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Tactical Doctrine

T-38C EMPLOYMENT FUNDAMENTALS/INTRODUCTION TO FIGHTER FUNDAMENTALS (IFF)

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The AETCTTP 11-1 is the primary tactical reference for IFF. This publication 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. With the exception of associate instructor pilot (IP) programs, this publication does not apply to the Air Force Reserve Command or the Air National Guard. This publication does not apply to the United States Space Force. This manual addresses basic employment tasks, provides information and guidelines on basic procedures and techniques used for standardization. It presents a solid foundation on which effective tactics can be executed and is designed to be used in conjunction with Air Force Manual (AFMAN) 11-202, Volume 3, *Flight Operations*, AFMAN 11-2T-38, Volume 3, *T-38 Operations Procedures*, AFMAN 11-2T-38, Volume 1, *T-38 Aircrew Training*, AFMAN 11-2T-38, Volume 2, *T-38 Aircrew Evaluation Criteria*, and technical order (TO) 1T-38C-1, *Flight Manual*. If conflicts arise between this publication and those mentioned above, the source publication takes precedence. When encountering situations not specifically covered by this publication, use safety considerations as a guide in determining the best course of action.

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Chapter 1

INTRODUCTION

1.1. Overview. War in the aerospace environment is currently in a period of fast-paced evolution. Since the beginning of aerial combat, technological development has driven, and been driven by, progress in building more efficient and effective aircraft and weapons. Nevertheless, the very basic principles of aerial combat remain virtually unchanged. As technology advances, mutual support and situational awareness (SA) are still critical to effective employment of airborne weapons. Current data link systems and situation displays will not replace core competence in basic skills. These fundamentals, or standards, are only part of training for combat, and provide the building blocks for effective tactical employment. Discussions on formation flying, air-to-air (A/A) and air-to-surface (A/S) in the T-38C are designed to aid in building a strong foundation of tactical skills. The maneuvers addressed are a means to an end, a starting point for pilots to study and explore firsthand describing the methods used to achieve desired results in air combat.

1.2. Purpose. This manual contains fundamental procedures and techniques to accomplish T-38C Introduction to Fighter Fundamentals (IFF) missions. It is designed to supplement training programs; and when used in conjunction with applicable Air Force instructions, flight manuals, and syllabi, provides a solid foundation on which IFF training can be accomplished. This volume is not directive in nature and provides no authority to depart from established training procedures, regulations, or directives.

1.3. Change Procedures. Aircraft modification and operational/training experience will, and should, dictate changes to this text. Old procedures and tactics should never be disregarded simply because they have been around for a while. However, new and better ways of accomplishing the mission will evolve and will need to be incorporated into this document. Safety-of-flight changes will be incorporated as soon as possible. Other inputs will be included during normal review cycles.

Chapter 2

MISSION PREPARATION

2.1. Introduction. Mission preparation, individually and as a flight, is the foundation of successful fighter operations. It encompasses cockpit resource management (CRM), psychological considerations, objective application, prioritization based on situational awareness (SA), and flight leadership. Each factor is part of a professional attitude, which enhances safety and increases tactical potential. The CRM core curriculum of communication, crew/flight coordination, mission analysis, risk management and decision making, situational awareness, and task management are addressed throughout this chapter. The success of all that follows (i.e., briefing, execution, and debriefing) is directly related to the amount and quality of preparation. First, determine mission objectives in terms of measurable combat capability and related basic pilot skills. Second, individually prepare for the mission. Finally, decide how to brief and execute the mission.

2.2. Cockpit Resource Management. The Cockpit Resource Management (CRM) core curriculum is referenced in AFMAN 11-290, *Cockpit/Crew Resource Management and Threat & Error Management Program,* and includes the following knowledge and skill sets that should be incorporated into flight briefings and debriefings when applicable.

2.2.1. Communication. Includes knowledge of common errors, cultural influences, and barriers (rank, age, experience, position, etc.). Skills will encompass listening, feedback, precision and efficiency of communication with all members and agencies (crew members, wingmen, weather, air traffic control, intelligence (Intel), etc.). Use precise terminology, acknowledge all communications, and ask questions/provide clarification when necessary.

2.2.2. Crew/Flight Coordination. Includes the knowledge and skills required within (internal) and outside the crew/flight members (external) for mission coordination, flight/mission integrity contracts, teambuilding, leadership, command authority, responsibility, behavioral styles, assertiveness, persistence, conflict resolution, hazardous attitudes, legitimate avenues/methods of dissent, and solution driven statements. Adapt as situational demands require, focus attention on task, and ask for inputs.

2.2.3. Mission Analysis. Includes pre-mission analysis and planning, briefing, ongoing mission evaluation, and post-mission debrief. Clearly define mission overview/goals. Analysis instruction will include specific threat and error management tools and techniques. Debrief instruction will include aircrew responses and outcomes to threats and errors.

2.2.4. Risk Management/Decision Making. Includes risk assessment (RM), the risk management processes (deliberate, real-time RM)/tools, breakdowns in judgment and flight discipline, problem-solving, evaluation of hazards, and control measures. Identify contingencies and alternatives, gather all available decision data, and clearly state decisions.

2.2.5. Situational Awareness. Includes knowledge and skill objectives for identifying errors, preventing the loss of situational awareness, recognizing the loss of situational awareness, and techniques for recovering from the loss of situational awareness. Recognize the need for action and verbalize/act upon unexpected events.

2.2.6. Task Management. Includes establishing priorities; using available resources to manage workload, overload/under-load and complacency; managing automation, checklist discipline and standard operating procedures; and stating problems and proposed solutions.

2.3. Establishing Priorities and Situational Awareness. It is an acknowledged fact that during the heat of any mission, there are occasions when everything cannot be done in the time available. This requires assigning priorities to each task. At the top of the list are things that must be done—do them first. Lower on the list are things that can be done when they do not interfere with the have-to-do items. The list of have-to-do tasks should be established prior to flight time. Some basic top-priority tasks are listed below:

- Maintain aircraft control.
- Never hit the ground (or any man-made obstacles).
- Never hit anything in the air (i.e., lead, wingman, traffic, or adversary).
- Never run out of fuel.
- Never let anything shot from the ground or air hit the aircraft.

2.3.1. Situational Awareness. SA in the air is a vital commodity. Channelized attention, task saturation, misplaced priorities, spatial disorientation, training rule violations, complacency, G-induced loss of consciousness (GLOC), and poor mission preparation can all degrade SA and lead to a mishap. Use available systems to warn the pilot of potentially dangerous situations. For example, set the altitude warning tone to 2,000 feet above the basic fighter maneuver (BFM) fight floor to remind the pilot to start the floor transition to avoid flying below the floor. For long range fights, one technique is to set the altitude warning tone 1,000 feet above the fight floor, or at the transition altitude if the low altitude (LOWAT) structure is incorporated.

2.3.2. Low Priorities. Lower-priority tasks range from answering fuel checks on the radio to calling METRO with a pilot report (PIREP). There may be some shifts in high-priority items, but they never go away completely. For example, at 20,000 feet in close formation in the weather, avoiding collision with members of the flight is a bigger concern than hitting the ground. Obviously, mission accomplishment has a high priority, but if the aircraft does not get home, the pilot has failed to accomplish a major part of the mission. In peacetime, there is no mission more important than safe recovery after a mission. If nice-to-do things take priority over have-to-do things, the pilot is guilty of mis-prioritization and jeopardizes the aircraft and other flight members. If the rare occasion comes up where aircraft malfunction and emergencies make it impossible to perform the top-priority task of self-preservation, it may be time to eject.

2.3.3. Task Management. Task management is the organization of tasks to maintain the workload at an acceptable level. The organization of tasks is in priority order is always aviate, navigate, and communicate. In more tactical scenarios, this may come in the form of formation, sensors, communication in the 4th generation fighter community, or intercept, avionics, communication in the 5th generation fighter community.

2.3.4. Task Saturation. Task saturation is a temporary failure to properly assess available information and initiate required pilot actions. At some point, most pilots experience input overload and the urge to believe false sensations, which can lead to dangerous misinterpretations of flight data.

2.3.4.1. Hazards. Some of the possible hazards of task saturation include the following:

- Loss of mission effectiveness due to inability to perform mission tasks.

- Interference with the tasks of others.
- Fuel waste.
- Flight member frustration.
- Training rule violations.
- Loss of control of the aircraft.
- Ground collision.
- Midair collision.
- Getting the pilot or the lead/wingman shot down during combat.

2.3.4.2. Causes. The main cause of task saturation is the sheer number of duties which must be handled by the single cockpit occupant, or poor CRM in crew aircraft. Among the tasks to be performed are aircraft control, navigation, refueling, formation, tactics, and weapons employment. Pilots can become saturated by trying to do too many of these tasks at once. Loss of visual references, which occurs most often while flying in weather, or at night, increases the possibility of task saturation. Other contributing factors include complex training or combat scenarios, habits formed while flying other types of aircraft (e.g., mistaking knob, switch, and display locations), and the transition to a single-seat aircraft. Managing cockpit tasks requires good judgment and strong interpretive and discriminatory skills. If the pilot's judgment has been degraded by peer pressure, threat of punishment, erroneous information, complacency, or a tendency to react too quickly, the pilot is more likely to become saturated.

2.3.4.3. Symptoms. How to tell when the pilot, weapon systems officer (WSO), or another flight member is becoming overloaded? Symptoms include the following:

- Missing radio calls.
- Difficulty controlling the aircraft.
- Loss of SA.
- Spatial disorientation.
- Channelized attention, focusing on one task only.

2.3.4.4. Coping. Stay alert to task saturation symptoms; recognize when approaching overload. If saturation is imminent, admit it. Avoid engaging in situations that may be too difficult to handle under the circumstances. One or more of the following techniques may help cope with overload:

- Treat the situation as an emergency.
- Climb to cope.
- Set new priorities such as aircraft control.
- Tell someone—lead or supervisor of flying (SOF).
- Fly back into a comfortable regime.
- Return to base (RTB).

2.4. Task Management Techniques. Employ the following techniques to reduce the chance of becoming overloaded.

2.4.1. Preflight. Be well rested, properly nourished, and mentally prepared.

- Know what is expected on the mission.
- Ask questions at the briefing.
- Ensure no checklist items are omitted.

2.4.2. In Flight.

- Push to stay ahead.
- Do not dwell on mistakes.
- Rely on sense of sight and flight instruments.
- Control false sensations.
- Rapidly transition to instruments when outside visual references become unreliable.
- Be prepared for task priority changes.
- Reduce head-in-cockpit time.
- Know switch positions.
- Watch for personal saturation symptoms in other flight members.
- Use the altitude warning tone or the radar altimeter warning tone to warn the pilot of potentially dangerous situations.

2.4.3. Postflight. A thorough debrief is good preparation for the next mission. Ask questions if unsure about anything.

2.5. Air-to-Air Tasks. Air-to-Air (A/A) flight tasks can be divided into four phases: (1) beyond visual range (BVR), (2) transition to visual, (3) merge/visual, and (4) post merge. Pilot experience and currency may make these tasks second nature. Proper mission planning and "chair-flying" can optimize mission success. In IFF, this is the Air Combat Fundamentals (ACF) mission set.

2.5.1. Beyond Visual Range. The BVR phase contains the following A/A flight tasks:

- Thorough mission preparation.
- Avionics and setup.
- Strict adherence to briefed flight member contract.
- TCAS detection.
- Intercept geometry.
- Tactical communications.
- Block Adherence.
- Ground-controlled intercept (GCI)/airborne warning and control system (AWACS) use.

2.5.2. Transition to Visual. The transition-to-visual phase contains the following A/A tasks:

- Flightpath deconfliction.
- Canopy code.
- Visual acquisition/early tally.
- Multiple tallies.
- Visual Identification (VID).
- Conversion execution.

2.5.3. Merge/Visual. The merge phase contains the following A/A tasks:

- Attention outside cockpit.
- Air combat maneuver (ACM) considerations.
- Weapons Employment.
- Engaged maneuvering.
- Support maneuvering.
- Flightpath deconfliction.
- BFM considerations.
- Listening to radio communications.

2.5.4. Post merge. If SA is slipping away, get away from the merge, regain awareness, and then assess the options. The post merge phase contains the following A/A tasks:

- Separation.
- Visual lookout.
- Sensor/Avionics management.
- Maintaining or regaining mutual support.
- GCI/AWACS use.

2.6. Psychological and Physiological Considerations. A fighter mission demands total involvement, whether it is actual combat or IFF training. This means being mentally and physically prepared for the mission. Mental preparation requires setting aside outside stresses, allowing for total concentration on the mission. Physical preparation means conditioning the body for the extraordinary demands of aerial combat and adopting a healthy lifestyle. This is an attitude! A fighter pilot's attitude is a proper blend of pride, desire, aggressiveness, and knowledge.

2.6.1. Psychological Considerations. In combat, one does not have the option of calling "KINGS X, I HAVE LOST MY FLIGHTLEAD" or "BINGO, KNOCK IT OFF." Do not plan on the enemy making a mistake. No one knows for sure how they will react in the next combat situation. This fact can cause anxiety. Anxiety is also caused by fear or misunderstanding one's own abilities or an opponent's abilities in the aerial arena under adverse conditions. The foundation for overcoming anxiety is established by developing confidence in the following:

- The aircraft.
- The wingman.

- The ability to accomplish the mission.

2.6.2. Habit Patterns. It is a documented fact that when fighter pilots find themselves in stressful situations, their performance tends to follow previously learned habit patterns. Habit patterns cannot be turned on and off at will. The same skills developed in training will be the ones used during actual combat. Combat does not act as a catalyst and bring hidden qualities magically to the surface, or suddenly quench poor habits developed in the past. Do not expect instant success. Being a good fighter pilot is, to a large extent, just plain old hard work. Professionalism is one quality that must be common to all fighter pilots. Too much pride can cause one to not admit their faults; too much desire can cause the pilot to overlook small details along the way; overly aggressive attitudes can cause the override of good judgment. Professionalism is the only quality that can achieve the proper blend of pride, desire, and aggressiveness.

2.6.3. Physiological Considerations. For a fighter pilot to be mentally and physically prepared to meet demanding mission tasks, a good diet, proper physical conditioning, and adequate rest are a must. The lack of respect for any one of these factors could turn a highly demanding environment into the basis for a safety board. There is also a synergistic effect when more than one of these factors is below standard. Proper mission planning begins with good physical and mental preparedness.

2.7. Sustaining G-Forces. USAF fighter aircraft capability can meet or exceed pilot tolerance for sustained high G-forces. This capability often allows pilots to apply more G than their body can tolerate; after a "short grace period," oxygen available to the brain is depleted and consciousness is lost. Pilots must anticipate G-onset, control G-onset rate, and coordinate an effective anti-G straining maneuver (AGSM). This takes mental discipline and practice to master.

2.7.1. Flight Factors. High onset rates and long periods of sustained high G can bring the pilot's body to near exhaustion more quickly than at lower G levels. High onset rates can bypass the normal stages of reduced vision resulting in nearly instant unconsciousness.

2.7.2. Diet, Conditioning, and Rest. Be prepared mentally and physically for high-G stress. Proper physical conditioning involving anaerobic training (e.g., free weights, machine weights) and aerobic training (e.g., running, racquetball, or cycling) plays an important role in improved G-tolerance and endurance.

2.7.3. Currency, Anxiety, and Aggressiveness. G-tolerance is increased through practice. Layoffs such as a long leave, duty not involving flying (DNIF), or even just coming out of a low-G flying phase requires a buildup of G-tolerance. Anxiety in new situations or other pressures can mask objectivity in assessing tolerance. Aggressiveness, if not properly controlled, can lead to overconfidence and inattention to or disregard for bodily warning signs of fatigue and stress. Pilots need to be aware of these factors and be on guard for signs of G-stress limits. An individual's G-tolerance and warning signs can vary from day to day. Fatigue, tunnel vision, or gray out are critical warning signs that the pilot is already at the limit. Do not push this limit; there is no buffer or reliable safety margin. Expect G-tolerance to vary at different times even on the same flight, based on all the factors discussed. When pilots suspect their effectiveness is being reduced, they must take appropriate action. In combat, it may mean separation, if able. In training, it may mean "knock it off."

2.7.4. AGSM. The AGSM is the best defense measure available to pilots. It is very important to perform the same, correct AGSM each time the pilot anticipates and/or applies G, regardless of the amount of G. The proper technique needs to become a skill that is integrated with other flying skills.

2.7.4.1. Preparation. The straining maneuver should begin prior to G onset. It can be difficult to catch up to the G if one gets behind from the start. Begin by leading with lower body tensing and then the breathing component.

2.7.4.2. Tensing Muscles. Ensure a squeezing or contracting of the muscles. Avoid a tendency to push with the legs. Tense and maintain all the lower body muscle groups to include the following:

- Legs, thighs, hamstrings, quadriceps, and calves.
- Gluteus maximus.
- Abdominal muscles.

2.7.4.3. Breathing Component. This consists of a forced exhalation against a closed airway. The following items are highlights of the breathing component:

- Sufficient initial breath.
- Block the airway, not just the lips.
- Short, quick air exchange every 3 seconds.
- Prevent air leaks such as groaning or breathing through the nose.
- Vary upper body intensity depending on the G-load.
- Maintain the technique until the G is unloaded.

2.7.5. G-Awareness. A G-awareness exercise should be conducted on all missions where heavy maneuvering (at or above 5 G) is planned or likely to occur. Consideration should be given to the following list:

2.7.5.1. Identify high-G stress situations and maneuvers in the briefing for each mission and the proper techniques for avoiding GLOC. Do not forget proper G-suit fit and straining maneuver techniques. By far, the most important factor in improving G-tolerance is the performance of a good, well-timed, and coordinated AGSM.

2.7.5.2. If the pilot has not flown high-G sorties recently, tailor the mission accordingly.

2.7.5.3. Perform a good G-awareness exercise.

2.7.5.4. Anticipate the onset of G-strain early.

2.7.5.5. Make G-awareness part of the SA in-flight. Avoid snatch pulls to high G. Make all G inputs smooth, with controlled build up, and within personal limits.

2.7.5.6. Exercise strong flight lead control and consider coming home early if any flight member seems fatigued.

2.7.5.7. Do not sacrifice good training but be sensitive to the dangers of GLOC through all engagements. Loss of consciousness is a serious problem, but it can be controlled. The

approach to the entire problem is the key to its solution. Take GLOC seriously. The consequences are life and death. The pilot will make the difference.

2.7.5.8. For a more comprehensive review of G-stress factors, GLOC, physiology of G-awareness, and further details of the AGSM refer to AFMAN 11-404, *Fighter Aircrew Acceleration Training Program*.

2.8. Mission Objectives. Preparation for any given mission should be based on mission objectives. The mission objectives should give the big picture of what is happening for each mission and are used to measure individual and team mission success. Well-defined objectives should be based on the mission requirements and tasking, environment, threat, and other factors such as wingman experience. Clear objectives limit the impact of distractions and focus attention on mission accomplishment. A valid objective has three parts: performance, conditions, and standards.

2.8.1. Performance. Performance describes what each pilot or the flight does during the mission. It is action and is not vague. Use action verbs such as employ, practice, or negate.

2.8.2. Conditions. The conditions describe starting parameters, such as "from an offensive perch" or "given two bandits with noise jamming and a BVR setup."

2.8.3. Standards. The standards state how well the performance must be done and is categorized by time limits, accuracy, and quality (i.e., meeting valid kill criteria, or ranging within ± 500 feet).

2.9. Mission Preparation. Individually and as a flight, mission preparation is the key to effective training and success in combat. The A/A and A/G chapters will cover basic methods of training and techniques to apply professional mission preparation.

2.9.1. Anticipate. The first step in preparing for a training mission is to check the schedule. Review the schedule to determine the mission designation, the flight lead's name, assigned airspace, and departure and recovery routing. Meet with the flight lead/instructor of record the day prior to the mission, if able, to discuss mission conduct and specific responsibilities, to offer help in mission preparation, and to answer any questions. Ensure unaccomplished tasks from prior missions are brought to the flight leads attention. Be prepared to brief the threat, emergency procedures of the day, specific mission task parameters, and any items requested by the flight lead.

2.9.2. Study. Preparation plays a vital role in determining the success of any mission. Read everything about specific missions, the aircraft, and its employment. Study the pertinent publications listed in **Table 2.1**., References. These and other sources should be regarded as required reading, supplementing the training received from flight leads and academic instructors. Pay special attention to the syllabus, mission guides, objectives, and squadron standards. All references should be available at the flying squadron.

2.10. Briefing. The briefing sets the tone for the entire mission, and the flight lead sets the stage for the briefing. The briefing will cover, in detail, all phases of flight including departure, recovery, abnormal procedures, special subjects, alternate missions, training rules, special instructions (SPINS), and tactics.

2.10.1. Flight Leads. Establish goals to accomplish during the mission and have a plan to achieve them. Display the mission objectives on the board or computer screen. Outline the standards to measure a successful performance.

Table 2.1. References.

Unclassified
Syllabus
Mission guides/playbook
TO 1T-38C-1
AETCMAN 11-251
TO 1T-38C-34-1-1
AFMAN 11-2T-38v3
Local base operating instructions (OI)
Wing and/or squadron standards
In-flight guide (standard instrument departure [SID], recovery, airspace)
AETCTTP 11-1
Approach plates

2.10.2. Wingmen. Wingmen should check in with their flight leads as early as possible and should arrive early enough prior to the sortie to complete pre-brief administration items. Check with the flight lead to see if they require any special items, other than the standard for the brief. Check the schedule for last-minute changes, check go/no-go item compliance, and complete operational risk management (ORM). Check the weather, notices to air missions (NOTAMs), safety and/or time-critical notices such as flight crew information file (FCIF), and pilot read file. Review the SID and recovery for the mission, and study a map of the working area, ensure familiarization with boundaries, altitudes, and restrictions. Arrive at the briefing room 10 to 15 minutes prior to the brief to review the lineup card and SPINS. Wingmen should be prepared to brief the weather, NOTAMs, emergency procedure (EP) of the day, and threat of the day on all missions. Be organized and professional when briefing the threat of the day. It is not necessary to know how to build the threat system, but it is important to know tactical numbers and how to fight and defeat the threat. In other words, know its strengths, weaknesses, radar warning receiver (RWR) indications, internal countermeasures set (ICS) effectiveness, and how to engage or avoid the threat. Stay focused and pay attention during the brief. Do not speak unless prompted. Write down any questions and ask them at the appropriate time. Never leave a briefing with doubts or unanswered questions.

2.10.3. After the Brief. There should be at least 10 minutes from the end of the briefing until step time. Use this time to mentally review the mission, absorb the brief, take care of personal needs, ensure sign-out on the flight orders, obtain aircraft tail number, pick up the data transfer cartridge (DTC), inspect life support equipment, and get Takeoff and Landing Data (TOLD).

2.10.4. Briefing Players. If adversaries, friendly players, Intel, or other mission support personnel are present, brief them first on only that information pertinent to them and the mission. GCI/AWACS controllers, however, should receive the entire tactical briefing whenever possible. Alternate missions are less complex, but also have specific objectives. The flight lead should be dynamic, enthusiastic, and should motivate and challenge the flight to perform. One effective technique for enhancing briefing effectiveness is to involve the flight members by asking them questions pertaining to the sortie.

2.10.5. Preparing the Briefing. One of the biggest keys for presenting a quality mission briefing is to write out the briefing on paper. Although this requires some time and effort, the dividends are well worth the effort. Putting the briefing in written format allows the pilot to organize thoughts, identify any potential pitfalls in the knowledge regarding specific execution techniques and procedures, and enhances familiarity with the subject matter. The exact format used to construct the briefing is a matter of personal preference. Some find the need to write every word they plan to say during the briefing, while others are comfortable briefing from an outline that highlights the major topics they plan to cover. Typically, the more comfortable and familiar the pilot is with the subject matter, the less need to write it down. Missions that are complex in nature, or require very exact time management in the briefing, may require the pilot to write the verbiage which will be used in more detail. Once the briefing has been written out, review/practice it at least twice prior to actual delivery. This will allow the pilot to identify areas that need to be modified and to practice for the brief.

2.10.6. Administrative Items. Ground operations, departure, recovery, and relevant abnormal and special subjects should be covered in an efficient manner. Elements of the mission which are standard should be briefed as standard. Spend most of the time describing the ‘what’ and ‘how-to’ of the mission.

2.10.7. Personal Equipment. Ensure proper fit of the G-suit, parachute harness, and helmet IAW current operating instructions. Preflight equipment prior to stepping to preclude flightline red-balls and equipment malfunctions during engagements. Time spent getting personal equipment in order is time spent toward eliminating potential problems.

2.10.7.1. Parachute harness. The parachute harness should fit snugly enough to function safely if the pilot bails out. However, it should not be so tight the mobility is inhibited when checking six.

2.10.7.2. Helmet and Visor. The helmet and visor require special consideration. The helmet must be tight enough to prevent movement under G, but not so tight as to be a distraction. Currently there are four types of visors approved for use by USAF aircrew: the standard dark visor, the high-contrast visor, the clear visor, and the gradient visor. Sun visors can reduce the percentage of light getting to the eyes by as much as 20 to 25 percent and may reduce the ability to detect a bandit. Although many lighting conditions may require use of the dark visor, keep these limitations in mind. The use of the high-contrast visor requires flight surgeon approval and was designed for special lighting conditions. Typically, the clear visor is used for night operations and low-altitude training missions. The gradient visor transitions from dark-to-clear visor, from top to bottom, and provides flexibility in a variety of environmental conditions. All four visors should be available from flying squadron aircrew flight equipment sections.

2.10.7.3. Attenuating Custom Communications Earpiece System (ACCES). ACCES earplugs offer increased hearing protection and better control over cockpit volumes and should be used whenever available. Ensure a proper fit and work with aircrew flight equipment after each flight to fine-tune the fit until the earplugs fit well. Pilots should bring a spare pair of ACCES on each sortie in case the primary set fails.

2.10.7.4. Glasses and Contact Lenses. Sunglasses may be used but produce the same light reduction effect as dark visors. However, this is not the only problem with using sunglasses. When wearing sunglasses, eyes adjust for visual conditions through the lenses and peripheral vision outside the lens may be reduced. Combined use of the dark visor and sunglasses is not recommended. Ensure that both normal eyeglasses and sunglasses fit appropriately to preclude movement during maneuvering and do not interfere with visors. Wear of contact lenses requires flight surgeon approval, and pilots wearing contact lenses must be entered into the USAF contact lenses program.

2.10.8. Tactical Content. The first principle regarding briefing content is to spend most of the time on what the pilot expects to expose the wingman to in the air. As an example, when briefing a 6,000-foot defensive perch BFM fight, do not spend 10 minutes talking about a bandit that goes pure or lead pursuit off the perch. The second principle is to start with general concepts and work to the specifics. As an example, consider a mission in which the pilot is instructing offensive BFM. The offensive BFM objectives provide a general framework for the desired performance. From here, narrow the scope to big picture maneuvering goals, which are to gain and maintain a position on the bandit's turn circle with an energy advantage until a weapon is available, and then kill the bandit. Having laid this groundwork, now brief the specifics of the setups the wingman will fly and provide precise techniques to achieve the objectives. The generalities require very little time, but they are essential to effectively narrow the scope of the discussion to specific techniques. Philosophical discussions, blanket statements, and academics should be avoided in mission briefings. Philosophy is an important element in tactics development, but these discussions should be reserved for an academic environment in which sufficient time is available to discuss the pros and cons of a certain philosophy. Once a philosophy is widely accepted, it becomes a tactic or technique and can then be incorporated into a tactical briefing. There is no time in a mission briefing for philosophical discussions. A final consideration when developing briefing content is to always strive to explain, in terms of quantifiable parameters and execution techniques, what a wingman can take into the air.

2.10.9. Briefing Delivery. The most important fundamental regarding mission briefings is that they are not seminars. Because a fixed amount of time is allocated to the briefing, it should be made clear to the wingman that the flight lead/instructor has the only speaking part in the briefing except when soliciting questions.

2.10.9.1. Briefing Room Boards/Computer Slide Preparation. Some forethought as to preparing the boards and slides will enhance the overall quality of the briefing. Generally, the less cluttered the boards and slides are, the less distracted the wingman will be during the mission brief. Information on the boards and slides should be limited to mission essentials (i.e., setup parameters, and/or visual aids to complement the discussion. It is poor technique to use the boards and slides for laundry lists of topics the pilot plans to cover during the briefing. This has absolutely no value to the flight and consumes board space, which could be better used for information pertinent to the mission execution.

2.10.9.2. Verbalization. The briefing content may be exceptional, but if the pilot is unable to effectively translate ideas into words, the briefing will lack effectiveness. The best way to improve verbalization skills is to practice the briefing. For missions that have never been briefed, this may mean giving the entire briefing out loud to an empty briefing room, or to anyone who is willing to listen and provide critique. If the pilot is familiar with the briefing, the practice session might consist of a 20- to 30-minute study session conducting a mental review. Practicing the briefing, whether mentally or out loud, will avoid one of the biggest briefing pitfalls - going off on "tangents". Without practicing the briefing, it is easy to spend 2 to 3 minutes on one administrative item such as no radio (NORDO) procedures, when with a little forethought the item could have been adequately covered in 30 seconds. During the tactical portion of the mission, it is even easier to go off on tangents. Complicated topics such as defensive reactions can turn into 25-minute discussions unless the pilot practices exactly what will be said, and then sticks with what was practiced. Practice will also help eliminate distracting verbal mannerisms (e.g., um, now, okay, basically, the bottom line, gentlemen, etc.).

2.10.9.3. Visual Aid Integration. The effectiveness of the mission briefing can be significantly enhanced by timely and accurate use of visual aids (i.e., models on sticks, hands, canopy bows, slides, and drawings). On the other hand, inappropriate or inaccurate use of visual aids can confuse the flight members, thereby detracting from the overall quality of the presentation. Integration of visual aids into the verbalization requires some forethought. Determine exactly what portions of the brief will be enhanced by visual aids, and then decide which mediums to use (i.e., drawing, sticks, or computer slides). Once this determination has been made, it is essential to practice using the visual aids. Drawings must be accurate enough to support the words. Some typical pitfalls include talking to the board while drawing and blocking the board work from the wingman's view. A good way to avoid these errors is to complete one task at a time. When drawing, look at the board and make an accurate drawing (without talking). When the drawing is complete, move to a side so both the drawing and the wingman can be seen. Look at the wingman while talking. As a technique, if right-handed, move to the right of the drawing, and vice versa if left-handed. This will allow easy reference or modification of the drawing with the appropriate hand, without obscuring the wingman's view. When using sticks, the same principles apply. First, position the body so the perspective makes sense from the wingman's cockpit and aircraft, not blocking the models from the wingman's view. Look at the sticks while positioning them, and then look at the wingman while talking.

2.10.9.4. The Finer Points. In addition to the considerations mentioned in previous paragraphs, there are some fine points regarding briefing delivery, which separate good briefings from outstanding briefings. First, although not already mentioned, stand up to deliver the entire briefing. This sets the stage/roles for the flight lead and wingman. It reinforces the roles of who is in charge from the time the brief starts through the end of the debrief. Second, make the writing on the boards neat and ensure the letters and drawings are large enough to be legible from where the flight is sitting. As a technique, use a ruler to improve legibility and neatness. Ensure the letters are big enough for all flight members to see. Third, avoid stagnating in one position while delivering the briefing. This will keep the flight's eyes and head moving and focus their attention on what is being said and referenced. Voice inflection is another excellent tool for retaining attention and

emphasizing key points. There is nothing worse than listening to a monotone delivery. Humor/jokes should be almost nonexistent. Maintain as much eye contact as possible with the wingman. The wingman's facial expressions can give instant feedback as to whether the wingman understands the concepts being presented. If the wingman appears obviously confused, another approach is needed. Present the technique in a different manner or determine the source of the wingman's confusion via very specific questions.

2.11. Flight Leadership. Flight leads have the general responsibility for planning and organizing the mission, leading the flight, delegating tasks within the flight, and ensuring mission accomplishment. They oversee the resources entrusted to them, and they must know the capabilities and limitations of each member of the team. Once airborne, they have the final responsibility and controlling authority for establishing the formations, maximizing their effectiveness, and leading the flight successfully during the mission.

2.11.1. Discipline. Discipline is perhaps the most important element for success in aerial combat. On an individual basis, discipline consists of self-control, maturity, and judgment in a high stress, emotionally charged environment. Teamwork is an integral part of discipline. Individuals must evaluate their own actions and how they will affect the flight and mission accomplishment. If the flight lead and wingman know their respective duties, they will work together as a team. Experience and realistic training will lead to solid and professional air discipline.

2.11.2. Wingman Flight Responsibilities. Wingmen have the supporting role in the flight. They help the leader plan and organize the mission. They have visual lookout, formation position, deconfliction, and perform backup navigation tasks. Wingmen engage as briefed or when directed by the leader and support when the leader engages. It is essential that wingmen understand their briefed responsibilities and execute their offensive or defensive contract in a disciplined manner.

2.12. Debrief. It is a well-accepted axiom that most of the learning takes place in the debrief. Because of this, it is important each flight member devotes as much intensity to this part of the mission as to the briefing and in-flight execution. The objective of the debrief is to determine if the desired mission objectives were achieved, identify lessons learned, and define aspects of training needing improvement. An honest assessment of performance is more important than "winning the debrief." Do not allow pride to stand in the way of admitting mistakes. Receive instruction openly using the debrief as a tool for improvement. Furthermore, the debrief should also cover those areas that were executed well, and the overall performance should be compared with the mission objectives. The result should be all participants gaining solid direction on how to do it better next time. All debriefs include the following main areas: preparation, reconstruction, analysis, instruction, and summary.

2.12.1. Preparation. Flight leads should have a specific mission debriefing guide aligned with the mission briefing guide – this will ensure a logical structure and flow. All participants should know (from the briefing) what will be required from them during the debrief, and sufficient time between arriving in the debrief area and starting the debrief should be allowed to gather that information (normally 20 to 30 minutes). Use everything available (notes, tapes, air combat maneuvering instrumentation (ACMI), etc.) to best gather the needed data. Have tapes cued for review. Preflight the debriefing room—clean boards; sufficient pens, sticks, props; operable playback equipment; etc.

2.12.2. Reconstruction. Flight leads set the rules of engagement (ROE) for the debrief to ensure accurate mission reconstruction. Additionally, they should be aware of all participants' time constraints – tight turn times, follow-on training events, other commitments, etc. The debrief is conducted in a professional atmosphere and critiques of execution should not be taken personally. Follow debrief etiquette – give only the information asked for when asked and save questions for the appropriate time. Avoid defensive attitudes and do not make excuses for poor performance. Take notes for later review.

2.12.3. Analysis. Once execution has been reconstructed, the next step is to highlight the areas that require further analysis. In any given mission or engagement, there are dozens of execution areas that could be discussed in detail. The problem with doing so is that it is impossible for the average flight member to absorb more than three or four major points per engagement. For this reason, it is critical to determine which errors were key to the overall outcome of the engagement and focus on these during the instructional phase of the debrief.

2.12.4. Instruction. There are two basic components to providing an instructional fix to a particular error. First, IPs must determine if the error was due to perception, knowledge, decision, or execution so the student can understand why the error was made. This is important to consider because there may be cases where the result was acceptable, but it was more due to luck or a gross error on the part of the adversary than on correct execution on the student's part. Second, the instructor must provide the student with quantifiable techniques or procedures to correct the flaw on future missions. If there are numerous methods for correcting the execution flaw, IPs must determine which one(s) will be most effective for each case. Too much information can create confusion; too little can leave the student with insufficient understanding. Like the mission briefing, if used correctly, visual aids can reinforce instruction and significantly enhance a student's understanding.

2.12.5. Summary. Use the mission objectives to provide a quantifiable measure of performance. In addition, look to each event to find learning points and determine trend items. At the conclusion of the debrief, summarize the key performance areas that are working well and those that need to be improved upon for the next mission.

2.12.6. Debrief Techniques. Begin the debriefing with an overview of the debriefing flow. While exact formats will vary depending on mission types, a normal debrief flow for an IFF mission is: plan/brief, flight admin to and from the working area, area/fight admin, and primary mission execution. In most cases, debrief of the plan/brief and admin should be expeditious – the focus should be on the execution of the primary mission. To ensure this, review tape/notes and be prepared at the beginning of the debrief with desired points. If a major execution error will be caused by the plan/brief, emphasize that point when debriefing the execution. There are numerous techniques to run an effective debrief. Two of the most common are:

2.12.6.1. Performance Measure Technique. Remember to debrief the mission training objectives, as this will provide the wingman with a quantifiable measure of performance. There are a lot of different techniques for relating performance to objectives, and each one has its merits as well as drawbacks. Whatever technique is used, be consistent throughout the debrief. At the conclusion of the debrief, summarize the key areas the wingman needs to concentrate on for the next mission, and try to end the debrief on a positive note.

- What Happened? This involves reconstructing of the event and determining "what" occurred. This portion helps focus the use of ACMI, drawings, and tapes to find a cause for the error.
- Why Did It Happen? This involves determining the cause or causes of why things went wrong. In this phase, the answer to "why" the event occurred should be drawn back to perception/"picture", decision/"plan", or execution.
- How to Prevent This Error from Happening Again? This is the most important portion of the debrief. The "how" gives all of the flight members a concrete lesson to pull from the training that just took place. Without this step in the debrief process, the opportunity for flight members to grow as combat aviators is lost. When answering the "how", the instructor is offering recommendations to the student as the best method to recognize the error, prevent the error, and fix the error if it occurs again.

Table 2.2. Performance Measure Debriefing—Board Matrix Example.

Event	What Happened?	Why Did it Happen?	How to fix?
6,000-foot OBFM	Did not kill Bandit	1. Poor rate fight mechanics 2. Late repo/HUD BFM 3. Gun out of range	1. Chair fly, simulator practice 2. Assessment window 3. Ranging Pictures
10° pop	GE – min rel	1.Short AOD 2.No track adjustment at track altitude	1. Pull to correct AOD 2. Appropriate correction/mechanics

2.12.6.2. Debrief Focus Points (DFP) Technique. DFPs are a way of selecting the major points in a sortie requiring analysis. This technique is especially effective during complex mission debriefs where it is not reasonable to analyze every individual event. Instead, DFPs focus the overall debrief to find the major lessons learned. See **Table 2.2**.

2.12.6.2.1. Points to Ponder (PTP). Previously referred to as PTPs, DFPs are usually phrased in the form of a question and point the learning in the direction of where the mission failed to meet objectives. A mission may have numerous DFPs, it may have sub-DFPs to help answer the main DFP, or, if all objectives were met, there may be no DFP.

2.12.6.2.2. Contributing Factors (CF). CFs are events or occurrences that potentially contributed to the DFP. They can be further classified into the particular type of error:

- Perception – fight analysis.
- Knowledge – lack of education or practical understanding
- Decision – maneuver selection.
- Execution – maneuver mechanics.

2.12.6.2.3. Instructional Fixes (IF). Once all DFPs and their associated CFs have been identified, IPs are responsible for providing the "how-to" fix to help ensure better performance next time.

2.12.6.2.4. Root Cause (RC). Following IFs, IPs should highlight the initial or primary CF that led to the DFP.

2.12.6.2.5. Learning Points (LP). LPs are used when no DFP is warranted but where an error occurred that merits increased emphasis in the debrief. LPs may exist in cases where the objectives were met, but mistakes were made which on another mission may have led to failure. LPs are answered with IFs the same as with DFPs.

2.12.6.2.6. Lesson Learned (LL). LLs are the overall/"big picture" takeaways for an engagement or sortie that highlight fundamental changes to be applied next time.

2.12.6.2.7. Trends. Trends are similar events that occurred numerous times during a sortie or engagement. Whether good or bad, identifying trends can be helpful during summary.

Table 2.3. DFP Debrief – 6,000-Feet DBFM Example.

DFP	**CF**	**Fix**
Why did Eagle 2 die?	Poor rate fight	Improve DBFM cross-check and apply briefed EM fixes
Root Cause→	Incorrect assessment of range, AOT, and planform	Provide instructional picture of good separation cues
	Poor separation mechanics	Unload to 0.5 Gs
	No countermeasures – perception/execution	Nose threat awareness, etc.
Lesson Learned – Correct assessment of range, angle off tail (AOT), and planform is required to assess valid separation cues. If you are not sure you have valid separation cues, do not attempt to separate.		

Chapter 3

FORMATIONS

3.1. Introduction. This chapter builds on the formation fundamentals learned in undergraduate flying training— refer to AETCMAN 11-251, *T-38C Flying Fundamentals*. Formation flying is required for efficient A/A and A/G employment, and discipline is essential for the safe and efficient employment of all fighters. During combat operations, disciplined formation is required to coordinate offensive firepower, mutual support, and survivability. The integrity of a formation can only be maintained when the leader has overall knowledge and control of the actions of each flight member. The flight lead will brief the formations to be flown and formation responsibilities. The wingmen's main duty is to fly formation on the leader and to always support their flight lead. Wingmen will maintain assigned formation position until change is ordered or approved by the flight lead. The flight lead is in command of the formation until split up for landing. The four-ship is the basic fighting formation employed by pilots in combat, and the two-ship is the basic fighting unit. Each four-ship flight is under the control of one flight lead and should be employed as a single entity. A four-ship may be forced to separate into two elements for a variety of reasons. A two-ship element is thus the fundamental building block for larger formations.

3.2. Purpose. The intent of this chapter is to provide some basic communication and visual signal reminders from pilot training, followed by a chronological daytime flow from start, taxi, end-of-runway (EOR) operations, takeoff, departure, rejoin, administrative formations, employment formations, battle damage check, RTB operations, formation approach/landings, and taxi back.

3.3. Radio Discipline and Visual Signals. Discipline within a formation is immediately evident in its communications, whether by radio or visual signals. Regardless of the method, all communications must be clearly understood by every flight member.

3.3.1. Formation Visual Signals. Formation visual signals are referred to in Air Force Pamphlet (AFPAM) 11-205, *Aircrew Quick Reference to Aircraft Cockpit and Formation Flight Signals*. Only standard signals should be used unless the flight lead specifically briefs nonstandard signals.

3.3.2. Radio Discipline. Radio discipline requires not only clarity and brevity in the message, but limiting unnecessary transmissions, as well. The first part of any radio call should include the call sign (CS) of the transmitting aircraft (i.e., if descriptive or informative) or the aircraft the call is intended for (i.e., if directive in nature). For example, a directive call from the flight lead to number 2 might be: "*Eagle 2, break left*". Similarly, if the call is informative, the pilot's CS is used: "*Eagle 2, bingo*". This serves to alert the listener a message is coming and specifies to whom it is directed. The use of personal CS or reliance on voice recognition to identify other aircraft is a poor practice and should be avoided. In an exercise or actual combat with many aircraft and many people on the radio, SA is the key to success. The proper use of assigned call signs enhances SA among and within flights. Poor radio discipline quickly degrades SA with potentially disastrous results. It is important to make commands, directions, and information clear and concise. Use Air Force Techniques, Tactics, and Procedures (AFTTP) 3-2.5, *Multi-Service Tactics, Techniques, and Procedures for Brevity Codes*, to the maximum extent possible, and limit radio use to essential calls. Conversational dialogue has no place in fighter cockpits. Wingmen will acknowledge with CS and repeat any specific data required.

"*Eagle 21, go channel 4*", acknowledgment - "*2, 3, 4*". A "*push*" call does not require a response.

3.4. Ground Operations as a Formation. Working as an element starts on the ground. Wingmen must ensure they cross-check flight lead during the preflight and engine start. A frequent glance to flight lead will build SA (ground aborts, etc.) and start good habit patterns that will transfer well once airborne. Additionally, it will allow wingmen to match flight lead's configuration in a timely manner.

3.4.1. Initial Check-in. The initial check-in is a great opportunity to build flight lead's confidence in the wingman's capabilities. Be aware of and ready for check-in time. Generally, if not moving switches, the wingman's left hand should be always on the throttle ready for a check-in (unless maintenance personnel are under the aircraft). Strive to be timely and crisp. The wingman's mask should be raised when expecting check-in. Be aware that there is a slight delay from the time the mike switch is moved to the time the radio transmits.

3.4.2. Taxi. On taxi out, maintain the correct spacing from the flight lead. When taxiing as a four-ship, number 3 and number 4 should mirror number 2's spacing. All formation members should mimic flight lead's configuration and checks.

3.5. Basic Formation. Basic formation is IAW AETCMAN 11-251. However, more is expected from a fighter wingman than just the basics of ensuring deconfliction, maintaining visual, and being in position. A smart wingman should also back up his flight lead by "staying ahead of the jet". One example is being in close route formation anticipating fingertip when approaching clouds or coming up initial yet moving out and forward during long visual meteorological conditions (VMC) transits to better clear for the formation. Being a smart wingman involves, but is not limited to:

- Maintaining SA on the profile.
- Keeping up with the NAVAIDs.
- Clearing for the flight both visually and by listening on the radios.
- Anticipating the next radio calls.
- Querying lead when unclear or when necessary to prevent safety or rule violations.

3.6. Two-Ship Tactical Formation. Two-ship tactical formations are the baseline formations for employment. These formations include line abreast (LAB) and wedge. Although the parameters vary from airframe to airframe, the tactical formations flown in IFF are very similar to those in the combat air forces (CAF). Factors that affect how we fly our formations include the threat, weather, visibility, background, and terrain. Unlike specialized undergraduate pilot training, we use tactical formations not as an end to themselves, but to facilitate proper visual lookout, task prioritization and offensive and defensive tactics. Wingmen should aggressively pursue being in position. This is an "aggressive" mental state, not necessarily aggressive flight control actuation. The degree of aggressiveness depends on how far out of position the wingman is. Maneuvers to correct excessively poor formation may be aggressive but never erratic. Continuously assess position and make corrections. The earlier a formation error is perceived the smaller the fix required and easier it will be to correct.

3.6.1. LAB. 4000 to 6,000 feet with 0° to 10° aft and up to 2,000 feet of altitude stack. Always strive for 0° aft. The wingman's priorities flying LAB formation are LAB first (0° aft), range

second, and lastly taking a stack. Maintaining a cross-check instead of constantly staring at the flight lead will allow wingmen to see subtle changes in position.

3.6.1.1. Correcting LAB Position. The easiest way to correct formation position is to establish a cross-check that allows wingmen to perform all assigned tasks and maintain the assigned formation position. To determine their position relative to flight lead, assess aspect angle; pilots should see 90° at LAB. Assuming both aircraft are on the same heading, this position is approximately when the wingman perceives the other aircraft over their shoulder to about an inch in front of their shoulder in the 4,000- to 6,000-foot range. Additionally, if the wingman is stacked above or below lead and can see both wingtips, they should be lined up. Always strive to use geometry to fix formation position versus just power.

3.6.1.1.1. Behind the Line. If wingmen assess their position to be behind the LAB line (less than 90° aspect), they should use the vertical and power to catch up to lead. Wingmen should bunt and use military (MIL) power since more airspeed than lead is needed to catch up. It is OK to change from a stack above lead to stacking below unless the formation is in the low altitude structure. As the airspeed increases aft line of sight rate should become visible. Wingmen should begin to decrease airspeed to match lead slightly before getting to LAB. This can be accomplished by reducing power and/or trading airspeed for altitude. If not in special use airspace and flying an air traffic control (ATC) assigned altitude, wingmen will primarily have to use power to get back into position.

3.6.1.1.2. Ahead of the Line. If positioned only slightly ahead of the line, wingman can climb to and fly a slightly longer total flightpath to move the aircraft aft towards LAB. Forward line of sight rate should be generated during this process. Once again, anticipate getting back to the LAB position and work to match lead's airspeed approaching the proper LAB position. If positioned far in front of lead, wingmen must maneuver in the horizontal as well. Generally, it is best to make an aggressive, slightly climbing bid away from lead. Once forward line of sight is perceived, check back into lead (this will collapse range again). Finally, return to co-heading with lead and reassess position.

3.6.1.2. Correcting Lateral Position. Correcting lateral position is generally simpler than correcting LAB. Check into or away from lead as required to get to 4,000 to 6,000 feet. When checking into or away, apply aft stick to make a positive input. An unloaded check that adjusts heading by a couple of degrees may not do much for the aircraft's lateral position. Every correction put in must be taken out again. The earlier pilots perceive a formation error the smaller the correction required and the easier it will be to fix.

3.6.1.2.1. Assessing Range. To assess range from lead, primarily use visual cues and then back them up with the air-to-air tactical air navigation (TACAN) (AAT). Use caution: the AAT lags and can cause range pilot-induced oscillations (PIO). This is especially true during and after tactical turns. Fly based on visual cues, then once the aircraft's position is stabilized, verify range using the AAT.

3.6.1.2.2. Visual Cues for Formation Ranges:

- >6,000 feet = "Cigar" with vertical tail, can't see distinct burner cans.

- 6,000 feet = Burner can barely visible protruding aft of vertical stab.
- 5,000 feet = Can see burner, can distinguish from tail, "L" shape where boat tail meets aft end of vertical stabilizer. Canopy detail starts to become visible.
- 4,000 feet = Canopy distinguishable from fuselage, can see but not read the tail letters, and the VHF antenna (shark fin) disappears.
- <4,000 feet = Detail on airplane, distinct canopy, can read tail letters. Beacon will be visible.

3.6.1.2.3. Common Error. The most common error related to range in tactical formation flying is simply not assessing it in the first place. Once the task load builds in flight, students roll out of turns and don't assess range. This allows current errors to go unchecked or even build. The best time to start correcting for both LAB and lateral spacing is ***during*** tactical turns (discussed in conjunction with tactical turns).

3.6.1.3. Correcting Vertical Position. Corrections to the vertical position are normally referred to as "setting a stack". At the proper range for LAB, a 1,500-foot stack will place flight lead approximately two beer cans above or below the horizon. Since it is the last priority, ensure the LAB and lateral aspects of the formation are correct before working for a stack. Once that is accomplished, choose a stack direction that is most advantageous for the formation to remain visual. When looking into the sun, stack to pull lead away from it. If positioned directly between flight lead and the sun, stack to stay above or below the sun (usually a low stack). If neither direction makes maintaining the visual easier, stack high, to increase potential energy for follow on maneuvering.

3.6.1.3.1. Stacking High. To achieve a high stack from a level or low position, wingmen must increase power. In the T-38, this almost always requires MIL power. Airspeed must increase very slightly to maintain a LAB position while climbing provided the aircraft was stabilized at LAB before initiating the climb. When the proper stack is achieved, remember to pull the power back to the previous setting.

3.6.1.3.2. Stacking Low. To move from a high or level position to a low stack, wingmen need to reduce power. The degree of power reduction will be proportional to the angle of dive used. Reduce the power enough to maintain airspeed during the move to stack low. Remember to push the throttle back up when approaching the desired position.

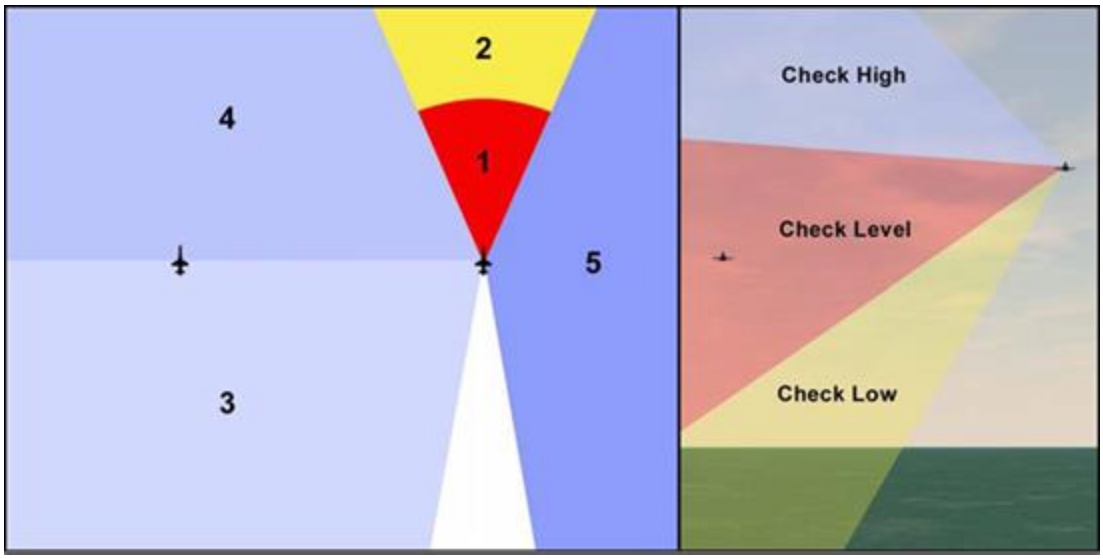
3.6.2. Two-Ship Tactical Turns. Two-ship tactical turns are accomplished IAW AETCMAN 11-251, except as noted here. Expect flight leads to have solid wingman consideration; however, they will fly wherever required to accomplish the mission. This means that turns may not be exactly 180°, 90°, or 45°. As tactical turns are initiated, wingmen should assume standard turn amounts, however, continue to monitor and fly off lead during the remainder of the turn. This will allow wingmen to make corrections early and still roll out in position. The contract for tactical turns is MIL power and G to hold airspeed (normally 350 knots calibrated airspeed [KCAS]). When in level flight between 10,000 and 18,000 feet, this will be approximately 80° of bank and 3 Gs. However, not all turns are level (e.g., climbing between BFM sets), and sometimes turns are initiated from nonstandard positions and/or energy states (e.g., just after a BFM set). A constant cross-check of the flight lead is necessary so that

wingmen can match their turn rate, radius, and line-of-site rate (LOSR) and end up in the proper formation.

3.6.3. Visual Lookout. One of the most compelling reasons to fly tactical formation is to increase the effectiveness of our visual lookout in the tactical scenario. Despite our advanced radars, RWR and off board SA enhancers such as AWACS, it is possible for an enemy to achieve an undetected entry into our combat formation. Therefore, wingmen need to exercise a disciplined visual lookout to detect threat aircraft before they can achieve a weapons engagement zone (WEZ) on any member of the formation. **Figure 3.1** shows the priority of visual lookout for both members of the formation. It is important to remember that we operate in three dimensions. Therefore, every sector of the visual lookout must be scanned. As a result, each sector depicted in **Figure 3.1** can be divided up into three vertical sectors as well. It is also important to pause in each sector allowing your eyes to focus at range and detect movement. The environment, threats, weather, and other factors may alter the visual search responsibilities of each member of the flight. For instance, at low altitude, checking 12 o'clock and own ship altitude are very high priorities.

3.7. Four-Ship Tactical Formation. Four-ship tactical formations build on the basics of two-ship formations. These formations are typically used to efficiently maneuver two elements to mass firepower and maximize offensive and defensive capabilities. Four-ship tactical formations include: Wall, Fluid-4, Container, and Offset-Container. Each of these formations have advantages based on the tactical situation and must be flown proficiently. Typically, number 2 will set the stack. Number 3 will stack opposite of number 2, and number 4 will stack further in the opposite direction. To maximize the advantages of each of these formations, all flight members should strive to maintain visual with the other flight members. As a minimum, wingmen MUST maintain visual with their respective element leads.

Figure 3.1. Visual Search Responsibilities.



3.8. FENCE Check. FENCE IN/OUT is a directive call made by the flight lead to set cockpit switches as appropriate prior to entering/exiting the combat or working airspace. Unit standards and/or the flight briefing will dictate what items are to be accomplished during FENCE checks. Normally it will require multiple intra-cockpit switch actuations.

3.8.1. FENCE IN. Do not forget the priorities as a wingman: visual, formation, radios. It is likely that the formation will be maneuvering during the FENCE check. As a technique, ensure to be in the proper formation, decide what switch needs to be changed and reach for it; make a quick glance inside the cockpit to ensure the correct switch is selected; and make the actuation while cross-checking and fixing formation position. Repeat until all required items are accomplished for the fence check.

3.8.2. FENCE OUT. The same principles apply to the FENCE OUT. Expect to be task saturated as flight lead may simultaneously direct the FENCE OUT, a rejoin, and frequency change. Chair fly before the flight and task prioritize once airborne.

3.9. G Exercise. The G exercise serves several purposes. First, it gets a pilot's mind and body used to the high-G environment. Second, it gives the pilots a chance to practice their AGSM with no distractions from tactical maneuvering. Third, it gives the pilots a chance to make sure the systems on the jet continue to function normally under G. Finally, it gives the student a fresh reference for lift vector (LV) and nose position pictures and aircraft feel that will be used during tactical maneuvering. Emphasis should be to focus on performing a good AGSM. The G exercise is not an instrument maneuver and will require looking outside the cockpit to deconflict with other aircraft. Starting parameters for the G exercise are LAB (striving towards 6,000 feet) and 420±20 KCAS. During the turns, constant adjustments to the LV will be required to maintain approximately 420 KCAS and the required G.

