BY ORDER OF THE COMMANDER AIR EDUCATION AND TRAINING COMMAND

AETC TACTICS, TECHNIQUES, AND PROCEDURES 11-1

4 SEPTEMBER 2009
Certified Current 13 September 2011
Tactical Doctrine

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

ACCESSIBILITY: Publications and forms are available for downloading or ordering on the e-Publishing website at www.e-Publishing.af.mil.
RELEASABILITY: There are no releasability restrictions on this publication.

OPR: HQ AETC/A3Z (Project Office: 19 AF/DOG) Certified by: 19AF/CC (Maj Gen Feest)
Supersedes: MCMAN11-238V2, 15 April 1995 Pages: 128

This publication applies to all regular, Air Force Reserve, and Air National Guard personnel. Ensure that all records created as a result of processes prescribed in this publication are maintained in accordance with Air Force Manual (AFMAN) 33-363, *Management of Records*, and disposed of in accordance with Air Force Records Information Management System (AFRIMS) Records Disposition Schedule (RDS) located at https://www.my.af.mil/gcss-af61a/afrims/afrims/. Attachment 1 contains a glossary of references and supporting information used in this publication.

Chapter 1—INTRODUCTION 6
1.1. Overview. 6
1.2. Purpose. 6
1.3. Change Procedures. 6
Chapter 2—PREPARATION 7
2.1. Introduction. 7
2.2. Psychological and Physiological Considerations. 7
2.3. Effective Communication (Comm). 9
2.4. Task Management. 10
2.5. Mutual Support. 12
2.6. Flight Discipline. 12
2.7. Mission Planning. 12
2.8. Briefing. 13
2.9. Debrief. 16

Table 2.1. Performance Measure Debriefing—Board Matrix Example. 18
Table 2.2. DFP Debrief – 6,000-Feet DBFM Example. 19
Chapter 3—FORMATION **20**
3.1. Introduction. 20
3.2. Purpose. 20
3.3. Communications. 20
3.4. Ground Operations. 21
3.5. Basic Formation. 21
3.6. Two-Ship Tactical Formation. 21
3.7. Four-Ship Tactical Formation. 24
3.8. FENCE Check. 25
3.9. G Exercise. 25
Chapter 4—AIR TO AIR (A/A) **27**
4.1. Introduction. 27
4.2. BFM Axioms. 27
4.3. BFM Concepts. 28
4.4. Power and Energy Management. 34
4.5. BFM Cross-Check. 36
4.6. Offensive BFM (OBFM). 37
4.7. Defensive BFM (DBFM). 48
4.8. High-Aspect BFM (HABFM). 60
4.9. Air Combat Maneuvering (ACM). 73
Chapter 5—BASIC SURFACE ATTACK (BSA) **89**
5.1. Introduction. 89
5.2. Surface Attack Definitions. 89
5.3. Mission Planning/Preparation. 90
5.4. Ground Ops. 91
5.5. Range Entry. 91
5.6. Range Comm. 91
5.7. Range Exit. 92
5.8. Switches Safe/FENCE OUT. 92
5.9. Abnormal Procedures. 92
5.10. Conventional Pattern Procedures. 93

5.11. Tactical Pattern Procedures. 96
5.12. Level Pattern Procedures. 99
5.13. Weapons Employment. 99
5.14. Error Analysis. 103
5.15. High-Angle Strafe (HAS). 104
5.16. Low Angle Strafe (LAS). 106
Chapter 6—SURFACE ATTACK TACTICS (SAT) 108
6.1. Overview. 108
6.2. Mission Planning. 108
6.3. Ground Ops. 108
6.4. Departure. 108
6.5. Mutual Support. 108
6.6. Theater Air Control System. 109
6.7. Medium-Altitude Tactics. 110
6.8. Low Altitude. 116
6.9. Adopted Forms. 121
Attachment 1—GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION 122

LIST OF FIGURES

Figure 3.1. Visual Search Responsibilities. 25
Figure 4.1. Aspect Angle. 29
Figure 4.2. HCA. 29
Figure 4.3. ATA (AON) and AOT. 29
Figure 4.4. Pursuit Curves. 30
Figure 4.5. LOSR. 31
Figure 4.6. The Control Zone. 32
Figure 4.7. Control Zone Canopy Bow References. 32
Figure 4.8. LV versus POM. 33
Figure 4.9. T-38 EM Diagram. 35
Figure 4.10. Corner Velocity. 36
Figure 4.11. Heats-to-Guns Exercise. 38
Figure 4.12. Estimating AA. 43
Figure 4.13. Canopy Bow Assessment: High AA at ~3,000 feet (Offset TCs). 44
Figure 4.14. IFF Bandit WEZ. 49
Figure 4.15. Setting the “FIGHT’S ON” AA. 51
Figure 4.16. Bandit Lag Assessment. 51
Figure 4.17. Two Common Reversal Pictures. 52
Figure 4.18. Reversal Cue, Lead Bandit. 54
Figure 4.19. Winning and Losing LOS Cues. 55
Figure 4.20. Separation Cues. 56
Figure 4.21. 3K DBFM Jink Lift Vector. 58
Figure 4.22. Keeping the Tally. 59
Figure 4.23. Regaining the Tally. 60
Figure 4.24. Turning Room. 61
Figure 4.25. Lead Turn. 62
Figure 4.26. Energy Atom. 63
Figure 4.27. Merge Objective. 64
Figure 4.28. Get to the Inside at the Turn In. 65
Figure 4.29. High-to-Low Turn In. 66
Figure 4.30. Lead Turn Cues. 67
Figure 4.31. Bandit Turn Direction. 67
Figure 4.32. When to Extend Part 1. 69
Figure 4.33. When to Extend Part 2. 69
Figure 4.34. One-Circle Assessment. 71

