that the JTAC has deconflicted all other factor aircraft for the attack.

5.2.8.4.1.2 FAD Considerations. When a FAD is used it should be passed in cardinal or sub cardinal directions (e.g., “ALL ATTACKS EAST TO WEST OR WEST TO EAST”). When passing FAD, it is understood that cardinal directions include ± 45 degrees on either side of the given direction for a total 90 degree fan (e.g., South-North would be 360 ±45 side). Additionally, when passing reciprocal, it would be the same parameters in both opposing directions. This freedom of maneuver is great to expedite attacks but should be approached cautiously when mitigating factors are required, such as friendlies in close proximity to the target.

5.2.8.4.1.3 FAD With Guns. When conducting gun attacks with FAD restrictions, it must be understood that the ricochet fan is 60 degrees, or ± 30 either side of the final firing heading. When FAD restrictions are used, it is possible for aircraft to ingress on maximum left or right limits, driving the ricochet fans to fall outside the restriction heading (e.g., attacking aircraft are given East to West for the FAD. Aircraft can attack 270 degrees 45 degrees or 225 degrees clockwise to 315 degrees. If the aircraft attacks at 315 degrees for the strafe the ricochet fan for the attack would be 315 degrees ± 60 degrees or 255 degrees to 15 degrees. This could be a factor to any friendlies that are north of the target). Due to this factor passing a FAD with gun runs with multiple geographically separated friendless, may not be the best technique. These factors can be mitigated by using high-angle strafe attacks and should be discussed with the ground force commander prior to employment.

5.2.8.5 Danger Close. If the attack is danger close (within the 0.1 percent probability of impact [P_I]) to friendly or coalition personnel, the JTAC must state “DANGER CLOSE” and pass the ground commander’s initials, as a restriction that must be read back by the attacking aircrew (e.g., “DANGER CLOSE, COMMANDER’S INITIALS DMR”). It is important to have a discussion with the GFC approving the attack, how the CAS team intends to mitigate the effects of the weapon. Refer to AFTTP 3-2.6, *JFIRE*.

5.2.8.6 FAATS Check. JTACs should execute a FAATS check prior to attacking a target. The FAATS check is defined as a mental and/or verbal check on the current status of friendlies, airspace, artillery status, threat, and sensors. This is a sanity check and not a lengthy coordination step.

5.2.8.7 Readbacks. Lines 4, 6, and any restrictions are required to be read back for each 9-Line passed. If the JTAC requires additional information to be read back, it may be requested. The JTAC must keep in mind that if employing BOC attack the JTAC must receive a readback of the coordinates entered into the system/weapon from each attacking aircraft, as it is the only form of target correlation.

5.2.8.7.1 Aircrew Derived Target. If lines 4 and 6 were given from the aircrew to the JTAC, Lines 4 and 6 should be incorporated into the associated CAS Brief. This suffices as the required readback between the ground parties and aircrew, but any additional restrictions passed are still mandatory readback items.

5.2.9 Target Correlation. Target correlation begins with line 5 and line 6 of the 9-Line. In order to accomplish a BOT employment, the aircrew and the JTAC must both identify the location and verify the description of what the GFC intends to attack. Once validated, expect a "Tally" or "Capture" call from the aircrew. Captured below are some preferred techniques used to accomplish an expedited or timely "talk-on."

5.2.9.1 Target Description/Talk-On Techniques. The preferred method for talk-ons or enhanced target descriptions is big-to-small and known-to-unknown. Establish a common unit of measure for referencing ground distances (e.g., the length of an airfield from east to west being one unit of measure). When using a unit of measure, tell the pilot where to start, how many units, and which direction, with a description of what should be seen at the end point. Using units of measure such as kilometer or miles does not work well and should be avoided. A unit of measure should be established, so that the JTAC does not have to move the distance more than four units or less than one-fourth of a unit. If this is the case, the JTAC needs to re-establish a new unit of measure. The talk-on should start with a large, easily recognizable feature or a known point and then work to smaller unknown points. It is best to start with the largest, most easily recognizable geographical feature as the starting point. As you are moving, the pilot's eyes between reference points, remember always to use cardinal direction/numeric heading and distance. The altitude of the attacking aircraft plays a major factor when referring to distance. If an aircraft is at medium/high altitude, distances given in meters may not work as well as distances given in miles. If an aircraft is at low altitude, distances given in meters may be more appropriate than distances given in miles due to the aircraft's relation to the ground. If you need the aircrew to confirm they are looking at the correct point, have them describe it to you. The aircrew confirms they see a specific reference point or location by transmitting "CONTACT." Once they call "CONTACT" on a point or location, it becomes the new reference point for further talk-ons. Once the aircrew calls "CONTACT" on the target array, the JTAC should transmit the desired point of impact (DPI). Once the aircrew calls "CONTACT" on the DPI, the JTAC states "THAT IS YOUR TARGET." The aircrew will then transmit "TALLY or CAPTURE."

5.2.9.1.1 FIDO. A technique that the JTAC should consider when conducting talk-ons is called FIDO. The acronym may be used as many times as needed when conducting a talk-on. In some situations it is necessary to use the mnemonic in order to drive the aircraft's point of view onto a distinct feature prior to arriving at the desired target.

- F—from an object.
- I—in a direction.
- D—for a distance.
- O—to the intended object.

5.2.9.2 Target Confirmation. Target confirmation is a procedure used to ensure that both the JTAC and the aircrew are looking at the same target. A target confirmation is accomplished by the JTAC requesting specific information (e.g., type, number, orientation, color/contrast, and activity) from the aircrew about the target. The JTAC can withhold certain information about the target, thereby prompting the aircrew to provide the withheld information. This will provide the JTAC with the confirmation needed. **Table 5.11**, Standard Marking Brevity Terms, lists the established brevity terms used during target talk-ons.

5.2.9.3 Enhanced Target Description (Low-Altitude Attack Terminology). The enhanced target description (ETD) typically used in low-altitude situations to aid aircrew in acquiring targets while they are "in the pop" during a low altitude attack. ETDs are designed to provide the attacking aircrew a snapshot of what they should see on their attack ingress attitude during the "pop." The same FIDO technique applies to this as it does with a traditional talk-on. The difference is that this is provided before the aircraft departs the IP and there will be no "contact" or "capture" calls during the description. See **Table 5.12**, Enhanced Target Description Example.

5.2.9.3.1 If controlling NATO aircraft the ETD will be expected to give a description of the entire attack run-in from the IP to the target. This is a continuous communication flow from the JTAC to the pilot during the ingress to the target. Once the aircraft are in "the pop" the JTAC must allow the aircraft to give a "TALLY" call in order to provide clearance.

Table 5.11 Standard Marking Brevity Terms.

Term	Definition
BLIND	• No visual contact with FRIENDLY aircraft, ship or ground position. Opposite of VISUAL.
CONTACT	• Sensor information at the stated position. • (A/S) Acknowledges sighting of a specified reference point (either visually or via sensor). • (A/A) Individual radar return within a GROUP or ARM.
LOOKING	• (A/S) (AIR-MAR) Aircrew does not have the ground or surface object, reference point, or target in sight (opposite of CONTACT).
MARK	• Record the location of a point or object of interest. • (A/S) (S/S) Spotting round, normally white phosphorus (WP) or illumination on the deck to indicate targets to aircraft, ground troops, or fire support. • (A/A) Challenge and response term for requested aircraft to report contrails.
NO JOY	• (A/A) (A/S) (S/A) Aircrew does not have visual contact with the TARGET or BANDIT. Opposite of TALLY.
OCCUPIED	• (A/S) Ground equipment present at tasked target location. Opposite of VACANT.
PADLOCKED	• Aircrew cannot take eyes off an aircraft, ground target, or surface position without risk of losing TALLY or VISUAL.
SMOKE	• (A/S) Smoke marker used to mark a position.
TALLY	• Sighting of a target, non-friendly aircraft, or enemy position. Opposite of NO JOY.
VACANT	• (A/S) Ground equipment not present at specific or tasked target location. Opposite of OCCUPIED.
VISUAL	• Sighting of a FRIENDLY aircraft or ground position or ship. Opposite of BLIND.

Table 5.12 Enhanced Target Description Example.

"RENO 21 THIS IS GATOR 25. AS YOU APPROACH THE TARGET AREA, THERE WILL BE A NORTHWEST TO SOUTHEAST RUNNING RIVER THAT BENDS TO THE NORTHEAST. AT THE BEND, YOUR TARGET WILL BE DUE SOUTH. IT IS A SINGLE BUILDING OFF AN EAST-WEST ROAD RUNNING ALMOST PARALLEL TO THE RIVER. THE TARGET BUILDING IS ON THE SOUTH SIDE OF THE ROAD SURROUNDED BY A LOLLIPOP DRIVEWAY WITH THE STICK POINTING EAST AND CONNECTING BACK TO THE ROAD."

5.2.9.4 Map/Imagery/GRG Talk-On. Using products will give the JTAC a ***bird's-eye view*** of the target area. Keep in mind the difference between vertical relief vs horizontal reliefs when conducting talk-ons. Tall structures such as buildings are vertical reliefs that is great for ground personnel but poor for the aircraft who fly above the target area. Roads, runways, tracks, and lakes are great for aircrews but can be difficult for the JTAC depending on the orientation of the elongated edge towards the target. (A rule of thumb to consider when using digital imagery via an end user device is to provide the CAS team with the date of when the digital imagery was captured, if known, to enhance CAS team SA on what the JTAC is looking at. This is helpful due to the rapid pace that structures can be built as well as destroyed, as well as time of year determines foliage coverage in certain parts of the world. Ideally this will be covered during the premission brief, but this information could also be provided in the SUC or prior to conducting a digital imagery talk-on). Typically, talk-ons verbiage begins starting from big to small using prominent features within target areas using techniques (i.e., FIDO). When looking into a target array compare it to what your map references. Target arrays may change rapidly (e.g., weather moving in, vehicles moving location/orientation, surface-to-air threats becoming active/inactive, or even the enemy identifying you and firing on your position). See **paragraph 3.10.21**, Step 7—Order Production, for GRG production techniques.

5.2.9.5 Pod Talk-On. JTACs need to consider pod/sensor type, aircraft distance from the target, coordinate accuracy, and weather. The pilot will conduct target area confirmation with the JTAC once initial correlation is completed. When conducting a pod talk-on, expect the pilot to call, Capture, rather than Tally, as they will find the target in their pod versus eyeball. See **Table 5.13**, Sensor Brevity. If required, the JTAC will continue the talk-on based on known points that have been identified by the JTAC and aircrew. JTACs should not to refer to colors when pilots are viewing the target through a pod, as most pods cannot see colors; however, smoke, certain shadows, and contrasting heat signatures can be seen through the pod. For more information on targeting pods, see **Table 5.21**, Aircraft Sensor Capabilities (later in this chapter).

5.2.9.6 Full-Motion Video (FMV). FMV is a tool that may assist JTACs in further intended target confirmation. When used correctly, FMV can expedite target verification. JTACs should use brevity terms, as much as possible, to ensure the CAS team are referencing the same thing. JTACs need to be vigilant when using cardinal directions during FMV talk-ons. Using the north-seeking arrow is the preferred method when providing screen adjustments. JTACs may find it easier to use up, down, left, or right, or clock positions when slewing the sensor aimpoint to the desired target. See **Table 5.14**, Video Downlink Brevity Terms.

Table 5.13 Sensor Brevity.

Terms	Definitions
MELD	1. [A/A] Bias radar coverage in accordance with briefed parameters. 2. [A/A] Shift radar responsibilities from sanitizing to gaining SA on the assigned GROUP. 3. [A/S] [AIR-MAR] Directive call to another aircraft to match sensor location.
MONITOR(ING) [GROUP or object]	1. [A/A] [A/S] Maintain(ing) sensor awareness on specified GROUP or object. Implies that tactically significant changes will be communicated. 2. [AIR-MAR] Maintain contact or targeting information on a maritime surface contact.
MOVER(S)	Unidentified surface vehicle(s) in motion.
POPEYE	1. Flying in clouds or an area of reduced visibility. 2. Reduced electro-optical infrared (EO/IR) visibility due to atmospherics.
[type] POSTURE	1. [A/S] Communicates sensor posture type (offensive, defensive, or neutral) by the joint terminal attack controller to assets. Does not imply the FRIENDLY ground forces' tactical situation.
SCAN	1. [A/S] Search sector indicated and report any CONTACTS.
SLANT	1. References number of people or objects noted at specified location (men/women/children). For example, in response to a request for SLANT on a target building (e.g., "SLANT 4/6/4").
SORT	1. [A/A] Assignment of responsibility within a GROUP; criteria can be met visually, electronically (i.e., radar), or both. 2. [A/S] Assignment of specific targeting responsibilities.
SORTED	[A/A] [A/S] [AIR-MAR] Sort responsibility within a GROUP has been met.
SQUIRTER	1. [A/S] [S/S] A ground-borne object of interest departing the objective area.
STATUS [phase]	1. [A/A] Request for an individual's tactical situation. 2. [A/A] [A/S] Directive call requesting amplifying information on current task or A/C state (e.g., "WORKING, JONESING, VOID, CONTACT, CAPTURE, TARGETED, LOCKED, CLEAN, ENGAGED, FUEL [RED/YELLOW/ GREEN], WEAPON [RED/YELLOW/GREEN] READY" or plain English).
TRACK [direction]	1. [A/A] GROUP or CONTACT's direction of flight or movement. 2. [A/S] [S/S] Directive call assigning responsibility to maintain sensors or visual on a defined object or area to an asset. 3. [A/S] Rotary wing directive call to establish race track (e.g., "TAZ 31, TRACK LEFT"). 4. [A/S] [AIR-MAR] Information call stating direction of vehicle or CONTACT in motion (e.g., "TALLY TECHNICAL TRACK NORTHWEST").
TRACKING	1. [EW] [S/A] infrared lock-on.

Table 5.14 Video Downlink Brevity Terms.

Term	Definition
CHECK CAPTURE	• Target appears to be no longer tracked by sensor.
CHECK FOCUS	• Sensor image appears to be out of focus.
HANDSHAKE	• Full motion video signal and data operative to ROVER.
HOLLOW	• Lost full motion video signal and/or data to ROVER.
(EXPECT) HOLLOW	• Conditions will likely limit ROVER reception (maneuvers and terrain).
SET	• No longer slewing sensor and awaiting further updates.
SHADOW	• Follow indicated target.
STAKE	• Reference point for air-to-surface (A/S) targeting operations. • A full motion video system mark has been set and is used as a frame of reference.
SWITCH CAMERA	• Switch full motion video to EO or IR.
SWITCH POLARITY	• Switch IR polarity to black hot or white hot.
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 FOVs to change.
OVERALL NOTE: * Recommend only one change in or out at a time be used for the FOV.	

5.2.9.7 Radar Talk-On. When doing a radar talk-on, the JTAC needs to be sure to reference radar significant terrain features. Examples of radar significant items would be objects with metallic reflectivity, significant terrain changes, paved roads, hard-packed dirt roads, waterways, large gatherings of trees, and pretty much anything that is in contrast to the surrounding area. No significant radar features would include personnel or minor terrain changes such as creeks or gradual slopes. An example of the flow of how a JTAC would do a radar talk-on follows-the JTAC will have the aircraft take a radar map of the target area. The aircraft normally does not need to be close in to the target. Radar-equipped aircraft typically can take this radar map from considerable distances out (approximately 12 to 25 NM). Once this map is completed, the JTAC is going to need to talk the aircraft onto the intended target referencing this overhead picture of the target area. This means that the JTAC needs to think about the items around the target area that will provide a return to the radar set. The JTAC will use these items to conduct a talk-on. An example of significant returns that would enable the JTAC to complete a talk-on would be six or more mobile vehicles in the linear formation.

5.2.10 Attack. The JTACs should conduct a final internal FAATS check before pushing aircraft to attack and verbally brief only pertinent changes to the battlespace. (e.g., friendly location movement, and artillery status changes).

5.2.10.1 Final Clearance Instructions. Final clearance instructions are briefed after all the applicable target information have been passed and the JTAC is ready for the attack. Final clearance instructions is a cue to the aircrew that the JTAC is ready for the attack and has no further information to pass. Using final clearance instructions can enhance a JTAC's SA by indicating where the aircrew is in the attack process. The information requested should be pertinent and reflect the desired level of urgency in the tactical situation. The following are recommended terms to be used in final clearance instructions:

- "PUSH IMMEDIATE."
- "PUSH WHEN READY."
- "PUSH TOT/TTT: XX/X+XX."

EXAMPLE: "PUSH IMMEDIATE, CALL IN WITH DIRECTION," or "PUSH WHEN READY, CALL DEPARTING IP" or "PUSH WITH TIME TO TARGET 4+00, READY, READY, HACK."

5.2.10.2 SQUIRTER Control Execution. If a tactical situation where multiple SQUIRTERS and MOVERS are possible from multiple locations, a standard labeling technique is imperative to maintain SA on the ground objects of interest. JTACs should establish labeling TTP during premission planning or during mission execution. Once established all players will maintain the same labeling technique throughout the mission.

5.2.10.3 Show of Force Considerations. At times immediate kinetic effects are not always the solution, and a simple show of force may be enough to deter enemy aggression or effect a situation through psychological means. A show of force may meet the needs of the JTAC, and a standardized mnemonic of LADR is the best format to request desired effect while keeping aircraft safe.

- Location—grid or known location.
- Altitude—base altitude for aircraft.
- Direction—desired run in.
- Remarks/Hazards—amplifying data or safety of flight considerations (e.g., flares approved or quickly rising terrain to the east).

EXAMPLE: Show of Force Request—JTAC: "DUDE 41, REQUEST IMMEDIATE SHOW OF FORCE, FRIENDLY CONVOY PS 283 509, APPROVED DOWN TO 500 FEET, DIRECTION NORTH TO SOUTH, HAZARD OF HIGH ANTENNA 1 NM WEST AND ENY SMALL ARMS FIRE."

5.2.11 Assess Effects. Decide if the GFC's desired effects were achieved. If a reattack is required, the JTAC should assess any changes to the battlespace, pass any necessary FAATS update, and proceed with the new game plan and any updated restrictions. Obscuration of the target may make assessment difficult for up to several minutes, but the tactical situation may dictate a hasty requirement for new effects. The JTAC must weigh munitions expenditures versus GFCI overall intent before reattacking a target that is obscured. If there are additional targets in the area of a previously struck target, the JTAC may shift fires hastily without requiring a new CAS brief, but restrictions should be reassessed to ensure applicability.

5.2.11.1 Reattacks. A reattack may be requested if additional weapons effects are required on the target. A quick and concise call to have aircraft reattack is, "SMOKE 21, YOU ARE APPROVED FOR AN IMMEDIATE REATTACK. SAME RESTRICTOINS APPLY. PUSH WHEN READY." Clearance to drop/fire on a reattack must be issued by the JTAC before ordnance release. Corrections and new restrictions can be given to the aircrew. If ordnance adjustments are required, they must be given in a timely manner. Corrections are given in cardinal direction and distance in meters from the previous bomb impact point to the target. An example of a proper adjustment transmission would be, “RAZOR 02, FROM LEAD’S HITS, NORTH 100.”

5.2.12 Battle Damage Assessment. BDA is used to update the enemy order of battle. The JTAC gives BDA for the flight, not for individual aircraft in the flight. If conditions preclude sending complete BDA, pass successful, unsuccessful, or unknown at a minimum. JTACs should consider passing specific effects achieved by the flight/section in accordance with the commander’s intent for CAS. BDA should also be passed to the ASOC/DASC, S-2, or other appropriate intelligence/C2 channels. JTACs should maintain a log of BDA, to include mission number, call sign, target coordinates, time on target, specific results, and whether the mission was successful. The standard BDA format for the passage to the ASOC/DASC is SALTR.

- Size—number and type of equipment/personnel observed.
- Activity—movement direction, stationary, dug in.
- Location—where was the target you attacked or observed?
- Time—what time did you attack the target or when did you observe the target?
- Remarks—munitions expended, observed damage, and mission number.

5.2.13 Departure Routing/Safety of Flight. JTACs are responsible to provide routing/safety of flight to aircraft as they depart the battlespace. An IP and altitude should be passed for safe egress, but JTACs should be prepared to place assets in a safe hold for C2 contact and approval of egress routing.

5.2.14 Coordinated Attacks. As the joint firepower expert on the battlefield, JTACs should practice conducting coordinated attacks with dissimilar MDSs as much as possible in training to become more proficient with the attack methods during combat. JTACs should become proficient with being the tactical lead (TL) themselves and recognizing when TL should be passed to an aircrew.

5.2.14.1 Tactical Lead. The JTAC/FAC(A) must approve use of coordinated attacks. JTACs should become proficient with creating coordinated attacks, and recognizing when TL should be passed to an aircrew. One flight lead may be established as the TL, if all flights/sections agree to work coordinated attacks. In this case the JTAC will generally select the asset with the most SA for TL. In situations where there is no asset adequately spun up on the current battlefield situation it is best for the JTAC to retain TL to hastily prosecute the target. When TL is delegated, the JTAC does not relinquish terminal attack control (TAC) responsibilities—rather, the TL should ensure deconfliction between aircraft is maintained and recommend attack geometry and timing between flights/sections. Factors that drive the function of a coordinated attack should include the GFCI, number of aircraft, number of targets, factor threats, and the urgency of the situation. When using coordinated attacks the JTAC should pass the call sign of intended assets in the game plan, pass the 9-Line(s)—may include “per the TIES brief” in line 9—and then brief the coordinated attack “TIES” brief post correlation.

5.2.14.2 Coordinated Attack Types. There are two types, combined or sectored. The type of attack is based solely on the avenue of approach to the target which has nothing to do with the target/targets' relationship to each other.

- Combined—same avenue of approach to the target from a given holding position.
- Sectored—different avenue of approach to the target (the pilot(s) will require some kind of conspicuous reference for the sector).

5.2.14.3 Coordinated Attack Timing. Simultaneous, sequential and random are timing options. Visual or Hack are timing deconfliction options. If the JTAC maintains TL, be clear about who/what is to be VISUAL of who/what. Hack is not generally a TOT, but spacing from an event (i.e., "30 SECONDS AFTER VIPER 21's IMPACTS."). See Table 5.15, Coordinated Attack Types/Timing.

Table 5.15 Coordinated Attack Types/Timing.

		Simultaneous	**Sequential**	**Random**
Type of Attack	**Combined** Same avenue of approach/attack to the target	**Visual or Hack** Simultaneous time on target or time to target	**Visual or Hack** Visual spacing or time hack separation	Not normally used
	Sectored Acknowledged Sector	**Visual or Timing** Simultaneous time on target or time to target	**Visual or Hack** Visual spacing or time hack separation	Free flow[1]

NOTE:
[1] Must ensure strafe fan/bomb and missile fragment deconfliction.

5.2.14.4 TIES. Type (By Flight), Ingress, Egress, Sort. TIES enables the JTAC/Aircrew a specific order to coordinated attack being generated.

- **T**ype of coordinated attack.
- **I**ngress direction for each attacking flight.
- **E**gress direction for each attacking flight.
- **S**ort for the intended target per flight and target direction priority.

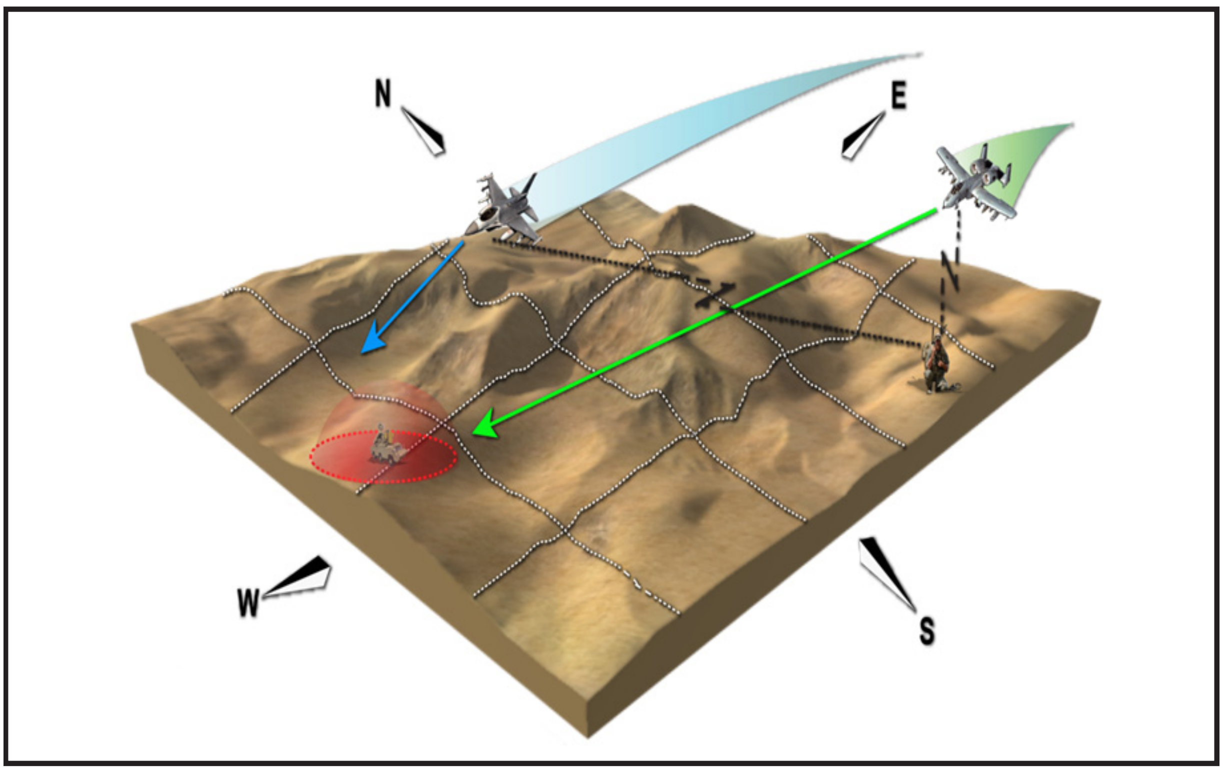
5.2.14.4.1 Combined Approach Considerations. Procedural deconfliction measures need to be in place when assets are coming from the same direction. The egress routes of each asset should provide an opportunity for aircraft to safely depart, defend against any potential threats, prepare for possible reattacks, and have enough separation to effectively attack.

EXAMPLE: Combined Attack: JTAC briefs coordinated attack intent in the game plan, passes individual 9-Lines for each attacking asset (i.e., Viper Type 2, BOC/Hawg Type 3, and BOT), and then briefs coordinated attack plan post each assets' completion of target correlation. See Table 5.16 Completion of Target Correlation Examples, and Figure 5.15, Coordinated Attack Sector Example.

Table 5.16 Completion of Target Correlation Examples.

Hardrock 25 (JTAC): "HAWG/VIPER, CALL READY COORDINATED ATTACK BRIEF."
Hawg/Viper: "HAWG READY. VIPER READY."
Hardrock: "HAWG, VIPER, THIS WILL BE A COMBINED, SEQUENTIAL, TIMING. VIPER FOLLOWED BY HAWG 30 SECONDS AFTER "KILL" CALL. BOTH IN FROM THE EAST, VIPER OFF NORTH TO IP YANKEE, HAWG OFF SOUTH FOR REATTACKS. VIPER IN ON THE SA-8, CALL KILL WHEN ABLE. HAWG IN ON THE ARMOR 30 SECONDS AFTER, GFC INTENT IS TO NEUTRALIZE 50 PERCENT OF THE ARMOR, SORT SOUTH TO NORTH."
Hawg/Viper: "HAWG COPY, VIPER COPY."
Hardrock: "VIPER PUSH WHEN READY, CALL IN WITH DIRECTION, WEAPONS RELEASE, AND KILL CALL. HAWG YOU ARE CLEARED TO ENGAGE, PUSH 30 SECONDS AFTER KILL CALL."
Viper: "VIPER IN FROM THE EAST."
Hardrock: "VIPER, CLEARED HOT."
Viper: "WEAPON AWAY, 35 SECONDS."
Viper: "VIPER OFF NORTH, KILL SA-8 137@24."
Hawg: "HAWG IS IN FROM THE WEST, COMMENCING ENGAGEMENT."
Hardrock: "HARDROCK."
Hawg: "ENGAGEMENT COMPLETE, 6 X ARMOR PIECES NEUTRALIZED."

Figure 5.15 Coordinated Attack Sectored Example.



5.2.14.4.2 Sectored Considerations. This provides aircraft with its own space to maneuver and may expedite reattacks and multiple types of control. Sectors can be given off geographical references, cardinal directions, gridlines, or radial, but a visual deconfliction measure is the most desired. When using a geographical references, cardinal direction, or gridlines the assets should maintain a 1 NM buffer from the deconfliction point. For radial deconfliction, the best technique is a ±10 degrees from the deconfliction line. Aircraft should positively acknowledge the sector to ensure all assets understand the plan and remain safe.

EXAMPLE: Sectored Geographic Separation: "HAWG 01 SECTOR EAST, VIPER 01 SECTOR WEST OF MSR CORONA, REMAIN OUTSIDE OF 1 NM FROM THE MSR IN YOUR SECTOR" or "HAWG 01 SECTOR SOUTH, VIPER 01 SECTOR NORTH OF 9-LINE CHARLIE, REMAIN OUTSIDE 1 NM." See **Figure 5.16**, Sectored Geographic Separation.

EXAMPLE: Sectored Radial Separation: "HAWG 01 SECTOR SOUTH, VIPER 01 SECTOR NORTH OF 050 RADIAL OFF OF 9-LINE ALPHA, REMAIN OUTSIDE 10 DEGREES FROM THE RADIAL AND 3 NM FROM THE TARGET." See **Figure 5.17**, Sectored Radial Separation.

Figure 5.16 Sectored Geographic Separation.

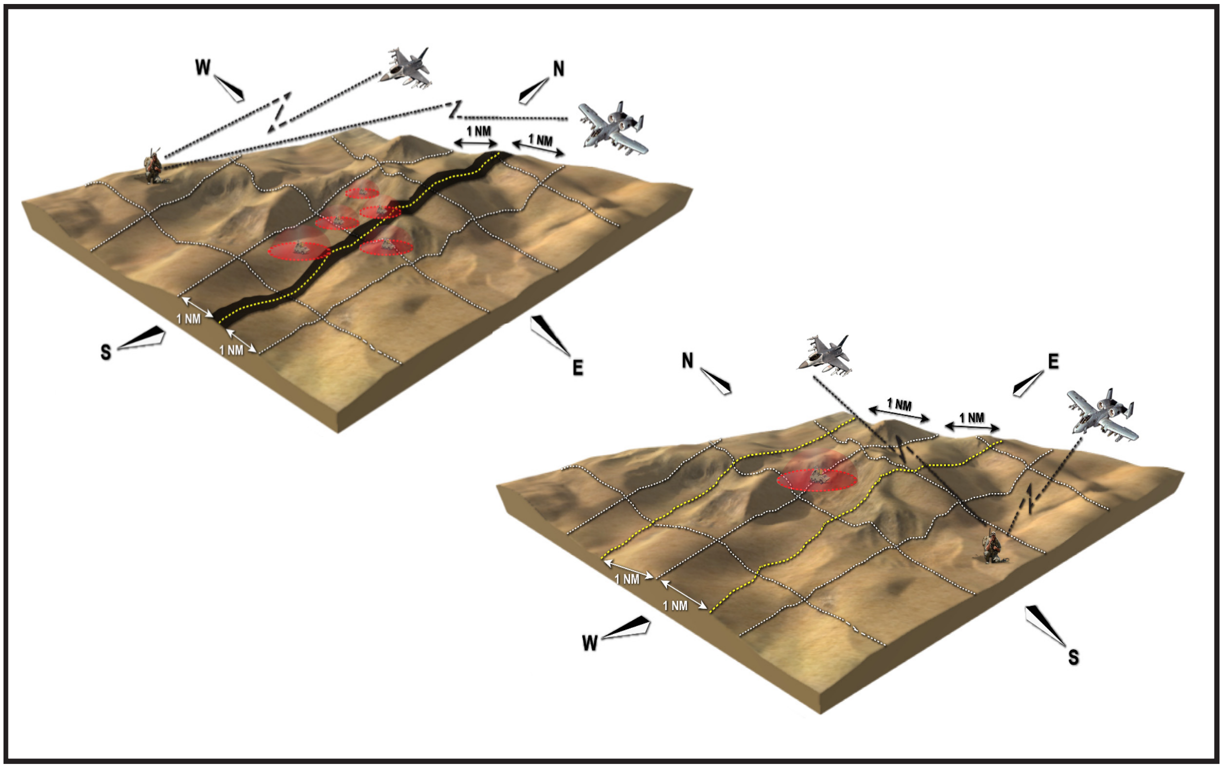
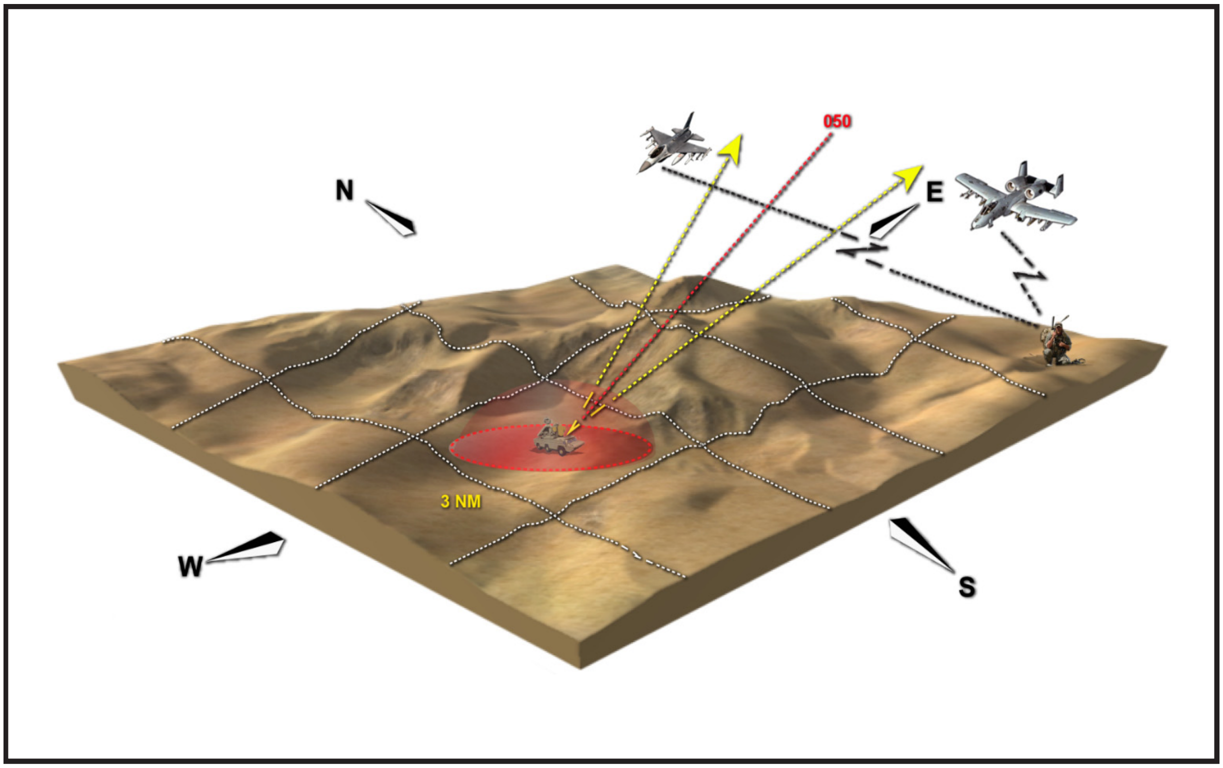


Figure 5.17 Sectored Radial Separation.



5.3 Army Attack Aviation and Rotary-Wing CAS Procedures. When controlling Army attack aviation, JTACs should still follow the 12-Step CAS Execution Process. There are specific maneuver requirements and briefs, included in this section, which can be easily adapted into the JTAC's proven processes to ensure safe and effective operations.

5.3.1 Army Attack Aviation. Army attack aviation units are organic, assigned, or attached to divisions, and/or brigades, and perform air-to-ground operations as part of a combined arms team. Army aviation assets normally receive mission-type orders and execute them as an integral unit or maneuver element. Special situations may arise where attack aviation assets are employed in smaller units (attack teams or air weapons teams [AWT]). The Army does not consider its attack aircraft to be CAS platforms, although they can conduct attacks employing CAS TTP, when operating in support of joint forces or when the tactical situation dictates. Additionally, Army attack aviation units conduct manned and unmanned-teaming (MUM-T) operations. MUM-T is the integrated maneuver of Army aviation rotary-wing and unmanned aircraft systems (UAS) to conduct movement to contact, attack, reconnaissance, and security tasks. For more information, refer to Army FM 3-04, *Army Aviation*.

5.3.1.1 Army aviation conducts attacks across the width and breadth of the supported ground commander's AO. When operating in close proximity to friendly forces, aircrews receive a situation update from the ground commander or observer and develop a plan to engage the enemy, while maintaining freedom to maneuver. The AMC or flight lead must have direct communication with the ground commander or observer on the scene to provide direct fire support. After receiving the Army attack aviation CFF from the ground forces, the aircrews must positively identify the location of the friendly element and the target prior to conducting any engagement. Methods for marking the location of friendlies and the enemy include: laser hand off, tracer fire, marking rounds (flares or mortars), smoke grenades, signal mirrors, VS-17 panels, IR strobe lights, laser target marker, or chemical sticks.

5.3.1.2 Army Attack Aviation CFF. The Army attack aviation CFF does not require terminal attack control to employ ordnance. The Army attack aviation CFF can be used for all threat conditions. It does not affect the aircrew's tactics in executing attacks. The Army Aviation Attack Request CFF and the Special Operations Forces (SOF) Gunship CFF are identical. See Table 5.17, Army Aviation Attack Request/CFF and SOF Gunship Call for the Fire Format.

5.3.2 RW CAS Employment Considerations. In addition to Army attack aviation, all joint RW assets conduct CAS attacks using the CAS 9-Line, and/or RW CAS 5- Line. See Table 5.18, Rotary-Wing CAS 5-Line Brief.