3.9.1. G Warmup. Select MIL power, roll to approximately 100□ of bank, and pull to 4 to 4.5 Gs. Initially, this will bring the nose in a downward vector, towards a pitch picture of 2/3 ground and 1/3 sky. The pilot will then need to reset the LV to slightly above the horizon to sustain airspeed and G. For the G warmup, this equates to approximately 8□ to 12□ nose low. Another reference which might help is to roll to drag the top of the heads up display (HUD) along the horizon. In any case, adjust LV as required to get the correct G and airspeed combination.

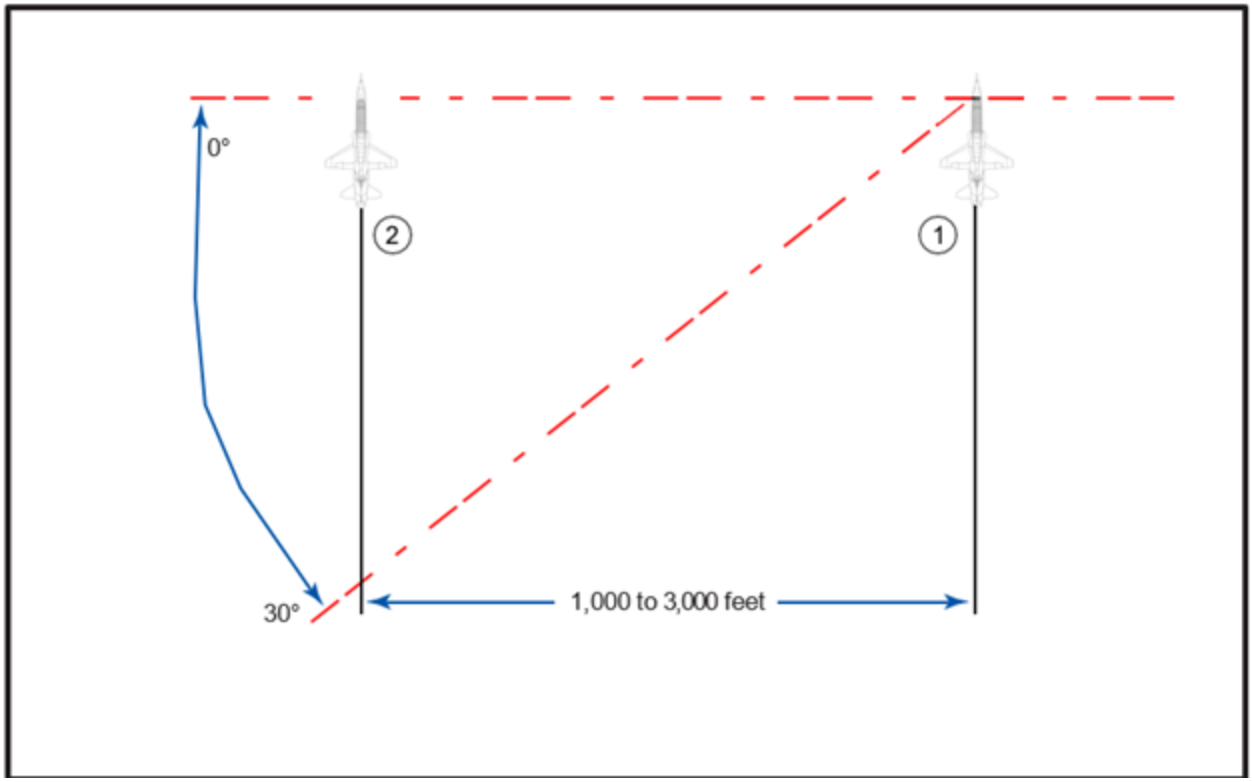
3.9.2. G Awareness. This turn is flown at 5 to 5.5 G/single-rate beeper and serves to continue to prepare the pilots, check the function of the aural warning system for Gs, and give the pilots a feel for the initial G to be used for BFM break turns. Execute the same mechanics as the G Warmup except for selecting MAX power immediately after initiating the turn, and blend to single-rate beeper, adjusting LV and backstick pressure as required.

3.9.3. Formation Considerations. While the G exercise will be initiated from LAB formation, there are special considerations for station keeping between the G warmup and G awareness. After rolling out of the first G-awareness turn, maintain MIL power and climb. Setting the FPM to approximately 3° to 5° should maintain 420 KIAS. Simultaneously, check into or away from lead to remain 6,000 feet. If not LAB, DO NOT attempt to accelerate or slow down to return to LAB. Instead, the wingman's priority is the correct airspeed for the second turn and setting range from flight lead. Once both turns are complete, if not in LAB formation, maneuver to get back into position.

3.10. Spread. Spread formation is used as the primary navigation formation for fighter pilots. It allows wingmen to devote more attention to tasks such as clearing visually and with the other NAVAIDs. Spread is flown with 1,000 to 3,000 feet between aircraft with the wingmen LAB to 30 degrees back in the T-38. Wingmen should strive to fly as close to LAB as possible, only drifting aft in anticipation of turns into their side of the formation. See **Figure 3.2**., Spread

Formation. Turns are performed as in route with a minimum of 500 feet between aircraft and flight members maintaining their side of the formation. On the inside of a turn, stack below lead's POM only as necessary to keep lead in sight. On the outside of a turn, maintain the same vertical references used in echelon. Tactical hook, delayed, and in-place turns will not be flown in Spread formation due to the close proximity of aircraft and inability to ensure deconfliction. This formation allows for easy transition to fighting wing or fluid.

Figure 3.2. Spread Formation.



3.11. Fluid Formation. Fluid is normally used as a highly maneuverable administrative formation. Wingman should fly in a position 1,000 to 3,000 feet behind lead, remaining aft of Lead's 3/9 line and crossing Lead's 6 o'clock as necessary. Avoid prolonged periods directly at Lead's 6 o'clock position. Generally, if wingmen can see lead's canopy bow, lead can see them. Maneuvering to maintain this formation should be accomplished by using lead, lag, and the vertical. Due to fuel constraints, try to avoid using excessive power inputs to maintain position. Only one wingman will be Fluid on a given element lead in a four-ship.

3.12. Preparation for Return to Base. After the mission is complete or some or all flight members reach Bingo fuel, the flight lead will initiate a rejoin to one of the administrative formations discussed in this chapter. Wingmen cannot let their guard down just because the fighting is over-deconfliction and a smooth transition to closer formations requires attention, even after the "*Knock it off*" or "*Terminate*" call. Listen for reference headings and airspeeds to determine what airspeed to establish to gain overtake and perform a turning or straight-ahead rejoin to the briefed or called formation. If the other element is rejoining on the far side of Number One, Number Two needs to ensure that an overshoot does not occur during the turning rejoin to ensure separation of aircraft. Number Two should make the rejoin slowly happen, primarily via geometry.

3.12.1. Battle Damage Check. Once the formation is rejoined, the flight lead will rock the wingman/men into close formation. The flight lead initiates a battle damage (BD) check with extension of the thumb and index fingers in the form of a check. The purpose of the BD check is to look for problem areas on each aircraft in the formation, to include holes from hostile fire, missing pieces or parts to aircraft or attachments (i.e., to include missile fins), hung flares, fluid leaks, open panels, and external light failures. When accomplishing the BD check, each pilot must be disciplined and methodical to check each of these parts of the aircraft to ensure something is not missed but must also remain aware of proximity to the base such that the check is not continuing while on initial.

3.12.2. Two-Ship BD Check. After the visual signal, the wingman should ensure wingtip clearance and climb above the flight lead to examine the top of the aircraft. Once satisfied, the wingman descends, again ensuring wingtip clearance, and initiates a cross under. Pause as required when under the aircraft, while maintaining nose-tail clearance, to check the underside of the aircraft. Move to the opposite side and repeat the climb to check the top on that side. Once complete, the wingman descends back into Fingertip formation on the opposite side from which started. If there are any problems noted, they should be passed on the radio. If not, a thumbs-up to the flight lead signifies BD check complete. The flight lead will now initiate a lead change to repeat the same procedure.

3.12.2.1. Lead Changes. Lead changes require a clear transfer of responsibilities from one flight member to another. Lead changes may be initiated and acknowledged with either a radio call or visual signal. Obtain visual contact before initiating a lead change. The lead change is effective upon acknowledgment. All flight members must continue to ensure aircraft separation during position changes. The new leader must continue to monitor the new wingman's position.

3.12.2.2. Communication or Visual. If using the radio to initiate or acknowledge the lead change, use callsigns and be specific-the wingman assuming the lead will state so in the acknowledgment. For example, "*Eagle 2, you have the lead on the left*." Acknowledgment: "*Eagle 2 has the lead left.*" Lead changes using visual signals are preferred since it ensures that the flight members are looking at each other. Flight leads visually pass the lead by pointing forward twice followed by a visual depiction of the element mate's formation position (two fingers up to signify Number Two) When assuming the lead, make a small bid away before going forward and pass a cranium nod to the flight lead.

3.12.3. Three-Ship BD Check. The flight lead signals for Number Two to start the BD check first. Number Two starts just like in the two-ship BD check, but after checking Number One's belly Number Two needs to continue moving aft in the cross under to check Number Three's belly and the top of Number Three's aircraft. Once the check on Number Three is complete, Number Two crosses under to the original side of Number One, re-establishes fingertip formation, and passes a thumbs-up to flight lead, indicating BD check is complete. Timing for Number Three to start the check of Number Two depends on local standards, but the procedures are identical to Number Two's for the check. Upon checking the top of Number Two's aircraft, Number Three returns to the original side and formation with flight lead and passes a thumbs-up.

3.12.4. Four-Ship BD Check. The procedures are identical to the three-ship BD check, except that Number Two performs the check first, followed by Number Four.

3.13. Show Formations. Show formations are not normally flown without special approval. Refer to directives for specific rules and appropriate approval levels to participate in static displays and aerial events.

Chapter 4

AIR-TO-AIR

Section 4A—Basic Fighter Maneuver (BFM) Concepts

4.1. Introduction. Success in visual A/A combat depends on the ability of the fighter pilot to maneuver the aircraft into a position from which ordnance can be employed against the adversary. BFM is the efficient application of aircraft handling skills to either attain a position from which weapons may be employed, deny the adversary a position from which weapons may be launched, or defeat weapons employed by the adversary. BFM is not a set of canned maneuvers; rather, it is a dynamic combination of maneuvers to either create or solve a BFM problem. BFM problems can be created in range, angles, and closure. Each BFM maneuver selected is based on solving or creating a problem while maneuvering in relation to another aircraft. The time and amount of maneuvering required depends on relative aircraft performance capabilities, ordnance load, threat reaction, and pilot skill. This section discusses BFM concepts; the tools of BFM; BFM setups in the training environment; and finally offensive, defensive, and high-aspect BFM. **Note**: For the remainder of this chapter, the adversary will be referenced as the "Bandit".

4.2. Aircraft Handling Characteristics. Aircraft handling characteristic (AHC) maneuvers are used to build and maintain pilot proficiency in aircraft performance throughout the flight envelope prescribed in the flight manual. The objective of AHC training is to produce a pilot who is knowledgeable of the flight envelope and has a head's-up feel for aircraft energy states. The goal is a confident and aggressive pilot who can safely maneuver the aircraft through the flight envelope but recognize and avoid potential excursions which might result in loss of control or overstress of the airframe. Each pilot is responsible for a thorough understanding of AHC found in the T-38C flight manual.

4.3. BFM Axioms. There three basic axioms of BFM that apply to any situation. Whether offensive, defensive, or high aspect (neutral), the following three concepts apply to every situation. They are:

- Lose Sight, Lose the Fight
- Maneuver in Relation to the Bandit
- Energy versus Nose Position

4.3.1. Lose Sight, Lose the Fight. In a fight where both aircraft are moving faster than 400 miles an hour, it takes only a few seconds for an object with a total apparent surface area of just a few feet (like a T-38C approaching head on or flying away) to disappear completely. Additionally, most of the world's air forces apply paint schemes to increase the difficulty of keeping sight of their airplanes. Just a couple seconds of not seeing the Bandit can mean the difference between victory and death. It will be necessary to occasionally take eyes off the Bandit during a fight. Learning when to take eyes off is critical. Offensively, pilots cannot shoot at an enemy they don't see. It is relatively easy for pilots to keep track of a Bandit that is in front of them. However, defensively, pilots are unable to defend themselves from an enemy they cannot see. There will be times in Defensive BFM (DBFM) when the Bandit flies out of view; knowing when and where to get the tally back will be paramount. Do everything possible to prevent going no joy, but if a no joy occurs, strive to get the tally back! In high

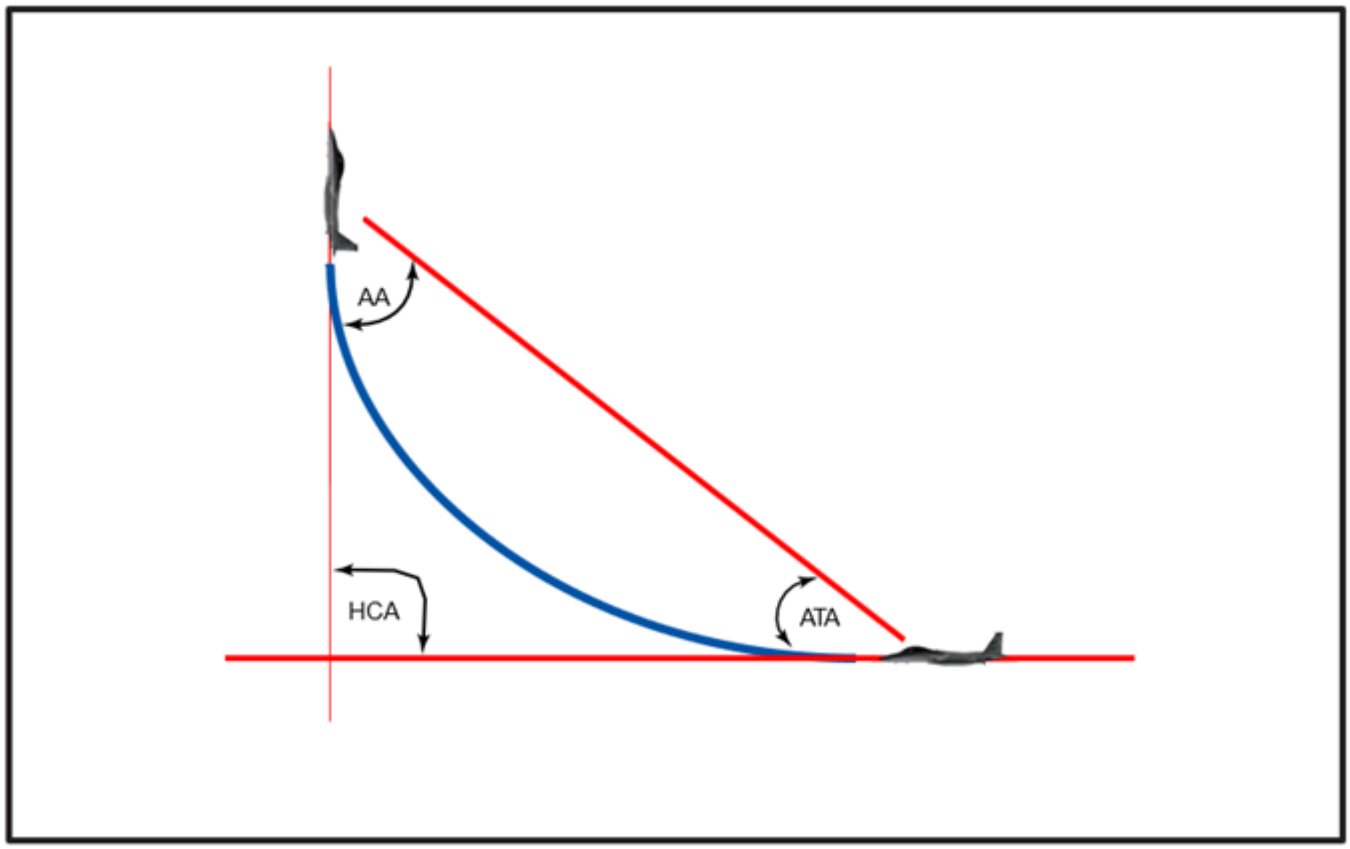
aspect BFM, the Bandit will be at greater ranges during the fight than offensive and DBFM. Keeping sight will require a visual scan to stay outside of the cockpit for longer periods of time. Generally, stay padlocked on the Bandit until 1) it is predictable, 2) it is easy to see, and 3) it is not threatening. If in doubt, stay padlocked and don't look inside the cockpit.

4.3.2. Maneuver in Relation to the Bandit. Nearly all maneuvering must be in relation to the Bandit. That means every time a fighter pilot does something with their airplane, it must be either a reaction to what the Bandit has done, or preferably, to drive the fight and cause the Bandit to react to them. All the basic BFM concepts apply no matter what the aircraft's attitude is, so maneuvering in relation to the horizon becomes less important in most fighter type aircraft. Exceptions to this rule include utilizing the effect of gravity advantageously and maneuvering to avoid the floor, or in actual combat, the ground. Offensively, and at high aspect, maneuver in relation to the Bandit to arrive in the WEZ based on the aircraft's position relative to the Bandit. Defensively, maneuver in relation to the Bandit to keep them from arriving in a WEZ. Regardless of the situation, pilots must maneuver in relation to the Bandit to defeat them. However, due to a lack of performance in the T-38, pilots must maneuver in relation to the horizon as well as the Bandit to achieve the best performance from the jet.

4.3.3. Energy Versus Nose Position. The last axiom of BFM is knowing when to fight an energy fight and when to fight a nose position fight. This boils down to either sustaining the current total energy state or cashing energy in for nose position to shoot or defend against weapons employment. Although high-performance A/A ordnance and helmet-mounted sights greatly expand WEZs, it is usually true that pilots cannot shoot someone unless their nose is pointed at them. That is why it is so important to know when to concentrate on the energy state of the jet and when to concentrate on its nose position. During Offensive BFM, pilots generally maintain energy until deciding to employ ordnance in a controlled manner for a high probability of kill (Pk) shot. Pilots then use nose position to employ ordnance. Defensively, pilots concentrate on the Bandit's nose position. When threatened by the Bandit, pilots must cash in energy to defeat his ordnance. Once no longer threatened by the Bandit, pilots must concentrate on maintaining or regaining energy to prevent the Bandit's nose from being pointed at them again. In high aspect, pilots should concentrate on energy when wanting to maintain a high turn rate over time, and cash in that energy for nose position when wanting a small turn radius or an increased instantaneous turn rate to employ or deny ordnance. At any given moment pilots should always know whether energy or nose position is more important, no matter what kind of fight they are in.

4.4. Geometry. Range, heading crossing angle (HCA), aspect angle (as indicated by radar metrics in the CAF), planform (visually-assessed aspect), angle off tail (AOT) and antenna train angle (ATA) are used to describe relationships when discussing one aircraft's position relative to another. See **Figure 4.1**., Basic Fighter Maneuver Geometry.

Figure 4.1. Basic Fighter Maneuver Geometry.



4.4.1. Range. Range is the distance by which the two aircraft are separated.

4.4.2. Heading Crossing Angle (HCA). HCA is the heading difference between two aircraft. With converging vectors, HCA can be measured up to a maximum of 180 degrees for a head-on pass. HCA is also referred to as angle-off.

4.4.3. Aspect Angle (AA). AA describes the relative position of the attacker to the target without regard to the attacker's heading and is measurement of the attacker's radar. AA is defined as the angle measured from the tail of the target to the position of the attacker. For aircraft without a radar, this is synonymous with planform.

4.4.4. Planform. Planform describes the visually-assessed aspect angle in terms of degrees.

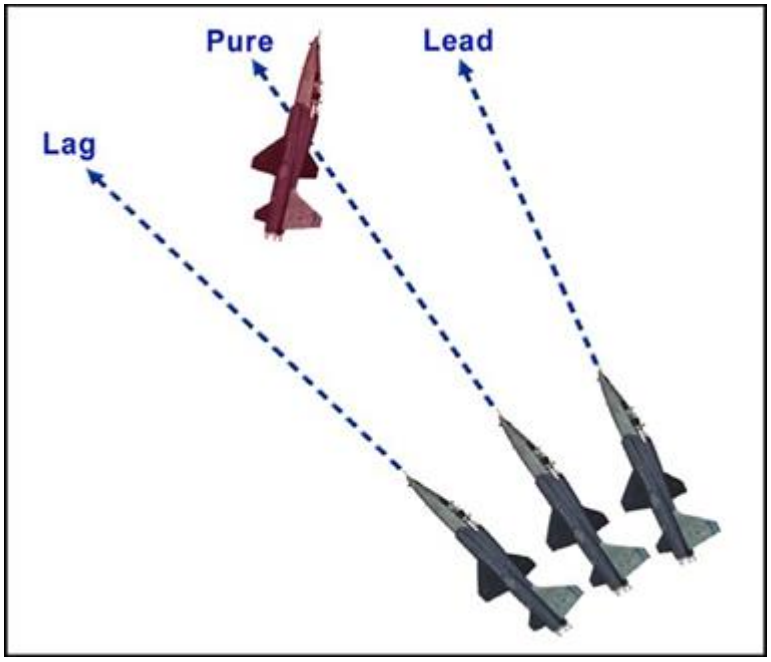
4.4.5. Angle Off Tail (AOT). AOT is the angle measured from the tail of the defender to the position of the attacking/offensive aircraft. AOT is independent of the heading/longitudinal axis of the other aircraft.

4.4.6. Antenna Train Angle (ATA). ATA is the "look" angle measured from the nose of one aircraft (typically the offender) to the position of the other aircraft. ATA is independent of the heading/longitudinal axis of the other aircraft. From a defensive point of view, this angle is generally regarded as the offender's planform.

4.5. Pursuit Curves (Figure 4.2). The three pursuit curves are lead, pure, and lag. The attacker's nose position and LV placement determine the pursuit curve being flown in relation to the defender's plane of motion (POM) (see **paragraph 4.10**.). If the attacker is in the defender's POM,

the position of the attacker's nose determines the pursuit curve. When the attacker is out of the defender's POM, the pursuit curve is determined by where the present LV will position the aircraft's nose once entering the defender's POM.

Figure 4.2. Pursuit Curves.



4.5.1. Lead Pursuit. (Nose in Front of the Bandit) All else equal, lead pursuit increases closure, increases AA, and decreases range. This pursuit curve is typically used offensively during gun employment and, from a defender's perspective; it helps to generate closure and/or angular problems.

4.5.2. Pure Pursuit. (Nose on the Bandit) Pure pursuit is useful from an offensive perspective when attempting to achieve a radar lock (boresight) and/or shoot certain missiles. Pure pursuit outside the Bandit's turn circle (TC) increases closure (but at a more moderate rate than lead pursuit), aspect, and AOT. Maintaining pure pursuit inside the Bandit's TC will continue to increase closure, AA and AOT until less than a turn radius from the Bandit. When less than a turn radius from the Bandit, closure and angles will increase until the offender either runs out of energy to maintain pure pursuit or must flow to lag to avoid hitting the defender.

4.5.3. Lag Pursuit (Nose Behind the Bandit). Normally, lag pursuit decreases closure, decreases AA, and increases range. Lag pursuit is often used in BFM to build turning room (TR) and control overtake. Excessive lag does, however, remove pressure from the Bandit. From an offensive perspective, lag pursuit can help control closure, range, and angular problems. Defensively, a Bandit in lag pursuit may offer opportunities to gain energy.

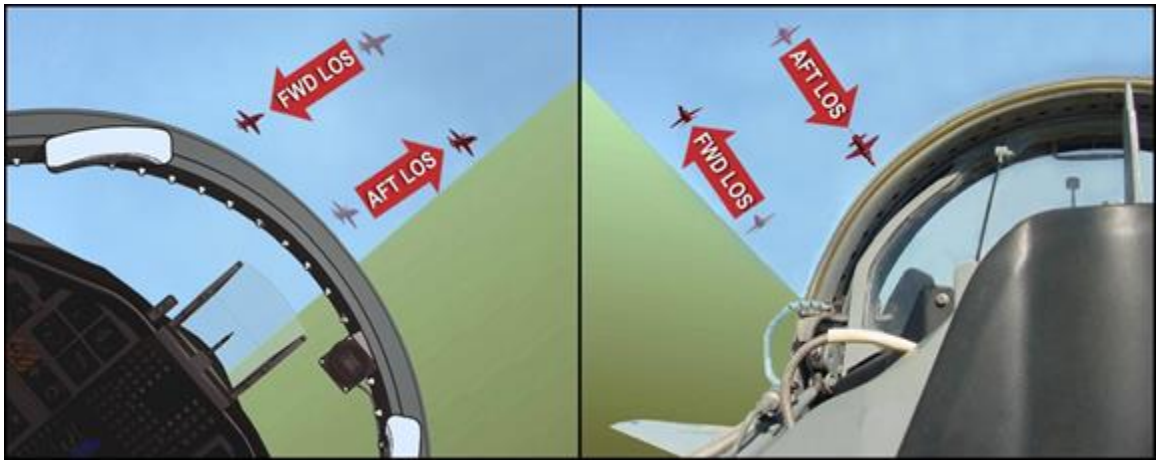
4.6. Turn. Turning allows the pilot to solve range, angle, and closure problems offensively, and to present the same problems defensively. For best turn performance, use available G to solve the problem with an acceptable specific power (Ps) bleed off. How well the aircraft can turn (turn rate and radius) is a function of TAS and available G. See **paragraph 4.12** for a detailed discussion of power and energy management.

4.6.1. Rate. Turn rate is defined in terms of the number of degrees per second (deg/sec) of heading change on a given TC. All else being equal, the aircraft with the higher turn rate travels around the circle quicker and either generates or solves BFM problems better than the aircraft with the slower turn rate.

4.6.2. Radius. Radius is one-half the size of an aircraft's TC. All else being equal, the aircraft with the smaller turn radius can create/solve problems in range, closure, and angles better than the aircraft with the larger turn radius. Offensively, a smaller turn radius permits a turn inside the defender's TC to achieve a weapons solution while maintaining an offensive advantage. Defensively, a smaller turn radius will deny a weapons solution and force the offender to fly outside the TC (assuming both aircraft remain in the same POM).

4.7. Line of Sight Rate (LOSR). LOSR is the speed with which the line of sight (LOS) is changing. Fighter pilots also use LOSR for assessment during BFM. LOS describes the Bandit's apparent motion across the canopy as observed by the pilot sitting in the cockpit. For example, an airplane that is flying in front of, and perpendicular to, an aircraft's flightpath would have an apparent LOS from one side to the other. During BFM, we describe the LOS with regard to direction and rate. It is important to remember that LOSR is relative to what the pilot sees in their aircraft. A Bandit that moves aft very quickly has a high LOSR aft, while a Bandit that moves slowly has a low forward LOSR. The actual motion of the airplane may be different than the LOSR (**Figure 4.3**). Pilots use LOS direction and rate to determine where they are in relation to the TC, and to determine what the Bandit is doing for the purposes of predicting what they will do next. It is very important to keep track of the LOSR of the Bandit during the fight. LOSR is generally described as either forward or aft. Forward LOSR means the pilot will see the Bandit's apparent motion from the back of their jet to the front (from the tail to the nose). Aft LOSR is just the opposite. The Bandit's apparent motion is from the nose to tail. LOSR is not dependent on the Bandit's heading, pursuit curve, or AA.

Figure 4.3. LOSR.



4.8. Control Zone (CZ) (Figures 4.4 and 4.5). The maximum range of the control zone is typically the max performance turn diameter of the bandit and a range where the fighter can maintain pressure on the bandit. The minimum range of the CZ is a function of the fighter being able to maintain an aligned turn circle with the bandit and preserve the time required to react to any bandit actions. As range to the defender decreases, the attacker should maintain lower AA to

maintain turn circle alignment. It is important to note that stabilizing in the CZ is not the end-state, it is merely a transitional position on the way to employing weapons. In the CZ, pilots influence the bandit's actions by forcing the bandit to react exclusively to them to survive. From the CZ pilots will be able to punish the bandit for bad BFM by transitioning to a WEZ and employing weapons. By maneuvering to the CZ, pilots place themselves in a position from which they can make the bandit predictable prior to pulling lead/pure to kill. The back edge of the control zone is a "pressure limit", i.e., it is the farthest position aft of the bandit from which pilots can legitimately threaten the bandit if they transition to a WEZ, whereas the front edge is a "reaction" or "time limit", i.e., it is the closest position to the bandit from which pilots can 1) react to any defensive action by the bandit and maintain the offensive, and 2) transition to a WEZ and still have enough time to kill the bandit before needing to reposition. In IFF, the CZ volume is generally defined as 2,500-4,500 feet behind the bandit, with 25-45° AA, on or near the bandit's turn circle (see **Figure 4.4**.).

4.9. The Assessment Window (AW). The AW is a tool used in the T-38 to help pilots maneuver to the control zone and recognize attack cues prior to employing ordnance or during a reposition. The AW consists of a rectangular area tangent to the highest point on the canopy bow, with the long axis extending to the outer edge of the mirrors and the short axis extending from the canopy bow to approximately a fist above the canopy bow (low aspect angle). In order to maneuver to the control zone, as well as recognize arrival in the CZ with attack cues met, place the bandit in the AW while executing the offensive BFM gameplan. After recognizing the appearance of attack cues with the bandit in the assessment window, pilots can commit out of the control zone to the WEZ. It is important to understand that the AW does not follow the curvature of the canopy bow; if pilots are making LV adjustments while maintaining the bandit in the AW, they must visualize the rectangle tangent to the highest point on the canopy bow and maintain the bandit in this area while adjusting LV. AW sight pictures vary based on sitting height. At the design eye sitting height position the AW sight picture is approximately between having the burner cans on the canopy bow to a shot glass above (30 AA). Determining a specific pilot's AW sight picture occurs through a combination of execution and debrief analysis. The higher aspect "assessment window" mechanics will be discussed in the HABFM section, also referred to as turn circle extensions.

Figure 4.4. The Control Zone.

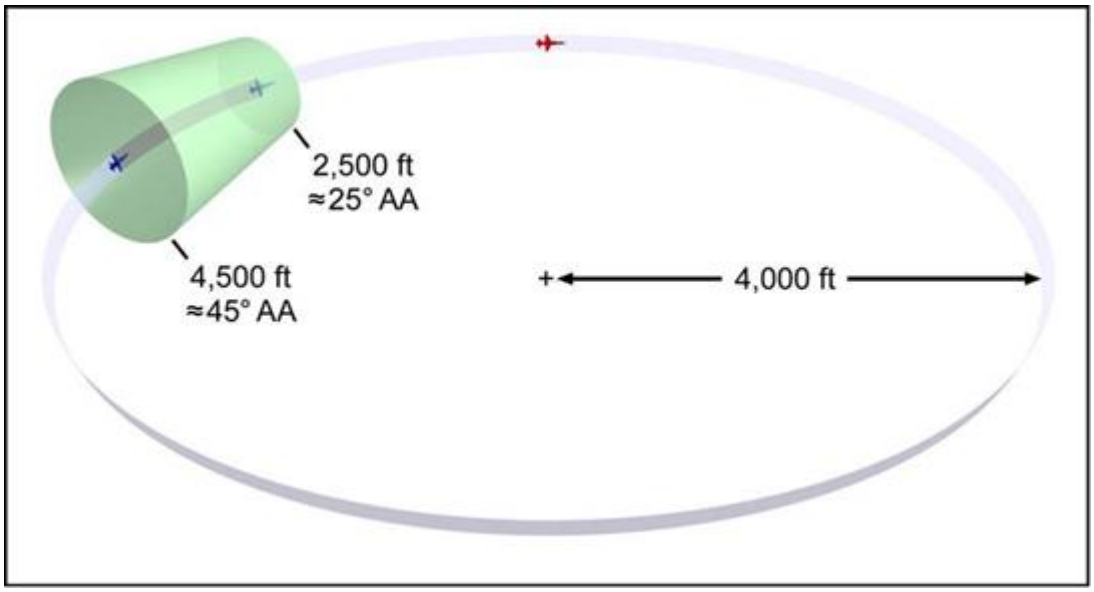
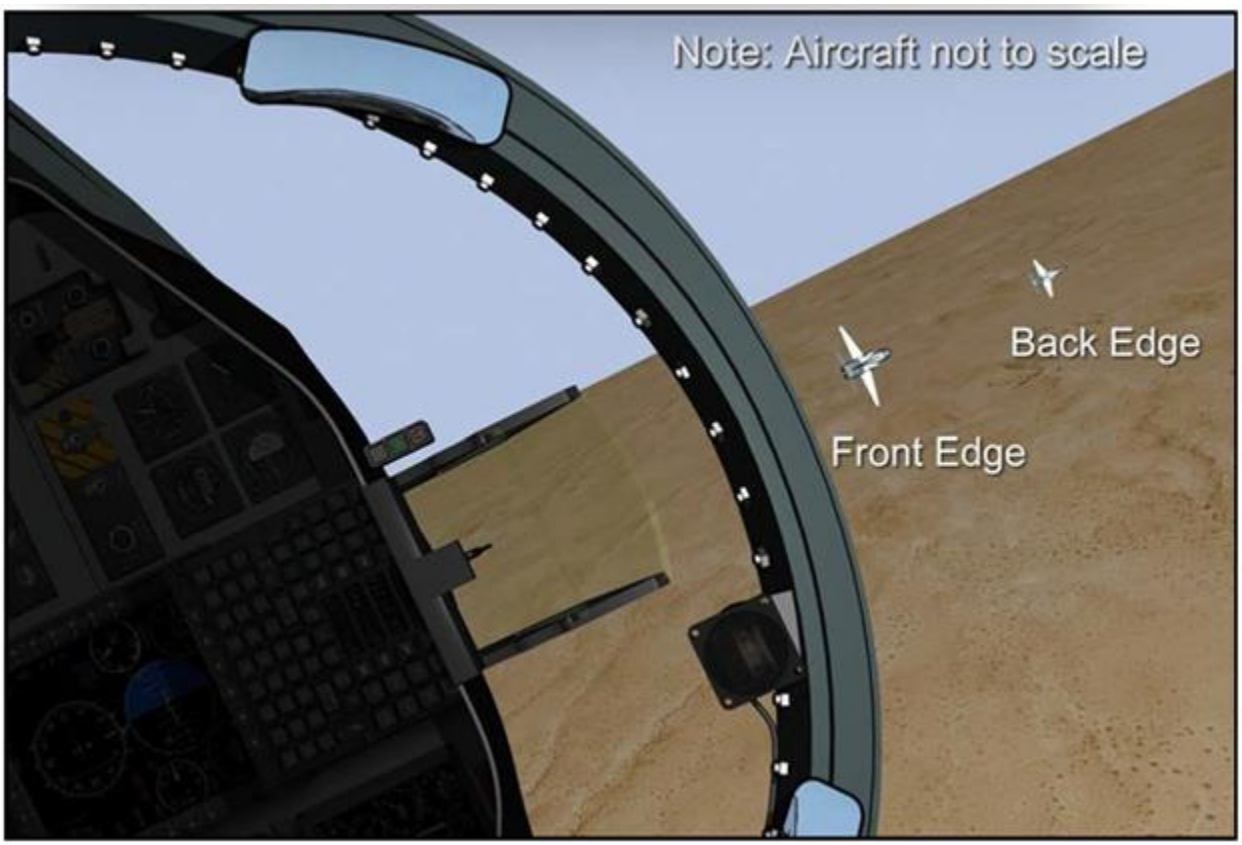


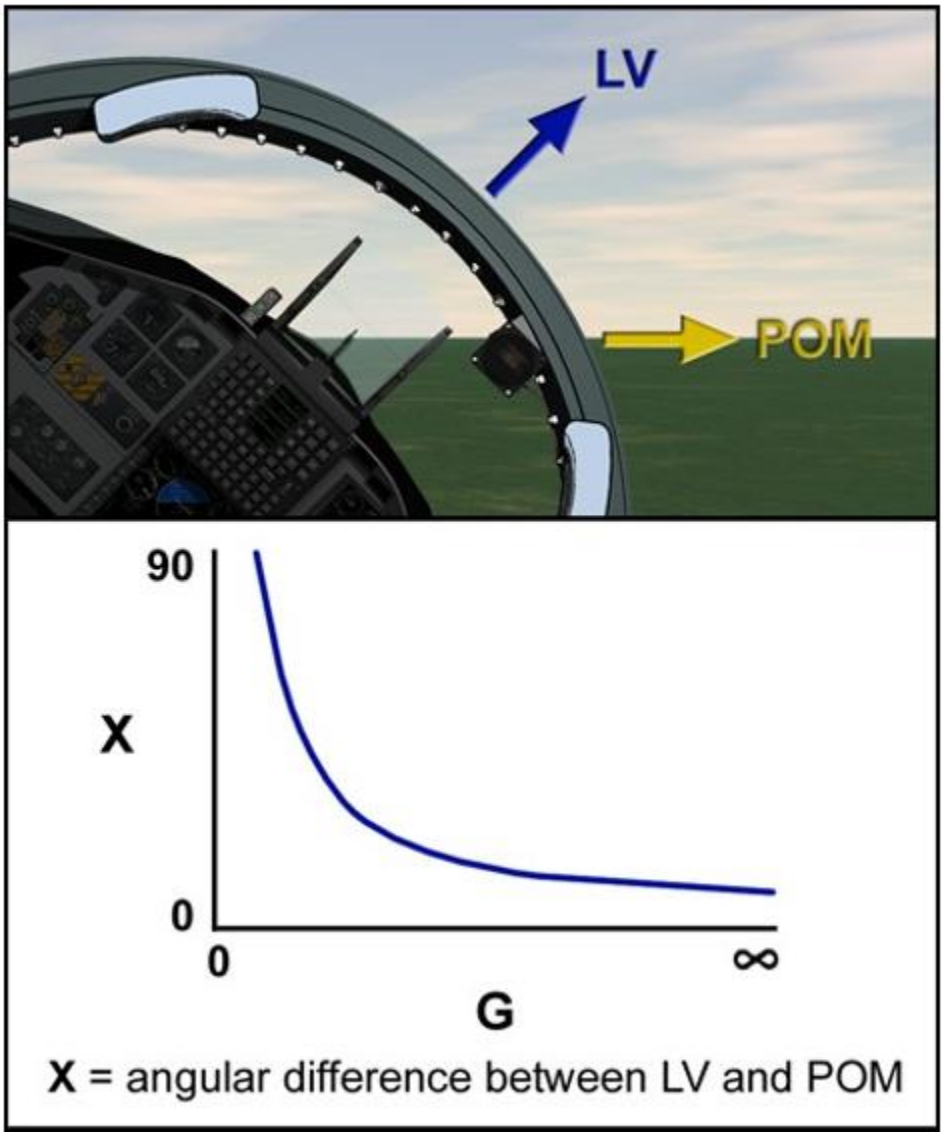
Figure 4.5. Control Zone Canopy Bow References.



4.10. Lift Vector (LV) (Figure 4.6). Roll and yaw allow the pilot to position the LV (a line perpendicular to the wings out the top of the canopy to infinity), thus determining the POM in

which the aircraft will turn. POM is the plane the aircraft is traveling through and will vary with the given LV placement, amount of yaw present, angle of attack (AOA), G, and airspeed.

Figure 4.6. LV versus POM.



4.11. Turning Room (TR). Turning room is any displacement from the Bandit's flightpath in any plane. The goal is to take advantage of available TR to either gain a position of advantage against a defender or create problems for the offender. An important point to remember is that TR for the attacker is also TR for the defender in most cases. Exclusive TR, however, exists when one aircraft can take advantage of TR but the other cannot (e.g., in a high-aspect, low-altitude pass where the high fighter is less than one TC above the ground and the low fighter is executing a pure low-to-high conversion. In this case, a majority of the TR is usable only by the low fighter since the high fighter would strike the ground if attempting to use it).

4.11.1. Offensive. The goal of the offender is to take full advantage of TR that cannot be denied by the Bandit, which when inside the TC, is in the Bandit's POM. If needed, the

offender can build TR in the Bandit's POM by using lag pursuit. Whenever the Bandit's POM changes, it may provide the offender with additional TR the Bandit cannot use due to relative energy states.

4.11.2. Defensive. With the Bandit outside the defender's TC, the defender can deny the attacker TR by turning with the LV on or near the Bandit. Once the attacker is inside the TC, the defender can only deny TR if the Bandit is out of the defender's established POM, energy allowing (e.g., the offender enters the TC 500 feet above the defender's POM. The defender can only deny TR by changing the POM upward toward the offender).

4.11.3. High Aspect. Pre-merge, high-aspect TR may be in the vertical, horizontal, or a combination of both. TR is not always equally usable by both fighters, as discussed previously. The goal of each fighter approaching a high-aspect merge is to use TR to reduce HCA prior to the merge (e.g., take lead turn).

4.12. Power and Energy Management. Power affects airspeed and, therefore, turn radius and turn rate. Power is also used to control energy. Energy provides the potential to maneuver. Non-optimal energy levels (i.e., usually expressed in airspeed) can result in degraded turn performance, reduced time in weapons parameters, or greater exposure to threat weapons. Expend available energy only as required for offensive advantage (e.g., align turn circles, exit control zone to kill, or save 3/9), defensive necessity (e.g., deny bandit WEZ/control zone (CZ), or to seize 3/9), or merge preparation (e.g., to neutralize angles and negate lead turn). Otherwise, strive to maintain or gain energy as the situation allows.

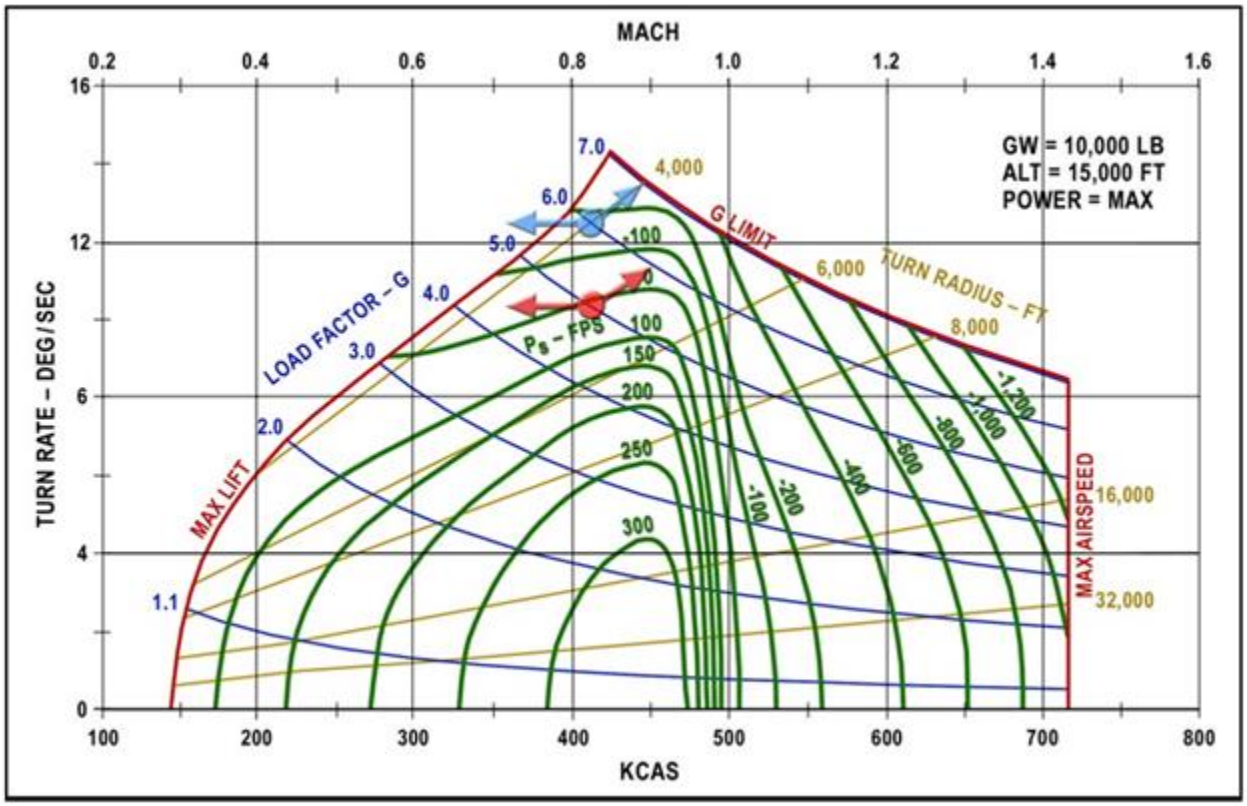
4.12.1. Energy Maneuverability (EM) Diagram (**Figure 4.7**). In BFM with all other variables equal, the more maneuverable aircraft usually has a better chance of winning. All BFM involves turning, and generally the tighter turning aircraft (radius) that can turn the greatest number of degrees over a specified time period (rate) has the advantage. Engineers have translated the data for use in EM diagrams which depict an aircraft's rate of turn, turn radius, and energy bleed rate at a given weight, throttle setting, altitude, airspeed, and G-loading. By comparing the EM diagrams, it can be determined who has the advantage, and where that advantage lies in terms of altitude and velocity. **Figure 4.7** shows the diagram for a T-38 at gross weight = 10,155 pounds and ALT = 15,000 feet and MAX afterburner. There are some important points on the EM diagram to be familiar with. Along the bottom axis is the airspeed. G is depicted by the blue lines. The placard G limit is 7.0 Gs. The curved line (labeled MAX LIFT) that runs down the left side of the diagram is the lift limit line. The area bounded by the max lift limit, placard G limit, and placard airspeed limit is the flight envelope. To read the diagram, enter from the bottom with airspeed and follow it up to one of the G-load lines that run from the upper left to the lower right. At the intersection of G and airspeed, reference the rate, shown on the left, and parallel to the radius lines up and to the right for turn radius.

4.12.2. Ps. Inside the flight envelope, every point defined by an airspeed and G loading has an associated energy gain or loss. They are measured by negative or positive feet per second, are numerated in hundreds of feet per second, and represent a measure of the energy bleed or gain rate. If the energy bleed rate is negative, it means that to sustain the current G load and airspeed, the aircraft must descend (change potential to kinetic energy) at the depicted rate. These lines are often referred to as excess power or Ps lines.

4.12.3. Turn Rate. Along the left, vertical axis is the turn rate. Rate is measured in degrees per second and graduated every 2. A turn rate of 12 per second means the nose will transit through

12 of turn in 1 second at the G load and airspeed depicted. If in a horizontal turn, this would mean 12 of heading change. If pulling in the pure vertical it would mean 12 of vertical attitude change. Note that, up to approximately 380 KCAS, the rate increases with airspeed.

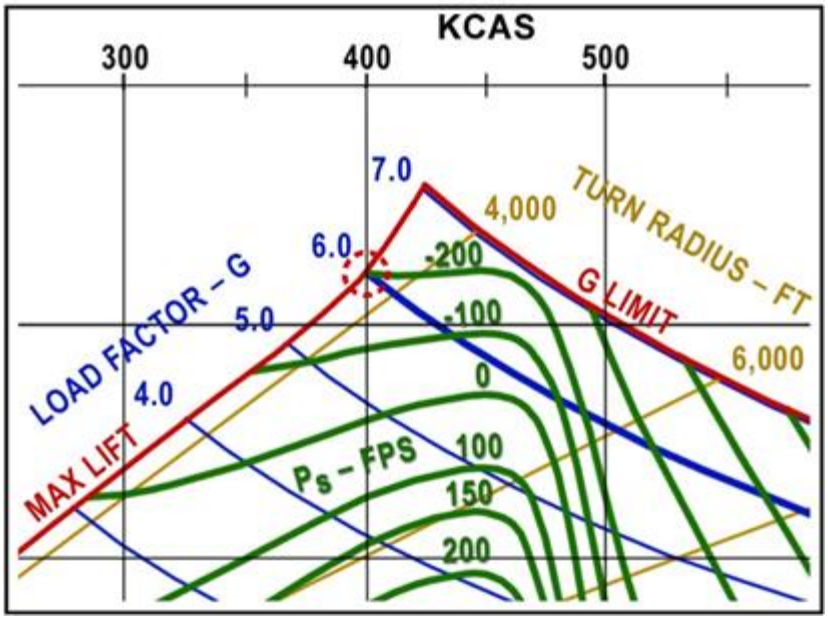
Figure 4.7. T-38 EM Diagram.



4.12.4. Radius. Turn radius is depicted by the straight lines that run from the lower left to the upper right of the diagram. They are measured in thousands of feet and graduated every 1,000 feet (ft). Note that, assuming a constant airspeed, the radius decreases as G is applied until the aircraft reaches either the maximum lift or the maximum G available.

4.12.5. Corner Velocity (**Figure 4.8**.). The very peak of the diagram is the instantaneous corner velocity. This is where maximum allowable G intersects with the lift limit line and depicts the slowest airspeed at maximum G can be applied. Instantaneous corner velocity can be approximated by referencing the G line and finding the intersection with the lift limit line. (Reference the red-dashed circle in **Figure 4.8**.). Instantaneous turn capability comes at a cost, however, in the form of negative Ps.

Figure 4.8. Corner Velocity.



4.12.6. Comparing EM Diagrams. When comparing fighter performance, overlaying the EM diagrams will determine areas of strength and weakness for both aircraft. This provides a good idea of the flight regime to engage the adversary. For instance, if one aircraft is superior at higher altitudes, that pilot should try to keep the fight high. If the other aircraft has a superior sustained rate, the pilot should strive to fight a rate fight. At IFF, the adversary is also flying the T-38C, but by restricting use of throttle and/or G, advantages are available to the unrestricted aircraft in the form of increased rate and decreased radius and less bleed rate during the turn (reference **Figure 4.7** to see the red and blue circles). A typical advantage enjoyed during an IFF engagement is approximately 2°/second and about 800 feet in radius. 2°/second over 360° of turn (about 28 seconds) equals 56° of advantage.

4.13. BFM Cross-Check. During a BFM engagement, fighter pilots need to keep track of two things to be successful. First, a pilot needs to monitor their own aircraft performance to execute our game plan. Second, they need to monitor the Bandit's position relative to themself and their actions to successfully fight them. Just as all pilots use an instrument cross-check to monitor several parameters at once while flying instruments, fighter pilots use a BFM cross-check to monitor their performance and the Bandit's actions during BFM. Depending on the phase and the nature of the fight (defensive, offensive, or high aspect), the BFM cross-check will emphasize different items. Each will be discussed later relative to specific engagement circumstances.

4.13.1. Fighter Cross-Check. During an engagement, fighter pilots are usually trying to max perform their jet to create the highest turn rate and the smallest turn radius. G, LV, and airspeed all affect the rate and radius of a turn in a T-38. Therefore, these three things form the foundation of the fighter cross-check. While fighting, fighter pilots also need to monitor their fuel state and the floor.

4.13.2. Bandit Cross-Check. The Bandit cross-check consists of range, AA, AOT (planform), HCA, LOSR, and closure. These parameters will telegraph the Bandit's game plan.

Section 4B—Offensive BFM (OBFM)

4.14. OBFM Objectives. OBFM trains the fighter pilot to maneuver from a position of advantage to a controllable WEZ and kill the Bandit. OBFM is a sequential set of problems solved by the offender to arrive at a controllable WEZ and employ valid ordnance to kill the Bandit in the minimum amount of time. Offensive BFM requires a well thought-out and executed game plan based on fighter and Bandit capabilities, training, and proficiency. The primary objective of OBFM is to kill the Bandit. Subobjectives further define the overall objective of KILL. Standard OBFM objectives are:

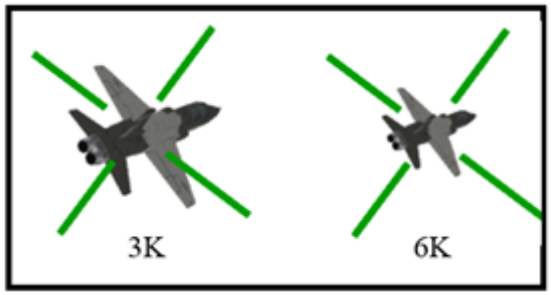
- KILL
  - Maneuver to the CZ.
  - Transition to a WEZ.
  - 100 percent valid weapons employment.
- Maintain the offensive.

4.15. OBFM Perch Setups. The current IFF syllabus requires two basic perch setups for OBFM: 6,000-foot (6K) perch setups and 3,000-foot (3K) perch setups. The primary difference is the fighter starts outside the Bandit's TC on the 6K setup and inside the Bandit's TC on the 3K setup. For mil sizing the 3K fight's on, the bandit should span slightly more than the gap plus one arm of the gun cross. For the 6K, the bandit should fill slightly more than the gap (see **Figure 4.9**.).

Table 4.1. OBFM Perch Setup Starting Parameters.

	Range	Airspeed (KCAS)		Altitude	Aspect
		Offender	Defender		
6K Perch	6000 ft ± 10%	415 ± 10	415 ± 10	± 300 ft	30-40º
3K Perch	3000 ft ± 10%	350 ± 10	315 ± 5	± 300 ft	30-40º

Figure 4.9. Boresight Cross Mil Sizing at Fight's On.



4.15.1. 6K Perch Setup. Per the standard setup, the fighter starts 6,000 OBFM from 6,000 feet behind the Bandit at 30° to 40° of AA. Squadron standards dictate how to arrive at this position, but the flight lead normally directs the wingman to 9,000 feet LAB at the planned "FIGHT'S ON" airspeed. The flight lead checks both aircraft to the right or left so the fighter turns toward

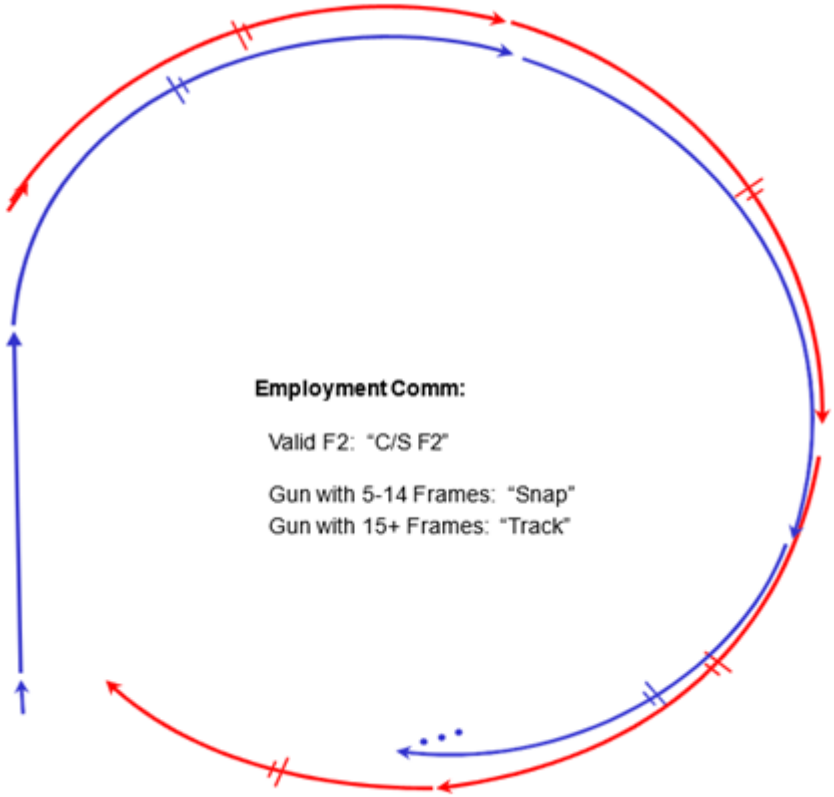
the Bandit. As the fighter reaches pure pursuit, the Bandit reverses the turn and sets the appropriate aspect angle. The fighter monitors the range and calls the fight's on at 6,000 feet. The fighter holds the Bandit under the gun cross until he reaches 6,000 feet and continues to modulate power to maintain the briefed "*Fight's on*" airspeed. For a T-38C, the wingspan is 4 mils at 6,000 feet. This is one mil larger than the inside gap of the gun cross and one mil smaller than each side of the horizontal arms of the gun cross. The AAT will display 1.1 nautical miles (NM) due to system lag.

4.15.2. 3K Perch Setup. This setup is applicable to short-range BFM and the quarter plane exercise. Initial position before the check turn is 350 knots, 6,000-foot lateral spacing, stacked level with the Bandit. At the check call, the offender checks towards the Bandit to achieve pure pursuit. The offender maintains pure pursuit on the Bandit, modulating power to maintain 350 knots until 3,000-foot range is achieved. At 3,000 feet, the Bandit's wingspan will be 8 mils. The AAT will display 0.6 NM due to system lag. The offender calls out "*Ease*" or "*Tighten*" as appropriate for aspect outside the 30° to 40° window.