Figure 4.35. One-Circle – Winning. 72
Figure 4.36. Use the Turning Room. 72
Figure 4.37. Weapons Deconfliction Zone. 76
Figure 4.38. High-Aspect Bracket. 80
Figure 4.39. Filming the Merge. 80
Figure 4.40. Bandit Turns with the Lead Fighter. 83
Figure 4.41. Bandit Extends to the Trail Fighter. 84
Figure 4.42. Defensive Perch (No Switch). 85
Figure 4.43. Defensive Perch (Early Switch). 87
Figure 4.44. Defensive Perch (Late Switch). 88
Figure 5.1. Basic Concepts. 90
Figure 5.2. Conventional Pattern. 94
Figure 5.3. Base References. 96
Figure 5.4. Indirect Pop Pattern. 97
Figure 5.5. Pop Attack Pulldown Canopy Code. 98
Figure 5.6. Adding ITP to the Roll In. 101
Figure 5.7. Delay Cue. 103
Figure 5.8. Auto Scoring Display. 103
Figure 5.9. Wire Analysis. 104
Figure 5.10. Strafe Final. 106
Figure 6.1. SA Cup. 109
Figure 6.2. Medium-Altitude Holding. 111
Figure 6.3. Wheel Canopy Reference. 111
Figure 6.4. Lookout Priorities. 112
Figure 6.5. Medium-Altitude Attack Pattern. 113
Figure 6.6. Medium-Altitude Shooter/Cover. 114
Figure 6.7. Medium-Altitude Cover/Shooter. 115
Figure 6.8. Medium-Altitude Shooters. 115
Figure 6.9. Low-Altitude Wedge Figure 8. 117
Figure 6.10. Low-Altitude Wedge Racetrack. 117
Figure 6.11. Low-Altitude Gun/Bomb. 118
Figure 6.12. Low-Altitude Bomb/Gun. 119
Figure 6.13. Low-Altitude Guns. 120

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 first hand 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. Suggested changes should be forwarded from any level of command using AF Form 847, *Recommendation for Change of Publication*. Send AF Form 847 to 19 AF/DOG.

Chapter 2

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, the prioritization based on SA, and flight leadership. Each factor is part of a professional attitude, which enhances safety and increases tactical potential. The CRM core concepts of SA—flight integrity, communication, risk management and decisionmaking, task management, mission planning and debrief—are addressed throughout this chapter. The success of all that follows (briefing, execution, and debriefing) is directly related to the amount and quality of preparation. First, individually prepare yourself for the mission. Second, determine mission objectives in terms of measurable combat capability and related basic pilot skills. Finally, decide how to brief and execute the mission.

2.2 Psychological and Physiological Considerations. A fighter mission demands total involvement, whether it is actual combat or continuation 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.

2.2.1 **Psychological Considerations.** In combat, you will not have the option of calling; “KING’S X, I HAVE LOST MY LEADER,” or “BINGO, KNOCK IT OFF.” You cannot plan on the enemy making a mistake. No one knows for sure how they will react in the next combat situation. This fact in itself causes 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:

- Your aircraft.
- Your wingman.
- Your ability to accomplish the mission.

2.2.1.1 **Situational Awareness (SA).** SA is the continuous perception of self and aircraft in relation to the dynamic environment of flight, threats, and mission and the ability to forecast, then execute, tasks based on that perception. It is gained through assimilating information obtained through:

- Visual cueing and perceptions.
- Flight members.
- Communication.
- On-board avionics.

One of most important factors in maintaining SA is a common understanding of the briefed plan. That understanding, overlaid with current fight conditions to arrive at an overall picture of what *is* happening and what *will* happen defines SA.

2.2.1.2 **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 to come to you. 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. Excessive pride can result in not admitting your faults; excessive desire can cause you to overlook small details along the way; overly aggressive attitudes can cause you to override good judgment. Professionalism is the only quality that can achieve the proper blend of pride, desire, and aggressiveness.

2.2.2 **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. Proper mission planning begins with good physical and mental preparedness.

2.2.3 **G-Awareness.** US Air Force fighter aircraft capability can meet or exceed pilot tolerance for sustained high Gs. This capability often allows pilots to apply more Gs 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. G-induced loss of consciousness (GLOC) is extremely dangerous for two reasons. GLOC episodes have historically resulted in loss of both the aircrew and aircraft, and unlike other pilot stresses, it is not possible for pilots to accurately and reliably know how close they are to the GLOC threshold. The best solution to the GLOC problem is pilot awareness. The pilot has ultimate control over G-stress factors.

2.2.3.1 **Flight Factors.** Sustained high G for long periods 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.