Table 5.17 Army Aviation Attack Request/CFF and SOF Gunship Call for the Fire Format.

1. Observer and Warning Order "____________, **this is** _________________, **fire mission, over."** (aircraft call sign) (observer call sign)
2. Friendly Location and 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 and Mark **"___________________________, marked by _____________________."** (target description) (infrared pointer, tracer, etc.)
5. Remarks: **"____, over."** (threats, danger close, clearance, restriction, at my command, TOT, etc.)
OVERALL NOTES: * Clearance. If airspace has been cleared between the employing aircraft and the target, transmission of this brief ***is*** clearance to fire unless ***danger close***, ***at my command*** or an additional method of control is stated. * Danger Close. For danger close fire, the observer or commander must accept responsibility for increased risk. State "cleared danger close" in line 5 and pass the initials of the on-scene ground commander. This clearance may be preplanned. * At My Command. For positive control of the aircraft, state ***at my command*** on Line 5. The aircraft will call, ***ready to fire***, when ready. * For synchronization of fires, methods of fire and control may be included in Line 5.

Table 5.18 Rotary-Wing CAS 5-Line Brief.

1. Observer/Warning Order/Game Plan: "______________________________,__________________________________, 5-line. (aircraft call sign) (JTAC call sign) **Type (1, 2, or 3) control, MOA (BOC or BOT), (ordnance requested)."**
2. Friendly Location/Mark: "**My position** ___________________, **marked by** ______________________________." (target reference point, grid, etc.) (VS-17, beacon, IR strobe, etc.)
3. Target Location: "Target location, "____." (magnetic bearing and range in meters, target reference point, grid, etc.)
4. Target Description/Mark: "________________________________, **marked by** _______________________." (target description) (infrared, tracer, etc.)
5. Remarks/Restrictions: • Laser target line (LTL) or pointer target line (PTL) • Surface-to-air threat, location, and type of SEAD • Additional calls requested • Additional remarks (gun target line [GTL], weather, hazards, friendly mark) • Final attack headings • Airspace coordination areas (ACA) • Danger close and initials • Time on target (TOT)/time to target (TTT) • Postlaunch abort coordination and considerations
OVERALL NOTE: * The rotary-wing CAS 5-Line should be passed as one transmission. If the restrictions portion is lengthy, it may be a separate transmission. **LEGEND:** BOT—bomb on target MOA—method of attack

5.3.2.1 The primary attack brief for RW CAS is the 9-Line. In certain situations, RW aircraft, including Army RW aircraft conducting attacks using CAS TTP, may have higher situational awareness due to a lower operating altitude. In these instances, the RW CAS 5-Line brief or CFF can expedite fires.

5.3.2.2 The RW CAS 5-Line brief is an observer-centric CAS brief. Typically, this TTP is used for bomb-on-target attacks. Transmission of the RW CAS 5-Line is NOT clearance to fire.

5.3.2.3 Once approved for a CAS attack, clearance to use off-axis weapons (e.g., crew served weapons) upon ingress to and egress from the target area is implied. Fires from off-axis weapons are subject to the restrictions outlined in the CAS attack brief (i.e., use gun-to-target line, and right/left door gun), in addition to run-in/attack direction).

5.4 AC-130 Gunship Fires. When controlling AC-130 gunship fires, JTACs should still follow the 12-Step CAS Execution Process. There are specific maneuver requirements and briefs, included in this section, which can be easily adapted into the JTAC's proven processes to ensure safe and effective operations. Due to unique systems and capabilities, AC-130s do not require terminal attack control from ground controllers for all weapons profiles (guns).

5.4.1 AC-130 Armament.

- AC-130U (Spooky): 25 mm, 40 mm, 105 mm.
- AC-130W (Scorpion II): 30 mm, 105 mm, GBU-39, AGM-176.
- AC-130J (Ghostrider): 30 mm, 105 mm, GBU-39, GBU-69, AGM-114, AGM-176.

5.4.2 CAS 5-Line and CAS 9-Line Accepted. The AC-130 Accepts SOF Gunship CFF, RW CAS 5-Line and CAS 9-Lines. AC-130 crews prefer 5-Lines/CFFs for gun engagements, and 9-Lines for precision guided munitions (W and J model gunships). When using both gun and precision guided munitions, during a simultaneous attack, use a 9-Line with gun reattack in the remarks. See **Table 5.19**, Adjusting AC-130 Gunship Fire, for AC-130 adjust fire procedures for guns. JTACs should ensure gun tweaks have been performed prior to TOS, if no combat tweaks were performed, expect initial rounds to be inaccurate for the several impacts.

5.4.2.1 The addition of PGMs on AC-130 W and J model gunships provide an additional standoff capability for strikes outside of the normal wheel of employment for threat and noise mitigation. Gunships will always fly in a counter-clockwise direction over the target area due to the guns and sensors positioned on the left/port side of the aircraft.

5.4.2.2 Refer to AFTTP 3-2.6, JFIRE, and AFTTP 3-1.AC-130, and AFTTP 3-1.AC-130, for information and tactics on how to integrate fighter aircraft with gunships to deconflict and mass fires simultaneously (i.e., wheel/perch ops, and sectors).

5.4.3 Acoustic Detection. Consideration should be given to the expected effects of aircraft noise on enemy activity in overall mission execution. The aircraft acoustic signature and/or the sound of weapons employment can be both a deterrent to enemy activity, and a means of detecting and tracking the aircraft. Weather conditions, ambient noise, and terrain features can enhance or limit acoustic detection of the gunship.

Table 5.19 Adjusting AC-130 Gunship Fire.

1. If there is a significant miss distance or the wrong target was hit, adjust the round impact by giving cardinal/subcardinal direction and range (meters) from impact to the desired target (e.g., "ADJUST FIRE NORTHEAST 200, OVER."
2. Marking or confirming targets may be accomplished using covert illumination with the IR marker (SPARKLE) or laser.
3. To move SPARKLE, say "MOVE/ROLL SPARKLE 100 METERS EAST."
4. Once SPARKLE is over the target, say "FREEZE SPARKLE." (If you say "CEASE SPARKLE," the gunship will turn off the SPARKLE).
OVERALL NOTES:
* Do not reference clock positions.
* Do not pass run-in headings for gun engagements.
* Do not correct left/right or short/long.
* If applicable, pass multiple target locations in precedence as soon as possible to allow the AC-130 to engage as rapidly as possible to preclude an enemy scatter effect.

5.4.4 AC-130 PGM Employment from the Orbit. The addition of PGMs to the AC-130's arsenal bolsters a gunship's ability to mass firepower and destroy a range of enemy targets with the appropriate ordnance. Traditional TTP needed the gunship to place targets within 30 degrees of the aircraft's track, which required the gunship to break out of an overhead gun orbit and maneuver away from the target for up to five minutes. This eliminated the possibility of immediately employing 30 mm or 105 mm gunfire in defense of ground units. Recent advancements in TTP have eliminated the need for maneuver out of a gun orbit and optimized CAS support by providing maximum flexibility in employment of GBU-39/B, A/B, B/B, AGM-176, and GBU-69. The capability of employing PGMs in a gun orbit enables an AC-130 to provide immediate fire support with any weapon and eliminates the need for a time consuming maneuver originally designed to optimize accurate weapons delivery. Reference AFTTP 3-1.JTAC, Chapter 5, "AC-130 PGM Employment Considerations," for detailed weapon attack profiles.

5.5 Sensor Management. Optimizing sensor allocation within an AOR is a frequently overlooked aspect of planning and execution. JTACs often have multiple sensors in the CAS stack and should brief a sensor management plan that pertains to areas of interest of specific target sets that clarifies reporting instructions. The sensor management plan should follow the concept of fire or the situation update and be refined throughout the mission as the tactical situation changes using the FAATS brief. See **paragraph 5.8.2.2**, COF, for more information. When multiple sensors exist, the JTAC should use them to cover the most amount of battlefield to provide enhanced situational awareness to both ground parties and aircrew. Dynamic operations may require constant updates and changes to the sensor management plan to ensure there is not a gap in coverage. Tactical problems may dictate duplicity of sensors on a specific target or location. See **Table 5.20**, Sensor Postures, and **Figure 5.18**, Sensor Management Example.

Table 5.20 Sensor Postures.

Term	Definition
Neutral	Lead aircraft's responsibility is the friendly force. Wing aircraft is primarily responsible for scanning the objective (or assigned checkpoint) and back to the friendly force.
Offensive	Both Lead and wing aircraft concentrate on the objective.
Defensive	Lead aircraft's responsibility is the friendly force. Wing aircraft is responsible for sanitizing the route directly in front of the friendly force.

Figure 5.18 Sensor Management Example.

5.5.1 Sensor Tasking Methods.

5.5.1.1 Neutral/Offensive/Defensive Posture. These brevity terms can be used to expeditiously shift sensors between postures, see **Table 5.20**, Sensor Postures.

EXAMPLE: Sensor Management Tasking: "SENSOR PLAN AS FOLLOWS; REAPER 61 OFFENSIVE POSTURE ON TGT BUILDING OUT TO 100 M, SPOOKY 31 HAS SQUIRTERS OUT OF TGT BUILDING, HAWG 21/22 HAS MOVERS INGRESSING OBJ NITTANY LIONOUT TO 500 M, NOTIFY IF VEHICLE COMES WITHIN 300 M OF TGT BUILDING, GUNSLINGER 11/12 DEFENSIVE POSTURE ON OP DELTA. CALL WHEN SENSORS SET." See **Figure 5.18**, Sensor Management Example.

5.5.1.2 Squirter Tasking. A Squirter consists of a ground-borne object(s) of interest departing the objective area. This sensor tasking gives an aircraft the responsibility to track the object(s). JTACs should consider assigning this sensor tasking to the most reactive CAS aircraft to warrant execution of expeditious air-to-surface fires.

5.5.1.3 Mover Tasking. Movers are unidentified surface vehicle(s) in motion. This sensor tasking assigns an aircraft with the responsibility of tracking a moving vehicle. JTACs provide detailed sensor parameters by providing scan instructions to aircraft (i.e., "REAPER 21, SEARCH FOR VEHICLES INGRESSING OBJ BUCKEYE OUT TO 1 KM, REPORT BACK IF VEHICLE COMES WITHIN 250 M OF BUILDING A2").

5.5.1.4 Dynamic Sensor Tasking. As a mission progresses or the tactical situation dictates, sensor tasks may need adjusting between areas of interest. One of the responsibilities of the JTAC is to shift sensors around the battlefield in accordance with the supported ground commander's intent. Aligning sensor management to the intent of the ground force commander is vital to enhance mission effectiveness. Additionally, continuous coordination between the staff, JTAC, and GFC is required to ensure proper use of sensor management.

5.5.2 Sensor Capabilities and Limitations. JTACs need to understand distinct sensor capabilities that are available with each supporting platform in order to meet the commander's intent. A dynamic operation will require constant updates and changes to the sensor management plan to ensure there is not a gap in coverage. When multiple sensors exist, there may be times when the JTAC wants multiple sensors on the same tasking, or it may be more appropriate not to duplicate taskings. JTACs should use the best sensor assortment and plan to provide enhanced situational awareness to both ground parties and aircrew for effective mission accomplishment. See **Table 5.21**, Aircraft Sensor Capabilities and **Table 5.22**, Sensor Limitations.

5.5.3 Multisensor Imagery Reconnaissance and ISR in CAS. Aircraft are capable of providing nontraditional multisensor imagery reconnaissance (MIR) and ISR, when there is not an immediate need to conduct CAS attacks. JTACs should develop and brief a comprehensive sensor allocation plan that delivers tasking for all available sensors. JTACs need to fully understand the scope of the mission which requires coordination through the appropriate and often aligned intelligence organizations, in order to reduce sensor redundancy.

Table 5.21 Aircraft Sensor Capabilities.

Sensor	Spectrum	Platforms	Laser Target Designator	Laser Spot Tracker	IR Pointer
AN/AAS-44(V)	IR	MH-60R/S	Yes	No	No
AN/AAS-44C(V)2	IR, EO, LLTV	SH-60B, HH-60H	Yes	No	Yes
AN/SZQ-2	IR, LLTV, SWIR	MH-47G, MH-60M	Yes	Yes	Yes
AN/SZQ-3 (V)2	IR, LLTV	A/H-6M	Yes	Yes(1)	Yes
ATFLIR	IR, CCD	F/A-18(2)	Yes	Yes	Yes
BRITE Star II	IR, CCD	UH-1Y	Yes	No	Yes
LITENING	IR, CCD	AV-8B, A-10C, B52/H, F-16, F/A-18 (USMC)	Yes	Yes	Yes
MTADS	IR, DTV	AH-64D/E	Yes	Yes	Yes
MTS-A/B(3)	IR, EO, LLTV, SWIR	MQ-1/MQ-9	Yes	No	Yes
MX-15Di	IR, CCD, SWIR	H-6, P-3, AC-130U King Air variants Lynx, Wildcat	Yes	Yes	Yes
MX-20	IR, CCD, SWIR	P-8A, P-3, AC-130W(4), AC-130J(4),(5)	Yes	Yes(6)	Yes
NTS/NTSU	IR, DVO, CCD	AH-1W	Yes	No	No(6)
SNIPER	IR, CCD	A-10C,B-1B, F-15E	Yes	Yes	Yes
TSS	IR, CCD	AH-1Z, KC-130J	Yes	No	Yes
TFLIR AN/AAQ-40	IR	F-35A/B/C	YES	YES	NO

NOTES:

(1) The AN/SQZ-3 fielded on some A/H-6Ms only has an LTD/IR pointer. The AN/SQZ (V)2 has an added LST capability.

(2) USN- and CVN-based USMC F/A-18s only.

(3) MQ-1B, MQ-1C, and MQ-9.

(4) AC-130W and AC-130J do not have LST.

(5)AC-130W/AC-130J have two MX-20 EO/IR sensors.

(6) The IR pointer is not boresighted to laser/EO/IR for AH-64/AH-1W helicopters.

LEGEND:

ATFLIR—advanced targeting forward-looking infrared
CCD—charge coupled device
CVN—carrier, fixed-wing aircraft, nuclear
DTV—day television
DVO—direct view optics
EO—electro-optical
IR—infrared
LLTV—low-light television
LST—laser spot tracker
LTD—laser target designator
MTADS—modernized target acquisition designation sight
MTS—multi-spectral targeting system
NTS—night targeting system
NTSU—night targeting system upgrade
SWIR—short-wave infrared
TISU—thermal imaging system upgrade
TSS—target sight system
USMC—United States Marine Corps
USN—United States Navy

Table 5.22 Sensor Limitations.

Sensor	Capability	Limitation	Good for Example
Sniper/Litening/ ATFLIR	CCD/IR/VDL/LST	Faster A/C deal with longer slant range/graze angle and masking issues. A flight/section equipped with FMV will stand a higher probability of maintaining a track if both A/C are on the same track.	Small area or specific track.
UAS with FMV	EO/IR/LST/extended playtime.	No ability to see outside field of regard (i.e., could miss large formation that would be seen just by looking outside cockpit.	Small area or specific track.
SIGINT	Reveals hostile intent.	Deniable in some environments, large TLE requires cross-cuing of other assets.	Large area COMINT intercept.
SAR	Radar significant terrain/objects resolution varies by platform.	Limited to no ability to see personnel depending on sensor, more capable sensors require analyst to exploit.	All weather, near-real-time mapping.
GMTI	Track incoming/outgoing movers, reactive where vehicle came from.	No ability to distinguish hostile MTIs from nonhostile MTIs	Large area recce relative target origination position.

5.5.4 Sensor Management Plan Considerations. Prioritize sensor tasking to meet commander's intent. The following considerations should be preplanned to the best of the JTACs ability prior to the start of the mission or aircraft check-in. Sensor considerations for ingress, actions on, and egress incorporate the desired sensor posture for each phase of attack. The JTAC should establish the required posture suitable to the target and follow on taskings. Refer to AFTTP 3-1.JTAC, Chapter 5, "CAS Execution," for additional sensor tasking considerations.

- Balance priority tasking with sensor capabilities and available times on station.
- Limitations (i.e., holding, altitude, and slant range which impact sensor capabilities or masking).

- Sensor posture (offensive/neutral/defensive).
- Squirter/mover plan (positive handoff briefed before the attack).
- Most dangerous/likely COAs.
- Terrain.

5.6 Threat Mitigation.

5.6.1 Effective Threats. Effective threats can both directly threaten CAS aircraft and restrict ability to attack targets by forcing them to employ at longer slant ranges, reducing on-station time, and hindering target acquisition. A multitude of near-peer adversaries have air defense weapons in which provide overlapping coverage to defend against aircraft flying at any altitude over the entire battlefield. As a result, in order to accomplish the ground commander's intent, it will remain necessary for JTACs to integrate all-aspects of joint firepower to mitigate threats, and attack nominated targets.

5.6.2 Types of Surface-to-Air Threats.

5.6.2.1 Strategic Air Defense Systems. Strategic AD systems are designed to protect fixed airspace, such as areas overlaying borders, commercial and industrial areas, high-value assets (i.e., nuclear facilities), population centers, or fixed military facilities. These AD systems generally use fixed or mobile assets from peacetime garrisons and centralized control as the primary means of operation.

5.6.2.2 Air Defense Artillery. ADA constitutes everything from small manual weapons to large-caliber (greater than 100 mm) computer-aided artillery. These weapons are categorized as small arms/automatic weapons (less than 14.5 mm), light ADA (greater than 14.5 mm, less than 35 mm), medium ADA (37 mm to 76 mm) and heavy (greater than 85 mm). The heavy ADA commonly will be found more to the enemy's rear. CAS missions are more likely to encounter medium and light ADA along the FEBA. If the ADA is aimed with radar, then SEAD missions should first target the radar system. For optical systems, target the guns themselves. Some ADA is mounted on vehicles with own radar (i.e., ZSU-23-4 and 2S6).

5.6.2.3 Man-Portable Air Defense Systems. MANPADS are self-contained surface-to-air missiles (SAM) that normally detect and lock onto an aircraft's infrared signature. These weapon systems are relatively inexpensive and widely proliferated. Older variants are easily defeated by an aircraft's self-protection flares, but newer systems have flare rejection technology. When briefing CAS aircraft, note that it will be nearly impossible to pass a MANPADS location. It will be more important to brief the aircraft on the level of MANPADS activity and observed tactics.

NOTE: Identification of threats and a basic understanding of capabilities are critical for a JTAC to be effective in a threat environment. You can find further information on threat systems in the AFTTP 3-1.Threat Guide. Additionally, use unit-level intelligence personnel for training and scenario development assistance related to air defense threat systems.

5.6.3 Threat Brevity.

5.6.3.1 Bullseye. An established reference point from which the position of an object can be referenced by bearing (magnetic) and range (NM) from this point. Typically the bullseye location for a specific theater will be published in the SPINS.

NOTE: In order to maintain SA on threat call outs in reference with bullseye, the JTAC should consider plotting the bullseye on SA tools (i.e., ATAK, and MAP).

5.6.3.2 Active. Refer to emitter is radiating at the stated location or along the stated bearing.

5.6.3.3 Awake. Land/surface emitter activity detected via communications intelligence.

5.6.3.4 Asleep. No longer detecting land/surface emitter activity via communications intelligence.

5.6.3.5 Empty. (EW) no emitters of interest detected.

5.6.3.6 Dirt. Radar warning receiver indication of surface threat in search mode.

NOTE: The JTAC should listen on his/her frequency for the CAS aircraft to make a "BULLSEYE CUT" call out. So the JTAC can build situational awareness to be able to provide solutions or assess the situation if the CAS team needs to flex the plan.

5.6.3.7 Mud. Radar warning receiver ground threat interceptor with no launch indication. Also, could be radar warning receiver indication of surface threat in track mode.

5.6.3.8 Singer. Radar warning receiver indication of a surface to air missile launch.

NOTE: When a JTAC hears the word "SINGER," immediately the JTAC (if possible) can be heads up and look for ADA tracer fire or smoke trails to help PID the SAM/ADA.

5.6.3.9 Jink. Perform an unpredictable maneuver to negate a tracking solution.

5.6.3.10 Break. Perform an immediate maximum performance turn in the indicated direction (default is a 180-degree turn).

NOTE: JTACs can find further information on threat brevity in AFTTP 3-2.5, *Brevity*.

5.6.4 Threat Information/Locations.

5.6.4.1 LOWDOWN. A LOWDOWN is factor surface to air threat information initially passed in bulk to aircrew. Aircrew can receive the LOWDOWN via the C2 at planned times, upon initial check-in with the C2, or when the situation has changed or when requested by flight/element leads. A LOWDOWN may be requested by the JTAC to any asset who has recently come from ASOC, TAC C2, or CRC control or any asset with the ability to contact those agencies while remaining on frequency with the JTAC. The combined SA of the AO or battle management area (BMA) will get reported by data link, mIRC, or voice from the reporting fighter/bomber/asset to the appropriate C2 agency as outlined in the SPINS. JTACs must pass "REPORTED" and "CONFIRMED" threat locations during routing and safety of flight so that pilots can maintain SA between all aircraft assets. Elements of the LOWDOWN should be passed in the following order. See **Table 5.23**, Threat Examples.

Table 5.23 Threat Examples.

EXAMPLE One Threat:
VIPER: "LOWDOWN: SA-6 ACTIVE 240/20."
EXAMPLE Two Threats:
VIPER: "LOWDOWN: SA-6 ACTIVE 240/20, SA-3 AWAKE 200/20."
EXAMPLE Three Threats:
VIPER: "LOWDOWN: SA-6 ACTIVE 240/20, SA-6 ACTIVE 250/15, SA-3 EMPTY 200/20."
OVERALL NOTE:
* To be able to successfully have SA on these threats the JTAC must find the established bullseyes in the AOR. To eliminate confusion if the bullseye is not stated, simply request what bullseye these cuts originated from. If the JTAC is unable to generate the bullseye, request the A/C for MGRS grids and TLE associated with the passed MGRS grids.

5.6.5 Threat Mitigation Plan.

5.6.5.1 Factor Threats. Factor threats are known threats in the AO that will affect the attacking aircraft's ingress and egress geometry or weapons delivery. JTACs or FAC(A)s and the attacking aircraft should work together to identify factor threats for the attacking aircraft. Additionally, the plan formulated should not prevent surface-to-surface fires from being employed in a timely manner.

5.6.5.2 Avoid. The aircrew and JTAC will plan to avoid only the factor threats to the engaging aircraft using standoff weapons, avoiding the threat Missile engagement zone (MEZ) or Weapons engagement zone (WEZ) using modified flight profiles, masking ingress and egress.

5.6.5.2.1 Altitude. Holding above the threat MEZ or WEZ.

5.6.5.2.1.1 Advantages: Keeps Aircraft out of Tactical ALT and maximum recommended intercept range (MRIR), be able to use a targeting pod to still be able to derive targetable coordinates, and over fly threat while being able to providing seamless effects for the supported ground force commander.

5.6.5.2.1.2 Disadvantages: The Aircrew could potentially restrict weapon effects for the supported ground force commander requests (i.e., rockets, guns, and MK-series weapons). Altitude separation can also affect the fidelity of the targeting pod.

NOTE: Planning a ***Safe Hold*** can be beneficial during a JTACs mission in the case of a pop up threat or the need for expedited deconfliction of surface to surface fire. The Safe hold will be a permissive holding area that is outside of the factor threat MEZ or WEZ. Additionally, it is critical during planning to not create a safe hold where surface to surface fires could potentially affect the safety of flight for the aircrew.

5.6.5.2.2 Lateral. The JTAC/FAC(A) can using a specific range of the specific threat to avoid the MRIR of the threat with straight-line distance.

- Advantages: Aircraft will maintain outside of MEZ/WEZ.
- Disadvantages: Slant range from target could affect targeting pod (TGP) fidelity or ability for TGP to derive coordinates to target off of, line of site could be an issue for specific weapons that do not have standoff capability.

5.6.5.2.3 Masking. If the tactical situation dictates, the aircrew could use masking as a technique to shield themselves from the known factor threat. This could be used by direct terrain masking (i.e., flying low level in deep valleys) to conceal ingress and egress to the target areas. Usually, this is used in low-altitude tactics when needing to employ forward-firing munitions. Masking can also be used against ADA during the day by ingress or egress with the sun to obscure enemy visual acquisition of the aircraft.

5.6.6 Suppression of Enemy Air Defenses.

5.6.6.1 Suppression Selection. The decision to use SEAD assets rests on the capabilities of the identified threat and the capabilities of the supporting CAS platform/employed weapon. For example, a flight of F-16s employing a GBU-12 on an SA-8 has the ability to simply overfly this threat's tactical effective envelope. Once the decision to use SEAD assets against a threat has been made, the type of SEAD to employ must be addressed. First, identify what forms of SEAD are available both organic to the aligned unit and through request. Organic forms of SEAD such as surface-based fires are the easiest to plan. In contrast, airborne jamming and antiradiation missile platforms may be able to provide better coverage of an area that has several threats to deal with, but these assets are low density, high demand and may not be available for localized suppression operations. Surface-based fires, being organic to aligned unit, are more flexible and less likely to be canceled or denied prior to execution. Surface-based fires also have limitations; they will be of little help if they are out of range or dealing with a significant counterbattery environment. They also rely heavily on accurate and timely targeting. If the decision is made to use this form of suppression, coordination with the appropriate fire support personnel will be crucial to mission success. The following are discussion points that should be covered during mission planning. Available Suppression will usually be a compromise between what the Fires Support Officer is able to provide and what the JTAC needs to receive. See **Figure 5.19**, Suppression Required; **Figure 5.20**, F-16 Versus SA-6; and **Figure 5.21**, Weapons Ride Chart.

NOTE: Using the aircraft speed and time conversions table along with the S/A threat capabilities table (unclassified values) in the J-Fire can give an amount of suppression in minutes and seconds.

Figure 5.19 Suppression Required.

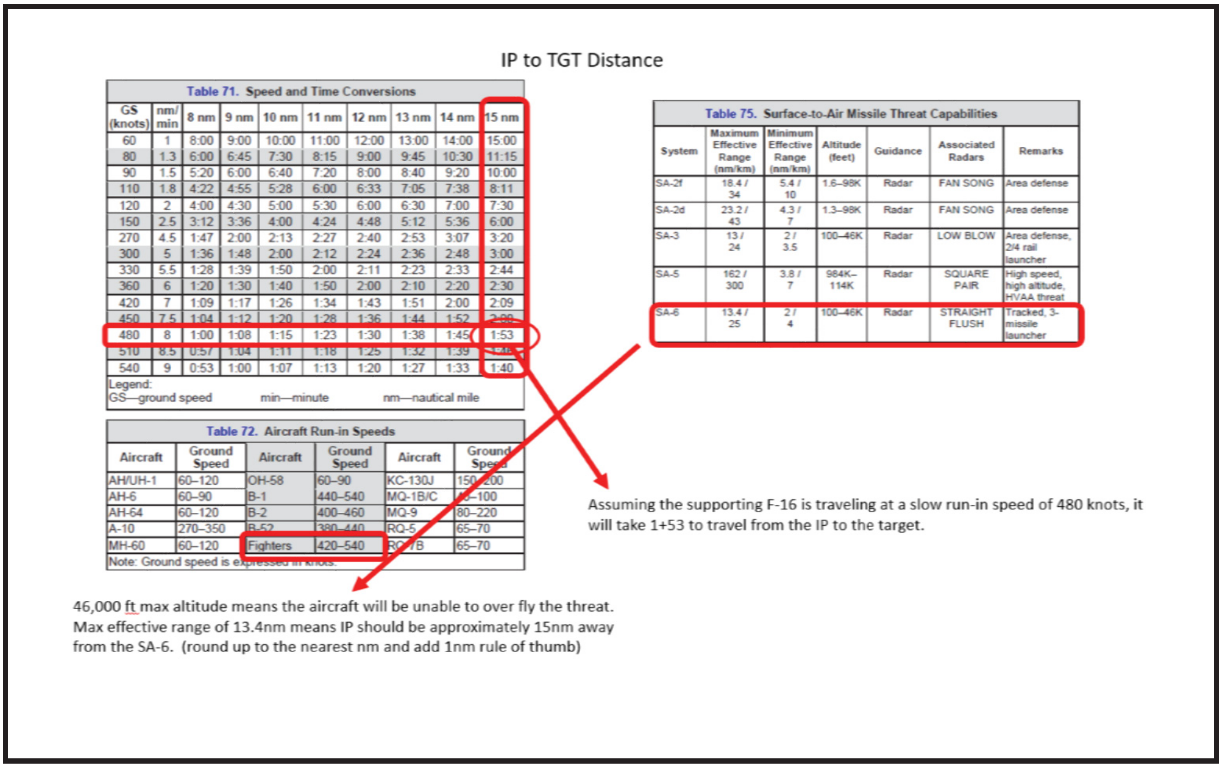


Table 71. Speed and Time Conversions

GS (knots)	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	[illegible]
540	9	0:53	1:00	1:07	1:13	1:20	1:27	1:33	1:40

Legend:
GS—ground speed min—minute nm—nautical mile

Table 72. Aircraft Run-in Speeds

Aircraft	Ground Speed	Aircraft	Ground Speed	Aircraft	Ground Speed
AH/UH-1	60–120	OH-58	60–90	KC-130J	150–200
AH-6	60–90	B-1	440–540	MQ-1B/C	[illegible]–100
AH-64	60–120	B-2	400–460	MQ-9	80–220
A-10	270–350	B-52	380–440	RQ-5	65–70
MH-60	60–120	Fighters	420–540	RQ-7B	65–70

Note: Ground speed is expressed in knots.

Table 75. Surface-to-Air Missile Threat Capabilities

System	Maximum Effective Range (nm/km)	Minimum Effective Range (nm/km)	Altitude (feet)	Guidance	Associated Radars	Remarks
SA-2f	18.4 / 34	5.4 / 10	1.6–98K	Radar	FAN SONG	Area defense
SA-2d	23.2 / 43	4.3 / 7	1.3–98K	Radar	FAN SONG	Area defense
SA-3	13 / 24	2 / 3.5	100–46K	Radar	LOW BLOW	Area defense, 2/4 rail launcher
SA-5	162 / 300	3.8 / 7	984K–114K	Radar	SQUARE PAIR	High speed, high altitude, HVAA threat
SA-6	13.4 / 25	2 / 4	100–46K	Radar	STRAIGHT FLUSH	Tracked, 3-missile launcher

Figure 5.20 F-16 Versus SA-6.

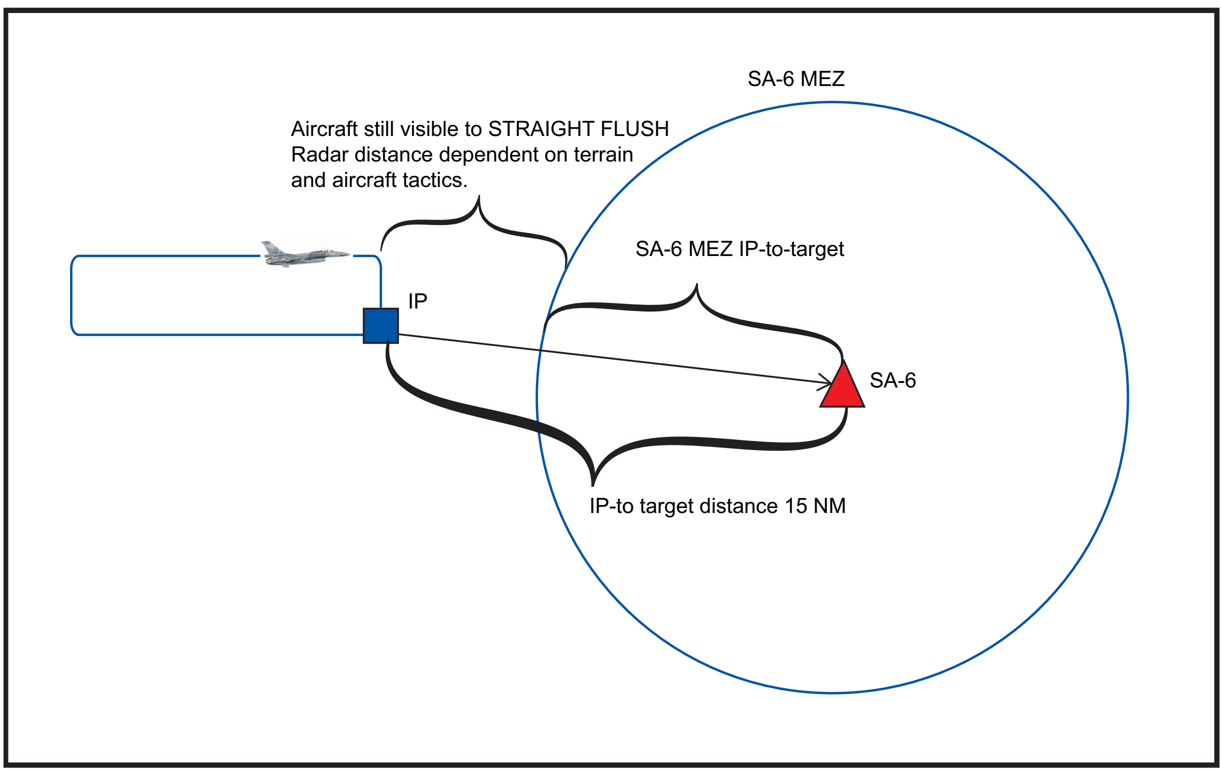
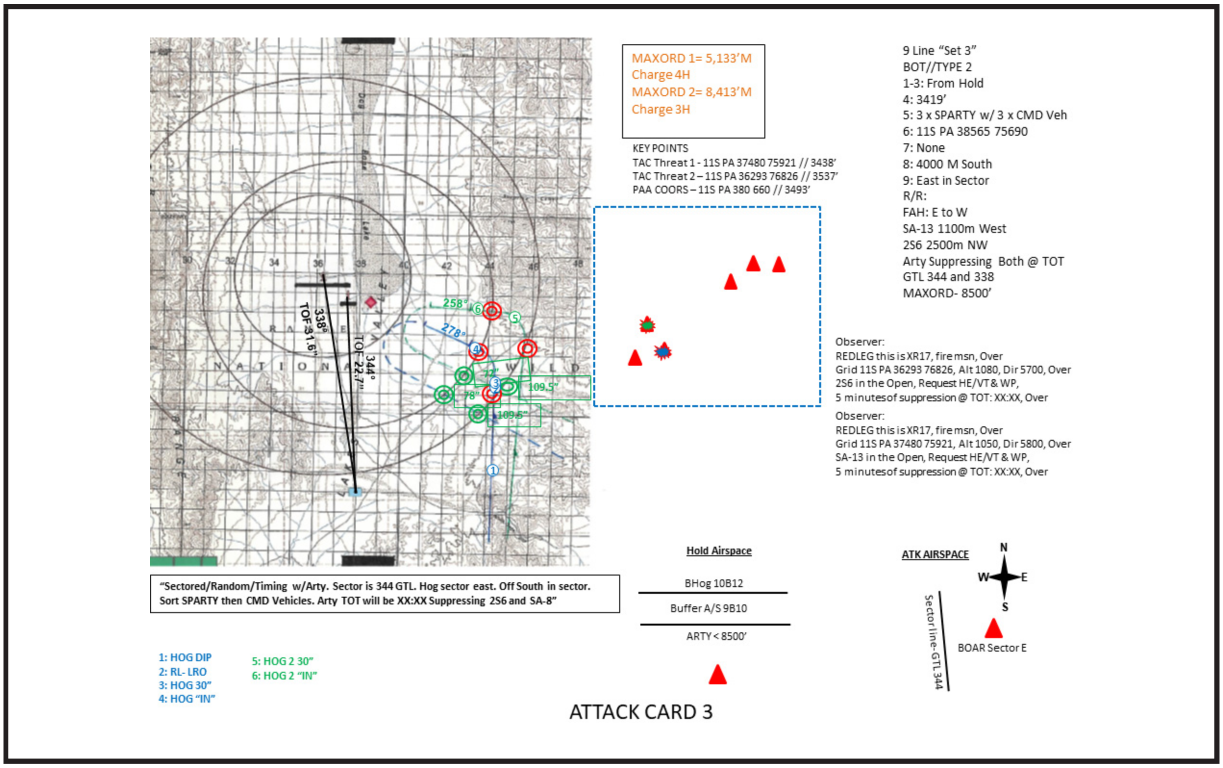


Figure 5.21 Weapons Ride Chart.



5.6.6.2 Timing of Suppression. As a rule of thumb suppression should be integrated from the time an aircraft departs the IP to the 30- to 45-second buffer, or weapon impact if no buffer is required (i.e., MAXORD is lower than employment altitude). As seen in **Figure 5.20**, F-16 Versus SA-6, an aircraft outside the MEZ is in theory safe from this threat but still may be visible by its supported radar, making it possible to time a missile engagement once the aircraft departs the IP so the two meet inside that MEZ. This is the reason suppression should begin striking the threat when the aircraft departs the IP. Timing of surface-based fires can be categorized as continuous, interrupted, and nonstandard. There are two official timing formats, TOT and TTT; reference Table 12 in the 2019 AFTTP 3-2.6.*JFIRE*.

5.6.6.2.1 Continuous suppression fires from the CAS TOT minus 1 minute to the CAS TOT minus 30 seconds and from the CAS TOT plus 30 seconds to plus 1 minute.

5.6.6.2.2 Interrupted suppression from the CAS TOT minus 1 minute to minus 30 seconds.

5.6.6.2.3 Nonstandard suppression missions can be anything that does not fall into a continuous or interrupted format. The best method for a JTAC to ensure that the aircraft ingress and egress are covered with suppression on the threat is to use nonstandard suppression from the moment the aircraft penetrates the threat's MRIR through the moment it exits. This is all subject to change based on the aircraft performing the attack.

5.6.6.3 Electronic jamming is another effective form of J-SEAD capable of suppressing more than one threat at a time. Airborne jamming platforms will not be organic to your unit and can be requested by the unit's electronic warfare officer (EWO) with input from the JTAC by DD Form 1972 JTAR or via theater-specific Electronic Attack Request Format (EARF). If approved, the tasked unit/sorties will be published on the ATO in support of the operation in the same manner as CAS fighters. Refer to AFTTP 3-1.JTAC, for amplifying data.