4.16. Offensive Ranging Exercise. Begin the offensive ranging exercise from a 6,000-foot setup. Pure pursuit the Bandit until reaching the 6,000-foot HUD reference. Roll out to view lag pursuit for 1 to 2 seconds, select MIL power, and place the Bandit back under the boresight cross. Continue to pure pursuit until reaching the 3,000-foot HUD reference. Note the details on the Bandit's jet at 3,000 feet as these references are important for OBFM. At 3,000 feet, the Bandit has a clearly visible canopy and canopy bows, distinct lines where the wings and tail meet the fuselage, and clear lines where the colors on the paint scheme change. At 3,000 feet, continue to pull the Bandit down the HUD until the Bandit's wingspan fills the gunsight. Modulate power for steady, controllable overtake until reaching reposition cues. Reposition to avoid the 1,000-foot bubble and, as the Bandit reverses, maneuver to remain at 1,000 feet to view the Bandit references at the bubble.

4.17. Heat-to-Guns Exercise (Figure 4.10). The objective of the heat-to-guns exercise is 100 percent valid weapons employment. Units will determine specific setup parameters and SPINS for the heat-to-guns exercise. Heat-to-guns can be flown from an in place 90 degree set up or a 6K perch setup.

Figure 4.10. Heat-to-Guns Exercise.



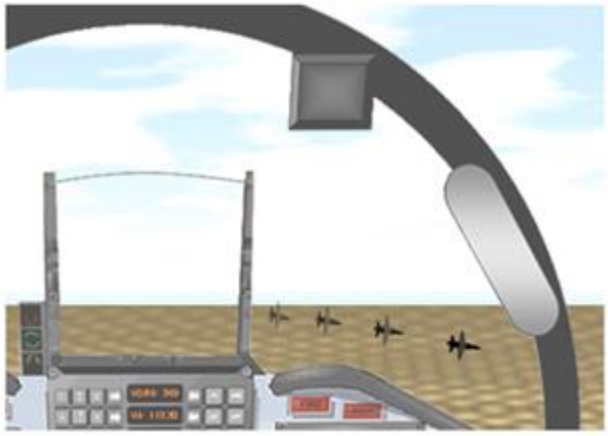
4.17.1. Communication. Reference specific communications guidance in unit standards.

4.17.2. Bandit. At the "*Fight's on*" call, the bandit will set MIL power and tighten to 350 KCAS and set 5°NL.

4.17.3. Maneuvering Aircraft. At the "*Fight's on*" call, set power as required to maintain 415 +/- 10 KCAS, roll out and drive to the bandits turn circle while setting a 1-3° climb to avoid the bandits jet wash. Then prepare to enter the Bandit's TC.

4.17.4. TC Entry Recognition Cues. Recognizing the proper TC entry cues proves vital to successfully entering the CZ. The maneuvering aircraft is on the TC when an increase of the aft LOSR of the Bandit occurs. Another recognizable cue occurs when the rotational motion of the Bandit turns into aft translational motion (AA stops increasing). Due to the low turn rates of the T-38, this increase in LOSR is relatively subtle (see **Figure 4.11**.).

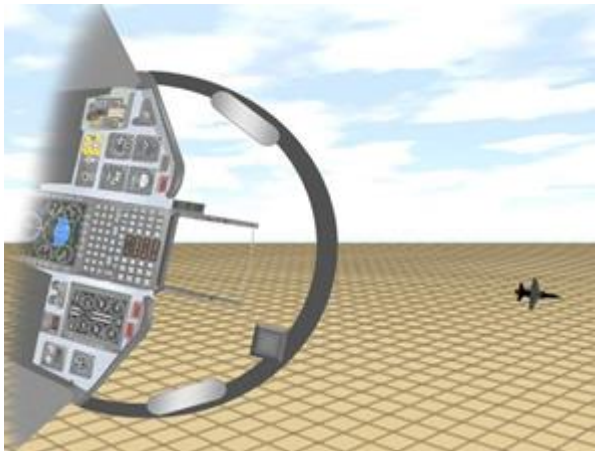
Figure 4.11. TC Entry Cues.



4.17.5. Maneuver to the CZ. At the TC entry, select G and power as appropriate (usually MIL) to maneuver to the Bandit's CZ. Begin the AGSM, set the LV near the Bandit, and start a light to moderate buffet pull. As the Bandit approaches the canopy bow, begin to assess range and aspect. The area within two fists of the canopy bow is the AW. Range and aspect should look appropriate for transition to the gun WEZ. Avoid the potential of flying through jetwash by maneuvering either above or below the Bandit's POM while flushing towards the Bandit's tail.

4.17.6. Assessing for a WEZ. When the Bandit reaches the canopy bow, assess range, aspect, and closure. The canopy bow assessment should occur approximately one to two fists above the canopy bow. Commonly briefed cues to search for during this assessment include 3,000 feet of range, 30° of aspect, and steady, controllable closure (referred to sometimes as "the rule of threes"). Details on the Bandit's jet provide the most accurate method to determine range. At 3,000 feet the Bandit has a clearly visible canopy and canopy bows, distinct lines where the wings and tail meet the fuselage, and clear lines where the colors on the paint scheme change. To determine 30° to 45° of aspect, refer to the wingspan-versus-length relationship (see **Figure 4.13**.). To determine acceptable closure, the Bandit's jet should slowly grow larger. If his jet is rapidly growing larger or smaller, improper closure exists. If all three cues from the Bandit exist at the canopy bow assessment window, continue to pull the Bandit into the HUD, and employ ordnance.

Figure 4.12. LV for TCE vs. Rate Bandit (Note: Bandit not to scale).



4.17.7. AIM-9 Employment. When pulling the Bandit into the HUD, consider a slight relax of G as required to slow the Bandit's LOSR to the missile seeker field of view (FOV). With the target's heat source in the missile FOV, uncage the missile by depressing the nose-wheel steering (NWS) button. Attempting to hold or freeze the Bandit in the center of the seeker FOV for too long can result in a significant closure problem and decrease the time available to prepare for follow-on maneuvers. Firmly depress the pickle button to fire the AIM-9 and confirm missile launch by witnessing the removal of the reticle (evidence of employment can also be checked by referencing the missile count in the bottom left corner of the HUD). After employing the AIM-9, call "*Fox 2*", roll out, and begin a slight climb (normally flightpath marker [FPM] 3° to 5° above the horizon) to avoid the Bandit's jetwash. Modulate power to accelerate or maintain airspeed while approaching the Bandit's TC.

4.17.8. Ease Reposition (Repo). If the range, aspect, and closure cues are not met at the canopy bow assessment window, execute an ease repo to drive the range and aspect lower. An ease repo drives the maneuvering aircraft back toward the Bandit's TC, reducing range and aspect in the process. Execute an ease repo by relaxing back- stick pressure to reduce G. Modulate power as required to maintain the desired rate fight airspeed. When reducing G, the fighter will see aft LOS from the Bandit (away from the canopy bow) as well as a reduction in aspect. Expect LOS to be immediate, although the amount of time required during the ease will vary based on the range, angles, and closure presented by the Bandit at the time of the ease. Select MAX afterburner, reset the LV for best rate, and blend the G back in. Maintain the best rate until the Bandit again enters the canopy bow assessment window. Assess and either execute another ease repo or pull G as required to enter the AIM-9/gun WEZ.

4.17.9. Gun Employment. A valid gun track opportunity requires proper POM, lead, and range during bullet time of flight. After deciding the attack cues are met, smoothly pull the Bandit into the HUD between the boresight cross and the AIM-9 FOV circle. Placing the Bandit in this position solves for POM. Next, establish the proper lead by matching the Bandit's wingspan to the width of the funnel. Finally, assess the range by comparing the Bandit's location in the funnel with the 2,500-foot pipper. While pulling the Bandit to the proper lead, range, and POM, the Bandit may pass through the AIM-9 FOV circle; if so, take a shot of opportunity as required. Prior to opening fire with the gun, ensure feet are on the floor or exerting symmetric pressure on the rudder pedals. Unintentional yaw inputs will cause POM errors. Using fine muscle movements, stabilize the aiming reference on the center of the target aircraft. Adjust power as required based on closure, aircraft buffet cues, and LOSR. To open fire, use one smooth, continuous trigger squeeze per gun attempt. Intermittent pulsing of the trigger will minimize the Pk and will jam the 20mm cannon. Small adjustments in back-stick pressure and lateral stick displacement will be required to refine aiming based on continuously changing range and POM. Adjust for POM error using lateral stick pressure by attempting to adjust for one-half the distance of firing evaluation display system (FEDS) or lead computing optical sight (LCOS) pipper displacement. A controlled gunshot should be held for a 2-to-3 second lethal burst. This time may be shortened based on range, closure, and significant aiming errors. To terminate the gun attempt, ***release the trigger prior to commencing a repo***. Marksmanship is critical: at 60 rounds per second, 450 rounds of simulated bullets will be depleted in approximately 7 seconds.

4.17.10. Repo Mechanics. While employing the gun, the maneuvering aircraft may encounter the need to repo. The maneuvering aircraft should repo for frag from a valid gun kill, or range

and closure problems created during the gun attempt. Range and closure problems are the most common reason for the maneuvering aircraft to repo. The repo is a calculated bid to lag, using the vertical and induced drag to solve range, aspect, and closure problems. The goal of the repo is to transition back to the CZ by preserving the vertical turning room and denying lateral turning room (overshooting turn circle).

4.17.10.1. Initial Move. Rotate the LV away from the Bandit; power placement, degree of LV change, and G/AOA used will depend on the severity of the closure problem the maneuvering aircraft is trying to solve. If unsure, a good default is to use idle, set the LV 60° to 90° above the Bandit (typically, perpendicular to the horizon) and use a smooth but deliberate pull to the moderate buffet.

4.17.10.2. Transition Back to the CZ. The repo is not finished after the initial move. Once arriving on or near the Bandit's TC, begin pullback towards the Bandit to reduce HCA and begin the reassessment. Throttle position will depend on LOS and range cues from the Bandit.

4.17.10.3. Recommit from the CZ. Once established in the CZ with valid assessment cues, recommit for an AIM-9 opportunity on the way back to the gun WEZ. Use power as required, to include MAX afterburner, and place LV as required to position the nose for valid weapons employment. Where the LV is placed will depend on how much vertical the Bandit is using. The fight will go downhill in pursuit of the WEZ and a low yo-yo may be required to increase/maintain energy for nose rate. Be aware of position relative to the training floor during the recommit. Based on the assessment, if valid attack cues are not met, remain in or maneuver back into the CZ before attempting another WEZ.

4.18. High-Angle Guns-to-Separation (HAGS) Exercise (6K Lead Bandit). Begin the HAGS exercise from a 6K setup. Call "*Fight's on*" at 6,000 feet. Begin an AGSM while selecting MAX afterburner and setting the LV in plane with the Bandit. Smoothly pull to 5Gs and blend to single-rate beeper (SRB). The Bandit will disappear beneath the nose of the aircraft. Continue to pull for 4 to 5 seconds. Roll out and modulate power for the briefed airspeed while reacquiring the Bandit. The Bandit should be level on the horizon and outside the canopy bow. As the Bandit approaches the canopy bow, squeeze the trigger, and hold until the Bandit reaches the edge of the HUD. Select MAX afterburner; reset the LV to the Bandit's deep 6 o'clock; and smoothly pull to either moderate buffet or SRB. Approximately 90° of heading change is required for a ballpark separation heading with a dive angle of 20°. Upon reaching this heading, look over the opposite shoulder to acquire the Bandit and update heading as required to place the Bandit at 6 o'clock. Modulate power to stay below the Mach while executing a floor transition.

4.19. Quarter Plane Exercise. This exercise starts from a 3,000-foot setup. The objectives are to maintain 3/9-line advantage. At the "*Fight's on*" maneuver the aircraft as to maintain pipper on the Bandit until the quarter plane picture is achieved shortly before reaching the bubble. At the quarter plane picture, set LV away from the Bandit ("feet on the Bandit"), select idle power, and execute a MAX performed pull to stop forward closure.

4.20. Medium-Range OBFM (6,000-Foot Perch Setup). The 6,000-foot OBFM setup begins outside the Bandit's TC and CZ.

4.20.1. Objective. The objective is to kill the Bandit. A commonly desired learning objective is to accomplish the kill within 720° of turn.

4.20.2. Game Plan. The initial game plan is to fly towards the Bandit's TC, execute an on-time TC entry, execute rate mechanics and assess for the ability to enter the WEZ.

4.20.3. Initial Move. When the Bandit begins his break turn at the "*Fight's on*", the fighter is outside of the Bandit's TC. The fighter must drive to the Bandit's TC in order to fly CZ BFM. Rolling out and pointing to the Bandit's location at the "*Fight's on*" is the easiest way to drive to his TC. While rolled out and in level flight, the fighter must begin power modulation to arrive at the Bandit's TC with the briefed airspeed. Typically, standing up the throttles maintains this airspeed, but additional power modulation will be required if the "*Fight's on*" airspeed was slightly fast or slow. Finally, the fighter must recognize and enter the Bandit's TC.

4.20.4. TC Entry Recognition Cues. Recognizing the proper TC entry cues proves vital to flying effective BFM. In any fighter, fighting any Bandit, from any range setup, the fighter is at the TC when ***an increase in the aft LOSR occurs and the Bandit's AA stops increasing***. Due to the low turn rates of the T-38C, the initial increase in LOSR and the AA increase is relatively subtle compared with more maneuverable aircraft. Rapid increase in Bandit LOS is the primary TC entry cue, but a few crutches exist to help see this sight picture. The most common crutch uses the Bandit reaching the inside edge of the rearview mirrors on the canopy bow. Other crutches include counting 2 to 3 seconds after rolling out at the "*Fight's on*", or starting the turn when the Bandit reaches 11 or 1 o'clock. These crutches only work under the specific conditions of a T-38C fighting a T-38C from a 6K setup with 30° to 40° of AA where the Bandit executes a 5G break turn.

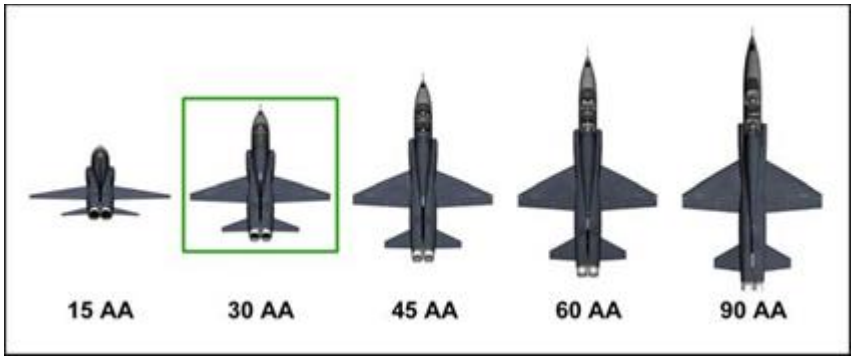
4.20.5. TC Entry Mechanics. Upon seeing the TC entry cues, begin the AGSM, select MAX afterburner, and use 1 G roll to set the LV. An LV setting to slightly below the Bandit brings the fighter's nose below the horizon and sets up for an effective rate right. After setting the LV, return the stick to neutral and smoothly apply aft stick until reaching 5Gs. Physical cues for 5Gs include the G-awareness feeling and inflation of the G-suit. Once reaching 5Gs, smoothly blend the aft stick pressure to obtain light buffet, airspeed sustaining feel. Cross-check the HUD to ensure airspeed is remaining steady. Continue to hold the POM on the Bandit (LV slightly above the Bandit) and maintain the airspeed while watching for LOSR cues from the Bandit. A quick laundry list of the actions that need to occur at the TC entry follows:

- AGSM.
- Power – MAX.
- LV - On to slightly below the Bandit.
- Pull to 5Gs and blend to light buffet feel.

4.20.6. Maneuvering to the CZ. After entering the Bandit's TC, the next step is to maneuver to the Bandit's CZ. To do this, use the concept of the assessment window. This is the point on the canopy bow approximately one to two fists above the canopy bow where the Bandit's range, AA, and closure can be assessed (**Figure 4.13**.). Ultimately, continuous assessment of the Bandit is the goal, but the assessment window provides a defined snapshot point on the canopy bow. Until the Bandit reaches the assessment window, the majority of the BFM cross-check should split between the Bandit and own ship parameters of power, LV, G, and airspeed. Bandit LOSR is another effective tool to judge rate fight success. Bandit LOS toward the canopy bow indicates one of two things. In an aligned TC rate fight, it indicates a winning rate

fight if it is not occurring because of bleeding down their own jet's airspeed. In the misaligned TC rate fight, this indicates reaching the apex outside the TC and starting to point back inside the Bandit TC. Bandit LOSR away indicates the exact opposite—a losing rate fight with an aligned TC or flushing outside the Bandit TC in a misaligned TC rate fight. The assessment window occurs as the Bandit is pulled down to one to two fists above the fighter's canopy bow. This position allows the fighter to determine whether they are established in the heart of the Bandit's CZ (30 AA and 3,000 to 3,500 feet). From the assessment window the fighter can determine which BFM steps to take next.

Figure 4.13. Estimating AA.



4.20.7. Assessing the Bandit. When the Bandit reaches the assessment window, analyze his range, aspect, and closure. Commonly briefed cues to search for include 3,000 feet of range, 30° to 45° of aspect, and steady, controllable closure (referred to sometimes as the "rule of threes" (**Figure 4.14**.). Details on the Bandit's jet provide the most accurate method to determine range. At 3,000 feet, the Bandit has a clearly visible canopy and canopy bows, distinct lines where the wings and tail meet the fuselage, and clear lines where the colors on the paint scheme change. As a crutch, ~0.5 to 0.6 on the AAT is a good cross-check of ~3,000 feet. To determine 30° of aspect, refer to the wingspan-versus-length relationship shown in **Figure 4.13**. To determine acceptable closure, the Bandit's jet should slowly grow larger. If his jet is rapidly growing larger or smaller, improper closure exists. If all three cues from the Bandit's jet are seen in the assessment window, continue to pull the Bandit into the HUD and kill. If one or more of the cues are not met, execute an ease repo as described in **paragraph 4.20.8**. An ease repo will help solve range and aspect problems by realigning TCs.

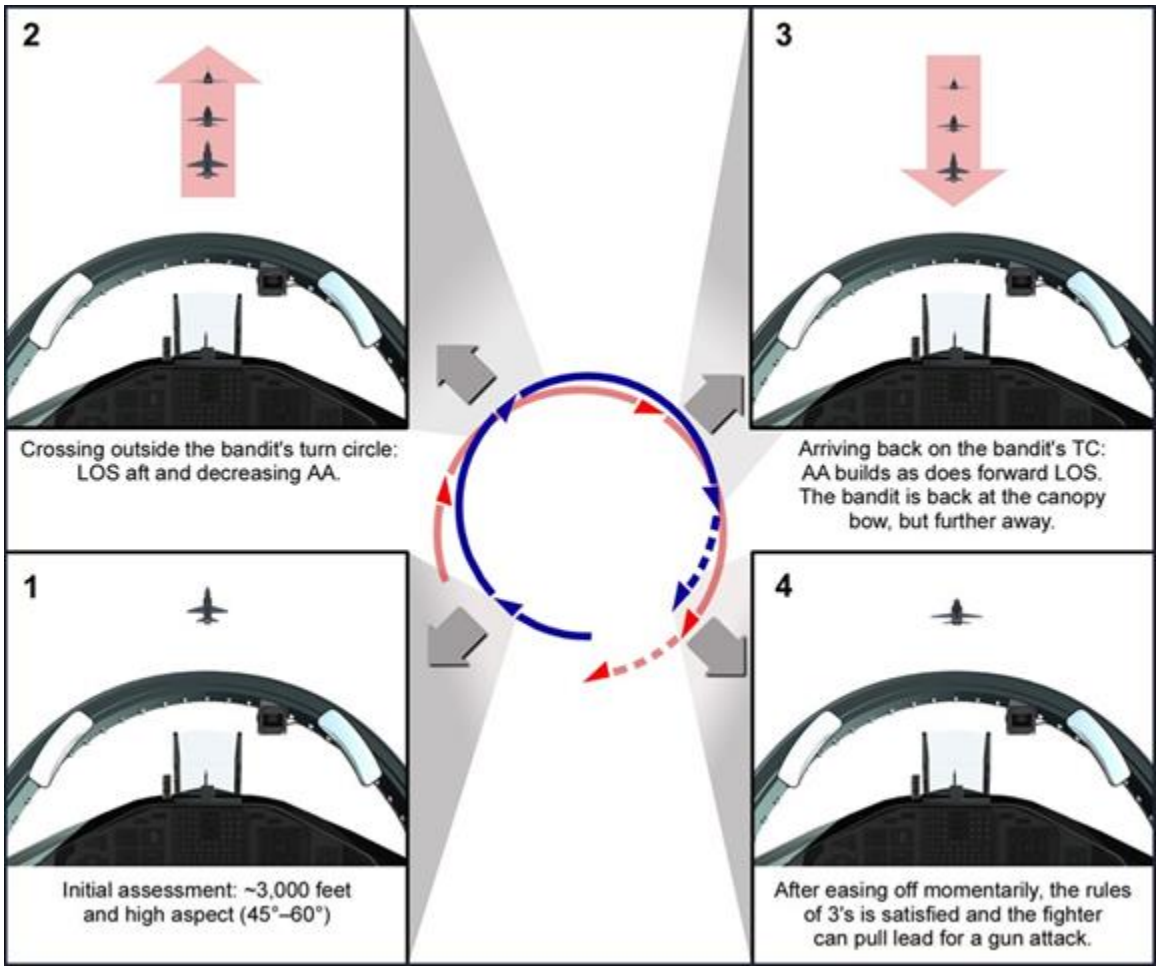
4.20.8. Ease Repo. If the range, aspect, and closure cues are not met at the assessment window, execute an ease repo to drive the range and aspect lower. An ease repo drives the fighter's jet back toward the Bandit's TC, reducing aspect in the process. Execute an ease repo by relaxing back-stick pressure to reduce G, freezing or reversing the Bandit's LOS. Closure and AA will decrease. Hold the ease repo until aft LOSR increases (TC entry cue). Select MAX afterburner, reset the LV on the Bandit, and blend the G back in. Maintain the airspeed sustaining feel until the Bandit again enters the assessment window. Assess the Bandit again, and either execute another ease repo or trade energy for nose position to employ ordnance. Ease repos are most appropriate outside of 3,000 feet or if the offender is unable to pull the bandit into the HUD based on a lower energy state.

4.20.9. Transition to a WEZ. This series of MAX performance turns, assessments, and repos establishes the fighter in the heart of the Bandit's CZ. From this position, the fighter can

employ high Pk weapons. Though the gun is the weapon of choice for killing the Bandit during OBFM, take advantage of any AIM-9 opportunities when the Bandit is in the HUD.

4.20.9.1. POM. Additionally, due to own ship maneuvering, the Bandit may be in a POM that requires a climb to position the Bandit in the HUD. To maintain the energy and ability to collapse the range while preserving energy, pull to ensure lead before aligning the POM and expect a throttle setting of MAX afterburner to "climb the hill" to the Bandit's POM.

Figure 4.14. Canopy Bow Assessment: High AA at ~3,000 Feet (Offset TCs).



4.20.9.2. Throttle Techniques. To prevent excessive overtake, reduce power based on the degree of LOSR towards the HUD. At light buffet feel on the jet, if the Bandit is marching quickly towards the HUD, pull the power to IDLE when the Bandit is between the canopy bow and the HUD. If the LOSR is slow with light buffet pull, reduce power commensurate with that LOSR. Once the Bandit is in the HUD, reduce power based on the jet feel required to hold the Bandit in the correct amount of lead for the gunshot; a "smooth" jet-to-light buffet will only require IDLE power; light-to-moderate buffet will normally require throttles "stood up"/MIL power; moderate-to-heavy buffet will normally require MAX afterburner.

4.20.10. Missile and Gun Mechanics. Reference the detailed discussion on weapons employment in **paragraph 4.17** (heat-to-guns exercise).

4.20.11. Repositioning From the Gunshot. Four factors drive the need to repo from a gunshot: range, AA, closure, and G. Range includes both maximum and minimum ranges. The repo must occur in time for the fighter to remain outside the TR bubble. Exact timing depends upon AA and closure but usually occurs between 1,500 feet and 1,800 feet. Training rules permit gunshots well outside comfortable AAs when employing a T-38C. When AA increases above 60 (Bandit's length twice his width), repo to prevent excessive closure. As aspect increases, angular closure also increases. Additionally, any difference in airspeed between the fighter and Bandit creates closure. If the Bandit's jet is rapidly growing larger, repo to prevent a Bandit reversal opportunity. Finally, if fighter is in MAX afterburner and moderate buffet with no LOSR towards HUD and not enough lead required for the gunshot, adequate radial G is not available. Repo to regain energy and reestablish a CZ position. To execute the repo, select idle, use 1 G roll to set the LV to 90° out of the Bandit's POM (should be almost straight up), and pull to moderate buffet or SRB. Wait for standard TC cues (LOSR away and AA stops increasing), then select MAX afterburner and set LV on the Bandit. Assess the Bandit's reaction to the repo. The Bandit either continues the turn or attempts to reverse to a neutral or offensive position. Bandit LOS away from the HUD indicates the Bandit is continuing the turn. Little to no LOS combined with the Bandit resetting his LV toward the fighter indicates a Bandit reversal.

4.20.11.1. Bandit Continues the Turn. An effective repo on the turn circle at 1,500 feet to 1,800 feet will force a smart Bandit to continue his turn. Continue to pull to 60-90° out of the Bandit's POM to force LOS and reverse the turn to arrive back in the heart of the CZ. Ensure MAX afterburner, use 1 G roll to set the LV on the Bandit, and smoothly pull to moderate buffet until the Bandit enters the assessment window. During this pull, adjust the LV as required based upon the altitude available to sustain a moderate buffet turn. Cross-check the floor and begin a floor transition as required. As the Bandit enters the assessment window, reassess the attack cues and either pull the Bandit to the HUD for a kill or execute another repo as required to solve the range, aspect, or closure. If done correctly, the offender should see range increasing (~2500 feet) while arriving on the Bandit's turn circle without showing the bandit reversal cues. This should result in an almost immediate recommit once range and closure are under control.

4.20.11.2. Bandit Reverses. In this situation a Bandit reverses attempting go neutral or offensive. If the repo occurred early enough for the fighter to return to the CZ, the Bandit's reversal presents an opportunity for a quick AIM-9 or gun kill. Capitalize on the Bandit's mistake with valid weapons employment. If the Bandit reverses at a closer range, fight to maintain 3/9. Roll at 1 G, reorient the LV to 90° out of the Bandit's POM and pull to moderate buffet. Select MAX afterburner to maximize nose rate and gain an altitude advantage over the Bandit. A Bandit that reverses within one aircraft turn radius forces the fight into a tree/scissors. Reference the DBFM section for scissors mechanics.

4.20.12. 6K OBFM Contingencies:

4.20.12.1. Fighter No Joy. Most no joy situations in OBFM occur from the fighter's improper BFM cross-check. After recognizing the no joy situation, simultaneously lag the Bandit's last known position while calling "*No joy*" and clearing flightpaths. Expect a "*Continue*" call from the Bandit and scan the Bandit's last known position to reacquire the tally. If at any time safety of flight is in doubt, call "*Knock-it-off*" IAW the training rules.

4.20.12.2. Bandit Tighten Down (TD). A Bandit with available energy will TD as the fighter's nose approaches pure to create aspect and closure problems for the fighter. Recognize a TD with the increased aspect and closure created by the Bandit. If the Bandit tightens down while still outside the HUD, execute an ease repo to solve the aspect and closure problems. If the TD isn't recognized until the Bandit is inside the HUD, execute a larger repo to fly back to the Bandit's CZ. The Bandit will be at a lower energy state post TD and less likely to create significant problems through subsequent TDs.

4.20.12.3. Bandit Jinks. Jinking Bandits are discussed in more detail in the 3K OBFM section (**paragraph 4.21**.). Use the same techniques in 6K OBFM to defeat a jinking Bandit as in 3K OBFM. In general, assess the Bandit's jinks for effectiveness and either employ weapons if ineffective or repo if effective.

4.20.12.4. Floor Transition. A smooth floor transition sustains energy for a fighter's floor fight while a floor save depletes energy to remain above the floor. Recognize an approaching floor through a proper BFM cross-check of altitude and not avionics warnings. One technique for beginning a floor transition is the 10° rule: Begin the floor transition 1,000 feet above the floor for every 10° of dive angle. For example, at 20° nose low, begin the floor transition 2,000 feet above the floor.

4.20.12.5. Floor Fight. Hold airspeed instead of G during a floor fight for best rate. Use any TR above the floor to maximize rate. Be patient as the maximum nose rate for a floor fight will be less than a normal fight, but the Bandit's turn performance is affected by the floor as well.

4.21. Short-Range OBFM (3,000-Foot Perch Setup). The 3,000-foot OBFM setup begins inside the Bandit's CZ.

4.21.1. Objective. The objective is to kill the Bandit. A common desired learning objective is to accomplish the kill within 540° of turn.

4.21.2. Game Plan. The initial game plan is to attempt a gun shot while assessing the Bandit's initial reaction.

4.21.3. Initial Move. At the start of the 3,000-foot BFM engagement, simultaneously roll to place the LV on the Bandit while evaluating the Bandit's defensive response. With the LV on or slightly below the Bandit, aggressively increase G to pull lead to solve the gun solution (POM, range, and lead). Power settings are based on aircraft feel, relative LOSR, and closure.

4.21.4. The Bandit Who Breaks Level or Jinks Up. If the Bandit fails to maneuver out of plane and/or does not jink effectively to create closure problems, the offender should be in a position to continue the gun attack. In the 3,000-foot OBFM setup, gun range is nearly solved requiring a momentary pause to get to 2,500 feet. Refine POM by maneuvering the aircraft as to place the gun cross "+" on the HUD along the Bandit's extended flightpath and establish the requisite amount of lead to take the shot. Continue to assess for cues to repo.

4.21.5. The Bandit Who Jinks Downhill. The Bandit may jink down and into the offender to spoil the gun solution and create a closure problem. Preserve TR by executing a repo to control closure velocity (Vc). The repo should include momentarily setting the LV back to the Bandit's CZ, pulling away to help generate LOS away (from the offender), and then aggressively realigning the TCs. Following the TC entry, select MAX afterburner and set the LV initially

halfway between the Bandit and the horizon. Execute a moderate buffet turn shy of the wing rock or just short of the stall turn to follow the Bandit's extended flightpath. Cues of max performing the aircraft during the turn include moderate buffet and airspeed not increasing. Continue to adjust LV and pull while maneuvering back into a position (in the CZ) to assess for a WEZ opportunity.

4.21.6. CZ Maneuvering. Once established in the CZ, most of the BFM concepts from medium-range BFM apply (**paragraph 4.20.6**.).

4.21.7. Follow-on Maneuvering. In addition to the concepts and considerations discussed in the medium-range section (**paragraph 4.20**), consider the following:

4.21.7.1. Repos. The repo is a lag maneuver designed to reduce AA, increase range, and decrease closure. Some reasons for executing a repo include the Bandit blowing up, excessive closure, approaching briefed minimum slant range (i.e., bubble), or the Bandit changing the POM. If closure is excessive, a high aspect gunshot is attempted, or a BFM error occurs, a flightpath overshoot may be imminent. The first key is to preserve the offensive by recognizing the potential overshoot early, and performing an out-of-plane lag maneuver called a quarter plane.

4.21.7.2. Quarter Plane Maneuver. After recognizing a potential overshoot, roll to place the LV 90° out of the Bandit's POM and execute a moderate buffet pull shy of the wing rock/stall in idle power to arrest closure and try to generate LOSR away. Once the overshoot is controlled, visualize the CZ, and fly to that point by placing the LV back on the Bandit and turning to align the fuselages.

4.21.7.3. Bandit Reversals. During the quarter plane, the defender may reverse, placing his LV on or near the offender's aircraft and executing a maximum performance turn. In this case, continue to analyze where the defender's CZ is and pull towards it to avoid the bubble. The goal in this situation is to regain the offensive advantage by outperforming the Bandit and minimizing forward ground track. There are two ways to do this: the tree and the scissors. Both minimize forward ground track in different ways. The tree (both high and low) minimizes the forward ground track with airspeed. In the scissors, minimizing forward ground track is accomplished by turning the jet with a minimized turn radius. To determine which to enter, the HCA at the flightpath overshoot must be assessed. Anything <120° of HCA will result in a tree, and greater than 120° of HCA at the overshoot will result in a scissors.

4.21.7.3.1. Tree. The fighter should select IDLE power initially and set the LV to level flight. Pull to the moderate buffet shy of the stall/wing rock and reapply MAX afterburner at ~175 to 200 KCAS to catch around 150 to 160 KCAS. The tree is now established. To get back to an offensive position, remain loaded at moderate buffet shy of the wing rock and attempt to fly shallow 'S' turns using rudder only (ailerons will drop the wing and result in loss of subsequent lift). Attempt to stay within 2,000 feet vertically of the Bandit as any more vertical is nearly impossible to use in the T-38. The combination of the slow airspeed and the 'S' turns will lead to a minimized forward ground track. Once greater than 3,000 feet of lateral spacing is achieved behind the Bandit, transition to OBFM.

4.21.7.3.2. Scissors. For HCA greater than 120° at the flightpath overshoot, the best way to minimize forward ground track is by entering a scissors. To enter the scissors at the flightpath overshoot, place the LV just above the Bandit such that the fighter will not encroach on the bubble. If possible, place the LV on the Bandit. Any higher placement of the LV will open the turn radius in relation to the Bandit and increase forward ground track. Once the LV is set, select MAX afterburner, and pull to the moderate buffet shy of the wing rock/stall to minimize the turn radius. Ensure bubble deconfliction approaching the following flightpath overshoot and reverse at the TC entry cues (rapid LOSR increase across the ground and AA stops increasing). By better performing the jet in MAX afterburner and moderate buffet shy of the wing rock, the Bandit will have a larger forward ground track. Once ~2,500 feet of lateral spacing behind the Bandit is achieved, transition to OBFM.

4.21.8. 3K OBFM Contingencies:

4.21.8.1. Fighter No Joy. Offensive maneuvering remains the same as medium- range BFM. The fighter must ensure strict adherence to training rules with respect to communications and fighter maneuvering.

4.21.8.2. Closing in Lag. If the fighter fails to max perform the aircraft post initial repo, the resulting increased turn radius and airspeed can generate cues of closing in lag where the fighter creates a faster turn rate along a larger circle. This is indicated by AA and range decreasing with the nose still in lag. The result if allowed to continue will be insufficient weapon separation. Once recognized, the first corrective action is to attempt to max perform the aircraft, specifically more AOA. If closing cues are recognized late, then a repo will be required to maneuver back to the CZ. This lag repo is essentially the same as a one-fourth plane—select IDLE power, roll to 90° out of the Bandit's POM and pull to the moderate buffet shy of the wing rock while waiting for range to open and LOSR away.

4.21.8.3. Jinking Bandit. Anytime the Bandit attempts to jink, the Bandit is expending energy to spoil POM. At high energy states, these jinks will be very effective at spoiling POM. Follow-on jinks will start with decreased energy, resulting in less effective changes to POM. If the Bandit's jinks are assessed to be effective enough to spoil POM, the fighter should repo to preserve TR and seek a quick follow on WEZ for a Bandit with a depleted energy state.

Section 4C—Defensive BFM (DBFM)

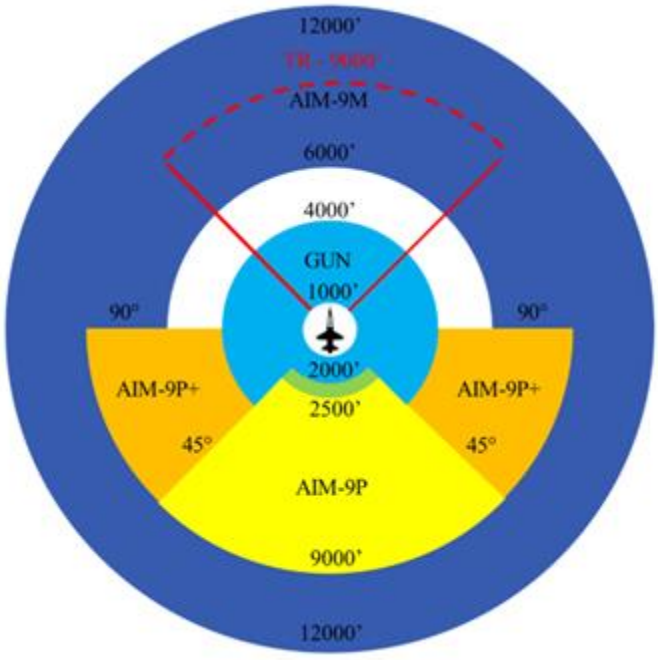
4.22. DFBM Objectives. The goal of DBFM is to train fighter pilots to survive while maneuvering from a position of disadvantage. The correct mindset is critical to DBFM, and a will to survive is paramount. Unlike offensive, DBFM requires pilots to max perform the aircraft, while spending increased time looking backwards. The focus should be on surviving for as long as possible and creating problems for the Bandit based upon the current situation. So long as a fighter pilot is still alive with a working aircraft, they are winning. ***Never give up!*** In addition to the proper attitude, pilots must be able to VID the aircraft behind them ("Is that a MIG-25 or an SU-27?"). Likewise, pilots must know both the threat aircraft and the pilot's capabilities. At what altitudes/airspeeds does your aircraft outperform theirs? What types and how many missiles do they carry? How far off-boresight can they shoot those missiles? Is their gun canted up or down (or do they have a gun at all)? Fighter pilots must know this information ***before*** the engagement

begins. The Bandit WEZ for IFF is depicted in **Figure 4.15**. Bottom Line: Know the threat before fighting it. In order of priority the objectives in DBFM are:

- ***SURVIVE***
- Defeat the Initial Attack
- Deny the Control Zone
- Deny Subsequent Weapons
- Neutralize, Separate, or Go Offensive

4.23. DBFM Perch Setups. Perch setups will be executed IAW the squadron standards and/or IFF Playbook. The "push it up" mechanics will be the same as OBFM. Since it is imperative that fighter pilots see the Bandit during the fight, they need to position their body to obtain the maximum rearward visibility. While on the ground, pilots should maneuver in the cockpit to ensure the opposite horizontal stab can be seen. This will equate to the required body position under G to maintain the tally. During the setup, rotate the upper body and adjust body position to ensure the stick and throttles are still accessible for full range of motion. A common technique is to lean forward and look "around" the seat back. Do not attempt to support the weight of the head and helmet by neck muscles alone. The second common error is to look forward under heavy G and then relax the Gs to look back at the Bandit. Improper body positioning during G-onset can lead to a loss of tally and possibly even injury.

Figure 4.15. IFF Bandit WEZ.



4.23.1. 6K Perch Setup. Once ready the flight lead will direct a check turn into the fighter. After turning 45°, roll out wings level. Maintain level flight and simultaneously prepare for the defensive body position and begin to assess the Bandit. At this point, it is fundamental to begin a cross-check between the Bandit and one's own ship parameters. Wait until the Bandit has achieved pure pursuit to reverse the turn. The defensive fighter will be responsible for

maintaining the airspeed contract, remaining level, and setting 30° to 40° of AOT. This will require pilots to start the DBFM cross-check during the fight setup. While looking backwards, assess and correct AOT (**Figure 4.16**). At 30° to 40° AOT, the Bandit should be above the wingtip. A common technique is to put the Bandit a fist distance away from the rear canopy bow and two fingers above the horizon. During the setup, occasionally reference the HUD and focus on airspeed (setup dependent) and the FPM to ensure level flight. Initially, time will be divided equally between looking backwards and glancing at the HUD. However, approaching the "*Fight's on*" call, more time should be spent looking at the Bandit, ready for the initial move.

4.23.2. 3K Perch Setup. Unlike the 6K defensive setup which requires the defender to maintain the same briefed airspeed as the pre "check" airspeed, the 3,000 feet setup requires slowing down. Decelerating from 350 KCAS and arriving at the "*Fight's on*" with less than 320 KCAS and 30° to 40° of AOT is a challenge. During the initial check turn, modulate power and pull to the buffet to bleed down to 320 to 330 KCAS; then allow the jet to decelerate the last 5 to 15 knots with throttle modulation after reversing your turn and setting the desired AOT.

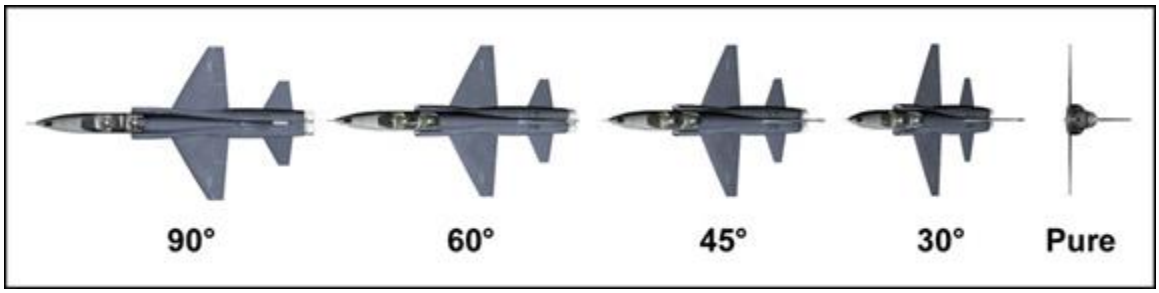
4.24. Defensive Ranging Exercise. Start from a standard 6K perch setup with the following exception: the Bandit will pull pure from 9,000 feet to 6,000 feet and then call "*Fight's on*" at 6,000 feet. At this point, the Bandit will roll out momentarily showing a "lag" pursuit curve. Then the Bandit will pull "pure" and then "lead" closing into a valid gun WEZ. The Bandit will continue closing the range and fly behind the fighter to not enter the 1,000-foot bubble.

4.24.1. Purpose. To familiarize the student with the defensive perch setup and to identify and practice assessing pursuit curves and ranges. The pure pursuit Bandit from 9,000 to 6,000 feet that is approaching the 6,000 feet "*Fight's on*" range is designed to calibrate long range estimation. Bandit pursuit course after momentarily driving to lag at 6,000 feet is designed to have primary emphasis on WEZ recognition (**Figure 4.15**.). The Bandit will show "lag, pure, lead," and drive all the way to the bubble. See **Figure 4.17** for defensive assessments of Bandit pursuit curves.

4.24.2. Mechanics. After the check away, reverse back when offender is pure to maintain tally/altitude/airspeed. Power modulate to slow from 415+10 KCAS to 350 KCAS while slightly descending. Hold Bandit at 30° to 40° AOT (approximately 2.5 to 3 Gs). The primary task is Bandit assessment. Assess pure, lag, and the transition from lag to pure to lead as range decreases. In addition, assess the cues indicating the Bandit is in the AIM-9 WEZ (pure) and gun WEZ (lead). As the Bandit approaches the bubble, they will repo to lag. Roll out, wings level and quickly move visual scan to the opposite side of the aircraft. The Bandit will be visible on the opposite side of the canopy, just outside the bubble (1,000 to 2,000 feet with low HCA). The exercise will end with a "*Terminate*" or "*Knock-it-off*" (KIO) call.

Figure 4.16. Setting the "FIGHT'S ON" AA.

Figure 4.17. Bandit Lag Assessment.



4.25. Reversal/Scissors Exercise.

4.25.1. Purpose. The purpose of the reversal/scissors exercise is to recognize and defend against a Bandit that continues to pull lead, identify the reversal picture, and execute a reversal. Following the reversal, the exercise continues with an entry into a scissors fight to gain the 3/9 advantage from the Bandit.

4.25.2. Initial Move. Execute a defensive break turn and assess the Bandit's pursuit curve. However, recognize that the Bandit will transition from pure to lead for a high- aspect gun attempt as he approaches a high-angle gun WEZ. Prior to the Bandit achieving pure pursuit, execute an out-of-plane maneuver to defeat the gun attempt. Assess the Bandit's position for a reversal opportunity.

4.25.3. The Reversal. As the Bandit overshoots, assess the Bandit's LOSR, range, and HCA. There are several combinations of range and HCA that could present a reversal opportunity; high HCA combined with close range (generally inside of 2,000 feet) and/or high LOS may allow for a successful reversal. **Figure 4.18** shows two typical reversal pictures: the lower HCA, repo near the bubble, and the higher HCA, rangier result of a Bandit attempting a high-angle gunshot. If in doubt, do not reverse and continue to turn while monitoring the

overshooting Bandit. For debrief purposes, a reversal definition can be defined as the following: HCA greater than range (2x range for IFF students works better), inside of a turn radius, with high LOSR. High LOSR can be defined as getting from the fights on picture to the turn circle in 1-2 seconds.

Ex: BDT has 50° HCA at 2500 feet at the turn circle overshoot (2 times the "range", i.e., 25 x 2 = 50). This would have resulted in high LOSR as the bandit approached the turn circle and a subsequent overshoot.

Figure 4.18. Two Common Reversal Pictures.

4.25.4. Reversal Mechanics. Simultaneously use an unloaded roll to reverse turn and move visual scan to the other side of the canopy to regain the tally. LV position will depend on HCA and LOS when the reversal is initiated. The higher the HCA and LOS, the closer to the Bandit the POM should be initially placed to use as much of the in-plane TR as possible. With low HCA and LOS, ensure POM is not on the Bandit to prevent pressing the bubble. In this case, POM placement relative to the Bandit will depend on their nose position. If the Bandit already has the high ground, go low and vice versa. Reference scissors mechanics in the OBFM section (**paragraph 4.6**.).

4.26. Jink Exercise.

4.26.1. Purpose. The purpose of the jink exercise is to identify the Bandit's gun WEZ and practice gun jinks. Jinks are last-ditch maneuvers to spoil POM and create closure.

4.26.2. Mechanics. Prior to the "*Fight's on*", maintain setup parameters. Primary emphasis should be on assessing Bandit range for WEZ (**Figure 4.15**). At the "*Fight's on*", immediately select IDLE power, unload, and roll to set LV below the Bandit. Perform an aggressive symmetric, maximum onset rate, two-hand, stick in the lap pull and hold until the aircraft aerodynamically stalls. Assess the Bandit. If the Bandit is still in lead, jink again. The AOA must be broken prior to resetting the LV. Be careful not to push forward on the stick while resetting POM as this may introduce negative Gs. While maintaining IDLE power, reset LV out of plane (OOP) with the Bandit (opposite vertical side of Bandit from the first jink).

Perform another aggressive symmetric, maximum onset rate, stick in the lap pull using two hands, and hold until the aircraft aerodynamically stalls. Assess the Bandit. Continue jinking until the Bandit repos. The Bandit will continue to threaten until forced to repo, presenting a reversal picture. Reverse and maneuver to gain 3/9. Reference reversal and scissors mechanics from OBFM. Power as required when necessary for own ship EM to ensure effective maneuvering. Use caution jinking down within 1,500 to 2,000 feet from the floor.

4.27. Medium-Range DBFM (6,000-Foot Perch Setup). The Bandit begins slightly inside of the defensive fighter's TC and outside the CZ.

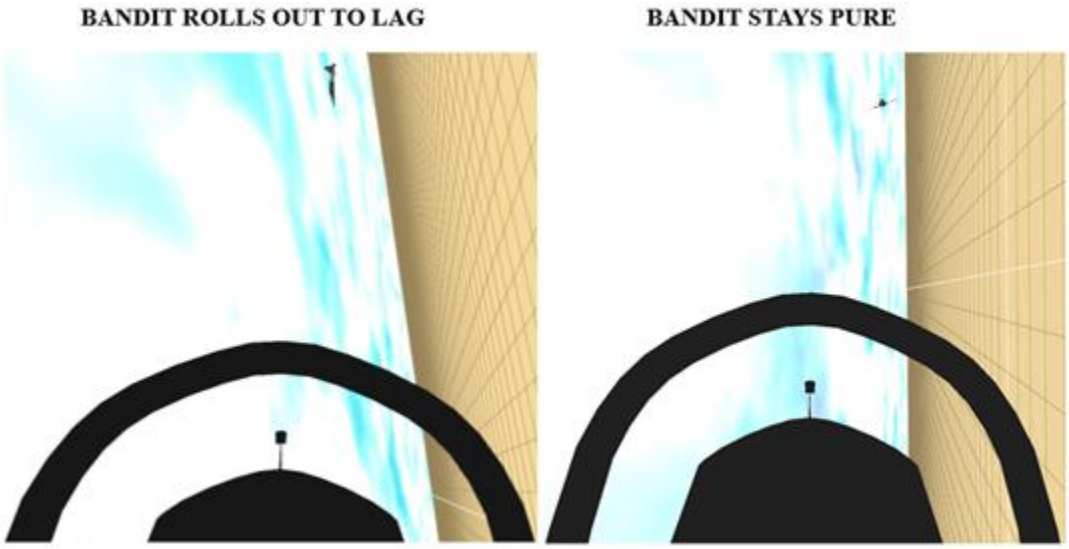
4.27.1. Objective. The objective is to survive.

4.27.2. Game Plan. The game plan is to execute a break turn and assess the Bandit's reaction.

4.27.3. Initial Move (The Break Turn). To survive this engagement, the first requirement is to defeat the initial attack. This is accomplished by turning the aircraft's WEZ away from the Bandit's WEZ. Execute a defensive break turn, looking at the Bandit to assess their pursuit curve. Select MAX afterburner, set the LV on or slightly below the Bandit, and pull to target G; 5.0 to 5.5 Gs. The G should feel the same as a during G-awareness maneuver. Continue to "squeeze" the G to the SRB and simultaneously assess the Bandit's pursuit curve. Due to power and G limitations, the Bandit will be forced immediately outside of your TC. For the AIM-9P, more than 45° of AA is needed to defeat the missile or prevent the Bandit from taking the shot. The break turn should be LV on and at max allowable G to generate as many angles as possible, minimize vertical TR for the Bandit, and maintain airspeed. **Figure 4.7** shows an additional advantage of a max performance turn while the Bandit is outside your TC. Each second the Bandit is outside your TC, you will generate 12 to 13 more degrees of turn, which are angles the Bandit has to make up once he enters your TC. Once the Bandit is on/inside your TC, your rate advantage will decrease to about 2° (assuming a 10.5 to 11 degrees per second (deg/sec) Bandit turn rate). MAX performing your aircraft is essential in maintaining this advantage and achieving the objectives.

4.27.4. Pure/Lead Bandit. If the Bandit continues in pure pursuit or pulls lead, immediately transition to a TD maneuver. Timely assessment of this pure/lead Bandit is critical as they are only moments away from employing ordnance. In this case, the defensive fighter will not see LOS aft, and the Bandit's AA will not change. To transition from the defensive break turn to a TD maneuver, continue the break turn mechanics while raising the LV to on the Bandit and apply max allowable G. Continue to assess the Bandit. Continue to pull max allowable G to the buffet as the aircraft slows down. Pilots will see forward LOS and range decrease as the Bandit approaches a WEZ. Prepare for guns defense. Recognizing the WEZ and honoring the Bandit's nose with guns defense is paramount. The Bandit who stays pure will have a fleeting snap at the back edge of the WEZ. The cue to start the OOP will be pure pursuit with range collapsing inside of 3,000'. The Bandit who aggressively pulls ***lead*** will have a high-angle snapshot at a closer range. Mechanics for these pictures will be IAW **paragraph 4.25** (Reversal/Scissors Exercise). **Figure 4.19** illustrates the lag and pure bandit immediately following the "*Fight's on*".

Figure 4.19. DBFM, 6K Initial Assessment (Note: Bandit not to scale).



4.27.4.1. OOP Components. There are two components to this OOP: (1) Change POM to defeat the gun attack, and (2) continue to assess the Bandit for follow-on game plan selection (i.e., reverse or continue the turn in a min radius fight).

4.27.4.2. OOP Mechanics. Quickly reduce G to break AOA and reset the LV to get OOP and smoothly pull back to the moderate buffet. If the top of the Bandit's jet can be seen below the defensive fighter, consider an OOP uphill. This moderate buffet pull will immediately create problems for the Bandit and will require follow-on maneuvers (i.e., repo or high-aspect GUN attempt). Do not hesitate to transition to follow-on game plan.

4.27.4.3. Assess and Select a Game Plan. Assessment must occur during the OOP. If high LOS due to high HCA and/or close range can be seen, reverse (**Figure 4.20**); if not, or in doubt, continue with the turning fight and transition to a min radius game plan.

Figure 4.20. Reversal Cue, Lead Bandit.

4.27.4.4. Reversal. Versus a Bandit that pulls excessive lead for a high-aspect gun attempt, defensive pilots will see high HCA and can afford to initially roll their LV closer to the Bandit without pressing the bubble. Fight to gain a 3/9 advantage and look for WEZ opportunities. Refer to Reversal discussion beginning with **paragraph 4.25.3**.

4.27.5. Lag Bandit. To transition from the defensive break turn to the sustained-rate game plan, pilots will need to refine the jet's LV. Begin DBFM cross-check, but don't look forward for any longer than an occasional cross-check. Alter LV as required to max perform the aircraft. Subsequently, refine the LV, striving for a sustained-rate fight airspeed and optimum rate fight.

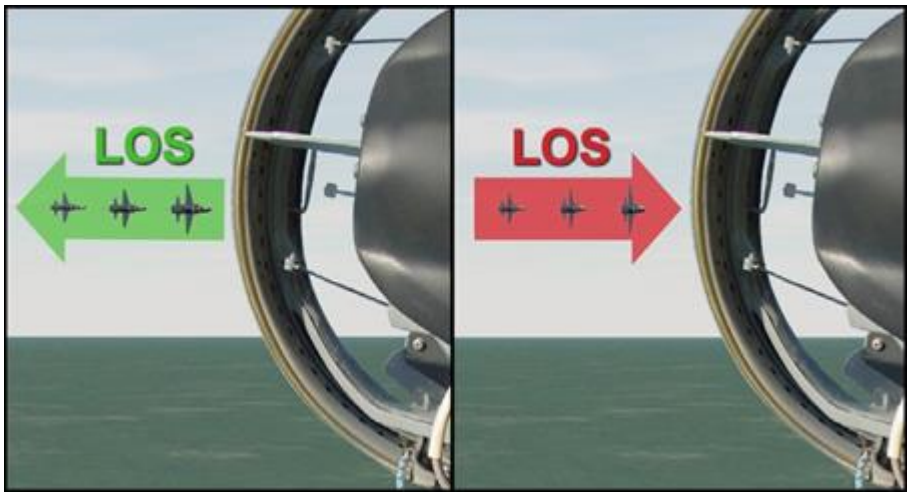
4.27.6. Bandit Assessment. Continue to assess the Bandit; the defensive fighter will either be winning or losing the rate fight (**Figure 4.21**.). Winning cues include forward LOSR with range and HCA increasing (as you pull the Bandit into deeper lag). Losing cues include aft LOSR with range and HCA decreasing.

4.27.7. DBFM Cross-Check. Cross-check LV, G, and airspeed to refine the optimum rate fight. The following are common errors and their corrective actions:

4.27.7.1. High Airspeed. Ensure max allowable G, apply a power reduction, and/or raise the LV to reduce airspeed. How much of each depends on the severity of the airspeed error. Take caution readjusting LV to prevent an asymmetric over-G.

4.27.7.2. Low G. If holding 400 KCAS or less, but sustaining 5 or less Gs, LV may be too high. Slowly move the LV lower and smoothly increase the G. Additionally, cross-check engine operation and throttle placement.

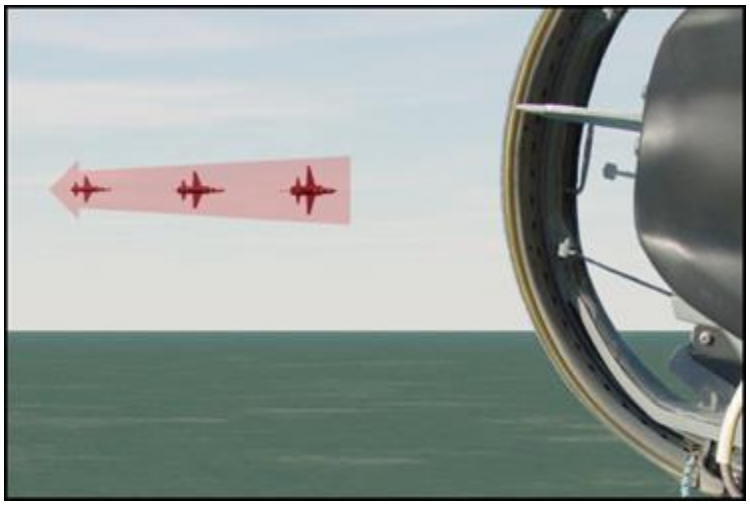
Figure 4.21. Winning and Losing LOS Cues.