2.2.3.2 **Conditioning.** Be prepared mentally and physically for high-G stress. Proper physical conditioning involving anaerobic training (free weights, nautilus, universal gym, hydra fitness, etc.) and aerobic training (running, racquetball, cycling, etc.) play an important role in improved G-tolerance and endurance.

2.2.3.3 **Currency, Anxiety, and Aggressiveness.** G-tolerance is increased through practice. Layoffs such as a long leave, duty not including flying, or even just coming out of a low-G flying phase require a buildup of G-tolerance. Anxiety in new situations or other pressures can mask your 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 grayout 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 (KIO).

2.2.3.4 **Anti-G Straining Maneuver (AGSM).** The AGSM is the best defense measure available to pilots. It is very important to perform the same, correct AGSM each time you anticipate and/or apply G. The proper technique needs to become a skill that is integrated with other flying skills.

2.2.3.4.1 **Preparation**. The straining maneuver should begin prior to G onset. It can be difficult to "catch up" to the Gs if you get behind from the start. Begin by leading with lower body tensing and then the breathing component.

2.2.3.4.2 **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.

2.2.3.4.3 **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 Gs are unloaded.

For more information, refer to AFPAM 11-419, *G-Awareness for Aircrew*.

2.3 Effective Communication (Comm). This includes knowledge of common errors, cultural influences, and barriers (rank, age, experience, and position). Skills will encompass listening, feedback, precision, and efficiency of comm with all members and agencies (that is, pilots, wingmen, weather, air traffic control, and Intelligence). Comm ties the mission together. From the beginning of mission planning through the lessons learned in the debrief, comm is the basic determinant of both mission accomplishment and success. The flight lead must effectively translate the plan and objectives to each wingman so assets can be directed to achieve the goals. The flight leads must communicate thoroughly during planning to produce the correct flight products for their mission. In the briefing, they must address the flight's execution plan and major contingencies that can be expected during flight and the planned reactions. Standards must be established to cover those contingencies that are not briefed. Briefings must be complete and understood so that contingencies can be executed in the air using concise radio communications. Visual signals must be understood and used correctly to be effective. Preparation to ensure effective in-flight communication includes the following:

- Know and adhere to accepted and standard terminology (squadron standards, AFTTP 3-1.1, *General Planning and Employment Considerations*, and ATC) (located at https://wwwmil.nellis.af.mil/units/561jts/dn/volumes.aspx).
- Brief anticipated comm flow.

- Have zero tolerance for complacent, sloppy, or ambiguous radio calls (in flight and during debrief).
- Establish an appropriate assertion level; ensure two-way communication.
- Assume nothing.
- State concerns and intentions and get an acknowledgment/decision.

2.4 Task Management. Task management involves establishing priorities for maximum efficiency and avoiding task saturation.

2.4.1 **Establish Priorities.** There are occasions during nearly every mission when you cannot do everything in the time available. This requires assigning priorities (task prioritization). At the top of the list are Critical Tasks – things you have to do. Lower on the list are things you would like to do – Noncritical Tasks. The list of have-to-do tasks should be established long before getting near an aircraft.

2.4.1.1 **Critical Tasks.** These are tasks that cannot be ignored without catastrophic consequences. If noncritical tasks begin to cause inattention to critical tasks, immediately disregard the non-critical tasks until all critical tasks are accomplished. Critical tasks include:

- Maintaining aircraft control.
- Deconflicting flightpath.
- Avoiding terrain.
- Being aware of fuel.

2.4.1.2 **Prioritizing Noncritical Tasks.** Lower priority tasks fall into two general categories: formation tasks and mission tasks. Formation tasks range from ops checks to proper execution of tactical turns. Critical tasks, such as element deconfliction, can never be disregarded, but other tasks will require monitoring and management. For example, Fencing in during military operations area (MOA) entry, formation tasks (deconfliction, staying in formation, and radio awareness) should be prioritized above mission tasks (heads-up displays (HUD), weapons checks, and avionics). Although mission success is usually measured by how well mission tasks are accomplished, keep overall mission success in perspective. ***Remember, if the aircraft does not get back home, the mission has failed.*** If formation tasks become secondary to mission tasks, as a general rule, mission success will suffer. Letting nice-to-do things take priority over have-to-do things will jeopardize yourself and those around you.

2.4.1.3 **Misprioritization.** Mispriortization can have disastrous results. Remember the basics of Aviate, Navigate, and Communicate. Be alert for situations that regularly require prioritization of critical and noncritical tasks: Switch changes during formation; Fencing out during a rejoin; digging out an approach plate while in instrument meteorological conditions (IMC); etc.

2.4.2 **Task Saturation.** Task saturation is a temporary failure to properly assess available information and initiate required pilot actions.

2.4.2.1 **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.
- Training rule violations.
- Loss of control of the aircraft.
- Ground collision.
- Midair collision.

2.4.2.2 **Causes.** The main cause of task saturation is the sheer number of duties which must be handled by the pilot or crew. Among the tasks to be performed are aircraft control, navigation, 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 as well as habits formed while flying other types of aircraft (such as switch and display locations). Managing cockpit tasks requires good judgment and strong interpretive and discriminatory skills.

2.4.2.3 **Task Saturation.** Symptoms of task saturation include:

- Missing radio calls.
- Difficulty controlling the aircraft.
- Getting behind the aircraft.
- Loss of SA.
- Spatial disorientation.
- Channelized attention.