5.6.6.4 Antiradiation missiles may be a good match in an environment where several threats are encountered. An F-16CM could be used to target a large threat while smaller threats could be suppressed by direct or indirect fires. However, these assets likely will not be organic to the efforts of your aligned army unit, meaning they must be requested through the 1972 JTAR. As much threat information as is available, should be passed to the aircraft (e.g., "INTENT IS TO DEAD THE SA-11 TO FACILITATE FOLLOW-ON ATTACKS ON OBJ GOLD" OR "INTENT IS TO SUPPRESS THE SA-6 FROM XX1200 TO XX1215 IOT ALLOW TASK FORCE APACHE TO CONDUCT ATTACKS ON OBJ GOLD"). Planners should consider requesting a FAC(A) with SEAD and DEAD experience to support such a mission. If approved, the tasked unit/sorties will be published on the ATO in support of the operation in the same manner as CAS fighters. Refer to AFTTP 3-1.JTAC, for amplifying data.

5.6.6.5 Air-delivered ordnance also can be used to suppress a threat. An example scenario would be a battle with an SA-8, 8,000-foot weather deck and two flights of A-10s. The JTAC could have a flight of A-10s fly over the top of the threat envelope and target the SA-8 with a GBU-38 (BOC). But unfortunately, the location for the SA-8 is only a CAT 4 coordinate or not accurate enough to ensure neutralization of the SA-8. In this situation, the GBU-38 from above the threat envelope could be the suppression, followed 45 seconds later by the other flight of A-10s under the weather deck performing a BOT attack on the threat to meet the intent of destruction of enemy air defenses (DEAD). When compared to the preferred method of using standoff weapons, this form of suppression is not ideal, as it will employ only a small duration of suppression, but is a good backup plan should the primary plan become unavailable and if multiple CAS flights/sections are supporting the operation.

5.6.6.6 Airspace Requirements. Surface-to-air threats will affect the JTAC's airspace planning. Longer range, radar-guided threats will require the JTAC to select IPs and/or contact points (CP) outside the tactical effective range of the threat. To ensure this, the JTAC should plot the known and predicted locations of these longer range threats on a 1:50 or 1:250 map, draw a circle around the threat equal to its tactical effective range, and then select an IP/CP location outside of this threat ring and over friendly held terrain to prevent holding aircrews within range of further unknown threats. Failure to do this could result in unnecessary exposure of CAS aircraft to a threat while at the IP/CP or having to hold at low altitudes at the IP/CP. Since artillery may be used to suppress the threats, the JTAC also can begin working artillery integration to include maximum ranges, and potential gun-to-target lines, deconflicting/integrating those with CAS run-ins for low and medium altitude.

5.6.7 Joint Suppression of Enemy Air Defenses Execution.

5.6.7.1 Jamming Considerations. Jamming platforms should be placed above the CAS stack on offset from the target area. Effective jamming can significantly degrade the detection/engagement capabilities of surface threats. Jamming can limit communications severely in regions of the radio spectrum; therefore, chattermark procedures should be used in case jamming degrades the primary strike frequency. Refer to AFTTP 3-1.JTAC for additional jamming considerations.

5.6.7.2 Antiradiation Missile Considerations. If the timing of the antiradiation missiles is a tactical factor, then the JTAC should relay a CAS TOT window/range-based trigger to the launch platform. Refer to AFTTP 3-1.JTAC for additional antiradiation missile considerations.

5.6.7.3 Surface-Based Fires Considerations. When surface-based fires are used to suppress threats the JTAC must stay heavily involved in coordination of the surface fires, as they are the primary liaison connected to both supporting functions of the ground forces and supporting aircraft to meet the commander's intent. In these scenarios, the briefing, time line development, and communication are notable changes required of a JTAC.

5.6.7.4 Time Line Development. Once the JTAC or collocated FO has sent a call for fire and the message to observer has been received, the four required pieces of information needed to build the time line are available.

5.6.7.4.1 Buffer. The buffer is the amount of time that the JTAC desires to separate suppression fires from the aircraft weapon employment. A buffer may not always be required if MAXORD is below flying aircraft. The standard is 30 to 45 seconds.

5.6.7.4.2 Suppression. Suppression is the amount of approved suppression or the duration of the fire mission from the first round to the last round. Suppression can be both before and/or after the aircraft attack.

5.6.7.4.3 Time of Flight (TOF). TOF is the amount of time an artillery round will remain in the air after being shot from the tube/gun.

5.6.7.4.4 Radio Transmit Delay (Rx/Tx). This is the amount of time it will take from transmitting the directive fire command to when the first round is shot during an At My Command mission. The standard buffer time is 10 seconds; however, the JTAC should confirm with the fire support element (FSE) prior to conducting the time line and be ready to flex left or right of the TOT.

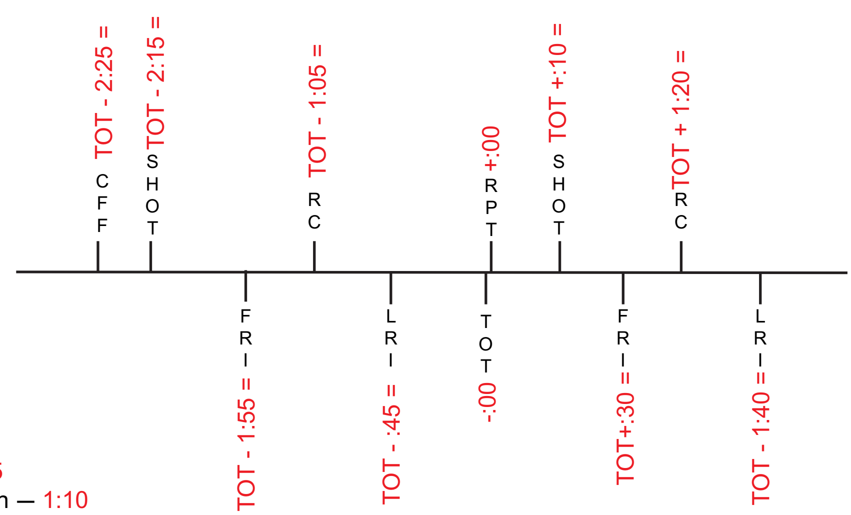
NOTE: MAXORD normally will be transmitted from the Army in meters (AGL), whereas aircraft will request MAXORD as feet MSL. Additionally, elevation of the position area of artillery (PAA) must be requested to calculate MAXORD accurately for the aircraft.

5.6.7.5 Time Line. JTACs should understand that knowing when to initiate the planned SEAD mission and when the rounds complete call of that mission should take place will be enough information to begin the attack. Knowing when to initiate the directive FIRE command is required to ensure proper and safe integration of surface-based fires into the supporting aircraft TOT/TTT. Knowing when in that time line the rounds complete call will happen gives the JTAC a final check on whether a safe amount of separation is present between the last SEAD round and the attacking aircraft. See **Figure 5.22**, Time Line

Development (Example). The graphic below explains how these four pieces of information are used to make that time line. See **Figure 5.23**, Time Line Development (Variable).

5.6.8 Communication. JTACs should strive to keep supporting aircraft informed on the effectiveness of the preplanned SEAD mission. JTACs need to advise the aircraft once the artillery gun line is HOT and the expected time of flight of the initial volley /round. Once the first round of artillery has hit the deck, JTAC will then advise supporting aircraft whether the suppression appears effective along with the duration of rounds to follow. Effective suppression rounds will be dependent on the type of round/fusing, but suppression within 100 meters of the intended target will hinder it from being operated. The JTAC will often be the first to observe enemy surface-to-air fire against CAS aircraft. In this case the fastest way to pass the information is over the CAS control frequency (Fires Net). Clear, concise, and timely callouts will result in more time for the targeted pilot to employ countermeasures and defensive action. The transmission must not be delayed and will include aircraft and flight call sign, action, surface-to-air fire type, and target reference point. When in the terminal phase of an attack, the pilot is PADLOCK on the target and a reference from the target to the SAFIRE point of origin will be the most effective.

Figure 5.22 Time Line Development (Example).

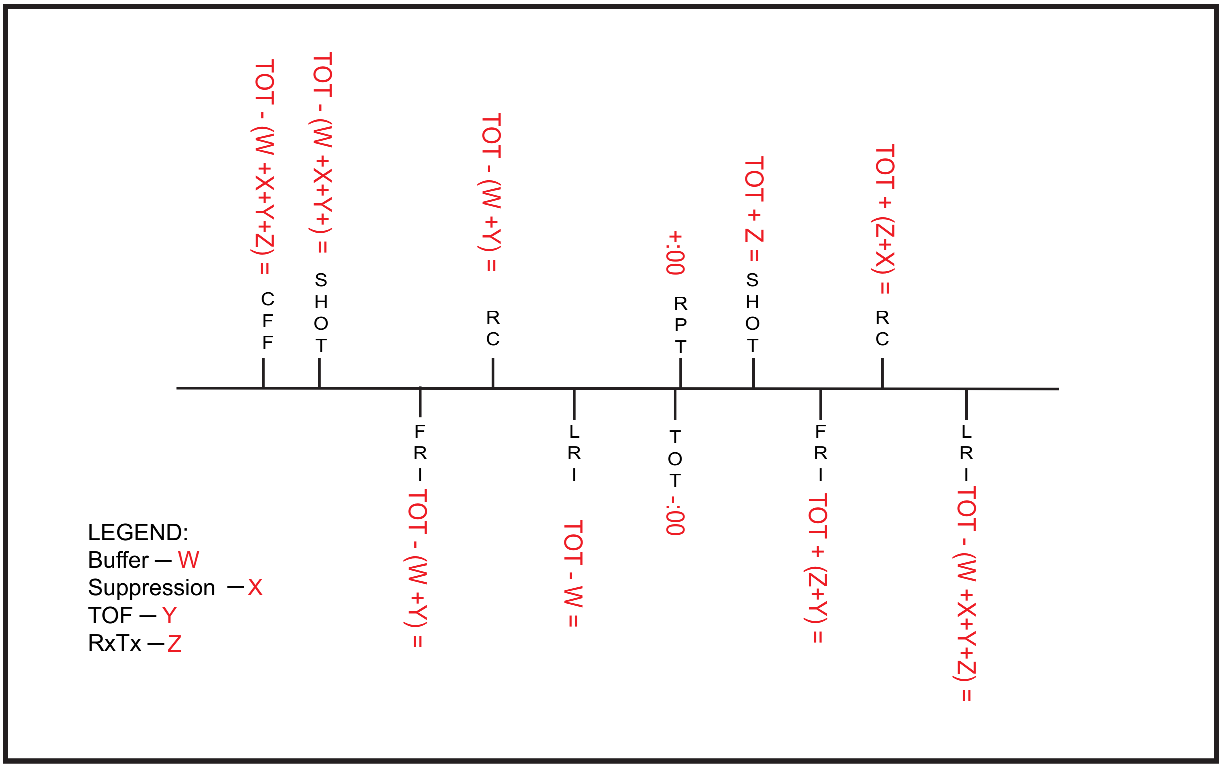


LEGEND:
Buffer — :45
Suppression — 1:10
TOF — :20
RxTx — :10

NOTE: In this case the JTAC has established 1410 as the TOT. The graph illustrates when the directive fire command should be given by the JTAC TO THE FDC and when the rounds complete call should be sent by the FDC.

Calc	Action	Time
-2:25	-2:25	1407:35
-1:05	RC	1408:55
-:00	TOT	1410

Figure 5.23 Time Line Development (Variable).



5.6.9 Threat Defensive Maneuvers and Communications. When targeted by a surface-to-air threat, the CAS aircraft will execute defensive maneuvers to allow them to survive long enough to egress the threat envelope. The type of defensive maneuver will depend on the type of threat.

5.6.9.1 Surface-to-Air Missiles. Due to the differences in aircrew tactics to defend against multiple guidance types, it is not recommended that the JTAC include an action command in the active threat call out for a SAM launch. In this case, time required to determine the guidance type and incorrect assumptions could lead to ineffective countermeasures and defensive action resulting in aircraft loss. See **Table 5.24**, JTAC Observed SAM Launch Comm Example.

Table 5.24 JTAC Observed SAM Launch Comm Example.

Pilot: "DUDE 69, IN FROM THE SOUTH."
JTAC: "DUDE 69, CLEARED HOT."
SAM fires, observed by the JTAC, targeting CAS aircraft on final.
JTAC: "DUDE 69, SAM LAUNCH, NORTH OF THE TARGET."

5.6.9.2 Air Defense Artillery. When encountering ADA targets, regardless of optical or radar guidance, it is important to get the aircraft moving three-dimensionally to evade the bullets already fired as they have no active guidance. This is done by providing the pilot the action command JINK. See **Table 5.25**, JTAC Observed AAA Fire Comm Example.

Table 5.25 JTAC Observed AAA Fire Comm Example.

Pilot: "DUDE 69, IN FROM THE SOUTH."
JTAC: "DUDE 69, CLEARED HOT."
AAA begins firing, observed by the JTAC, targeting CAS aircraft on final.
JTAC: "DUDE 69, JINK, AAA FIRING 900 METERS WEST OF THE TARGET."

CAUTION: Planning for missions in a contested/degraded/operationally opposed (CDO) ops environment often focuses on ingress and target attack. Planning must also include egress considerations for possible unknown threats or if the intended target threat was not destroyed.

5.7 Forward Air Controller (Airborne). FAC(A) is a specifically trained and qualified officer who exercises control from the air of aircraft engaged in CAS of ground troops. The FAC(A) is normally an extension of the TACP.

5.7.1 FAC(A) Integration. The FAC(A) provides coordination and can execute TAC duties for CAS missions. The JTAC holds the authority to delegate TAC duties to the FAC(A). The JTAC should be specific when delegating these duties due to the complexity of each TAC role.

5.7.2 FAC(A) Roles and Responsibilities. There are four main TAC responsibilities: Brief, Stack, Mark, and Control. Each of the responsibilities expand into specific duties, which need to be considered and specified when delegating FAC(A) responsibilities. Additionally, the JTAC should develop contracts with the FAC(A) that clearly define an AOR and/or tactical situation that dictate an assumption of TAC responsibility.

5.7.2.1 Brief. When delegating the brief responsibility the JTAC needs to consider what brief duties the FAC(A) has the capacity to execute. Realize that delegating "brief" can include aircraft check in, situation update, game plan, CAS brief, CFF, RW 5-lines, remarks and restrictions, and readbacks. Each are inherently different and should be considered before assigning.

5.7.2.1.1 The tactical scenario will dictate when the brief is delegated. A JTAC can assign any/all of the brief responsibility when task saturated and the FAC(A) has sufficient SA of the AO. For example, with in an ACM a FAC(A) may receive A/C check-in and pass updated situation update to incoming aircraft. This technique requires the JTAC to ensure battlefield SA is clearly updated to the CAS team.

5.7.2.2 Stack. There are varying levels of situational awareness that are required when owning the stack. Before delegating a stack, the JTAC should take into consideration the SA of the FAC(A) within the AO. The stack duties include but are not limited to surface-to-surface fires deconfliction, aircraft holding deconfliction, aircraft deconfliction for employments of PGM and diving delivered munitions, and any additional requirements for the designed airspace control measures.

5.7.2.2.1 Stack can be delegated to a FAC(A) when sufficient coordination has been accomplished. A FAC(A) can manage airspace deconfliction above the max ord of surface fires. This technique works when the FAC(A) does not have ability to monitor a fires net, the JTAC can manage the deconfliction during engagements. ACMs can also be used to create a delineation for duties. An additional technique can be to create a specific sector(s) of responsibility for the FAC(A).

5.7.2.3 Mark. The mark responsibility encompasses providing kinetic and/or non-kinetic marks for the CAS team with in certain parameters. The JTAC should consider what types of marks are delegated to the FAC(A). When delegating, consider the GFCI for marks required for the target area. CAS marking will be defined as identifying a specific position (friendly or target) by any means that can be detected by air or ground players participating in an engagement. Equipment characteristics are referenced in **Chapter 2**, "Equipment."

5.7.2.3.1 Non-Kinetic marks can be used for area or point target marking and include, but are not limited to, J3.5 messages, J12.6 messages, Laser, IR pointer, and IR flood light.

5.7.2.3.2 Kinetic marks should be used in accordance with theater specific ROE/SPINS. Kinetic marks can also be used for point or area target(s). The JTAC should consider an area limitation that works in conjunction with the GFC's acceptable collateral risk assessment. Kinetic marks can range from a 2.75 in WP rocket to a MK 82. The JTAC needs to be specific to what level of kinetic marks are allowed and where.

5.7.2.3.3 Friendly Marking. JTACs should establish or know their supported unit's SOP or Primary, Alternate, Contingency, and Emergency (PACE) plan.

5.7.2.3.4 Target Marking: Smoke. Smoke can be used for day marking helicopter landing zones (HLZ) and friendly positions. Smoke may also be used at night by admitting a thermal signature generated by the heat of the smoke canister. JTACs should practice the TTP of letting the aircraft call the color of the smoke to confirm the correct mark. When marking the HLZs, place the smoke on the downwind side of the HLZ to avoid obscuring the landing zone. Smoke should be employed for HLZs at the "1 MINUTE OUT" call or if used for friendly centric CAS prior to the 9-Line. See **Table 5.26**, JTAC Marking with Smoke COMM Flow.

5.7.2.4 Control. To delegate the control responsibility to a FAC(A), the JTAC is giving the authority to grant clearance for weapons release. Before delegating control, the JTAC needs to consider:

- How is the FAC(A) going to communicate the fires approval process with the appropriate weapons release authority?
- What areas of responsibility will the FAC(A) have control?
- What tactical situations warrant delegation of control to the FAC(A)?

NOTE: Regardless of the TAC responsibility, the JTAC should always ensure the delegation of responsibility is well understood by the FAC(A). With that in mind, parameters for each of the responsibilities can be distinguished by boundaries, altitude and specific tactical situations that have been precoordinated to ensure ground commander's intent is being met.

Table 5.26 JTAC Marking With Smoke COMM Flow.

JTAC: "HAWG 01, EXTERMINATOR 91, FRIENDLIES TIC MARKING MY POSITION WITH SMOKE, CALL READY SMOKE."
Aircraft: "HAWG 01, READY SMOKE."
JTAC: "SMOKE OUT."
Aircraft: "CONTACT YELLOW SMOKE."
JTAC: "CALL VISUAL, STANDBY 9-LINE."
Aircraft: "HAWG 01 VISUAL, READY 9-LINE."
JTAC: "HAWG 01, EXTERMINATOR 91, TYPE 2, BOT, GFCI NEUTRALIZE HEAVY MACHINE GUN TEAM."
JTAC: "1 THROUGH 3 N/A, ELEVATION 4,486 FEET, HEAVY MACHINE GUN TEAM DUG IN, 270 DEGREES FOR 400 METERS, NO MARK, EAST 400 METERS, EGRESS SOUTH, 180 ± 20 DEGREES."
JTAC: "GOOD READBACK."
JTAC: "APPROVED IMMEDIATE PUSH, EXPECT CLEARANCE ON FINAL."

5.8 TAC(A). TAC(A) is both joint and service defined as, "An officer who coordinates, from the aircraft, the actions of other aircraft engaged in air support of ground or sea forces." Each service theater air ground system (TAGS) further defines TAC(A) to suit the needs of the respective system. See JP 3-09.3, *Close Air Support*, for TAC(A) service definitions.

5.8.1 TAC(A) Responsibilities. A TAC(A) performs duties similar to FAC(A), while also acting on behalf of C2 entities, to include CAS aircraft hand-off to terminal attack controllers; integrating CAS with other supporting arms; terminal guidance operations (TGO); communications relay between C2 and CAS entities; coordination of aircraft and surface fire support, FW/RW operations support, and indirect fire (IDF) support. At the discretion of the JTAC or FAC(A), the TAC responsibilities of Brief, Stack, and/or Mark may be delegated to a TAC(A). See **Table 5.27**, Terminal Attack Roles and Responsibilities; **Table 5.28**, TAC(A) Roles and Responsibilities; and **Table 5.29**, TAC(A) Duties.

Table 5.27 Terminal Attack Roles and Responsibilities.

Role	Responsibilities
Brief	Is the primary AO battle tracking agent. Builds and manages the situation update. Performs the tactical risk assessment with the ground commander. Builds the game plan and CAS briefs, remarks, and restrictions. Collects readbacks and verifies target correlation. Tracks the battle damage assessment (BDA).
Stack	Owns aircraft routing and safety of flight. Deconflicts aircraft from other air assets and surface fires. Collects CAS aircraft check ins. May relay the situation update if tasked by brief owner. Provides primary AO threat mitigation. Tracks airspace coordinating measures (ACM) and fire support coordination measures (FSCM).
Mark	Accomplishes target correlation. Provides and coordinates target talk-ons and target marks. Coordinates approval and restrictions for kinetic and non-kinetic marks.
Control	Provides terminal attack control for CAS attacks. Obtains fires approval authority from the ground commander. Monitors attacking aircraft to ensure compliance with restrictions.

Table 5.28 TAC(A) Roles and Responsibilities.

Role	Responsibilities
BRIEF	Is the primary AO battle tracking agent. Builds and manages the situations update. Performs the tactical risk assessment with the ground force commander. Builds the game plan and CAS briefs, remarks, and restrictions. Collects readbacks and verifies target correlation. Tracks the battle damage assessment (BDA).
STACK	Owns aircraft routing and safety of flight. Deconflicts aircraft from other air assets and surface fires. Collects CAS aircraft check-ins. May relay the situation update if tasked by brief owner. Provides primary AO threat mitigation Tracks ACMs and FSCMs.
MARK	Accomplishes target correlation. Provides and coordinates target talk-ons and target marks. Coordinates approval and restrictions for kinetic or non-kinetic marks.
Additional Responsibilities	
SENSOR	Assigns the sensor plan of action and sparkle plan. Primary asset for area naming and labeling convention. Accomplishes squirter sort, track, label. Provides talk-ons as required to meet briefed sensor plan

Table 5.29 TAC(A) Duties.

Category	Implied Task	Assigned Task
Coordinate Offensive Air Support	Pass Weather Updates* • Assist with air-refuel timing* • Relay Situation Update	• Support TGO • Relay Joint Tactical Air Strike Requests (JTAR) • Execute delegated TAC responsibilities*
Coordinate and Execute C2 of Designated Assets	• Communication Relay	• Coordinate CSAR • Execute delegated C2 responsibilities
Coordinate Assault Support Operations	• Coordinate CASEVAC • Sensor Plan of Action*	• Coordinate surface to surface fires • Support helicopter-borne operations • Coordinate reactive • SEAD packages • Support ground based operations*

5.8.2 TAC(A) Considerations. The TAC(A) must be familiar with the same products required for FAC(A) preparation (operations order [OPORD], fragmentary order [FRAGO], air coordination order [ACO], air tasking order [ATO], special instructions [SPINS], etc.). Refer to JP 3-09.3, *Close Air Support*, for more details on FAC(A) planning considerations. Plan on-station times to ensure TAC(A)s can accomplish the mission and execute within the intent of the supported commander. At a minimum, plan TAC(A) on-station times to cover critical portions of mission if the TAC(A) cannot be airborne for the entire duration of the mission. It is crucial to mission efficiency that all air and ground players are familiar with the duties and responsibilities granted to a TAC(A). When using a TAC(A), the two products listed below are crucial for identifying TAC(A) duties for an operation.

5.8.2.1 Concept of Operation (CONOP). The CONOP is normally a product built by the supported GFC's staff. It contains the GFC intent, grid reference graphics (GRG), concept of fires (CoF), task organization, objective location and background information, infiltration and exfiltration routes, communications plan, contingency plans, combat search and rescue (CSAR), medical brief, SPINS update, and time line. The CONOP should state the TAC(A) AO, assigned duties, and specific contracts for communications, target handoffs, and TAC(A) contingency responsibilities.

5.8.2.2 CoF. The CoF is the FSO plan on how to support the ground element with non-organic fires and identifies responsibilities for each air asset attached to the assault force. This can include surface-to-surface, air-to-surface, or non-kinetic fires. Specific TAC(A) duties and responsibilities should be detailed on the CoF as a reference for all air and ground players to ease integration (e.g., all assets check in with TAC[A] on air coordination frequency [AIRCOORD] prior to entering restricted operating zone [ROZ]).

5.8.3 TAC(A) Use. TAC(A) can be assigned in either premission planning, or ad hoc during an operation execution. The following are common reasons to use a TAC(A).

5.8.3.1 Expecting a large number of CAS or ISR aircraft in a restrictive airspace.

5.8.3.2 Complex ground operations with multiple JTACs or ACM for simultaneous operations.

5.8.3.3 Expecting rapid CAS engagements requiring expedited multiple target talk-ons.

5.8.3.4 Task saturating dynamic situations (troops in contact [TIC], casualty evacuation [CASEVAC], CSAR).

5.8.3.5 When deconfliction is required in absence of a FAC(A) or JTAC (non-JTAC controlled CAS, SOF kinetic strike, airborne alert interdiction (XAI).

5.8.3.6 Operating in restrictive terrain (urban, mountains) where a platform with the same perspective as CAS or ISR assets would aid in target talk-on efficiency.

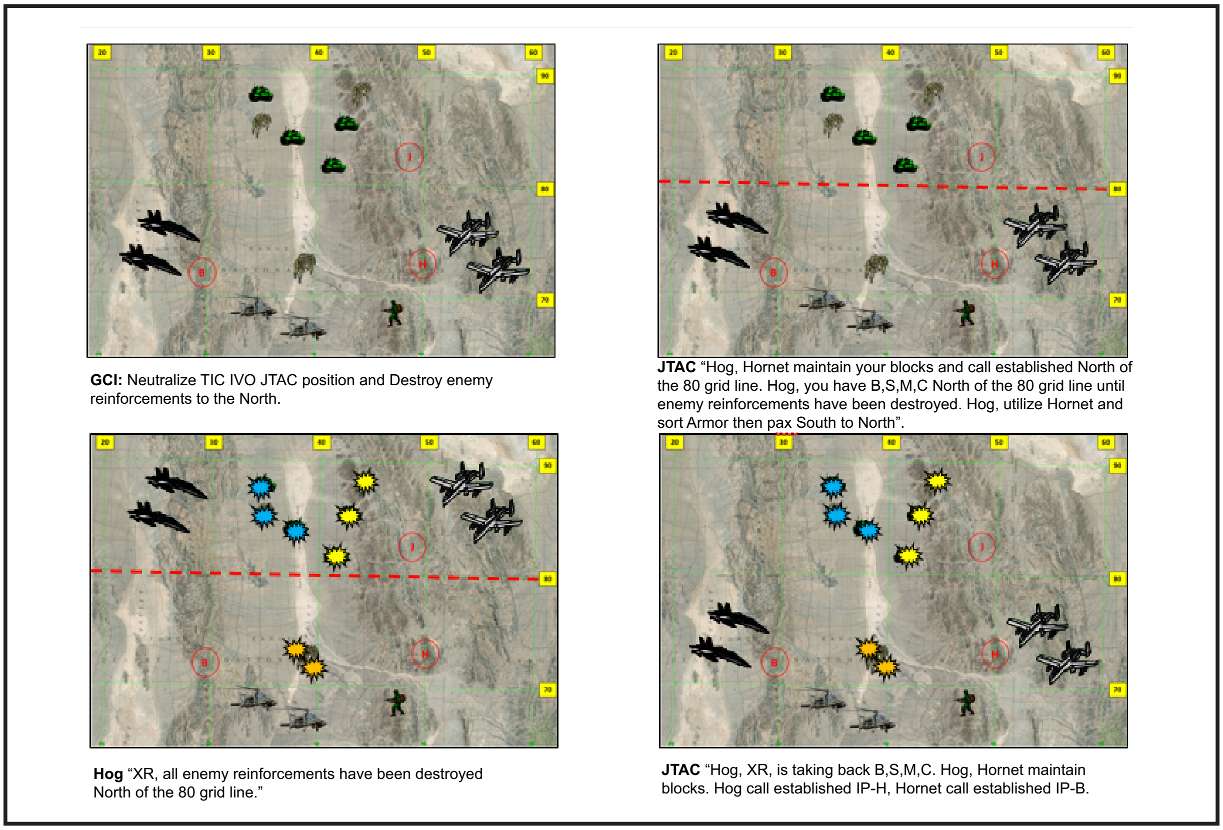
5.8.3.7 Operating with limited capability to mark targets.

5.8.3.8 Expecting difficult communications due to terrain, threats, aircraft capability, multiple frequencies, or amount of air and ground players.

5.8.3.9 When operational needs require an aviator overhead who is intimately familiar with the ground commander's intent and scheme of maneuver, and versed in CAS TTP, to assist in the operation.

5.8.4 TAC(A) Integration. Detailed integration and coordination prior to execution will provide the JTAC and TAC(A) with a template from which to deviate when unforeseen tactical problems arise during execution. Planners should be very specific in which specific duties the TAC(A) will have, ensuring those duties are reflected on the mission products and are briefed to all applicable players. Failure to disseminate the specific TAC(A) integration contracts does not mean the mission will be a failure, however it means air assets will be less prepared during execution and may cause confusion, delays, and decrease SA. See **Figure 5.24**, JTAC Handoff Brief, Stack, Mark, and Control to FAC(A).

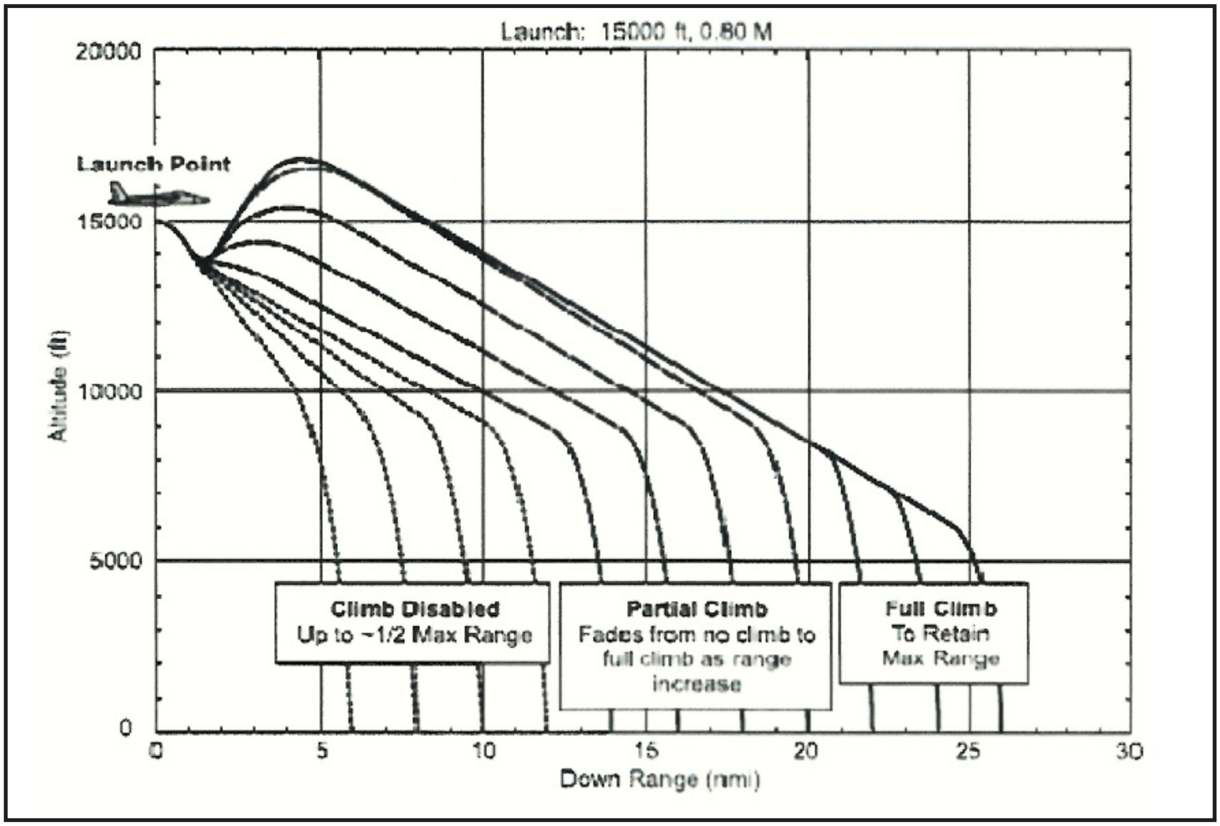
Figure 5.24 JTAC Handoff Brief, Stack, Mark and Control to FAC(A).



5.8.5 Weapons Employment Considerations (GBU-39 SDB). The GBU-39 SDB is a commonly employed weapon that does not fly a ballistic profile. Aircrew-selectable impact conditions in addition to release altitude, range, airspeed, and heading all affect the flightpath of the weapon. The SDB follows a unique trajectory that is dependent upon release conditions and commanded impact parameters.

5.8.5.1 Direct Action Region. TIC situations or fleeting targets of opportunity often necessitate minimizing unnecessary delays in getting bombs on target. The Block 9 SDB has a direct attack region that was specifically designed to minimize TOF by flying a more direct flight profile instead of the standoff-optimized bump-up and glide flight profile. During an attack, as an ROT, the SDB is released approximately 7 NM from the target. This attack results in a more predictable joint direct attack munition-like trajectory and TOF and allows aircrew to use traditional deconfliction measures because of the present run-in axis. See **Figure 5.25**, SDB Climb vs Increasing Range for Close Air Support.

Figure 5.25 SDB Climb vs Increasing Range for Close Air Support.



5.8.5.2 Standard CAS Wheel. The SDB can also be employed from a standard CAS Wheel with the target 90 degrees off the nose of the aircraft, but the arcing flight of the weapon path can be drastically different based on the release altitude, range, airspeed, and off-boresight angle. This makes traditional deconfliction measures more difficult to integrate as the vertical and horizontal confines of the flightpath can differ by thousands of feet, or miles respectively, depending on the release conditions.

5.8.5.3 SDB Deconfliction Procedures. Given the unique fly-out profile of the SDB, the creation of a target-centered TEZ specifically designed for the SDB is of great value for weapon and aircraft deconfliction in a CAS stack with multiple aircraft. Rather than modifying the orbits, and thus sensor coverages, of multiple CAS platforms by using rudimentary timing deconfliction or geographical deconfliction for a target attack, a TEZ ensures a simple way to employ the SDB with minimal impact on other CAS assets in the same stack. Fundamentally, the TEZ uses a combination of altitude and geographical deconfliction procedures to reduce the impact on other aircraft in the stack.

5.8.5.4 The SDB deconfliction TEZ is represented by two cylindrical columns. The first column of airspace is 3 NM in radius, with the target point located at the center, reaching from the target surface up to and including 14,000 feet MSL. The next column of airspace is 5 NM in radius, also centered on the target point, reaching from 14,001 feet MSL to 28,000 feet MSL. This TEZ allows for the standard Wheel of typical CAS platforms. Specifically, MQ-1, AC-130, and potentially MQ-9 aircraft can maintain lower

(14,000 feet MSL or less), slower, and smaller CAS Wheels while fighter aircraft can maintain higher (14,001 feet MSL or greater), faster, and wider CAS Wheels. See **Figure 5.26**, SDB Deconfliction TEZ.

5.8.5.5 The following examples give a CAS stack of 2x F-15E, call sign Dude 01/02 operating at 20,000 feet to 25,000 feet, call sign Viper 21/22, operating at 15,000 feet to 19,000 feet, and 1x MQ-1C, call sign Cyclops 30, holding at 12,000 feet and below. See **Table 5.30**, SDB TEZ Established Comm Flow, and **Figure 5.27**, SDB Example Stack.

EXAMPLE: An F-15E is called to employ an SDB and elects to a target-direct attack profile. The F-15E employs the SDB from 23,000 feet MSL, 6 NM from the target. Prior to the attack, the F-15E ensured 4,000 feet of altitude deconfliction below them by remaining above the top of the F-16 block. For the duration of the SDB flight, as long as the F-16s stay in their block, and 5 NM or greater from the target and the MQ-1 stays at its current altitude and 3 NM or greater from the target, all players are deconflicted from the SDB. After the SDB impacts the first target, the F-16s are called to execute an additional target attack. For this attack, they choose to release target direction from 18,000 feet MSL, 7 NM from the target. With the MQ-1 at a hard altitude of 12,000 feet MSL, guarantee deconfliction. Additionally, the F-15Es are greater than 1,000 feet above them which also ensures deconfliction. In this scenario, again, as long as the MQ-1 stays at its current altitude and no closer than 3 NM from the target, all CAS players are deconflicted from the SDB while it is in flight.

Figure 5.26 SDB Deconfliction TEZ.