4.27.7.3. Getting Too Slow. The LV is too high, but in this case, airspeed has already been traded for G attempting to keep target G or better. Deliberately lower the LV towards the game plan pitch picture, or lower. Pilots must keep altitude in their BFM cross-check to build floor awareness (see Floor Transition, **paragraph 4.20.12.4**.). Additionally, cross-check engine operation and throttle placement.

4.27.8. Separation. (**Figure 4.22**.) Whether out of ordnance or fuel, or in a multi-bogey environment, the overall tactical circumstances may demand exiting the fight. Regardless, none of these reasons are worth giving the Bandit an easy AIM-9 opportunity. Defensive fighters must make sure their assessment is accurate and, if in doubt, not attempt the separation.

Figure 4.22. Separation Cues.



4.27.8.1. Separation Decision. If the Bandit is trending towards 90° of HCA (approximately 45° AOT and 45° planform) and greater than 6,000 feet, consider separating. Trend information is important; the Bandit should be seen getting smaller over time and lag increasing (**Figure 4.22**.). A good range cue is to ensure the Bandit looks smaller than a T-38 in tactical formation and decreasing in size. Continue to assess the Bandit for winning and losing cues.

4.27.8.2. Separation Execution. If the cues to separate exist but altitude and airspeed are unknown, take a glance forward and cross-check own ship parameters. If slow and close to the floor, reconsider separating. With awareness of airspeed and altitude, reassess the Bandit and if separation cues exist, leave the fight. Use MAX afterburner and unload to less than 1 G to increase airspeed as quickly as possible. A technique is to leave the bank in during the unload to mask the separation longer. Attempt to maintain tally or awareness of the Bandit's nose position while keeping an eye on the pending floor transition. Use of a small check turn during the separation will assist in tracking the Bandit, although do not turn too much. Continue to monitor the Bandit's nose position and dispense countermeasures as required to defend against potential weapons employment from the Bandit.

4.27.9. Mature Fight Guns Defense. During the fight, if the Bandit demonstrates the ability to threaten with nose position, transition from the optimum rate game plan to OOP maneuvers. As soon as the Bandit's nose begins to rotate from lag towards pure at range, transition to the TD, flare, and get ready for guns defense.

4.27.9.1. OOP Maneuver. The priority is to recognize the Bandit's WEZ and subsequently move the aircraft's POM out of the Bandit's POM. Whether the first move is up or down will depend on altitude remaining to the floor. Ideally, use gravity to command a downhill maneuver, but if within 1,500 feet of the floor, a level or pullup may be more appropriate. The decision to select an OOP maneuver or a jink will depend on Bandit AA and closure. Following an effective TD and getting AA to greater than 45°, defensive fighters can expect to force the Bandit's nose off with one OOP maneuver. If AA is less than 45°, it's likely a series of jinks will be necessary before the Bandit is forced to repo. Airspeed will also be a factor in game plan selection; full-up jink mechanics above 320 KCAS will increase over-G potential. Reference **paragraph 4.26.2** for jink mechanics.

4.27.9.2. Post OOP/Jink. When the Bandit's nose is forced to lag, look for reversal cues. If rapid LOS with high HCA is seen with the Bandit inside approximately 2,000 feet, reverse. If not, continue the turn. SA on altitude in relation to the floor is a must during a mature fight.

4.28. Short-Range DBFM (3K Perch Setup).

4.28.1. Game Plan. "Jink and assess." Initial Move: Set power to IDLE, rotate the LV OOP below and towards the Bandit while applying max allowable G. To expedite the OOP maneuver, attempt to use both hands to pull the stick towards the seat pan. The aircraft will aerodynamically stall as the nose of the aircraft digs in. Pay attention to the Bandit's nose during the jink. If it's still at pure pursuit, a follow-on jink up is required while the Bandit is attempting to adjust to the newly set POM. Reset the LV approximately 90° back above the horizon and jink again. Continue jinking until the Bandit's nose repos to lag. Assess for reversal cues.

4.28.2. Jink Timing. Each jink needs to be held long enough to allow the aircraft to begin moving to a new POM. A delay in transitioning to a follow-on POM allows the Bandit to find a gun solution easily. Break the AOA prior to resetting the LV. Rolling the LV with AOA will not allow the aircraft to pivot around its flightpath axis quickly enough.

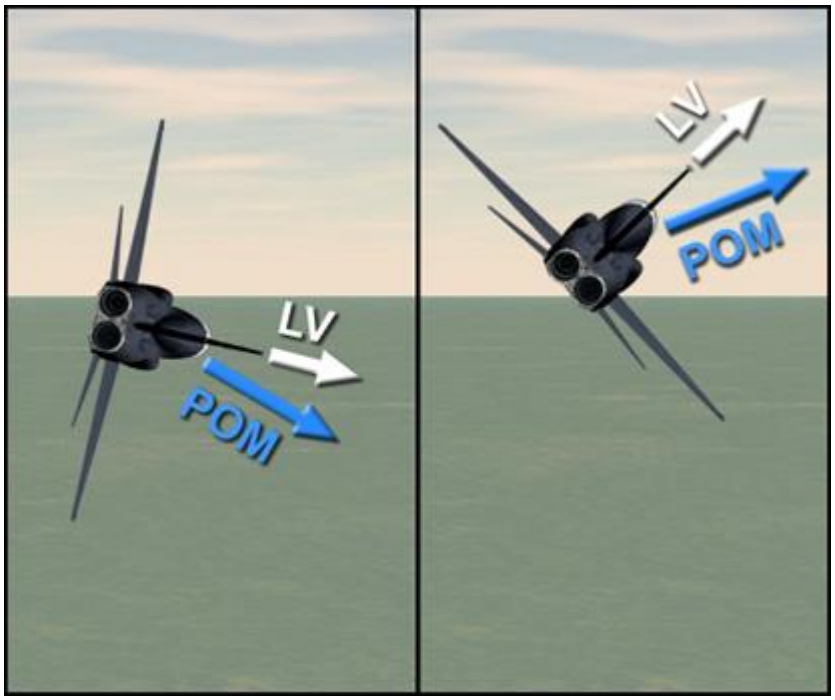
4.28.3. Setting the LV. As the Bandit gets closer, POM adjustments must be further away from the Bandit. Remember that POM will always fall below the LV— as the aircraft slows down in subsequent jinks, the difference between the two will increase. The T-38 does not fly well with the nose buried low due to small horizontal stabilizers and limited thrust. As a technique, aim to place the LV approximately 45° above or below the Bandit to ensure adequate POM changes (**Figure 4.23**.).

4.28.4. Don't Give Up. While the priority is initially getting OOP, emphasis must also include increasing aspect and closure to force the Bandit out of the WEZ. If jinks are weak and don't generate closure, it may take several jinks before the Bandit is forced to lag.

4.28.5. Follow-On Maneuvering. The jink sequence will end with the Bandit in a repo. During the repo, assess for reversal cues.

4.28.6. The Reversal. See **paragraph 4.25.4** for specifics on cues and reversal mechanics. Be aware if reversing, HCA will probably be low, requiring a new LV towards the Bandit's high CZ. Quickly update it with a tally on the other side of the canopy if LOS, HCA, and/or range allow.

Figure 4.23. 3K DBFM Jink Lift Vector.



4.28.7. No Reversal Cues. If reversal cues are not present, immediately transition back to a max performing turn. Use MAX afterburner and set the LV as required below the horizon. This may require either a large LV change or none depending on if jinks were above or below the Bandit during their reposition.

4.28.8. Pulling to Moderate Buffet. Continue pulling to the moderate buffet in MAX afterburner while maintaining awareness of the Bandit. Airspeed should stay approximately the same throughout the turn. Extreme nose low and high attitudes will affect airspeed. Snapshots to the HUD will be required over time to build SA on attitude and the floor; however,

during the first few seconds of the transition to the min radius fight, pilots should concentrate on the tally.

4.28.9. Maintain the Tally. Effective jinks followed by a quick transition to the min radius fight will allow pilots to maintain the tally. Pilots should see planform and low HCA. Keeping the tally will be extremely difficult unless you start the fight in a good body position and are timely with your game plan selection and execution.

4.28.10. Mature 3K Fight. Stay with the turn and keep up with the DBFM cross-check, preparing for a floor transition. Carefully assess the Bandit for a transition to pure/lead and a threatening nose position. As the Bandit approaches an AIM-9 WEZ, flare and immediately transition to guns defense. Reference mature fight guns defense (**paragraph 4.27.9**.).

4.28.11. Future WEZ Expectations. Given the offset TCs, expect the Bandit to transition to another WEZ. Once the Bandit's nose is visible, begin to rotate from lag to pure at range, transition to a TD, flare, and get ready for another OOP and potential reversal opportunity. Despite the high probability of a second WEZ for the Bandit, it is possible to keep their nose in lag over time. In this case, there ***may*** be consideration for transitioning from the min radius fight towards a sustained-rate fight. If LOS is stagnant on the canopy and the Bandit's nose is stuck in 45° of lag or more with range opening to >4,000 feet, begin the transition to a rate fight. Relax G as much as Bandit will allow to gain energy (i.e., airspeed), but keep the Bandit from reentering a WEZ.

4.28.12. Keep The Tally. Aft LOS towards the 6 o'clock will be clearly visible, but it should slow down and stagnate near the tail and/or canopy bow (possibly under it) (Reference **Figure 4.26**.**)**. Given the Bandit's high offensive potential, a lost tally at this point might allow the Bandit an unobserved WEZ entry. Regardless, ***do not*** ease off the pull. If you momentarily go no joy with the Bandit under the canopy bow or behind the seat, sustain the G/AOA. Per AFMAN 11-214, *Air Operations Rules and Procedures*, you are allowed to TD to "remain predictable" while "no joy". The TD maneuver will help to reacquire the tally by pulling the Bandit forward on the canopy.

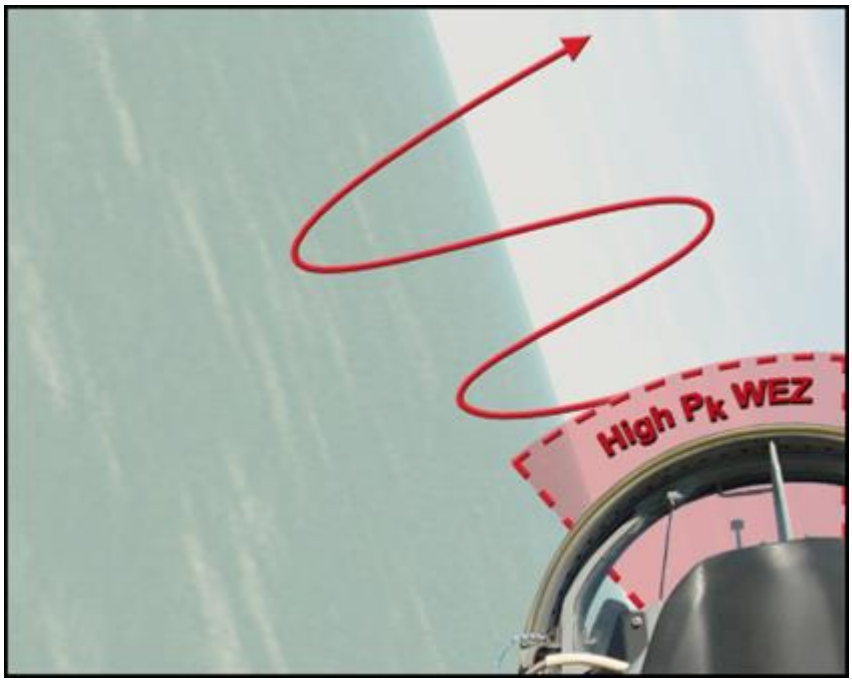
4.28.13. No-Sight Defense. The primary goal of no-sight defense is to recover the tally while executing a min radius game plan. Pilots must prioritize scanning for the Bandit while maintaining a frequent cross-check to the HUD for altitude and attitude SA. MAX performing the aircraft in the min radius fight will provide the best opportunity to pull the Bandit forward on the canopy and regain tally. Additionally, countermeasures dispenser (CMD) should be considered based on fight pacing SA.

Figure 4.24. Keeping the Tally.

4.28.14. Tally Recovery. SA on the Bandit's HCA as they fly behind the seat will help the pilot recover the tally. If HCA was low, pilots should look first and longest in the high Pk WEZ (**Figure 4.25**). If HCA was higher as the Bandit crossed the 6 o'clock, offset TCs will develop and as time goes on, and therefore pilots must move their scan from the WEZ forward on their canopy, zigzagging both high and low.

4.28.15. Floor Transition. The fight will be going downhill. The goal is to slowly adjust the LV during a floor transition to eventually level off before reaching the floor. Without a floor transition, the fighter will be forced to roll wings-level in a floor save, which is energy depleting and will straight-line their TC. This could be the difference between keeping the Bandit's nose in lag or allowing them to point and employ ordnance. To execute an effective floor transition requires the fighter to incorporate altitude in the BFM cross-check. For every 1,000 feet above the floor, the fighter should be no more than 10° nose low. This is referred to as the "10 percent rule." As an example, with a 9,000-foot MSL floor, the aircraft should not be more than 20° nose low passing 11,000 feet. Additionally, consider using a 1,000-foot BARO setting above the BFM floor. This will allow for small errors in LV control during a floor fight. Remember that once at the floor, the fighter must fight Ps=0 BFM. Referencing the T-38 EM diagram, at Ps=0 the aircraft won't be able to sustain the same G as during the descending, rate fight. The jet will feel smoother further away from the lift limit line (reference EM diagram, **Figure 4.7**.).

Figure 4.25. Regaining the Tally.



Section 4D—High-Aspect BFM (HABFM)

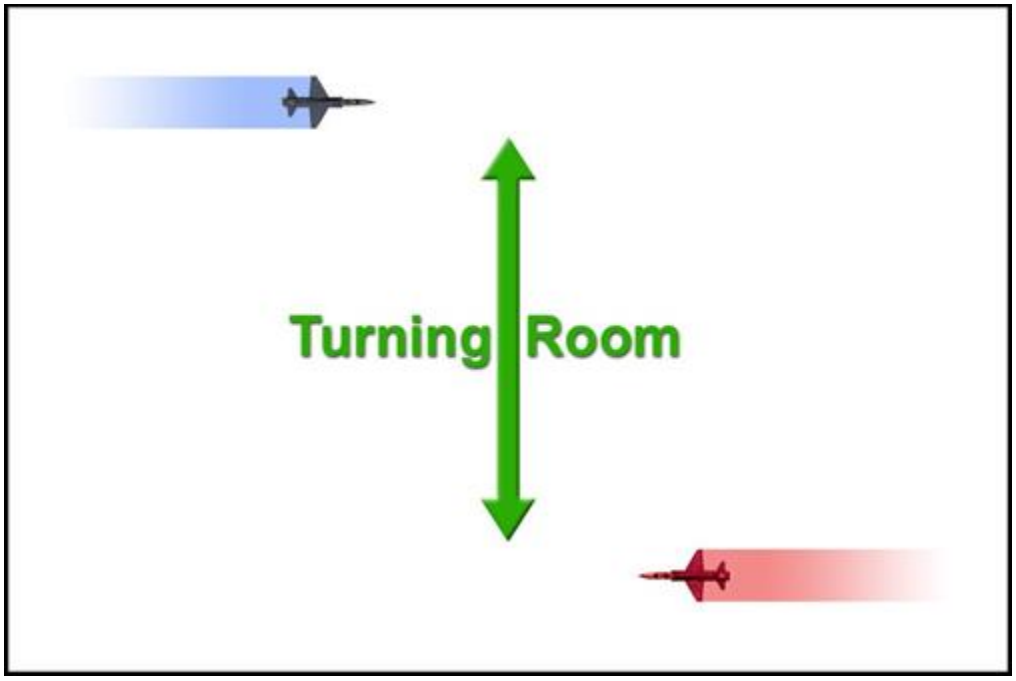
4.29. Introduction to HABFM. HABFMs may occur throughout many phases of a tactical engagement. During the transition from the intercept to the BFM phase, the Bandit may have a tally or may be turning into the attacker based on RWR indications, radar contact, or GCI information. Always attempt to achieve TR prior to a merge. If the Bandit is aware, the Bandit may deny any TR opportunities. Do not continue to try for TR and lose the opportunity for a lead turn. Remember that the TR for both the fighter and the Bandit is typically the same. The Bandit may have a tally and may attempt to achieve TR also.

4.30. HABFM Concepts. The BFM concepts already introduced in the offensive and defensive phase will be expanded upon and some new concepts added for application in the high aspect arena. Unlike perch BFM which starts at specific parameters, HABFM is much more fluid and unpredictable.

4.30.1. Pre-merge Turning Room. TR is displacement in any plane (vertical, lateral, or a combination) from an adversary's flightpath (**Figure 4.26**.). Prior to the lead turn, the fighter will seek to gain an advantage by "building" TR prior to the lead turn. The optimum amount of TR is a full turn diameter between you and your adversary's flightpaths. In the T-38, strive for at least 6,000 feet. It is important to realize, however, that TR for one fighter is normally TR that can be used by the adversary as well. There are exceptions to this rule. For instance, one fighter may have exclusive use of TR that the other fighter cannot use. An example of this exclusive TR is when two aircraft merge high aspect at low altitude with one aircraft just above the ground and the other less than a turn diameter above the ground. The low fighter can execute a pure vertical lead turn; however, the higher aircraft cannot execute the same maneuver to match the lower aircraft. Doing so will lead to impacting the terrain. Thus, the lower fighter enjoys exclusive use of this TR.

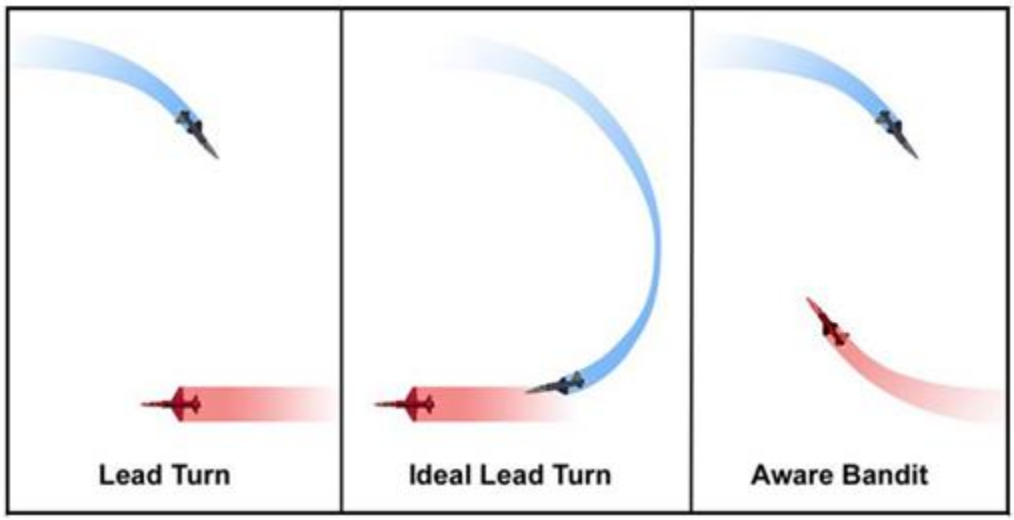
4.30.2. Merge Entries. The decision to merge above or below the Bandit is dependent on several considerations to include environmental factors, current energy, and the surrounding tactical situation. Weigh all the factors and execute a decisive game plan.

Figure 4.26. Turning Room.



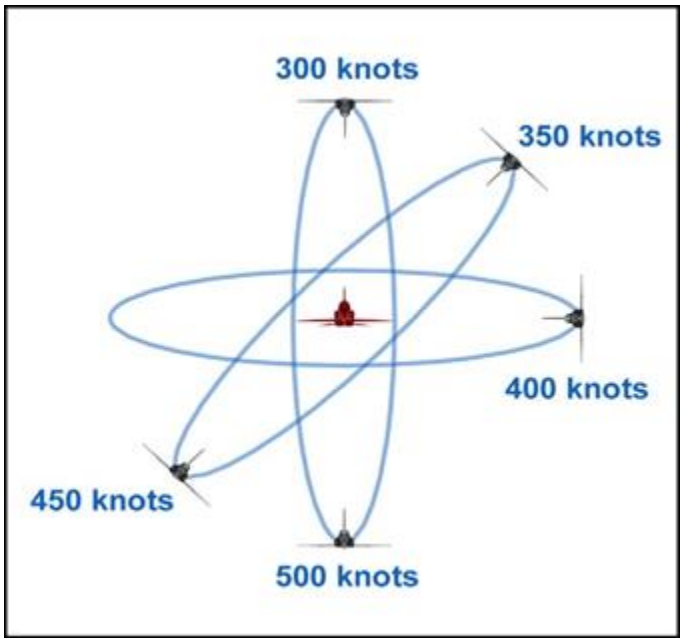
4.30.3. Lead Turn (**Figure 4.27**.). The lead turn is an attempt to use TR to decrease HCA prior to passing the opponent's 3/9 line. In an ideal situation, against an unaware, non-maneuvering Bandit, the initial lead turn will result in the fighter rolling out in a WEZ at the Bandit's 6 o'clock. If both aircraft are aware and simultaneously use the TR, the result will be a close aboard, neutral pass. In general, the objective is to gain TR before the merge, or the Bandit becomes aware and begins to turn into the fighter. However, if your adversary begins to take that TR away (they become an aware Bandit and turn into you), you must stop trying to get more TR and use what you have. The figures below are two dimensional, but HABFM will happen in three dimensions. In a pure sense, a lead turn that maximizes use of available TR will have POM on the Bandit regardless of where the LV is in relation to the horizon (specific LV considerations are discussed later).

Figure 4.27. Lead Turn.



4.30.4. Energy Atom (**Figure 4.28**.). 6K OBFM or DBFM engagements always start with the fighter and Bandit at the same altitude. Since the fighter's nose position is near the horizon and will predictably lower, it is advantageous to start close to rate airspeeds. After the "check away" in HABFM, however, the fighter will intentionally maneuver to build in an altitude differential to gain vertical TR in addition to lateral TR. Regardless of power setting, the T-38 will quickly slow down maneuvering uphill and likely accelerate when going downhill. As a result, the fighter will want to be slower than rate airspeed when maneuvering high to low in the lead turn and faster than rate in the opposite situation.

Figure 4.28. Energy Atom.



4.30.5. Use of the Vertical. Hypothetically, 300 KCAS is the desired airspeed to execute a pure vertical lead turn from high to low. With airspeed any higher it would be difficult to

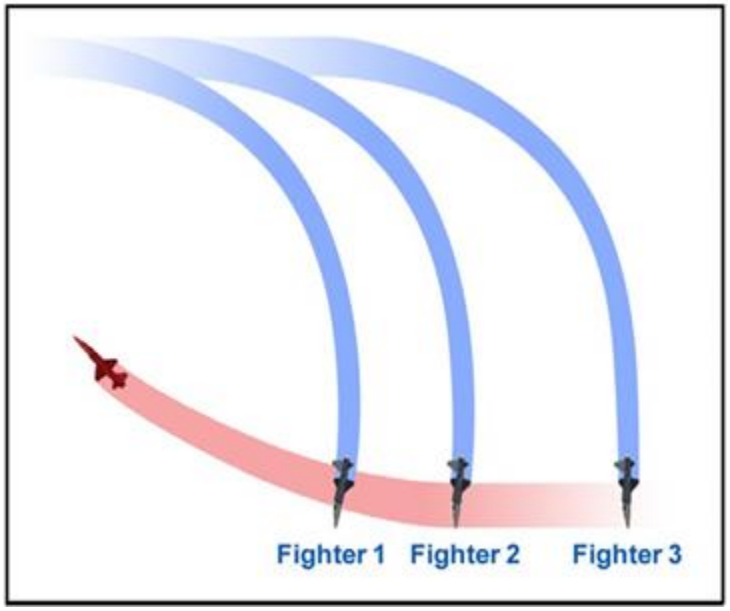
control airspeed going low. As airspeed builds, so does the over-G potential. Additionally, the turn radius at high speeds may make the floor more of a threat than the Bandit. Conversely, if converting from low to high, purely in the vertical, an airspeed closer to 500 KCAS is desired. Starting at this airspeed, using target G, the fighter will easily be slowing through 400 knots in less than 90° of turn. The closer to co-altitude with the Bandit, the closer the desired airspeed is to 400 KCAS.

4.31. HABFM Setups. Butterfly setups will be executed IAW the squadron standards and/or IFF Playbook. The goal of "canned" high-aspect setups, especially early in IFF, is to introduce HABFM execution in a more predictable engagement. On subsequent missions, the student will be given the opportunity to evaluate the tactical situation and make a decision prior to the check away regarding planned merge geometry. Flying the proper setup mechanics will allow the fighter to arrive at the merge in a position of advantage. The Bandit will not allow the fighter an ideal lead turn to a stern conversion. Instead, the Bandit will allow the student some amount of TR depending on mission and engagement circumstances. Additionally, the Bandit will not typically maneuver until the fighter has reached their 3/9 line. Refer to **Figure 4.29**. The fighter should strive to cross through the Bandit's CZ (Fighter 2) with airspeed between instantaneous corner and sustained-rate velocity (380-420 KCAS). If the fighter crosses inside the Bandit's turn radius (Fighter 1), he will allow the Bandit the opportunity for a reversal and give up the advantage gained in the lead turn. If the fighter merges too far behind the Bandit (Fighter 3), range will build and increase the time and fuel required to kill the Bandit. Additionally, this could allow the Bandit to capitalize on a separation opportunity.

Table 4.2. HABFM Starting Parameters.

	Range	Airspeed (KCAS)		Altitude	Aspect
		Offender	Defender		
HA Check Away	4000 ft ± 10%	415 ± 10	415 ± 10	± 300 ft	90º ± 5º
HA Turn In	-	415 ± 10	415 ± 10	-	-

Figure 4.29. Merge Objective.

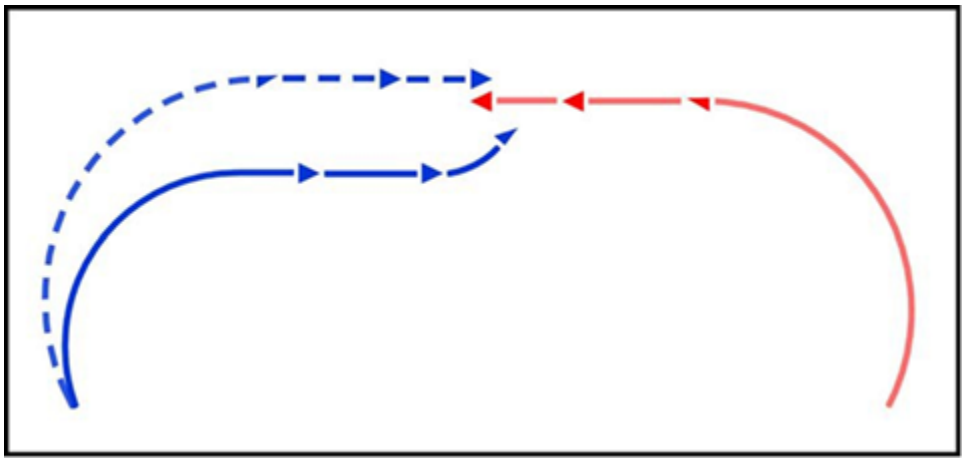


4.31.1. Prior to the Check Away. Determine whether vertical TR will be necessary above or below the Bandit. There are several factors that will affect the HABFM game plan selection of whether to use a high-to-low or low-to-high conversion. However, the most important and therefore overriding factor is ease of tally for the fighter and attempting to deny the Bandit the tally. Use the environment to your advantage. Placing the Bandit between you and a cloud layer will vastly improve your ability to keep the tally. Likewise, placing yourself between the Bandit and the sun will make his job much harder.

4.31.2. Check Away. Select military power and begin a 30° turn away from the Bandit. While modulating power as required and maintaining awareness of the Bandit, begin to build vertical TR with a climb or descent and apply a cross-check with increasing attention to the Bandit as the aircraft diverge. Monitor airspeed in the climb or descent to achieve briefed game plan. If approaching the limits of visual acuity prior to the "*Fight's on*" begin to turn as directed or briefed to maintain the visual and call "*Padlocked*".

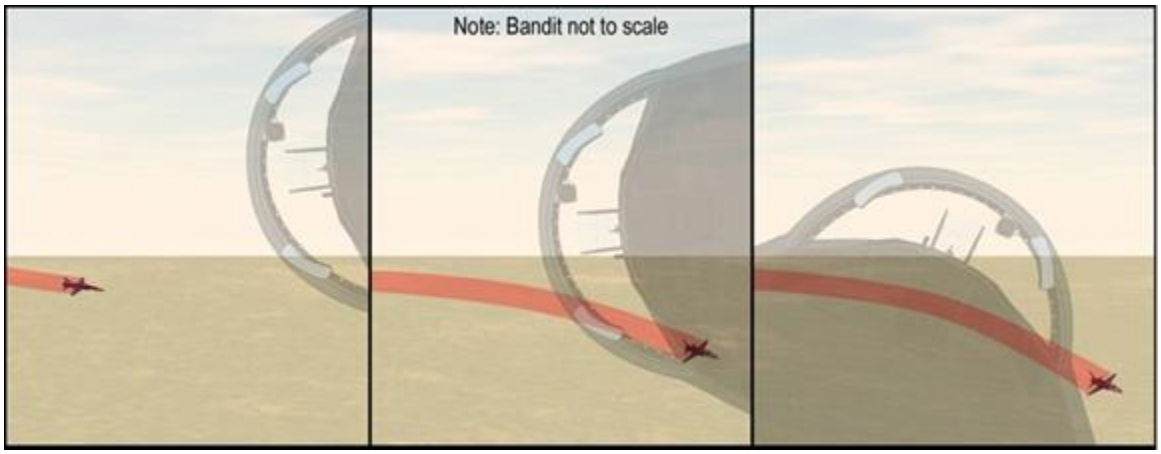
4.31.3. At the "*Turn in, fight's on*". The best way to achieve the merge objective is to build in a combination of vertical and lateral TR prior to the lead turn. This combination of vertical and lateral TR will then be used in the lead turn to decrease HCA and fly to the merge objective. This will require a max performance energy depleting turn. The objective is to turn inside the Bandit's TC to point at his CZ (**Figure 4.30**.). If the fighter floats to the outside, there won't be enough time or range to gain TR prior to the merge. During the turn, AGSM is a priority to maintain the tally. The fighter will be looking at a T-38 rotating towards pure pursuit more than 2 NM away. If the pilot is not padlocked on the Bandit, the tally will be lost. ***Do not look in the cockpit during the turn in***. The fighter's second priority is a max performance turn that gains lateral TR and doesn't use up too much of the vertical TR already gained.

Figure 4.30. Get to the Inside at the Turn In.



4.31.4. High-to-Low Turn in Mechanics. Start the AGSM, set throttles to MAX afterburner, stare at the Bandit while over rotating the LV, and begin a max allowable G pull. As the nose drops towards the horizon, reset the LV closer to the horizon to preserve vertical TR. Continue the turn, pulling the Bandit across the aircraft's nose for approximately two seconds (**Figure 4.31**.). The Bandit may momentarily pass out of sight as they pass under the nose. Regardless, continue to pull the Bandit across the nose and aim your gun cross towards the Bandit's CZ. Consider rolling past wings level into the Bandit to aid in tally maintenance and Bandit assessment. The goal now is to manage energy and assess LOSR cues for initiating the lead turn. Even after a well-executed turn in, there won't be longer than one to two seconds prior to executing the lead turn. Power placement will depend on current airspeed and vertical displacement relative to the Bandit. However, as a default, leaving the power in MAX afterburner is usually warranted. Reference the energy atom discussion (**paragraph 4.30.4**) for desired airspeed based on the ratio of lateral to vertical TR available. Generally, 350 to 400 KCAS is a good target airspeed for the lead turn. There will be little more than just enough time for one quick BFM cross-check in the HUD prior to starting the lead turn.

Figure 4.31. High-to-Low Turn In.



4.31.5. Low-to-High Turn In Mechanics. Start the AGSM, select power as required, and set the LV to bring the nose up to the Bandit's low CZ. For the turn in, blend the G into the SRB

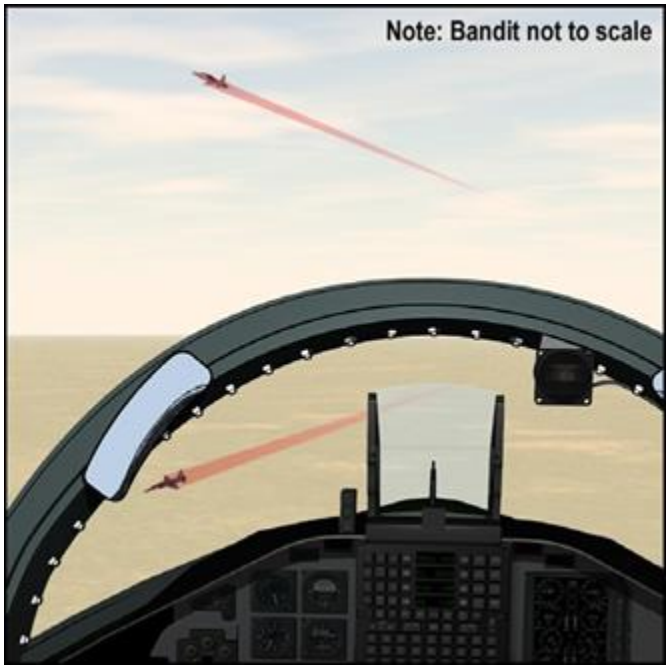
or moderate buffet, whichever occurs first. As a default, select MAX afterburner during the pull. However, if the SRB is encountered with little to no buffet, sustain the SRB and delay increasing power. Similar to the turn in for a high-to-low conversion, pull the Bandit across the nose aiming to put the gun cross in the Bandit's low CZ. This time the Bandit will be above the fighter and tally maintenance will be easier. Given a max performance turn in, it will be necessary to gain airspeed. Leave the throttles in MAX as a default and if circumstances allow cross-check parameters (with the Bandit against a blue-sky background, it won't be possible). Depending on how quickly the game plan airspeed is approached it may be necessary to reduce power. Attempt to have 420 to 450 KCAS for a typical low-to-high conversion. Use caution for the floor. Depending on altitude at the check away and descent rate prior to the turn in, the fighter may have to adjust LV before or during the turn in to stay above the floor.

4.32. Lead Turn. Lead turn keys to success are continuous Bandit assessment, LV placement, and turn performance.

4.32.1. Lead Turn Cues. A rapidly increasing LOSR aft is the cue to start the lead turn. For a right-to-right pass, the Bandit will swing from approximately 1 to 2 o'clock (**Figure 4.32**.). The most common error is a late lead turn. If in doubt, start the lead turn early; however, do not to turn in front of the Bandit.

4.32.2. Lead Turn Assessment. If the lead turn is started late, nothing can be done immediately to correct it; a BFM problem has been created that will need to be solved later. If the lead turn is started early, the LOSR will slow down or freeze on the canopy. In this case, ease off the G momentarily to let the LOSR increase again.

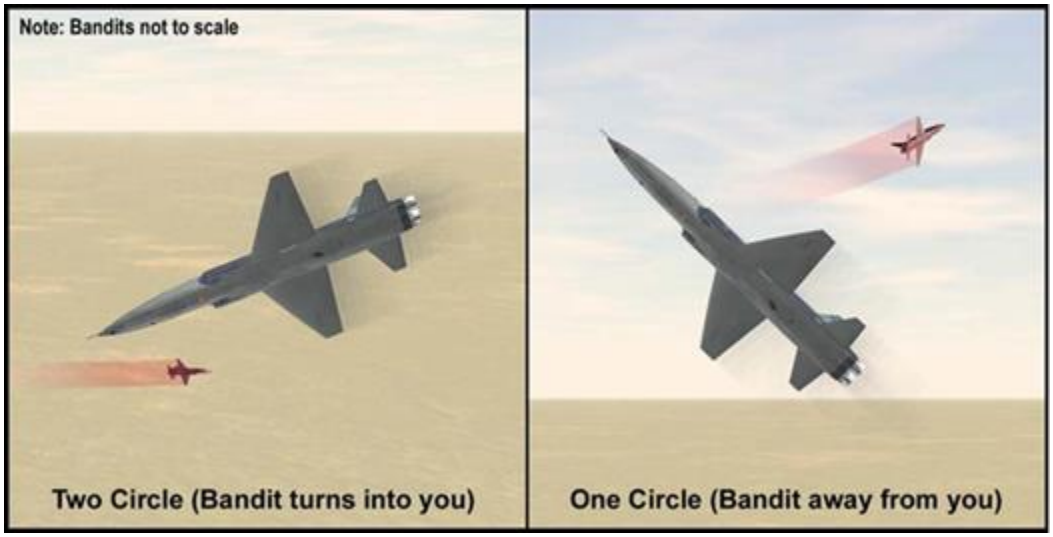
Figure 4.32. Lead Turn Cues.



4.32.3. Bandit Turn Direction. While in the lead turn, the fighter must develop a gameplan by evaluating the Bandit's gameplan. The Bandit will be the last to turn and therefore will determine whether the fighter initially enters a one or two-circle fight. If, as the Bandit's 3/9

is crossed, they turn into the fighter, they have established a two-circle fight. On the other hand, if he turns away, the fighter will be in a one-circle fight. Early recognition of the fight the Bandit has set will be critical to achieve the quickest kill. **Figure 4.33** illustrates the cues to identify a two-circle and one-circle fight respectively.

Figure 4.33. Bandit Turn Direction.



4.33. Post-Merge Two-Circle Fight.

4.33.1. Game Plan. The game plan in HABFM is to gain TR, execute an effective lead turn, transition to a sustained-rate fight, align TCs, and kill.

4.33.2. Merge Assessment. A two-circle fight (when both fighters turn toward each other at the merge and continue) is primarily a rate fight where the fighter with the better rate over time gains an offensive advantage. At the completion of the lead turn, readjust LV slightly below the Bandit and sustain the best rate airspeed the Bandit will allow. Immediately assess position in relation to the Bandit. A good check point for this assessment is the 180° point in the turn. This point is when the two aircraft are the furthest apart and may present WEZ opportunities.

4.33.3. Transition to the Rate Fight. Post-merge mechanics will vary depending on the Bandit maneuvering. Regardless of merge geometry, maneuver to gain the sustained-rate airspeed between 380 to 420 KCAS.

4.33.3.1. High-to-Low Conversion. Continue the max performance pull of the lead turn and adjust LV and power to achieve sustained-rate airspeed between 380 and 420 KCAS. If accelerating to or through the target sustained-rate airspeed, reduce power and/or the LV to get closer to the G warmup picture then return to MAX. If the lead turn LV was closer to the horizon, the required LV change will probably be small, and power may be left in afterburner (AB).

4.33.3.2. Low-to-High Conversion. If the Bandit turns into the fighter as they're crossing through the Bandit's CZ, the fighter's nose will likely be above the horizon and airspeed will be decreasing. The longer this continues to happen, the more difficult it will be to transition to the rate game plan. Timely assessment of the Bandit's turn into the fighter and subsequent rapid repo of the LV lower are critical to success. The instant a developing two-

circle fight is perceived, the fighter must move their LV to below the horizon and ensure the throttles are in MAX. How far below the horizon the LV is placed will depend on airspeed and the position of the Bandit. The further above the horizon the nose is and the slower the fighter is, the further below the horizon the LV should be (up to 60° initially). As the nose transitions through the horizon, update the LV. However, the fighter will need to use the vertical to recover airspeed while maintaining G. As the fight matures, capitalize on TC extensions to increase airspeed if required.

4.33.4. Energy Management. Given the limitation of the T-38 and rear aspect ordnance, the fighter must first realign TCs striving for the CZ to achieve a WEZ and subsequent kill. The fighter should have an angular and a power advantage throughout the fight. The use of TC extensions will help realign TCs. The average two-circle fight will require more than one extension. This will take time compared to offensive perch setups. Patience and a solid BFM cross-check to manage the LV for sustained energy are critical. Additionally, the fighter will hold a significant amount of Gs for an extended period of time, so an effective AGSM will be required to maintain the tally and correctly assess the Bandit.

4.33.5. Turn Circle Extensions (TCX). Achieving a nose position advantage and extending to the Bandit's TC becomes the fighter's next priority. TCX's will be required to bring the TCs closer together and allow the fighter to establish themselves in the CZ. Some axioms of TCXs include:

- Can only be used if the fighter is winning.
- Must happen at the correct time.
- Should be held long enough to pull the TCs towards each other, but not so long that range and HCA build excessively.

4.33.5.1. Winning Cues. LOSR towards the canopy bow, with aspect angle usually <90° is one cue. If AA is building significantly past 90° (the Bandit's nose is rotating towards the fighter) with LOSR towards the canopy bow, execute another lead turn. The fighter should continue the turn, prioritizing rate parameters to gain a rate advantage. Given typical merge geometry and Bandit cuffs, most of the time the fighter will quickly see winning cues.

4.33.5.2. When to Execute the TCX (**Figures 4.34 and 4.35**). The goal is to extend just inside the apex of the Bandit's TC. This is the quickest way to move the fighter's TC closer to the Bandit's. Extend too late (dotted line) and you will cut too far inside the Bandit's TC; if too early, then range will build significantly (dashed lines). With forward LOSR towards the canopy bow, the Bandit will appear to rotate (increasing aspect) as the fighter starts to point towards or slightly inside the apex of the Bandit's TC. A simple rule of thumb of extension direction is to pull the Bandit to the assessment window, assess AA and LOSR and then extend or continue to the second merge.

Figure 4.34. When to Extend Part 1.

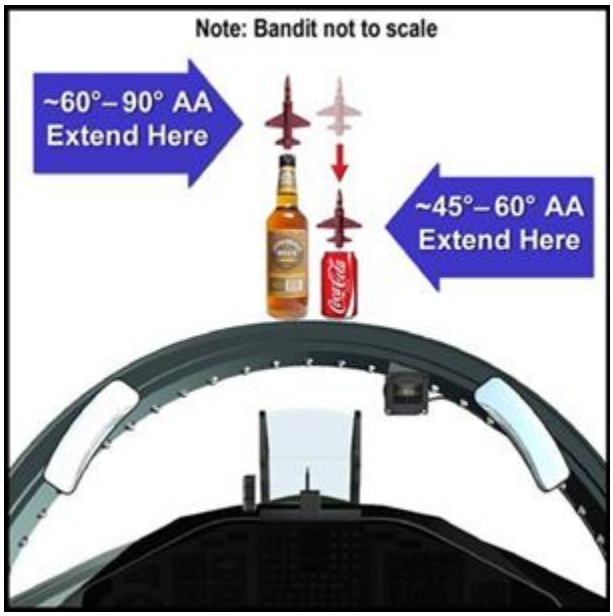
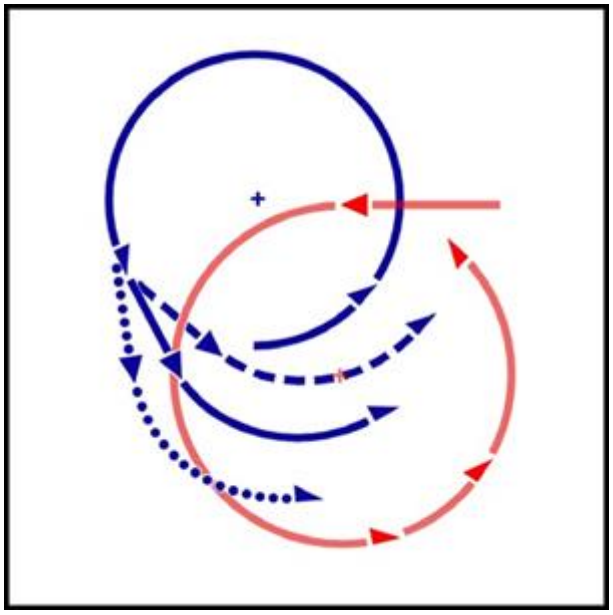


Figure 4.35. When to Extend Part 2.



4.33.5.3. TCX Mechanics. Pull the Bandit to the assessment window, ease off the G, and freeze the picture. Once LOSR aft develops, reapply G to the sustained turn rate. The ease normally lasts 2 to 3 seconds. Airspeed awareness prior to reapplying the G is essential. If sustaining target airspeed and G, the fighter will need to reduce power or climb during the extension to prevent getting fast. On the other hand, if slower than desired, leave the power in MAX and deliberately unload to accelerate during the extension. If the fighter doesn't extend for long enough and G is applied too soon, immediate LOSR towards the canopy bow will be seen; ease off again and let LOSR aft develop before "getting back on the pull". Remember, the merge objective and requirement to assess Bandit turn direction

applies to every merge. At subsequent merges, if the fighter erroneously crosses too close behind the Bandit, they may reverse and transition to a one-circle fight.

4.33.6. Transition to OBFM. Eventually, the range and aspect pictures will look similar to the canopy bow assessment from the OBFM phase. The amount of TR allowed, lead turn effectiveness, and energy management all factor into how long it will take (and how many TCXs) before the transition to recognizable OBFM "pictures" will happen. Depending on the above factors, the time required can vary from 500° of fighting to over 1,000°! It is likely the fighter will be near the floor before transitioning to OBFM. Remember that Ps=0 mechanics at the floor won't allow the same G as during the descending portion of the fight. To continue with a sustained-rate game plan the fighter will have to let G taper off slightly at the floor; the pilot will feel less buffet as they are further away from the lift limit line (**Figure 4.7**.). Be patient and be deliberate with BFM cross-check and Bandit assessment.

4.34. Post-Merge One-Circle Fight.

4.34.1. Game Plan. Once identified as a one-circle fight, the game plan is to transition to a min radius fight and lead turn the Bandit to align fuselages and kill.

4.34.2. Merge Assessment. A one-circle fight results when the fighters turn in opposite directions at the merge, but both aircraft's ground track is in the same direction.

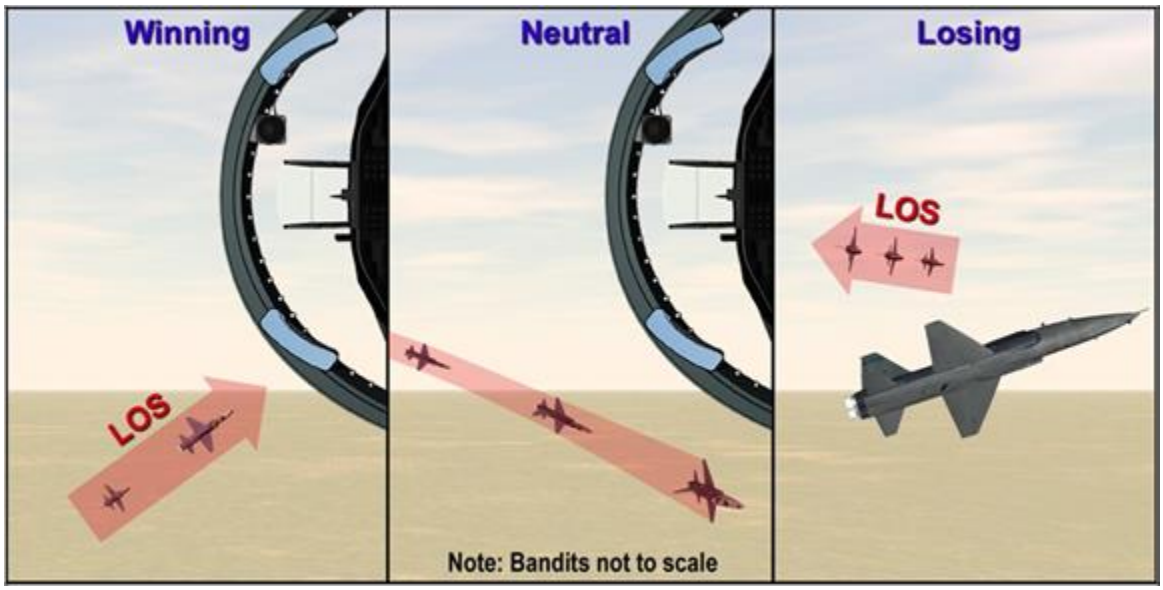
4.34.3. Transitioning to the Min Radius Fight. Post-merge mechanics will vary depending on if the fighter is merging from below or above the Bandit. Regardless of merge geometry, pull to the moderate buffet (or SRB, whichever occurs first).

4.34.3.1. Low to High. Given the fighter has the desired airspeed relative to merge geometry, leave the power in MAX and pull with POM on the Bandit. As the aircraft slows down, SRB will be replaced by buffet (assuming constant pull); the aircraft is transitioning from the G limit to the lift limit. Approaching 350 KCAS, radius will decrease as the aircraft slows. From 350 to approximately 250 KCAS the turn radius remains about the same. Below 250 KCAS, however, the turn radius opens back up again.

4.34.3.2. High to Low. If airspeed is high, immediately select IDLE power. As the aircraft's nose will be below the horizon, quickly reset the LV to get POM on to slightly above the Bandit (use caution if in the SRB). As the nose tracks to or above the horizon the aircraft should be slowing towards instantaneous corner; put the power back in MAX and continue a moderate buffet pull.

4.34.4. Bandit Assessment Across the Circle (**Figure 4.36**.). As the fighter and the Bandit are approximately co-heading across the circle from each other, the fighter should start to assess whether they are winning, neutral, or losing the min radius fight (**Figure 4.36**.). At the second merge, expect the fight to transition to a scissors, a two-circle (energy fight), or continue in a min radius fight.

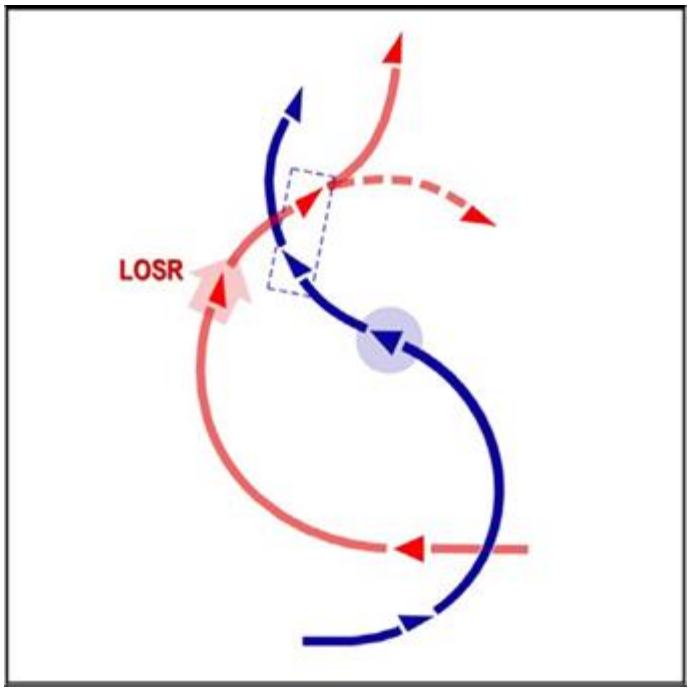
Figure 4.36. One-Circle Assessment.



4.34.4.1. Winning Cues. With AA stagnant or decreasing, LOSR forward will be seen beginning to develop. With winning cues, execute a lead turn to minimize HCA. Use LOSR towards and then across the nose as the cue to execute the lead turn. At this second merge, Bandit turn direction must be assessed as it was at the initial merge (dashed rectangle in **Figure 4.37**.).

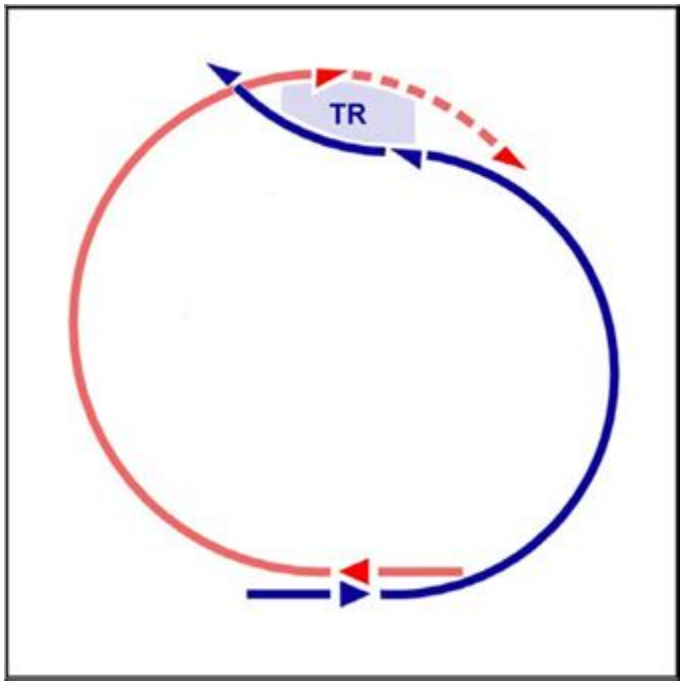
4.34.4.1.1. Scissors. If the Bandit reverses their turn (the solid red arrow in **Figure 4.37**), the fighter will transition to scissors. The game plan is to lead turn to align fuselages and slow down as required to gain weapons separation.

Figure 4.37. One-Circle – Winning.



4.34.4.1.2. Two-Circle Fight. If the Bandit continues their turn (with LV and nose dropping below the horizon), they are transitioning to an energy fight (dotted red line in). Use power as required and quickly reset the LV to below the horizon to get on the briefed rate fight game plan.

Figure 4.38. Use the Turning Room.



4.34.4.2. Neutral Cues. LOSR is forward, but Bandit aspect steadily increases towards pure approaching the nose. The LV may have to be changed as range decreases to ensure vertical deconfliction in a truly neutral second merge. With neutral cues, the fighter will end up in a second merge where neither aircraft possesses a significant advantage. The engagement could continue one-circle or transition into a two-circle fight. The last fighter to turn determines the fight. Do not be indecisive.

4.34.4.2.1. Approaching the Next Merge. ***If there is any lateral TR between you and the Bandit, use it; don't let the Bandit lead turn you!*** As seen in **Figure 4.38**, if the fighter continues the turn (solid blue line) the TR between them and the Bandit (green hashes) becomes exclusive TR for the Bandit. Instead, the fighter should use the TR (dotted blue line). While doing so, the fighter must assess Bandit turn direction and continue the min radius fight or transition to the two-circle fight.

4.34.4.2.2. Neutral Pass. In a completely neutral pass with no lateral TR, the last fighter to turn sets the fight. Again, don't be indecisive; however, take your energy state and nose position into consideration. At 350 KCAS or less, consider forcing a one-circle, min radius fight. If >350 knots or with the nose >~15° below the horizon, consider forcing a two-circle fight.

4.34.4.3. Losing Cues. The losing cues are LOSR is stagnant or aft with the Bandit's nose rotating towards pure. Typical BFM errors that cause this situation are a light G pull at the initial merge and poor LV control transitioning from a high-to-low conversion to the one-circle, min radius fight. If losing cues are assessed, make sure to be in a moderate buffet pull close to the lift limit line, and transition to DBFM if necessary. While executing the appropriate defense mechanics, continue to assess the Bandit for opportunities to reverse, neutralize, or separate. ***Never give up!***

Section 4E—Air Combat Maneuvering (ACM)

4.35. Introduction to ACM. ACM is a substantial leap from BFM in terms of employment. No longer is it a single-man concept where your only cross-check is the Bandit. Now the fighter must bring their element mate into their cross-check along with the normal Bandit assessment. ACM is the first mission where fighters employ as a team and attempt to maximize visual mutual support. Task prioritization now becomes an issue because the fighters are attempting to either kill or survive while maintaining element deconfliction. While it is the responsibility of each pilot to clear their own flightpath with all sensors available, the wingman carries the ***primary*** responsibility of element deconfliction. There are situations, however, when the wingman is not capable of adhering to their primary responsibility, and that responsibility needs to be transferred to the flight lead until the wingman is in a position to reassume his primary role. If deconfliction responsibility is disregarded or not shared appropriately, there can be disastrous consequences.

4.36. ACM Roles.

4.36.1. Engaged Fighter Versus Support Fighter. The term "engaged" is used to establish the engaged fighter role in an ACM engagement. Once established, the other fighter by default is the "support" fighter.

4.36.2. Establishing the Roles. Establishing the engaged and support roles is important in the visual arena because ***both fighters are maneuvering in relation to the Bandit*** to defensively

survive and offensively achieve a quick kill, while deconflicting within the element. The establishment of engaged and support roles can aid in ensuring element deconfliction by shifting the responsibility for deconfliction to the fighter in the best position to deconflict. Initially, before roles are established, it is the wingman's responsibility to deconflict with the flight lead. While both fighters are responsible for clearing their own flightpath, the support fighter has the ultimate responsibility for element deconfliction, allowing the engaged fighter to have the right of way. The bottom line is ***one Bandit equals one engaged fighter***.