2.4.3 **Task Management Techniques.** The following techniques will assist in preventing or overcoming task saturation:

2.4.3.1 **Preflight:**

- Ensure aircrews are well rested, properly nourished, and mentally prepared.
- Know what is expected on the mission. Ask questions if any aspects of the mission are unclear.
- Ensure checklist items and habit patterns are followed. If events interrupt habit patterns (ground abort, night, etc.), slow down to ensure everything is accomplished.

2.4.3.2 **In Flight:**

- Anticipate and be prepared for the next briefed event. Always try to stay ahead of the aircraft.
- Do not dwell on mistakes.
- Control false sensations and quickly transition to instruments when visual cues become unreliable.
- Be prepared for changes in task priorities.
- Reduce head-down time by maintaining a good cross-check among instruments, sensors, and visual references.
- Watch for symptoms of task saturation and act to minimize them:

- If low altitude, climb to cope.
- Reprioritize current tasks, placing aircraft control first.
- Inform crew mate or flight member about situation.
- Pass control of aircraft.
- Call a KIO if tactically maneuvering.

2.4.4 **Mission Accomplishment.** This task has a high priority; however, in peacetime there is no mission more important than safe recovery of the flight. The aircrew cannot afford to exceed personal limits in the desire for mission accomplishment. Aircrew limits vary from day to day, based on capabilities and experience, as well as psychological and physical preparation.

2.5 Mutual Support. Mutual support is a contract within a flight of two or more aircraft that supports the flight's mission accomplishment. It is directly related to SA in that it requires positional awareness and performance evaluation of all flight members and any threats, as well as an understanding of both the flight's and threat's capabilities.

2.5.1 **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 are in charge of 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 formations, maximizing the flight's effectiveness, and leading the flight successfully during the mission.

2.5.2 **Wingman Responsibilities.** Wingmen have the supporting role in the flight. They help the flight lead plan and organize the mission. They have visual lookout and sensor responsibilities and provide backup navigation for the flight as required. Wingmen execute as briefed or when directed by the flight lead and provide mutual support throughout all phases of the mission.

2.6 Flight Discipline. Discipline is perhaps the most important element for success in any aspect of aerial combat. On an individual basis, it consists of self-control, maturity, and judgment. Teamwork is an integral part of discipline; individuals evaluate their actions and how they affect the flight and mission accomplishment. If all flight members know their respective duties, they work together as a flight. Experience and realistic training leads to professional air discipline.

2.7 Mission Planning:

2.7.1 **Planning Considerations.** The flight lead establishes priorities for mission planning and delegates them to flight members to ensure all planning considerations are addressed and to preclude any duplication of effort. All flight members should be involved in the mission preparation. The depth of planning detail is dictated by the syllabus, mission and flight experience level, but the bottom line is "All necessary mission planning is completed in time to conduct a concise, comprehensive briefing."

2.7.1.1 **Flight Lead/Direct Support Instructor Pilot (IP) Responsibilities.** 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 are in charge of the resources entrusted to them; they must know syllabus requirements and 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.

2.7.1.2 **Wingman Responsibilities**. Wingmen have critical responsibilities of helping the leader plan and organize the mission. Wingmen should contact their flight lead the day prior for specific direction and arrive early enough to complete prebrief administration items. Check with the flight lead again the day of to see if he requires any special items, other than the standard for the brief. Check the schedule for last-minute changes; fill out your mission data card and sign out on the flight orders as required (students normally sign out only on solo flights). Check the weather, notices to airmen (NOTAM), safety and/or time-critical notices such as flight crew information file, and pilot read file. Review the standard departure and recovery for the mission and study a map of the working area; ensure familiarization with boundaries, altitudes, and restrictions.

2.7.2 **Mission Objectives.** Preparation for any given mission should be based on mission objectives. Mission objectives will normally be driven by the syllabus on IFF missions. 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.

2.7.2.1 **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, negate.

2.7.2.2 **Conditions.** Describes starting parameters such as "from an offensive perch" or "given two Bandits with noise jamming and a BVR setup."

2.7.2.3 **Standards.** States how well the performance must be done and is categorized by time limits, accuracy, and quality (such as, "meeting valid kill criteria," or "ranging within ±500 feet").

2.7.3 **Operational Risk Management (ORM).** Part of mission planning is assessing and managing the risks inherent in fighter operations with respect to individual limitations and vulnerabilities. Review the mission and clearly define what is to be accomplished. Then focus on critical phases throughout the flight; keep in mind many mishaps occur during takeoff, en route, rejoins, and landing, not just during tactical operations in the MOA. Attempt to assess all possible risks during these flight phases by building a mental picture of the sequence of events—look for the obvious risk factors, then ask yourself: if something goes wrong, how do I adapt? In addition, critically assess each of these areas:

- Pilot—proficiency/currency issues; physical and mental health, skill level, and experience.
- Environment—weather, time-of-day (TOD), terrain, altitude, Gs, and temperature.
- Aircraft—configuration limitations, cockpit setup, and potential distractions.
- Supervision—personality conflicts, discipline, supervisory, and peer pressures.