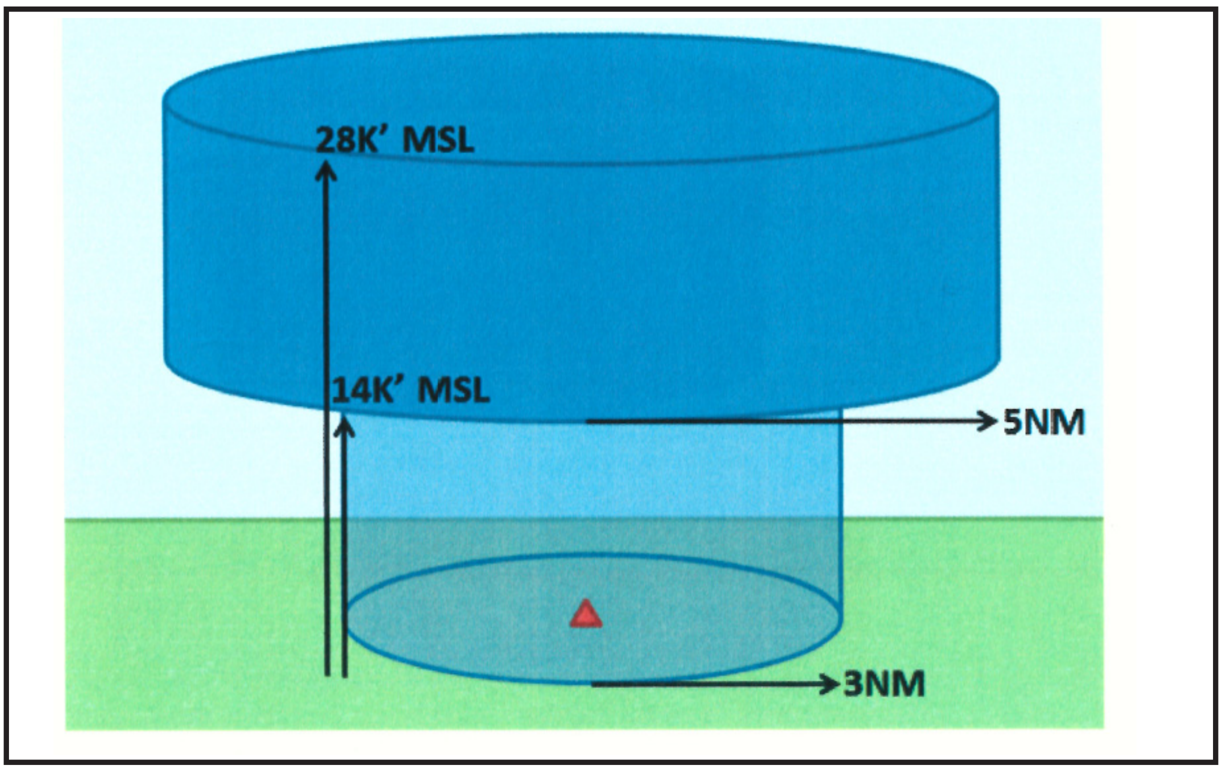


Table 5.30 SDB TEZ Established Comm Flow.

JTAC: "DUDE, VIPER, CYCLOPS, SAY WHEN READY SDB DECONFLICTION GAME PLAN."
F-15E: "DUDE READY."
F-16: "VIPER READY."
MQ-9: "CYCLOPS READY."
JTAC: "ANCHOR POINT IS 12A CD 3214 6857. FROM SFC TO 14,000 FEET THE TEZ WILL BE A 3 NM RADIUS AROUND THE ANCHOR POINT." "FROM 14,000 FEET TO 25,000 FEET, THE TEZ WILL BE 5 NM RADIUS AROUND THE ANCHOR POINT." "DUDE 01, MAINTAIN 23,000 FEET TO 25,000 FEET. VIPER, MAINTAIN 16,000 TO 19,000 FEET, AND CYCLOPS, MAINTAIN BELOW 12,000 FEET, DUDE, VIPER, CYCLOPS, ACKNOWLEDGE."
F-15E: "DUDE COPIES."
F-16: "VIPER COPIES."
MQ-9: "CYCLOPS COPIES."
JTAC: "DUDE FLIGHT, YOU'RE APPROVED ENTRANCE INTO THE TEZ AT THIS TIME, CALL CLEAR OF THE TEZ." "VIPER FLIGHT, ONCE DUDE FLIGHT CALLS CLEAR OF THE TEZ YOU ARE APPROVED IN, CALL WHEN CLEAR. DUDE, VIPER, ACKNOWLEDGE."
F-15E: "DUDE COPIES."
F-16: "VIPER COPIES."
NOTE: Once all engagements in the TEZ are complete, the TEZ should be closed to allow freedom of maneuver for all assets.

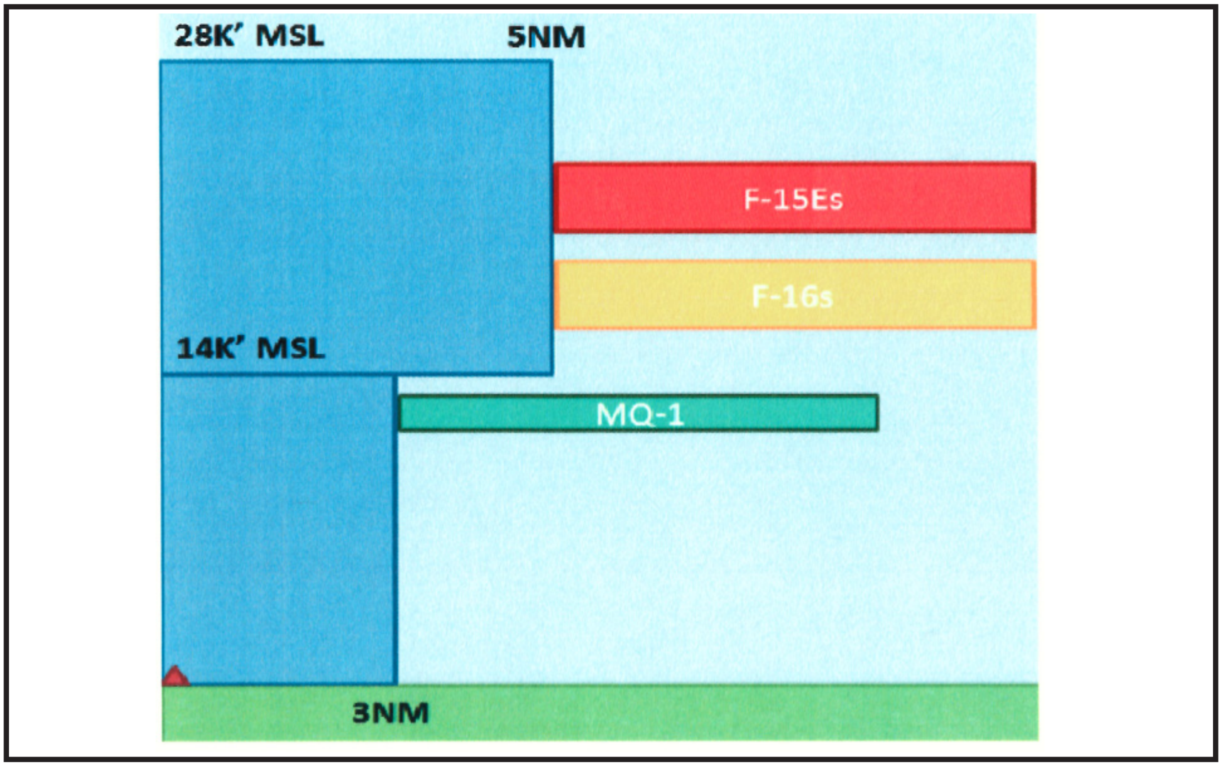
5.9 Joint Fires Observer Integration. As a low density enabler on the battlefield, the JTAC is required to integrate with ground maneuver elements to derive real-time battle tracking of friendly forces and targeting data, ground commanders priorities, synchronize fire support and airspace requirements. When working with Army, Marine or Coalition elements that have JFO-trained personnel it is critical to incorporate the JFOs into the JTAC's CAS mission execution. Refer to JP 3-09.3, *Close Air Support*, JFO MOA, and AFTTP 3-2.6, *JFIRE*, for further information.

5.9.1 JFO Terminology.

5.9.1.1 The JFO is defined as a certified/qualified Service member trained to request, control, and adjust surface-to-surface fires, provide timely and accurate targeting information in support of CAS to a JTAC/FAC(A), or directly to aircraft when authorized by the controlling terminal attack controller (TAC), and perform autonomous TGO.

5.9.1.2 TGO is defined as those actions that provide electronic, mechanical, voice, or visual communications that provide approaching aircraft and/or weapons additional information regarding a specific target location. Various ground elements or aircrews conducting a wide variety of missions can search for, identify, and provide the location of targets using equipment like GPS, laser designators/range finders, and aircraft targeting pods.

Figure 5.27 SDB Example Stack.



5.9.2 JFO Integration Considerations. Prior to the mission, the JTAC should coordinate, in person if at all possible, with the JFO(s) supporting the mission. This will allow the JTAC/JFOs to make an assessment of strengths and weakness that need to be capitalized on or protected.

5.9.2.1 JFO Training and Proficiency. A JFO that is well trained and proficient becomes a contributing member of the CAS team and can be relied on for assistance on managing the integration of CAS into the overall fires scheme. However; the JFO that is not competent due lack of training and proficiency becomes more of a traditional forward observer (FO), being an asset that can provide information, but will require JTAC supervision while performing JFO duties. The poorly trained JFO may slow down the kill chain, and will require additional real time coordination by the JTAC during TGO and terminal attack phases of execution.

5.9.2.2 JFO Position on the Battlefield. Understanding the JFO's location on the battle field, field of view and line of sight to key terrain allows the JTAC to determine the duties and tasks that are delegated during execution (i.e., TGO).

5.9.2.3 JFO Equipment. Baseline JFO equipment should include VHF/UHF capable radios, GPS device, laser range finder, NVD, map, compass, and binoculars. Additionally, they may have at their disposal, laser target designators, infrared pointers, thermal and laser spot imagers and remote video receivers. Any items missing from the baseline JFO equipment list should be noted by the JTAC as a deficiency. Additional items available to the JFO above the baseline should be taken into consideration by the JTAC during execution as they can expedite CAS fires.

5.9.2.4 JTAC/JFO Contracts. Prior to mission execution a vital consideration is to establish contracts between the JTAC and JFO for role and responsibilities that will expedite the kill chain.

5.9.2.4.1 Communication contracts should include an understanding of what nets the JTAC and JFO will monitor and communicate on. The JTAC should be prepared to monitor and contact the JFO on the fires net, while the JFO should be prepared to monitor and contact the JTAC or aircrew on the tactical air direction (TAD) or strike net. The JTAC should judiciously consider the JFO(s) training, position and equipment prior to expecting the JFO to communicate on the TAD.

NOTE: It is far more effective for the JFO to monitor the strike frequency to maintain awareness than rely on the JTAC to relay time-critical information to the JFO, particularly if the JFO is providing a target talk-on or marking the target with a laser designator or IR pointer.

5.9.2.4.2 Friendly battle tracking may be redundant if unit SOP dictate on both the command and fires net. When this is not unit SOP, the net that friendly battle tracking communicating must be established. The JTAC and JFO must establish a standard practice of how friendly positions will be update (i.e., phase line, checkpoints, GRG, or grid location).

5.9.2.4.3 The coordination of target nomination and information is a critical element. With an experienced/proficient JFO, the JTAC may rely on the JFO to pass full or abbreviated 9-Lines to the JTAC or aircrew and can be expected to execute TGO. With an inexperienced/incompetent JFO the JTAC should elect to have the JFO pass the JFO target brief to the JTAC and should request the JFO to perform TGO under JTAC supervision.

5.9.2.4.3.1 Minimum Targeting Data Contract. The JTAC should request that the JFO at a minimum pass the three Ds, distance, direction and description, to the JTAC for targeting data at initial target nomination. This TTP contract allows for friendly centric CAS TTP to be executed if the JTAC loses communication with the JFO.

5.9.3 JFO Integration Execution. Basic contracts between the supporting JTAC and JFO(s) with the maneuver force must exist in order to meet the ground force commander's (GFC) intent for CAS. Contracts should cover contingencies that preclude direct communications between the JTAC and the JFO. During operations were there is direct communication between the JTAC and JFO CAS operations should follow the standardized methods.

5.9.3.1 Operations when the JTAC and JFO have direct communications, JFIRE formats provide the standardized methods for expected communication flow. For this example, assumptions are the JTAC and JFO are dislocated and operating from forward locations, the JTAC is collocated with a high headquarter element GFC, the JTAC has direct communications with the JFO and Aircrew, there is a single flight supporting the overall mission, and the JTAC is relying on the JFO for near real-time battle tracking and targeting information. In this situation the JTAC will act more as a liaison between the JFO and the aircrew because the JTAC's collocated supported GFC has overall target and fires prioritization.

5.9.3.1.1 Communication Follows the Standardized Methods. Roles and responsibilities are in line with established JCAS methods, see **Table 5.31**, Working Relationship of Roles and Responsibilities, of CAS team tasks.

5.9.3.1.2 Execution flow expects the JFO to contact the JTAC, passing the Observer Lineup prior to CAS checking on station. See **Table 5.32**, Observer Lineup, for expected communication flow and information.

5.9.3.1.3 On CAS check-in, JTAC will execute their CAS execution template, while battle tracking updates passed by the JFO over ground nets. When the JFO identifies a CAS target and begins the fires approval process with the collocated GFC for coordination with the overall mission GFC. The JTAC monitors and coordinates with JFO to receive the JFO Target Brief. See **Table 5.33**, Joint Fires Observer Target Brief, for example.

5.9.3.1.4 Upon receipt of the JFO Target Brief, the JTAC coordinated with the mission GFC to confirm priority of the target for CAS fires and continues CAS execution template steps as appropriate. Prior to the CAS attack sequence, the JTAC should coordinate with the JFO who nominated the CAS target, passing information relevant to the attack and coordinate for TGO and BDA reporting if required. See **Table 5.34**, Example of JTAC to JFO Coordination.

5.9.3.1.5 Postattack procedures for BDA or BHA involve the JFO relaying BDA to the JTAC and GFC to update the enemy order of battle and request reattack approval if required. If the GFC intent for the target is met, the JTAC continues CAS execution template and the JFO will contact the JTAC to update friendly position and nominate further CAS targets, as required.

Table 5.31 Working Relationship of Roles and Responsibilities of CAS Team Tasks.

Tasks	JFO	JTAC	Aircrew
Communication Roles	Ground-to-ground communications	Ground/Air to communications	Air to ground communications
Target Identification and Location	GPS+PLRF (Friendly location/Distant and Direction to Target)	Ground/ air-to-ground communications	Targeting POD
Battle Tracking Target for Correlation	Map and/or GRGs, VDL	Map and/or GRGs, VDL	Map and/or GRGs
Target Correlation	Kinetic mark or air-to-ground communication	Digital or air-to-ground communications	Kinetic/Non-kinetic marking
Battle Tracking Friendly Forces	Reporting/Marking friendly position	Near real-time battle tracking	Near real-time battle tracking

Table 5.32 Observer Lineup.

"__________________ this is _________________ with observer lineup, over." (JTAC call sign) (JFO call sign) "My position is ____." (i.e., grid and reference point) Note: JFOs should only pass their position directly to the JTAC. "I am in ____, (overwatch, convoy, defensive, etc.) located _____________________________________ from target area, (direction and distance m/km) marked by ________________. I have _________________targets for CAS. (friendly mark type) (number) My specialized equipment is ____, over." (PSS-SOF, LTD with JFO PRF code, LRF, GPS, IR pointer, etc.)
OVERALL NOTES: (1) The JFO should be prepared to describe how the target coordinates were derived for each CAS 9-Line. (2) Friendly grid coordinates should not be passed on an unsecure net. (3) The number of targets refers to the number of CAS 9-Lines, not the total number of DPI.

5.9.3.2 Operations when the JTAC and JFO do not have direct communications, a nonstandard method can be used. Assumptions are the JTAC is supporting the JFO from a higher echelon, the JTAC is using the supported collocated headquarters for near real-time battle tracking, the JTAC does not have direct communications with the JFO but may have communication through a non-real time device (i.e., Blue Force Tracker), or relaying unit airborne asset, and the JTAC and JFO both have direct communication with the Aircrew. See **Figure 5.28**, Example JTAC JFO Without Direct Communication Flow for CAS Tasks, and **Table 5.35**, Example JTAC JFO Without Direct Communication Flow for CAS Tasks, for example template.

5.9.3.2.1 The JFO collocated ground unit reports a request for CAS via relaying device or entity. The JTAC requests CAS, and coordinates with the supported unit headquarters to battle track the situation.

5.9.3.2.2 Upon allocation of CAS assets the JTAC coordinates with the supported headquarters to confirm priorities for CAS. The JTAC then begins to CAS execution template tasks, but after passing the situation update to the aircrew, directs them to contact the JFO on the JFO net for further information and tasking.

5.9.3.2.3 The aircrew contacts the JFO, and the JFO reports the most updated situation, including the intended CAS target, updated friendly locations and then transmits the JFO target brief to the aircrew.

Table 5.33 Joint Fires Observer Target Brief.

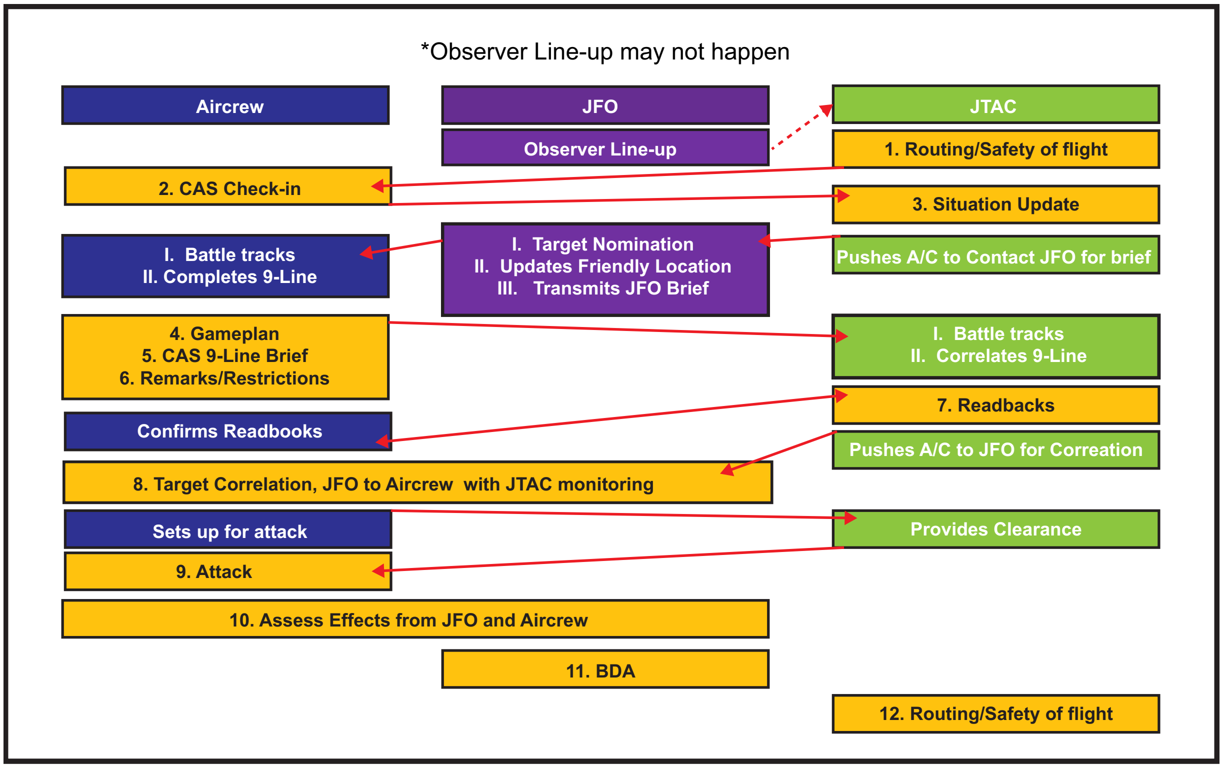
1. Target elevation: **“Line 4**, ________________________________.” (in feet mean sea level)
2. Target description: “________________________________.”
3. Target location: “________________________________.” (latitude and longitude or grid coordinates or offsets or visual)
4. Type mark/terminal guidance: “________________________________.” (description of the matrix, If laser handoff, call sign of lasing platform and laser code)
5. Location of friendlies: “________________________________.” (from target, cardinal direction and distance in meters)
Position marked by: “________________________________.”
Advise when ready for remarks
Remarks and Restrictions:
Final attack heading: “________________________________.”
Laser target line (LTL) or pointer target line (PTL): “________________________..”
Threat: “________________________________.” (direction and distance)
Suppression of enemy air defenses (SEAD): “________________________________.” (interrupted, continuous, or nonstandard)
Gun target line (GTL) or Line of Fire (LOF): “________________________________.” (max ordinate)
Restrictions: “________________________________.”
Time on target (TOT): “________________________________.” (requires readback)

Table 5.34 Example of JTAC to JFO Coordination.

• Target refinement.
• Ordnance or effects requested.
• Direction of attack.
• Abort code.
• Time on target.
• Mark information and joint fires observer (JFO) marking responsibilities (if required):
  • Mark the target.
  • Provide corrections from mark.
  • Set pulse repetition frequency (PRF) code to:________________________________.

OVERALL NOTE: * With this information, the JFO confirms the ability to provide any required marks, terminal guidance operations, talk-ons, and briefs the close air support mission plan to the ground commander.

Figure 5.28 Example JTAC JFO Without Direct Communication Flow for CAS Tasks.



5.9.3.2.4 The aircrew records the JFO target brief, completes the 9-Line and provides readbacks to the JFO. After the JFO confirms the readbacks, the aircrew contacts the JTAC to coordinate, passing the completed 9-Line and any updated friendly positions received from the JFO. The aircrew may recommend the game plan and remarks/restrictions to the JTAC.

5.9.3.2.5 Upon receipt of 9-Line and updates from the Aircrew, the JTAC plots target and friendly positions for game plan, remarks/restrictions consideration and GFC approval. The JTAC passes or confirms game plan, remarks/restrictions, then performs readbacks with the aircrew. The JTAC then directs the aircrew to contact the JFO for correlation.

5.9.3.2.6 The aircrew contacts the JFO for correlation and the JTAC monitors the net, following along to gain SA and confirm target location(s). Upon completion of correlation, the aircrew contacts the JTAC for final coordination, and provides updated to target coordinates, if appropriate, to confirm GFC approval.

5.9.3.2.7 After completion of final coordination, the JTAC directs the aircrew to attack and provides clearance. The JTAC and JFO share ABORT authority.

Table 5.35 Examples JTAC JFO W/O Direct Communication Flow for CAS Tasks (1 of 2).

Aircraft: "FIEND 36, NAIL 51 CHECKING IN"
JTAC: "NAIL 51, SAY POSITION AND ALTITUDE"
Aircraft: "NAIL 51 IS AT CP TREE, 16 BLOCK 18"
JTAC: "NAIL 51, YOU ARE THE ONLY AIRCRAFT ON STATION, ARTILLERY IS COLD, THREATS ARE AAA IN THE TARGET AREA, AND ALTIMETER IS 2995. PROCEDURE DIRECT TO IP LAKE, HOLD EAST TO WEST RACETRACK, APPROVED 15 BLOCK 18."
Aircraft: "NAIL 51 WILCO, CALL READY MY CHECK-IN"
JTAC: "NAIL 51 SEND YOUR CHECK-IN"
Aircraft: "NAIL 51, MISSION NUMBER A2551, 2X A-10CS, PROCEEDING TO IP LAKE 15 BLOCK 18, ORDNANCE IS 2 X GBU-54 JOINT PROGRAMMABLE FUZING, 2 X AGM-65S, 1100 RDS OF 30 MM, 40 MINUTES OF PLAYTIME, SNIPER POD, VDL CAPABLE, NAIL 51 VDL CODE 4500, NVG CAPABLE, REQUEST ABORT LIMA KILO."
JTAC: "FIEND 36 READS BACK, 2 X GBU-54 JOINT PROGRAMMABLE FUZING, 2X AGM-65S, 1100 RDS OF 30 MM, ABORT LIMA KILO, CALL READY SITUATION UPDATE"
Aircraft: "NAIL 51 READY"
JTAC: "THREATS IN THE TARGET AREA UP TO 57 MM AAA, EXPECT MANPADS UP TO SA-14S, TARGETS ARE ENEMY ARMOR COLUMNS HEADING NORTH TO SOUTH. FRIENDLIES ARE A 4 MAN SCOUT ELEMENT WITH JFO C/S PAIN 95 COLLOCATED AT FRIENDLY GRID CH 538 061, ALL OTHER FRIENDLIES ARE SOUTH OF THE 03 GRID LINE, ARTILLERY IS COLD, PAA IRON IS OCCUPIED AT CH 508 023. CLEARANCE WILL COME FROM FIEND 36, PAIN 95 WILL PROVIDE 9-LINE DATA AND TGO, FIEND 36 IS UNABLE DIRECT COMMS WITH PAIN 95, REQUEST YOU RELAY, REQUEST READBACKS OF FRIENDLY GRIDS WHEN ABLE"
Aircraft: "NAIL 51 COPY ALL, PAIN 95 AT FRIENDLY GRID FRIENDLY GRID CH 538 061, PAA IRON FRIENDLY GRID FRIENDLY GRID CH 508 023"
JTAC: "NAIL 95, GOOD READBACKS, CONTACT PAIN 95 THIS PUSH"
Aircraft: "NAIL 51 WILCO"
Aircraft: "PAIN 95, NAIL 51"
JFO: "NAIL 51, PAIN 95 LOUD AND CLEAR HOW ME"
Aircraft: "PAIN 95, NAIL 51 READS YOU LOUD AND CLEAR, READY YOUR 9-LINE"
JFO: "NAIL 51, I MONITORED YOUR CHECK-IN ABORT CODE IS LIMA KILO, 9-LINE TO FOLLOW, IP LAKE, 017, 3.8 NAUTICAL MILES, 425 FT MSL, FOUR T-62S STATIONARY ON THE EAST SIDE OF MSR 47 AT CH 544 068, NO MARK, SOUTHWEST 900M, EGRESS TO IP LAKE, READBACK LINES 4 AND 6."
Aircraft: "NAIL 51 READS BACK, 425 FT, CH 544 068"
JFO: "NAIL 51 GOOD READBACKS, CONTACT FIEND 36 TO COMPLETE GAME PLAN, REMARKS AND RESTRICTIONS."
Aircraft: "NAIL 51 WILCO, FIEND 36 CALL READY PAIN 95 9-LINE"
JTAC: "NAIL 51, FIEND 36 IS READY 9-LINE, REQUEST WE LABEL IT 95A"
Aircraft: "9LINE 95A, RECOMMEND TYPE 2 BOT, IP LAKE, 017, 3.8 NAUTICAL MILES, 425 FT MSL, FOUR T-62S STATIONARY ON THE EAST SIDE OF MSR 47 AT CH 544 068, NO MARK, SOUTHWEST 900 M, EGRESS TO IP LAKE, RECOMMEND AGM-65 AND GBU-54S, FINAL ATTACK HEADINGS EAST TO WEST OR RECIPROCAL."

Table 5.35 Examples JTAC JFO W/O Direct Communication Flow for CAS Tasks (2 of 2).

JTAC: "NAIL 51, FIEND 36 COPIES ALL, STANDBY COORDINATING"
JTAC performs map plot and GFC coordination.
JTAC: "NAIL 51, FIEND 36, 95A GAME PLAN AND AGM-65S APPROVED, I READBACK 425 FT, CH 544 068, EAST TO WEST OR RECIPROCAL APPROVED, CONTACT PAIN 95 FOR CORRELATION, COME BACK TO ME FOR FINAL COORDINATION AND APPROVAL"
Aircraft: "NAIL 51 WILCO"
Aircraft: "PAIN 95, NAIL 51 IS READY CORRELATION"
JFO: "NAIL 51, CALL CONTACT ON THE OVERPASS OF MSR 47 AND THE EAST TO WEST RUNNING CANAL VICINITY THE TARGET GRIDS."
Aircraft: "NAIL 51 IS CONTACT IN THE POD, CONTINUE"
JFO: "FROM THE OVERPASS SCAN SOUTH EAST INTO THE OPEN FIELD AND CALL CONTACT ON 4 BY T-62S IN COLUMN ARRAY NORTH TO SOUTH"
Aircraft: "CONTACT 4 TANKS BARRELS POINTING SOUTH ON THE EAST SIDE OF THE OPEN FIELD"
JFO: "NAIL 51, THAT IS YOUR TARGET"
Aircraft: "NAIL 51 CAPTURE TARGET, FIEND 36, NAIL 51 IS CORRELATION COMPLETE"
JTAC: "NAIL 51, FIEND 36 MONITORED CORRELATION, YOU ARE APPROVED 9-LINE 95A, APPROVED REATTACKS UNTIL ALL TANKS NEUTRALIZED, PUSH WHEN READY, CALL DEPARTING IP, REQUEST YOU RELAY BDA FROM PAIN 95."
Aircraft: "NAIL 51 WILCO"

5.9.3.2.8 Postattack procedures require the JFO to pass BDA to the aircrew, who reports to the JTAC to update the GFC to update the enemy order of battle and request reattack approval if required. If the GFC intent for the target is met, the JTAC continues CAS execution template.

5.9.3.2.9 This process requires added attention by the JTAC to ensure that the CAS mission is executed safely. In some instances, due to adverse weather, lack of information or a lack of confidence in information, rotary-wing CAS assets or Army attack aviation maybe the best asset to successfully engage the target with friendly centric capabilities and tactics. See Example JTAC JFO without direct communication flow for CAS.

5.10 Night Close Air Support Considerations. Modern night CAS uses NVD, IR devices, and numerous other marking and targeting systems. In some cases equipment used during day CAS can be used at night in addition to night-specific equipment. Night CAS maintains all mandatory procedures from day CAS while introducing additional procedural requirements and considerations.

WARNING: Enemy proliferation of NVDs has increased the need for IR discipline. Use caution when employing marking devices as this may highlight the friendly positions to the enemy. Limit the use of marking equipment and decrease exposure time. It is highly advised to consult with Intelligence when planning on conducting night operations to gain fidelity on the proliferation of NVDs in the area of operations (AO).

5.10.1 Advantages/Disadvantages.

5.10.1.1 Advantages:

- Decrease enemy ability to acquire aircraft visually with optically directed ADA and optical/ IR-guided SAMs.
- IR pointers/marking devices can rapidly pinpoint targets, points of interest, or friendly positions to aircrew or ground parties.
- Tracer/ground fire activity may be more easily used as marks.
- HAF/GAF Infil/Exfil covered by darkness.

5.10.1.2 Disadvantages:

- NVDs are becoming widely proliferated and easily available throughout the world.
- Dependency on NVDs and aircraft sensors and fewer external references cause a higher workload for aircrew/JTAC.
- Airborne and ground illumination may degrade night vision capabilities and/or highlight friendly position.
- Multiple ground fires may create confusion when identifying a specific friendly/enemy position.

5.10.2 Types of Illumination.

5.10.2.1 Ambient Illumination. The moon phase is the most significant factor of ambient illumination; however, starlight, cultural lighting, and solar glow are also contributing factors. Ambient illumination will affect IR marking ability, ground movement, target identification, and SOF/RW airframe availability. When planning for different illumination levels, ensure that planned tactics are in line with the environmental conditions of the objective area for the duration of the mission.

5.10.2.1.1 CAS employment during dusk and dawn can become more challenging due to lighting conditions. During this time natural light degrades the effectiveness of NVDs because the environment is too bright and NVDs become “washed out.” While NVDs cannot be used, ambient light is insufficient to identify friendly or enemy positions with eyes only. Throughout the conversion from daytime to nighttime operations aircraft that are supporting CAS operations will become NVD capable at different times due to their assigned block altitudes (e.g., when the sun is going down the aircraft lower in the stack will be able to use NVDs sooner than aircraft above them. Additionally, the aircraft that are not NVD capable will only see a blacked-out area when they look down at the battlefield with their eyes). There will also be points during this transition that aircraft will be limited to certain types of weapons delivery. It is recommended that the JTAC establishes a premission contract with the CAS team to identify when they are “IR capable.” If no contract has been established prior to operations commencing use plain English to ask when they are able to use NVDs. Environments effected by time of day may benefit from digital systems to help aid friendly battle tracking. Harris SA allows VULOS and ANW2/ANW2C to transmit the radio position, as reported by the GPS, to one or more receiving radios every time the radio is keyed. See AFTTP 3-1 JTAC, Chapter 8, “Twilight Operations,” for additional information.

5.10.2.2 Cultural Lighting. Cultural lighting is the light produced from an inhabited area associated with patterns of life. City lights are useful for navigation and situational awareness for both aircrew and ground parties. Excessive light sources can wash out NVDs, and reduce the ability to identify an IR marker or IR strobe.

5.10.2.3 Artificial Illumination. Artificial illumination is any illumination employed by surface or air forces; it can be either overt or covert and has many tactical uses. It is employed in order to illuminate a specific area for a set amount of time and to provide enough illumination for aircraft and/or ground controllers to acquire targets or target areas. Because illumination can significantly affect a large portion of the battlefield, all illumination missions must be coordinated and approved through the ground force commander to ensure that adverse effects on ground forces have been mitigated or accepted. See **Table 5.36**, Ground-Delivered Artificial Illumination Specifications, and **Table 5.37**, Air-Delivered Artificial Illumination Specifications.

WARNING: Incorrectly placed illumination and night marking devices can highlight ground forces as well as aircrew and can negate friendly NVD advantages, possibly giving enemy forces an unintentional tactical advantage.

Table 5.36 Ground-Delivered Artificial Illumination Specifications.

Mark type	Height of Burst (meters)	Burn Time (seconds)	Coverage (meters)
60 mm			
M83A1	160	25	300
M83A2/A3	160	32	—
M721	275 to 350	32	500
81 mm			
M301A3	600	50 to 60	360
M853A1	475 to 600		650
120 mm			
M930	500	50	1,500
105 mm M314A2/3	750	60 to 65	Varies depending on number of rounds and range/lateral spread.
155 mm			Varies depending on number of rounds and range/lateral spread.
M118	750	60	
M495	600	120	

Table 5.37 Air-Delivered Artificial Illumination Specifications.

Mark Type	Rate of Fall	Burn Time (minutes)	Coverage
LUU 1/B LUU 5/B LUU 6	Burns on ground	30	Terrain dependent
LUU 2 A/B	8 fps	4	3 km
LUU 19B (IR)	9 fps	7	4 km
M257 Rockets	15 fps	2	1 km (+)
M278 (IR)	15 fps	3	1 km (+)

5.10.3 Marking Capabilities.

5.10.3.1 Ground Based Marking. IR pointers can be used to aid in either aircrew or ground unit acquisition of targets or points of interest. When planning for the utilization of ground-based IR pointers, ground parties need to consider illumination levels, IR beam deconfliction, enemy NVD capability, battlefield obscurants, and weather. While IR is the most common, it is not the only method available to mark locations at night. Other methods available are laser, direct/indirect fire, illumination, and artillery.

5.10.3.2 Airborne Based Marking. Aircraft with an IR-designator capability can enhance battlefield situational awareness greatly and expedite target acquisition. Airborne IR markers may be used to cross-reference a ground-based IR mark or to match SPARKLE to identify NAIs, fleeing or maneuvering forces, or potential threats, and assist ground forces with navigation or maneuver. If a target is obscured from JTAC view, the aircraft can use its IR marker to pinpoint a target location for an outside targeting source (e.g., JFO, RPA, or other aircraft). Other airborne capabilities exist, such as aircraft with laser capability that can be used similarly to ground-based lasers. Additionally, some RPAs have the ability to mark the target but are not LST capable.

5.10.4 Light Discipline. Each supporting unit has internal SOPs regarding light discipline for specific operational environments. However, JTACs operating at night must maintain high levels of light discipline when operating all forms of equipment (e.g., white light, cigarettes, and end user device screens). Techniques encompassing light discipline include the use of IR marking devices by reducing the amount of time used or minimizing the use of IR strobes per unit SOP and nearby friendly force elements. Failure to establish night operating procedures may compromise tactical objectives or lead to the misidentification of targets. Brief all supporting aircraft on the intended night procedures prior to mission execution or as part of the AO update.

WARNING: Multiple IR strobes, beacons, and excessive GLINT tape within a close area will degrade sensor effectiveness in identifying friendly positions. Also, the use of IR strobes seen through full motion video (FMV) may be misidentified as muzzle flashes.

5.10.5 Lost Communications. Unplanned loss of communications can greatly hinder CAS execution. "Comm-out" plans should include a comm-out trigger to identify the problem to all players, a target identification and verification method, and a sign of permission to execute. Refer to AFTTP 3-1.JTAC.

EXAMPLE: Beacon/strobe initiation, JTAC IR pointer on target, aircraft "MATCH SPARKLE." JTAC switches IR pointer to steady, and aircraft executes.

5.10.6 Target Marking Techniques. The following are target-marking techniques.

5.10.6.1 The closer the pilot parallels the IR pointer-to-target line on final attack heading, the easier to acquire the beam.

5.10.6.2 If having a hard time seeing the target, JTAC can use the pointer on wide beam to acquire it first, and then go to narrow beam to mark the target.

5.10.6.3 Artificial illumination that is offset 90 degrees from the final attack heading can act as an effective target mark.

5.10.6.4 Laser spots are an effective mark for LST-equipped aircraft and are still the preferred method of marking.

5.10.6.5 Tracer rounds/direct fire are effective night marking techniques but may be limited to tracer burnout range and munition availability (caliber versus altitude of platform may or may not be visible).

5.10.6.6 White phosphorus, red phosphorus, rockets, artillery shells, and ammunition make excellent short-duration (approximately 10 minutes) hot spot marks or reference points that can be seen by thermal imaging devices.

5.10.6.7 When aircraft engage targets using NVDs the actual DPI may not be acquired and the aircraft may be forced to attack the mark only. When employing this technique, the use of multiple IR pointers from geographically separate locations offers better results than just one mark. It is recommended to "MATCH SPARKLE" with the aircrew to ensure proper target acquisition. If the JTAC is concerned about the enemy night vision capabilities, consider delaying IR mark until aircraft are in the terminal control phase. This technique allows aircrew to strike targets before enemy forces can react to friendly IR signatures.

5.10.6.8 With multiple formations or pod-equipped aircraft and RPAs operating in the same area, a JTAC can request one formation to use pulse and the other to use steady beam in order to differentiate between airborne IR sources.

5.10.6.9 Ground-based IR marks may appear on target, but from the aircraft perspective, the mark is actually off the target array. Aircraft typically can match SPARKLE and either self-mark or buddy mark to provide a more stable and accurate mark for attacking aircraft. If using guided weapons, the pilot is simply searching visually and matching SPARKLE. Understand that most aircrew are seeing the IR marks visually and not with systems.

5.10.7 Friendly Marking. Marking friendly ground forces is an important aspect of night operations. Many techniques have been developed to identify the JTAC's position to the aircraft, while still concealing it from the enemy IR and thermal capabilities.