4.36.3. Engaged Fighter Role and Responsibilities. The engaged fighter executes their best BFM to survive and kill the Bandit, regardless of status (defensive/offensive/neutral). In addition, the engaged fighter should strive to maintain tally and visual, if able.

4.36.4. Support Fighter Roles and Responsibilities. The support fighter's primary responsibility is to deconflict from the engaged fighter. To provide element deconfliction, the support fighter must stay visual throughout the fight, even at the expense of good BFM against the Bandit. The support fighter's secondary responsibility is to take shots of opportunity with a clear field of fire. The support fighter's tertiary responsibility is to clear the fight for other adversaries that are a factor to the element and to maintain overall element SA to include area orientation, fuel, and separation opportunities.

4.36.5. Establishing Roles. The key to positive role establishment is clear, concise, correct, and timely comm. Roles are established by an "*Engaged*" call from one fighter and a "*Press*" call acknowledgement by the other. The roles are not established without the "*Press*" call. It's important to note that the "*Engaged*" call is a request from number 2, and until the flight lead responds with a "*Press*" call, number 2's primary responsibility as the support fighter is to continue to deconflict. The hierarchy to determine who should be calling "*Engaged*" is as follows:

4.36.5.1. Most Defensive. The fighter upon whom the Bandit has focused the offensive attack should call "*Engaged*", or a defensive fighter whose immediate priority is focused on survival instead of deconfliction should call "*Engaged*".

4.36.5.2. Most Offensive. With the element being offensive, the most offensive fighter should call "*Engaged*". The most offensive is:

- The only fighter with a tallyho. If both fighters have a tallyho; then…
- The fighter with the most offensive entry (will have offensive angles). If not clear, whoever has the most offensive entry; then…
- The first to merge with the Bandit.

4.36.5.3. Flight Lead. If a maneuvering fight is developing, and no roles have been established, the flight lead should declare "*Engaged*". If there is any confusion, the wingman continues to deconflict until roles are confirmed.

4.36.5.4. Directing the Wingman to Engage. The flight lead can direct the wingman to call "*Engaged*" with a "*Press*" call. In this example, the wingman should be engaged but has not called it. The flight lead calls, "*Eagle 2, press*". The wingman responds with, "*Eagle 2's engaged*". The role swap has now officially occurred, and Eagle 2 is the engaged fighter with Eagle 1 providing deconfliction as the support fighter.

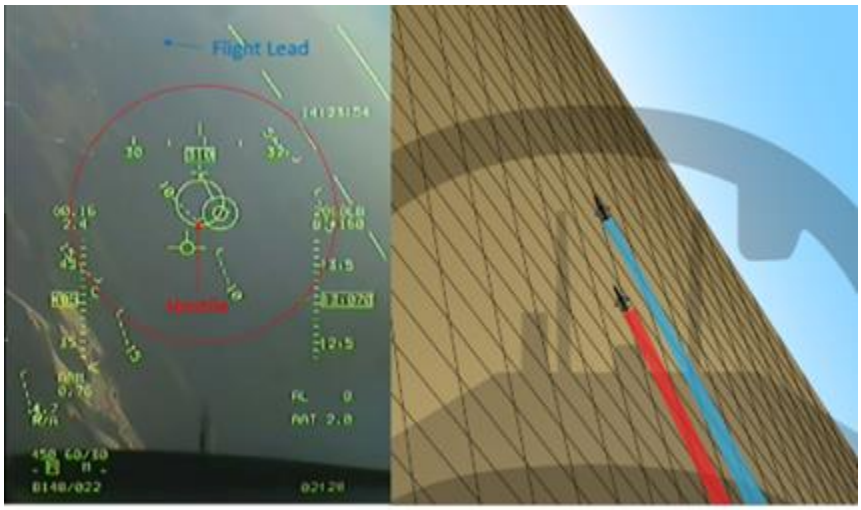
4.36.6. Engaged and Support Role Changes. Once roles have been established, the element should strive not to change the engaged/support roles unless absolutely necessary (unnecessary communications and possible confusion). The driving factor to force a role swap is the support fighter's inability to "survive/kill" while continuing to deconflict. The following are examples of when the role exchange would be required.

4.36.6.1. Engaged Fighter Is Offensive/Neutral. The support fighter does not require permission to employ ordnance if flightpath and weapons deconfliction can be maintained. Shots should always be communicated. If the support fighter cannot employ ordnance and deconflict, call "*Engaged*". Consideration should be given to not calling the engaged fighter out of an offensive position for a fleeting missile WEZ. If the engaged fighter is neutral or stagnated in an offensive position and the support fighter has a better entry into the CZ and gun WEZ, the support fighter should call "*Engaged*" to initiate and request the role exchange. The support fighter will maintain deconfliction until the role swap has occurred through a "*Press*" call. (See **paragraph 4.37** for detailed discussion on ACM communication. The support fighter should call "*Engaged*" prior to maneuvering the aircraft into a position where there is a potential flightpath conflict.

4.36.6.2. Support Fighter Becomes Defensive. The Bandit could elect to switch fighters at any time. The roles should swap when the support fighter becomes defensive and can no longer defend and deconflict. This will require communications for the swap to be complete. Until the role swap has occurred, however, the support fighter's primary job is maintaining element deconfliction, even when defensive.

4.36.6.3. Weapons Employment and Deconfliction (**Figure 4.39**.). After the support fighter has maneuvered his aircraft to a position where he can maintain deconfliction, he should start looking for shots of opportunity with a clear field of fire (CFOF). Different A/A weapons have different weapon deconfliction requirements. For the T- 38C AIM-9 (to include the P+) to meet weapons deconfliction, the other blue fighter can't be within a 10° FOV at pickle for the entire time of flight (TOF) of the missile. A 10° FOV can be simulated by an area inside the airspeed, altitude, and heading bars on the HUD. If the other blue fighter is or will be in that region at pickle through missile impact, CFOF has not been satisfied and the shot should not be taken. Missile TOF can be simulated by the following rule of thumb (ROT): 6 seconds per NM with a tail aspect, 4 seconds per NM in the beam, and 2 seconds per NM with an H aspect. If the engaged fighter calls "*Defensive*" at any point in time, or if the support fighter determines the engaged fighter is defensive, weapons deconfliction may be relaxed but not entirely discarded. The track of the missile is still the responsibility of the shooter, but a much smaller CFOF may be acceptable if the engaged fighter is in danger of being killed in a short period of time. Example: If a fighter is defensive at ground level, out of energy and ideas, with a Bandit stuck at 6 o'clock and 1,000 feet, the situation is a bit more pressing.

Figure 4.39. Weapons Deconfliction Zone.



Deconflict by keeping the blue fighter outside of the red circle shown in this HUD field of view

4.37. ACM Communications.

4.37.1. Standard Communication. Pilots must use standard terminology in order to avoid confusion, enhance SA, and minimize excessive radio transmission time. Nonstandard radio terminology, lack of call signs, and excessive communication can cause confusion and misunderstanding at a critical time. Use a separate radio to the maximum extent possible for ACM communication.

4.37.2. Categories. There are four categories of communication words that apply to ACM: engaged/support, directive, descriptive, and informative. This discussion is presented in terms of an engaged element.

4.37.2.1. Engaged/Support Communication:

4.37.2.1.1. "*Engaged*". The fight member is informing the element of the intent to take the engaged fighter role. From the wingman, it is a request for the engaged fighter role. In either case, a response is required. If it will enhance SA, include a descriptive term: "*Eagle 1, engaged, defensive*".

4.37.2.1.2. "*Press*". A response to an "*Engaged*" call that confirms the flight member who called "*Engaged*" is the engaged fighter. The member who called "*Press*" is the support fighter. This is the only acceptable response from a wingman when the flight lead calls "*Engaged*" unless the wingman is blind or will go defensive and die. Roles are established or swapped.

4.37.2.1.3. "*Unable*". A response to an "*Engaged*" call indicating the engaged fighter is unable to disengage or pick up the support role without going defensive or dying. This communication usually includes a descriptive term stating the reason. "*Eagle 2, unable, defensive/blind*". Roles are not swapped.

4.37.2.1.4. "*Negative*". A flight lead's only response which simply means "*No*". The flight lead, based on inherent authority, is unwilling to allow the wingman to become the engaged fighter. Roles are not swapped.

4.37.2.1.5. "*Continue*". Mainly reserved for flight leads if there is requisite SA to maintain deconfliction without being tally/visual. Geographic and or vertical separation must exist, most commonly confirmed with comm. "*Bandit switched, Eagle 2's engaged, 1 circle to the North, climbing through 15K*". "*Eagle 2, continue*".

4.37.2.2. Directive Communication. Directive communication tells the other fighter in the element to do something. Used to maneuver the element in the most advantageous manner to survive or engage the threat. When using directive communication, preface the call with the call sign of the flight member to act. For example, a wingman who visually detects a Bandit approaching weapons parameters from the flight lead's right side would say, "*Eagle 1, break right*". Examples of directive terms are:

- *Break* (with direction): a maximum performance, energy depleting turn with flares
- *Hard* (with direction): a maximum power sustained performance turn
- *Flare*
- *Separate* (with direction)
- *Jink*
- *Reference* (with direction)

4.37.2.3. Descriptive Communication. Descriptive communication informs the other fighters where to look or what they may see. After initiating a reaction with directive communication, fill in with descriptive commentary, as required to coordinate between involved fighters. Descriptive commentary is normally prefaced with the call sign of the flight member being addressed. For example, Eagle 2 says: "*Eagle 1, bandit, right 3 o'clock, 2 miles, low.*" The following are additional descriptive items as the situation requires:

- Type aircraft or threat identification
- Left or right (side of aircraft)
- Clock position
- Range
- High/level/low
- Amplifying remarks

4.37.2.4. Informative SA Building Communication. Additional examples of descriptive communication that informs the other flight members of intentions include "*Eagle 2...*":

- "*offensive/defensive*"
- "*anchored*"
- "*in/out*"
- "*bandit switch*"
- "*split*"
- "*Fox 2*"

4.37.2.5. Plain English. While communication discipline is of extremely high importance in the air combat arena, killing the Bandit in minimum time while ensuring blue force deconfliction is paramount. If undecided what to say, revert to plain English to convey intentions to the other fighter.

4.38. ACM Execution Based on Attack/Detection Quadrant. The following sections address element ACM execution when committed to a merge. The requirement to enter the ACM environment could occur at the end of an intercept or in the post-merge arena. Execution mechanics will address response based on threat detection from visual detection, traffic collision avoidance system (TCAS), or AWACS/GCI. The principles of ACM are:

- Detect the threat.
- Engage:
  - Direct an initial move to defeat any initial attack.
  - Maintain element mutual support by establishing roles.
  - Best BFM to kill and survive.
- Separate with visual mutual support.

4.38.1. Threat Detection. To prosecute and defeat a short-range attack, the threat must first be detected. Detecting threats is a continuous effort. Element members must clear the area around their flight for new threats and multi-quadrant attacks. The complete attention of both element members cannot be focused on a single threat attacking them. The support fighter must be alert for additional threats. Detection can occur from a GCI point out, TCAS, or visually. To successfully prosecute and defeat a short-range attack, visual acquisition by at least one element member early in the initial move sequence is essential.

4.38.2. Target Detection. Once the decision to engage has been made, the element needs to effectively communicate, sanitize for other threats, and arrive in the visual arena with an offensive advantage. As a minimum, be able to get the tallyho and have immediate weapons opportunity at the merge. If the pilot with the initial detection is expecting to merge with a Bandit, the other fighter needs to quickly know where to visually search as well as where to position the aircraft.

4.38.3. Initial Communications at Visual Pickup. The fighter who initially detects the threat needs to base their initial radio transmission on the Bandit's proximity to a WEZ. Communicate with the appropriate AFTTP 3-1.1 brevity terms to state the Bandit's location. If the Bandit appears unaware, depending on the mission, the initial call may just be descriptive to point out the threat: "*Eagle 2, tally one, BRA 260, 2, cold*". If the intent is to get the flight turning toward a Bandit who is not in a WEZ (due to range or nose position) then a hard turn should be called by the flight lead: "*Eagle hard right*". If the Bandit is in or approaching a WEZ the first radio transmission needs to be geared toward ensuring the survival of the flight: "*Eagle 1, break right*". The first priority is directive calls to ensure flight survival, followed by descriptive calls to allow the other flight member to get a tallyho. As a general ROT, all visual pickups with an aspect >90° should be assumed to be approaching a WEZ and consideration should be given to "*Break*" turns versus "*Hard*" turns to engage.

4.38.4. Formation. The element should attempt a bracket with both vertical and lateral offset to maximize split-plane maneuvering to deny the Bandit "Tally 2". The objective is to intercept the Bandit from two distinct sides, force the Bandit to turn, providing one fighter a shot/kill opportunity. Both fighters should maneuver for TR. If the Bandit maneuvers to flank or beam the element, it may be impossible to execute a bracket attack and should transition to a single-side offset (SSO) intercept with vertical offset. If intercepting from a SSO, the non-tally fighter should take spacing and establish a 1- to 1.5-NM lateral and 2000-3,000 feet of vertical separation. Vertical spacing should be in relation to the Bandit. This ensures TR and weapons

separation at the merge while preventing the Bandit from visually acquiring both fighters. The element should be in a position that if the Bandit survives to the merge, the ACM roles can then be defined, and visual maneuvering will result in a quick kill of the Bandit.

4.39. Visual Pickup in the Front Quarter.

4.39.1. High-Aspect Bracket Game Plan. The element should attempt a bracket with both vertical and lateral offset to maximize split-plane maneuvering to deny the Bandit "Tally 2". The objective is to intercept the Bandit from two distinct sides, denying the ability to defend against both fighters, and giving one fighter a shot opportunity. See **Figure 4.40** for an example of the merge flow. Both fighters should maneuver for TR if able and force the Bandit to pass between the aircraft in the element. The engaged fighter (the flight lead or whoever the Bandit is leaning on) should execute the merge prep checklist and strive to arrive at the merge in an offensive position. The support fighter should float his formation out to visual limits with a vertical stack off the horizon to deny the Bandit "Tally 2" (the desired formation is a 1- to 1.5-NM lateral and 2,000- to 3,000-foot vertical separation) to achieve TR and weapons separation. The support fighter should then turn towards the fight and prepare to take a quick shot with weapons deconfliction once the identification (ID) is made. A common description of this event is "filming the merge" because of the opportunity that exists for the wingman to have the Bandit in the HUD at the time of ID (due to the geometry of the intercept) (**Figure 4.41**.). In this case, the fighter without the tally (default to the wingman) should pick up a formation position that will allow shot at the merge.

Figure 4.40. High-Aspect Bracket.

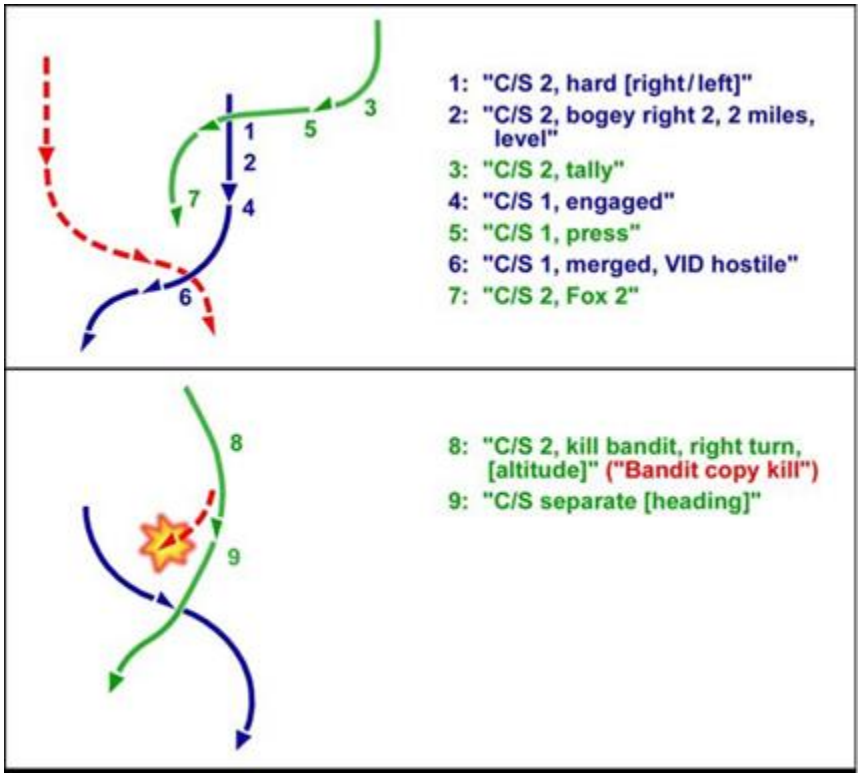
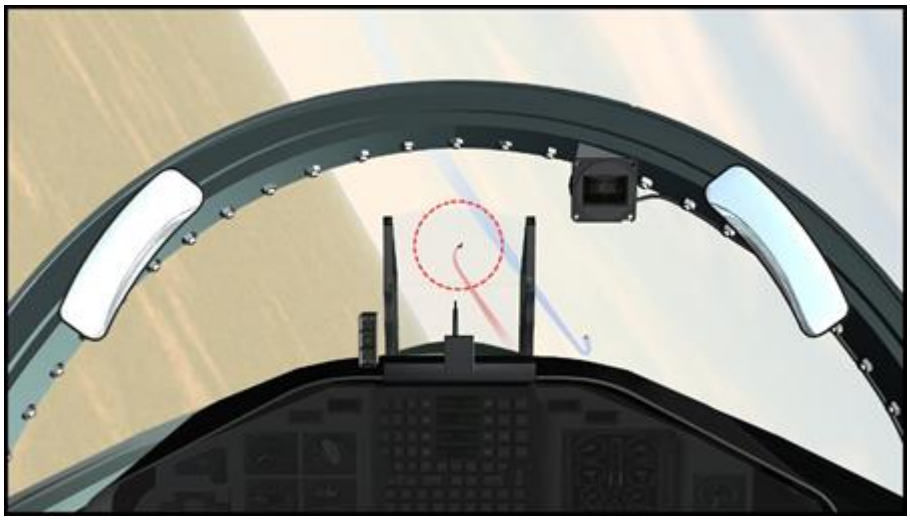


Figure 4.41. Filming the Merge.



4.39.2. Establishing Engaged and Support Roles. Just prior to the merge (turning is about to begin), the element should establish the engaged and support roles. Since neither fighter is defensive, the most offensive fighter should call "*Engaged*". This would be the only fighter with the tallyho. If both have tallyho, then the fighter with the most "offensive entry," will call "*Engaged*". If neither fighter clearly has an offensive advantage (significant lead turn), then maintain the element deconfliction contract and assess Bandit actions. The Bandit's choice on whom to turn with should determine the resulting engaged or support roles. If the wingman is unsure, then lean forward with an "*Engaged*" call, and the flight lead can easily veto with "*Negative, Eagle 1 engaged*".

4.39.3. Merge. When merging with a Bandit, the appropriate fighter should always make a "*Merged*" call if the flight has visual mutual support (VMS). This should help to get the other fighter's eyes on the Bandit and ensure both fighters see the same Bandit.

4.39.4. Visual Identification (VID). If a VID is being accomplished and all ROE have been met, make the call in the following format: "*Eagle 1, VID* (ID ROE), (TYPE AIRCRAFT as required)". The merge and VID call may be combined to reduce excessive comm. Example: "*Eagle 1 merged, VID, hostile* (*FLANKER*)".

4.39.5. Quick Kill or No Turn at Merge. With effective communications, formation, intercept, and ID, the fight should be over at the merge with a quick missile kill. The support fighter should have weapons separation prior to the merge and be in a position to shoot once the ROE and weapons deconfliction criteria have been met. If this is not accomplished and/or the flight lead does not want the element to turn at the merge, this should be communicated as soon as possible with a radio call.

4.39.6. Engaged Fighter Turning at the Merge. The engaged fighter should turn to execute the best BFM to kill the Bandit. This will also make the Bandit somewhat predictable. Typically, one-circle fights put more pressure on an adversary than two-circle fights. One-circle fights force the Bandit to get anchored and low on energy, allowing for an unobserved rear-hemisphere WEZ entry by the support fighter.

4.39.7. Status Calls. If unsure of which aircraft is which, the support fighter should query with a radio call: "*Eagle 1, status high/low*". "*High/low*" can be substituted with whatever the support fighter sees or makes sense from his angle. Other acceptable description fill-ins may be "*Nose high/low, right/left side, left/right turn*". Cardinal directions and headings should be avoided because it requires head's down time by both fighters. Eagle 1 at this point should be as descriptive as possible and always tell the status in response to what was asked, and then any other SA enhancing parameters of Eagle 1's aircraft. As an example, "*Eagle 1 is high man, offensive*".

4.39.8. Kill Calls. The shooter should use the ROT as mentioned earlier for missile TOF before making a kill call. Kill calls should be as descriptive as possible. Example: "*Eagle 2, kill bandit, right hand turn, 14K feet, nose low*". The shooter should ensure the Bandit acknowledges the kill, "*Bandit, copy kill*", while directing the separation.

4.39.9. Separations. Once a kill is achieved, execute a separation. The support fighter is primarily responsible for directing the separation since his tertiary responsibility is to gain SA on the battlefield. The support fighter needs to assess the energy states of both fighters to give a separate heading that will put them close to LAB. As a general ROT, the separation direction should be limited to less than 90° from the current flow. This will ensure that both fighters will be banked up for a limited amount of time, thereby decreasing the possibility of another Bandit picking up the tally. It also allows the fighters to get to a VMS formation quickly so that the coordinated sensor ops game plan can be reestablished in a timely fashion. Power should be MAX, and the jet should be unloaded to 0.5 G. This gets the formation back to an acceptable energy state and gets the formation low to decrease possible WEZ's from other Bandits.

4.40. Visual Pickup in the Beam.

4.40.1. Shooter-Eye Game Plan. The element should position itself to engage as described in visual pickup in the front quarter. As stated earlier, if it was a visual pickup, assume the Bandit is approaching a WEZ. The fighter who picked up the Tally should direct the formation towards the Bandit with a break turn. If a "*Tally*" from the defensive fighter is not immediately forthcoming, whichever fighter called the break should follow quickly with directive and descriptive communication to prevent the other fighter from breaking so far as to go belly-up to the Bandit. If both fighters see the Bandit, the closest fighter to the Bandit should call "*Engaged*" and press an attack on the Bandit since they will be the first to merge. The initial break turn will likely drive the fighters into a trail formation from which the trail and outside fighter should have weapons separation and a shot opportunity if the Bandit engages the lead fighter.

4.40.2. Merge. As stated above, the inside fighter is best suited to be the engaged fighter (first to merge). Lack of proper VID may force a merge before any T-38Cs can shoot. Whether or not the engaged fighter turns immediately at the merge depends on whether trailers are suspected. Regardless, the first to merge should call the VID. Turning at the merge will immediately put pressure on the Bandit and will facilitate a quick exit of the trailing fighter's field of fire (depending on what the Bandit does). This will present a quicker shot opportunity to the trailing fighter and allow offensive angles by the engaged fighter if the Bandit extends to merge with the support fighter. Regardless of which fighter merges and engages with the Bandit, they should still execute merge prep and be prepared to fight their best 1v1 BFM with the game plan of anchoring the Bandit single-circle if the merge geometry allows.

4.40.3. Bandit Turns with the Lead Fighter. If the Bandit turns on the first fighter to enter the merge, the trailing fighter should have an easy shot opportunity and an offensive entry. The trailing fighter should ensure weapons deconfliction and shoot if in a WEZ. If required to enter a gun WEZ, the support fighter (the trailing aircraft) can subsequently initiate or request an exchange of roles by calling "*Engaged*". See **Figure 4.42** for an example of the fight flow.

4.40.4. Bandit Extends to the Trail Fighter. The Bandit also has the option to blow through the first merge and switch to the trail fighter if "*Tally 2*". The first to assess this should call out "*Bandit switch*" with your callsign and expect a role swap will logically ensue. This will allow the engaged fighter (first to merge) to rapidly gain an angular advantage on the Bandit. In either case the element should be able to achieve a quick kill. See **Figure 4.43** for an example of the fight flow.

4.41. Visual Pickup in the Stern. Despite tremendous advances in all-aspect weaponry, the stern quadrant is still the flight's most vulnerable cone. First, the fighter will have no shot opportunity until nearly 180° of turn—an expenditure of time and energy. Second, in a stern attack, the Bandit may continue firing ordnance until forced out of 6 o'clock. Unlike a beam or head-on attack, reduced closure will allow the Bandit to remain in firing parameters for a longer period. Both fighters can greatly increase their probability of post-merge survival by keeping their speed up, descending to lower altitudes (SA and threat permitting), and maintaining optimal tactical formation. If possible, an altitude stack (1,000 to 3,000 feet, unless on the deck) and wider tactical formation (9,000 feet, plus) should be flown. A Bandit converting on two co-altitude, 6,000-foot spaced T-38s is presented with a much easier tally two (or four) opportunity. This section will cover element maneuvering against a threat that is initially detected in the flight's stern quadrant.

Figure 4.42. Bandit Turns with the Lead Fighter.

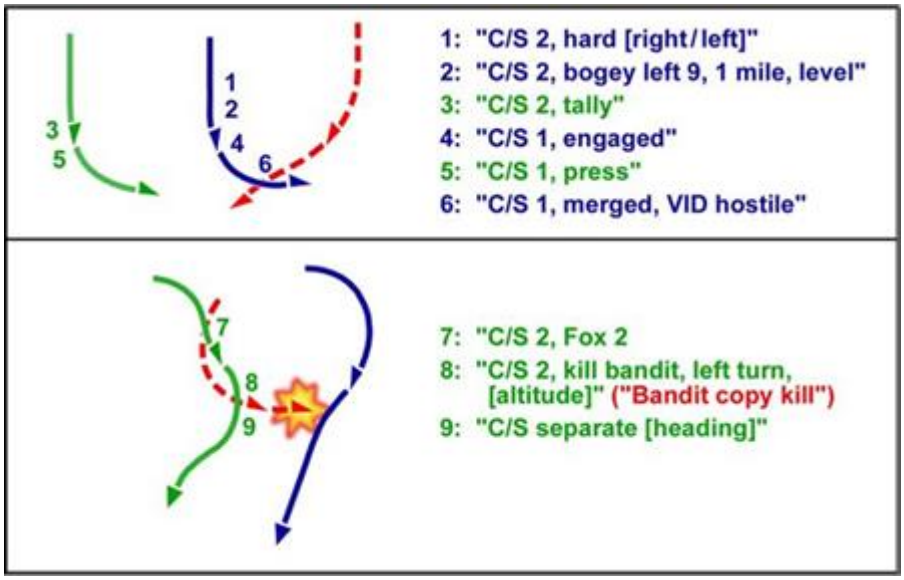
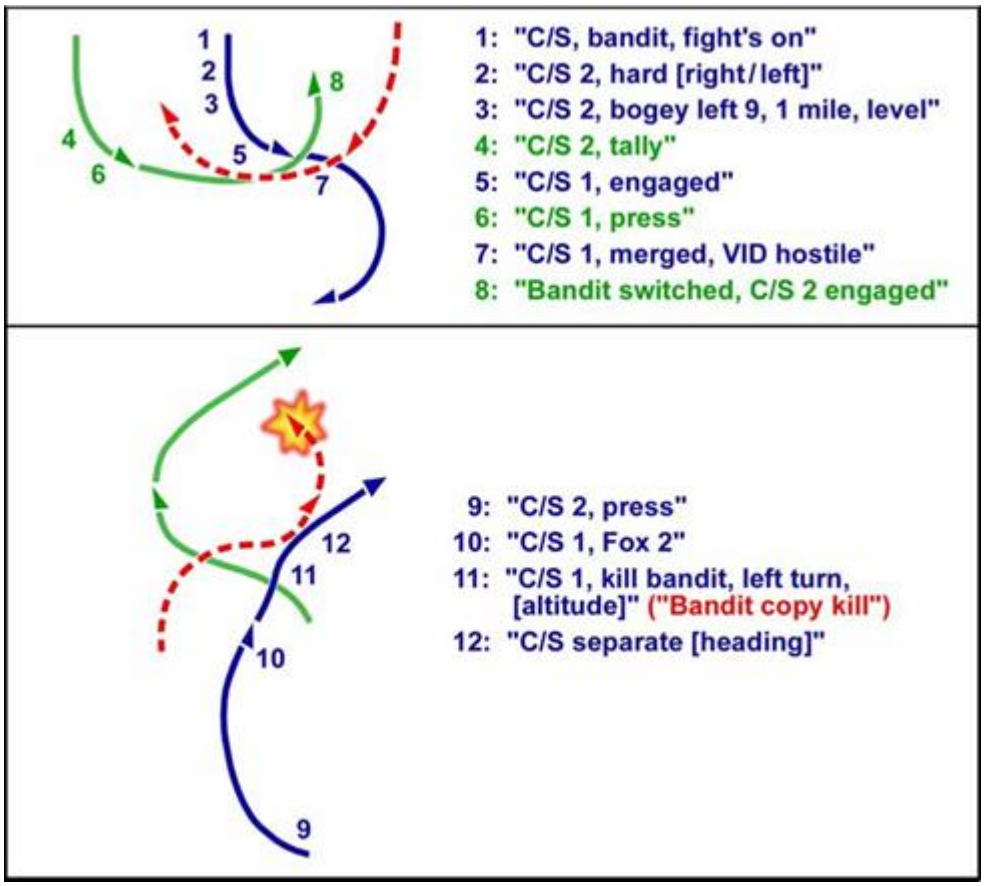


Figure 4.43. Bandit Extends to the Trail Fighter.



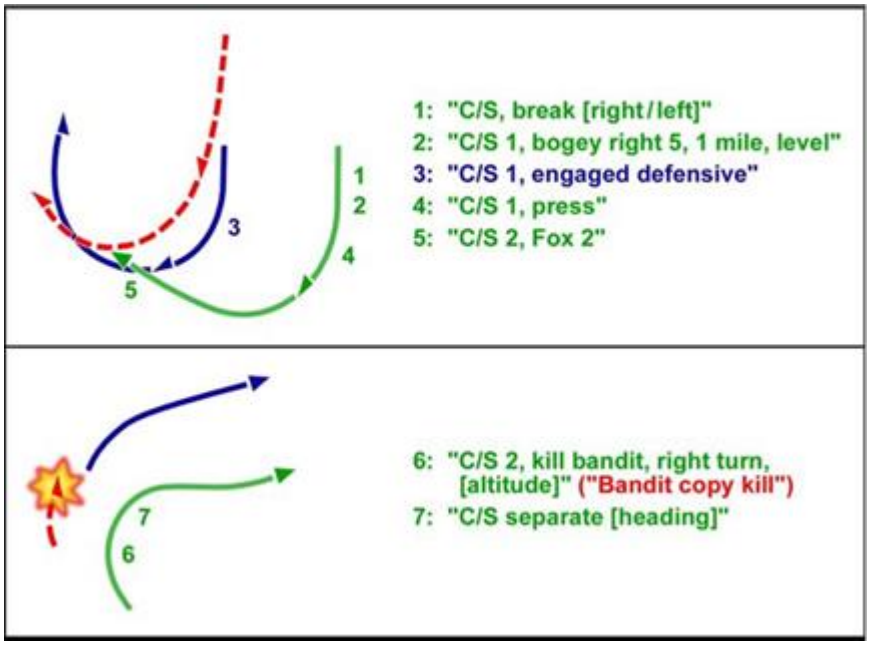
4.41.1. Initial Move. Bandit is assumed in a WEZ. With a Bandit in a WEZ, the first to gain tallyho should direct a break turn into the attacking Bandit. The break direction should always be called in the direction most advantageous for survival for the person being attacked. The formation should break in the direction of whomever the Bandit is lined up on. If the Bandit is attacking from significantly above or below the horizon (more than 30°), the fighter directing the break should include the terms "up" or "down" respectively: "*Eagle 1 break left and up*". The element should execute their best DBFM and infrared missile defense (IRMD) while continuing to deconflict from each other.

4.41.2. One Fighter Tally. The fighter with the tally must provide descriptive commentary to get the other pilot's eyes on the Bandit. This requires descriptive calls that isolate the Bandit in a portion of the other fighter's canopy and includes range. For example, if Eagle 2 were pointing out the threat to Eagle 1: "*Eagle 1, Bandit left 7 o'clock, 2 miles, level*". Communication is required to add SA if the Bandit is clearly attacking one eagle or the other: "*Eagle 1, Bandit lean on you*" or "*Eagle 2 engaged, defensive*". This way, the engaged and support roles are established even if only one fighter has tallyho.

4.41.3. Establishing Roles and Execution. Once it is clear who the Bandit is focusing the attack on, the "*Engaged/Press*" calls should be made to establish roles. To allow an effective energy state for maneuvering, the support fighter should immediately select full AB and consider a sustained energy turn as soon as the Bandit's nose is off.

4.41.3.1. No Switch. Optimal tactical formation discussed previously may limit the Bandit to see only one fighter. In this case, or due to a poor tactical decision, the Bandit may press the attack without regard to the other fighter. The support fighter should have a quick missile shot or transition to a gun WEZ. Since WEZ opportunities are fleeting, the support fighter should anticipate the WEZ and be prepared to shoot while ensuring weapons deconfliction is met. See **Figure 4.44** for an example of the fight flow.

Figure 4.44. Defensive Perch (No Switch).

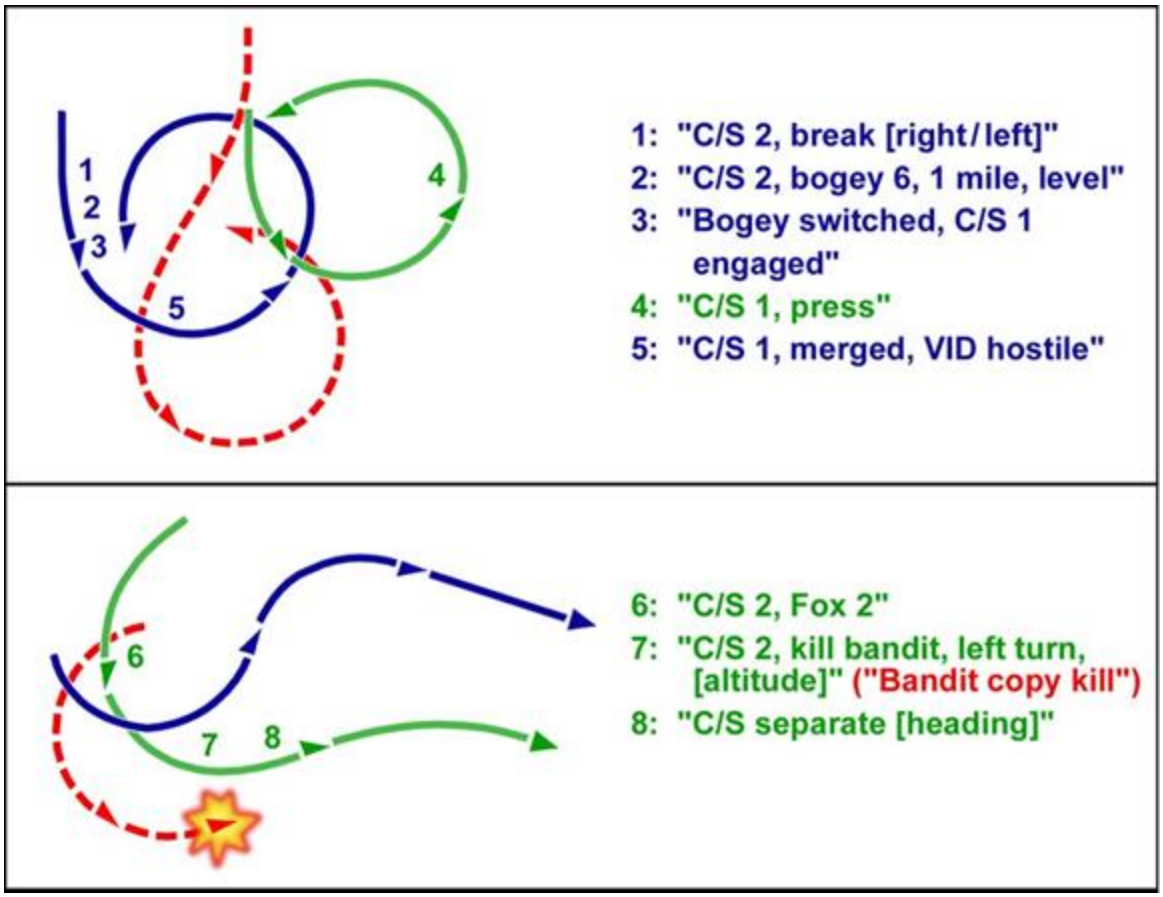


4.41.3.2. Bandit Switch. A Bandit who stern converts on two fighters, both of which are seen, will usually attempt to switch to the fighter on the outside of the turn at some point after the fighters initiate their break. This could happen immediately ("Early Switch") or after the Bandit pursues one fighter for a short time and then switches to the other ("Late Switch"). Typically, the inside fighter will see the Bandit's nose go to lag with LOS towards the outside fighter. Both fighters should be careful not to confuse a Bandit belly check or quarter plane with an actual switch. When the switch occurs, it must be quickly recognized and, if possible, communicated within the element. If it was not clear within the element who the Bandit was on, then use previously discussed calls to make it clear and establish roles. If roles had been established, call the switch and exchange of roles if necessary: "*Eagle 2, Bandit switch*", "*Eagle 2, engaged*", "*Eagle 2, press*". As soon as the Bandit's nose comes off to execute the switch, the defensive fighter must anticipate the three-dimensional (3D) merge geometry to assess whether his element mate will be able to execute the overall game plan and take the Bandit single-circle, or if the merge geometry requires the fighter to take him two-circle. If the Bandit has more than 1,500 feet of TR and/or 30° of lead turn at the merge, the merging fighter has no choice but to go two-circle with the Bandit to prevent putting himself in an immediate defensive position. If the Bandit has less than 1,500 feet of TR and/or 30° of lead turn at the merge, the merging fighter can execute the overall game plan and force the Bandit into a single-circle fight. Whether the

merging fighter forces a single-circle or two-circle fight will determine the support fighter's follow-on maneuvering.

4.41.3.2.1. Early Switch. An early switch will almost always allow the Bandit to gain greater than 1,500 feet of TR and/or 30° of lead turn. This forces the merging fighter to go two-circle. Prior to arriving at the merge, the fighter should execute merge prep and establish roles. At the merge the now engaged fighter needs to call the VID. This can all be condensed into one comm call. "*Eagle 1, merged, VID hostile, 1's engaged*" followed by "*Eagle 1, press*" from Eagle 2. Eagle 1 as the engaged fighter should execute their best two-circle BFM. As soon as the Bandit executes the early switch from Eagle 2 onto Eagle 1, Eagle 2 needs to start executing their smartest BFM while maintaining deconfliction, IAW the support fighter's priorities. This scenario is the most difficult for the support fighter to maintain deconfliction because it stretches the formation to visual limits. The best game plan for the support fighter is to keep power in MAX, immediately set LV 45° to the horizon (pitchback picture) in the direction of the merge, and max perform the aircraft into the vertical. This will get the support fighter sufficiently off the horizon, so that as the Bandit's nose turns toward them, it will be difficult for the Bandit to see them. If the Bandit does see the support fighter, this maneuver ensures that the Bandit will not threaten them with his nose because it will allow the engaged fighter an easy WEZ opportunity if they do. This maneuver will also slow the support fighter's forward ground track (in the same way scissors do) so that they can maneuver to a more mutually supportive position from the engaged fighter while maintaining WEZ separation for shots of opportunity. Weapons deconfliction, kill calls, and separation execution still apply as the fight matures and reaches those milestones. See **Figure 4.47** for an example of the fight flow.

Figure 4.45. Defensive Perch (Early Switch).

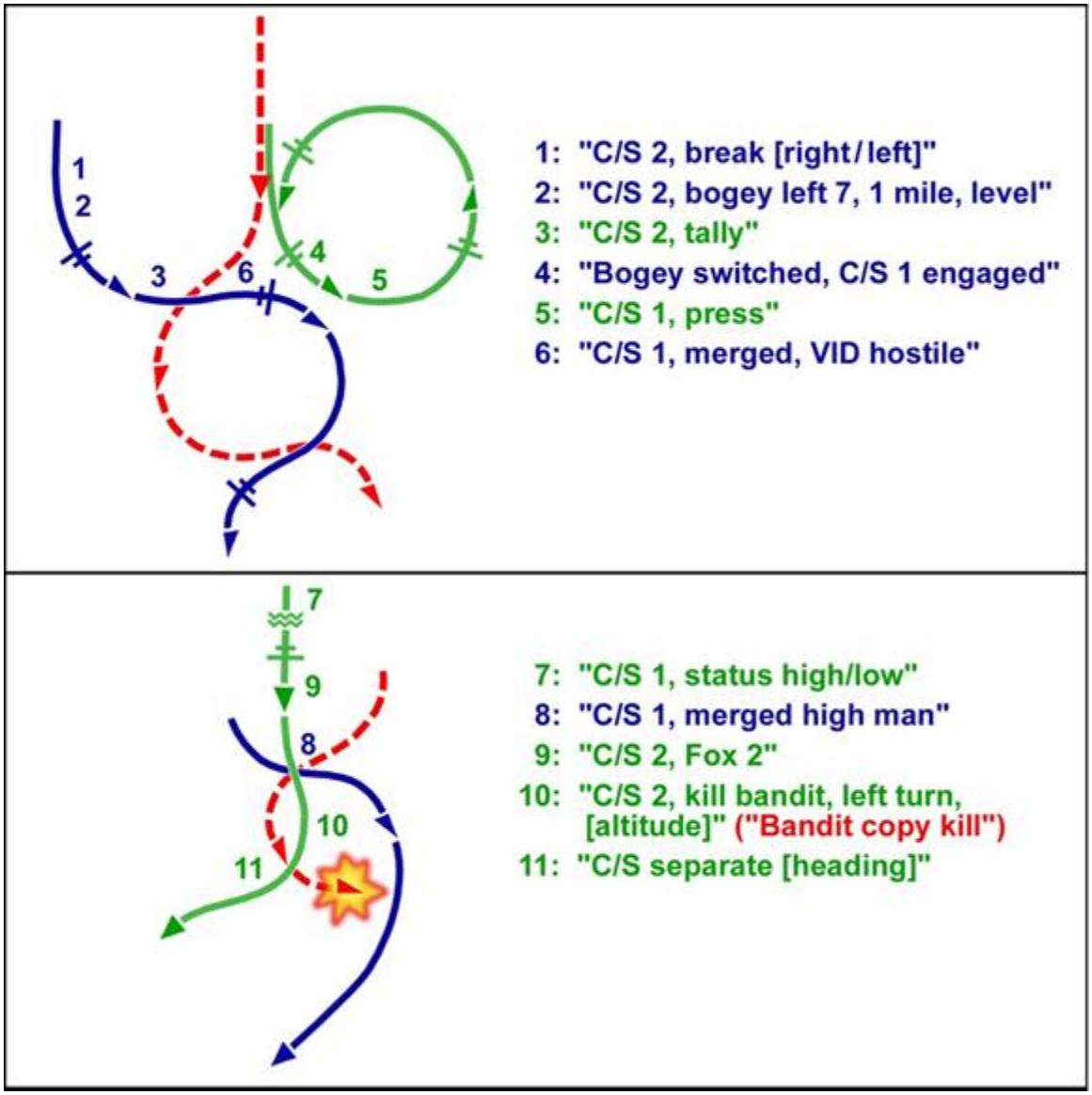


4.41.3.2.2. Late Switch. A late switch will almost always allow the merging fighter to gain some TR and lead turn on the Bandit as they execute their merge prep. At the very least the merging fighter should have a neutral merge and geometry that allows the merging fighter to drive a single-circle fight. Prior to arriving at the merge, the fighter should establish roles. At the merge, the now-engaged fighter needs to call the VID. This can all be condensed into one comm call. "*Eagle 1, merged, VID hostile, 1's engaged*" followed by "*Eagle 1, press*" from Eagle 2. As soon as the Bandit executes the late switch from Eagle 2 onto Eagle 1, Eagle 2 needs to start executing their smartest BFM while maintaining deconfliction IAW the support fighter's priorities. The best game plan for the support fighter is to keep power in MAX, over-rotate LV (G-awareness picture) to use altitude to get nose turned around quickly, and MAX G allowable (SRB). It may be difficult for Eagle 2 to keep sight of Eagle 1 at this point due to the geometry putting Eagle 1 at their dead six. Element deconfliction can still be assured due to SA that they are not in the same piece of sky at this point (nor will they be in the next 15 seconds), thereby negating the requirement to call "*Eagle 2, blind*". It should be rather easy for Eagle 2 to maintain the tally on the Bandit throughout this turn. Eagle 2 should follow the Bandit until he hears Eagle 1 call "*Merged*" and then look around the Bandit with a good search pattern to reacquire the visual on Eagle 1. If at this point Eagle 2 still is not visual, it warrants an "*Eagle 2, blind*" call. If Eagle 2

sees two aircraft but is unclear of which aircraft is which, their priority is determining which aircraft is friend or foe.

4.41.3.2.2.1. Use status comm as depicted earlier and offset the fight at the 11 to 1 o'clock position until tally/visual is regained. Once Eagle 2 is tally/visual (knowing who everyone is), they can point at the fight while assessing range for a valid AIM-9 opportunity with weapons deconfliction. Eagle 2 needs to be vigilant about assessing closure because the single-circle fight will quickly decay into a 150-knot joust for 3/9 advantage. If Eagle 2 is faster than 250 to 280 KCAS, they can cause excessive closure, including the possibility of flying out in front of the fight prior to missile impact. See **Figure 4.48** for an example of the fight flow.

Figure 4.46. Defensive Perch (Late Switch).



Section 4F—Air Combat Fundamentals (ACF)

4.42. Introduction to ACF. Air Combat Fundamentals the culmination of numerous tactical skills and principles, essential for any fighter pilot. Exposure and application of these fundamentals will help prepare wingman for the complexities of modern fighter engagements and understand how to succeed in the training environment.

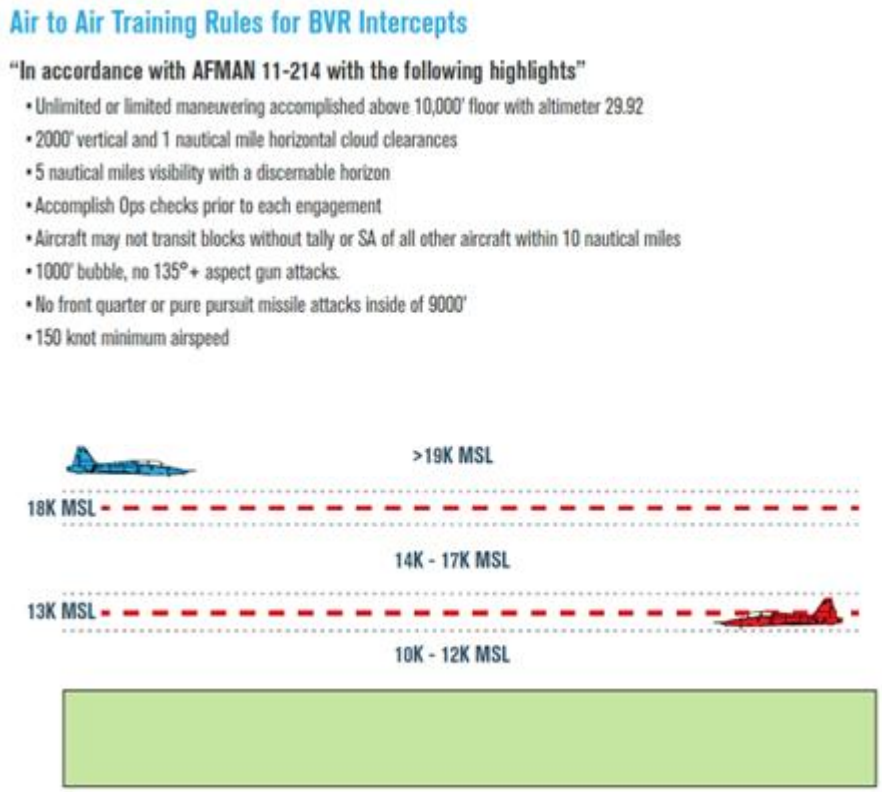
4.43. Rules of Engagement (ROE). ROEs are directives issued by competent military authority that delineate the circumstances and limitations under which forces will initiate and/or continue combat engagement with other forces encountered. For fighter pilots, understanding and adhering to ROE is crucial for legal, ethical, and operational reasons. Several items and terms are used to determine if a threat aircraft meets the criteria to employ lethal force. Some common terms used for ROE briefs follow:

- **LOF** - Lack of Friendly (not squawking a specific discreet code that would identify a jet as a friendly force).
- **PEI** - Positive Enemy Indication (can be any onboard sensor or visual identification to positively identify threat aircraft type).
- **VID** - Visual Identification (used to positively identify a threat aircraft type).
- **BANDIT** - An aircraft that meets LOF and PEI (requires additional criteria in order to engage with lethal force).
- **HOSTILE** - Enemy aircraft (Bandit) that meets all criteria to be engaged by fighters. For example, ROE for air-to-air engagements may require a threat to be in a geographic location, have a specific point of origin, or be within certain airspace before it can be declared hostile.

For ACM/ACF, positive ID is paramount to not shoot your flight lead or wingman.

4.44. Training Rules and Special Instructions (SPINS). BVR training is critical for preparing pilots to engage enemy aircraft at distances beyond direct visual contact. This section outlines the fundamental rules, procedures, and safety measures specific to BVR air-to-air training. Effective BVR training enhances pilots' situational awareness, sensor proficiency, and decision-making skills, ensuring they are ready for real-world engagements. ACF training will be executed IAW AFMAN 11-214 Training Rules. SPINS will be briefed every sortie, and may change depending on the squadron/location, and will be tailored to the mission.

Figure 4.47. A/A Training Rules Example.



4.45. Combat Air Patrol (CAP). A CAP is a critical element of air defense operations, involving aircraft tasked with patrolling a designated airspace to provide protection against enemy aircraft and other airborne threats. The objectives of a CAP are to maintain air superiority, protect high-value assets, and ensure the safety of ground and naval forces. CAPs can be categorized based on their specific missions and the assets they are assigned to protect.

4.45.1. Defensive CAP (Defensive Counterair (DCA)):

4.45.1.1. Mission: Protect friendly forces and assets from enemy aircraft.

4.45.1.2. Location: Typically positioned over or near the area or asset being defended.

4.45.1.3. Tactics: Involve maintaining a constant airborne presence to detect and intercept incoming threats before they can reach their targets.

4.45.2. Offensive CAP (Offensive Counterair (OCA)):

4.45.2.1. Mission: Establish air superiority by engaging enemy aircraft and preventing them from attacking friendly forces.

4.45.2.2. Location: Conducted in or near enemy airspace to proactively engage threats.

4.45.2.3. Tactics: Focus on patrolling enemy ingress routes and attacking enemy air defenses and aircraft.

4.45.3. CAP Fundamentals. In the ACF phase at IFF/Fighter Bomber Fundamentals (FBF), students will practice basic CAP procedures which they will build upon during follow-on major weapons system (MWS) training. Aircraft specific weapons capabilities, sensors, and threat

types will drive longer ranges and more complex scenarios in advanced training. The fundamentals will always apply.

4.45.3.1. Holding Pattern: Racetrack is a common pattern geometry (**Figure 4.48**.).

4.45.3.2. Formation: As directed by FL for ease of sensor operation, visual lookout (at IFF/FBF, tactical line abreast, Fluid, or Fighting Wing).

4.45.3.3. Axis: Aligned with threats, a defended location, or airborne asset can also be driven by defensive counter air lane orientation.

4.45.3.4. Altitude: Driven by Airspace Control Order (ACO) deconfliction, surface to air threats, and/or terrain.

4.45.3.5. Sensors (T-38): HSD, TCAS, AAT, and eyes (contrails, early tally, other threats).

4.45.3.6. Communications: Use AWACS/GCI comm to build a 3D picture in your mind, plot course of bullseye to correlate.

Figure 4.48. ACF CAP.

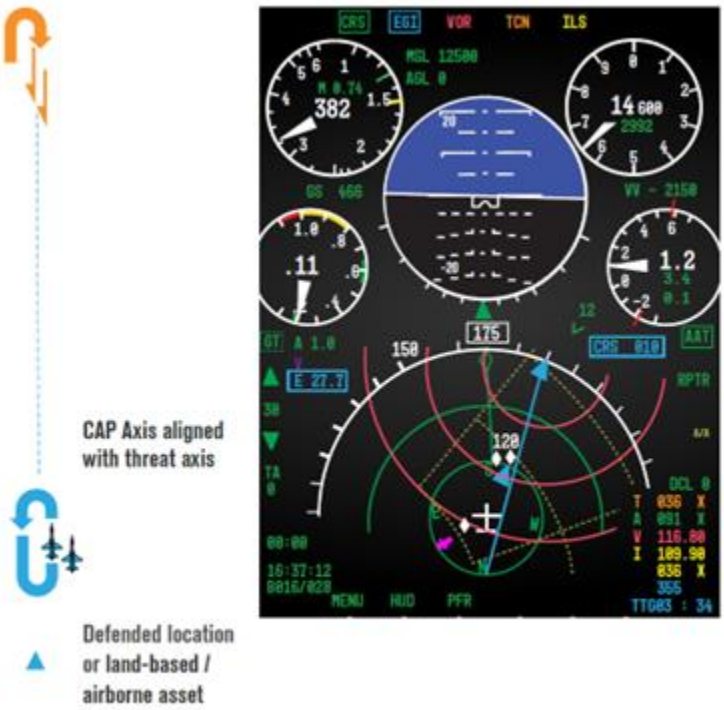
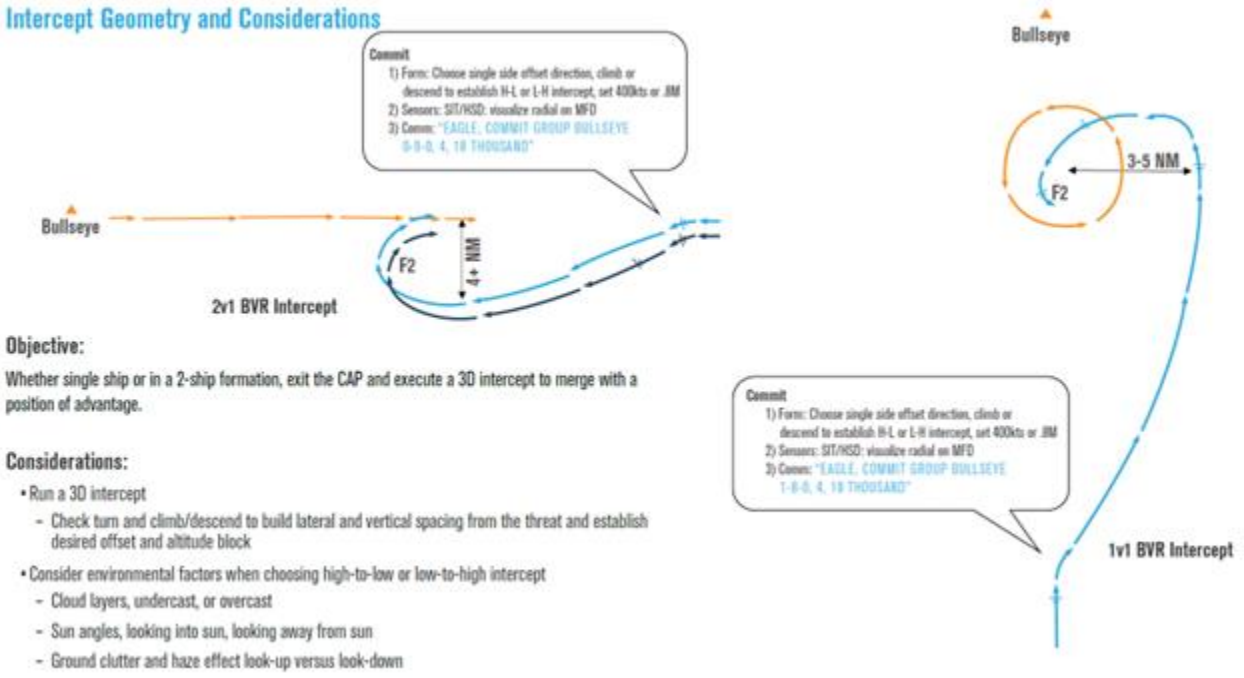


Figure 4.49. Beyond Visual Range (BVR) Intercept Geometry and Considerations.