2.8 Briefing. The purpose of the briefing is to clearly convey the "what" and "how to" of the mission.

2.8.1 **Preparation—The Key to a Quality Briefing.** If the briefing time is limited, and/or a large amount of information needs to be covered (instructional or highly complex missions), management of the allotted briefing time will be improved by practicing the briefing. This will allow the briefer to formulate verbiage and rework areas that may not have been well thought out.

2.8.1.1 **Briefing Guides.** Briefing guides are one of the most useful tools for preparing and delivering flight briefings. They help the briefer organize thoughts and identify areas where knowledge may be lacking. Using another aviator's briefing guide, or a generic, can be useful as a reference; however, developing an individual briefing forces the briefer to think through the briefing material. The detail contained in the briefing guide will depend on the familiarity with the subject. The less familiar a briefer is with the topic, the more detailed the briefing guide should be. If a briefer is familiar with a topic, an outline may be sufficient.

2.8.1.2 **Briefing Room Boards and Computer Slide Usage.** Preparing white boards and/or slides is essential to enhancing the overall quality of the briefing. Information on boards should be limited to essential information. As a general rule, the less cluttered the briefing boards, the less distracted the flight will be during the briefing. Avoid filling the boards with laundry lists for the mission or "memory joggers" for the briefing. If utilizing computer slides for a presentation, turn off the screen or use a black slide when proceeding to the next topic.

2.8.1.3 **Briefing Room Interactive (BRI) Usage.** BRI is an outstanding tool for making expeditious briefs that can quickly incorporate high fidelity visual aids. BRI is also very useful for premission study and preparation. On instructional sorties, using BRI allows students to go back and review areas on their own. Consider using example videos to put a picture to instruction.

2.8.1.4 **Speaking Ability.** A briefer may be very knowledgeable in a subject, but if the individual is unable to communicate ideas in a clear and logical way, the briefing will not be effective. Practice, including "dry runs," will help improve speaking skills as well as prevent some of the most common pitfalls during briefings: improper focus/time allotment, excessive rambling/going off on tangents, and not presenting in a logical order/disjointed flow. Practice also aids in eliminating distracting verbal pauses (for example, "with that," "basically," "big picture," or "um").

2.8.2 **Flight Lead/Direct Support Coordination Briefing.** The "coord" briefing describes what is to be accomplished and sets the tone for the entire mission. Establish objectives that include a standard that measures successful performance. Admin, or "motherhood," items should be covered in an efficient manner. Locally developed standards can be used to brief common or repetitive elements of the mission. Most of the time should be spent on the "meat," or primary focus, of the mission. Alternate missions should be less complex than the original mission but also have specific objectives. The flight lead controls the brief and should be dynamic, credible, and enthusiastic. He should motivate and challenge the flight to perform to planned expectations, asking questions to involve flight members and determine briefing effectiveness. The IFF coordination briefing should not normally last longer than 15 minutes to allow adequate time for the instructional briefing.

2.8.2.1 **Techniques for a Good Briefing:**

- Ensure the boards are clean prior to setting up any presentation.
- Ensure all writing and drawings are neat and legible from where the flight is sitting.
- Always stand when presenting the briefing.
- Start the briefing on time and with a precise and correct time hack.
- After any necessary introductions, lead the briefing with the overall mission objective(s) and "big picture" overview.
- Maintain eye contact with the flight while briefing.

2.8.2.2 **Wingman Briefing Role.** Wingmen should be prepared to brief all topics required by the flight lead, syllabus, and/or squadron standards. Topics normally include the weather, NOTAMs, emergency procedure (EP), and threat of the day. Be organized and efficient while briefing. Stay focused and pay attention during the brief. Write down any questions you may have and ask them at the appropriate time. ***Never leave a briefing with doubts or unanswered questions***.

2.8.3 **Instructional Briefing.** The instructional briefing describes how to accomplish specific mission tasks. Like the coord briefing, the focus should be on the primary mission objectives—the "meat" of the mission. The instructor must take into account the experience level of the wingmen and adjust the brief accordingly. Be sure to end your brief with adequate time for everyone to mentally review the mission and accomplish any other prestep requirements—normally not less than 10 minutes.

2.8.3.1 **Briefing Flow.** The briefing should start with the mission objectives and narrow to the specific mechanics, incorporating how to recognize the pictures and describing techniques to execute the correct maneuvers – Picture, Plan, and Execution. Philosophical discussions and blanket statements should be avoided.

2.8.3.2 **Visual Aid Usage.** Correct integration of visual aids in a briefing will enhance a briefing and better communicate the message to the flight. Conversely, the inappropriate or inaccurate use of visual aids can confuse the flight and distract from the overall quality of the brief. Some common visual aids include drawings and canopy/HUD cutouts, briefing sticks, air combat maneuvering instrumentation (ACMI), and BRI.

2.8.3.2.1 **Drawings and Canopy Bow/HUD Cutouts.** Drawings and canopy bow/HUD cutouts must be accurate enough to support the desired point. Common errors include talking at the board while drawing and blocking the drawing from the student's view. A good way to avoid these errors is to limit one's action to one at a time. When using the board for drawings or canopy bow references, look at the board and make an accurate drawing or depiction—without talking. When finished, move to a side allowing the student to see the picture, and look at the flight while briefing to the visual aid. Drawings may also be put up prior to the instructional brief. If using the same room as the coord brief, be sure coordinate with the flight lead to avoid stealing his boards or cluttering his presentation.