5.10.7.1 Infrared. If the tactical situation dictates, marking of friendly positions without highlighting friendly positions to the enemy can be a challenge. An IR strobe may be set at an offset location so as not to give away the actual friendly location. Aircraft can SPARKLE an established reference point. JTAC will provide direction and distance from SPARKLE to a friendly location as a means to confirm friendly locations. Using a cylindrical device (e.g., soda can or coffee can) to give IR strobes directional focus toward the aircraft can aid in preventing identification by enemy forces. JTACs should limit IR exposure through timed marking such as limiting transmission or giving short bursts of IR strobe/pointer. This technique should be coordinated with the aircraft to ensure effectiveness. See **Table 5.38**, Night CAS Brevity.

WARNING: Most FMV capable assets are not able to see IR mark and strobe through the targeting pod.

WARNING: IR markers emit strong electromagnetic waves that can permanently damage eyes if proper protection is not used.

5.10.7.2 Thermal. Thermal marking is based on unit SOPs, they are commonly used on vehicles.

WARNING: Thermal markers can create fire hazards. Extreme caution should be used when employing.

5.10.8 Additional Considerations.

- Practice night time operating procedures for issued equipment.
- Organize equipment for ease of use during night ops, especially when dismounted.
- Tie down sensitive equipment.
- Use tabs to identify key pages readily in commonly used manuals.
- Create field expedient reference cards for HLZ briefs, CFF briefs, SCL ordnance, MEDVAC 9-Line, chalk loads, and/or vehicle loadout plan with battle rosters.
- Review artificial illumination capabilities.
- Use colors on products that are compatible with nighttime light sources and NVDs (e.g., do not use red markers or pens on maps when using a red lens flashlight; the lines will not be visible).
- Blue lights on yellow highlighter helps signature and readability.
- SWIR target talk-ons.
- Military tactical means (MTM).

Table 5.38 Night CAS Brevity.

Term	Definition
BUZZSAW	A chemical light-stick tied to a string and swung overhead; used to mark a FRIENDLY position.
CEASE (activity)	Discontinue stated activity; e.g., CEASE BUZZER, CEASE LASER, CEASE SPARKLE, etc.
CONTACT SPARKLE	Call acknowledging the sighting of a specified reference point (either visually or via sensor). After the “SPARKLE” call is made, the close air support aircraft should respond with “NO JOY” or “SNAKE.” Once the aircrew sees the IR energy and is able to discern between the friendly and target end of the pointer, a “CONTACT SPARKLE” call may be made.
MATCH (type)	Overlay requested target designator type (e.g., MATCH SPARKLE, MATCH LASER).
NO JOY	Aircrew does not have visual contact with the TARGET or BANDIT. Opposite of TALLY.
ROPE	Circling an infrared pointer around an aircraft to help the aircraft identify the FRIENDLY ground 80 position.
SHIFT (direction, track number)	Shift laser or infrared or radar or device energy or aimpoint. NOTE Can be used to shift from the offset position onto the target. Also used during multi-aircraft attack to shift laser energy or target assignments.
SNAKE	Oscillate an infrared pointer in a Figure Eight about a target.
SPARKLE	Mark or marking target by infrared pointer.
STEADY	Stop oscillation of infrared pointer.
SUNSHINE	Illuminating target with artificial illumination.
STOP	JTAC stops the beam. This can aid in verifying that the aircrew is looking at the proper IR pointer, especially if followed with another “SPARKLE” call.
VISUAL	Sighting of a FRIENDLY aircraft or ground position or ship. Opposite of BLIND.
PULSE	JTAC uses pulse mode available on some IR pointers. Can be initiated by JTAC or aircrew. May be used by JTAC to emphasize that an enemy position is being illuminated by flashing IR energy, which is often used to identify friendly position. Proper aircrew response is “CONTACT,” “STEADY,” or “NO JOY.”
TALLY	Sighting of a target, non-friendly aircraft, or enemy position. Opposite of NO JOY.

5.10.8.1 Thermal Crossover. Thermal crossover is defined as a time when two objects (e.g., metal truck and asphalt road) that are heating and cooling at different rates are the same temperature and emit the same amount of thermal energy (i.e., heat). Normally, this occurs twice during a 24-hour period for two specific objects and can cause complications for weapon systems that rely on IR sensors. For a short period of time around thermal crossover, when the two objects are very similar in temperature, thermal sensors may not be able to distinguish between the two, as both objects appear to merge into one. Appropriate planning is required to mitigate the effects of thermal crossover.

5.10.8.1.1 Factors that affect thermal crossover include vehicle type, background, winds, and cloud cover. Weather personnel may use computer models to predict exactly when thermal crossover will occur, but as a general rule, thermal crossover will occur approximately within 2 hours of sunrise and sunset.

5.11 Helicopter Assault Force Operations. HAF is one of the various types of airborne operations that enables expeditious infiltration and exfiltration to warfighters, supplies, and contingencies on the battlefield. Significant planning considerations should be taken to ensure the safest execution in order to meet mission priorities. See **Chapter 3**, "JTAC Mission Planning," for planning considerations.

5.11.1 Steps for Determining a Suitable HLZ. Factors when determining a suitable HLZ include the following.

- Aircraft size and weight.
- Ground compositions/weight bearing.
- Slope of landing surface.
- Key terrain features.
- Last cover and concealment (LCC) for friendlies.
- Ingress/egress for helicopter operations.
- How will the HLZ be marked / staging or personnel.

5.11.1.1 HLZ Selection for Aircraft Size and Weight. HLZs are dependent on the aircraft type and size, and whether the HLZ will be used for takeoffs/landings or alternate insertion/extraction (AIE). During mission planning that will involve helicopter support, either for infiltration/exfiltration, or planned MEDEVAC, one should determine possible HLZs. Best results for premission planning HLZs is to use the intelligence section of the unit the JTAC is working with. They will provide the most advantageous and safest LZ that correlates with the mission. See **Table 5.39**, Rotary-Wing Landing Parameter.

5.11.1.2 Weight Bearing Capacity. HLZs are dependent on the aircraft type or size. Weight bearing capacity is not required for helicopter operations, but care must be exercised to ensure the HLZ is cleared to prevent possible engine damage or personnel injury from flying debris due to hover operations.

Table 5.39 Rotary-Wing Landing Parameters.

Aircraft Type	Landing Zone Size (Length x Width/feet) Single Ship	Landing Zone Size (Length x Width/feet) Two-Ship	Remarks
AH-1/64	100 x 100	200 x 200	Narrow footprint, requires a smooth, flat surface.
A/OH-6, H-6	65 x 65	130 x 130	Requires a smooth, flat surface.
H-47	120 x 120	240 x 240	Large rotor wash.
H-53	200 x 300	300 x 400	
H-60	100 x 100	200 x 200	
UH-1	100 x 100	200 x 200	Requires a 25 foot clearance from the helicopter.
CV-22	240 x 240	240 x 740	Significant rotor wash. Brown-out conditions should be anticipated. Numbers listed are for brown-out conditions.
MV-22	200 x 200 (160 x 180 night visual conditions)	600 x 600	

5.11.1.3 Slope of Landing Surface. LZ selection can be limited greatly by terrain when not only looking at ground composition but the slope of the terrain. Look to choose landing sites with relatively level ground. For the helicopter to land safely, the slope should not exceed 7 degrees. Whenever possible, pilots should land upslope rather than downslope. All helicopters can land where ground slope measures 7 degrees or less and no advisory is required. When the slope exceeds 7 degrees, observation and utility helicopters that use skids for landing must terminate at a hover to load or off-load personnel or supplies. When the slope measures between 7 and 15 degrees, large utility and cargo helicopters that use wheels for landing are issued an advisory, and they land upslope. When the slope exceeds 15 degrees, all helicopters must be issued an advisory and terminate at a hover to load or off-load personnel or supplies.

NOTE: To determine slope in percentage or degrees, express all measurements in either feet or meters, but not both. If the map sheet expresses elevation in meters, multiply by 3.28 to convert into feet. If the map sheet expresses elevation in feet, divide by 3.28 to convert to meters.

CAUTION: Never land an aircraft facing downslope, if possible.

5.11.1.4 Ingress and Egress for Helicopter Operations. The JTAC must consider ingress and egress options which relies heavily on the tactical scenario. This can range from location of obstacles, friendlies, threats, and terrain. JTACs should make every effort to talk through with the supporting helicopter(s) as well as allocated air assets what everyone's roles and responsibilities are going to be in the event of a contested ("hot") HLZ. Establishing contracts with the air players on how hostile targets are going to be identified on the radio (i.e., using the infil helicopter as an anchor point and calling distance and direction from) as well as what the communication will sound like from the infil helicopter(s) if/when they begin to maneuver outside of the planned ingress route (infil helicopter calls "BREAKING" with a cardinal direction to provide the rest of the CAS team with SA for supporting the infil helicopter(s). Aircrews will take this into account during infiltration/exfiltration but ultimately the aircrews will do what they think is best to ensure the safety of the airframe.

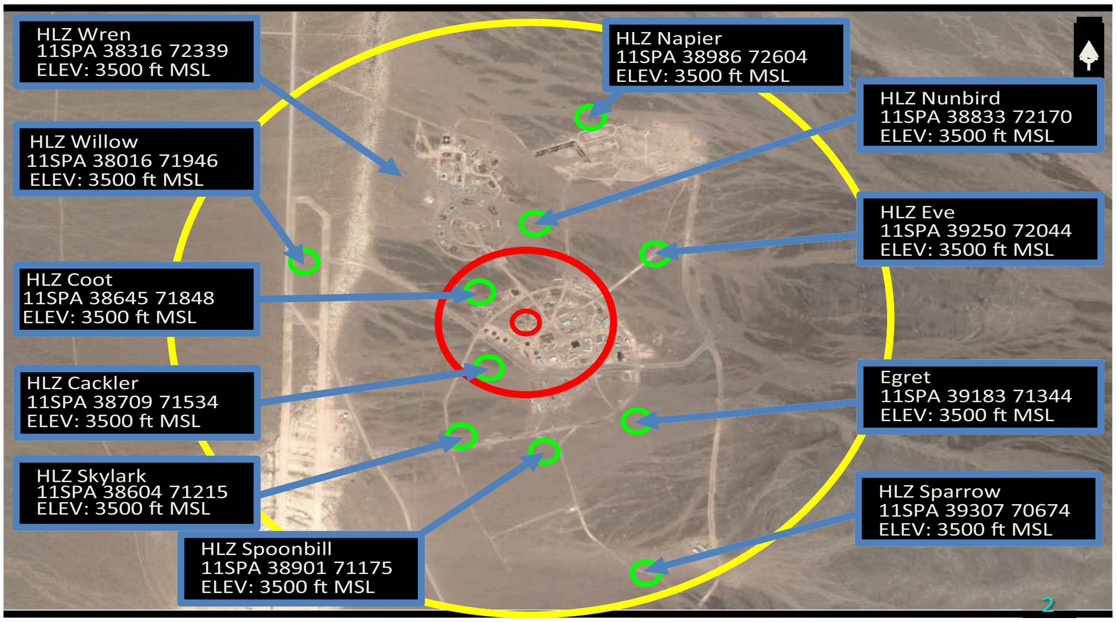
5.11.1.4.1 Generally, HLZs will be placed around a target area and in a cardinal direction from the target. Use the cardinal heading to name the HLZ. Listed are examples. If there is a need to deviate, ensure all players are aware. Tactical considerations are needed to determine where the HLZ will be located. See **Figure 5.29**, Helicopter Landing Zone, and **Table 5.40**, Helicopter Landing Zone Brief.

- Landing on the X—landing on objective or within 300 meters of objective area.
- Landing to the Y—landing from 300 meters to 1 km outside of objective area.
- Offset—landing more than 1 km away from objective area.
- Naming conventions for preplanned and hasty HLZs.
- Bird names in Cardinal Directions in relation to the target. (i.e., North—Nighthawk, E—Egret, S—Sparrow, W—Whippoorwill).
- Hasty HLZs are referred to as HLZ BLACK.

5.11.1.5 HLZ Markings. MAJCOMs may supplement this instruction with unique requirements. There are no USAF requirements to mark HLZs for day or NVG use.

5.11.1.5.1 For daylight operations, JTACs predominately use smoke to mark HLZs. The smoke is not only easy to acquire visually for helicopter pilots, it also doubles as a wind direction indicator. A TTP widely used to confirm that the pilot(s) are visual the proper smoke is to have them verbalize what color the smoke they see is. Signal mirrors are also highly effective marks for helicopters and are not as easily identified by potential enemy. VS-17 panels can provide the ground party with two different colored marks for identifying multiple touch down points (TDP) due to having an orange colored side as well as a cerise colored side. To assist the helicopter pilot in breaking out the panel from the surrounding landscape a TTP that is used is to have the individual who is holding the panel at chest level and collapsing and expanding the panel in the direction of the incoming aircraft, creating movement to assist in getting the pilot's eyes "VISUAL." Requesting the pilot to initiate when to start providing the agreed upon mark will ensure that the mark is not initiated too early nor is the ground party potentially exposing themselves to enemy locations longer than necessary.

Figure 5.29 Helicopter Landing Zone.



5.11.1.5.2 At night, JTACs should consider the enemy NVG capabilities in the area that they are conducting operations in. If the NVD capability is assessed as low then the primary means of HLZ mark for exfil should be IR strobe marked per chock and an aircraft hosted IR SPARKLE for chock 1. If aircraft are unable to mark HLZ then JTAC will provide a ground IR SPARKLE for chock 1 HLZ. If enemy NVG capability is assessed as high a better technique is for the JTAC to use a high concentrate smoke grenade for visual reference outside 1 minute. Once inside 1 minute chocks, turn on IR strobes, but shield strobes so they can only be acquired by the incoming helicopters. IR buzzsaws (IR chemlight attached to a piece of 550 cord or string approximately 2 to 3 feet in length and swung in a circular motion) are also highly effective at getting a helicopter visual friendly and can be stowed away or buried in the ground post use to mitigate IR light emission for the ground party in the event that they remain on the battlefield.

5.11.1.6 No Radio (NORDO) Markings. JTACs must be prepared to execute no radio ("no comm") markings in support of air-to-ground engagements as well as incoming helicopters to HLZs. These contracts ideally will be covered during premission briefing as well as during ROC drills prior to mission execution. See Table 5.41, No Radio Markings.

Table 5.40 Helicopter Landing Zone Brief.

HLZ NAME or LOCATION:
GRID/ELEVATION:
Marked by:

LAND HEADING/DIRECTION:
In From:
Land:
Off To:

WINDS:
FORMATION:
(Trail, Echelon L/R, Online, Trail)

CHALK 1	**PAX #**	**DOOR LOAD**	**MARK**
CHALK 2			
CHALK 3			
CHALK 4			

HAZARDS:
Obstructions:

Terrain (Brown-out conditions, pinnacle landing required, etc.):

Enemy (Last known contact location):

Table 5.41 No Radio Markings.

Description	Day Primary	Day Alternate	Night Primary	Night Alternate
Team Marking	VS-17 Panel	White Smoke	IR Strobe	IR Bundle
CCA	Yellow Smoke marks enemy direction; VS-17 marks friendlies	HEDP marks enemy direction; white smoke marks friendlies	ROPE A/C IR Pulse marks enemy; A/C Match Pulse; Steady confirms Tally 2nd Rope = abort	IR strobe on friendlies, target marked with tracer fire; A/C matches sparkle tracer fire stops for clearance.
Cold Extract	Green smoke	Hand signals/ Flashing VS-17 in hand	IR Buzzsaw	Rope A/C HLZ marked by IR pointer making "Y" shape
Hot Extract	Yellow smoke marks enemy direction; (Red smoke + green smoke) marks friendlies	HEDP/RED smoke marks enemy direction; green smoke marks friendlies	IR Pulse marks enemy; IR buzzsaw marks friendlies	IR Pulse marks enemy; IR buzzsaw marks friendlies
Ground Link-up	Iron Cross	Profiling	IR Flash 3-2-1 send 3/respond 2/ confirm 1	Profiling/IR strobe

5.11.2 Communication. As soon as arrival at the landing site, JTACs may assist with the setup of communications nets. If needed, may also set up the HLZ internal net. It is essential to monitor these radio nets continuously, unless directed otherwise, until operations cease at the site. Tactical situation permitting, JTACs may assist in locating each helicopter landing site within ground communication range of the other sites and manned release points (RP). The range of available radios dictates what facilities within the LZ can communicate with each other.

5.11.2.1 The commander of the landing site for utility and cargo helicopters quickly assesses the area to determine the exact direction of landing. An intercept heading from the RP is and the location of the landing point of the lead helicopter of each flight is calculated if required. Then it is decided if the terrain or situation dictates any change to the planned landing formation. The site commander should have JTACs or other personnel (pathfinders) compile landing instructions for transmittal to inbound helicopters while also having personnel remove or mark obstacles in or around the site.

5.11.2.2 During the air assault planning phase, it is recommended that the JTAC coordinates with aircrews to solidify the communication aspect of the operation. Doing so will create a common language between the JTACs and aircrews. Format 5.7.3 represents a simple and useful tool to inform aircraft about a particular zone. If more information is necessary to ensure aircraft has an appropriate level of situational awareness, it shall be included. Format 5.7.3 should not preclude a conversation or plain language dialogue from occurring in order to ensure ground personnel and aircrew know exactly what needs to occur and why (i.e., threat). See **Table 5.42**, Example of a Transmission.

Table 5.42 Example of Transmission.

(BULLET 23) "RAVEN 01, HLZ LOCATION 12A BC 345 678, ELEVATION 4500 FEET, MARKED BY SMOKE, REQUEST IN SOUTH AND OFF EAST, WINDS NORTH AT 5 KNOTS."
(RAVEN 01) "BULLET 23 COPY'S 12A BC 345 678 AT 4500 FEET, IN SOUTH OFF EAST, WINDS FROM THE NORTH AT 5 KNOTS.
(BULLET 23) "RAVEN 01 GOOD READ BACK, REQUEST ECHELON RIGHT CHALK 1 WITH 8 PAX, CHALK 2 WITH 8 PAX, AND CHALK 3 WITH 7 PAX PLUS 1 CHARGER, ALL RIGHT SIDE LOAD, CALL COLOR SMOKE WHEN INBOUND."
(RAVEN 01) "BULLET 23 COPY'S ECHELON RIGHT, CHALK 1 EAGLES 8, CHALK 2 EAGLES 8, CHALK 3 EAGLES 7 PLUS CHARGER, RIGHT SIDE LOAD. WILL CALL SMOKE WHEN INBOUND."
(BULLET 23) "RAVEN 01 GOOD COPY"

5.11.3 Flight Formations. Ideally, all helicopters land at the same time in a planned flight formation. The landing site commander includes this information in landing instructions to the flight leader. JTACs lay out the landing site in a location where helicopters will not fly directly over aircraft on the ground. The layout of the site also depends on the landing space available, the number and type of obstacles, unit SOPs, and prearranged flight formations.

NOTE: General rule of thumb for an HLZ size is double the rotor blade length. Some aircraft can accept smaller sizes, depending on training.

5.11.4 Mission Operations. Coordination between all ground parties and aircrew for a given mission is required from infiltration to exfiltration. During an infiltration, ground parties may desire specific door entries that face in a particular direction in order to meet the tactical situation. Additionally, the JTAC should be capable of notifying helicopters pertinent information such as the expected ground hold duration and approximate load times for all elements (both after infiltration and prior to exfiltration). Immediately after insert, helicopters will proceed to a designated hold point to wait for a call to be released. This allows quicker response for immediate exfiltration if needed. Prior to exfiltration, helicopters need to be advised of a hold point and report inbound calls. JTACs are capable of notifying inbound aircraft specific missing timing elements such as, the pickup zone (PZ), friendly force extraction posture, and when ready for exfiltration. Holding points can be established during the planning phase of the operation. Holding points may vary depending on the situation they are required for (nontraditional MEDEVAC, hostage evacuation, overall exfiltration).

5.11.4.1 Cherry/Ice. LZ updates are provided just prior to as well as during the air movement. Escort aircraft shift to an LZ overwatch mission as assault aircraft conduct the air movement. Attack assets will provide an LZ update with a "Cherry" or "Ice" call. This call lets the air assault task force commander (AATFC), and air mission commander (AMC) know the status of the LZ. If enemy activity is occurring on the LZ, then the LZ is considered "Cherry." Conditions for a "Cherry" criteria are developed pre-infil by the associated GFC. If no (or a GFC accepted amount of) enemy activity is observed, then the LZ is considered "Ice."

5.11.4.2 If the LZ is "Cherry." the personnel with eyes on and/or the aircraft conducting overwatch will provide a situation report (SITREP) consisting of enemy activity, what actions will be toward the enemy, an estimation of how to achieve an "Ice" status, and/or recommendation for use of one of the alternate LZs.

5.11.4.3 The requirement for a Cherry/Ice call is risk assessment based on the need to preserve surprise/sustainment on the objective.

5.11.4.4 Fixed-wing aircraft are available to make the Cherry/Ice call when assets are on station. All aircraft should be operating on a common frequency net that both fixed and rotary can operate on can call directly to the AATFC. If these capabilities are not present, fixed-wing aircraft can relay the call to the JTAC located with the AATFC. The plan must account for the time it will take to relay the call to all parties. UAS platforms may be used to make the Cherry/Ice call based on the AATFC assessment of risk.

5.11.4.5 The Cherry/Ice call should be made at the start of the air movement and at 10 minutes out from the time on target, but no later than 6 minutes from time on target. A common TTP to plan for is that helicopters are audible at the objective area inside 6 minutes (when conducting mission planning certain Intel units are able to provide an updated distance from the proposed HLZs of when the infil platform will be within audible range). The manner in which rotary-wing aviation conducts its Cherry/Ice call should not give away the exact location of the LZ.

5.11.5 Alert Level. Depending on the mission requirements, aircraft institute various alert postures to afford timely lift response in order to meet ground unit needs. It is imperative that an effective communication plan is established prior to the start of a mission in order to maintain suitable interactions between rotary assets and controlling JTACs. This can be done with either having a direct link with either the aircraft or the tactical operations center (TOC). If unable to establish an effective direct link with rotary assets, preplanned relay networks are highly advised. One method of initializing contact with low flying aircraft or TOCs is by using on-station assets with communication relay reachback capability. JTACs should be familiar with the associated execution checklist (if applicable) given during mission rehearsals that highlight mission time lines, requirements, and comm plans. In situations where assets are launched without prior mission planning for extraction JTACs should be ready to pass pertinent mission information. See **paragraph 5.2.3**, CAS Aircraft Check-In, and **Table 5.43**, Rotary Alert Posture Levels.

5.11.5.1 PZ posture can determine final landing direction, multiship landing formation (in-trail, echelon left/right). Information must be passed at earliest time possible. The JTAC may be required to specify this information if pertinent changes exist from those briefed, during mission planning: New HLZ, wind shifts, brownout conditions, and enemy contact.

Table 5.43 Rotary Alert Posture Levels.

LVL	Response Time	Engines	A/C Status
1	Immediate Response	Engines on, rotors spinning	Pilots in seats monitoring radios
2	15 minutes	Auxiliary power unit (APU) on	Pilots IVO the A/C, awaiting the call to respond.
3	30 minutes	Set for start	Pilots on standby with RTO.

LEGEND:
IVO—in vicinity of
RTO—radio transmitter operator

5.11.5.2 After mission completion and during exfiltration from the target area, all JTACs should remain vigilant of the rotor wash/brownout from approaching aircraft. When loading any aircraft, it is imperative that all party members to include the JTAC, follow all instructions from the loadmaster or crew chief before approaching the platform. For side loaded aircraft, approach the helicopter from the 1 to 3 or 9 to 11 (clock reference). For rear loaded platforms, approach from the 5 to 7 (clock reference) from the aircraft. Remain outside rotor blades until signaled to proceed. Load the helicopter as outlined in the prebriefed load plan.

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CHAPTER 6

CONTESTED DEGRADED OPERATIONALY LIMITED

6.1 Contested, Degraded, Operationally-Limited. Contested, degraded, operationally limited (CDO) describes the operational environment and planning construct that drives identification of and the compensation for enemy actions, friendly-force limitations, and operational constraints that prevent full employment of integrated warfighting or freedom of action. Contested operations include the following; restrictions imposed by the enemy (threats, jammers, and direction finders), degradation of systems imposed by the operating environment (weather, terrain, and friendly electromagnetic interference), and operational limitations internally imposed by the friendly force (rules of engagement, special instructions, and acceptable level of risk).

6.1.1 Anti-Access/Area-Denial. Anti-access (A2) refers to those actions and capabilities, usually long-range, designed to prevent an opposing force from entering an operational area. Area-denial (AD) refers to those actions and capabilities, usually of shorter range, designed not to keep an opposing force out, but to limit its freedom of actions within the operational area.

6.2 Surface-to-Air Threats. Surface-to-air threats are a central part of any adversary's A2/AD construct and ability to contest the friendly force's use of the air domain. Enemies use surface-to-air missile (SAM) systems and air defense artillery (ADA) to limit the effectiveness of friendly air operations, specifically close air support (CAS). This chapter will provide some considerations about employing CAS in the vicinity of surface-to-air threats, but JTACs should refer to AFTTP 3-1.Threat Guide, for a detailed description of each threat along with its capabilities.

6.2.1 Strategic Threats. See AFTTP 3-1.JTAC.

6.2.2 (FOUO) Operational Threats. Operational threats have a significant impact on CAS due to extended ranges and maximum altitudes. They are typically employed in locations where they can provide area protection over enemy headquarters, forward elements, and tactical threats. While legacy operational threats operate from semi-fixed locations, modern operational threats are extremely mobile.

6.2.2.1 Vertical Avoidance of Operational Threats. Refer to AFTTP 3-1.JTAC, paragraph 6.2.3.1, Vertical Avoidance of Operational Threats.

6.2.2.2 Lateral Avoidance of Operational Threats. Refer to AFTTP 3-1.JTAC, paragraph 6.2.3.2, Lateral Avoidance of Operational Threats.

6.2.2.2.1 An additional planning consideration for conducting CAS inside of operational threat maximum recommended intercept ranges (MRIR) is using final attack heading profiles that do not force the attacking asset to fly directly at the threat. Since an aircraft traveling at a 45-degree angle, relative to the threat, can turn and exit the threat's ring faster than an asset flying directly towards the threat, it could fly significantly closer to the threat to prosecute an attack without being exposed to as much risk. This does not affect the threat's MRIR, it simply provides JTACs another technique of working targets in the vicinity of a threat. AFTTP 3-1.Threat Guide provides specific examples of limitations that attack profiles place on a specific threat's effective range.

6.2.3 (FOUO) Tactical Threats. Tactical threats are the forward most element of the enemy's integrated air defense system (IADS). These systems typically provide localized protection of forward combat elements or high value objects. Due to employment near the front-lines, tactical threats are the systems most commonly faced by JTACs at the brigade level and below. Most tactical threats operate in batteries consisting of four to six individual systems. They include man-portable air defense systems (MANPADS), ADA, IR-guided SAMs, and radar-guided SAMs. Some specific tactical threats are the SA-18, ZSU 23-4, SA-13, 2S6/SA-19, SA-22, and depending on employment tactics, SA-11s/SA-17s.

6.2.3.1 Vertical Avoidance of Tactical Threats. Refer to AFTTP 3-1.JTAC.

6.2.3.1.1 JTACs must remember to add a threat's elevation to its maximum vertical range when determining the safe overflight altitude.

6.2.3.2 Lateral Avoidance of Tactical Threats. Refer to AFTTP 3-1.JTAC.

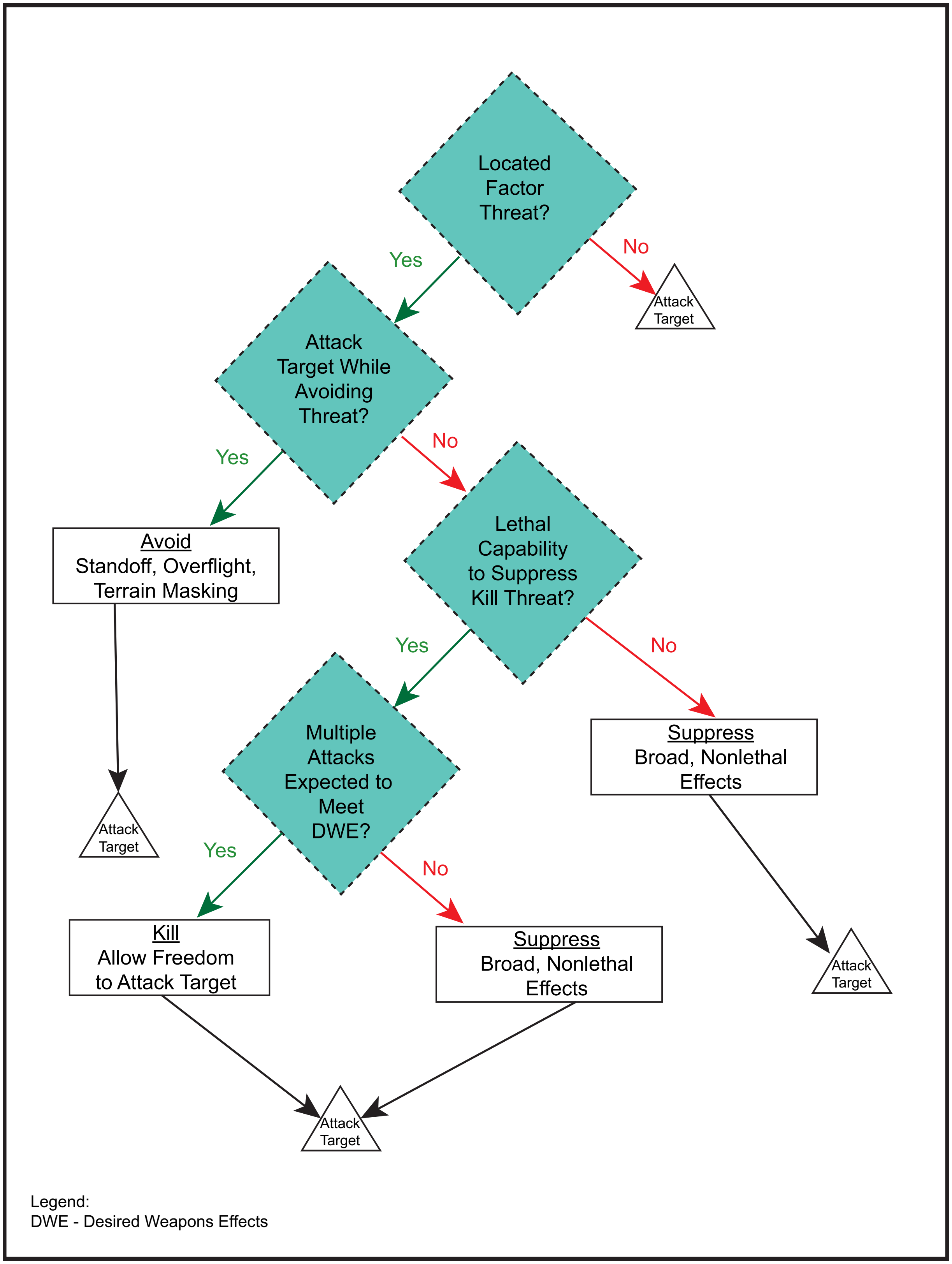
6.2.3.3 Avoid/Suppress/Kill (ASK) Methodology. The basic air force technique for operating in an increased threat environment is ASK. This provides a means of ensuring that the commander's intent is met, remaining within the acceptable level of risk (ALR), and while minimizing the threat to aircraft. This technique should always be applied when working templated or reported threats, but once a factor threat is located, and multiple attacks are required, JTACs might consider bypassing avoid and suppress to achieve a kill against a higher valued target.

6.2.3.3.1 (FOUO) Avoid. If a threat has not been located, JTACs should hold aircraft in areas that are outside of the MRIR of the threat's forward-most expected location. As a rule of thumb, expect two-thirds of a tactical level threat's MRIR to reach beyond the enemy's forward line of troops (FLOT). For example, a threat with a MRIR of 9 km would be 3 km behind the FLOT. Smaller tactical threats, such as ADA, may be collocated with the front-line and MANPADS are often carried with the forward most elements. If a threat has been reported in an area, but not positively identified, JTACs should use initial points (IP) significantly outside of the associated MRIRs, and dictate final attack headings and weapons employment that minimize time spent inside of the templated MRIR to the greatest extent possible.

6.2.3.3.2 (FOUO) Suppress. If JTACs must conduct an attack within a threat's MRIR, they should make an appropriate effort to suppress the threat. This includes using artillery, requesting and employing electronic warfare (EW), and or antiradiation missile (ARM) equipped assets. There are associated risks with enemies employing air defenses; counter-fire radars are expected. Firing suppression missions at an unlocated threats may not be worth the risk to the friendly fires element.

6.2.3.3.3 (FOUO) Kill. Surface-to-air threats are typically high-payoff targets and finding/fixing them is the most challenging part of the kill chain. JTACs should make an effort to kill tactical threats, when identified. This will enable the Army to effectively employ attack helicopters, which are the most effective anti-armor weapon system on the modern battlefield. JTACs should attempt to kill operational-level threats when identified. However, this will often be outside of CAS ALR, and require dedicated air, land, or sea SEAD assets. This will typically be coordinated from higher headquarters elements. See **Figure 6.1**, Ask Model.

Figure 6.1 Ask Model.



6.2.4 Preparing for a Contested Air Environment. To effectively control CAS in an increased threat environment, JTACs must understand the capabilities and performance characteristics of adversary threat systems. A JTAC should pay special attention to pertinent data found in AFTTP 3-1.Threat Guide, Chapter 3, “Adversary Early Warning/Air Surveillance Systems;” Chapter 4, “Adversary Air Defense Artillery and Small Arms;” and Chapter 5, “Adversary Surface-to-Air Missiles Systems,” but characteristics that a JTAC should pay special attention to include the concept of operation for each system and the performance characteristics described in this section.

6.2.4.1 Concept of operations for each system will provide the following.

6.2.4.1.1 System Configuration. System configuration provides the composition and organization of a surface-to-air unit (i.e., early warning [EW] radar, transporter launcher and radar [TLAR]/transporter erector and launcher [TEL], and C2). This information aids in threat identification and verification.

6.2.4.1.2 Engagement Sequence. Engagement sequence provides information on the systems’ target acquisition and tracking radar, to include: tracking nodes and how the transition is made from EW radar to the firing battery. This will help determine if it is possible to break the link between EW radar and the firing battery.

6.2.4.1.3 Firing Doctrine. Firing doctrine identifies the procedures used by individual adversaries to employ the systems, including the rate of fire and attack parameters. This will assist in determining the survivability of the aircraft if fired upon while inside the threat MRIR.

6.2.4.1.4 Missile Track and Guidance. Missile track and guidance identifies the radio frequency types the system uses, transmission times to fire weapons, accuracy standards for the guidance system, fusing and overall kill assessment. This area is vital to the JTAC for determining the type of aircraft and weapons they should use if avoidance is not an option.

6.2.4.1.5 Threat to Helicopters. This will identify the effectiveness of a threat against helicopters flying at low altitude and airspeed. It will help the JTAC determine if rotary-wing assets will be able to penetrate threat rings to kill treats or prosecute targets in its vicinity.

6.2.4.1.6 Anti-Precision Guided Munitions (PGM) Capabilities. This area determines the threats survivability against PGMs.

6.2.4.2 Performance and Characteristics. The most important information about a threat can be found in AFTTP 3-1.JTAC, paragraph 6.2.5.2, Performance and Characteristics, and **Table 6.1**, Threat Considerations.

Table 6.1 Threat Considerations.

System	Maximum Effective Range (nm/km)	Minimum Effective Range (nm/km)	Altitude (feet)	Guidance	Associated Radars	Remarks
SA-2f	18.4/34	5.4/10	1.6 to 98K	Radar	FAN SONG	Area defense
SA-2d	23.2/43	4.3/7	1.3 to 98K	Radar	FAN SONG	Area defense
SA-3	13/24	2/3.5	100 to 46K	Radar	LOW BLOW	Area defense 2/4 rall launcher
SA-5	162/300	3.8/7	984 to 114K	Radar	SQUARE PAIR	High speed, high altitude, HVAA threat
SA-6	13.4/25	2/4	100 to 46K	Radar	STRAIGHT FLUSH	Tracked, 3-missile launcher
SA-7	2.3/4.2	0.2/1.2	82 to 7.5K	IR		MANPAD tail only
SA-8	5.5/10	0.8/1.5	90 to 16.5K	Radar	LAND ROLL	6-wheeled vehicle
SA-9	2.3/4.2	0.4/0.8	98 to 11.5K	IR		BRDM-2 4 missile canisters
SA-10	40/75	2.7/5	33 to 82K	Radar	FLAPLID	Cruise missile defense
SA-11A	17/32	1.6/3	49 to 72K	Radar	FIRE DOME	Tracked, 4-missile launcher
SA-12A	40/75	4/7	820 to 98K	Radar	GRILL PAN	High performance, anti-ARM
SA-12B	54/100	7/13	2K to 98K	Radar	GRILL PAN	Standoff jamming aircraft threat
SA-13	2.7/5	0.3/0.6	32 to 11.5K	IR	SNAP SHOT	MT-LB chassis, tracked
SA-14	3.2/6	0.3/0.6	165 to 19.7K	IR		MANPAD all aspect
SA-15	6.5/12	0.8/1.5	50 to 19.6K	Radar	SCRUM HALF	Mobile, SA-8 follow-on
SA-16	2.7/5	0.27/0.5	0 to 11.5K	IR		MANPAD, improved SA-14

6.3 Counter Communications Electronic Warfare. Tactical communications on the modern battlefield may be subject to several factors. These factors can be the result of enemy jamming and deception, terrain interference, equipment malfunctions. See **Table 6.2**, Types of Jamming.

6.3.1 Techniques of Transmitting Jamming Signals.

- Spot Jamming—a narrowband signal intended to disrupt one specific frequency or channel.
- Barrage Jamming—a wideband signal to cause chaos on a wideband of frequencies or adjacent channels.
- Sweep through Jamming—the jammer repeatedly sweeps back and forth across the band.

Table 6.2 Types of Jamming.