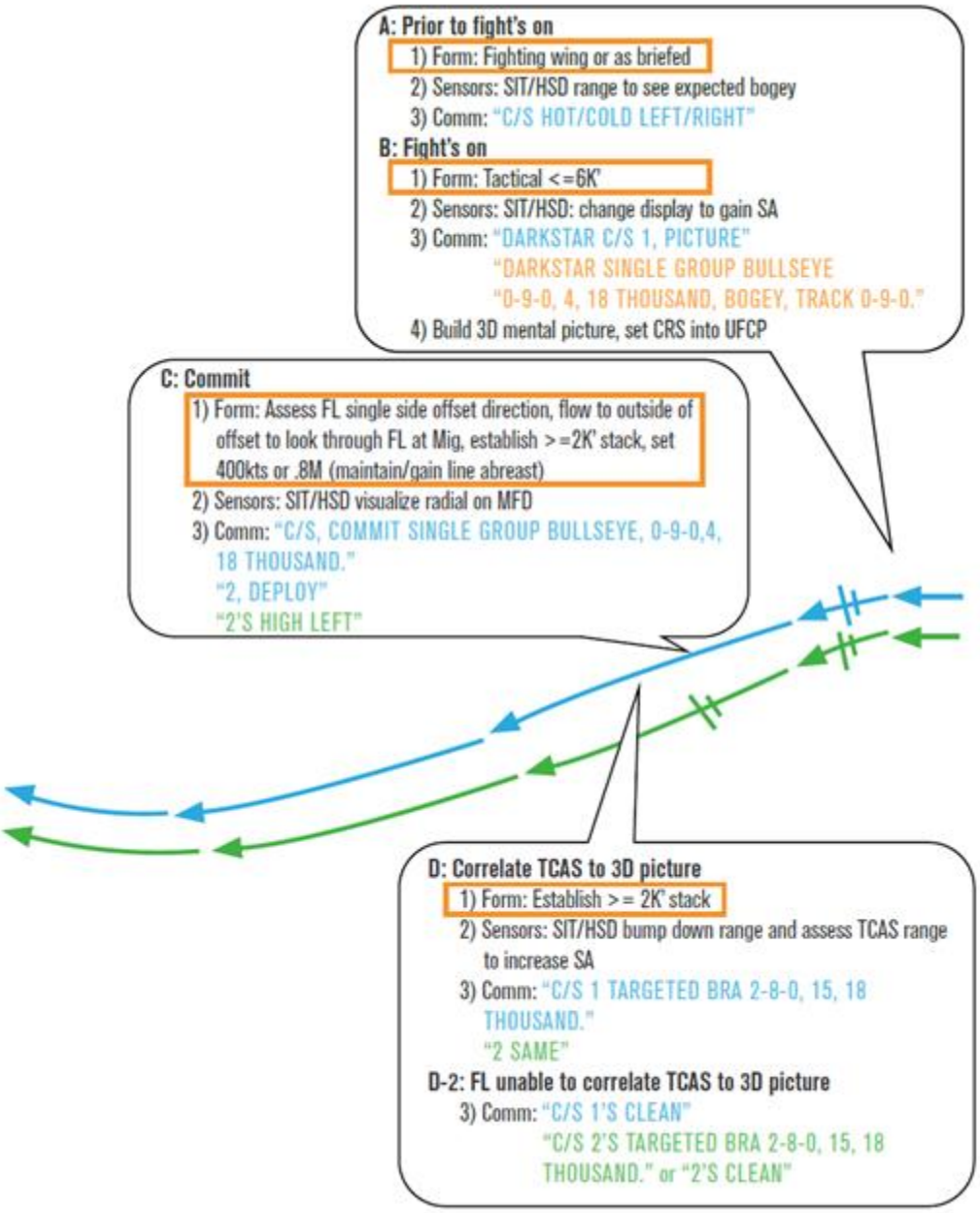
4.45.4. BVR Intercept Decisions. Key components of situational awareness and decision making throughout the course of a BVR intercept are formation/position management, sensor operation, and communications. Each of these components contains multiple elements that vary throughout the flow of the intercept as well as the intercept type: 1v1, 2v1, 1v Furball. Briefings and depictions of BVR intercepts describe the intercepts by speaking to formation, sensors, and comm at each phase of the flow (**Figure 4.49**.).

4.45.4.1. Formation/Position.

4.45.4.1.1. In 1v1 intercepts, this refers to the general position of the aircraft (altitude block, intercept geometry high to low or low to high, offset direction, pointing pure.)

4.45.4.1.2. In 2v1 intercepts, formation refers to the formation position directed by the element lead (tactical LAB, fighting wing, etc.) as well as the wingman positioning to look “through” lead to the threat as the fight transitions to the visual arena (**Figure 4.50**.).

Figure 4.50. BVR Formation Example (2v1 Intercept).



4.45.4.2. Sensors. Sensors refers to the onboard equipment available to detect and build situational awareness on threats, friendlies, as well as overall battlespace awareness.

4.45.4.2.1. The HSD/SIT displays in the MFD are an important tool, including the setup of lines and bullseye to enable easy visualization of target information called over the radio (**Figure 4.51**.).

4.45.4.2.2. AAT is another important "sensor" to help you keep SA on range to your flight lead in the visual and BVR environment, especially when starting out split by a significant distance (1v Furball scenario).

4.45.4.2.3. Lastly, the pilot's eyeballs are a key sensor for visual pickup when transitioning from BVR to the visual phase of an intercept/engagement. Correlating HSD heading/radial info into "canopy code" references in the cockpit is essential to acquiring the tally/visual in an engagement (**Figure 4.52**.).

Figure 4.51. BVR Sensor Example (2v1 Intercept).

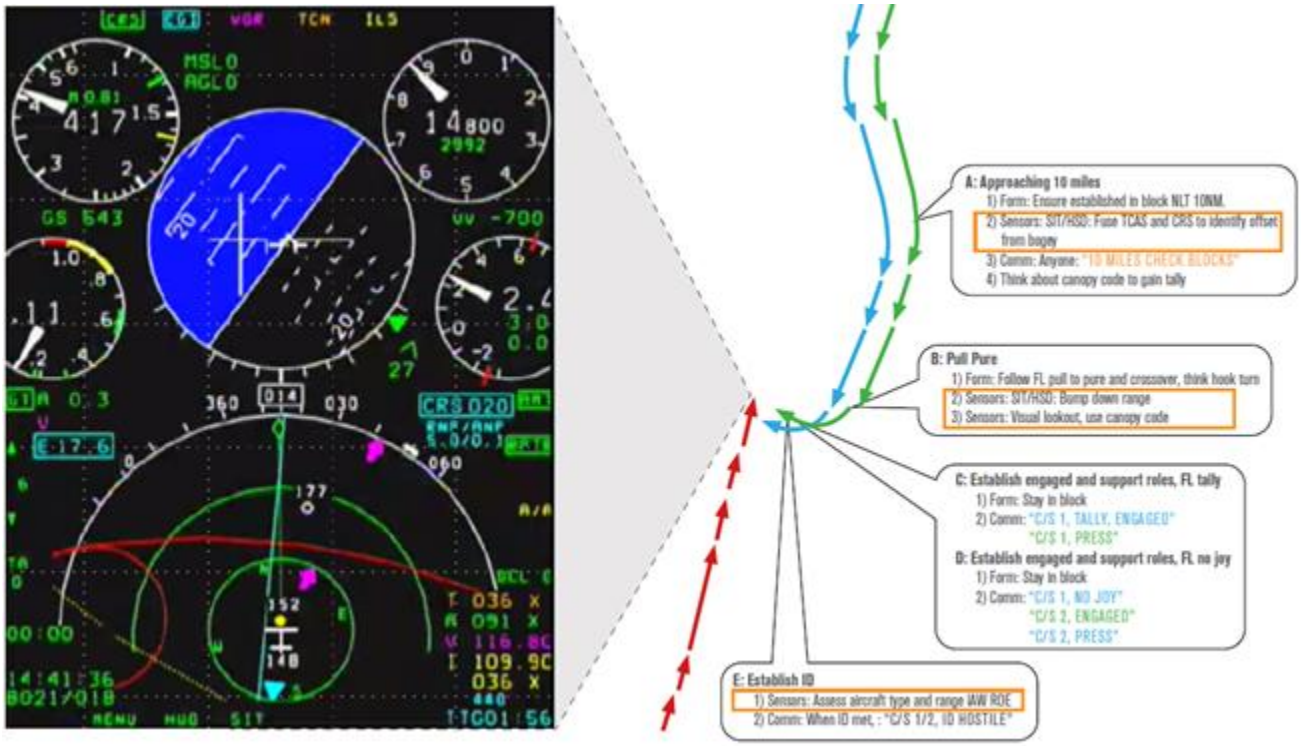
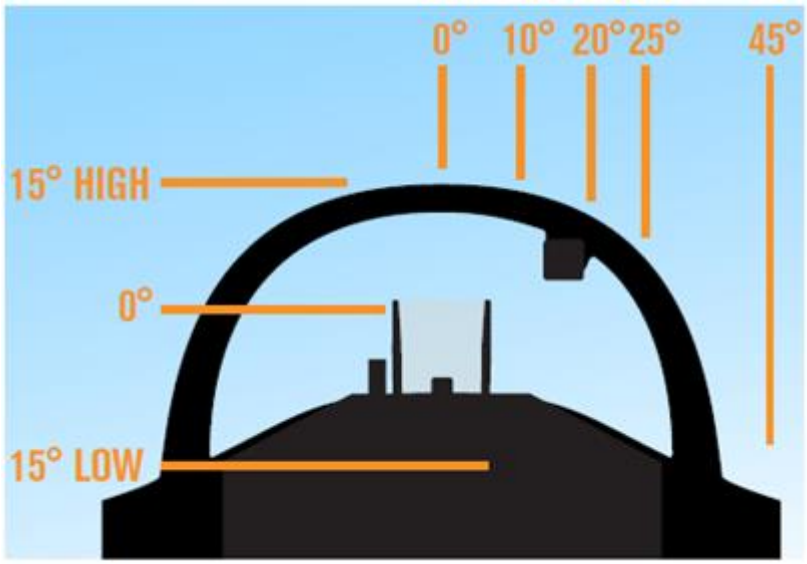
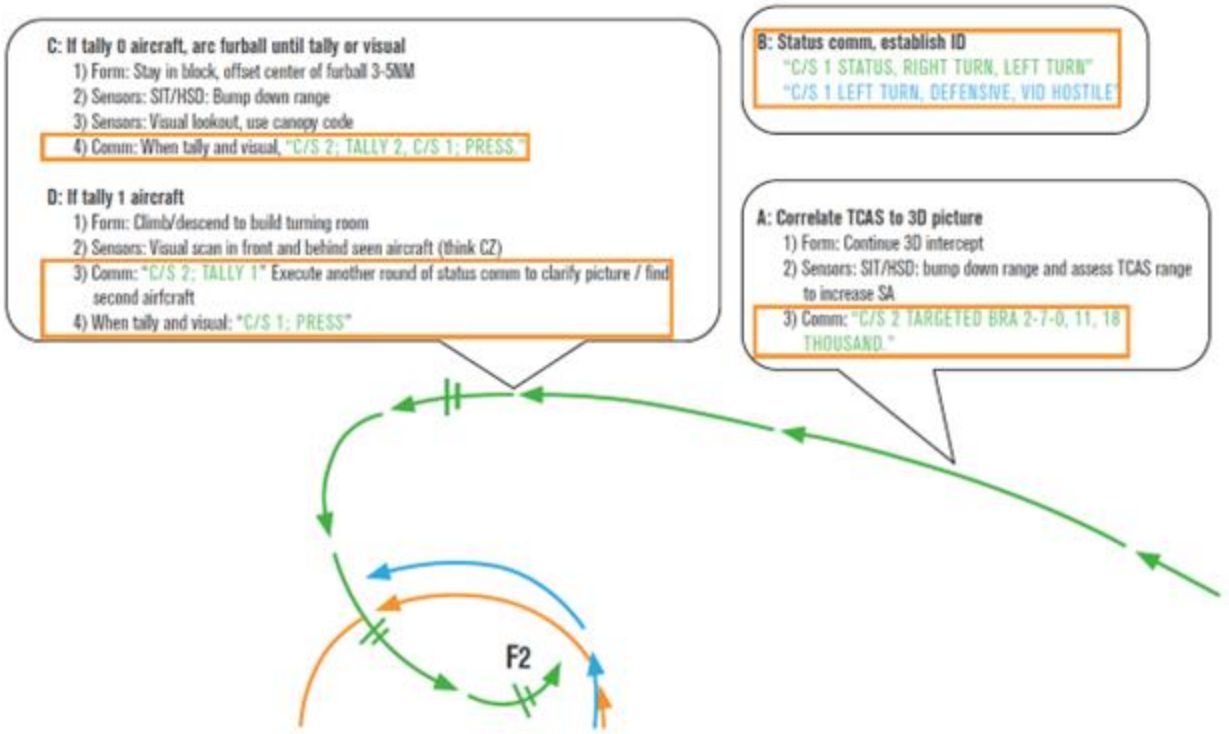


Figure 4.52. Canopy Code.



4.45.4.3. Communication. Both inter-flight communications as well as comm from AWACS and/or GCI are key factors in situational awareness and decision making while running the intercept. The flight lead directs formation positions, intercept flow, and threat comm (**Figure 4.53**.). Flight members use Air Land Sea Application (ALSA) Air Control Communication (ACC) to transmit threat information or query AWACS/GCI to build the threat picture. As the fight transitions to the visual arena, engaged/support comm between flight lead and wingman is essential.

Figure 4.53. Communications Example Furball Intercept.



4.45.5. Detached Formation Mutual Support. ACM and ACF are a substantial leap from BFM in terms of employment. No longer is it a single-fighter concept where the only cross-check is the Bandit. The fighter now must bring an element mate into the crosscheck along with the normal Bandit assessment. ACM is the first mission where fighters employ as a team and attempt to maximize mutual support. While defensive perch ACM takes place in the visual arena, ACF expands the scenario outward to include BVR components as well. One such scenario begins with the wingman 10 to 15 NM from an engagement involving lead and a single bandit. This is referred to as a furball intercept. Entering an ongoing visual engagement from BVR, the objective is to execute a 3D intercept to merge in a position of advantage with mutual support. As a wingman, detached formation mutual support entails the use of sensors, comm, and geometry to locate and enter an ongoing air-to-air engagement involving flight lead from BVR. A valid AIM-9P kill requires VID and weapons deconfliction from flight lead to achieve an expeditious kill. Maintaining a crosscheck on key items throughout the engagement is essential to achieving a kill. Continuously assessing and managing formation (location/position), sensors (HSD/SIT, TCAS, AAT), and comm (AWACS, GCI, flight lead)

builds SA during the transition from BVR to the visual arena. Some key points of a furball intercept can be seen in **Figure 4.54**.

Figure 4.54. 1 v Furball Example.

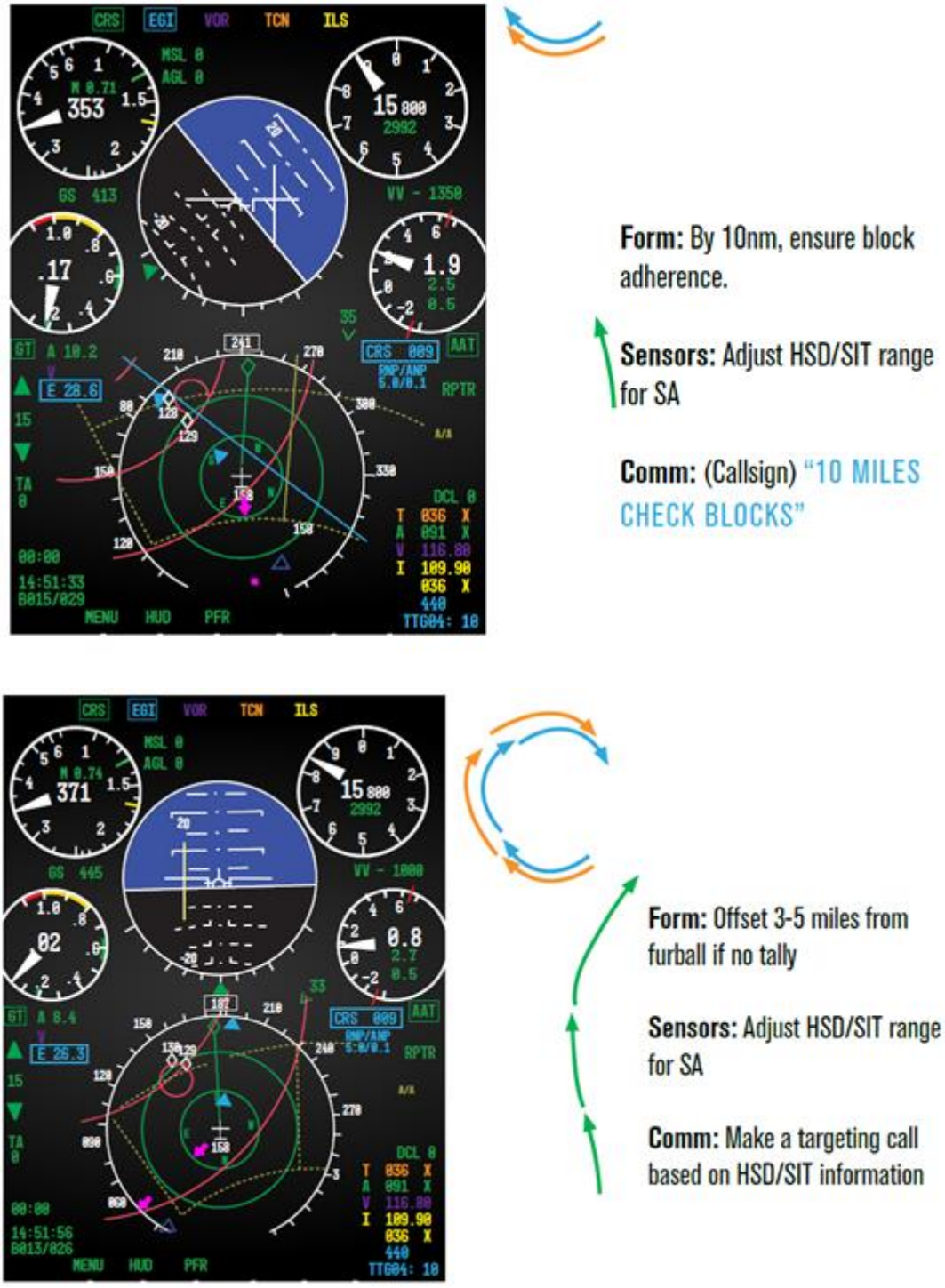


Figure 4.55. Transition to Within Visual Range (WVR).

Form: Once tally/visual, climb/descend to build vertical turning room

Sensors: Visual lookout using canopy code

Comm: Call Tally/Visual once acquired. Make status calls as required to establish ID

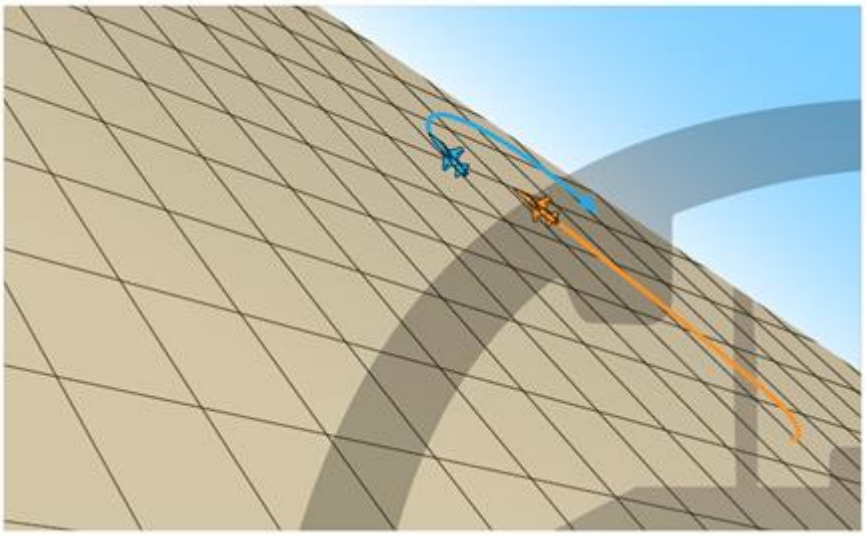


Figure 4.56. Kill Call's, Contingencies, and ROE.

Furball Intercepts

"(CALLSIGN) KILL BULLSEYE 360/18, THIRTEEN THOUSAND,LEFT HAND TURN"
"BANDIT COPIES KILL"
"(CALLSIGN) SEPARATE 260"
"(CALLSIGN) 2, POSIT"
"(CALLSIGN) 2 IS LEFT 8 O'CLOCK 1 MILE LOW"

Formation: Get to tactical airspeed, return to block
Sensors: Visual lookout, bump scope to increase SA
Comm: Regain visual mutual support

1 v Furball Intercept Contingencies

NO JOY – Stay in your block or lag last known position of furball, and return to block continue to arc the fight

- Ask AWACS/GCI for updated position furball (Bullseye or BRAA)
- Use canopy code
- Call "TALLY 1 ONLY", "BLIND", or "NO JOY" as required

No TCAS hits

- Use radial/DME(BULLSEYE) for SA, query lead for turn direction of the fight
- Cycle TCAS (TA → Standby → TA)

4.45.6. Post-Fight Flow. The post-fight flow is a critical phase following an air-to-air engagement. It involves a series of procedures and checks to ensure the safety of the aircraft and pilot, assess mission outcomes, and prepare for potential re-engagements with follow on adversaries. In ACF, once a kill is achieved, the priority is to deconflict from "red air", i.e., the Bandit, get back to a tactical airspeed, regain visual mutual support, and continue to build SA. Typically, in IFF/FBF, this will result in a picture call, and ultimately a terminate/KIO to set up another engagement.

4.45.7. Debrief. ACF debriefs will be conducted IAW squadron standards. At a minimum, this should include any training rules/SPINS violations, safety of flight issues, and watching the lines with a shot validation.

Chapter 5

BASIC SURFACE ATTACK (BSA)

5.1. Introduction. BSA is the building block for all air-to-ground (A/G) missions. This chapter addresses surface attack definitions, pre-mission planning, delivery parameters, controlled range patterns, and weapons delivery. Refer to **Figure 5.1**.

5.2. Surface Attack Definitions. Several surface attack terms must be understood for the fighter pilot to fly the attack and arrive as close as possible to the planned weapons release window. While these concepts are introduced and defined here, specific mechanics and further discussion of how to use them starts at the "Roll-in" section later in this chapter. For more information regarding the calculations and T-38C specifics, refer to Technical Order (T.O.) 1T-38C-34-1-1, *Simulated Weapons Delivery* flight manual.

5.2.1. AIM Off Distance (AOD). AOD refers to a distance beyond the target that is predictable for any weapons delivery. That distance is the no-wind projected flightpath of an aircraft (where the aircraft would hit the ground if the pilot did not recover) in a dive delivery.

5.2.2. AIM Off Point (AOP). AOP is the point on the ground, long of the target, to which the aircraft must fly during the weapon's delivery pass. The AOP provides a ground reference to fly the aircraft to until a track reference can be set.

5.2.3. Dive Angle. Dive angle is the planned angle of dive for weapons delivery.

5.2.4. Initial Pipper Placement (IPP). IPP is the angle from target to a point in the HUD in mils at track altitude.

5.2.5. Initial AIM Off Angle (IAA). IAA is the angle between the AOP and the target at track altitude. IAA is setting the FPM a planned number of degrees above the target at track altitude.

5.2.6. Initial Target Placement (ITP). ITP is the angular "distance" measured from the horizon to the target in degrees (adding IAA to the planned dive angle at track will always yield ITP). It is an excellent reference for knowing what type of wire you are on, but it is NOT a "track reference" and cannot be "set" at track altitude.

5.2.7. Mil. Mil is a term commonly used by pilots as an abbreviation for milliradian (1/1,000th of a radian). Mils are used to measure sight depression or relative positions and sizes of objects as seen through the HUD. One mil is equal to 1 foot at a range of 1,000 feet. Another useful relationship is approximately 1° equals 17.45 mils. "Mils" are also sometimes used to reference the delivery parameters on the lineup card.

5.2.8. Minimum Release Altitude (MRA). MRA is a contingency altitude. It allows the fighter to be fast, steep, or both (up to a limit), and still satisfies safe escape, safe separation, and fuse arming criteria. Units may compute MRA differently to reflect mission design series (MDS) specific considerations.

5.2.9. Planned Release Altitude. The expected release altitude based on attack planning and assumptions.

5.2.10. Percent Bomb Fall Line (%BFL). %BFL is an alternate HUD track reference. In principle, it is the same as IAA and serves the same purpose. The only difference being the

angular distance from the FPM to the pipper is described as a percentage of total BFL. It is similar to IPP in that it is setting the pipper a known number of mils below the target.

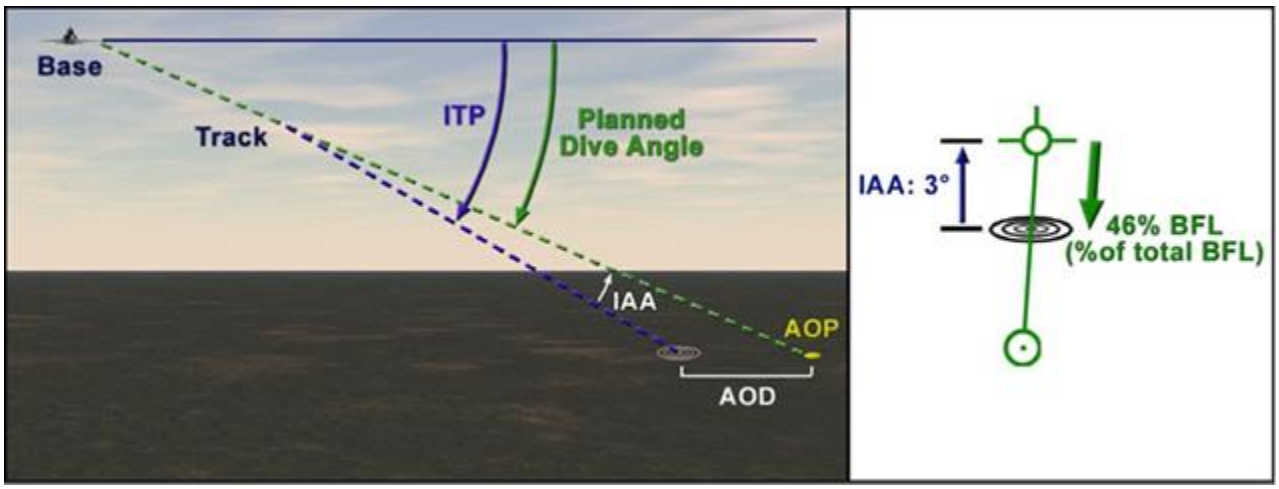
5.2.11. Release Altitude. Release altitude is the altitude above the ground at which weapons delivery is accomplished.

5.2.12. Track Reference. Track reference is a position or point in the HUD that is used to maintain or correct the aircraft to the planned wire. Some common track references used in weapons delivery are IAA and BFL (IPP).

5.2.13. Tracking. Tracking refers to a portion of any dive weapons delivery that is devoted to the final alignment of aircraft sighting systems with the target. The amount of time associated is referred to as wings-level or tracking time.

5.2.14. Track Altitude. Track altitude is the preplanned altitude at which your HUD track reference is valid. BFL and IAA relationships are only valid at track altitude.

Figure 5.1. Basic Concepts.



5.3. Mission Planning/Preparation. BSA mission planning starts with and is based on the type of weapon used and the target. The use of a BSA conventional or tactical pattern simplifies most of the planning by removing the target "weaponeering" and allows pilots to practice various methods of attacking the target safely.

5.3.1. Weather Planning. Check the ceiling height to evaluate possible delivery options both below and above the weather. Check the winds at the surface and at the track altitudes of each delivery planned and have that ready for the brief. Upper-level winds can have a dramatic effect on weapons delivery. Prevailing visibility and sun angle will affect ease of target and landmark identification. A call to the range should be made to get an eyes-on assessment of the weather and pass the delivery and target plan to the ranger. Additionally, aviation hazard advisory system should be checked prior to the brief and updated at step.

5.3.2. Target Study. Review slides, pictures and diagrams of the range, target area, and planned targets for the mission. Note the position of the range tower, prominent visual features, and any avoid/noise sensitive areas. Check range NOTAMs if applicable and always reference the range regulation.

5.3.3. Attack Planning. IFF student missions will be flown IAW the preplanned attacks in the in-flight guide. Review the attacks planned for your mission. In addition to the pattern altitudes and airspeeds, commit to memory the information related to each individual event, to include track altitude, ITP, IAA, %BFL, AOD, planned release altitude, and MRA. These numbers can be placed on a line-up card for reference in flight. Also, each pilot must be familiar with the training rules in AFMAN 11-214.

5.4. Ground Ops. Confirm the weapons menus are set up correctly to include delivery parameters and break X altitude. Target coordinates and target elevation should be verified (or entered if required) on the ground. Set the altitude warning to radar altimeter (RALT) and choose a warning altitude that won't distract from the mission but will provide timely SA and aid in ground collision avoidance (refer to the squadron standards). In the upfront control panel (UFCP) HUD menu, ensure to select Drift (DRF) mode and not Drift-Cut-Out (DCO) mode.

5.5. Range Entry. Prior to entering the range, flight lead will call the range operator who will provide range entry clearance, the current altimeter, which targets are available, and additional information IAW range regulations. Every member of the flight is responsible for understanding this information and will acknowledge with position number after flight lead reads it back to the ranger. The ranger may also provide current weather and wind information. Build SA on the actual winds compared to the forecast used to plan attacks. Approaching the range, check the winds at departure altitude on the multifunction display (MFD), listen to the surface wind call from the ranger, and look for smoke or dust clouds from vehicles for additional surface wind SA. Expect to enter the range in either route or tactical formation.

5.5.1. FENCE-IN. An A/G FENCE check will normally be accomplished before entering the BSA pattern. While it may vary from flight to flight, it should include selecting A/G master mode (constantly computed impact point [CCIP], constantly computed release point [CCRP], or as briefed), the target steer point, and weapons program for the first event (AAT, IFF, and CMD IAW the brief). Set up NAVAIDs to aid in SA on the range course deviation indicator (CDI) to run-in heading with the heading bug on the crosswind or base heading as a technique. A chaff/flare check may be accomplished as well. ***Do not*** perform a trigger/pickle check. Leave the master arm switch safe until within the range confines and directed or briefed to arm hot by flight lead.

5.5.2. G-Exercise. The flight lead may or may not perform a G-exercise. A G-exercise may be accomplished prior to entering the range boundaries or once established on the range, IAW the brief or unit standards (AFMAN 11-214 does not require a G-exercise).

5.5.3. Spacer Pass. Once the flight is ready to enter the BSA pattern, the wingman will need to achieve a trail formation. A delay of 5 to 7 seconds in route, or 2 seconds in tactical LAB will provide for sufficient spacing behind the preceding aircraft.

5.6. Range Comm. Apart from safety of flight calls (say position or KIO), full callsigns will be used when communicating on the range (e.g., "*Viper 2's base*"). The ultrahigh frequency (UHF) radio will be used exclusively to keep the Range Control Officer (RCO) in the loop with high SA. Very high frequency (VHF) will be used by exception.

5.6.1. Pattern Calls. Standard required pattern calls are: "*C/S base*," "*C/S up*" (for tactical pop patterns), and "*C/S in dry*". Flight members will use callsign or formation position as briefed. The calls and turn initiation should be accomplished simultaneously. All members of the flight

must listen carefully prior to transmitting. If another fighter has called "*In dry*", do not transmit until the RCO has given a "*Continue dry*" (unless the transmission is for safety of flight).

5.6.2. Base Call Considerations. The "*base*" call will be prefaced with "*extended*", or "*late*". These are used to increase the SA of following aircraft for station-keeping purposes. If forced to turn base somewhere other than the briefed ground track, add the appropriate description. The preface "*late*" is used in the same way as in the landing pattern. If turning base at the correct position but unable to transmit on time due to higher priority comm, delay the "*base*" call and preface it with "*late*".

5.6.3. "*C/S off dry*". "*C/S off dry*" will be called post safe escape maneuver (SEM) if the fighter rolled in with intent to drop but ended up not pickling. Add the reason for not dropping ordnance to the off-dry call (e.g., "*Viper 2's off dry, parameters*").

5.7. Range Exit. Flight lead will add "*C/S last pass*" to his base and in call and "*C/S up for the rejoin*", after completion of his safe escape. After pickle ***and*** completion of a valid safe escape, turn in the briefed direction and look for the preceding aircraft. Call off with number of aircraft in sight, (e.g., "*C/S 3's off, 2 aircraft in sight*…") and begin the rejoin. If not all the preceding aircraft are in sight, transmit the number of aircraft seen and continue to fly the briefed ground track, leveling off at the briefed "sanctuary" altitude. Once visual with all the preceding aircraft, notify lead and continue the rejoin.

5.8. Switches Safe/FENCE OUT. Flight lead will call for the FENCE OUT as a directive call for all flight members to safe the master arm and CMD. Once switches are safe, acknowledge in order by position number. Complete the rest of the FENCE OUT as briefed or directed. Be aware that all of this may be happening during the rejoin; task prioritize appropriately.

5.9. Abnormal Procedures.

5.9.1. Fallout/Late Join Up. Have a game plan for how the formation will execute if any member falls out, both on the ground and in the air. If a flight member joins up late on the range, one technique is to have them hold above the pattern altitude and flow them into the last position in the flight.

5.9.2. Weather. For a solid deck with good visibility underneath, eliminate the higher events. It gets trickier when there are scattered clouds the formation needs to work around, or the visibility underneath is marginal. Expect dry passes for clouds obscuring the target and more "*Say position*" calls. If weather will be a factor on final, or TRs are in doubt, remain high and dry.

5.9.3. Emergency Procedures (EP). For any EPs, be ready for a KIO call, including the RCO, and the flight lead to be directive. Most EPs can be handled by elements. Be sure to safe switches during KIO call.

5.9.4. NORDO. The NORDO aircraft should remain high and dry in the pattern and rock their wings on final. Once it's determined an aircraft is NORDO, lead will be directive with the rest of the flight to recover that aircraft IAW standards and local procedures. With an EP, the NORDO aircraft should do the same thing unless an immediate single-ship recovery is warranted. If a single-ship recovery is warranted, avoid overflight of pattern ground track at the current pattern altitude and turn opposite the traffic pattern.

5.9.5. Blind. If not visual with the preceding aircraft or if there is any doubt as to which position can be seen after rolling out on crosswind, crosscheck altitude and stay 500 feet away from base altitude for the pattern being flown. If descending to the base altitude, remain above the base altitude. If climbing up to the base altitude, level off lower than the base altitude. Clear flightpath and transmit "(position number for the aircraft in front of you), *say position*". The preceding aircraft should immediately answer the call with position and altitude. No other aircraft will transmit except those necessary to resolve the potential conflict. Follow-on calls must be as specific as possible.

5.9.5.1. Post Blind – "*Continue*". If the visual is reacquired ***or*** the pilot has high SA for which there is adequate deconfliction, call "*Continue*". If on final and not directly involved in a "*Say position*" situation, the fighter may continue the pass and deliver ordnance unless a "*Knock-it-off*" is called (assuming the RCO transmitted "*Continue dry*" prior to the "*Say position*"; if not, don't request clearance – go through dry).

5.9.5.2. Post Blind - "*Knock It-Off*." If the situation cannot be immediately resolved, a "*Knock-it-off*" should be called. All members of the flight and the RCO will acknowledge it; safe the master arm and fly the altitude, airspeed and ground track for the event flight lead is on. The blind aircraft will maintain briefed altitude deconfliction. Expect the flight lead to be directive and/or the preceding aircraft to give bearing, range, aspect, and altitude (BRAA) calls. Listen carefully and build SA on other members of the formation. When warranted, flight lead will direct the flight to continue weapons delivery (e.g., "*Next pass hot*" or "*Green 'em up*").

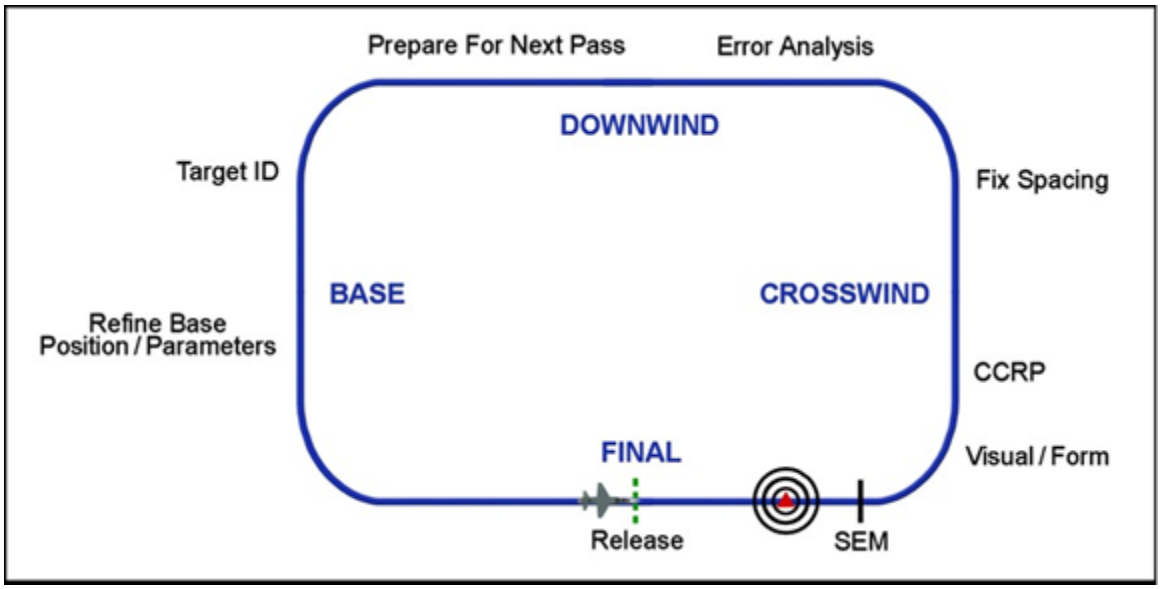
5.9.6. Fouls. Two fouls or one dangerous foul on range will usually result in that flight member either holding high and dry or being directed to RTB. Use judgment based on the severity of the problems. Since the T-38C does not physically drop anything, it will be hard for anyone outside your jet to assess a foul. Fess up to foul situations so that you can learn from them.

5.10. Conventional Pattern Procedures.

5.10.1. Purpose. The conventional pattern allows orderly, repetitive weapons delivery practice for up to four aircraft on the range. It is designed to allow you to get from one pass to the next as efficiently as possible to maximize learning basic diving weapons delivery.

5.10.2. Conventional Pattern Overview. The conventional pattern is similar in structure to a standard landing pattern, with the following segments: crosswind, downwind, base, and final (**Figure 5.2**.). While the basic pattern remains the same between different events, altitude and base position will change to accommodate the various release altitudes and dive angles. Depending on the event, a complete "lap" around the pattern will take only 1 to 2 minutes or about 100 to 150 pounds of fuel. In addition to the required tasks for each segment of the pattern, you will have to maintain briefed altitude, airspeed, and ground track.

Figure 5.2. Conventional Pattern.



5.10.3. SEM. All SEMs will be executed IAW T.O. 1T-38C-34-1-1. Using 4.1 to 4.3 Gs in the pull is a good technique to ensure the SEM is valid while minimizing the potential for an asymmetric over-G due to jetwash. Use caution on steeper events; airspeed errors and dive angle increase over-G potential. Rapid G application is not necessary; you have 2 seconds to blend to 4 Gs. It is a good technique to complete an SEM anytime you commit your nose to the target, even if the decision is made not to release ordnance.

5.10.4. Crosswind. The first priority after the SEM is to regain visual on the preceding aircraft. With 8,000 feet of pattern spacing, the preceding aircraft should be near 10 o'clock and hold steady on the canopy until rolling out on. The pilot will be looking at almost tail aspect making the visual tougher to reacquire. When turning crosswind (or any other place in the pattern), realize that pilots may be turning inside the preceding aircraft (the "coffin corner"). Look outside as well as inside the turn until certain the turn is clear.

5.10.5. Check Spacing. After finding the preceding aircraft, assess pattern spacing; there should be 6,000 to 9,000 feet separating the aircraft. The AAT can be used to back up a visual assessment of 6,000 to 9,000 feet. TCAS and a 2.5-NM primary flight reference (PFR) scope may also be used to back up visual assessment. If position is close or wide, then adjust the turn to downwind to either increase or close range. If adjusting the downwind turn, orient the downwind leg so to arrive over the briefed ground track at the turn to base. Pilots in Number 2 or Number 3 positions of a four ship should avoid airspeed deviations as they will affect the subsequent aircraft; instead use geometry. Prior to "cutting" any corners, pilots must be visual or have SA with comm with all the preceding aircraft. This will prevent an unaware, belly-up pull on the preceding aircraft that can create a midair collision potential in the form of a "coffin corner".

5.10.6. Downwind. Lead will establish the downwind leg ground track in the brief. This is not a fixed position and may be varied by individual pilots if required to adjust spacing. Use the time on downwind to prepare for the next pass and analyze errors from the previous pass.

5.10.6.1. Prepare for the Next Pass. While not all-inclusive, the following checks cover the minimum and highest priority tasks while on downwind. In addition, continue to evaluate pattern spacing and analyze winds; adjusting as necessary to fly the correct ground track for the planned weapons delivery and spacing. The following techniques help the aircrew develop habit patterns that can be applied in future aircraft. The individual checklist items are discussed in this chapter.

5.10.6.2. T-A-G. An easy to remember acronym to aid in accomplishing downwind checks is T-A-G:

T – Target/Weapons Program.

A – Attack Numbers.

G – Gas (Complete Ops Check).

5.10.6.3. W-A-M-O-E. The W-A-M-O-E check is another common technique. It includes error analysis, which reminds aircrew to think through adjustments for the next pass.

W – Weapons Mode (A, B, C…).

A – Arm.

M – Master Mode (A/G, CCIP).

O – Ops Check.

E – Error Analysis.

5.10.6.4. M-M-G-P-T-W. Most common downwind check to accomplish all A/G items.

M – Master (Arm, A/G, CCIP)

M – Mode (Weapons Mode (A, B, C…)).

G – Gas (Ops Check).

P – Pass (Attack Numbers Review).

T – Target (EGI Steer point).

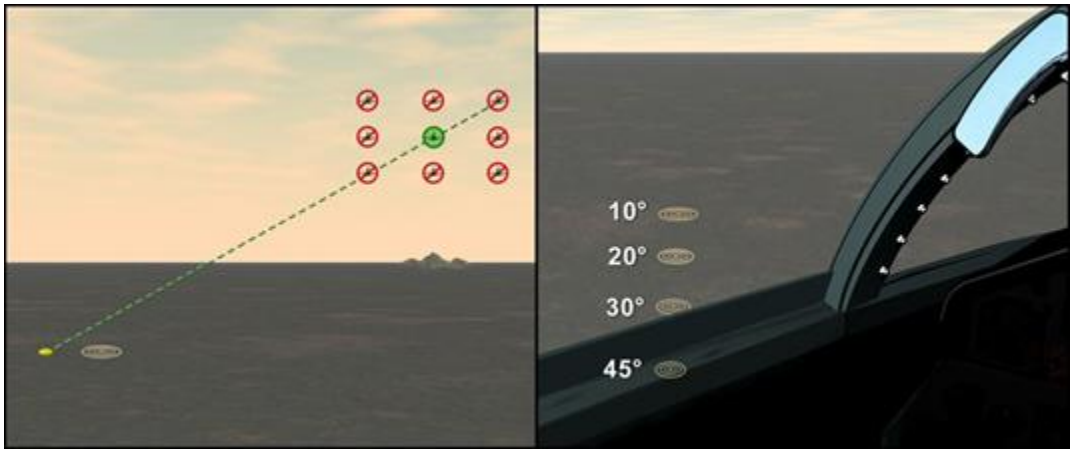
W – Winds (Pattern Corrections).

5.10.7. Base. For accurate weapons delivery, base position is crucial. There are three major conditions required to begin a successful roll in: airspeed, altitude, and base distance. As shown in **Figure 5.3**, there are nine possible aircraft positions, eight of which are incorrect for a given set of weapons-delivery parameters. To arrive on the planned wire, base distance and altitude must be accurate. Airspeed deviations on base will lead to devoting excessive time on final to airspeed corrections. Strive to shack the base parameters.

5.10.7.1. Base References. The proper base distance can be achieved via two sources: ground reference and canopy codes. Using ground references in a commonly used pattern is advantageous for learning the basics of surface attack and establishing canopy codes. In a more tactical environment, pilots will have to use canopy codes to visually assess their base position. If a ground reference is available, select a lead point to begin the base turn to roll out pointing toward the reference (**Figure 5.3**.). Select MIL power and execute a level turn with G to hold airspeed. While refining parameters on base, acquire the target.

Another method used to set base distance is a visual assessment of the planned wire. This involves setting the correct target-to-canopy reference or "sight picture" while wings level on base (**Figure 5.3**.). For no wind, put the target 1½ fist widths above the canopy rail for a 10°, a fist width above for a 20°, on the canopy rail for a 30°, and for a 45°, the target will be a fist width below the canopy rail. These references are only valid when wings level, at the appropriate base altitude, and at a nominal sitting height which can be found in T.O. 1T-38C-34-1-1. These methods can be combined to help build the base sight picture and refine your base distance. For either method, the target should be the primary reference for planning the roll in.

Figure 5.3. Base References.



5.10.7.2. Base Ground Track Corrections. To make a correction, angle in or out from the target, and then roll out. Once the picture is set, if time allows prior to the roll in, return to the original base ground track that is perpendicular to the planned attack heading. Generally, there is time for one correction on base. While base position may be slightly altered to adjust pattern spacing, it is discouraged as this requires changes to the roll in to get to the planned wire on final. If excessively close to the preceding aircraft, consider using a normal base position and go through dry on final. Subsequently, adjust pattern spacing on downwind.

5.10.8. Wind Corrections in the Conventional Pattern. When dealing with winds in the pattern, three adjustments need to be made: the lead point for the turn to base, the base position itself, and the heading to hold that ground track. For a headwind (on final), pilots will need to turn base slightly earlier compared to no wind. In addition, adjust the base distance closer to the target, and roll out with a crab into the wind. The opposite is true for a tailwind (on final). This will also affect the canopy references, so the target should be slightly closer to the canopy rail for a headwind or slightly further away for a tailwind. One finger width correction for each 10 knots of head/tailwind is a good ROT. For crosswinds (on final), adjust the roll in earlier or later, and expect to crab into the wind to achieve proper parameters.

5.11. Tactical Pattern Procedures.

5.11.1. Purpose. Like the conventional pattern, the tactical pattern allows "canned" delivery pattern training. In the tactical pattern you will perform popup attacks. Popup attacks are flown when weather or threats force you to ingress the target at low altitude.

5.11.2. Tactical Pattern Overview. There are two types of pop patterns that are flown in BSA: direct and indirect. Direct pop patterns involve a run-in directly to the target followed by an "action" where a turn is made a specific distance from the target to create an offset prior to rolling in. An indirect pop pattern is constructed so that the offset heading is flown immediately after rolling off the base position. Both attacks allow for target acquisition during the pop and subsequent pulldown to a diving attack.

5.11.3. Tactical Pattern Spacing Fixes. If required, use geometry to correct spacing; do not use airspeed changes. Depending on the pattern and airspace limitations, pilots may adjust spacing on the turn to downwind or at base. The lead aircraft will turn at the briefed spots. All following aircraft should use the preceding aircraft for timing the turn to base.

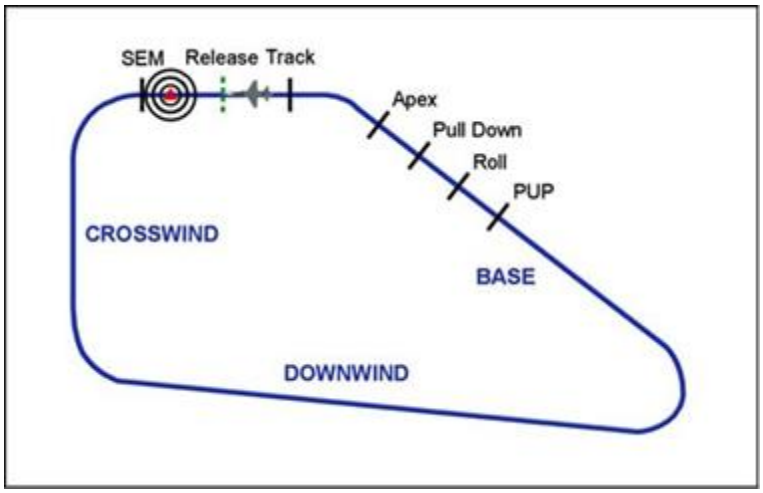
5.11.4. Downwind. After completion of the SEM, turn to crosswind. Priorities and tasks during this turn remain the same as during the conventional pattern. Once turning on downwind, complete the error analysis. Basic analysis of your position on final relative to the planned wire remains the same as during the conventional patterns.

5.11.5. Base Turn. Call "*Base*" just like in the conventional pattern, select MIL power, and start a descending turn toward the run-in ground track/approach heading. The goal is to roll out pointed at the appropriate target/heading as close to the planned parameters as possible. For a direct popup attack, roll out with the target designator container (diamond) centered in the pitch ladders (the FPM should be centered on the CCRP steering line). For an indirect pop-up attack, roll out on the appropriate heading. During the turn, pilots should keep their attention outside the cockpit while descending under G.

5.11.6. Run-in. The cross-check during the run-in should start with airspeed and altitude. Accelerate to and maintain the planned airspeed for the action and stay at the briefed altitude above the ground (typically 500 feet above ground level [AGL]). After initial adjustments to airspeed and altitude, bring range to the target (in the NAV block in the bottom right corner of the HUD) and heading into the cross-check. For indirect patterns, flying a wind-corrected ground track is necessary to arrive at the proper pullup point. As the distance measuring equipment (DME) counts down to within 0.2 NM of planned action or pullup range, attention should stay on the range to the target to ensure a timely action.

5.11.7. Action Point. For direct pops, the check turn at the action point is designed to set the target at a known angular distance off the nose. At the specified range, select MIL power, and execute a 3 to 4 G level turn for the appropriate amount of check angle and roll out. Several ground references may exist in the pattern to confirm the accuracy of the action point, the action heading, and/or the popup point. Attention should be outside with the priority being the ground. For indirect pops, there is no action; fly directly from the base turn to the popup point (**Figure 5.4**.).

Figure 5.4. Indirect Pop Pattern.



5.11.8. Popup Point. Select MIL power and execute a 3-G pullup to the appropriate climb angle (15° for a 10° delivery and 30° for a 20° delivery). Call "*C/S up*". The goal is to precisely fly the "climb wire," acquire the target, and be ready for a timely pulldown.

5.11.8.1. Cross-Check Pacing. Start with the FPM/pitch ladder, transition to the target, look back inside at the FPM, and finally, check altitude. For both the 10° and 20° pop patterns, this pacing will get your eyes through the required items and back to altitude about 2 seconds prior to pulldown altitude.

5.11.8.2. Target Acquisition. As noted above, after the climb angle is initially set, the next task is to find the target. The target should be just behind the canopy bow, slightly below the mirror. From there it will drift down and aft. For the 10° pop, when pulldown altitude is reached, the target will be in the "pocket" formed by the canopy rail and canopy bow intersection. For the 20° pop, the target will be further aft and on to just under the canopy rail at pulldown (**Figure 5.5**.).

Figure 5.5. Pop Attack Pulldown Canopy Code.

5.11.8.3. Climb Angle. It is important to double-check the FPM is at the desired climb angle after acquiring the target. It is common for it to drift high or low while finding the

target. This leads to deviations in the "climb wire," which in turn make it harder to roll out on final on the planned wire for weapon release. Trim as a technique to combat this effect.

5.11.9. Pulldown Point. Anticipate the pulldown altitude, but there is no need to lead it. At pulldown altitude, execute an unloaded roll to put POM long of the target on the AOP, and start a 4 G pull.

5.11.9.1. Pulldown LV placement. The pulldown LV should be placed to keep the POM on the AOD, just like the conventional pattern. For the 10° pop, initially, this will equate to about 100 to 110° of bank (LV just past the horizon). For the 20° pop, pilots will have to over-rotate further to about 135° of bank.

5.11.9.2. Apex Crosscheck. Approaching the apex of the pulldown, a quick crosscheck in the HUD is warranted to build airspeed SA. If it appears the aircraft will approach or slow below 300 KCAS, modulate the pulldown G to stay above 300 KCAS, or abort the pass and go through dry. This problem is more of an issue on 20° popup attacks with the aircraft below briefed airspeed prior to the popup point.

5.11.10. Rolling Out on Final. Just like the conventional pattern, as the target approaches the edge of the pitch ladders, begin a smooth rollout so that once wings level the target is centered in the pitch ladders. On the 20° attack, a rollout of ~135° is required to get back to wings level. It is important that the roll is unloaded; if this roll is loaded, the FPM may run well long of the AOP prior to finishing the rollout. Additionally, be aware that, compared to the conventional pattern, there are more opportunities to induce errors prior to rolling out on final that will put the aircraft somewhere other than on the exact planned wire. Knowing this, strive to be as precise as possible with airspeed, action/pullup range, G, climb angle, and pulldown altitude, as deviations in any of these areas can lead to follow-on problems.

5.11.11. Final. Once rolled out on final, the 10° and 20° pop pattern finals are identical to those of the conventional pattern. Procedures from this point through the SEM are the same as the conventional pattern roll in through final and are discussed in **paragraph 5.13**.

5.12. Level Pattern Procedures.

5.12.1. Level Pattern. The level pattern is similar in shape to the conventional pattern except for a wider base distance; the flight lead will brief the specific ground track plan. Basic priorities and tasks remain the same as the conventional pattern; however, base distance does not impact weapons delivery like it does for diving events.

5.12.2. Base. The base distance is not as critical in the level pattern, but a tight base will shorten the time on final. Call "*Base*" and execute a MIL power descending turn. The amount of descent should be commensurate with the visibility. Strive to get at least halfway down to 500 feet AGL during the turn. Remain higher if visibility requires, until the target references can be seen.

5.12.3. Final. Lead the turn to final to roll out on the attack axis. Call "*In dry*" while starting the turn. Continue the MIL power descending turn to roll out no lower than 500 feet AGL (FPM centered on the CCRP steering line if using CCRP). Get down to 500 feet AGL expeditiously, adjusting power to maintain 420 KCAS and trim the jet. If CCRP was used initially, select CCIP using the hands-on throttle and stick (HOTAS). Make small adjustments in heading and crab angle to maintain the ground track with the BFL through the target.

Anticipate the fast pipper track and pickle at the base of the target. Select MIL power at G onset and execute the briefed SEM.

5.13. Weapons Employment.

5.13.1. Roll In. Pilots should use the target as your reference for when to roll in; attempt to lead turn to roll out on final at the planned attack heading. Roll-in pacing will vary based on altitude and airspeed at the roll in. The lower and/or faster the aircraft is prior to roll in, the earlier the roll in should be. The roll in is used to transition from base to the planned wire, arriving on final at the planned attack heading, flying to the AOP. It is essential that the attacking aircraft's POM remain on the AOP throughout the roll in.

5.13.1.1. Communication and HOTAS. Upon cracking wings for the roll in, call "*C/S, in dry*". The RCO may wait until visual to confirm that the aircraft is rolled out on the attack heading before calling "*Continue dry*". Make another call if clearance is not received after a couple of seconds. Additionally, the RCO may respond to an "*In*" call with "*Continue*". In this case, no response is required; continue the attack expecting to hear "*Continue dry*" shortly. Do not release ordnance unless/until the RCO calls "*Continue dry*". If in CCRP, wait to go from CCRP to CCIP until rolling towards the target area to minimize the opportunity to accidentally release a weapon somewhere other than the impact area on the range.

5.13.1.2. Roll-In Mechanics. While the target is the primary reference, eyes should transition from the target to the AOP in the roll in. The goal is to set the LV to start the aircraft tracking towards the AOP and then refine the LV to keep POM on the AOP. Adjust the LV as required during the end of the roll in to have the AOP set as precisely as possible prior to roll out.