2.8.3.2.2 **Briefing Sticks.** Briefing sticks must be used in a manner accurate enough to convey aircraft relationships and movement. When using sticks for offensive basic

fighter maneuvering (OBFM) and defensive BFM (DBFM), hold them underhanded and anchor the student's aircraft with either the nose or tail aimed at the student's ear so the perspective makes sense from the student's view. Look at the sticks while positioning them, then look at the student while briefing. The student's jet should remain stationary, and only the adversary's jet should move to present the instructional picture. Upon completing the briefing point, put the sticks down. Do not use the briefing sticks as a pointer.

2.8.3.2.3 **ACMI and BRI.** IP demo ACMI files can be used to show the student expected lines and fight progression as well as cockpit views. BRI can be used to view animations and IP demo HUD footage. Prior setup is recommended and system knowledge is essential to coherently integrating these instructional tools

2.9 Debrief. It is a well-accepted axiom that the majority 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 end 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.

2.9.1 **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, 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.

2.9.2 **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.

2.9.3 **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.

2.9.4 **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, 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 end 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 particular 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.

2.9.5 **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.

2.9.6 **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:

2.9.6.1 **Performance Measure Technique.** When accomplishing multiple repetitive events, such as BFM sets or container pattern bombing, a good technique is to evaluate the performance at each event. See Table 2.1. When doing this, look to answer the following questions:

2.9.6.1.1 **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.

2.9.6.1.2 **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," plan, or execution.

2.9.6.1.3 **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.
- Fix the error if it occurs again.

Table 2.1. Performance Measure Debriefing—Board Matrix Example.

ITEM	A	B	C	D
	Event	**What Happened?**	**Why Did It Happen?**	**How to fix?**
1	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
2	10° pop	GE – min rel	1. Short AOD 2. No track adjust-ment at track altitude	1. Pull to correct AOD 2. Appropriate correction/mechanics

2.9.6.2 **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.

2.9.6.2.1 **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.

2.9.6.2.2 **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.
- Decision – manuever selection.
- Execution - manuever mechanics.

2.9.6.2.3 **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.

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

2.9.6.2.5 **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.

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

2.9.6.2.7 **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 2.2. DFP Debrief – 6,000-Feet DBFM Example.

ITEM	A	B	C
	DFP	**CF**	**Fix**
1	Why did Eagle 2 die?	Poor rate fight	Improve DBFM cross-check and apply briefed EM fixes
2	**Root Cause⇨**	Incorrect assessment of range, AOT, and plan form	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 plan form is required to assess valid separation cues. If you are not sure you have valid separation cues, do not attempt to separate.

Chapter 3
FORMATION

This chapter builds on the formation fundamentals learned in undergraduate flying training—refer to AFMAN 11-251, Volume 1, *T-38C Flying Fundamentals*.

3.1 Introduction. We generally understand formation to mean two or more aircraft working together with understood roles under one flight lead's control. Control of the formation and flight integrity are essential to coordinated effort, and can only be maintained if the lead has complete knowledge and control of all the wingmen's actions. It is the lead's responsibility to brief and direct the desired formation position and the wingman's responsibility to be in that position until the flight lead directs another, or the wingman gets permission to change his position.

3.2 Purpose. The two-ship is the basic employment standard for tactical aviation. Even when part of a four-ship, you will have element leads and wingmen. The primary reason for two-ship execution is mutual support. This concept follows the basic rules of war: mass of firepower and coordinated maneuvering. Additionally, aerial warfare moves at a rapid pace and in multiple dimensions. As a result, visually supporting one another in the air increases our likelihood of survival and mission success. In many fourth- and fifth-generation fighters, this visual mutual support is enhanced with "sensor" mutual support as well.

Solid formation flying by both flight leads and wingmen is the foundation upon which element tactics are built. Flight leads are responsible for directing the formation to maximize lethality and survivability. Wingmen are responsible for being in position and ensuring flightpath deconfliction from their element lead as well as other members of the flight. As a wingman, your priorities are remaining visual, being in the correct/correcting to the correct formation position, and then working the radio and navigational aids (NAVAID). This can be remembered with the acronym VFR. When multiple tasks are required, the key to success as a wingman is task prioritization—knowing what to do first. At FENCE OUT, it is preferable to be padlocked and momentarily on the wrong frequency than blind on the correct frequency.

3.3 Communications. All communications must be received and understood by every member of the flight in order to be effective. As a guide to clear, concise, and correct communication, utilize the brevity words found in AFTTP 3-1.1, Attachment 1. As a rule, you will use visual signals in accordance with (IAW) AFI 11-205, *Aircraft Cockpit and Formation Flight Signals*, to the max extent possible in order to preserve communication time available on our working frequencies. While in IFF, you and your flight lead will likely be the only players using your tactical frequency. Nonetheless, we will strive to use visual signals whenever possible to train for future tactical environments where multiple players are using the same frequency simultaneously.

3.3.1 **Radio Discipline.** Efficiency on the radios requires discipline. By discipline we mean not only clarity and brevity when you transmit, but also limiting unnecessary transmissions. An old fighter pilot mantra says that a pilot, and especially a wingman, should never miss the opportunity to be quiet on the radio. However, there will be times when it is necessary to communicate information that is crucial to mission success. The fine line of silence versus transmission varies from mission to mission and is something that should be debriefed on every sortie.