Signal	Description
Random Noise	Synthetic radio noise. It is indiscriminate in amplitude and frequency. It is similar to normal background noise, and can be used to degrade all types of signals. Operators often mistake it for receiver or atmospheric noise, and fail to take appropriate EP actions.
Stepped Tones	Tones transmitted in increasing and decreasing pitch. They resemble the sound of bagpipes. Stepped tones are normally used against SC AM or FM voice circuits.
Spark	Easily produced and is one of the most effective jamming signals. Bursts are of short duration and high intensity; they are repeated at a rapid rate. This signal is effective in disrupting all types of radio communications.
Gulls	Generated by a quick rise and slow fall of a variable RF, and are similar to the cry of a sea gull. It produces a nuisance effect and is very effective against voice radio communications.
Random Pulse	Pulses of varying amplitude, duration, and rate are generated and transmitted. They are used to disrupt teletypewriter, radar and all types of data transmission systems.
Wobbler	A single frequency, modulated by a low and slowly varying tone. The result is a howling sound that causes a nuisance effect on voice radio communications.
Recorded Sounds	Any audible sound, especially of a variable nature, can be used to distract radio operators and disrupt communications. Music, screams, applause, whistles, machinery noise, and laughter are examples.
Preamble Jamming	A tone resembling the synchronization preamble of the speech security equipment is broadcast over the operating frequency of secure radio sets. Results in all radios being locked in the receive mode. It is especially effective when employed against radio nets using speech security devices.

6.3.2 Countering Communications Jamming.

6.3.2.1 Secure Active Nets. When creating a communication plan, it is recommended to consider the enemy capabilities. It is recommended to consider creating electronic counter-countermeasures (ECCM) to include HAVE QUICK II or SINGARS to maximize the potential of jamming. These measures will help prevent the enemy from direction-finding (DF), interception and jamming of the JTACs radio communications. Refer to AFTTP 3-1.JTAC, paragraph 6.3.3.2, Primary, Alternate, Contingency and Emergency Frequency Plans. See **Table 6.3**, Example of How to Push From Initial to Active.

NOTE: It is important to establish a POGO plan prior to transitioning to the active net in the event of unforeseen timing or programming errors that prevent two way communication with the JTAC.

Table 6.3 Example of How to Push From Initial to Active.

HOG1: "EXTERMINATOR 94, HOG 1 ON WE02 IN THE RED."
XR94: "HOG 1 SAY POSIT."
HOG1: "HOG 1 AND 2 10 MILES SOUTH OF CP RED DELTA."
XR94: HOG 1 PROCEED CP RED DELTA, MAINTAIN BLOCK 15 TO 17 HOLD E TO W LEGS CALL WHEN ESTABLISHED."
HOG1: "PROCEEDING RED DELTA BLOCK 15 TO 17, WILCO."
XR94: "HOG 1 XR94 IS READY FOR MICKEY."
HOG1: "C, XR94 MICKEY IN 5."
TOD SENT
XR94: "GOOD MICKEY, PUSH ACTIVE WE01, IF NO COMMS IN 30 SECONDS POGO WE02."
HOG 1: "WILCO PUSHING ACTIVE WE01."

6.3.3 Secure Communications. Secure frequencies, either frequency agile (active) or single channel, are often the primary frequencies used during mission execution. Signal clarity is a significant factor in determining the use of secure communications. If operating unencrypted (in-the-clear) to enhance transmission clarity, consider switching members of the flight to the secure mode to pass sensitive information. Refer to AFTTP 3-1.JTAC, paragraph 6.3.3.1, Secure Frequency Hopping.

6.3.3.1 Brevity Codes. Brevity codes include pro-words and code words. Pro-words and code words can be coordinated between the airborne command element (ACE) and the ground command element (GCE) in mission planning and standardized in special instructions (SPINS). Pro-words are used for passing procedural information during the execution of a mission and are not intended to keep the meaning classified from the enemy. An example of a pro-word is Buster, meaning fly at maximum continuous speed. Code words serve to keep the meaning of the word classified from the enemy. Code words are most often used in an execution checklist (EXCHECK). An example of a code word might be Lions, meaning the GCE is requesting extract. Code words should change the meaning from mission to mission, but pro-words remain the same. This method of communicating requires use of a radio, but the brevity of transmission does not allow the threat to hone in on the aircraft. This method also requires close coordination between team members prior to the mission.

6.3.4 Preplanned Frequency Changes. A PACE plan is essential in a communication degraded environment. The enemy can deny the use of a radio frequency without the JTAC being aware of jamming. Preplanned frequency changes are used to enhance JTAC air-to-ground communications with a minimum use of the radios. Changing frequencies based on time, phase lines, visual signals, or checkpoints. If the JTAC's HAVE QUICK (UHF) net is being denied, the ability to CHATTERMARK to another HAVE QUICK TAD sometimes can be rendered ineffective. JTACs should develop PACE plans that use HF, VHF-LOW, VHF-HIGH and UHF frequencies. CAS players can then CHATTERMARK from a UHF-HIGH to VHF-LOW to escape UHF jamming. Even a single channel VHF-LOW frequency would have the desired intent and all CAS platforms are equipped and trained for this. Refer to AFTTP 3-1.JTAC, paragraph 6.3.3.2, Primary, Alternate, Contingency and Emergency Frequency Plans.

- **P**rimary.
- **A**lternate.
- **C**ontingency.
- **E**mergency.

6.3.5 RADIO Procedures for Jamming.

6.3.5.1 If a JTAC Suspects Radio Frequency Jamming.

6.3.5.1.1 Disconnect the Antenna. If the interference continues, there is an internal radio problem. If the interference decreases, it is from an outside source. If the interference is from an outside source, tune the radio several kilohertz on either side of the operational channel. If the noise level drops, the radio is probably being spot jammed. If the noise level remains the same, the interference is either barrage jamming or interference from friendly electronic devices. It can be difficult to tell the difference between barrage jamming and friendly interference. One way to determine this is to search the immediate area to see if there are any power lines, or electronic devices, motors, or generators operating. See **Table 6.4**, Checklist When Jamming Occurs.

6.3.5.2 If a JTAC Suspects Radio Frequency Spoofing. In situations where there is jamming or spoofing present on the net, or when an unauthorized user is monitoring, the word "CHATTERMARK" should be called over the net with a named frequency to transition to. See **Table 6.5**, Chattermark Comm Flow.

Table 6.4 Checklist When Jamming Occurs.

1. Ensure the antenna is able to achieve optimal line of sight.
2. If antenna is remoted, relocate antenna to radio.
3. Ensure the radio is on high power.
4. Change locations to terrain mask antenna.
5. Keep transmissions short.
6. Communicate only when essential.
7. Send clear, concise messages.
8. Use the phonetic alphabet and numbers.
9. Speak slowly.
10. Change antenna type or it is polarization.
11. Keep operating on primary frequency.
12. Change frequency (when authorized).
13. Authenticate to avoid deception.
14. Do not reveal jamming effectiveness over the air.
15. Increase volume.
16. Send a MIJI Report to the ASOC ASAP.

Table 6.5 Chattermark Comm Flow.

HOG1: "EXTERMINATOR 94, HOG 1 ON WE02 IN THE RED."
XR94: "HOG 1 SAY POSIT."
HOG1: "HOG 1 AND 2 CURRENTLY 10 MILES SOUTH OF CP RED DELTA."
XR94: "HOG 1 PROCEED CP RED DELTA, MAINTAIN BLOCK 15 TO 17 HOLD EAST TO WEST LEGS CALL WHEN ESTABLISHED."
HOG1: "PROCEEDING RED DELTA BLOCK 15 TO 17, WILCO."
XR94/HOG01 Hearing Grunting sounds on WE01
XR94: "HOG01 CHATTERMARK YELLOW01."
HOG 1: "CHATTERMARK YELLOW01."

6.3.6 JTAC ECCMs. Terrain Masking. JTACs should plan to protect communications with terrain masking whenever they are operating in a contested environment. Since radio waves are incapable of penetrating solid terrain, direction finders and jammers are much less effective at telling exactly where transmissions are coming from when they have been deflected by an object. Likewise, in regards to long-haul communications, the sources of sky-wave signals are much harder to direction find than direct signals due to the refraction that occurs in the ionosphere. Selecting an observation position (OP) that permits direct LOS to a target area and direct LOS to the aircrafts holding area (HA), while also limiting LOS to anticipated jammer locations. This is usually accomplished by placing observers partway up a ridgeline, permitting LOS of a specific named area of interest (NAI) or engagement area (EA), while the majority of the enemy-occupied terrain is obscured by the rest of the terrain feature.

6.3.6.1 Aircraft Holding Areas Against EW Assets. JTACs must also consider using multiple, flexible HAs, IPs, and BPs for aircraft during contested operations. Ideally, these will have clear line of sight to the target area and the JTAC, facilitating target acquisition and communications. It may become necessary for the JTAC to shield the aircraft from enemy EW interference reducing the aircraft's holding altitude and using an IP/BP behind a terrain feature, but the JTAC must maintain line of sight to the aircraft communications. When using this technique, the JTAC might lose communications with the aircraft once it unmasks or departs the IP/BP, forcing the JTAC to provide early clearance.

6.3.6.2 Forward Observation Integration. It is important to note that forward observers (FO) and other personnel providing terminal guidance operations (TGO) may become completely ineffective in a jamming environment, primarily due to lack of redundant systems capable of defeating ECMs. JTACs should make every effort to prepare them for success by explaining and rehearsing communications and CHATTERMARK plans, providing necessary equipment items, and ensuring that a get-well frequency has been established. CAS players should plan to transition to the get-well frequency after a limited period (usually 1 minute) of losing communications.

6.3.6.3 Communications-Out Clearance Plans. When facing peer adversaries, JTACs must consider the possibility that the use of the electromagnetic spectrum will be completely denied during execution.

6.3.7 Reporting Communications Jamming. If suspecting any type of jamming/ interference with LOS or BLOS communications immediately collect data to create a meaconing, Intrusion, Jamming, and Interface (MIJI) report to higher headquarters. Pertinent info needed to pass with this report should include in **Table 6.6**, MIJI Report.

NOTE: Once the MIJI Report is filled out, the report is considered Secret due to the information on the documentation.

6.3.8 Chemical, Biological, Radiological and Nuclear Defense.

6.3.8.1 Chemical, Biological, Radiological and Nuclear defense and High yield Explosives (CBRNE). When the JTAC is working in this type of environment, protected measures must be taken to ensure survivability. These measures include levels of MOPP gear application, as well as sanitation procedures when crossing over into different areas to avoid contamination or cross-contamination. JTAC TTP are currently in the works to solve the issue of radio communication equipment (e.g., headsets that work with the GAS mask, and PTT). Unit supply managers should seek out emerging equipment to update J-List items for deployed environments.

Table 6.6 MIJI Report.

			This Is		**Standby for MBI Report Over**	**Unit Called Responds Back**
Unit Called				**Unit Calling**		
			This Is		**Flash-Immediate-Priority-Routine Top Secret-Secret-Confidential-Unclassified**	
Unit Called				**Unit Calling**		
Line 1	or	Unit				(Unit Identification)
Line 2	or	Type	Meaconing-Intrusion-Jamming-Interference-Chaff			
Line 3	or	Location				(Location-Lat/Long, UTM, or MGRS)
Line 4	or	On Time				(Start Day-Time-Zone)
Line 5	or	Off Time				(End Day-Time-Zone)
Line 6	or	Effects				(Operations/Equipment Affected)
Line 7	or	Frequency				(Frequency/Frequency Range)
Line 8	or	Narrative				(Short description of what was experienced)
Line 9	or	Time				(Time Reporting Day-Time-Zone, as needed)
Line 10	or	Authentication				(Authentication IAW JTF Requirements)

6.4 Contested Space-Based Systems. As with LOS-based communication systems, space-based systems can also fall victim to jamming. The JTAC can load CV keys into the GPS to provide the best position and time accuracy information, and also increase protection from jamming and spoofing. When a JTAC has identified if GPS denial or jamming is suspected, it is critical to rely on the tools that cannot be affected (i.e., map and compass). Signal interference (jamming) may occur due to hostile parties or when operating near large metal objects, dense foliage, or high power electronic emissions. Improve operations by completing the following.

- Break LOS by putting significant terrain or distance between you and the emitter is the best option when available.
- Operate the GPS close to the ground to minimize reception of ground-based signals.
- Terrain masking. Density of earth, thickness, and height are all factors to consider when combating jamming. A simple rule of thumb to use is “The bigger the better.”
- Avoid operating the GPS near a tank, dense foliage, or a source of high power electronic emissions.
- Block the jamming signal by placing your body between the DAGR and the jamming source.

- Use average mode of operation to acquire present position data.
- Use jammer finder procedures to aid in finding source of jamming.
- Use the anti-jam accessory when in a host platform.

6.4.1 Effects and Steps in a Contested Space Domain. See AFTTP 3-1.JTAC.

6.4.2 GPS Malfunction/Inoperable. When a JTAC has a GPS malfunction or GPS is damaged or broken, it is imperative to revert back to basic field skills and SA enhancing tools in order effectively battle track. Examples of SA tools include terrain association, map/compass, terrain sketches or imagery downloaded to SWAK.

6.4.2.1 Terrain Association. One of the key requirements for the delivery of accurate fire on a target is an accurate target location. The observer must be able to determine an accurate position of a target on the ground. The keys to accurate target location are as follows: Self-locating to within 100 meters each time he moves. Using prominent terrain features to relate potential target areas to grid locations on the map. Making a thorough study of terrain by drawing a terrain sketch (in a static environment). Associating the direction in which he is looking with a direction line on the map. Ensuring that a planned target is always a recognizable point on the ground (except for cannot observe missions). Terrain-map association may not be possible when maps are unavailable, or the terrain has no features. Using large-scale maps (1:250,000 or larger) may also make terrain-map association difficult.

6.4.2.2 Resection. This method is for locating one's position on a map by determining the grid azimuth to at least two well-defined locations that can be pinpointed on the map. For greater accuracy, the desired method of resection would be to use three or more well defined locations. See **Table 6.7**, Resection.

Table 6.7 Resection.

1. Orient the map using the compass.
2. Identify two or three known distant locations on the ground and mark them on the map.
3. Measure the magnetic azimuth to one of the known positions from your location using a compass.
4. Convert the magnetic azimuth to a grid azimuth.
5. Convert the grid azimuth to a back azimuth. Using a protractor, draw a line for the back azimuth on the map from the known position back toward your unknown position.
6. Repeat 3, 4, and 5 for a second and third position, if desired.
7. The intersection of the lines is your location. Determine the grid coordinates to the desired accuracy.

6.4.2.3 Intersection. The location of an unknown point by successively occupying at least two (preferably three) known positions on the ground and then map sighting on the unknown location. It is used to locate distant or inaccessible points or objects such as enemy targets and danger areas. There are two methods of intersection: the map and compass method, and the straight edge method. See **Table 6.8**, Intersection, and **Table 6.9**, Straight Edge Method.

Table 6.8 Intersection.

1. Orient the map using the compass.
2. Locate and mark your position on the map.
3. Determine the magnetic azimuth to unknown position using a compass.
4. Convert the magnetic azimuth to a grid azimuth.
5. Draw a line on the map from your position on this grid azimuth.
6. Move to a second known point and repeat Steps 1, 2, 3, 4, and 5.
7. The location of the unknown position is where the lines cross on the map. Determine the grid coordinates to the desired accuracy.

Table 6.9 The Straight Edge Method.

1. Orient the map on a flat surface by the terrain association method.
2. Locate and mark your position on the map.
3. Lay a straight edge on the map with one end at the user's position (A) as a pivot point; then rotate the straight edge until the unknown point is sighted along the edge.
4. Draw a line along the straight edge.
5. Repeat the above steps at position (B) and check for accuracy.
6. The intersection of the lines on the map is the location of the unknown point (C). Determine the grid coordinates to the desired accuracy.

6.4.2.4 Laser Range Finder Malfunction/Inoperable and TTP. In the JTAC community there are multiple types of optics. When you are constricted on time or your LRF is damaged/lost, it is crucial to understand the capabilities to be able to effectively estimate range with the given optics. Using your available optics can give you a rapid range estimation.

6.4.2.5 Ranging Features of the Advanced Combat Optics Gunsight (ACOG). The horizontal stadia lines represent 19 inches at the respective ranges between 400 and 800 meters. See **Figure 6.2**, Ranging Features of the ACOG. They should fit the average width of the frontal view of a man's shoulders:

- Range your target using the width of the stadia lines.
- The outside legs of the Chevron equal 19 inches at 300 meters.

6.4.2.6 Flash-to-Bang Method. To use this method for determining range to an explosion or enemy fire, begin to count when the flash is seen. Count the seconds until weapon fire is heard. This time interval may be measured with a stopwatch or by using a steady count, such as one-thousand-one, one-thousand-two, and so forth, for a three-second estimated count. If there is a count higher than 10 seconds, start over with one. Multiply the number of seconds by 350 meters to get the approximate range. See **Table 6.10**, Flash to Bang Formula, and **Table 6.11**, HRM Rule.

Figure 6.2 Ranging Features of the ACOG.

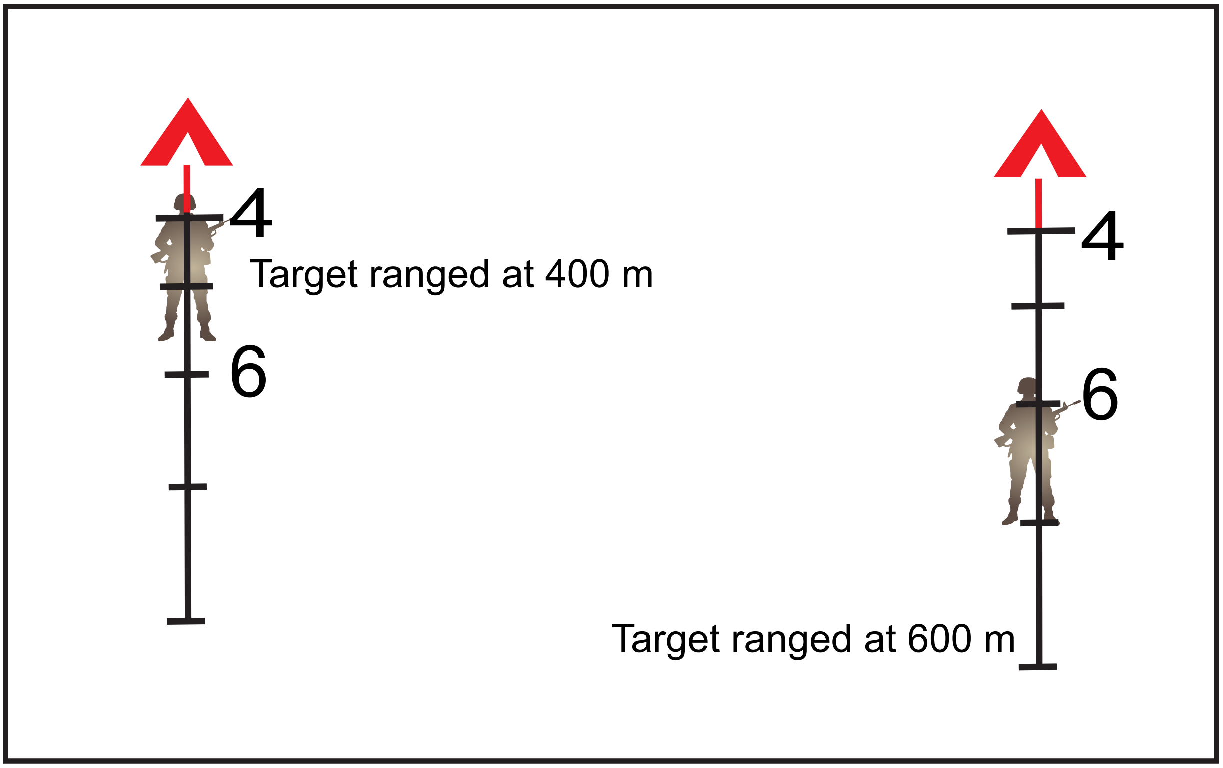


Table 6.10 Flash to Bang Formula.

Flash to bang (sec) x 350 = distance
• Speed of sound is 343.2 m/sec
• Round off method: 350 m/sec
• An observer sees a T-72 cannon fire after 6 seconds hears from firing.
• Range = 6 sec x 350
• Range = 2,100 meters

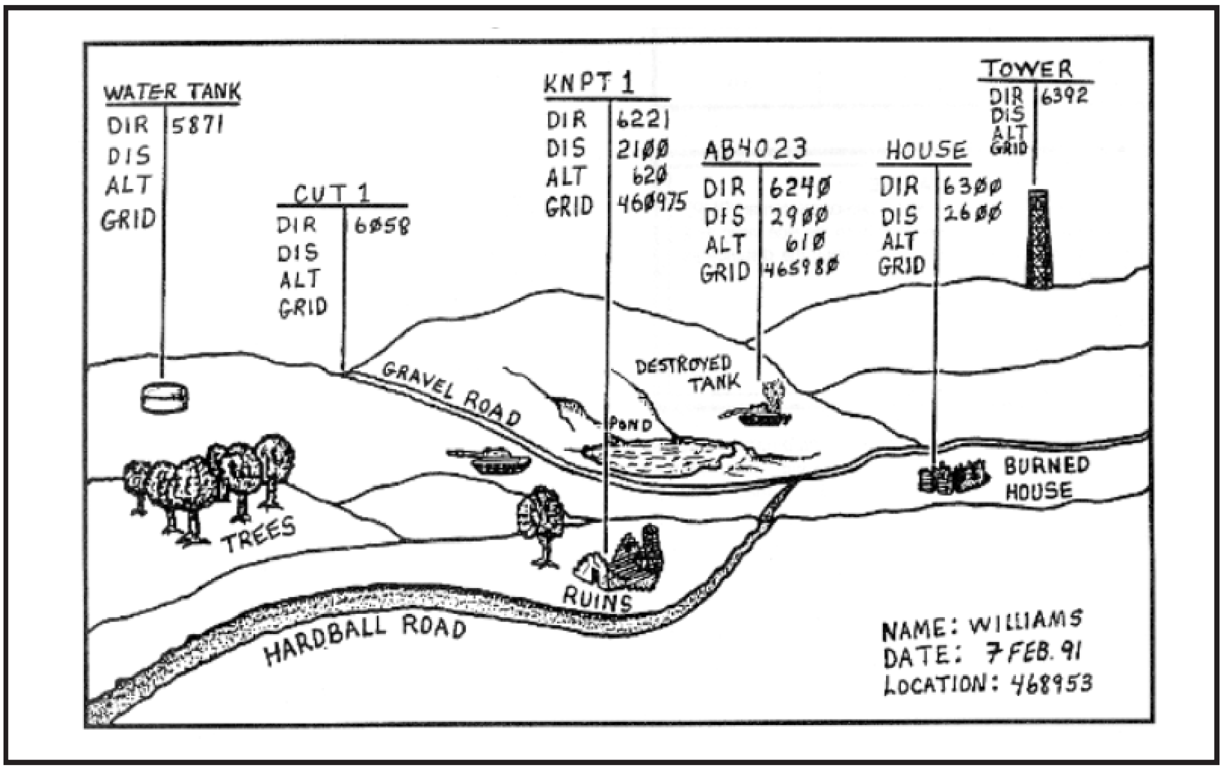
Table 6.11 HRM Rule.

• Height (x 1,000) = range x mils
• Range = Height (x 1,000)/mils
• An observer sees a bmp that measure 2 mil tall in his mil Reticle binoculars. The bmp is known to be 2.06 m in height
• Range = 2.06 (x 1,000)/2
• Range = 1,030 meters

6.4.2.7 Terrain Sketches. The terrain sketch is a panoramic sketch as precise as possible of the terrain by the observer of his area of responsibility. It aids in target location in a static environment. See **Figure 6.3**, Terrain Sketches. The terrain sketch should include the following.

- The skyline (horizon).
- Intermediate crests, hills, and ridges.
- Other natural terrain features (distinctive bodies of water and vegetation).
- Man-made features (i.e., buildings, roads, power lines, towers, antennas, and battlefield debris).
- Labels (reference points and targets).

Figure 6.3 Terrain Sketch.



6.4.2.7.1 Sketch Map. Road sketches show the natural and military features in the immediate vicinity of the road. The width of terrain sketches do not exceed 365 m on each side of the road. Road sketches may be used to illustrate a road when the existing map does not show enough detail. Area sketches include sketches of positions, OPs, or places. A position sketch is one of a military position, campsite, or other area on the ground. An OP sketch shows the military features of the ground along a friendly OP line as far toward the enemy position as possible. A place sketchone of an area made by a sketcher from a single point of observation. Such a sketch may cover ground in front of an OP line, or it may serve to extend a position or road sketch toward the enemy. Once it is constructed, the observer can use the terrain sketch to help quickly and accurately locate targets by referencing from information already known in the area of responsibility. A terrain sketch also provides a rapid means of orienting relief personnel. Terrain sketches must be continually refined and updated with data from available fire support planning documents, to include target numbers, the final protective fire (FPF), and any fire support coordination measures (FSCM).

6.4.2.8 M22 Binocular Reticle Range. See **Figure 6.4**, M22 Binocular Range Reticle, and **Table 6.12**, Known Dimensions of Weapons Systems.

6.4.2.8.1 Binocular Measurement Formula. View target and measure target size in mils. Each long TIC = 10 mils, Short TIC = 5 mils. Apply formula to determine range:

(Known target size in [Meters]) x 1,000 = Range (M) (Target Size in mils)

EXAMPLE: Tank in reticle is a M-1 with a known height of 2.9 meters. Target height in mils = 15 based on the range reticle.

2.9 meters x 1,000 = 193.3 meters x 3.28 = 634 feet range 15 mils

Figure 6.4 M22 Binocular Range Reticle.

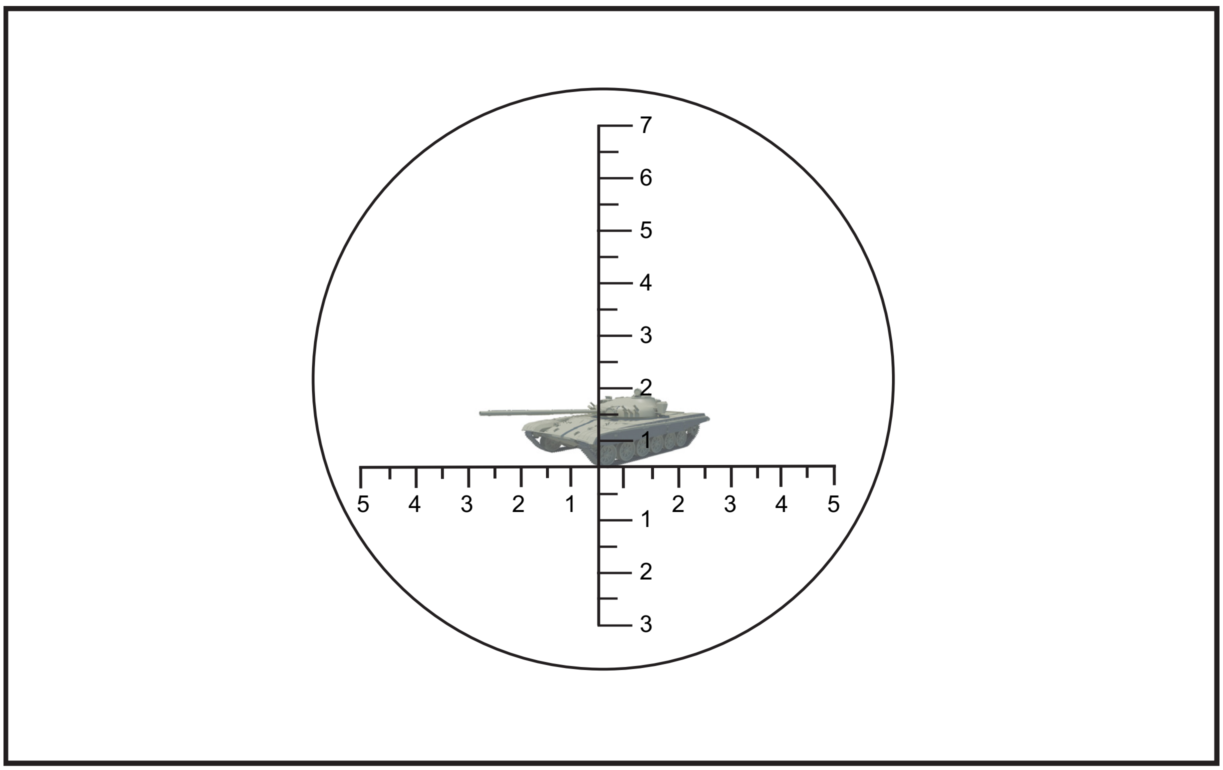


Table 6.12 Known Dimensions of Weapon Systems.

System	Length	Width	Height
M-113	4.85 m	2.54 m	NA
LAV-25	6.39 m	2.5 m	2.69 m
M-2/3	6.5 m	7.6 m	3 m
M-1A1	9.78 m	3.66 m	2.89 m
System	**Length**	**Width**	**Height**
T-72	9.66 m	3.58 m	2.19 m
BMP-1	6.7 m	2.74 m	2.13 m
BTR-70/80	7.85 m	2.8 m	2.45 m
T-80/90	9.66 m	3.6 m	2.2 m
System	**Length**	**Width**	**Height**
2S6	7.77 m	3.33 m	NA
ZSU-23-4	7 m	4 m	3 m
SA-8	9.2 m	2.2 m	4.57 m
SA-13	6.9 m	2.87 m	4 m

6.5 Contested Cyber Domain. See AFTTP 3-1.JTAC, paragraph 6.5, Contested Cyber Domain.

6.5.1 JTAC Steps to Operate in a Contested Cyber Domain. Successful CAS operations in a contested-cyber environment requires several things. The first is the situational awareness to tell when cyber interference is happening. This requires players at all levels knowing what right, to include computer operations and real-world battle tracking, looks like, and comparing that to what is being displayed on digital systems. Reporting discrepancies to higher headquarters to identify enemy intrusions. If enemy intrusion is detected on digital systems, JTACs must be prepared to revert back to a purely analog method of planning, battle tracking, and controlling with maps, compasses, protractors, and strictly voice communications. See Table 6.13, Joint Tactical Cyber Request.

Table 6.13 Joint Tactical Cyber Request.

1. Mission Request	**Description of Request (Required)**
JTCR Priority	[High] [Medium] [Low]
Cyber Operation Type	[OCO] [DCO] [DODIN] [Cyber ISR/OPE]
Operation ISO	
Related CERF	
Requesting Organization	
2. Timing and Tempo	**Description of Request (Required)**
Planning	[Preplanned] [Immediate]
Schedule Type	[Scheduled] [Immediate]
Start By	mm/dd/yyyy nn.mm Z
Finish By	mm/dd/yyyy nn.mm Z
3. Effects Requested	**Description of Request (Required)**
Requested Effect	
Target/Threat Location	
Desired Effects	
Termination Criteria	
4. Cyber IRS/OPE	**Description of Request (Only required for Cyber ISR and OPE)**
Area of Operations	
ISR Reference Points	
Amplifying Information	
5. DCO Mission	**Description of Request (Only required for DCO missions)**
Threat	
Assessment Location	
Assessment Information	
Amplifying Information	
6. OCO Mission	**Description of Request (Only required for OCO missions)**
Intel Trigger (Optional)	
IO Product (Optional)	
Valid Targets	
Amplifying Information	
7. DODIN Mission	**Description of Request (Only required for DODIN POND missions)**
Justification	
Locations Affected	
Amplifying Information	

LEGEND:
CERF—cyber effects request format
DCO—defensive cyber operations
DODIN—Department of Defense Information Network
IO—information operations
ISO—information security
ISR—intelligence, surveillance, and reconnaissance
JTCR—joint tactical cyber request
OCO—offensive cyber operations
OPE—operational preparation of the environment
POND—period of nondisruption

6.6 (FOUO) Tactical Camouflage and Concealment. At the tactical level, adversaries are most reliant on camouflage and concealment to hide personnel, locations, equipment, and intentions. This is usually accomplished with camouflage paint or uniforms. Additionally, light and noise discipline, limiting engine operation to reduce heat signatures, using low-light, poor visibility (fog or rain) to improve/move positions, and conducting movements in forested areas, along the back-slopes of terrain, or in other areas that are concealed by visual and system-aided detection. Engineers are also used to create dug in fighting positions for personnel and equipment. Refer to AFTTP 3-1.JTAC, paragraph 6.6.1, Tactical Camouflage and Concealment.

6.6.1 JTAC CCD Countermeasures. There are several means of reducing the enemy's ability to employ camouflage, concealment, and decoy (CCD), and FSU doctrine. It is essential to confirm valid targets through redundant means. The potential for a decoy to be planted in a column of tanks or under the disguise of a DFP is likely. There will always be an inherent level of risk employing a munition onto one of the decoys. Prioritizing non PGMs on initial attacks is recommended. Field artillery can be another cheap tool to fix and confirm the validity of any decoys. Whether it is through ground means, i.e., laser range finder (LRF) equipment, binoculars, INT sources etc., or from the air using heat signatures, looking over the rail, or employing on a ground based laser, patience and redundant means are crucial to not being deceived.

6.7 Laser Countermeasures. See AFTTP 3-1.JTAC, paragraph 6.7, Laser Countermeasures.

6.7.1 Laser Warning Receivers. Adversaries have also begun employing laser warning receivers (LWR), like the Russian vehicle-mounted soft-kill active protection system (ShTORA), at the tactical level. When a target detects that laser energy, ShTORA provides a warning that identifies the laser type, provides an azimuth to the source, and recommends defensive actions. In addition to detecting laser target designators (LTD), current LWRs are capable of detecting LRF, placing concealed Ops at significant risk of detection.

6.7.1.1 (FOUO) Other Laser Countermeasures. When a vehicle is not equipped with an advanced LWR, it will likely contain other laser countermeasures, such as vehicle engine exhaust smoke systems (VEESS), vehicle-launched smoke grenades (VLSG), large area smoke generators (LASG) artillery-delivered smoke, smoke pots/drums/barrels, and handheld smoke grenades. VEESS are almost universal on Russian armored vehicles, and while they cannot identify the source of a laser, they are capable of severely degrading an LGMs effectiveness.

6.7.2 JTAC Operations in a Laser-Contested Environment. See AFTTP 3-1.JTAC, paragraph 6.7.2, JTAC Operations in a Laser-Contested Environment.

6.8 Degraded Operations. Degraded operations can typically be split into two main sub-areas: physical degradation (terrain, weather, night, and civilian infrastructure) and friendly force degradation (ground and airborne electronic interference). Degraded systems also include damage to the equipment and resultant failure of equipment systems and/or notional injuries to crew members. Communications degradation may include one or multiple radio failures, data link degradation, battery troubles, LOS obstructions and/or saturation of voice or data link communications. Weapons delivery degradation may consist of removing subsystem components from the support aircraft weapons solution that will varying levels/types of degradation observed weapons impacts to a pre-specified level of accuracy.

6.8.1 Environmental Effects to Radio Communications. See **paragraph 8.8.2**, Cultural Lighting.

6.8.1.1 Field Expedients Antennas. In a Satellite degraded, lack of satellite environment and/or lack of LOS due to the environment and terrain, HF/FM might be the best form of communications for long haul communications. In the event of not having a prefabricated HF/FM antenna, use field expedient antennas to enable communications in the field. See **paragraph 2.3.8**, Field Expedient Antennas.

6.8.1.2 Weather Conditions. Sensor and weapon capabilities are degraded by inclement weather and limited visibility conditions. JTACs should consult weather forecasts to plan for the impacts of precipitation, could cover, fog, and ice. All of these have adverse impacts on lasers and sensors. Wind can also degrade mission effectiveness by blowing smoke marks away from targets, blowing smoke and debris over targets and obscuring them, degrading weapons employment. Finally, sunrise/sunset times, thermal crossover, moon phases, and ambient light can significantly impact most sensor types. JTACs can mitigate the effects of weather has on sensors by using synthetic aperture radar (SAR), moving target indicator (MTI), radar marks, and shortwave infrared (SWIR).

6.8.2 Synthetic Aperture Radar. The SAR is an all-weather imaging tool able to penetrate through clouds and collect data during the day or night. The longer wavelengths also can penetrate into the forest canopy and in extremely dry areas, through thin sand cover and dry snow pack. SAR is a line-of-sight sensor and takes advantage of the long-range propagation characteristics of radar signals and the complex information processing capability of modern digital electronics to provide high-resolution imagery. Synthetic aperture radar complements photographic and other optical imaging capabilities because of the minimum constraints on time of day and atmospheric conditions and because of the unique responses of terrain and cultural targets to radar frequencies. See **Figure 6.5**, Synthetic Aperture Radar Imagery; AFTTP 3-1.JTAC, paragraph 6.8.2, Synthetic Aperture Radar; and Table 6.3, Radar Capable Aircraft.

6.8.3 Moving Target Indicators. See AFTTP 3-1.JTAC, paragraph 6.8.3, Moving Target Indicators.

6.8.3.1 Counter-Insurgency Techniques. See AFTTP 3-1.JTAC, paragraph 6.8.3.1, Counter-Insurgency Techniques.

6.8.3.2 Major Combat Operations Techniques (MCO). In an MCO environment JTACs can use MTI sensors to scan NAIs for vehicles and rotating antennas, and use DMTI to detect personnel movements. If enemy forces are detected, grids can be generated and used for artillery or CAS attacks. MTI also helps the friendly force identify the enemy conducting mass and maneuver, prepare for defense, and move into an advantageous position.

Figure 6.5 Synthetic Aperture Radar Imagery.

6.8.4 Moving Target Track. In addition to GMTI, many radars (i.e., those found on the B-1B, F/A-18 and F-15E) provide ground moving target track (GMTT). By constantly computing a GMTT's direction, speed of travel and a selected weapon's time of flight, the bombing computer can determine an aimpoint for both freefall and guided munitions that provides a reasonable chance of achieving effects on a target. Many factors, such as changes in the vehicle's rate or direction of travel will reduce the probability of a kill, however this provides the ability to stop or delay a mobile enemy in an area advantageous for follow-on attacks, in all-weather conditions.

6.8.5 Radar Marking. It is only accurate to 30 meters per NM. Not all aircraft can track the same radar codes. JTACs must coordinate with aircrews prior to ensure compatibility.