5.13.1.2.1. Initial LV Reference and Bank Angle. IFF conventional attacks are normally planned for 3 to 4 Gs. Approximate, initial LV ROTs are:

- 10: LV 5° above the horizon (equates to approximately 100 ° of bank)
- 20: LV on the horizon (equates to approximately 110° of bank)
- 30: LV 10° below the horizon (equates to approximately 120° of bank)
- 45: LV 30° below the horizon (equates to approximately 135° of bank)

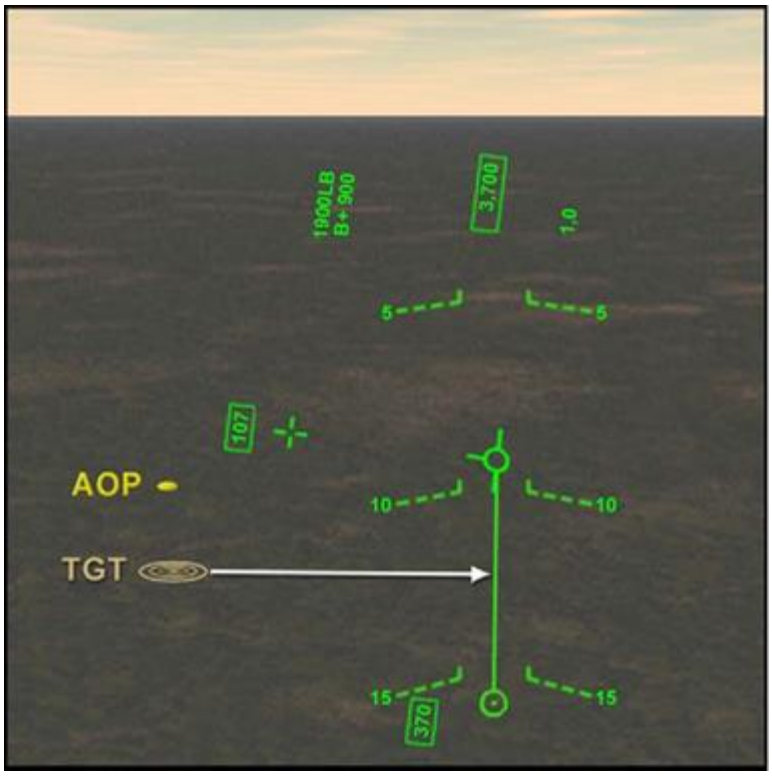
Note: These references are good for understanding where the LV should be for an accurate POM; however, during execution attention should be on the AOP. Concentrate on pulling the gun cross or FPM toward the AOP and not directly to the target. Precise base parameters followed by a repeatable roll in are the best way to build the experience to "see" and fly to the planned wire.

5.13.1.2.2. Using the Roll in to Compensate for Base Errors. If rolling in from an incorrect base position without correcting it or noticing it until time to roll in, it is possible to adjust the roll in LV to compensate. If the base position appears too far out, the turn should be flown level for the first 30° to 45° before over-rotating toward the AOP. If the base position appears too tight, slightly over-rotate (by 5° to 10° of bank) for the first portion of the turn, and then readjust the LV towards the AOP.

5.13.1.2.3. Adding ITP to the Roll In. Initial target placement is a useful technique to refine LV control during the final portion of the roll in. ITP can be read directly off the pitch ladders as the target approaches the HUD (**Figure 5.6** shows an ITP of 13° for the 10 low-angle high-drag [LAHD] roll in). Approximately two-thirds of the way through the turn, the FPM will approach the planned dive angle for the attack. As the target approaches the HUD FOV, an assessment of the wire is made to adjust the final portion of the roll in, the earlier, the better. Assess where the target is tracking relative to the pitch ladder in the HUD. If it is trending towards a point that is greater than planned ITP, the aircraft is above the planned wire: over-rotate slightly. The opposite is true if the target is trending towards a point on the pitch ladder that is less than ITP. In this case, raise the LV slightly. Making the above ITP corrections will get the aircraft closer to the planned wire at roll out.

5.13.1.2.4. Rolling Out on Final. As the target approaches the edge of the pitch ladders, begin a smooth rollout so that once wings level the target is centered in the pitch ladders. This will compensate for any crosswind present; the target and pitch ladders will be offset downwind left or right with the BFL centered vertically through the target.

Figure 5.6. Adding ITP to the Roll In.



5.13.2. Final. Once rolled out on the final attack heading, there are numerous items to cross-check and adjust in a relatively short amount of time (approximately 5 seconds).

5.13.2.1. Fly to the AOP. If the base, roll in, and rollout portions of the pattern have been flown well, the aircraft should arrive on or near the planned wire and be pointing at the wind corrected AOP (while the flightpath marker will be close to the target's 6/12, the gun

cross will be more offset left or right; pointed into the wind). Flying towards the AOP will help keep the aircraft on the planned wire and fly it to the correct point in space at release producing the desired weapons effects. If base distance or the roll in weren't flown perfectly and the aircraft ends up off the planned wire at rollout, adjustments can be made to converge back towards the appropriate wire to arrive as close as possible to the desired release point.

5.13.2.2. AOP References. On range, AOD markers (easy to identify points at known distances), are helpful in judging where a particular AOP lies. If at roll out the AOD is not set, a positive push over or pullup must be made to put the FPM on the AOP. The earlier this is done the more time the jet has to correct back to the proper release point before release. Visually, the FPM should remain on the AOP through pickle. Different from HUD track references, AOD is valid at any altitude and so should be set and held from rollout to release. The use of the HUD references can be used on the range as well. HUD references are discussed later in this section. Regardless of the technique used, pilots will set dive angle by adjusting the FPM relative to the visual AOP or the target. ***Do not*** blindly adjust the FPM relative to the pitch ladders to achieve the planned dive angle. Correct dive angle does not always indicate correct wire.

5.13.2.3. Confirm Target Location. During any attack, make certain that the correct target has been identified; if unsure, abort the pass.

5.13.2.4. Power Modulate. Build awareness and modulate the throttles as required. Assuming that roll in airspeed were flown, the following power adjustments to idle will generally result in a weapons release inside the airspeed window of 400 to 440 KCAS:

- 10°: 400 KCAS (half-way down final)
- 20°: 380 to 390 KCAS (half-way down final)
- 30°: 350 KCAS (at roll out)
- 45°: starting the roll in

5.13.2.5. Correct 3/9. The target should be on or very near the BFL. Make a small change in bank to put the target on the BFL and roll out. Avoid 'S'ing through final by attempting one small correction. Hold a small amount of forward stick pressure or trim so as not to let the FPM run during 3/9 corrections. If a big 3/9 correction is required, bank into the target pulling the BFL back to the target and roll out. A small amount of bank at pickle is acceptable but not ideal. Make big 3/9 corrections quickly as positive G on final will cause the nose to drift up away from the AOP.

5.13.2.6. Adjust at Track Altitude. IAA and %BFL are only valid at track altitude. Track altitude is planned to occur shortly after rolling out on final. With experience, pilots will be able to maintain awareness of track altitude while diving through it by precisely using the HUD track reference right at track altitude. Until then, using the HUD track reference shortly after rolling out on final is a good approximation of track altitude.

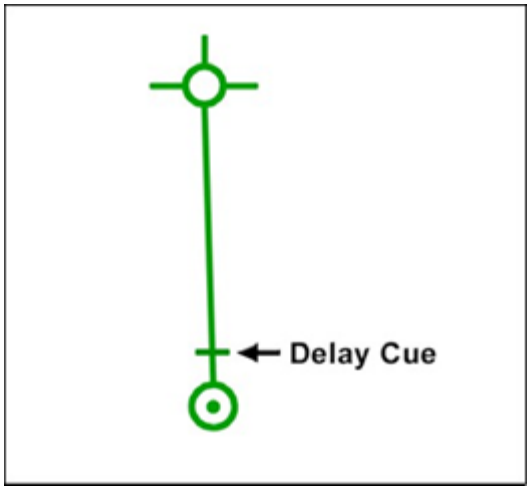
5.13.2.6.1. Using IAA. Once rolled out on final (at track altitude), pullup or push over as required to set the FPM the specified number of degrees (IAA) long of the target. If you rolled out on the planned wire, it should already be there with no adjustment required. Once it is set, the point on the ground now under the FPM is the AOP, and

the aircraft must be flown to that point using the visual AOP techniques discussed above. The point of using a HUD reference is that it eliminates the need to visually estimate distances over the ground. Once the HUD reference tells you where the AOP is, however, flying to it is accomplished the same way.

5.13.2.6.2. Using %BFL. All the above principles associated with IAA are the same for %BFL. The only difference is that instead of setting the FPM relative to the target using degrees, pilots will use a position on the BFL relative to the total BFL. Once rolled out on final (at track altitude), pullup or push over as required to set the target at the specified percentage of total BFL (measured down from the FPM).

5.13.2.6.3. BFL Delay Cue. There are times when the pipper is HUD limited (due to being excessively high, slow, or due to heavy headwinds on final). In this case, the entire BFL is not displayed in the HUD. Real-time this is indicated to the pilot by the presence of the delay cue on the BFL (**Figure 5.7**). This rarely happens, however, if %BFL is used, plan to include the delay cue in the cross-check after rolling out on final; be ready to transition to IAA if required.

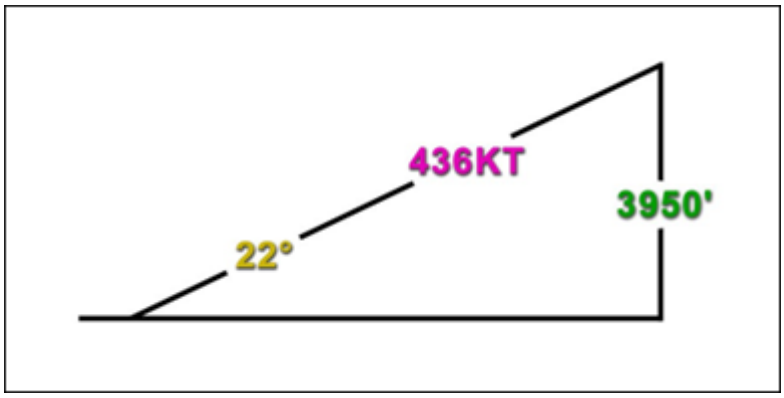
Figure 5.7. Delay Cue.



5.14. Error Analysis. Once established on downwind, with SA on the preceding aircraft, assess the previous pass relative to the plan. Both pilot-induced errors and wind can cause deviations. Many pilot-induced errors can be fixed by returning to and reinforcing the original game plan; common errors include forgetting the throttles on final, roll in LV on the target, etc. In other cases, the base position may need to be adjusted, either because it was errantly flown or to compensate for wind.

5.14.1. Automatic Scoring Display. The automatic scoring display can aid in analyzing weapon delivery (**Figure 5.8**.). Dive angle, altitude, and airspeed at release will be displayed. If confident the roll in and weapons delivery mechanics were executed IAW the plan, consider moving the base position closer or further away from the target as required. Remember to account for winds; they may be different on range compared to the forecast for which the plan was built.

Figure 5.8. Auto Scoring Display.



5.14.2. Wire Analysis. Wire analysis using the automatic scoring display is based on the dive angle and altitude at release (**Figure 5.9**.).

5.14.2.1. High/Steep (High, Converging Wire). Pilot rolled out above the wire but likely found the correct wire with an accurate AOP.

5.14.2.2. High/On Planned Dive Angle (High, Parallel Wire). Pilot rolled out above the wire but did not set the AOP (probably errantly set the planned dive angle).

5.14.2.3. High/Shallow (High, Diverging Wire). Pilot rolled out above the wire, didn't set the AOP correctly, and subsequently let the FPM run long.

5.14.2.4. Low/Shallow (Low, Converging Wire). Pilot rolled out below the wire but likely found the correct wire with an accurate AOP.

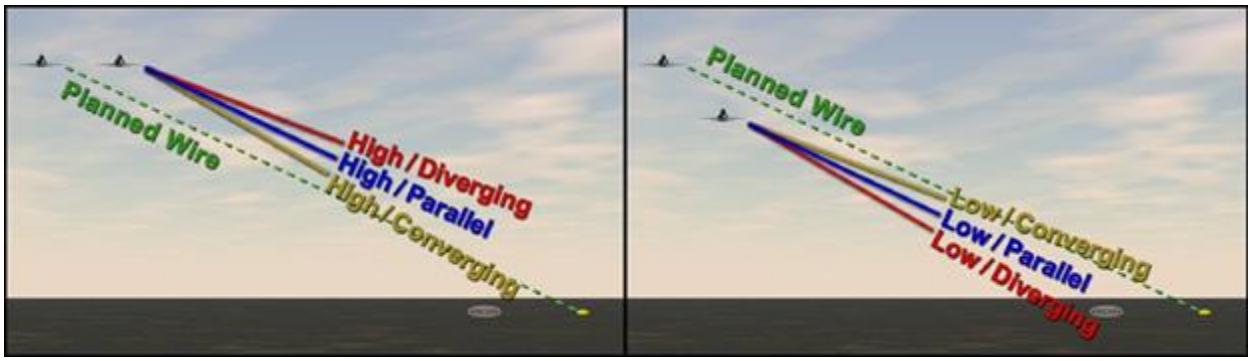
5.14.2.5. Low/On Planned Dive Angle (Low, Parallel Wire). Pilot rolled out below the wire but did not set the AOP. (MRA was probably a factor.)

5.14.2.6. Low/Steep (Low, Diverging Wire). Pilot rolled out below the wire, did not set the AOP and subsequently "pushed" the FPM even lower. (This scenario is unlikely to happen as MRA will likely be a factor well before the pipper reaches the target.)

5.14.3. Pipper Placement. Once flying good parameters, pilots can begin to assess where they pickled. Was it at the intended location? If not, then on the next pass, do so while flying an on-parameters pass. If the pipper was on target, work to improve it by changing the spot of the pickle. One technique is to apply 1/2 correction in the opposite direction (a correction for a score of 69/12 would be to pickle 34/6).

5.15. High-Angle Strafe (HAS). HAS is defined as any strafe pass planned with 15° of dive or greater. Currently, each fighter MDS executes HAS slightly differently. For example, F-15Es and F-16s typically use 25°; and A-10s use 30° or greater. The minimum recovery altitude is 500 feet AGL daytime and 1,000 feet AGL for night. HAS attacks are often planned to recover above 1,000 feet AGL to allow the use of one set of numbers for both day and night. Units will incorporate MDS-specific considerations when computing standardized attacks.

Figure 5.9. Wire Analysis.



5.15.1. Pattern. HAS is flown out of the conventional pattern. During the downwind checks, ensure the correct target steer point is selected.

5.15.2. Base Position. Because the AOP for strafe is the target and not a point beyond the target and the track time is longer than for a typical bombing pass, the base position will be wider than for a bombing pass of similar dive angle. The canopy code for HAS base position will look slightly wider than a bombing pass of the same dive angle as well. For 25° HAS, use the same canopy code as for a 20° bombing pass. For 30° HAS, use approximately two fingers above the canopy rail (no wind).

5.15.3. Roll In. The roll in should be planned to roll out on the attack heading pointed directly at target. This roll in will be very similar to the conventional 30° roll in. Use MIL power and call "*C/S, in dry*" once starting the turn from base. Switch to the strafe mode once starting the roll in. Remember that if switching from CCRP to strafe mode, it will require two clicks of the weapon mode switch. Use the target approaching the gun cross as a reference for when to roll out.

5.15.4. Final. The CCIP gunsight will initially fall below the gun cross and horizontally will be positioned between the FPM and gun cross (if there are no crosswinds, the gun cross, FPM and gunsight will all be lined up vertically). Once tracking towards the target and slant range decreasing, the gunsight will rise closer to the gun cross. Track time will be longer than on a typical bombing pass, approximately 6 to 9 seconds.

5.15.4.1. Initial Aiming References. Initially, pull the gun cross towards the target and set the bottom of the gun cross on the target. If there are crosswinds on final, put the target laterally halfway between the gun cross and FPM. Hold this picture (bottom of the gun cross on the target's 3/9, with the target between the gun cross and FPM) and start to bring airspeed and slant range into your cross-check (**Figure 5.10**.).

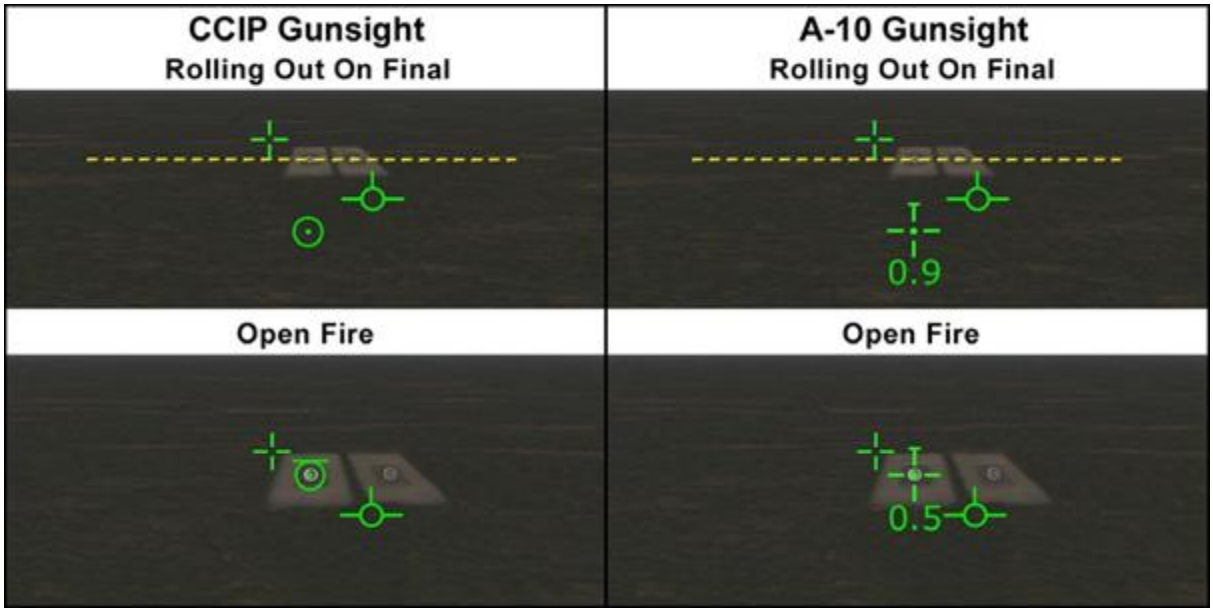
5.15.4.2. Airspeed. Reduce power from MIL to idle as airspeed accelerates through 350 to 370 KCAS.

5.15.4.3. Slant Range. The T-38C "A-10" gunsight gives slant range in nautical miles immediately below the gun cross. The T-38C gunsight provides slant range in hundreds of feet in the lower right-hand corner of the HUD—a more difficult cross- check. With either pipper, as slant range decreases towards open fire range, refine the firing solution, easing the pipper to the target. Note: Once inside 4,000 feet, the "in- range cue," or "hat", is

displayed on top of the T-38C pipper. This range is well inside of planned open fire range (and even inside of cease fire range) for HAS, so it is of little use for HAS attacks.

5.15.5. Open Fire/Cease Fire. Reference **Figure 5.10**. Use the slant range indicated below the CCIP gunsight (A-10 pipper) or in the bottom right corner of the HUD (T-38C pipper) to determine when to open fire. Different airframes open fire at different ranges. F-16s and F-15Es need to open fire with their 20mm cannon inside of 6,500 feet slant range to achieve the minimum required bullet impact velocity for weapons effects. The A-10 with its 30mm cannon can effectively open fire well outside of this range, target dependent. All platforms normally fire a 2-second burst. All airframes also attempt to "track – shoot – track"; there should be enough time to be able to get a good 2-second burst before starting the climbing SEM. Thinking "track – shoot – track" will help ensure that the trigger is released prior to the SEM. In any case, cease fire and start the SEM once arriving at the cease fire slant range. The only requirement is to avoid a lazy pull-off; however, because of close proximity to the ground, it is generally briefed to treat the recovery similarly to a climbing SEM.

Figure 5.10. Strafe Final.



5.16. Low Angle Strafe (LAS). LAS is defined as any strafe pass planned with less than 15° of dive and is normally planned for 10°. The minimum recovery altitude is 75 feet AGL. The minimum cease fire slant range is 2,000 feet.

5.16.1. Pattern. LAS can be flown out of the conventional or the pop pattern. During the downwind checks, ensure that the correct target steer point is selected. A technique is to reduce the altitude for the RALT warning or turn it off (expect to be less than 300 feet AGL prior to cease fire slant range).

5.16.2. Base Position. Because the AOP for strafe is the target and not a point beyond the target, and the track time is longer than for a typical bombing pass, the base position will be wider than for a bombing pass of similar dive angle. The canopy code for an LAS base position from the conventional pattern will look slightly wider than a 10° bombing pass. Use a canopy code of two fist widths above the canopy rail.

5.16.3. Roll In. The roll in should be planned to roll out on the attack heading, pointed directly at the target. This roll in will be very similar to the conventional 10° roll in. Use MIL power and call "*C/S, in dry*" once starting the turn from base. Switch to the strafe mode once starting the roll in. Remember, if you are switching from CCRP to strafe mode, it will require two clicks of the weapon-mode switch. Use the target approaching the gun cross as a reference for when to roll out.

5.16.4. Final. The CCIP gunsight will initially fall below the gun cross and will be horizontally positioned between the FPM and gun cross (if there are no crosswinds, the gun cross, FPM, and gunsight will all be lined up vertically). Once tracking towards the target and slant range decreases, the gunsight will rise closer to the gun cross. Track time will be longer than on a typical bombing pass, approximately six to nine minutes.

5.16.4.1. Initial Aiming References. Initially, pull the gun cross towards the target and set the bottom of the gun cross on the target. If there are crosswinds on final, put the target laterally halfway between the gun cross and FPM. Hold this picture (bottom of the gun cross on the target's 3/9, with the target between the gun cross and FPM) and start to bring airspeed and slant range into the cross-check (**Figure 5.10**.).

5.16.4.2. Airspeed. Like the 10° conventional bomb final, reduce power from MIL (stand up the throttles) as airspeed accelerates through 390 KCAS.

5.16.4.3. Slant Range. See **paragraph 5.15.4.3**.

5.16.5. Open Fire/Cease Fire. See **paragraph 5.15.5**.

5.16.6. Alternate Panels. Normally on a controlled range, there will be at least two active panels. A common technique is to strafe alternate panels (that is, if number one chooses panel one, then number two strafes panel two; number three strafes panel one, etc.). This allows time for the dust to clear on that panel from a previous pass. If the flight is using more than one panel, add "*Panel one*" (or two as required) to the "*In*" call.

Chapter 6

SURFACE ATTACK TACTICS (SAT)

6.1. Overview. Although several definitions of SAT exist throughout the CAF, for the purposes of this chapter, SAT will be the bridge between BSA sorties and close air support (CAS). This mirrors the A-10 community's use of the acronym and purpose of the sortie. SAT is the first time you will be asked to find the bombing/strafing wire without the use of ground references like base distance and AOD. Additionally, you will be introduced to the Theater Air Control System (TACS), two-ship attack profiles and geometry, and mutual support contracts, both from medium and low altitude.

6.2. Mission Planning. Detailed mission planning is the key to success in the SAT phase. In addition to the standard BSA mission planning tasks, aircrew will discuss a kill container type scenario. Pilots will need to provide copies of target area maps (1:50,000) and/or imagery (1:5m). Learning as much as possible about the target area, lead-in features, and environmental and target descriptions will reduce workload during the target ID stage of the sortie. Typically, a 1:50,000 scale map with military grid reference system (MGRS) grids clearly depicted will be most useful in the air. Target imagery can be helpful in the brief more than in flight but having it on hand in the air could prove useful. In addition, SAT mission planning is the first opportunity to understand how combat weapons delivery software can assist in computing attack parameters. The SAT brief will consist of target area discussions, weapons delivery, flight lead's contracts, and attack geometry. Know the range regulations and the A/S training rules.

6.3. Ground Ops. Most of the changes to the avionics and UFCP can and should be made on the ground. The EGI steer-point plan should match flight lead (the card) to avoid confusion in the air when discussing different targets. Most scenarios will involve an initial point (IP) for reference, and two or more steer points with preplanned target coordinates. Weapons other than BDU-33s will be simulated, so the weapons menu on the MFD will need to be updated to reflect the simulated weapons. Flight lead will also be directive as to what weapons program will be assigned to each bomb type and delivery parameters. Because pilots will likely have more products than they are used to, a good discussion on cockpit organization is warranted.

6.4. Departure. Flight plans to and from the range will be standard. A low-level that can lend itself to low-altitude ingress may also be used. Expect to fly only a few legs of the low-level to save gas for the SAT. Flying a stereo and canceling early enough to ingress the range at hold altitude may also be a viable tactic for your low-altitude ingress. Your priorities when flying this departure are mutual support providing visual lookout and communication to keep your flight safe from threats (both real and simulated). Some of the Theater Air Control System (TACS) coord can be done on the ground, and some enroute to the range, so be ready for both.

6.5. Mutual Support. The reason fighters fly in formation is to provide one another with mutual support. Mutual support in its basic form is visual lookout, communication, and firepower. Everything in IFF has been a building block to get to this point. Pilots learned how to fly formation; provide clear, concise, correct communications; and how to employ simulated weapons through the various phases of IFF. Now it's time to combine them all in what could be a real-world mission. Flight lead will brief how the flight is going to provide and maintain mutual support throughout the entire sortie.

6.6. Theater Air Control System (TACS). The TACS provides the commander the capability to plan and conduct joint air operations. The purpose of this paragraph is to introduce TACS, not to build a complete command and control (C2) system. There are many facets to TACS, but this document will focus on information gathering from the pilot's perspective in the jet, and specifically to the IFF syllabus. For an in-depth reading on TACS, reference Joint Publication (JP) 3-09.3, *Close Air Support*, Chapter II. Information gathering for a SAT sortie will begin in the brief. Performing thorough map study and having a working knowledge of the scenario will lessen confusion airborne. Normal pre-mission planning cannot be overstressed. This is the start of what is known as "filling your SA cup". (**Figure 6.1**.)

Figure 6.1. SA Cup.

6.6.1. AWACS/Control and Reporting Center (CRC). The AWACS is an airborne platform designed to provide the air picture to the war fighters. The CRC is the same type of system but is based on the ground. Both can provide almost the same information. When checking in with them, a member of the formation will provide them with the following information: callsign, mission number, and position relative to bullseye (B/E). Expect that they will want to authenticate the formation with a known code. Information that is provided to the formation is a sweet-and-sour check of the IFF/selective identification feature (SIF) system (covered more in the CAF) and the picture of the airspace. They can provide status of tankers, fighters, and other players in the area of operations (AO) as well.

6.6.2. Air Support Operations Center (ASOC). The ASOC is the focal point for all the Army ground requests for air support. The Navy and Marines also have a similar unit. When contacting the ASOC, pilots will provide them with callsign and mission number. Once again, expect authentication procedures. They should provide an AO update consisting of threats, targets, friendlies, artillery, clearance authority, and possibly target area weather. They should also give the callsign and frequency of the forward air controllers (airborne) (FAC(A)) or joint terminal attack controllers (JTAC) in the assigned area of responsibility (AOR). During the SAT phase, pilots may not get all this information due to training limitations. The ASOC is also where pilots will provide an in-flight report upon exiting the AO. The in-flight report

consists of callsign, mission number, location (coordinates), time on target, results, and any other remarks (e.g., weather, threats, significant sightings).

6.6.3. FAC(A)/Fighters. Once in the AO and if present, the flight will contact the FAC(A) or the fighters that are leaving the AO. Pilots can always ask them for any updates to the AO. Usually, these players will have good SA and information about the AOR. If a FAC(A) is present, expect to work with them throughout the AO time slot.

6.6.4. JTACs. JTACs are enlisted Air Force personnel assigned to work with the Army. They are trained much like an FAC(A) on how to control air assets from the ground to destroy targets. They are on the front lines putting eyes on targets that the ground commander wants or needs destroyed. They will generally have the highest SA on what targets need to be hit. However, they can have limitations due to their positions on the ground such as radio LOS, visual LOS to targets, etc. During SAT training, pilots will likely not talk to or have a simulated JTAC. Having a JTAC on the ground generally implies that there are other friendly forces in the area. This situation requires detailed coordination with ground forces to safely affect the battlespace. Employment in this situation is called CAS and beyond the scope of this chapter.

6.6.5. Flight Lead Eyes On. Finally, once the flight is established in the AOR, the flight should have all the pertinent data with respect to Threats, Targets, Friendlies, Artillery and Clearance (TTFAC). Flight lead can now use all the data gained through the TACS coord and compare it with what the flight is seeing on the ground. With that information, the flight lead can make an informed decision on how best to maximize the flight's mutual support to achieve the desired effects of the battle space.

6.7. Medium-Altitude Tactics. There are several reasons why one would choose medium altitude tactics. Oftentimes, flight leads are forced into medium-altitude tactics due to constraints from higher headquarters. In these cases, the threat is generally low, and medium-altitude tactics offer a safer margin from error. These tactics can aid the pilot in consistently being able to have eyes on the target area. It also increases LOS capabilities for communication and loiter time due to gas savings. Some drawbacks include not being able to positively identify friendly versus enemy forces, susceptibility to unknown threats, weather issues and, in some cases, weapons effects. All these factors are part of the flight lead's mission planning and are always being updated once in the battle space.

6.7.1. Medium-Altitude Tactical Administration. Once the flight is established in the AOR, or in the case of IFF, the range, some tactical administration must be accomplished. Expect the flight lead to check in with the ranger and call for the FENCE-IN. FENCE-IN according to the brief and fly the briefed formation. The flight may or may not execute a G-exercise. Next, expect the flight lead to establish the flight into some sort of holding pattern from which to attack.

6.7.2. Medium-Altitude Holding. The most common hold in the daytime medium-altitude arena is the wheel. Although any fighter pilot, if given the option, would prefer a left-hand wheel to facilitate left-hand roll ins, pilots should strive to see both right- and left-hand wheels. In the future, the fighter's main sensor will be the targeting pod, and wheel directions will depend on which side of the jet the pod is mounted. Other holding options are offset **figure 8**, bone holding, and random holding. Depending on the tactical situation, the flight lead may choose one over another to maximize mutual support. Be attentive in the brief to see what holding is expected, but be ready for whatever the tactical situation requires once in the AOR.

6.7.3. Medium-Altitude Execution. In the T-38, the most common medium altitude deliveries are 30° dive bomb (DB) and 30° HAS. Typical base altitudes for these deliveries are in the 8,000 to 10,000 feet AGL regimes. As such, the hold will be in a similar altitude regime. At approximately 3 NM from the target area, a 10,000-foot hold allows a comfortable 30° to 45° of constant bank at 300 KCAS. One formation you may fly is a trail position (**Figure 6.2**.). Using the canopy reference shown here (**Figure 6.3**.), 1.0 to 1.5 NM on the AAT will help hold a good position. Another good holding formation is wedge (**Figure 6.2**.). This allows the wingman to hold high and outside the flight to provide better mutual support. The wingman may burn more gas being on the outside but by using altitude and geometry, it can be avoided. One technique to avoid getting stripped and falling to trail is to close in the range from 6,000 to 9,000 feet to 3,000 to 6,000 feet. Some flight leads may refer to this as "Combat Trail".

Figure 6.2. Medium-Altitude Holding.

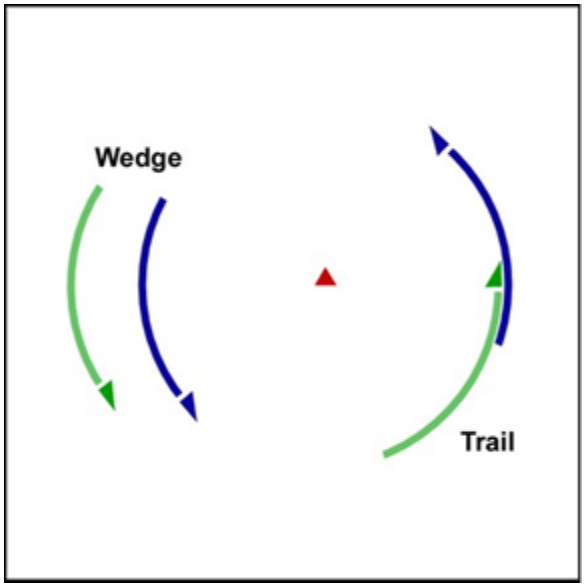
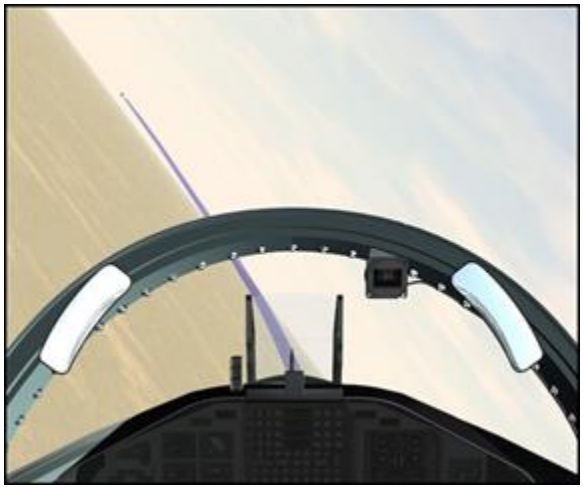


Figure 6.3. Wheel Canopy Reference.



6.7.3.1. Attack Roles. While established in the AO, pilots will spend a great deal of time looking outside and listening to the radio to gather all the information needed about the

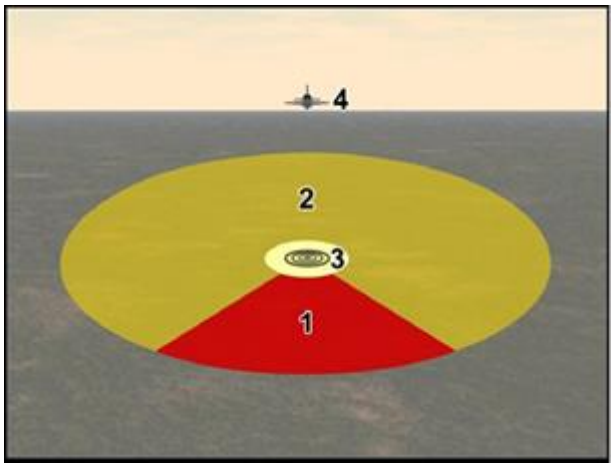
next attack and to find the target. For each attack, each pilot will have a specific role. Flight lead will brief what exactly is expected of the wingman for each attack. As a result, in the air flight lead will pass the Fighter-to-Fighter brief over inter-flight radio. Typically, it will be in the format: Formation, Role, Ordnance, Timing, In and Off Directions, and a Sort. Wingman's contract/responsibilities for each of these roles will be briefed. Here are some examples of the types of roles to expect:

- Shooter – Employing ordnance
- Cover – Guaranteeing mutual support with visual and comm
- Suppressor – Employing to suppress enemy defenses (so similar to 'shooter' that it's rarely used)
- Recce – Building target area SA with visual lookout (wingman are always recce)

From medium altitude, expect the flight to run either Shooter/Cover or Shooter's attacks. The wingman's job leaving the hold will be to maneuver to a good base position for the delivery or to a mutually supportive formation while flight lead employs.

6.7.3.1.1. Cover. If tasked with the cover role, the wingman will stay in the wheel at altitude while providing flight lead with visual lookout and comm mutual support. Continue to fly the same ground track while lead rolls in. The wingman will be almost looking down flight lead's tail pipes as they pickle. This position will build SA on the target, as well as give the wingman a great view of the section of earth flight lead can't see, behind and underneath their jet. Wingman's lookout priorities are 1) underneath flight lead, 2) the area around the target, 3) the immediate target area, and 4) flight lead (**Figure 6.4**.). Flight lead will recover from the attack with the following priorities: SEM, clearing their six with 3D maneuvers, and then finding the wingman. Typically, lead is assumed to be blind off target, while the wingman is assumed to be visual in the cover role. The attacker, in this case the flight lead, should call "VISUAL" after the 3D maneuvering and prior to becoming established in the hold. Even prior to lead regaining the visual, the wingman may see the need to maneuver to regain position. Always strive to use geometry to fix spacing versus just power.

Figure 6.4. Lookout Priorities.



6.7.3.1.2. Shooter. When directed to drop, lead will assume the mutual support and deconfliction contracts that are normally the responsibility of the wingman. The wingman should, however, strive to stay close to the briefed formation position until starting the maneuver to a good base.

6.7.3.1.2.1. Finding Base. While accelerating to base airspeed, pilots should maneuver to the correct base altitude and distance. The primary reference for base distance is the canopy references learned on the conventional range sorties. This canopy reference is only valid from a wings level attitude and heading 90° to the desired attack heading, no wind. The tendency to 'mothball' or fly closer to the target to see it better will often lead pilots to be in a banked turn while establishing a known canopy reference. This results in being too steep to employ due to the 5° steep TR stop. To combat this problem, most pilots will 'square off' the last portion of their base turn to be both 90° out to the desired run-in heading, as well as allow a wings-level canopy reference assessment **(**Figure 6.5.).

Figure 6.5. Medium-Altitude Attack Pattern.

6.7.3.1.2.2. Finding the Attack Heading. A common error when executing wheel attacks is overshooting the desired final attack heading. A common technique for finding the right heading on final involves the use of the horizontal situation indicator (HSI). Pilots should be in the blue EGI mode during these sorties with the target coordinates plugged into the current steer point. Cross-check the blue bearing needle and start the roll-in when the bearing pointer is about 15° from the desired heading. Some pilots choose to mark their desired attack heading with the heading bug or CDI. Remember that flying a base position approximately 90° to the desired attack heading will make it easier to visualize the proper point at which to roll-in.

6.7.3.1.2.3. Finding the Wire. Realize that it may take several attempts to find the right base position. Don't be afraid to 'BFM the wire' when recognizing being close or wide of the planned base distance as learned in the SA phase (see **paragraph 5.13.2.4**.).

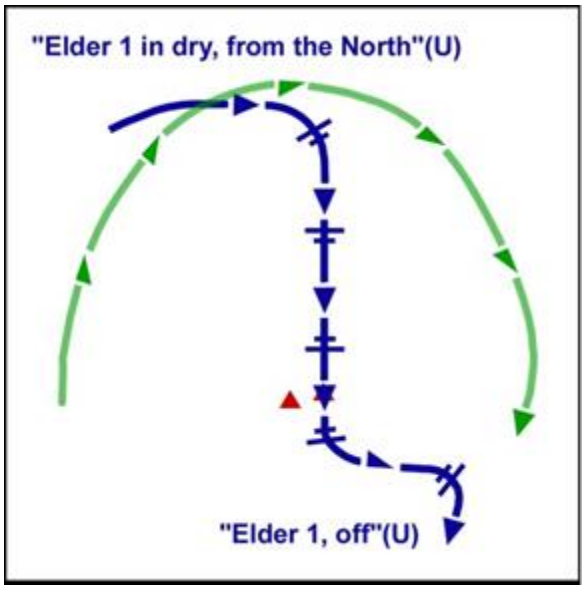
6.7.3.1.2.4. The Roll-In and On Final. In the medium-altitude regime, target ID should be taken care of prior to rolling in. During roll-in, if the target is small or difficult to break out based on surrounding features, the EGI target designator container (TDC) is a viable target acquisition aid. With these types of targets, it is common to pull directly to the target since the pilot is padlocked on it, resulting in a low wire. Remember to pull the FPM long and upwind of the target initially. Using ITP halfway through roll-in can help approximate AOD, then pilots can refine their AOP on final with IAA or %BFL. It is also common for the basics like power control and pipper placement to fall out when task saturated finding the wire. Be methodical about pull, center, set, your throttle technique, and get the BFL through the target.

6.7.3.1.2.5. Wind Corrections. With no attack heading restrictions and a significant wind aloft, consider rolling in based on the wind direction. Generally, tail winds are best because they push the bombing solution up in the HUD making for an easier pass. Headwinds have the opposite effect but can be easier to handle than a crosswind. Remember that the basic canopy references must be corrected for wind. A good ROT is one finger width for the first 20 knots of headwind or tailwind (on final) and an additional finger for every 10 knots above that. An example, if planning a west to east final attack heading and the winds are 30 knots out of the west, the pilot should fly the target two finger widths above the no-wind reference. Crosswinds should be avoided if possible but can be combated by centering the target in the pitch ladders at rollout and keeping the BFL on the target.

6.7.3.2. Medium-Altitude Tactics:

6.7.3.2.1. Shooter/Cover. The most basic of medium-altitude two-ship tactics is the shooter/cover role. This tactic maximizes mutual support but can sacrifice firepower. Fly the jet into a position that provides a good view of the ground underneath lead. Continue to fly in the same wheel and altitude while lead rolls in. As lead completes the SEM, the wingman adjusts the wheel to end up in a mutually supportive formation on lead once again. Be ready to build his SA about relative position if he asks for posit. (**Figure 6.6**.). Notice that the formation will use dry, CAS comm to build good habit patterns.

Figure 6.6. Medium-Altitude Shooter/Cover.



6.7.3.2.2. Cover/Shooter. Role swap, Number 2 is the shooter and lead is cover. The key to success is getting into a good base position. Stay in position in the wheel until about 90° out from the desired run-in heading. Square off the last 90° before rolling in to make the base canopy references familiar and valid. Adjust the base distance as appropriate with wings level when checking the canopy reference. Remember the technique that pilots are assumed to be blind off target. A "*Visual*" call will be required if visual and once the attack and 3D maneuvering is complete. You can expect your flight lead to be between 10 and 2 o'clock once off target (**Figure 6.7**.).

6.7.3.2.3. Shooters. Another common medium-altitude two-ship tactic is the shooter/shooter roles—both aircraft expend ordnance. This attack maximizes firepower but can sacrifice mutual support. This is most often used for multiple targets, hasty attacks, and Troops-In-Contact (**Figure 6.8**.).

Figure 6.7. Medium-Altitude Cover/Shooter.

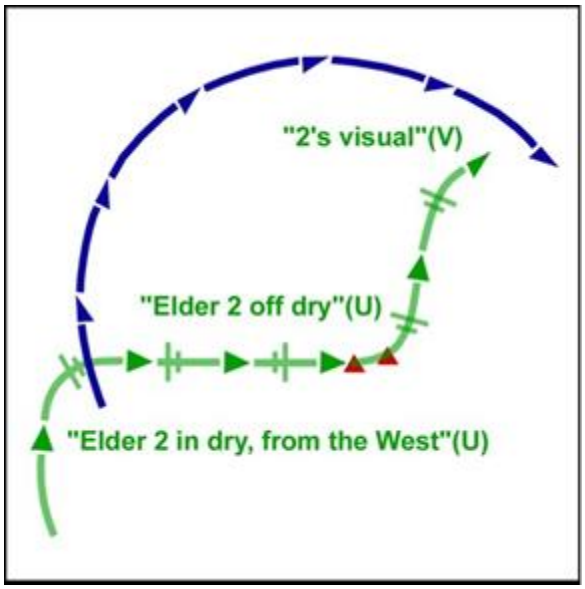
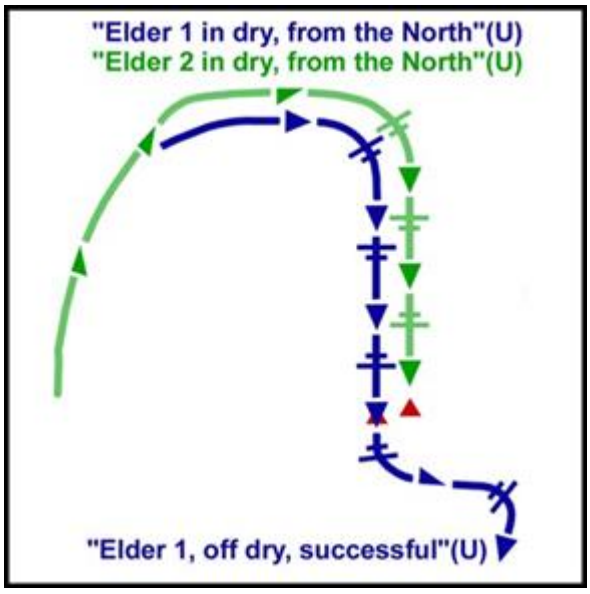


Figure 6.8. Medium-Altitude Shooters.



6.7.3.3. Off-Target Priorities. There are several tasks to accomplish once the pilot has pickled. Be sure to prioritize flying the jet first as always.

6.7.3.3.1. Valid Climbing SEM. The priority after weapon release is a valid SEM. The mechanics and parameters of the climbing SEM remains the same as the BSA pattern. Realize that the purpose of this maneuver is to keep safely away from the ground, the frag of the weapon, and to get away from threats in the area as quickly as possible. In the IFF SAT environment, there are no simulated threat reactions, but pilots should start practicing clearing their six, maneuvering three dimensionally, and flying the briefed geometry to help regain the visual and get back to a mutually supportive formation.

6.7.3.3.2. Clear Your Six. Use preemptive CMD to decoy infrared (IR) and radar threats. In all cases, your primary defense against anti-aircraft artillery (AAA) is three-dimensional maneuvers. In a medium-altitude (low-threat) environment, a climbing SEM will already have the aircraft moving in two dimensions; some minor check turns left and right while climbing back to hold altitude will suffice. Ensure sufficient energy is maintained to allow for a threat reaction.

6.7.3.3.3. Find Your Flight Lead. Pilots can expect lead to be between 10 and 2 o'clock after turning 60° to 90° off the attack heading. Pilots are assumed blind off target. Flight lead will typically give a few seconds following the wingman's SEM to move the jet IAW the contracts and to acquire the visual. If the visual is not gained (or not called) in a timely manner, lead will talk wingman's eyes back on. Lead should also provide a basic altitude deconfliction plan in the brief if the wingman is blind for an extended period. Remember to continue flying the geometry briefed even if not visual with lead and maintain the altitude deconfliction. In other words, turn back into the wheel around 3 miles vice extending several miles outside the fight.

6.7.3.3.4. Get Back into Position. Even with an 8,000-foot hold, the wingman will find themselves low on energy when trying to get back into formation on lead. Remember that a good SEM will increase energy. Beyond that, the best a wingman can do is keep the power in MIL and use geometry/cutoff to regain correct distance from Number 1.

6.8. Low Altitude. There are two main reasons why one would be forced into low-altitude tactics. It is usually derived from threats in the AO or from weather. These tactics demand a much higher level of SA and attention to detail than medium-altitude tactics. The biggest focus of low-altitude tactics is task prioritization. SAT sorties are demanding on their own, and much more so when having to perform all the tasks at low altitude. Remember, the biggest threat at low altitude is the ground. Some benefits of low-altitude tactics are surprise and in some cases weapons effects. Some drawbacks are not being able to identify the target, susceptibility to threats, and decrease in fuel efficiency, not to mention increased task loading. All these factors are part of the flight lead's mission planning and are always being updated once in the battle space.

6.8.1. Low-Altitude Tactical Admin. Low-altitude tactical administration will be the same as medium altitude. However, task prioritization is a must. Mutual support isn't just looking out for threats; it's keeping each other honest with respect to basic aircraft control as well.

6.8.2. Low-Altitude Holding. There are several ways to hold low altitude; however, the large turn radius of the T-38C limits these options. Here, in IFF, pilots will hold one of two ways: Racetrack or **Figure 8** at approximately 2,000 feet AGL and 350 KCAS. The shape of both is relatively self-explanatory. More specifically, however, the wingman should always strive to be in wedge outside of flight lead looking through them to the target and threat area. Also, whenever possible, flight lead will attempt to orient holding turns towards the target area. The main reasons for this are target area SA and target ID. By swinging the nose through the target area, pilots keep their visual lookout up and, if able, build target area SA via a quick steer-point diamond check as the target area passes through the HUD. During low altitude holding, the pilot's eyes must be outside the cockpit during any turns.

6.8.2.1. Figure Eight (**Figure 6.9**.). In the **figure 8** hold, the wingman will again be outside of flight lead in a line or wedge formation. Flight lead will turn towards the target at both ends of the hold.

6.8.2.2. Racetrack (**Figure 6.10**.). In the racetrack, the wingman will be outside of flight lead in line or wedge formation. Flight lead will turn as required to keep the flight in the hold; the wingman must use geometry to always end up on the outside of flight lead, opposite of the threat and target area.

Figure 6.9. Low-Altitude Wedge Figure 8.

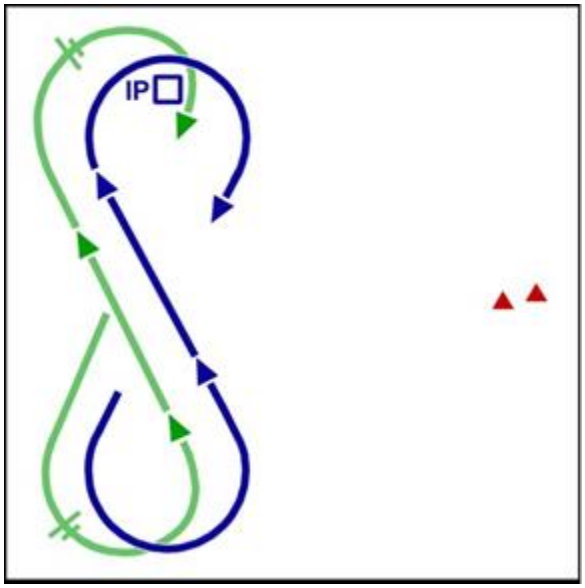
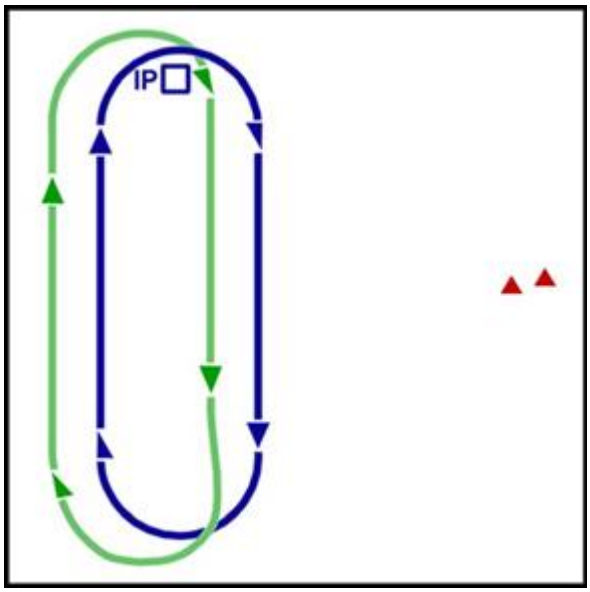


Figure 6.10. Low-Altitude Wedge Racetrack.



6.8.3. Low-Altitude Execution. Most likely, shooters attacks will only be executed in a low-altitude (high-threat) environment. The concept is that fighters do not stick their nose into the bee's nest without being offensive in some way. So, walking out of the brief pilots already know their role to be shooters, allowing for increased concentration on flying the briefed geometry and employing valid ordnance. Remember, the toughest task during the first pop will

be target ID, so good target area study in the brief is key. Although pilots will see other formations in the future, most attacks low altitude are done from wedge or trail.

6.8.3.1. Exiting the Low Altitude-Hold. As the wingman is on the outside of the hold turns, and lead will likely exit the hold turning away from the wingman, the wingman must take advantage of the geometry and available energy to expeditiously achieve the attack formation on the appropriate side.

6.8.3.2. General Contracts:

6.8.3.2.1. Fly Off of Lead. After exiting the hold, flow out to the 45° to 60° wedge cone, and strive to maintain at least 1 NM spacing. At the same time, the flight will be descending to 500 feet AGL and accelerating to 420 KCAS. Fly off flight lead, remembering to not fly below their altitude, and the wingman will end up close to the desired parameters. Cross-check RALT, AAT, and KCAS as required.

6.8.3.2.2. Action With/In the Same Direction as Lead. At the appropriate range for the attack, flight lead will action to pop. When lead's wings crack for this maneuver, the wingman should also begin their action. How much action will depend on the attack.

6.8.3.2.3. Pop Off of DME. Flight lead will provide visual cues for when the wingman should be popping. This is usually a specific time in their attack such as wings level on final, or at pickle. These are good cues, but when dropping bombs, parameters are so specific the wingman will need to use DME from the target as the primary reference for when to pop. The gun is a much more flexible weapon, so wingmen can use flight lead's cues as primary, but a DME backup will also be given.

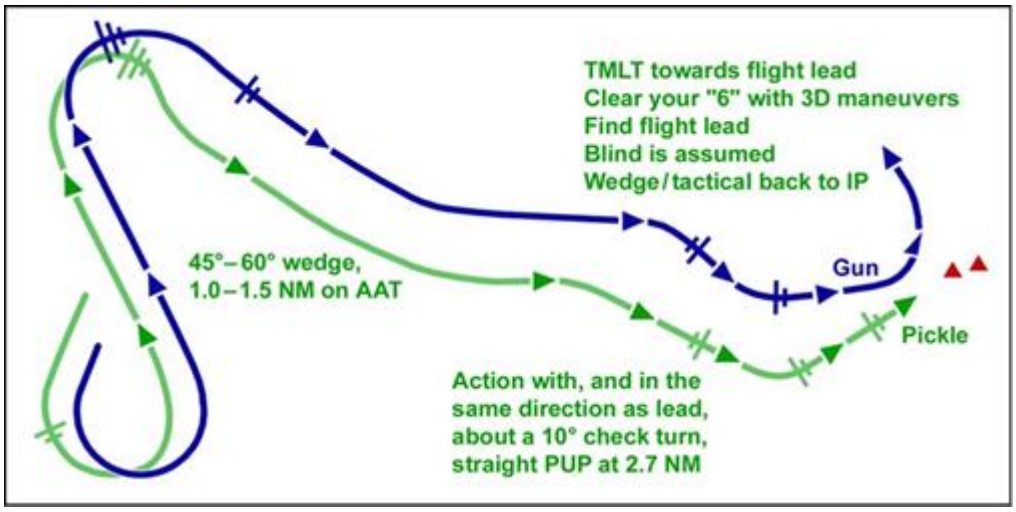
6.8.3.2.4. Ensure CFOF. If at least 1 NM spacing is not maintained between the jets, the wingman may roll out on final ready to shoot with lead still in the HUD. In all cases, pilots must comply with applicable ROE regarding CFOF. If unable, come off dry.

6.8.3.2.5. SEM Into Lead. Always make the turning maneuver level turn in the same direction that lead egresses.

6.8.3.3. Low-Altitude Attacks. Tactics will drive numerous variations in low-altitude attacks; below are some sample attacks that emphasize various roles and attack geometry.

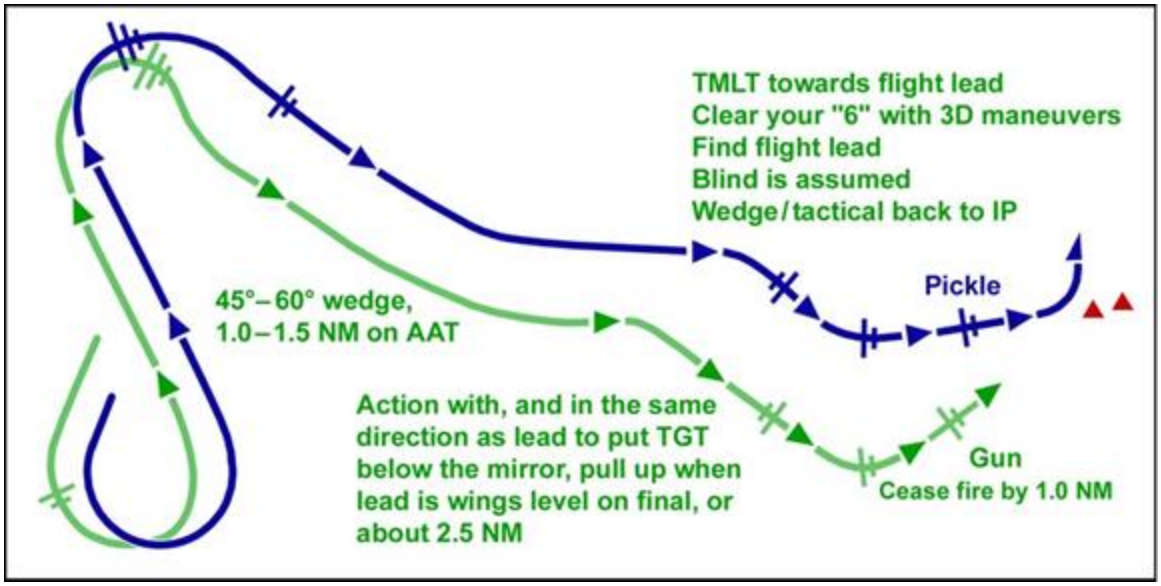
6.8.3.3.1. Gun/Bomb. This is one of the more flexible attacks from low altitude because it allows flight lead to find and "mark" the target while you drop bombs to destroy it. The attack geometry will be built around the bomb pass since the delivery parameters are more restrictive. Pilots should arrive at an action/pop distance that is similar to those on the range rides (**Figure 6.11**.).