3.3.2 **Transmission Format.** The first part of every call should always be the call sign. In the case of directive or interrogative communication, this should be the call sign of the aircraft you are transmitting to. This serves to get the attention of the person to whom you are directing the transmission. After the call sign, the communication should be directive, then descriptive. This format is important because it gets the flight moving in a very dynamic environment, and then tells why the action was necessary. EXAMPLE: “SMURF 1, CLIMB, TRAFFIC 12 O’CLOCK, 1 MILE LEVEL.”

3.3.3 **Acknowledgement**. When responding to radio transmissions, you should mimic flight lead whenever possible. EXAMPLE: "SMURF 1 OPS CHECK, 1 IS 2.7, 5.0 Gs." "2 IS 2.5, 6.1Gs." Not all radio calls require a radio response, such as when you can signal acknowledgement with your actions. EXAMPLE: "SMURF 2 GO FIGHTING WING." As a general rule, if flight lead’s direction involves safety of flight (aircraft separation, terrain avoidance, fuel, etc.) or switches related to weapons, wingman should acknowledge on the radio.

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

The initial check-in is a great opportunity to build your flight lead’s confidence in your capabilities. Be aware of and ready for check-in time. As a general rule, if you’re not moving switches with your left hand, have it on the throttle ready for a check-in at all times (unless maintenance personnel are under the aircraft). Strive to be timely and crisp. If your mask is hanging, raise it first. Be aware that there is a slight delay from the time you move the mike switch to the time the radio actually transmits.

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 AFMAN 11-251, Volume 1. 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 longer during visual meteorological conditions (VMC) transits in order 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 what you

will see 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 as a means 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 you are. Maneuvers to correct excessively poor formation may be aggressive but never erratic. Continuously assess your position and make corrections. The earlier you perceive a formation error the smaller the fix required and easier it will be to correct.

3.6.1 **Line Abreast (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. Your priorities in 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 you to see subtle changes in your position.

3.6.1.1 **Correcting LAB Position.** The easiest way to correct formation position is to establish a cross-check that allows you to perform all assigned tasks and *maintain* your assigned formation position. In order to determine whether or not you are LAB with your flight lead, assess aspect angle; you should see 90°. Assuming you are coheading, this position is approximately when the other aircraft is over your shoulder to about an inch in front of your shoulder in the 4,000- to 6,000-foot range. Additionally, if you are stacked above or below lead and can see both wingtips, they should be lined up. Always strive to use *geometry* to fix your formation position versus just power.

3.6.1.1.1 **Behind the Line.** If you find yourself behind the LAB line (less than 90° aspect), use the vertical and power to catch up to lead. You will need more airspeed than lead, so expect it to increase as you bunt and use mil power to catch up. It is OK to change from a stack above lead to stacking below unless you are in the low altitude structure. As the airspeed increases you should start to see aft line of sight rate. Remember, when you are LAB again you will still have overtake, so begin to decrease your airspeed to match lead slightly before you get to LAB. This can be accomplished by reducing power and/or trading airspeed for altitude. If not in special use airspace and flying an ATC assigned altitude you will primarily have to use power to get back into position.

3.6.1.1.2 **Ahead of the Line.** If you are only slightly ahead of the line, you can climb to and fly a slightly longer total flightpath to "let" lead catch up with you. 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 as you arrive at the proper LAB position. If you are far in front of lead, you must maneuver in the horizontal as well. Generally, it is best to make an aggressive, slightly climbing bid away from lead. Once you perceive line of sight forward, check back into lead (this will collapse range again). Finally, you will need to return to coheading and reassess whether you are LAB again.

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. When checking into or away, apply aft stick to make a positive input. An

unloaded check that adjusts your heading a couple of degrees may not do much for your lateral position. Every correction you put in has to be taken out again. The earlier you perceive a formation error the smaller the correction required and the easier it will be to fix. 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 you have stabilized, verify your range using the AAT.

3.6.1.2.1 **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.
- <4,000 feet = Detail on airplane, distinct canopy, can read tail letters. Beacon will be visible.

3.6.1.2.2 **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, the flight level will be approximately two beer cans above or below the horizon for a 1,500-foot stack. 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 you and your flight lead to remain visual. When looking into the sun, stack to pull lead away from it. If you are directly between your 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 your potential energy for follow on maneuvering.

3.6.1.3.1 **Stacking High.** To move from a level or low position, you must increase the power to achieve a high stack. In the T-38, this almost always requires MIL power. Your airspeed must increase very slightly to maintain your LAB position while climbing provided you were stabilized at LAB before you started 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, you need to reduce your power. The amount you reduce the power will be proportional to the angle of dive you use. Reduce the power enough to maintain your airspeed during the move to stack low. Remember to push the throttle back up when you achieve the desired position.