6.8.6 Shortwave Infrared. Refer to AFTTP 3-1.JTAC, paragraph 6.8.6, Shortwave Infrared.

6.8.7 Fused Sensors. See AFTTP 3-1.JTAC, paragraph 6.8.7, Fused Sensors.

6.9 Friendly Forces Interference. See AFTTP 3-1.JTAC, paragraph 6.9, Friendly Forces Interference.

6.10 Operational Limitations. Operational limitations include theater ROE, SPINS, acceptable levels of risk (ALR), weapons availability, dynamic targets, C2 limitations (e.g., proximity, blind zones), friendly/neutral country political border constraints, support asset limitations, and intelligence gaps.

6.10.1 ROE/SPINS. ROE includes self-defense, hostile act, hostile intent, and hostile force. It is important to thoroughly understand and comply with the theater specific ROE/SPINS as they can limit operational TTP and present challenging constraints during certain situations.

Additionally, ROE/SPINS will dictate the dynamic targeting (DT), weapons availability, and friendly/neutral country political restrictions. While execution of the DT mission in a denied and degraded environment will follow established ROE and procedures dictated in theater guidance, adaptations may need to be made if authorization for certain targets are required from supported commanders. Therefore, it is imperative to conduct battle drills to ensure the entire staff and supported commander understand theater specific DT process.

6.10.2 Command and Control Limitations. Refer to AFTTP 3-1.JTAC, paragraph 6.10.2, Command and Control (C2) Limitations.

6.10.3 Intelligence Gaps. Refer to AFTTP 3-1.JTAC, paragraph 6.10.3, Intelligence Gaps.

6.10.4 Collateral Damage. Collateral damage (CD) is effects to structures and noncombatant that are unintended targets during an attack due to fragmentation or a weapon miss. Consult local ROE as to the exact nature of collateral damage concerns for the specific battlespace. In general, limit CD first with weapon selection, then with fuzing. An unguided weapon generally will have more potential for collateral damage than a guided weapon due to the greater CEP of unguided weapons.

6.10.5 Mitigation Techniques. Attempt to mitigate CD by first using smaller, more accurate weapons. If unable to mitigate with weapons selection, then consider mitigating CD with fuzing to allow the weapon to penetrate into the target before functioning. Use the smallest delay setting required, as weapons penetration will increase the chance of failure. A third option is to change attack restrictions (e.g., run-in). Finally, collateral damage can be mitigated even further by shifting the impact location of the target away from the collateral damage concern. This technique should be used only if no other option exists.

6.10.6 Weapons Availability. Throughout mission planning, consideration should be applied towards the remaining type(s) of munitions available to the GFC. There is potential, theatre dependent, for all PGMs to be expended and/or inaccessible due to the priority of a mission set.

CHAPTER 7

PERSONNEL RECOVERY

7.1 General. Personnel Recovery (PR) is defined as the sum of military, diplomatic, and civil efforts to prepare for and execute the recovery and reintegration of isolated personnel. The branches of the US Armed Forces approach personnel recovery in different manners that reflect the overall mission and capabilities. Militarily speaking PR missions fall on a broad spectrum from picking up an ejected fighter pilot from international waters, extracting aircrew and assault force members out of a crashed helicopter, or rescuing stranded ground forces. TTP will vary greatly based on the location of the operation, style of conflict, and capability of threats. This document will discuss TTP for a JTAC on a dedicated and designated PR operation, and in uncontested and contested environments. For further information, refer to JP 3-50, *Personnel Recovery*, AFTTP 3-1.JTAC, and/or AFTTP 3-3.Guardian Angel (GA). DOD common practices are in **Table 7.1**, Department of Defense Common Practices table.

Table 7.1 Department of Defense Common Practices.

Combat Search and Rescue (CSAR)	US Air Force and US Navy	TTP performed by US Air Force and US Navy forces to recover isolated personnel from hostile or uncertain operational environments.
Tactical Recovery of Aircraft and Personnel (TRAP)	US Marine Corps	Performed by any combination of aviation, ground, or waterborne assets for the specific purpose of the recovery of personnel, equipment, and/or aircraft when the tactical situation precludes SAR assets from responding and when survivors and their location have been confirmed.
Quick Reaction Force (QRF)	US Army and US Marine Corps	Forces organized to react quickly to multiple missions, not just PR, but redirected to react to an isolating event. A QRF can respond via ground or air, depending on availability of assets and stage from afloat or from ground locations.
Search and Rescue (SAR)	All DOD	The use of aircraft, surface craft, submarines, and specialized rescue teams and equipment to search for and rescue distressed persons on land or at sea in a premissive environment.

7.2 Roles and Responsibilities.

7.2.1 Joint Personnel Recovery Center. The joint personnel recovery center (JPRC) is responsible for assisting the joint force commander (JFC) in planning and coordinating PR operations within the assigned operational area.

7.2.1.1 Each geographic combatant commander (GCC) will establish a JPRC. This may be done by designating a Service component command as the JPRC or by task organizing assigned forces. For example, CENTCOM has an established JPRC at the CAOC.

7.2.2 Personnel Recovery Coordination Cell. Service component commanders establish a personnel recovery coordination cell (PRCC) (or functional equivalent) to coordinate all component PR activities, including coordination with the JPRC and other component PRCCs.

7.2.3 Personnel Recovery Task Force. When an isolating event occurs, a personnel recovery task force (PRTF) is organized to execute that specific PR mission. A PRTF is a cohesive, interoperable force that may consist of any variety of dissimilar aircraft, ground vehicles, or maritime vessels. Its size can range from a single recovery vehicle operating within a joint C2 context, to dozens of air, ground, or sea elements working in concert. The forces that make up a PRTF fall into two general categories: dedicated or designated. A doctrinal PRTF will include an AMC, rescue combat air patrol (RESCAP), SEAD, rescue mission commander (RMC)/on-scene commander (OSC), rescue escort (RESCORT), rescue/recovery vehicle (RV), and an extraction force.

7.2.3.1 Dedicated forces are units and assets that are specially organized, trained, and equipped to conduct PR missions. The likelihood for success of a PR mission increases when dedicated PR assets are in a position to execute. An example of a dedicated PR asset is a Guardian Angel team or a tactical recovery of aircraft and personnel (TRAP) team.

7.2.3.2 Designated forces are not specifically organized, trained, and equipped to conduct PR missions but which possess capabilities that can be applied to the PR mission. An example of a designated PR asset would be a quick reaction force (QRF) with STRYKERs located in a favorable position when the isolating event occurred or an Operational Detachment Alpha (ODA) team located near a crash.

7.2.4 Airborne Mission Coordinator. The primary role of the AMC is to coordinate and control aircraft during a PR mission and facilitate information flow between tactical assets and C2 elements. The primary AMC platform is the E-3 AWACS with the secondary being the E-8 JSTARS. Other suitable assets include the HC-130J, E-2D Hawkeye, MC-130, and the RC-135 RIVET JOINT. These assets can provide a limited AMC capability if no other asset is available.

7.2.4.1 The desired AMC aircraft is an airborne platform with the best combination of on-station time and organic communications capability.

7.2.4.2 Ground based assets, such as a control and reporting center (CRC), air support operations center (ASOC), or direct air support center (DASC) can fulfill the roles and responsibilities of the AMC in the absence of a more capable airborne asset.

7.2.5 On-Scene Commander. The OSC is the individual with the highest level of SA in vicinity of the isolated personnel (IP) with the ability to communicate with the IP, recovery personnel, and C2 agencies. In theory, this could be the JTAC with the understanding the JTAC is still working for the GFC. Regardless, be prepared to build a Personnel Recovery 15-Line Execution Brief (PR 15-Line) (**Table 7.2**) for handover when an RMC checks on.

- In the event the JTAC has the highest SA or perceives no one has taken charge, clearly declare self as OSC and take control of air assets.
- The OSC will accomplish initial steps of A-TLC.
- Authentic the IP.
- Determine threats to the IP and other aircraft.
- Locate the IP.
- Determine the condition of the IP.
- Once communications have been established with the IP, the OSC should continue to monitor the IP's radio frequency in case immediate actions are required to prevent capture.

7.2.5.1 The OSC will assume command of the PR effort until relieved by an RMC.

7.2.5.2 Treat incident site/IP location like any other objective area. Provide sensor taskings, use on-station assets to keep enemy and civilians away. Use aircraft to locate nearest infil HLZ or route if convoying.

7.2.5.3 Once a rescue mission commander (RMC) is in position to take control of the recovery effort, the OSC should perform a turnover of the PR 15-Line. If an RMC is nominated and on station, they are in charge. As a JTAC, assist by providing continuous ground situation updates. RMC may task aircraft may engage enemy and possible enemy positions without JTAC clearance, or GFC approval.

7.2.6 Rescue Mission Commander. The RMC is a specially trained aircrew that is an expert in the application of airpower and control of a PRTF. The primary USAF RMC platform is the A-10 and the USN trains F/A-18F crews. Additionally, some USAF F-16 and F-15E crews may be able to assume the role of RMC.

7.2.6.1 The RMC controls the airspace above and in the objective area, which may be defined by a restricted operations zone (ROZ).

7.2.6.2 RMC responsibilities (regardless of Service, platform, or domain):

- Threat assessment.
- Support forces required.
- Go/No-Go criteria.
- Minimum force package required.
- Timing of execution.

Table 7.2 Personnel Recovery 15-Line Execution Brief (1 of 3).

Isolated Personnel Information		
1.	Call Sign and Frequency	• Use the full call sign of the isolated person (e.g., HAMMER 11). • In the absence of a call sign, (e.g., an isolated Soldier), use the first two letters of the individual's last name and their last two numbers of their SSN. (e.g., PFC Smith equals SM12). • With multiple isolated personnel, use alphanumeric designation (e.g., HAMMER 11A, HAMMER 11B). • Brief the primary frequency the isolated personnel are using to communicate, followed by alternate frequency, and radio identification.
2.	Number of Isolated Personnel	• Include the total number of isolate personnel collocated and any additional personnel not accounted for. • Provide the actual number of isolated personnel, or an estimated number if the actual number is unknown.
3.	Location	• LOCATION: Format it per the PR SPINS. • DTG: Always provide the date and time the location is derived (FIX time for GPS). • SOURCE: Always provide the originating source of the location. **NOTE:** In this context, "SOURCE" does not refer to the medium by which the information was transmitted (e.g., tactical chat or VHF). • ELEVATION: Brief the elevation in MSL, if known. • TRANSLATIONS: Ensure there are no errors if coordinate format is changed (e.g., LAT-LONG to MGRS). • Notify the receiving agency of the translation.
4.	Condition	• AMBULATORY: The isolated personnel can walk. • NON-AMBULATORY: The isolated personnel are unable to walk. • List any known injuries and treatment being provided.
5.	Equipment	• List any specific survival and communications equipment the isolated personnel possess. • Include the HHRID or PLS code. • If the isolated personnel's EPA/ISG is known, inform the PRTF and provide the information, if requested.

Table 7.2 Personnel Recovery 15-Line Execution Brief (2 of 3).

Isolated Personnel Information		
6.	Authentication Method (Mark off when each item is used)	• Provide information regarding authenticating the isolated personnel (e.g., what method was used, how the information was provided, and if the method can be used again). • Provide follow-on authentication plans, if required (e.g., "RV will reauthenticate using the number of the day").
Objective Area Information		
7.	Threats	• Provide the current threat picture to the isolated personnel in order of precedence. • Provide the current threat picture to the PRTF in order of precedence.
8.	PZ Description	• Provide the location and elevation of the designated PZ, if it is different from the isolated personnel's location. • Describe the PZ including size, shape, slope, terrain type, and distance and range to the isolated personnel, if offset.
9.	On-Scene Commander	• Provide the OSC's call sign and frequency. • Provide the follow-on OSC's station time and call sign, if a hand-off is expected.
Execution Information		
10.	Recovery Vehicle	• Provide the RV's call sign. • Provide the type and number of vehicles. • Brief the primary frequency to establish contact.
11.	Initial Point or Assault Point and Ingress Routing	• Use spider points, when available. • Pass information via coordinates, if spider points are not used or unavailable. • Brief the routing or heading inbound, as required.
12.	RESCORT	• Provide the call sign of the primary RESCORT asset. • Provide the type of asset. • Brief the primary RESCORT Frequency.
13.	Objective Area Game Plan	• Provide the detailed game plan for the execution. • Brief any preplanned fires. • Brief the planned recovery type and any special equipment required (e.g., hoist, medical, or extrication). • Brief actions upon contact. • Brief contingencies, if not previously considered. • Brief the expected time in the zone.

Table 7.2 Personnel Recovery 15-Line Execution Brief (3 of 3).

Execution Information		
14.	Recovery Signal	• Brief the procedures for contact with isolated personnel. • Brief which asset will contact the isolated personnel and how any signaling devices will be used.
15.	Egress Point and Egress Routing	• Use spider points, when available. • Pass information via coordinates, if spider points are not used or unavailable. • Brief the routing or outbound heading, as required.

7.2.7 SANDY. The Sandy package is a four-ship of A-10s, which manage the incident site while simultaneously providing rescue escort (RESCORT) to recovery vehicles. Crew qualification standards are indicated by call sign. Sandy01 is a qualified instructor pilot, four-ship flight lead and FAC(A). Sandy02 is a four-ship flight lead and FAC(A). Sandy03 is a two-ship flight lead, and Sandy04 is a wingman. During a PR event, Sandy01 will be the RMC, Sandy02 will direct fires, Sandy03 and Sandy 04 are RESCORT. See AFTTP 3-1 A-10 for amplifying data.

7.2.8 Rescue Escort. Air assets capable of providing armed escort and threat suppression for the recovery vehicles (RV), (e.g., A-10 [Sandy03/04]/AH-64/F/A-18E/F).

7.2.9 Rescue Combat Air Patrol. Rescue combat air patrol (RESCAP) assets are counterair aircraft assigned to protect the PRTF and IP from airborne threats, (e.g., F-15C/F-22).

7.2.10 Rescue Vehicles. There are three choices for RVs; helicopters, land vehicles, and waterborne vessels.

7.2.11 Extraction Force. The force tasked to disembark the RV, identify and authenticate the isolated personnel, provide initial medical care, and bring the isolated personnel to the RV. The extraction force (EF) can operate as an independent ground force or as an integrated part of the RV team.

7.3 JTAC Role in PR. Given the unique position on the battlefield, JTACs may be the first to become aware that an isolating event has occurred. Using inherent communications capabilities, they can provide initial report and location of the event, and can provide basic C2 until relieved by an airborne platform if the situation allows. A JTAC may assume initial OSC duties and can provide a link between recovery/medical means of transportation and strike aircraft. A JTAC can be part of either a dedicated or a designated PR force. All JTACs should have thorough understanding of PR section of the SPINS as they may find themselves supporting PR missions without notice. The Personnel Recovery 15-Line Execution Brief is self-explanatory brief used to organize the PRTF and facilitate the rescue of the IP. If already at an incident site, JTACs can help acquire data for 15-line to inform HHQ. If prior to launch, JTACs should ask for 15-line data, see Table 7.2, Personnel Recovery 15-Line Execution Brief.

7.4 Designated JTAC Role. Most of the following information only applies to an uncontested environment or low intensity conflict. Due to capabilities or proximity at the time the isolating event occurs, a JTAC and the assigned unit may receive an ad hoc tasking to respond to an incident IOT assist in an IP or sensitive item recovery operation. For example: ODA conducting clearance operation when RW asset crashes in AO.

7.4.1 Common Friction Points.

7.4.1.1 Prior to an RMC checking on, who is in charge? If another aircraft declares OSC, the JTAC should make every effort to enhance SA. The JTAC does not necessarily have control of the airspace. There is currently no doctrine for this scenario.

7.4.1.2 However, if no one is in charge, take charge of the situation. Declare OSC, begin 12-step CAS cadence, routing safety of flight, aircraft check-in, and situation update. Develop a sensor plan to secure the incident sight, IP, and friendlies approaching the AO. Verify authentication, threats, location, and condition (ATLC) of IP as soon as possible and pass on to HHQ. This can be updated throughout the mission and by various methods, such as talking directly to the IP, wingman, or an asset with SA of the event.

7.4.1.3 Ensure HHQ is kept informed. This will inform decisions involving what assets are vectored to the incident site.

7.4.1.4 Responding assets may not be familiar with a PRTF structure, or the duties and responsibilities. JTACs should know capabilities of air assets, specifically EW and ISR, in order to properly task/organize. Do not expect aircraft to come forward with recommendations.

7.4.1.5 Aircraft already on station during an isolating event may not be aware of a JTAC being tasked to the PR mission. If unable to contact overhead aircraft, the JTAC should reach back to HHQ/ASOC to determine if there is already a designated frequency in use, or to establish TAD as the primary CSAR frequency in order to assume control.

7.4.1.6 The JTAC must determine who the battlespace owner or GFC is for the incident site. If it is not your GFC, determine if there is already a JTAC responding. Be prepared to push to the other JTAC’s net to assist with friendly force link-up.

7.4.1.7 Expect multiple responding QRF units that may not be aware of each other. Use air assets SATCOM and mIRC, other JTAC TADs to gain SA on responding assets and units.

7.4.1.8 During recovery of IP or sensitive items work with the extraction force to estimate how much time on the ground is needed before exfil. Inform the RMC/OSC/RV to begin fuel planning for all assets.

7.5 Dedicated JTAC Role. As a JTAC on a dedicated PR team the biggest advantage is the ability to conduct premission planning and data collection for all operations inside the AO.

7.5.1 Mission Planning Considerations.

7.5.1.1 Study SPINS information: search and rescue dot (SARDOT), SARNEG, word, number, color, letter of the day, and RAMROD. Picking up a downed fighter pilot will be different from a crashed helicopter on an assault. Fighter pilots will most likely be using SPINS data.

7.5.1.2 Maintain programming of PR frequencies (i.e., SAR-A and SAR-B) from SPINS as well as TADs of JTACs on identified high risk operations. Additionally, maintain current, past, and future COMSEC for all assets in theater. There are times when theater crypto role over takes place while assets and ground units are still on missions and using the previous crypto.

7.5.1.3 If part of a dedicated PR team (EF), do not assume air assets have also been dedicated. Like in the previous section, JTACs may find themselves in chaotic situations where no one has the entire story.

7.6 Uncontested Environment Considerations. Using recent conflicts, OIR, or ORS, expect IP recovery will most likely be the main effort across the AO. Expect to immediately push to the incident site/IP with minimal mission planning. Air assets checking in will mostly be designated assets, unfamiliar with PR TTP.

7.6.1 Establish Echo Point. Because aircraft can hold overhead, sensor task as you would with a direct action mission. Establish the incident/crash site as the Echo Point.

7.6.2 Holding for Recovery Vehicle. If the RV is a helicopter, JTACs need to update them on expected time to extraction. Factors for time required include proximity or condition of IP, terrain, extrication. RV hold options include ground loiter nearby, air loiter offset from incident site or return to FARP and await call for extraction. Holding rotary-wing RVs overhead is the least preferred method as it puts them into unnecessary risk and they are the only way to extract the IP expeditiously.

7.6.3 IP Without SPINS. When conducting A-TLC in this environment, the IP may not be familiar with SPINS. Use common sense. If the IP is using the appropriate call sign, frequency, and asks for help in English, your team will infil.

7.7 Contested Environment Considerations. In a contested environment an extensive amount of planning and coordination is required to execute a PR mission. PR doctrine, SPINS data verification and A-TLC must be adhered to and used IOT avoid SAR traps and avoid endangering already limited assets. For further information, reference AFTTP 3-1 JTAC, Chapter 7, "Personnel Recovery."

7.7.1 IP Communication. Expect communication with IPs to be in accordance with SPINS search and rescue frequencies.

7.7.2 Authenticating the IP. SAR-A and SAR-B frequencies will be loaded into aircrew evasion radios, and must be known by the JTAC. Communications should be over a secure net when possible, otherwise all grids must be encoded using the SARNEG.

7.7.2.1 Authenticating the IP is critical to confirm the IPs identity.

7.7.2.1.1 SARNEG is a simple encoding device that associates a number with a ten-letter word (using ten different letters). SARNEG works the same way as RAMROD. See **Table 7.3**, STINKYFROG.

7.7.2.1.2 The SPINS will define the method of authentication. These methods could include: isolated personnel report (ISOPREP) data, code words, letters, numbers, colors, and visual signals.

Table 7.3 STINKYFROG.

S	T	I	N	K	Y	F	R	O	G
0	1	2	3	4	5	6	7	8	9

7.7.2.1.3 If the SPINS are not available when an event occurs, the JTAC should ask the IP questions that Americans will know (i.e., questions relating to the IP's hometown or state, current events, and general knowledge on sports teams). When using this method, multiple questions should be asked until the JTAC confirms talking with the IP.

7.7.3 Threats. Threats should be prioritized, in order, by threats to the IP, threats to the RV, threats to Sandy, and then threats to the PRTF. If passed from ISR aircraft expect threats to be passed using bullseyes.

7.7.4 Location. There are multiple methods used to locate an IP. From direction finding their position using survival radio and A/C systems, to calling an aircraft that witnessed the event, or talking with the IP directly. For further information, reference the AFTTP 3-1 JTAC, Chapter 7, "Personnel Recovery."

7.7.4.1 Search and rescue dot (SARDOT), similar to a Bullseye point, is a CSAR point used to reference the survivor's position during CSAR operations. The SARDOT should be reserved for exclusive use by the survivor and the RMC/OSC.

7.7.4.1.1 SARDOT Usage. If the survivor has a handheld GPS, it is possible to instruct the survivor to give a range and bearing to the SARDOT. While this method is not very accurate and is subject to error, it will aid the CSARTF in refining the search area. If a SARDOT position is obtained, do not translate the SARDOT position into coordinates (e.g., STINKYFROG=012345 6789, where F=6). The SARDOT is only used to reference the survivor's position.

7.7.4.2 Electronic searches require permissive environments where jamming is not a factor. The JTAC should use SEAD and CAS to degrade enemy capabilities that affect the aircraft working to locate the IP.

7.7.4.3 When able, all isolated personnel location information should be communicated via tactical data links (i.e., Link 16 or SADL). This will reduce the chance that the enemy can exploit the voice communications.

7.7.4.4 Condition. Standard MEDEVAC planning consideration apply; ambulatory/litter, hoist/airland, special medical equipment, extrication equipment. This will effect amount of time the ground force has to stay on the ground, the RVs hold plan, and sensor plans.

7.8 Terminology.

7.8.1 Bullseye. A predesignated point used to refer another position using radial and distance information from that predesignated point.

7.8.2 Combat Search and Rescue. TTP performed by USAF and USN forces to recover isolated personnel from hostile or uncertain operational environments.

7.8.3 Hostage Rescue. Hostage rescue (HR) is used to rescue personnel who are specifically designated as hostages.

7.8.4 Isolated Personnel. United States military, DOD civilians and contractor personnel, and others designated by the President or Secretary of Defense, who are separated from the unit (as an individual or a group), while participating in a US-sponsored military activity or mission and are, or may be, in a situation where they must survive, evade, resist, or escape.

7.8.5 Isolated Personnel Report. A DOD form containing information designed to facilitate the identification and authentication of an isolated person by a recovery force.

7.8.6 Jack. Isolated personnel.

7.8.7 Nonconventional Assisted Recovery. Nonconventional assisted recovery (NAR) uses indigenous/surrogate personnel who are trained, supported, and led by special operations forces (SOF), or other government agencies' personnel who have been specifically trained and directed to establish and operate indigenous or surrogate infrastructures.

7.8.8 Quick Reaction Force. Forces organized to react quickly to multiple missions, which can be redirected to the location of the isolating incident.

7.8.9 Search and Rescue. SAR uses aircraft, surface craft, submarines, and specialized rescue teams and equipment to search for and rescue distressed persons on land or at sea in a permissive environment.

7.8.10 Tactical Recovery of Aircraft and Personnel. TRAP is a USMC mission performed by any combination of aviation, ground, or waterborne assets for the specific purpose of the recovery of personnel, equipment, and/or aircraft when the tactical situation precludes SAR assets from responding and when survivors and the location have been confirmed.

CHAPTER 8

ENVIRONMENTS

8.1 General. This chapter discusses how the physical environment affects the JTAC. It is reasonable to assume that any limiting factors (LIMFACS) that the US encounters will also negatively impact adversaries. However, the theater of operations being conducted in will dictate how familiar the enemy is with the territory.

8.2 Desert.

8.2.1 Tactical Risk Assessment. The following information should be taken into account when building a tactical risk assessment (TRA) for this environment.

8.2.1.1 Hot Weather. In higher temperatures, air becomes less dense, and the performance characteristics of an aircraft could become limited.

8.2.1.1.1 FW Considerations. The JTAC should assign larger blocks of altitude due to the increased time it takes an aircraft to climb. An example would be an aircraft conducting a high angle strafe in this climate; after the attack, it will require more time to climb back up to altitude. Additionally, higher temperatures will decrease the aircraft's ability to carry standard munitions and fuel.

8.2.1.1.2 RW Considerations. Hot temperatures can decrease a RW assets ability to conduct hovering operations.

8.2.1.2 Target Correlation. When terrain offers no outstanding references, target acquisition becomes increasingly difficult. This of course will impact the JTAC and aircrew's ability to use marking techniques on targets. If able, digital marks could be prioritized.

8.3 Jungle.

8.3.1 Communications. The following information should be considered when planning for communications in the jungle environment.

8.3.1.1 Frequencies. Due to dense vegetation and high canopies found in the jungle environment, frequency spectrums normally used in air-to-ground communications could be severely degraded. In order to identify specific methods for mitigating the degraded communications in the jungle environment refer to AFTTP 3-1.JTAC, paragraph 8.3.1.1, Frequencies.

8.3.2 Equipment to Mitigate Environmental Effects. For TTP involving equipment to mitigate environmental effects of the jungle, refer to AFTTP 3-1.JTAC, paragraph 8.3.2, Equipment to Mitigate Environmental Effects of the Jungle.

8.3.3 Sensors.

8.3.3.1 Light detection and ranging (LIDAR) uses light or laser pulses to accurately measure distances to objects from a sensor, enabling precise surface modeling and accurate geospatial positioning. It is capable of penetrating foliage and provides images of what lies beneath. JTACs should work with the S-2/ISRLO to request this capability through the CAOC-ISRD when trying to find and fix targets.

8.3.4 Employment.

8.3.4.1 Canopy Penetration. BDA from recent AC-130U jungle operations demonstrated that 105 mm FMU-153/B or M557 fuses set to delay were generally able to penetrate the canopy. Approximately half the rounds with fuses set to point detonate (PD) penetrated the canopy. Army Field Manual (FM) 7-90 also suggests delay fused munitions for canopy penetration. Refer to AFTTP 3-1.JTAC, Chapter 4, "Weaponeering," for rule of thumb table on delay settings.

8.3.5 Tactical Risk Assessment.

8.3.5.1 Threats. Consider the enemy capability and foliage density over the immediate target area. JTACs should focus attention on areas with less vegetation as potential threat locations. If the thickness of the canopy precludes visual contact with the terrain below, it is reasonable to conclude that the enemy will have difficulty in visually acquiring the aircraft, and to an even greater degree employing weapons against aircraft.

8.3.5.2 Key Terrain. Rivers will be essential for both enemy and friendly forces. It provides maneuverability, line of sight communication, and is more forgiving in regards to weapons delivery. JTACs should be cognizant of any and all nearby rivers and waterways that provide locations for ambushes, resupplies, and critical LOS to aircraft.

8.4 Mountain.

8.4.1 Subterranean. Mountainous terrain is known to have habitable caves and man-made subterranean features also known as underground facilities (UGF) that the enemy will use for operations. These locations provide an ability to protect functions, equipment, and personnel stationed or stored inside.

8.4.1.1 Portal. The portal is the mouth of the subterranean feature. For caves, this may be natural and unmodified. For man-made or altered tunnels, these are known as adits. An adit is typically constructed out of concrete and steel in order to retain the mountain face and tunnel from collapsing. See **Figure 8.1**, Adit Example, for a visual representation of an Adit.

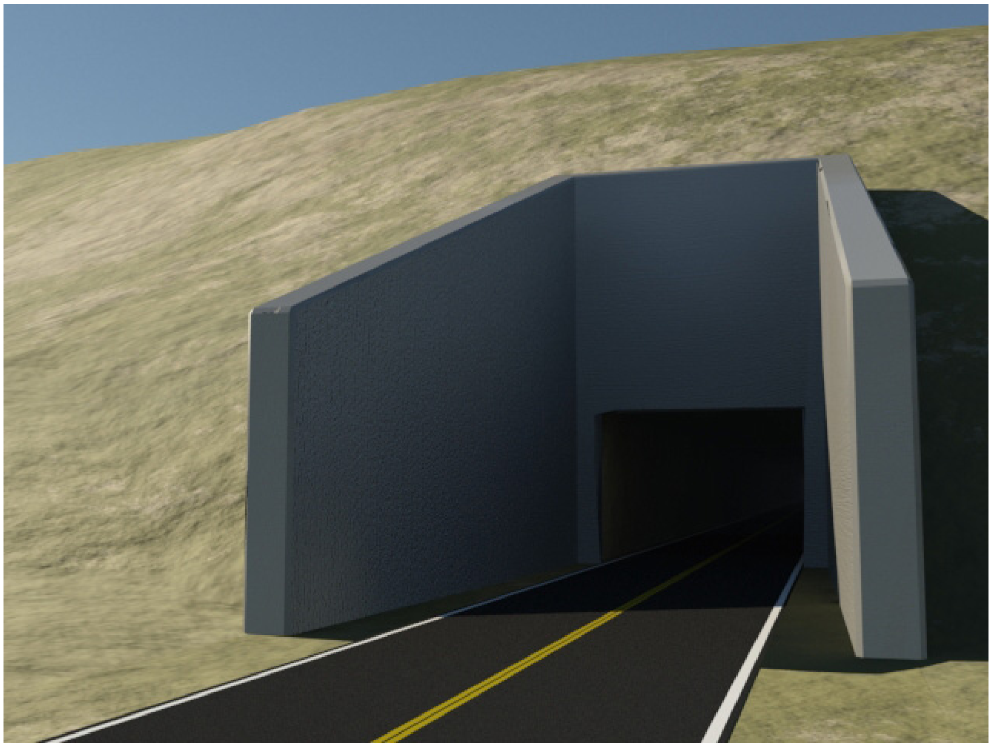
8.4.2 Employment. For specific TTP on how to mitigate environmental characteristics in mountainous terrain, refer to AFTTP 3-1.JTAC, Chapter 4, "Weaponeering."

8.4.2.1 Terrain Interference. Aircrew have difficulty locating targets being blocked by terrain. In mountainous terrain, the CAS team will not be able to perform long-range reconnaissance due to intervening terrain. This problem is compounded in areas where lines of communications (LOC) and points of interest are located along the surface or sides of a valley. When creating holding areas or during the selection of IPs, JTACs should consider these impacts.

8.4.2.2 Acoustics can be enhanced and degraded in a mountainous environment. Refer to AFTTP 3-1.JTAC, paragraph 8.4.2, Employment, for more information.

8.4.2.3 Elevation in a mountainous environment can have drastic changes that affect various aspects of navigation and weapon employment. Refer to AFTTP 3-1.JTAC, paragraph 8.4.2.4, Elevation, for detailed information on the various limitations.

Figure 8.1 Adit Example.



8.4.2.3.1 Digital Terrain Elevation Data (DTED). The National Geospatial-Intelligence Agency (NGA) has developed standard digital data sets, DTED, which is a uniform matrix of terrain elevation values which provides basic quantitative data for systems and applications that require terrain elevation, slope, and/or surface roughness information. This data has three levels: Level 0, Level 1, and Level 2. Descriptions of each level are listed below.

8.4.2.3.1.1 DTED Level 0. Elevation post spacing in is 30 arc seconds or 900 meters. DTED Level 0 was derived from NGA DTED Level 1 to support a federal agency requirement. It allows a gross representation of the earth's surface for general modeling and assessment activities. Such reduced resolution data is not intended and should not be used for precision targeting.

8.4.2.3.1.2 DTED Level 1. This is the basic medium resolution elevation data source for all military activities and systems that require landform, slope, elevation and/or terrain roughness in a digital format. DTED Level 1 is a uniform matrix of terrain elevation values with post spacing every 3 arc seconds or 100 meters. The information content is approximately equivalent to the contour information represented ion a 250,000 scale map. DTED Level 1 file size is 100 times the size of DTED Level 0. Expect this to be sued as a minimum level for which to mensurate coordinates.

8.4.2.3.1.3 DTED Level 2. This is the basic high resolution elevation data source for all military activities and systems that require landform, slope, elevation, and/or terrain roughness in a digital format. DTED Level 2 is a uniform gridded matrix of terrain elevation values with post spacing of 1 arc second or 30 meters. Due to the extremely sparse area coverage there is no catalog listing for DTED Level 2. The information content is equivalent to the contour information presented on a 1:50,000 scaled map. This will be the preferred level for all mensuration programs.

8.5 Maritime.

8.5.1 Littoral Zone. Littoral (i.e., brown water) operations are defined as regions relating to a shore or coastal region and the vulnerability to striking power of naval expeditionary forces. The JTAC can expect the majority of targeting to happen within the littoral zone. Targets within this zone can range from large warships to smaller boats such as fast attack crafts (FAC) and fast inshore attack crafts (FIAC).

8.5.2 Equipment. JTACs should ensure to do a fresh water rinse on all equipment after it is exposed to salt water, even sea spray. Refer to AFTTP 3-1.JTAC for additional TTP relating to equipment in this environment.

8.5.3 Employment. The maritime environment presents a wide variety of complications related to weapon and sensor employment. Refer to AFTTP 3-1.JTAC, paragraph 8.5.3, Employment, for specific considerations that cover targeting, GRG building, and sensor degradation issues.

8.5.3.1 Ships in open water can travel up to 35 knots in any direction. The importance of this for a JTAC is that old information can force an extremely wide search area. For example: 1-hour old information would force the JTAC and aircrew to search a circular area approximately 70 NM in diameter. JTACs waiting for aircraft support with targeting information in-hand should maintain communications with the asset that provided initial information for target updates.

8.6 Military Operations on Urbanized Terrain. Refer to AFTTP 3-2.29, *Aviation Urban Operations*, for military operations on urbanized terrain (MOUT).

8.6.1 Employment. Urban terrain is similar to mountain terrain in that they both present significant challenges in regards to communications and A/C system capabilities. For specific considerations in the urban environment refer to AFTTP 3-1.JTAC, paragraph 8.6, Military Operations on Urbanized Terrain.

8.7 Arctic.

8.7.1 Characteristics. The arctic is typically referred to as anywhere north of the 66.5-degree latitude. While the Arctic is usually associated with baron icy terrain, the arctic can also yield warm temperatures, rolling tundra, and deciduous forests.

8.7.2 Tactical Risk Assessment.

8.7.2.1 Aircraft Offset. Since sound carries farther in cold conditions, aircraft noises and the sounds of an attack will be heard at greater distances. JTACs should consider this when determining offset holds and IP selection, especially if there is a concern for burning the target.

8.7.2.2 Icing. Remotely piloted aircraft do not have de-icing capabilities and as such, ISR coverage with these assets will be extremely limited in this environment. JTACs should plan to cover ISR gaps with either manned ISR, organic capabilities, or CAS.

8.7.2.3 Inclement Weather. Due to the unpredictable and extreme weather conditions in the arctic, the JTAC must be prepared to have a plan to adapt to limited visibility operations. In these times of limited visibility consider relying on bomb on coordinate attacks (BOC), synthetic aperture radar (SAR), ground moving target indicator (GMTI), and signals intelligence (SIGINT).

8.7.3 Communications. In the arctic environment depending on the season, there is potential for extended periods of daylight and extended periods of darkness. This becomes a significant consideration for drastic changes times that the ionosphere and magnetic interference at the poles affect communications. For considerations for specific affected communications and in regards to environmental factors, refer to AFTTP 3-1.JTAC, Chapter 8, "Environments."

8.8 Night Considerations. During mission planning, JTACs should be identify potential gaps in situational awareness and ensure they are implementing equipment and techniques to mitigate. For night operations, JTACs should consider ambient illumination, cultural lighting, and artificial illumination. For specific JTAC organic night equipment, refer to AFTTP 3-1.JTAC.

8.8.1 Ambient Illumination. The moon phase is the most significant factor of ambient illumination; however, starlight, cultural lighting, and solar glow are also contributing factors. Ambient illumination will affect IR marking ability, ground movement, and target identification. When planning for different illumination levels, ensure that planned tactics are in line with the environmental conditions of the objective area.

8.8.2 Cultural Lighting. Cultural lighting is the light produced from an inhabited area consistent with patterns of life. City lights are useful for navigation and situational awareness for both aircrew and ground parties. Excessive light sources can wash out NVDs, and reduce the ability to identify an IR mark or strobe.

8.8.3 Artificial Illumination. Artificial illumination can be employed by surface to surface or air-to-ground platforms. The illumination can be either overt or covert and has many tactical uses. It is employed in order to highlight a specific area for a set amount of time and to provide enough illumination for aircraft and/or ground controllers to acquire targets. Illumination can significantly affect a large portion of the battlefield. All illumination missions must be coordinated and approved through the ground force commander to ensure that adverse effects on ground forces have been mitigated or accepted.

8.8.3.1 When planning for artificial illumination to be delivered by either surface based system or airborne platform, JTACs need to understand the capabilities of the munition in use. See **Table 8.1**, Ground Delivered Illumination Planning Numbers. During planning JTACs can brief these capabilities to commanders and show how they can increase situational awareness on the ground when employed in the correct manner. JTACs should also use caution and not oversell a specific type of munition, rather they should explain the effect that it will have. See **Table 8.2**, Air Delivered Illumination Planning Numbers.

Table 8.1 Ground Delivered Illumination Planning Numbers.

Mark Type	Height of Burst (meters)	Burn Time (minute)	Coverage (meters)
60 mm M83A1 M83A2/A3	160 160 275 to 350	25 32 32	300 — 500
81 mm M301A3 M853A1	600 475 to 600	50 to 60	360 650
120 mm M930	500	50	1,500
105 mm M930	750	60 to 65	Varies depending on number of rounds and range/lateral spread.
155 mm M118 M485	 750 600	 60 120	Varies depending on number of rounds and range/lateral spread.