Figure 6.11. Low-Altitude Gun/Bomb.



6.8.3.3.2. Bomb/Gun. When it's time for flight lead to drop their bombs, the wingman will follow them into the target area and kill with the gun or suppress the enemy defenses while lead egresses. The primary concern on the wingman's pass should be effectively employing the gun and remaining clear of leads frag cylinder. Remember that the frag cylinder of a basic MK-82 is about 3,000 feet in height and diameter. As a general ROT, if pilots fire by 1.3 NM slant range (under the gun cross) and start the recovery, they will stay clear of the frag (**Figure 6.12**.).

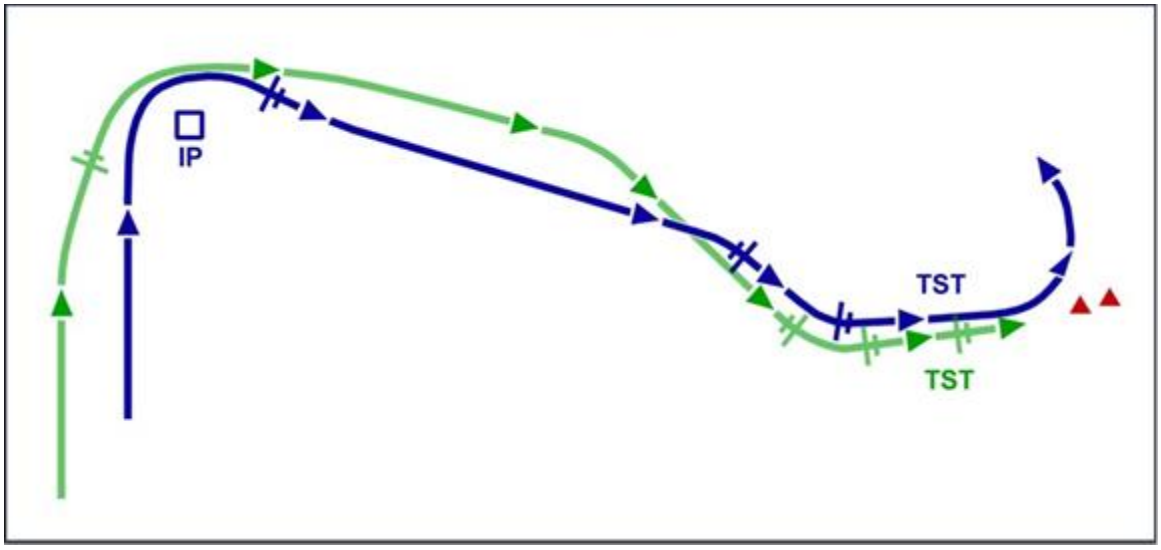
Figure 6.12. Low-Altitude Bomb/Gun.



6.8.3.3.3. Guns. Remember that the gun is a very flexible weapon that can be shot from almost any reasonable distance. A general way to think about gun shots is that a valid solution in the HUD will result in the bullets hitting where the pilot is aiming; the amount of damage/penetration the bullets produce depends on slant range. Always remember to track – shoot - track. In this attack, notice that the lead actions away from

wing in **Figure 6.13**. This allows both jets to be down virtually the same run-in heading. This type of attack, where flight lead actions away from wing, can be used with any combination of ordnance.

Figure 6.13. Low-Altitude Guns.



6.8.3.3.4. Bombs. Another low-altitude attack is a Shooters - Bombs attack. This attack requires some planning due to frag deconfliction. By looking at the frag cylinder for the type of weapon being employed, pilots can determine whether timing or altitude deconfliction would be best. Usually, timing deconfliction offers the most mutual support during this attack but requires more work from the wingman. Altitude deconfliction minimizes the work of the wingman but can sacrifice mutual support prior to expending and during off target maneuvering.

6.8.3.4. Off-Target Priorities. There are several tasks to accomplish once a pilot has pickled. Be sure to prioritize flying the jet first as always.

6.8.3.4.1. Turning Maneuver Level Turn SEM. The priority after weapon release is a valid SEM. The mechanics and parameters of these SEMs remain the same as the BSA pattern. Realize that the purpose of these maneuvers is to remain safely away from the ground, the frag of the weapon, and to get away from other threat rings in the area as quickly as possible.

6.8.3.4.2. Clearing Your Six. With threats in the target area, pilots should keep their jet moving and use CMD to decoy IR and radar threats. In all cases, the primary defense against AAA is 3D maneuvers. In a low-altitude (high-threat) scenario, following a training maneuver – level turn (TMLT) pilots will be slightly below pickle altitude, approximately 600 to 800 feet AGL. With a minimum altitude of 500 feet AGL, pilots are not left with much maneuvering room below them. Pilots must move the jet in three dimensions, but with understanding that the biggest threat is the ground. While accomplishing this, pilots should also preemptively CMD to defeat any man-portable air-defense systems (MANPADS).

6.8.3.4.3. Find Your Flight Lead. After concentrating on attack geometry, valid weapons employment, and off-target priorities, finding lead turns out to be much easier low altitude. Lead will give the wingman a rough idea of where they will be upon completion of off-target maneuvers, but the wingman will be assumed to be blind off target. Pilots must call "*Visual*" while egressing the target area in a good mutually supportive formation like wedge or tactical.

6.8.3.4.4. Get Back into Position. Even at low altitude, pilots can find themselves low on energy when trying to get back into wedge on lead. Remember to use geometry/cutoff to regain correct distance/AA from flight lead.

Chapter 7

CLOSE AIR SUPPORT (CAS)

7.1. Overview. The primary objective of CAS is to support the ground commander's (GCC) intent. CAS will challenge pilots to combine all skills of BSA and SAT with a missionized scenario. Consider the weather, enemy threats, available weapons, and briefed tactics to support the ground forces.

7.1.1. Weather. The weather (real or simulated) may dictate tactics. Be prepared for the brief with range weather, winds, and bird condition.

7.1.2. Threats. Enemy threats are scenario dependent. Be familiar with tactical effective ranges of the threats in the scenario. Also, be familiar with the tactical means to defeat these threats and effective countermeasures. Since threats drive tactics, a high threat scenario will often drive low altitude tactics, and vice versa. FL will brief game plans on how to avoid, suppress, and kill threats. Expect to continue the use of CMD along with aircraft maneuvers in a CAS scenario to defeat the simulated threats.

7.1.3. Reacting to AAA. Defeating small arms, automatic weapons and AAA is accomplished primarily by 3D aircraft maneuvers (see Off Target Priorities). At medium altitude, keep the jet moving by changing heading and altitude. A good ROT is to change heading and/or altitude at a rate of half the current altitude in seconds. For example, if holding at 10,000 feet, change heading every 5 seconds. At low altitude, when engaged by a AAA threat, execute a low altitude guns jink. This jink is like a pop from the tactical SA rides with the roll-in portion being away from the threat. Re-mask down to 500 feet as soon as possible. Some AAA systems are radar assisted requiring the use of chaff along with tactical maneuvering.

7.1.4. Reacting to IR threats. Defeating MANPADs and other heat seeking missiles requires maneuvering with the use of IR countermeasures (flares). To defeat an IR threat, break to place the threat on the beam. To perform the break, execute a max performance, sub-AB, break turn with LV into the missile while dispensing flares. If altitude allows, a descending maneuver may be combined with the break turn if attempting to terrain mask.

7.1.5. Weapons. In IFF, students will simulate high- and low-drag MK-82s and the simulated (30MM) gun. A working knowledge of the function of a general purpose (GP) bomb and a high drag tail kit will help the understanding of the deliveries. Although not a focus in IFF, fragmentation (frag) deconfliction is an important factor in attack planning and execution. An easy memory jogger for the frag cylinder of a MK-82 is "The Rule of 3's": 3,000 feet vertically and horizontally remains over the target area for approximately 30 seconds. When employing bombs after the previous flight member special considerations should be given to remaining clear of the frag. Options include, timing or altitude deconfliction.

7.1.6. Products. CAS products can include a lineup card, a 9-Line card, an accurate 1:50,000 scale map, gridded imagery, or a gridded reference graphic (GRG) of the target area as required. Refer to squadron standards and training aids for threat lay downs, enemy and friendly locations prior to making final copies. Familiarity with maneuver element symbols (i.e., Armor, Infantry, or Mech Infantry) will help decipher the scenario. Reference U.S. Army Field Manual (FM) 1-02.2, *Military Symbols*.

7.1.7. Ground Ops. Building on the SAT phase contracts, CAS ground ops include properly setting up the EGI steer point plan, weapons menus/parameters, and cockpit. Be prepared to work in Lat/Long and MGRS or Universal Transverse Mercator (UTM). Set up the UFCP to default to the MGRS coordinate system and update the target destination place holders: (14X) and the appropriate grid (AB) of the target area, so there is less to type airborne. Be sure to distinguish steer points between potential targets and friendly or neutral positions. Be familiar with the destination locations in the DTC load for IPs, targets, friendlies, etc. Input any coordinates that you may have from the brief such as the IP or known threats.

7.2. Departure and TACS/Army Air-Ground System (AAGS). Expect an increase in comm enroute to the assigned AO or assigned airspace. A good understanding of the TACS/AAGS system and joint fire support (JFIRE) procedures will minimize task saturation. Although a great deal of information will be passed, it is important for pilots to retain the pieces of information significant to accomplishing the mission (i.e., threat locations, friendly locations, and coordinates).

7.2.1. AWACS/CRC. AWACS/CRC will confirm the appropriate squawk is set and provide the 'air' picture between the formation and their assigned AO. They may also provide updates to potential assets airborne tasked to support the mission such as tankers, OCA or DCA CAPs, suppression of enemy air-defense (SEAD) assets, unmanned aircraft systems (UASs), other air-to-ground sensor assets like the Joint Surveillance Target Attack Radar System (JSTARS), and other squadron mates. The scenarios in IFF will be simplistic, however realize that AWACS can build a tremendous amount of SA about the air picture. Another role of the AWACS/CRC is to provide ATC if needed such as changes to altitude and routing. An example of something that may be heard during IFF sorties follows:

TALON 1: "*Darkstar, TALON 1, B/E 340/20, MSN #4388, as fragged*."

Darkstar: "*TALON 1, parrot sweet, picture North clean, no updates to routing….Exxon on station Bullseye 360/25, Contact Trinity* (ASOC) *on TAD 17.*"

7.2.2. Air Support Operations Center (ASOC). The ASOC is the link between CAS assets and the ground war. Armed with the scenario from the ground liaison officer (GLO), pilots should be ready for changes in the ground picture. An update can range from a frequency change to a list of information including friendly status, enemy status, threats, artillery, and JTAC information. A Pilot Update Code (PUC) can be used to reduced repeated information.

TALON 1: "*Trinity, TALON 1 MSN# 4388, as fragged, with AO update PUC18 Alpha.*"

Trinity: "*TALON 1 authenticate Delta Bravo.*"

TALON 1: "*TALON 1 Authenticates Echo.*"

Trinity: "*TALON 1, standby for AO update PUC18 Bravo.*"

TALON 1: "*TALON, ready to copy.*"

Trinity: "*Information Bravo…arty cold. Proceed to IP X & contact Callsign XX* (JTAC) *on TAD XX.*"

7.2.3. A lot of information may be passed, and it can get overwhelming if not prepared. To assist with handling the flow of information, the TTFAC ORB acronym helps pilots remember what information is important for the update.

- **T**argets: An update to what type of targets to expect as well as the GCC priorities and intent when presented with multiple types of targets.
- **T**hreats: An update to the AO threats based on JTAC or previous fighters as to the factor threats, location changes, or recent activity.
- **F**riendlies: An update on the location and status of friendlies.
- **A**rtillery: An update on the status and locations of friendly artillery prior to proceeding to the hold to deconflict laterally or vertically until you are talking with the JTAC for further coordination. The most common format for artillery information is: location of gun, gun-to-target line (GTL), and finally max-ord (or the highest altitude the artillery ordnance will fly).
- **C**ontrol: JTAC info such as callsign, location, equipment, frequency. This category may also include type of control: Type I, II, or III.
- The last three letters are typically gathered from the JTAC following initial check-in or via the 9-Line:
- **O**rdnance: What type of ordnance to expect (GCC approved), any specific weapons effects that might be required.
- **R**estrictions: Usually part of the 9-line briefing, run-in restrictions, or no-fire areas.
- **B**attle Damage Assessment and **B**omb Hit Assessment (**B**DA/**B**HA): Good BDA is required to give the GCC and the Combined Forces Air Component Commander (CFACC) the clearest picture of the battle. Inflight it's more realistic to know the status of BHA, was the target hit, versus what battle damage was achieved. It's better to be more conservative than to over inflate an assessment.

7.3. Area of Operation (AO).

7.3.1. Holding. Once established in the hold, a pilot's SA on the enemy order of battle (EOB), friendly order of battle (FOB), and ground order of battle (GOB) should be high enough to execute an effective attack. The JTAC is the link between the pilot and the maneuver GCC. They are also a translator, trained to speak Army, Marine, and Air Force and be the voice of the GCC's intent. While flight lead interacts with the JTAC, wingmen will be in a cover role, in a mutually supportive formation, build their target area SA, and gather the required information to execute the attack. Wingmen will assume flight lead is heads down anytime information is flowing. Flight lead will start by giving the flight's information to the JTAC via the fighter check-in (see **Figure 7.1**.).

Figure 7.1. CAS Check-In (Fighter to FAC) Briefing.

(Aircraft transmits to controller) Aircraft "_____," this is "_____" (e.g., "Bronco 26, this is TALON 1") (JTAC c/s) (Aircraft c/s)
1. Mission Number _____. (e.g., "Mission number 8869") (ATO assigned MSN #)
2. Number and type of aircraft: _____. (e.g., "2 by T-38C")
3. Position and altitude: _____. (e.g., "Currently 20 NM south of AO Falcon, block 6-7")
4. Ordnance: _____. (e.g., "900 rds of 30 Mike Mike, 8 by Mark 82AIR")

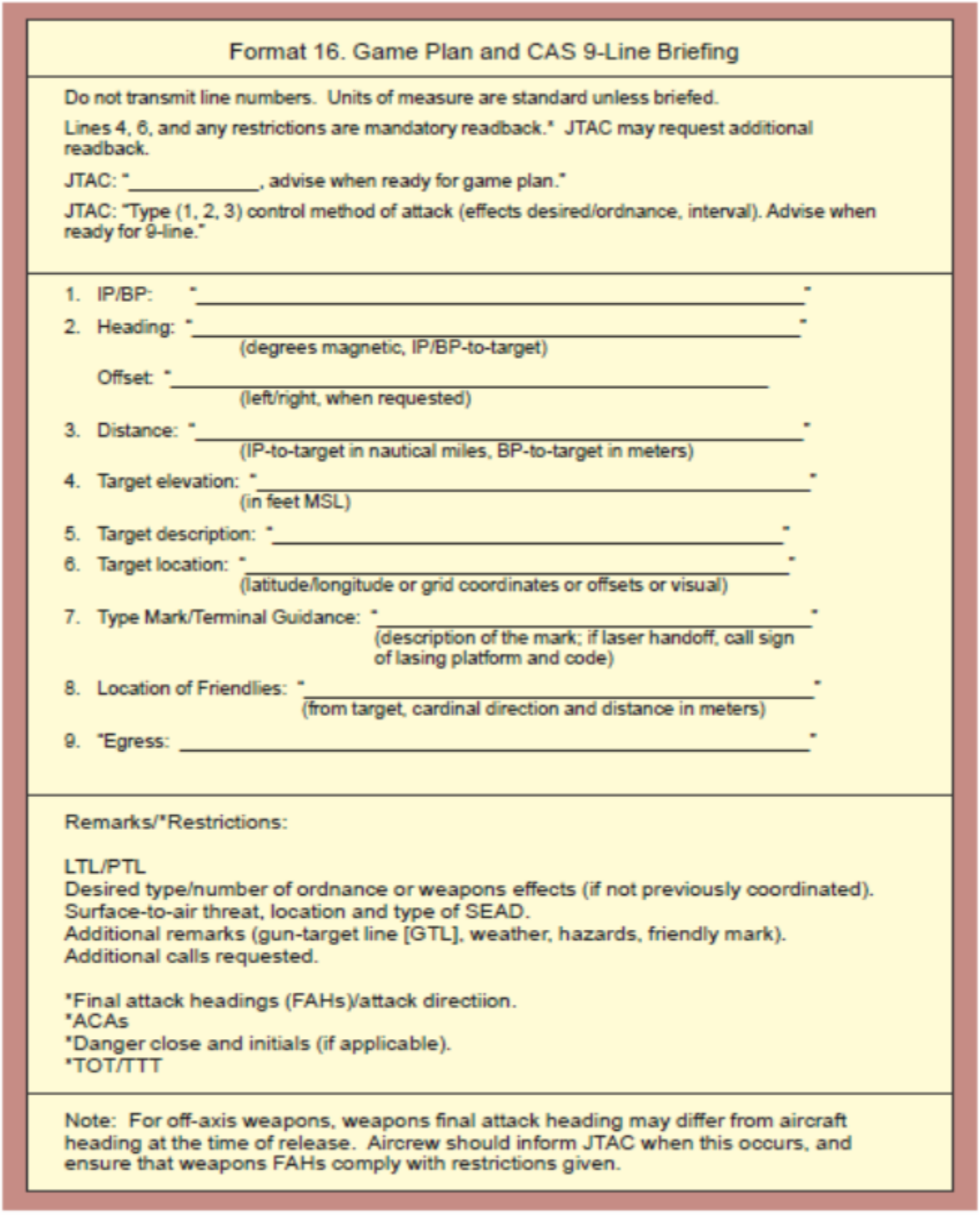
5. Playtime or Time on Station: _____. (e.g., “We have 30 minutes time on station”)
6. Capabilities: FAC(A), Type of Sensors, Link-16, VDL code, SITREPs on board, map version or GRGs, UAS Lost Link Procedures/Route: (e.g., “TALON 1 is negative FLIR, negative Timber. We have SITREP 11C and micro-GRG 1A onboard.”)
7. Abort code: _____. (e.g., “Request aborts in the clear, ready to copy your updated SITREP.”)

7.3.2. Situation Update (FAC to Fighter). The JTAC provides the current AO update. This may include:

- Unit mission
- Enemy disposition
- Threat activity in the target area
- Weather (if required)
- Friendly positions
- Current Fire Support Coordination Measures (FSCM)

7.3.3. The CAS 9-Line Brief**.** The wingman’s priority when the 9-line is being passed is to stay in position and cover flight lead. Wingmen should strive to comprehend as much 9-line information as possible. As saturation level allows input information into the UFCP as allowed by the squadron standards and flight lead’s contracts. Pay close attention to lines 4, 6, 8 and restrictions. Since lines 4, 6, and restrictions are mandatory read back items, these important pieces of info will be transmitted twice, giving ample opportunity to get them and recheck them.

Figure 7.2. Game Plan and CAS 9-Line Briefing.



Format 16. Game Plan and CAS 9-Line Briefing

Do not transmit line numbers. Units of measure are standard unless briefed.

Lines 4, 6, and any restrictions are mandatory readback.* JTAC may request additional readback.

JTAC: "_____, advise when ready for game plan."

JTAC: "Type (1, 2, 3) control method of attack (effects desired/ordnance, interval). Advise when ready for 9-line."

1. IP/BP: "_____"
2. Heading: "_____"
   (degrees magnetic, IP/BP-to-target)
   Offset: "_____
   (left/right, when requested)
3. Distance: "_____"
   (IP-to-target in nautical miles, BP-to-target in meters)
4. Target elevation: "_____"
   (in feet MSL)
5. Target description: "_____"
6. Target location: "_____"
   (latitude/longitude or grid coordinates or offsets or visual)
7. Type Mark/Terminal Guidance: "_____"
   (description of the mark; if laser handoff, call sign of lasing platform and code)
8. Location of Friendlies: "_____"
   (from target, cardinal direction and distance in meters)
9. "Egress: _____"

Remarks/"Restrictions:

LTL/PTL
Desired type/number of ordnance or weapons effects (if not previously coordinated).
Surface-to-air threat, location and type of SEAD.
Additional remarks (gun-target line [GTL], weather, hazards, friendly mark).
Additional calls requested.

*Final attack headings (FAHs)/attack directiion.
*ACAs
*Danger close and initials (if applicable).
*TOT/TTT

Note: For off-axis weapons, weapons final attack heading may differ from aircraft heading at the time of release. Aircrew should inform JTAC when this occurs, and ensure that weapons FAHs comply with restrictions given.

7.3.4. After getting all the information and processing it, lead will give the wingman an opportunity to do the same. This is the wingman's chance to ask questions or confirm all important pieces of information gathered along the way. Flight lead will take the mutual support contract from the wingman momentarily, giving them the chance to plot the coordinates on their map, and ensure the EGI is set up as desired. Let flight lead know on the aux radio once complete.

TALON 1: "*TALON 2 cleared to plot.*" (Aux)

TALON 2: "*TALON 2 complete. Plot North of the runway, just East of a small pond.*" (Aux)

or

TALON 2: "*TALON 2 complete. Plot Red 12 on the GRG.*" (Aux)

TALON 1: "*Good plot.*" (Aux)

"*TALON'S ready for the talk-on.*" (Prime)

7.4. Talk-Ons. Some general ROTs for any good talk on:

7.4.1. Unit of measure. Since it is difficult to estimate distance on the ground from 10,000 feet, the JTAC should find a large reference like a runway, a large building, section of a road or a lake and define its length as one unit of measure.

7.4.2. Known starting point. Working big to small is the most efficient way to move the pilot's eyes, so the JTAC will start somewhere easily identifiable and unique like the main intersection of a small town, or the tower on an airfield.

7.4.3. Cardinal directions. Be as accurate as possible when describing directions to go with cardinal headings. "*TALON go up the road to the Northeast one unit and tell me what you see.*" Don't try to change the orientation of something if it is close just to make the comm easier. In other words, be exact and describe a NE/SW-running runway as Northeast/Southwest, not East/West.

7.4.4. Get well points. If an extensive talk-on is required, the JTAC will usually label easily identifiable points to go back to if the pilot gets lost.

7.4.5. Confirmatory comm. The JTAC may ask lead to tell him what they see in a particular area. Another example would be giving additional info about the target once the pilot has eyes on.

Diablo 11: "….*Just North of that intersection, you should see two vehicles*."

TALON 1: "*TALON 1, contact two vehicles. They appear white in color and parked on the West side of the road.*"

Diablo 11: "*Affirm, those vehicles are your targets.*"

7.4.6. The wingman's priority during the talk-on is to stay in position and cover flight lead. It is far better to miss the entire talk on, stay visual and in position than be blind and tally the target, but follow the talk on as much as practical. If the wingman is confident that they followed the entire talk-on and are tally, then let lead know. If at any point the wingman gets lost, go back to the nearest get-well point, stay there, and stay quiet until lead is tally. Once

lead is tally, they will confirm where the wingman is, and finish getting them tally. In a case where lead plans to have the wingman cover, they may even forgo the wingman's tally to expedite the attack. If wingmen have an idea of the general target area, they can be a good cover fighter. Real world, this situation works out even better; one mark is worth a thousand talk-ons, and a MK-82 makes a fantastic mark.

TALON 1: "*TALON 1, tally target."* (Prime)

TALON 2: "*TALON 2, tally target.*" (Aux)

7.5. Fighter-to-Fighter.

7.5.1. Typical Format. The fighter-to-fighter brief is flight lead's direction to wingmen as to how the two-ship will kill the target at hand. Below is a typical format, however most flight leads will pre-brief several items to minimize comm airborne.

- Formation
- Role
- Ordnance
- Timing
- In-direction
- Egress direction
- Sort

TALON 1: "*Fighter-to-fighter: Shooters, gun/bomb, in from the West, off North, 2 sort Northern, 1 sort Southern."* (Aux)

TALON 2: "*2.*" (Aux)

TALON 1: "*TALON 1, ready, 2.0.* (current fuel)" (Aux)

TALON 2: "*TALON 2, ready, 1.9.*" (Aux)

7.5.2. There is one and only one READY call. Pilots will not say ready until sure that their EGI, weapons systems, and eyeballs are ready to kill the target, and have no questions on the attack. If the wingman does still have questions, it is better to ask them at this point and take another spin in the hold than attempt an attack with low SA.

7.6. Medium Altitude Attacks.

7.6.1. The attack game plans, geometry, and comm will be very similar to those on SAT rides with addition of some interaction with the JTAC. Flight lead will relay the game plan to the JTAC; pay attention to make sure it checks with what was gathered in the fighter-to-fighter. Flight lead should also give the JTAC a heads up with a rough time before the first jet rolls in.

TALON 1: "*TALON 1 will be in from the West in 30 seconds.*" (Prime)

Diablo 11: "*TALON flight continue.*" (Prime)

7.6.2. Cracking the wings to roll-in will typically be the wingman's first speaking part on Prime, so make sure to be ready with the correct comm.

TALON 2: "*TALON 2, in dry from the West.*" (Prime)

Diablo 11: "*TALON 2 continue dry*." (Prime)

7.7. Low Altitude Attacks. Expect flight lead to give the JTAC a heads up when the flight is ready to start the attack. Lead will make an "*IP inbound*" call when the flight leaves the hold to prosecute the attack. At this point the wingman will maneuver to end up in the briefed position and the fly the briefed geometry much like in the SAT phase. The JTAC must pick up both aircraft, listen for both "*In dry*" calls and then give the "*Continue dry*" calls individually. Try to minimize comm down to a single radio call. The "*up*" call for the pop is not required as it was for the ranger. The minimum needed is "*In*" with direction; additional SA building comm can be added if able.

TALON 2: "*TALON 2 in dry from the West, tally.*"

7.8. Off Target. In both cases (med and low), once off target pilots have the same priorities as during the SAT phase; SEM, CMD, clearing their six, 3D maneuvers, and finding flight lead. If required by squadron standards or briefed to do so by the flight lead, make an "OFF DRY" call. The words "OFF DRY" take on a different meaning than during the SA phase. This additional comm is strictly for the benefit of the JTAC and flight lead. Since there is no bomb for either of them to see, they need to know if the wingman was successful in order to make the scenario as realistic as possible.

TALON 2: "*TALON 2 off dry, successful/unsuccessful.*"

7.9. RTB/In-flight Report. A CAS ride is not over after the last bomb is dropped or once Bingo is reached. Remember that the 'B' in TTFACORB stands for BDA. Wingmen will typically hear some comm between the JTAC and flight lead after each attach about how successful each one was. At some point during the RTB, flight lead will simulate the ASOC just as they did on the way out, so that the wingman can give the in-flight report. Keep in mind that it's unnecessary to read off the coordinates of every target struck; instead pick one of the coordinates that is centrally located. Give a time block, e.g. 1400Z-1430Z. Line 5 (results) is the most common place for the report to stray from the truth. It is crucial to not inflate the BDA. Just because a bomb was dropped on it does not mean it's dead. Unless a burning hulk of a tank can be seen before leaving the area, pilots need JTAC verification of success. There are many things that can go in the remarks but try to pick one or two things that would be most important to the fighters who will show up next. Things like factor threats or weather are typical remarks (see **Figure 7.3**.).

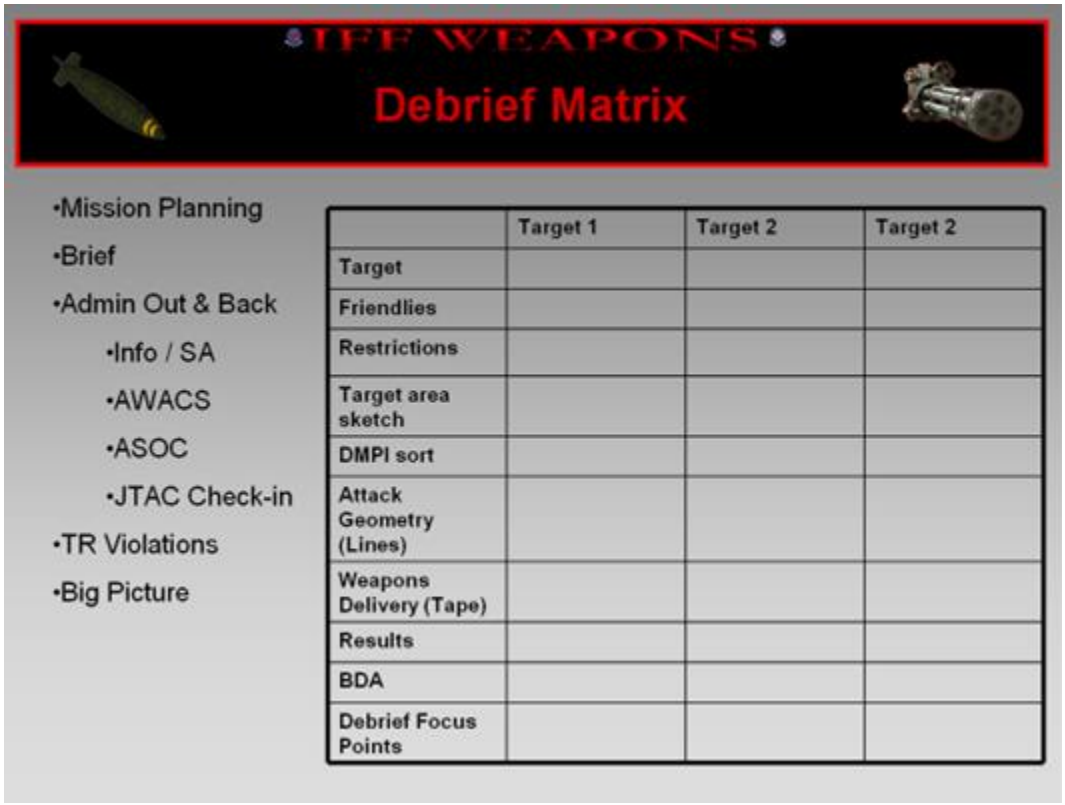
Figure 7.3. Inflight Report.

Aircrew Transmits " Addressee this is aircraft callsign, INFLTREP, over"
Authentication as required
Addressee Responds "This is addressee callsign, INFLTREP."
1 Callsign "_____"
2 Mission Number "_____"
3 Location " latitude/longitude, grid, place name "
4 Time on Target "_____"
5 Results "_____"
R Remarks " Target area weather, significant sightings, essential information "

7.10. Debrief. Flight lead will debrief to the objectives. Wingmen should be prepared to answer questions about the info they were able to gather throughout the sortie. Lines and tapes will be

reviewed to grade the flight attack geometry and weapons employment. CAS debriefs will seem more conversational than previous sorties due to the fluid nature of the mission. Remember to answer only what is asked and save questions for the appropriate time. The debrief matrix (see **Figure 7.4**) is an example of how lead might organize all the information.

Figure 7.4. Example CAS Debrief Matrix.



7.11. Conclusion. Obviously, there is a great deal of information changing hands on a CAS sortie. A wingman's success lies in knowing how the system works and their priorities. If armed with knowledge of how the system works and the priorities as a wingman, pilots should have no problems.

- Don't hit the ground or lead.
- Stay visual.
- Mutual support in all things.
- Build as much target area SA as possible.
- Bombs on target!

Chapter 8

WEAPON SYSTEMS OFFICER (WSO) CREW COORDINATION

8.1. Formation.

8.1.1. Overview. The lead pilot and WSO will work together as a crew ("flight lead") to meet the desired learning objectives (DLOs) for each mission. They oversee the resources entrusted to them; they must know the capabilities and limitations of each member of the flight. Once airborne, they have the final responsibility and controlling authority for establishing the formations, maximizing the flight's effectiveness, and leading the flight successfully during the mission.

8.1.2. Ground Operations Systems Setup. Ensure the following items are set correctly in addition to the other normal preflight items. Pilots and WSOs will verify all avionics are properly set up and will provide directive/descriptive comm in accordance with briefed crew coordination.

8.1.3. While Airborne. The WSO will verbally confirm gear and flaps up by saying "Clean" and the airspeed at which gear and flap retractions are complete (i.e., "*CLEAN, 230*"). Additionally, the WSO will back up the pilot with instrument readings throughout instrument flight and maintain awareness of aircraft attitude and performance gages, and situational awareness of formation members, clearance, working airspace boundaries/limitations, home base and relevant divert fields. WSOs should run as much comm as possible within the formation and with ground agencies.

8.1.4. Formation Responsibilities. The flight lead is always responsible for the flight. Each pilot is responsible for the aircraft. The WSO assists the pilot in a variety of ways, depending on the situation. This not only involves crew coordinating certain responsibilities for the WSO, but also involves more direct interaction. An example of this could be providing directive and descriptive comm during a defensive Break. Typical crew coordination involves assisting the pilot with tactical formation management to include:

- Fuel/weapons state
- Airspace management
- NAVAIDS/comm management
- Timing control
- Formation position
- Visual lookout

8.1.5. Visual Search Responsibilities. In all tactical formations, each flight member has a visual search responsibility. Even though each pilot and WSO concentrates on a different area, this does not preclude searching other areas when required by tasking, threats, or the environment.

8.1.6. Low altitude. The WSO is responsible for operating more or most of the onboard sensors as the pilot is focused on maintaining positive terrain separation and correct formation position. The following terminology will be used during day visual low-altitude operations.

8.1.6.1. Terrain Avoidance. "Rocks" when spoken by the pilot means "I see terrain ahead." When spoken by the WSO, it means, "Terrain ahead. Do you see it?"

8.1.6.2. Bunt. “Bunt” is an advisory from pilot to WSO to prepare for a less than 1-G pushover ridge crossing.

8.1.6.3. Minimum Safe Altitude (MSA). “Next MSA 3.2” is an informative call from WSO regarding next leg MSA.

8.1.6.4. Bird Strikes. If aircraft control is in doubt, both crew members should take the controls and safely climb away from the ground. The WSO should stay on the controls until convinced that the pilot is capable of flying.

8.1.7. Traffic Pattern. After receiving clearance to land, the WSO must confirm aircraft configuration and clearance, and say, “Three green, cleared to land.”

8.1.8. Landing. To prevent runway departure, early assessment of high speed and rapidly decreasing runway remaining is required. One technique used to discern a normal deceleration is 20 knots per 1,000 feet remaining (e.g., at 6,000 feet, maximum speed would be 120 KCAS). The WSO will call off the board number and speed of the aircraft to ensure the pilot is complying with this ROT.

8.1.9. Emergency Procedures. The WSO will back up the pilot by analyzing the problem, communicating their assessment, and reading the checklist as required. The WSO and pilot should crew coordinate how to handle emergencies and the recovery/divert in detail.

8.1.9.1. Checklist usage. As a technique, the WSO will inform the pilot which emergency procedure checklist they are referencing and the page it is on. The WSO will wait for the pilot to call “Ready for checklist” before proceeding. The WSO will then read each step, waiting for confirmation from the pilot that the action has been accomplished, before proceeding to the subsequent step. At the end of the checklist, the WSO will call “Checklist complete”, and “Next checklist is…” as applicable.

8.1.9.2. Out of Control. Ejection should be crew coordinated to the max extent possible, vice simply pulling the ejection handles without notification. If in a rapid, uncontrolled descent, do not delay the decision to eject. Normal communication includes the command of ejection, “BAILOUT, BAILOUT, BAILOUT” to notify the other crew member of ejection. Additionally, if conditions permit, the WSO will provide altitude callouts to the pilot.

8.1.9.3. Crew Coordination Brief. The pilot and the WSO will complete a crew coordination brief prior to arriving at the aircraft. The crew coordination brief will include command select valve position, decision to eject while on the ground and in the air. Other brief topics should include division of duties during preflight check, avionics setups, mission and recovery tasks.

8.2. Air-to-Air.

8.2.1. Overview. Proficient air-to-air employment of the dual crew T-38C requires both pilot and WSO to become experts in five areas: maneuvering, avionics, weapons, crew coordination, and communications.

8.2.2. Offensive BFM. While OBFM is primarily the pilot’s responsibility, a proactive WSO can help the pilot by maintaining overall fight SA to include floor awareness, energy management, fuel, airspace, weapon status, element VMS, and threat lookout. WSOs should be prepared to use tactical crew coordination (TCC) during OBFM to meet the fight objectives.

8.2.2.1. Power. If the WSO recognizes that the pilot did not select the briefed throttle position, the WSO should make a directive "Idle", "MIL", or "MAX AB" call as appropriate.

8.2.2.2. Weapons. When reaching attack cues, WSO's should call "Attack!" Additionally, WSOs should call "SRM" when in the AIM-9 WEZ and "Gun" when in the gun WEZ.

8.2.2.3. Reversal Scissors Ex (WSO Offender). WSO comm should start when the offensive position is neutralized unless deviations from the plan occur earlier. When presenting the reversal opportunity for the bandit, the WSO will call "Tighten down" to enter scissors and will be directive with power as appropriate.

8.2.2.4. Jink Ex (WSO Offender). The WSO should recognize a closure problem and call "Closure" to warn the pilot of the issue. If range and/or excessive closure dictates the WSO will call "Repo" to direct the pilot to put LV in lag pursuit and execute a lag reposition. WSOs will be directive with power as appropriate.

8.2.2.5. 3K. If the WSO perceives a closure problem, they will make a descriptive "Closure" call. If required, WSOs will call "Repo" to direct a lag reposition as described in the Jink Ex. WSOs will call "Tighten down" to direct a moderate buffet turn.

8.2.2.6. 6K. While waiting for LOS to increase, monitor parameters to ensure arrival at the TC with optimum energy. WSOs should call "Slow" or "Fast" if outside of briefed parameters.

8.2.3. Defensive BFM. Sound tactical crew coordination during defensive BFM is imperative. The defensive WSO can add significant SA to the pilot by calling out altitude and directing floor transitions/saves. Additionally, WSOs must assess the bandit, anticipate the offender's next attack, and give timely and concise directive/descriptive comm to the pilot if they are not executing correctly. WSOs must timeshare their scan between the bandit, scanning for other potential threats, fuel gage, and the HUD repeater. The WSO will employ flares as appropriate.

8.2.3.1. HAGS Ex (WSO Defender). At fight's on, WSOs will call "Break left/right", employ flares, and provide further directive/descriptive comm as required based on bandit maneuvers (i.e., "LV on, tighten down"). Use the call "Snap D" when recognizing a high aspect (>90 degrees) bandit gunshot to communicate the need for an out of plane maneuver. Upon recognizing the opportunity to reverse after the out of plane maneuver, the WSO will call "Reverse".

8.2.3.2. Quarter Plane Exercise (WSO Defender). At fight's on, WSOs will call "Jink!" and repeat the call as required to defeat continued gunshots. This will require the WSO to maintain tally. Upon recognizing the opportunity to reverse after the out of plane maneuver, the WSO will call "Reverse".

8.2.3.3. Floor Transition. DBFM requires the aircrew to divide attention between the offender and the floor. Floor transition ROTs are 10 degrees nose low per 1,000 feet to the floor with less than 3,000 feet remaining to the floor. Approaching the floor, maintain the schedule to arrive at the floor with as much energy as possible. It is imperative to keep a rapid cross-check between the floor transition schedule and the offender. WSOs can help the pilot by providing descriptive cues initially ("3,000 to the floor") and directive comm

("Floor transition") to keep the floor transition smooth and energy sustaining. Arriving at the floor with an energy advantage is critical.

8.2.3.4. Floor Save. If the offender exceeds 20 degrees nose low per 1,000 feet to the floor with less than 3,000 feet remaining to the floor, they must execute a floor save. If the WSO is the first to see a floor save situation, the WSO should make a directive "Floor save" call to the pilot to begin a max-performance dive recovery. If the pilot returns to within floor transition ROTs, the WSO can make a directive "Floor transition" call to allow the pilot to relax AOA or reorient the LV. During the floor save, WSOs should time share between the HUD repeater, ensuring the pilot is flying the floor save maneuver, and keep tally on the bandit. Once a floor save is complete, WSOs should be ready with directive comm to continue the fight as the pilot may have lost the tally while performing the floor save.

8.2.3.5. 3K. At fight's on, WSOs will call "Jink" and employ flare while assessing bandit maneuvers. Ideally, WSOs should call the jink direction ("Jink down"), and, if within 3000' to the floor, the direction should include distance to the floor ("Jink up, 5 hundred to the floor.") If the bandit repositions, the WSO will call "Tighten down" to direct a moderate buffet turn. If the WSO is the first to recognize incorrect lift vector placement, they should call "Lift vector up/down". As the bandit's nose rotates to show a heat threat, the WSO will call "Tighten down" and employ flares. Once the bandit enters a gun WEZ, the WSO will direct a jink. Directive/descriptive comm may include "Tighten down (or opt turn), Bandit repo." If the WSO is the first to detect a reversal opportunity, he/she will make a directive "Reverse" call for the pilot to apply reversal mechanics. WSOs must monitor LV placement in relation to altitude available and be prepared to direct a floor transition or save. If the pilot is inadvertently putting the aircraft into an accelerated stall, the WSO should direct "Ease".

8.2.3.6. 6K. At fight's on, WSOs will call "Break left/right", employ flares, and provide further directive/descriptive comm as required based on bandit maneuvers. In addition to what was discussed under 3K DBFM, common crew coordination includes "Opt turn" (rate fight) when the situation dictates. The WSO will assess the bandit turn circle entry timing.

8.2.4. High Aspect BFM. WSOs will use the skills they developed in OBFM and DBFM to aide in HABFM execution.

8.2.4.1. Approaching Merge. WSOs should use calls "Fast/Slow" or "440" as required based on the game plan and briefed crew coordination if outside acceptable merge parameters.

8.2.4.2. Lead Turn. At the LOS increase, if the pilot is not executing a lead turn, WSOs should direct "Lead turn".

8.2.4.3. Fight Recognition. Upon recognition of the two-circle fight, the WSO should direct "Opt turn, two-circle". Upon recognition of the one-circle fight, the WSO should direct "Tighten down, one-circle".

8.2.4.4. Ditch. If the WSO assesses the need for a ditch, the call "Ditch, ___K feet to floor" will be made. Both pilot and WSO need to carefully cross-check the floor during Ditches and apply floor transition/floor save ROTs.

8.3. Air-to-Ground.

8.3.1. Overview. WSOs must become proficient in air-to-ground employment of their MWS. The primary role of the WSO is to enable air-to-ground combat success. A proficient WSO is a force multiplier in the surface attack realm.

8.3.2. Before Flight. Like any other phase of flight, a good crew coordination brief will help establish roles and responsibilities and eliminate duplication of effort. The range is a good place to practice crew coordination in the air-to-ground arena.

8.3.3. Ground Operations. The WSO will confirm target coordinates and altitudes (UFCP DST) in addition to weapon programs and delivery parameters (MFD WPN).

8.3.4. Aircrew Division of Duties. The WSO's primary responsibility is to manage offensive systems to kill the target. Pilots are primarily responsible for flying the briefed parameters to achieve desired weapons effects. Additional WSO responsibilities include:

- Monitor aircraft parameters.
- Confirm avionics (EGI Steer point, WPN setting, Master Mode).
- Monitor proper pattern procedures.
- MASTER Arm as briefed or directed.
- Monitor delivery parameters, MRA and minimum recovery altitude/slant range.
- Provide pre-briefed pacing calls.

8.3.5. Crew Coordination. Good crew coordination can significantly improve CCIP bombing accuracy. Although the delivery is primarily a visual pilot event, systems management and parameters assessment are two areas where the WSO can increase the success rate of a pass. First, the WSO will confirm the WPN program is set properly. The WSO will also ensure that the pilot is executing a STAGE check (and may be tasked to verbally accomplish the STAGE check with the pilot). The WSO will monitor and make calls (as required) concerning dive angle, airspeed, and altitude. Since too many calls may distract and break the pilot's concentration during pipper tracking, the exact calls desired should be covered in a thorough crew coordination briefing before flight. As a minimum, the crew coordination brief should require the WSO to call "Abort" and "Recover" dependent upon the severity of error to ensure safety of flight.

8.3.5.1. Abort. "Abort" is directive brevity to cease action, attack, event, or mission. For weapons deliveries, use "Abort" for situations such as: bad parameters, lack of ID/clearance, systems problems, at minimum recovery altitude (MRA), or at cease fire slant range for strafe.

8.3.5.2. Recover. "Recover" is directive brevity to execute a wings-level, maximum performance pull to avoid flying into terrain.

8.3.5.3. On Base. If the WSO recognizes that the aircraft is more than 0.2 NM from the planned EGI base distance at roll-in, inform the pilot. Call "Wide" if outside, or "Tight" if inside, this range tolerance.

8.3.5.4. On Final (Bombing). WSOs should monitor the HUD repeater on final to assess parameters. Check the dive angle, altitude, and airspeed; verify IAA is set at track altitude; and look for any errors. At track altitude, WSOs state "Track," and the pilot sets the FPM at the appropriate IAA. A common technique is for the pilot to call out "Pressing" when

passing through the planned release altitude. At MRA the WSO will call "Abort". The pilot may have already initiated a recovery, but to ensure the pilot does not still have the pickle button depressed in the pull, an "Abort" call is still applicable. If the pilot does not react to the abort call, the WSO will call "Recover!" and the pilot will initiate a max performance pull to avoid impacting the terrain. If the pilot still does not recover, the WSO may need to take aircraft control to avoid impact with terrain.

8.3.5.5. On Final (Strafe). A common technique is for the WSO to call "OPEN" at open fire slant range and "Abort" at cease fire slant range. If the pilot continues the attack inside of the cease fire slant range, the WSO will call "Recover!" and the pilot will initiate a max performance pull to avoid impacting the terrain. If the pilot still does not recover, the WSO may need to take aircraft control to avoid impact with terrain.

8.3.5.6. Tactical Pattern. WSOs will call "1 mile" at 1.0 NM from the action or pull up point. At the action point or pull up point, if the pilot does not action on time, the WSO must quickly call, "Action". In the climb, the WSO will visually acquire the target and call "Tally target". At the pull down altitude, the WSO should call "Pull down" if the pilot is not in the process of doing so. Based on the briefed crew coordination, the WSO may state the apex altitude if it deviates significantly from planned. As a technique, most crews coordinate for no calls unless the apex altitude deviates more than 200 to 300 feet from planned.

8.3.5.7. CCRP Deliveries. The WSO will ensure the correct WPN Program is selected (found on UFCP), to include weapon type (found on the MFD WPN submenu), and the correct target steer point is selected. Once these tasks are accomplished and clearance to employ from the RCO is obtained, the WSO will communicate "Cleared to release." The pilot should not depress the pickle button until this crew coordination is complete.

8.3.5.8. Working. If pilots do not hear "Cleared to release" by 6 seconds TREL, they should make a "6 seconds" call. The only replies from the WSO should be "Cleared to release", "Abort," or "Working" (meaning continue the attack, expect clearance from the WSO momentarily). If not cleared to release by 3 seconds TREL, pilots may call "Bunting" and execute either a bunt or dive to build time before the solution cue reaches the FPM.

8.3.6. Most of the aircrews' time should be spent listening to other assets provide SA. A talkative pilot or WSO can step on a critical radio call with extraneous chatter. WSOs will accomplish TACS coordination to the max extent possible. 1B will be the primary POC for coordination with the JTAC/FAC(A). Execute in accordance with 1A's contracts set in the brief.

8.3.7. Contingency - Pilot Blind. Maintaining the visual in the bombing pattern is primarily a pilot duty. If the pilot goes blind and initiates a "*Say position*" drill, the WSO, if visual, can provide descriptive communication to direct the pilot's eyes back onto the preceding aircraft. If a deconfliction issue is developing and the pilot is still blind, then the WSO may direct the pilot to maneuver the aircraft to maintain separation between flight members. To avoid collision, if the situation is time critical, the WSO should take aircraft control until the situation is resolved. "My aircraft" will be used as a crew coordination term to signify change of aircraft control.

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Director, Operations & Communications

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

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Prescribed Forms

None

Adopted Forms

DAF Form 847, *Recommendation for Change of Publication*

Abbreviations and Acronyms

%BFL—percent bomb fall line

3D—three dimensional

3K—3,000 feet

6K—6,000 feet

A/A—air-to-air

A/G—air-to-ground

AAA—anti-aircraft artillery

AA—aspect angle

AAT—air-to-air tactical air navigation

AB—afterburner

ACF—air combat fundamentals

ACM—air combat maneuvering

admin—administration

AGL—above ground level

AGSM—anti-G straining maneuver

AHAS—avian hazard advisory system

AOA—angle of attack

AO—area of operations

AOD—aim off distance

AON—angle off nose

AOP—aim-off point

AOR—area of responsibility

AOT—angle off tail

ASOC—Air Support Operations Center

ATA—antenna train angle

AW—assessment window

AWACS—Airborne Warning and Control System

BD—battle damage

BDA—battle damage assessment

BFL—bomb fall line

BFM—basic fighter maneuvers

BSA—basic surface attack

BVR—beyond visual range

C/S—callsign

CAP—combat air patrol

CAS—close air support

CCIP—constantly computed impact point

CCRP—constantly computed release point

CFOF—clear field of fire

CMD—countermeasures dispenser comm—communication

CRC—Control Reporting Center

CRM—cockpit resource management

CZ—control zone

DBFM—defensive BFM

deg/sec—degrees per second

DFP—debrief focus points

DME—distance measuring equipment

EGI—embedded global positioning and inertial navigation system

EM—energy maneuverability

EP—emergency procedures

FAC(A)—forward air controllers (airborne)

FBF—fighter bomber fundamentals

FENCE—fire control, emitters, NAVAIDs, communications, and electronic countermeasures (as in FENCE check)

FOV—field of view

FPM—flightpath marker

FPS—feet per second

GCC—ground commander

GCI—ground control intercept

GE-min rel—gross error-minimum release

GLOC—G—induced loss of consciousness

HABFM—high aspect basic fighter maneuvers

HAS—high-angle strafe

HCA—heading crossing angle

HOTAS—hands on throttle and stick

HUD—heads up display

IAA—initial AIM off angle

IAW—in accordance with

ID—identification

IFF—introduction to fighter fundamentals; identification, friend or foe,

IF—instructional fixes

IP—instructor pilot; initial point

ITP—initial target placement

JTAC—joint terminal attack controllers

KCAS—knots calibrated airspeed

KIO—knock-it-off

LAB—line abreast

LAS—low-angle strafe

LOS—line of sight

LOSR—line of sight rate

LP—learning points

LV—lift vector

MAX—maximum afterburner/maximum power

MDS—mission design series

MFD—multifunction display

MIL—military (power)

mil—milliradian

MRA—minimum release altitude

NAVAID—navigational aid

NM—nautical mile

NORDO—no radio

OBFM—offensive basic flight maneuver

OOP—out of plane

POM—plane of motion

Ps—power

RCO—range control officer

repo—reposition

ROE—rules of engagement

ROT—rule of thumb

RTB—return to base

SA—situational awareness

SAT—surface attack tactics

SEM—safe escape maneuver

SPINS—special instructions

SRB—single-rate beeper

T.O.—technical order

TACS—Theater Air Control System

TCAS—traffic collision avoidance system

TC—turn circle

TCX—turn circle extension

TD—tighten down

TGT—target

TR—turning room

UFCP—up front control panel

VID—visual identification

WEZ—weapons engagement zone

Terms

3/9 Line—An imaginary line extending through the 3 and 9 o'clock positions of an aircraft (also known as the pitch or lateral axis).

Abort—Directive to cease the action, attack, event, or mission.

Acceleration maneuver—A maneuver flown to increase airspeed. Zero G is optimum.

Admin lead—Used to pass lead responsibilities to another member of the flight. The administrative (admin) lead is expected to run all aspects of the profile to include navigating, managing the radios, and making changes to the profile if external conditions dictate (e.g., changing the bingo fuel with a change in the alternate). With an admin lead change, the callsigns within the flight are administratively renumbered to match the position being flown. Lead still retains ultimate authority for the formation.

Angle-off—The angle formed by the extension of the longitudinal axes of two aircraft; the difference in headings. Also called the HCA.

Aspect angle—The angle measured from the tail or longitudinal axis of one aircraft to another aircraft's position. For example, 0° aspect angle is directly behind and 180° aspect angle is directly in front. The aspect angle is independent of the other aircraft's heading.

Aux—Auxiliary radio, usually VHF radio

Bingo—A prebriefed fuel state needed for recovery using prebriefed parameters.

Blind—No visual contact with friendly aircraft; the opposite of "visual."

Break (Up, Down, Right, or Left)—To perform an immediate maximum performance turn in the indicated direction. Assumes a defensive situation.

Cleared—Requested action is authorized.

Closure—Overtake created by airspeed advantage and/or angles. The rate at which range decreases (also known as Vc: closure velocity "V-sub-C"). Closure can be positive (getting closer) or negative (getting farther away).

Cross turn—A 180° heading reversal by a flight where aircraft turn into each other.

Element lead—The pilot responsible for the conduct of a two-ship element. In a two-ship formation, the element lead is the flight lead (see definition). Number 3 is the element lead in a four-ship formation.

Extension or acceleration maneuver—An unloaded maneuver, almost always at a high-power setting, to gain airspeed and either generate closure (decrease distance) or increase opening velocity (separation).

FENCE—The boundary separating hostile and friendly areas. Entering or exiting designated area.

FENCE check—Set cockpit switches as appropriate.

Flight lead—Although perhaps not the most experienced pilot in the flight, the flight lead (referred to as "lead") is charged with the safe and successful completion of the mission. Wingmen may lead portions of the mission, but the designated flight lead does not change.

High six—A position physically above and behind an aircraft regardless of heading or bank angle.

Joker—Fuel state above bingo at which separation, bug out, or event termination should begin and proceed with the remainder of the mission.

Knock-it-off—Training term used to stop maneuvers in progress for safety of flight issues.

Lag pursuit—Maneuvering to control closure, range, and/or aspect angle by positioning the lift vector (or flightpath) toward the outside of another aircraft's TC. Lag pursuit usually decreases AA.

Lag reposition—An out-of-plane maneuver performed to control overtake, decrease aspect angle, and/or prevent an overshoot by using vertical TR above and behind another aircraft's POM.

Lead pursuit—Maneuvering to control closure, range, and/or AA by positioning the LV (or flightpath) toward the inside of another aircraft's TC. Lead pursuit usually increases or maintains aspect angle.

Lead reposition—An out-of-plane maneuver generally performed to increase overtake and aspect angle and/or decrease range by using vertical TR below another aircraft's POM.

Lift vector—An imaginary plane going vertically through the top of the aircraft, representing the POM in a straight pull. "Set the lift vector" means to roll the aircraft to set the point you want to pull to at your 12 o'clock high.

Line abreast—Two groups, contacts, formations, or aircraft side by side.

Line of sight—A direct line between two aircraft.

Line-of-sight rate—Speed of apparent drift of one aircraft in relation to another, speed of angular change of LOS.

Nav lead—May be used when lead wants the wingman to navigate and clear. Lead will fly the wingman position, deconflict within the flight, and keep the radios; for example, battle damage check.

Ops check—Periodic check of aircraft systems performed by the aircrew (including fuel) for safety of flight.

Overshoot (flightpath)—Results in one aircraft crossing through or behind the flightpath of the other aircraft, but not necessarily in front of the other aircraft's 3/9 line.

Overshoot (3/9 line)—Results in the aft aircraft flushing forward of the other aircraft's 3/9 line.

Perch—A position behind and to the side of an aircraft used to define a starting point for follow-on maneuvering.

Plane of motion—A plane extending from the flightpath of an aircraft to the center of its turn radius.

Prime—primary radio, usually UHF

Pure pursuit—An aircraft with its nose pointing at another aircraft is in "pure pursuit".

Push—Change frequency without acknowledgment.

Quarter plane—A last-ditch maneuver used to prevent a 3/9 overshoot or to "preserve 3/9 line" at closer ranges and higher LOS rates.

Radial G—The vector sum of the aircraft's LV and gravity when turning in a vertical POM; that is, the G effectively turning the aircraft.

Squawk—Operate IFF as indicated or IFF is operating as indicated.

Tactical lead—May be used when lead needs the wingman to lead an event (for example, extended trail) or a segment of the flight. In this case, the wingman will pick up tactical, navigation, and radio responsibilities but not the overall flight lead responsibility. Individual callsigns do not change.

Terminate—Training term used to stop maneuvers in progress for non-safety of flight issues.

Turn circle—The flightpath described by an aircraft in a turn.

Turn radius—The distance between an aircraft's flightpath and the center of the TC.

Turn rate—Degrees per second an aircraft turns.

Turning room—Volume of airspace in the vertical, horizontal, or both, which can be used to execute a desired maneuver.

Visual—Sighting of a friendly aircraft or ground position; the opposite of "blind".

Zipper—A double-click of the microphone button used to attract the attention of another pilot in the formation without compromising mission information (e.g., callsigns or flight composition) or cluttering the frequency.