Table 8.2 Air Delivered Illumination Planning Numbers.

Mark Type	Rate of Fall	Burn Time (minute)	Coverage
LUU 1/B LUU 5/B LUU 6	Burns on ground	30	Terrain dependent
LUU 2 A/B	8 fps	4	3 km
LUU 19B (IR)	9 fps	7	4 km
M257 rockets	15 fps	2	1 km (+)
M278 (IR)	15 fps	3	1 km (+)

ATTACHMENT 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

A1.1 References.

1. Joint Publication 1-02, *DOD Dictionary of Military and Associated Terms*.
2. Joint Publication 3-0, *Joint Operations*.
3. Joint Publication 3-03, *Joint Interdiction*.
4. Joint Publication 3-09, *Joint Fire Support*.
5. Joint Publication 3-09.3, *Close Air Support*.
6. Joint Publication 3-33, *Joint Task Force Headquarters*.
7. Joint Publication 3-52, *Doctrine for Joint Airspace Control in the Combat Zone*.
8. Joint Publication 3-60, *Joint Targeting*.
9. Joint Publication 5-0, *Joint Operation Planning*.
10. Joint Publication 3-56.1, *Command and Control for Joint Air Operations*.

Air Force Publications

1. AFDD 1, *Air Force Basic Doctrine*.
2. AFDD 1-02, *Air Force Glossary*.
3. AFDD 3-03, *USAF Doctrine on Counterland Operations*.
4. AFDD 3-50, *Combat Search and Rescue*.
5. AFTTP 3-1.General Planning, *General Planning and Employment Considerations*.
6. AFTTP 3-1.Threat Guide, *Threat Reference Guide and Countertactics*.
7. AFTTP 3-1.A-10, *Tactical Employment-A-10*.
8. AFTTP 3-1.F-16, *Tactical Employment-F-16*.
9. AFTTP 3-1.AWACS, *Tactical Employment-E-3*.
10. AFTTP 3-1.HH-60, *Tactical Employment-HH-60G*.
11. AFTTP 3-1.HC/MC-130, *Tactical Employment-HC/MC-130*.
12. AFTTP 3-1.TACS, *Tactical Employment-Theater Air Control System*.
13. AFTTP 3-1.AC-130, *Tactical Employment-AC-130*.
14. AFTTP(I) 3-2.5, *Multiservice Operations Brevity Codes*.
15. AFTTP(I) 3-2.6, *J-FIRE: Multiservice Procedures for the Joint Application of Firepower*.
16. AFTTP(I) 3-2.29, *Multiservice Procedures for Aviation Urban Operations*.
17. AFI 11-214, *Air Operations Rules and Procedures*.
18. AFTTP 3-3.B-1, *Tactical Employment B-1*.
19. AFTTP 3-1.JTAC, *Tactical Employment-JTAC*.

US Army and US Marine Corps Publications

1. FM 5-0 (formerly FM 101-5), *Army Planning and Orders Production*.
2. FM 6-0, *Mission Command: Mission Command and Control of Army Forces*.
3. FM 101-5, *Staff Organization and Operations*.
4. FM 3-09.32, *Multiservice Procedures for the Joint Application of Firepower*.
5. MAWTS 1, *Aviation Combat Element Military Operations on Urban Terrain Manual*.
6. MCWP 3-35.3A, *Operations on Urbanized Terrain*.

JTCG Publications

1. JMEM/AS, Joint Munitions Effectiveness Manual/Air-to-Surface: Risk Estimates for Friendly Troops.
2. JMEM, Target Vulnerability.

Miscellaneous

1. *Russian Battlefield Development Plan Module I: General Principles*, National Ground Intelligence Center, May 2017.
2. Slusser TSgt Timmothy J.; *Radar Aided CAS*,USAF Weapons School Paper, 66th Weapons Squadron, JTAC WIC/15B, December 2015.
3. Cavanaugh, SSgt Jarrid, *CAS Marking in all Combat Environments*, USAF Weapons School Paper, 66th Weapons Squadron/JTAC/14B, December 2014.
4. Herbison, TSgt Clinton, *Controlling CAS in a CDO Environment*, USAF Weapons School Paper, 66th Weapons Squadron/JTAC/13A, June 2013.
5. Lynch, SSgt Joshua J.; *Advanced Employment Techniques Utilizing CAS*, USAF Weapons School Paper, 66 Weapons Squadron/JTAC WIC/15B, December 2015.
6. (FOUO) *Countersensor Threat Module: Communication Jammers*, National Ground Intelligence Center, January 2017.
7. E-3 Airborne Warning and Control System (AWACS) Security Classification Guide, 3 June 2013, (FOUO), Declassified: NA.
8. CJCSI 3160.01C, *No-Strike and the Collateral Damage Estimation Methodology*.
9. TO 1-1M-34, *Aircrew Weapons and Delivery Manual (Nonnuclear) Standard Volume*.

A1.2 Acronyms and Abbreviations. Acronym list is UNCLASSIFIED unless otherwise marked.

µm	micron
A2	anti-access
A-A	air-to-air
AAA	antiaircraft artillery
AATC	Air National Guard Air Force Reserve Command Test Center
AATFC	air assault task force commander
ABCT	armored brigade combat team
A/C	aircraft
ACA	airspace control authority/airspace coordination area

ACC	Air Combat Command
ACCI	Air Combat Command instruction
ACE	airborne command element
ACL	aircraft load
ACM	airspace control measure/airspace coordinating measure
ACO	airspace control order
ACOG	advanced combat optics gunsight
AD	area-denial
ADA	air defense artillery
AES	advanced encryption standard
AFI	Air Force instruction
AFMAN	Air Force manual
AFSPECWAR	Air Force Special Warfare
AFTTP	Air Force tactics, techniques, and procedures
A-G	air-to-ground
AGL	above ground level
AGM	air-to-ground missile
AI	air interdiction
AIE	alternate insertion/extraction
AIRCOORD	air coordination
ALE	automatic link establishment
ALO	air liaison officer
ALR	acceptable level of risk
AM	amplitude modulation
AMB	air mission brief
AMC	air mission commander
AMD	air mobility division
AME	amplitude modulation equivalent
ANDVT	advanced narrowband digital terminal
ANW2	advanced networking wideband waveform
AOC	air operations center
AOD	air operations directive
AOI	area of influence
AOR	area of responsibility
AOS	aircraft on-station
AP	armor piercing
API	armor piercing incendiary
APIT	armor piercing incendiary tracer
APKWS	advanced precision kill weapon system
APT	armor piercing tracer
APTD	attack position and target designation
APU	auxiliary power unit
ARM	antiradiation missile
ARSOF	Army special operations force
A/S	air-to-surface
ASAP	as soon as possible

ASCOPE	area, structures, capabilities, organizations, people, events
ASK	avoid, suppress, kill
ASOC	air support operations center
ATAK	android tactical assault kit
ATFLIR	advanced targeting forward-looking infrared
ATLC	authentication, threats, location, condition
ATLEAST	additional factor friendlies, target sort, lasers, effects, artillery, SEAD, threats
ATO	air tasking order
AWACS	airborne early warning and control system
AWT	air weapons team
BALO	battalion air liaison officer
BCT	brigade combat team
BCVm	black cryptovariable monthly
BDA	battle damage assessment
BFT	Blue Force tracker
BGAN	broadband global area network
BGUV	black group unique variable
BHA	bomb hit assessment
BHO	battlefield handover
BIT	built in test
BKAUPD	black key algorithm update parameter
BLOS	beyond line of sight
BMA	battle management area
BOC	bomb on coordinate
BOT	bomb on target
BP	battle position
BPC	building partnership capacity
bps	bits per second
BSO	battlespace owner
C	Celsius
C2	command and control
CAAS	common avionics architecture system
CAP	combat air patrol
CAS	close air support
CASEVAC	casualty evacuation
CAT	category
CB	citizens band
CBRNE	chemical, biological, radiological, nuclear defense, explosives
CBU	cluster bomb unit
CCD	camouflage, concealment, and decoys
CCD	charge coupled device
CCIR	commander's critical information request
CCT	component critical target
CD	compact disk/collateral damage
CDE	collateral damage estimate

CDO	contested, degraded, operationally limited
CDP	CAS decision point
CE	circular error
CENTCOM	Central Command
CEP	circular error probable
CERF	cyber effects request format
CFD	common fill device
CFF	call for fire
CFL	coordinated fire line
CI	counterintelligence
CIB	current intelligence brief
CID	combat identification
CIVCAS	civilian casualties
cm	centimeter
CMR	combat mission ready
CNR	combat network radio
COA	course of action
CoF	concept of fires
COIC	current operations integration cell
COMINT	communications intelligence
COMSEC	communication security
CONOP	concept of operations
CP	contact point
CPA	computer programming application
CRC	control and reporting center
CSAR	combat search and rescue
CT	cyber text
CTOL	conventional take-off and landing
CU	central unit
CV	crypto variable/carrier variant
CVd	crypto variable daily
CVm	crypto variably monthly
CVN	carrier, fixed-wing aircraft, nuclear
CVSD	continuous variable slope delta modulation
CVw	crypto variable weekly
CW	continuous waveform
DA	direct action
DACAS	digitally-aided close air support
DAFCS	digital automatic flight control system
DAGR	defense advanced GPS receiver
DAMA	demand assigned multiple access
DAMIT	dimensions, attrition, munitions, intent, time
DASC	direct air support center
DCA	defensive counter air
DCO	defensive cyber operations
DDL	digital downlink

DEAD	destruction of enemy air defenses
DES	data encryption standard
DF	direction-finding
DFP	debrief focus point
DIEE	digital imagery exploitation engine
DMLGB	dual-mode laser-guided bomb
DOD	Department of Defense
DODIN	DOD Information Network
DPI	desired point of impact
DPICM	dual purpose improved conventional munition
DPIP	departing initial point
DSN	Defense Switch Network
DT	dynamic targeting
DTD	data transfer device
DTED	digital terrain elevation data
DTV	day television
DWE	desired weapons effects
DZ	drop zone
EA	engagement area
EARF	electronic attack request format
ECCG	enhanced computer control group
ECCM	electronic counter-countermeasures
ECU	end cryptographic unit
EEFI	essential elements of friendly information
EEI	essential elements of information
EF	extraction force
EHF	extremely high frequency
EIT	external intelligence training
ELF	extremely low frequency
ELINT	electronic intelligence
ELOS	extended line of sight
EM	electromagnetic
EO	electronic optical
EOD	explosive ordnance disposal
EOTS	electro-optical targeting system
EPA	evasion plan of action
EPLRS	enhanced position location reporting system
ETD	enhanced target description
EUD	end user device
EW	electronic warfare
EWO	electronic warfare officer
EXCHECK	execution checklist
EXFIL	exfiltration
F2T2EA	find, fix, track, target, engage, assess
F3EA	find, fix, finish, exploit, analyze
F	Fahrenheit

FAATS	friendly, artillery, airspace, threats, sensors
FAC	fast attack craft
FAC(A)	forward air controller (airborne)
FAD	final attack direction
FAH	final attack heading
FARP	forward area refuel point
FARRP	forward arming and refueling point
FASCAM	family of scatterable mines
FAQ	frequency asked questions
FB	flash bulletin
FBCB2	Force XXII Battle Command, Brigade and Below
FBI	Federal Bureau of Investigation
FCI	fire control information
FEBA	forward edge of battle area
FFIR	friendly force information requirement
FIAC	fast inshore attack craft
FID	foreign internal defense
FIDO	from an object, in a direction, for a distance, to the intended object
FISINT	foreign instrumentation signals intelligence
FLOT	forward line of own troops
FM	frequency modulation/field manual
FMS	foreign military sales
FMT	frequency managed training net
FMV	full motion video
FO	forward observer
FOV	field of view
FRAGO	fragmentary order
FRIES	fast rope insertion and extraction system
FSC	fire support coordination
FSCL	fire support coordination line
FSCM	fire support coordination measure
FSE	fire support element
FSO	fire support officer
FST	fire support tasks
ft	feet
FW	fixed-wing
GAF	ground assault force
GBU	guided bomb unit
GCC	geographic combatant commander
GCI	ground commander's intent
GCS	guidance command section
GCE	ground command element
GCU	guidance control unit
GEOINT	geospatial intelligence
GFC	ground force commander
GFCI	ground force commander's intent

GHz	gigahertz
GLO	ground liaison officer
GMTI	ground moving target indicator
GMTT	ground moving target track
GOTS	government off-the-shelf
GP	general purpose
GPS	global positioning system
GRG	grid reference graphic
GTL	gun target line
GUI	graphical user interface
GUV	group unique variable
GW	gateway
HA	holding area
HAE	height above ellipsoid
HAF	helicopter assault force
HAT	height above target
HCLOS	high capacity line of sight
HE	high-explosive
HEDP	high-explosive dual purpose
HEI	high-explosive incendiary
HEI-P	high-explosive incendiary-plugged
HEIT	high-explosive incendiary tracer
HF	high frequency
HHL16	handheld Link 16
HHQ	higher headquarters
HIDACZ	high density airspace control zone
HIMAR	high mobility artillery rocket system
HLM	handheld laser marker
HLZ	helicopter landing zone
HMCS	helmet mounted cuing system
HOB	height of burst
HPW	high performance waveform
HQ	headquarters/HAVE QUICK
HR	hostage rescue
HRST	helicopter rope suspension technique
HTPW	hardened-target penetrator warhead
HUMINT	human intelligence
HUMRO	humanitarian relief operations
IADS	integrated air defense system
IAW	in accordance with
IBCT	infantry brigade combat team
ID	identification
IDF	indirect fire
IDO	intelligence duty officer
IDO/T	intelligence duty officer/technician
IED	improvised explosive device

IFAC	individual first aid kit
IFF	identification, friend, foe
IMEA	integrated munitions effects assessment
IMINT	imagery intelligence
in	inch
INFIL	infiltration
InGaAs	Indium Gallium Arsenide
INST	instantaneous
IO	in order to
IP	Internet protocol/initial point/isolated personnel
IPE	integrated planning and employment
IPOE	intelligence preparation of the operational environment
IPv4	Internet protocol version 4
IR	infrared
ISLID	infrared zoom laser illuminator/designator
ISO	information security
ISOPREP	isolated personnel report
ISR	intelligence, surveillance, and reconnaissance
ISRLO	intelligence, surveillance, and reconnaissance liaison officer
IVO	in vicinity of
JACS	Joint Alternate Communications Suite
JAGIC	joint air-to-ground integration center
JARN	Joint Air Request Net
JDAM	joint direct attack munition
JDPI	joint desired point of impact
JEM	JTRS enhanced MBITR
JFACC	joint forces air component commander
JFE	joint forcible entry
JFLCC	joint forces land component commander
JFO	joint forward observer/joint fire observer
JICO	joint interface control officer
JMEM	joint munitions effectiveness manual
JMPS	joint mission planning system
JP	joint publication
JPEL	Joint Prioritized Effects List
JPRC	joint personnel recovery center
JRFL	Joint Restricted Frequency List
JTAC	joint terminal attack controller
JTAR	joint theatre air request
JTCR	joint tactical cyber request
JT&E	joint test and evaluation
JTRS	joint tactical radio system
JWS	joint weaponeering system
Kbps	kilobits per second
KDU	key display unit
kg	kilogram

kHz	kilohertz
km	kilometer
LADR	location, altitude, direction, remarks/hazards
LAN	local area network
LAR	launch acceptability region
LASG	large area smoke generators
lbs	pounds
LCC	last cover and concealment
LED	light-emitting diode
LF	low frequency
LGB	laser guided bomb
LIDAR	light detection and ranging
LIMFACS	limiting factors
LLTV	low-light television
LNO	liaison officer
LOAL	lock on after launch
LOC	lines of communication
LOS	line of sight
LRF	laser range finder
LST	laser spot tracker
LTD	laser target designator
LTL	laser target line
LWR	laser warning receiver
LZ	landing zone
m	meter
M2M	machine-to-machine
MAJCOM	major command
MANET	mobile ad hoc network
MANPADS	man-portable air defense system
MASCAL	mass casualty
MASINT	measurement and signature intelligence
MAX ORD	maximum ordinate
MBITR	multiband intra/inter team radio
Mbps	megabits per second
MCO	major combat operations
MCRP	Marine Corps reference publication
MDCOA	most dangerous course of action
MDMP	military decision making process
MDS	mission design series
MEDEVAC	medical evacuation
METT-TC	mission, enemy, terrain, troops, time, civil
MEZ	missile engagement zone
MF	medium frequency
MFCD	multifunction color display
MGRS	military grid reference system
MHz	megahertz

mil	military/milliradian
MILSAT	military satellite
MIL-STD	military standard
MIR	multisensor imagery reconnaissance
mJ	millijoule
MK	manual rekey
MKEK	master key encryption key
MLCOA	most likely course of action
mm	millimeter
MMT	multimode tracker
MNPOPCA	mission number, number and type of aircraft, position and altitude, ordnance, playtime or time on station, capabilities, abort code
MOA	method of attack
MODPATH	modernization path
MOUT	military operations on urbanized terrain
MPCC	mission planning coordination cell/mission planning coordination checklist
MPP	multi-purpose penetrator
MRDS	mini red dot sight
MRIR	maximum recommended intercept range
MRR	minimum risk route
ms	millisecond
MSL	mean sea level
MTADS	modernized target acquisition designation sight
MTI	moving target indicator
MTM	military tactical means
MTOE	modified table of organizations and equipment
MTS	multi-spectral targeting system
MUM-T	manned and unmanned teaming
MUOS	mobile user objective system
MWIR	medium wave infrared
MWOD	multiple word of day
NAI	named area of interest
NAR	nonconventional assisted recovery
NATO	North Atlantic Treaty Organization
NAV	navigation
NCO	noncommissioned officer
NET-T	network-tactical
NFA	no-fire area
NFOV	narrow field of view
NGA	National Geospatial-Intelligence Agency
NIPR	nonsecure Internet protocol router
NIPRNET	nonsecure Internet protocol router network
NIR	near infrared
NKE	non-kinetic effect
NM	nautical mile

NORDO	no radio
NSA	National Security Agency
NTO	number, type, orientation
NTS	night targeting system
NTSC	National Television Standards Committee
NTSU	night targeting system upgrade
NVD	night vision device
NVG	night vision goggles
OAKOC	observation and fields of fire, avenue of approach, key and decisive terrain, obstacles, cover and concealment
OBJ	objective
OCA	offensive counterair
OCO	offensive cyber operations
OCS	operator control system
ODA	operational detachment alpha
OE	operational environment
OGA	other governmental agencies
OP	observation point
OPE	operational preparation of the environment
OPORD	operations order
OPR	office of primary responsibility
OPTASKLINK	operational tasking data link
ORP	objective rally point
OSC	on-scene commander
OSINT	open-source intelligence
OSR	on-station report
OTAD	over-the-air distribution
OTAR	over-the-air rekey
PAA	proposed area of artillery/position area of artillery
PACAF	Pacific Air Force
PACE	primary, alternate, contingency, emergency
PAX	passengers
PBX	polymer-binded explosive
PCC	primary channel controller
PCIDM	personal computer improved data modem
P_D	probability of damage
PD	point detonate
PFPS	portable flight planning system
PGM	precision-guided munition
P_I	probability of impact
PI	probability of incapacitation
PIR	priority information requirement
PJC	private JOSEKI component
PLOTCR	purpose, location, observer call sign, triggers, communications, remarks
PLRF	pocket laser range finder

PMA	publications management application
PMT	point mensuration tool
POND	period of nondisruption
PPP	point-to-point protocol
PR	personnel recovery
PRCC	personnel recovery coordination cell
PRF	pulse repetition frequency
PRI	portable reference imagery
PRTF	personnel recovery task force
PSS-SOF	precision strike suite for special operations forces
PTL	pointer target line
PTT	push to talk
PW	Paveway
PX	proximity
PZ	pick-up zone
QRF	quick reaction force
R	routing
RCVR	receiver
recce	reconnaissance
RED	risk estimate distance
RESCAP	rescue combat air patrol
RESCORT	rescue escort
RF	radio frequency
RFA	restrictive fire area
RFL	restrictive fire line
RMC	rescue mission commander
ROE	rules of engagement
ROVER	remotely operated video enhanced receiver
ROZ	restricted operations zone
RP	release point
RPA	remotely piloted aircraft
RSR	remote secure receiver
RTO	radio transmitter operator
RV	rescue/recovery vehicle
RW	rotary-wing
RX	receive
S/A	surface-to-air
SA	situational awareness
SAA	satellite access authorization
SAASM	selective availability anti spoofing module
SAD	size, activity, disposition
SADL	situational awareness data link
SALT	size, activity, location, time
SALTR	size, activity, location, time, remarks
SAM	surface-to-air missiles
SAPHEI	semi-armor piercing high-explosive incendiary

SAR	synthetic aperture radar
SARDOT	search and rescue dot
SARNEG	search and rescue numerical encryption group
SATCOM	satellite communication
SBCT	Stryker brigade combat team
SCAR	strike coordination and reconnaissance
SCL	standard conventional load
SE	spherical error
SEAD	suppression of enemy air defenses
SHF	superhigh frequency
ShTORA	vehicle-mounted soft-kill active protection system
SIGACT	significant activity
SIGINT	signals intelligence
SINCGARS	single-channel ground and airborne radio system
SIPR	secure Internet protocol router
SIPRNET	secure Internet protocol router network
SIR	Soldier ISR receiver
SITREP	situation report
SKL	single key loader
S/N	signal-to-noise
SOC	size, orientation, composition
SOCOM	South Command
SoF	safety of flight
SOF	special operations forces
SOFLAM	special operations laser marker
SOP	standard operating procedures
SOTF	special operations task force
SP	start point
SPIES	special purpose insertion and extraction system
SPINS	special instructions
SPO	special programs office
SPS	SWIR pocket scope
SRW	soldier radio waveform
SSB	single sideband
SSE	sensitive site exploitation
STANAG	standard NATO agreement
STG	(preface)
STOVL	short take-off and vertical landing
STS	(preface)
SUAS	small unmanned aircraft system
SUC	situation update code
SWAK	special warfare assault kit
SWIR	short wave infrared
TAC	terminal attack control/terminal attack controller
TAC(A)	tactical air controller (airborne)
TACAN	tactical air navigation

TAC-C2	tactical command and control
TACP	tactical air control party
TACSAT	tactical satellite
TAD	tactical air direction
TAGS	theater air ground system
TAI	target area of interest
TAS	tail actuator subsystem
TAWS	target acquisition weather software
TB	tactics bulletin
TCPED	task, collect, process, exploit, disseminate
TDL	tactical data link
TDP	touch down points
TDY	temporary duty
TEA	target engagement authority
TECHINT	technical intelligence
TEFACHR	target, enemy, friendly, artillery, control, hazards, restrictions
TEK	traffic encryption key
TEL	transporter erector launcher
TES	test and evaluation squadron
TEZ	tactical employment zone/tactical engagement zone
TFT	tabular firing table
TGO	terminal guidance operations
TGP	targeting pod
TGT	target
TIC	troops in contact
TIES	type, ingress, egress, sort
TIP	tactics improvement proposal
TISU	thermal imaging system upgrade
TL	tactical lead
TLAM	Tomahawk land attack missile
TLAR	transporter launcher and radar
TLE	target location error
TNT	trinitrotoluene
TO	technical order
TOC	tactical operations center
TOD	time of day
TOE	table of organizations and equipment
TOF	time of flight
TOS	time on station
TOT	time on target
TP	target practice
TPFDD	time-phased force deployment data
TRA	tactical risk assessment
TRAP	tactical recovery of aircraft and personnel
TRANSEC	transmission security
TRB	tactics review board

TSK	transmission security key
TSS	target sight system
TST	time sensitive target
TTP	tactics, techniques, and procedures
TTT	time to target
TV	television
TX	transmit
UAR	unconventional assisted recovery
UAS	unmanned aircraft system
UGF	underground facilities
UHF	ultrahigh frequency
URL	uniform resource locator
USAF	US Air Force
USB	universal serial bus
USMC	US Marine Corps
USN	US Navy
USSOCOM	US Special Operations Command
USSTRATCOM	US Strategic Command
VDL	video downlink
VDO	vehicle drop off
VE	vertical error
VEESS	vehicle engine exhaust smoke system
VHF	very high frequency
VLSG	vehicle-launched smoke grenade
VMF	variable message format
VT	variable time
VULOS	VHF/UHF line of sight
WARNO	warning order
WCDMA	wideband code division multiple access
WCMD	wind corrected munitions dispenser
WEZ	weapons engagement zone
WFOV	wide field of view
WinTAK	windows tactical assault kit
WOD	word of the day
WP	white phosphorous
WPS	weapons squadron
WSEP	weapon system evaluation program
WVWHS	web hosting service
WW2	World War II
XAI	airborne alert interdiction
Z	Zulu

ATTACHMENT 2

INTELLIGENCE SUPPORT TO JOINT TERMINAL ATTACK CONTROLLERS

A2.1 Intelligence Support. It is critical that JTAC unit intelligence personnel be familiar with all chapters of the AFTTP. However, this attachment seeks to provide intelligence personnel assigned to JTAC units with the tailored intelligence direction necessary to support the wide range of JTAC missions. This attachment will not address the duties and responsibilities associated with intelligence, surveillance, and reconnaissance liaison officer (ISRLO) or intelligence duty officers/technicians (IDO/T) positions normally associated with air support operations squadrons. Instead, it focuses on the capabilities that intelligence should provide in a unit support role in-garrison and deployed, as well as how JTACs can leverage and integrate intelligence entities (ISRLO, IDO/T, S-2/J-2/G-2).

A2.1.1 Local Networking. Intelligence support to JTAC units requires ground-focused intelligence with a level of fidelity not normally available from Air Force intelligence units or personnel. Maneuver force intelligence units have the best fidelity on ground-based threats. Developing a professional relationship with these intelligence units by regularly exchanging information is essential for joint combat operations.

A2.2 General Outline. This attachment will be broken up into in-garrison intelligence unit support responsibilities, deployed intelligence support, intelligence tools, and intelligence references. It is important to recognize that intelligence personnel that provide support to JTAC operations require a specialized ground-focused intelligence perspective. Intelligence personnel should be familiar with various JTAC mission sets, and tasking in order to provide appropriate support. This includes keeping up-to-date with projected deployments and possible crisis response areas. Intelligence personnel should use this attachment as a guide as opposed to a checklist.

A2.3 In-Garrison Intelligence Unit Support Responsibilities. Air Combat Command Instruction (ACCI) 14-202, *Unit-Level Intelligence Mission and Responsibilities*, guides unit-level intelligence responsibilities. While in-garrison, intelligence personnel are responsible for developing and teaching an external intelligence training (EIT) program for JTAC personnel. There are also four additional intelligence specific duties: geospatial information and services, personnel recovery, intelligence support to force protection, and intelligence oversight.

A2.3.1 External Intelligence Training. EIT is training in support of JTAC personnel. Primary topics for training are enemy threat systems, capabilities, TTP, doctrine and ISR capabilities, limitations, and integration. EIT is most effective when integrated into the unit's existing training plan and/or weapons and tactics program. For example, a threat of the day brief on a particular SAM system would ideally be followed by a lesson from a JTAC-I on effective ways to avoid, suppress, or kill that system. EIT includes but is not limited to combat mission ready (CMR) training support, predeployment preparation, and intelligence inputs to scenario development, threat of the day and current intelligence briefs, and integration into CAS training.

A2.3.1.1 Combat Mission Ready Training Support. JTAC personnel have specific training requirements in order to achieve CMR status. JTAC specific AFIs and AFMANs will outline intelligence support required to assist in CMR training for the JTACs. These training requirements can be achieved through various means including recurring classroom training, combined with weekly briefings, incorporated with field exercises, or consolidated into one large training event. The manner in which individual units execute CMR training will guide which of these options is most appropriate.

A2.3.2 Intelligence Inputs to Scenario Development. There are several key scenario components that intelligence personnel need to provide: a road to war background to set the scene for the scenario, enemy order of battle, enemy systems capabilities, enemy COAs, and any other pertinent information about the enemy that will enhance the scenario (i.e., civilians in the area, geopolitical factors, etc.). These elements need to be developed in close coordination with the lead JTAC-I to ensure that they are meeting the intent for the scenario. It is also crucially important to the effectiveness of the scenario that intelligence inputs are based on realistic operational TTP and capabilities. Training to an unrealistic threat not only creates a false sense of security, but it may also reinforce ineffective friendly TTP and fail to grow tactical problem solving skills. Therefore, once the overall goals for the scenario are developed, intelligence personnel need to be leveraged to provide a realistic and comprehensive threat picture.

A2.3.3 Threat of the Day Brief/Current Intelligence Brief. The purpose of these briefs are to provide a JTAC with the minimum amount of knowledge to survive the different states of an encounter with a specific threat system. It should be tailored to specific TTP of the threat country and the capabilities of the various systems the JTAC can employ to assist in locating and defeating that system (systems and countertactics). According to Maj Stephen C. Price's Weapons School paper, *Five Questions for Better Threat Training Integration*, USAF Weapons Review, Spring/Summer 2007, there are five questions to be answered when building a threat of the day brief: What is it? How do we know it is there? What can it do to us? How can we prevent it? How does a threat country use it? Briefs should be built around these questions with a focus on ground-based threat systems that will affect the JTAC and the aligned unit, taking into account ground perspective considerations (such as whether or not the system is up-armored or can engage win both surface-to-air and direct fire). Briefs should be incorporated in to the unit's weapons and tactics program and conducted on a regular basis. Current intelligence briefs (CIB) should address worldwide events that are pertinent to JTAC operations and mission sets. The focus should be on new or evolving threat TTP, areas of conflict/instability, current JTAC operations downrange, and other information that will enhance JTAC knowledge and situational awareness. If possible they should be completed on a weekly basis but at a minimum they should be completed on a monthly basis.

A2.3.4 Integration into CAS Training Events. CAS training events can encompass CAS TDYs, large exercises, practical exercises, and simulations in which JTACs and fires personnel are the primary training audience. Incorporating both threat and ISR training greatly increase the overall effectiveness of these training events. Intelligence personnel can integrate into these events in a variety of ways including providing inputs to scenario development, providing SIR capabilities, limitations, employment knowledge, providing threat capabilities and employment knowledge, "playing" as the S-2 during premission staff coordination, coordinating with the training lead to create preplanned and dynamic target sets, giving current intelligence injects during the training event, coordinating with the associated flying unit intelligence personnel, or "playing" as an ISR asset over the radio. This is not an inclusive list, and intelligence personnel should be creative and flexible when integrating into CAS training. The bottom line is that however intelligence is incorporated, personnel must ensure that it is coordinated ahead of time with the training lead.

A2.4 Deployment Intelligence Support. Intelligence personnel assigned to JTAC units should provide comprehensive predeployment training in the form of briefs that follow the true intelligence preparation of the operational environment (IPOE) process. JP2-01.3, *Joint Intelligence Preparation of the Operational Environment*, outlines the type of information that should be included in IPOE.

A2.4.1 IPOE Steps. The four steps and specific considerations of the IPOE process are as follows.

A2.4.1.1 Step One: Define the Battlespace Environment. The purpose of this step is to identify and delineate the specific geographical extent of the battlespace. The area of operations (AO) is part of the area of influence (AOI) in which operations will be conducted.

A2.4.1.2 Step Two: Describe the Battlespace Effects. In this step, the effects of the physical environment should be evaluated. Intelligence personnel should identify both aspects on friendly and threat force operations. This assessment of the environment includes an examination of terrain and weather, but also includes evaluation of the characteristics of geography and infrastructure, and the effects on friendly and threat operations.

A2.4.1.3 Step Three: Evaluate the Threat. Threat evaluation is a detailed study of threat forces, to include composition and organization, tactical doctrine, weapons and equipment, and support systems. Threat evaluation determines threat capabilities and limitations and how the threat would operate in the given AO.

A2.4.1.4 Step Four: Determine Threat Courses of Action. Step four integrates the results of the previous three steps. Analysts should develop estimative threat models that depict the threat's available course of action (COA). At a minimum, these should include the most likely and most dangerous COA.

A2.4.2 JTAC Specific Considerations. Current JTAC "beddown" locations as well as aligned unit locations should be presented as a visual for the JTACs to conceptualize the battlespace. Specifically, the enemy situation fort each of these locations should be presented prior to deployment so the JTACs understand the tactical problems they are likely to face in the AO. Significant kinetic events in the AO should also be addressed. The purpose of breaking these kinetic events down is to familiarize the JTACs in the unit with specific enemy TTP in the AO as well as the JTAC and/or aligned unit reaction to those TTP.

A2.5 Additional Intelligence Specific Duties. While EIT is the bulk of intelligence support to JTAC units, there are also four intelligence specific duties that are included in unit support.

A2.5.1 Geospatial Information and Services. All hard-copy maps, charts, and geodesic products can be obtained through the unit intelligence representative. Types of products normally used for mission planning include: city graphics, topographic line maps, joint operations graphics, tactical pilotage charts, nautical charts, and grid reference graphics (GRG). There are also various types of nonstandard and foreign-produced maps/charts which may be available. Digital maps can be accessed through tools such as TAK-TICS (**https://takmaps.com**), Digital Globe, and FalconView. TAK-TICS information can be found in **paragraph 3.16**, ATAK Planning Considerations. Hard-copy maps can be ordered through NGA or the 36th Intelligence Squadron at Langley (contact 36IS.ING.GPB@us.af.mil/DSN 574-6757). Hard-copy maps are helpful for locations where CAS training occurs regularly.

A2.5.2 Personnel Recovery. Unit intelligence personnel should be familiar with evasion plan of action (EPA), isolated personnel report (ISOPREP), and all related evasion and recovery (E and R) items. Intelligence personnel are also responsible for ensuring that unit member ISOPREPs are maintained and updated regularly.

A2.5.3 Intelligence Support to Force Protection. Intelligence supports force protection directly through training, mission planning support, and threat analysis. Responsibilities for force protection will vary between the host unit and tenant unit which will impact how intelligence personnel will specifically contribute. Unit intelligence personnel can reference ACCI 14-202, *Unit-Level Intelligence Mission and Responsibilities*, for more detailed information on intelligence support to force protection.

A2.5.4 Intelligence Oversight. AFI 14-104, *Oversight of Intelligence Activities*, guides intelligence oversight responsibilities. Due to the nature of JTAC units, this program will have only a small number of requirements for intelligence personnel.

A2.6 Intelligence Tools. This section is designed to give a basic understanding of tools and products that can be leveraged by intelligence analysts in support of JTAC units.

A2.6.1 Joint Mission Planning System. Joint mission planning system (JMPS) is a government-off-the-shelf (GOTS) full-featured mapping application that allows JTACs to mission plan as well as debrief with digital charts and imagery of target areas. It allows users the ability take mapping, image, and elevation data and use it to mission plan in a digital environment. This system is available on standard PCI3 loads although it is not accessible on Army networks.

A2.6.1.1 SkyView analysis and a threat line of sight plot are two products that can be produced in JMPS for JTAC mission planning and execution. Refer to AFTTP 3-1.JTAC, Attachment 2, Figure A2.1, SkyView and FV Analysis Tool Screen Capture and Figure A2.2, Threat Line of Sight Plot, for visual representations of these products.

A2.6.2 Special Warfare Assault Kit. Special warfare assault kit (SWAK) is a situational awareness tool used by JTAC units for mission planning as well as mission execution. It has robust capabilities for digitally-aided CAS (DACAS) and other peripheral controls (e.g., radio control, battery monitoring, and ISR feed viewing) for the JTAC. Intel personnel can use this software to build local point files for areas to interest as well as SIGACTs and distribute them out to JTACs via stand-alone computer systems. Additionally, intel personnel should refer to **paragraph 3.16**, ATAK Planning Considerations, for a how-to guide on downloading imagery for SWAK.

A2.6.2.1 Windows Tactical Assault Kit (WinTAK) is the windows based version of SWAK. All files developed in WinTAK are transferable to SWAK.

A2.6.3 Digital Globe. The digital globe enhanced view web hosting service (WVWHS) allows intelligence personnel and JTACs to download high quality, up-to-date satellite color imagery to be used on multiple mediums. Intel personnel supporting JTAC units should create an account using the following websites: **https://evwhs.digitalglobe.com** and **https://evwhs.nga.smil.mil**.

A2.6.3.1 MrSid imagery is the cross-compatible map format for multiple digital systems to include FalconView, JMPS, SWAK, and WinTAK.

A2.6.4 Target Acquisition Weather Software. This tool allows intelligence personnel to assist mission planners in determining sensor/weapon capabilities for a given target with applicable environmental effects. Although weather personnel should conduct this analysis, they may not be available during the planning phases. Additionally, target acquisition weather software (TAWS) can plot sensor capability information in FalconView/JMPS so that it can be combined with other overlays to include threat masking data to determine the best attack axis based on the target and sensor to be used. The resultant product can be used to evaluate the acquisition ranges of EO, IR, and laser based systems, as well as provide information on illumination data that may affect NVG usage or highlight supporting asserts during nighttime operations.

A2.6.4.1 The product developed from TAWS should include an IR Delta-T and detection range versus view direction and target temperature and Delta-T versus time. The Delta-T and temperature graphs will give a general idea of when thermal crossover will occur and whether it will be a factor for the planned TOT. The IR Delta-T and detection range versus view direction will show optimal attack directions and approximate launch and lock ranges as well as relative temperature of the targets. If the target is cold versus the background, then IR shadows will need to be considered.

A2.6.5 Google Earth. Google Earth is a virtual globe software program. It maps the either by superimposing images obtained from satellite imagery, aerial photography, and GIS over a 3D-globe and allows the user to import vector data for overlay on the initial mission planning to the digital environment. Google Earth can be used in a myriad of ways; some examples include: order of battle overlays, demographic overlays, and significant activity (SIGACT) tracker.

A2.6.6 FalconView. FalconView is a GOTS full-featured mapping applicationJTACn that is part of the portable flight planning system (PFPS) suite of software. It allows users the ability to take mapping, imagery, and elevation data and use it for mission planning in a digital environment.

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