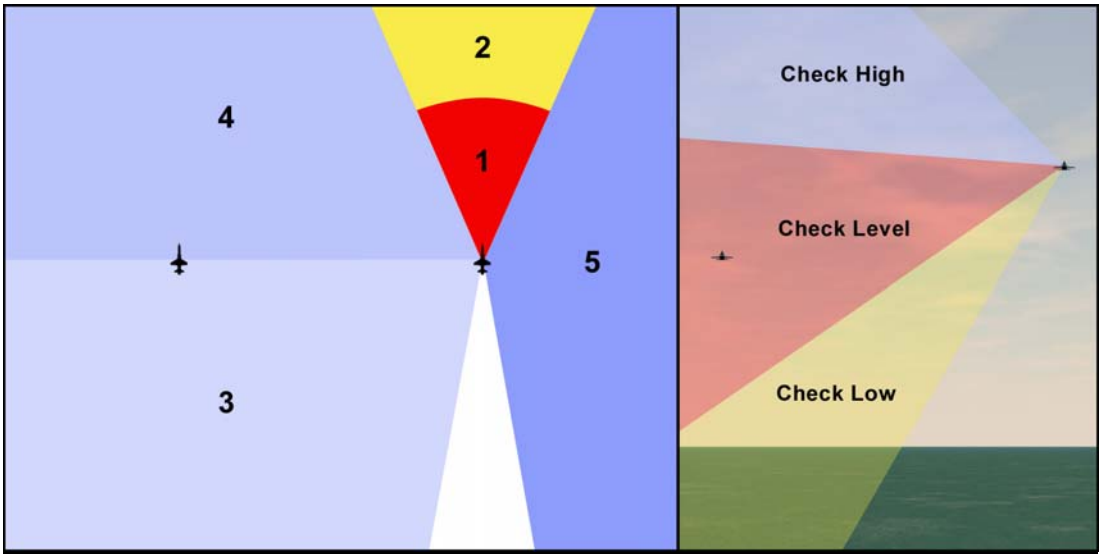
3.6.2 **Two-Ship Tactical Turns.** Two-ship tactical turns are accomplished IAW AFMAN 11-251, Volume 1, except as noted here. Expect flight leads to have solid wingman consideration; however, they will fly wherever required to accomplish the mission. This means that turns may not be exactly 180°, 90° or 45°. As tactical turns are initiated, you should assume standard turn amounts, however, continue to monitor and fly off of lead during the remainder of the turn. This will allow you 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 (for example, climbing between BFM sets), and sometimes turns are initiated from nonstandard positions and/or energy states (for example, just after a BFM set). A constant cross-check of the flight lead is necessary so that you 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, radar warning receivers (RWR) and off board SA enhancers such as Airborne Warning and Control System (AWACS), it is possible for an enemy to achieve an undetected entry into our combat formation. Therefore, you 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 not only level with your own jet, but higher than you, and lower than you. 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 intracockpit switch actuations.

3.8.1 **FENCE IN.** Do not forget your priorities as a wingman: visual, formation, radios. It is likely that the formation will be maneuvering during the FENCE check. As a technique, ensure you are in the proper formation, decide what switch needs to be changed and reach for it; make a quick glance inside the cockpit to ensure you have the correct switch; and make the actuation as you are cross-checking and fixing your 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 your 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 your 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$\pm$20 knots indicated airspeed (KIAS). During the turns, constant adjustments to the LV will be required to maintain approximately 420 KIAS 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. You 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 your 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. Roll to approximately 120° to 135° of bank, and select MIL power and blend in the G. For a sustained nose position reference, the horizon should be near the "high" mirror (this is about 15° to 25° nose low). Manage LV in the same manner as the G warmup while sustaining G.

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 4,000 to 6,000 feet. If not LAB, DO NOT attempt to accelerate or slow down to return to LAB. Instead, your priority is the correct airspeed for the second turn and setting range from your flight lead. Once both turns are complete, if not in LAB formation, maneuver to get back into position

Chapter 4

AIR TO AIR (A/A)

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. **Note:** For the remainder of this chapter, the adversary will be referenced as the "Bandit."

4.2 BFM Axioms. There are 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

4.2.1 **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, you cannot shoot at an enemy you don't see. It is relatively easy to keep track of a Bandit that is in front of you. However, defensively, an enemy that you cannot see is at liberty to shoot you while you are unable to defend yourself. There will be times in DBFM when the Bandit flies behind your seat; 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. As a general rule, stay padlocked on the Bandit until: 1) it is predictable, 2) it is ***easy to see***, and 3) it is not threatening you. If in doubt, stay padlocked and don't look inside the cockpit.

4.2.2 **Maneuver in Relation to the Bandit.** Nearly all maneuvering must be in relation to the Bandit. That means every time you do something with your 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 you. All the basic BFM concepts apply no matter what the attitude of your airplane 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 to your advantage 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 your position relative to the Bandit. Defensively, maneuver in relation to the Bandit to keep him from arriving in a WEZ. Regardless of the situation, you must maneuver in relation to the Bandit in order to defeat him. However, due to lack of performance in the T-38, you must

maneuver in relation to the horizon as well as the Bandit to achieve the best performance from the jet.

4.2.3 **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 you cannot shoot someone unless your 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 OBFM, you generally maintain energy until you decide to employ ordnance in a controlled manner for a high probability of kill (Pk) shot. You then use nose position to employ ordnance. Defensively, you concentrate on the Bandit's nose position. When the Bandit threatens you, cash in energy to defeat his ordnance. When his nose no longer threatens you, concentrate on maintaining or regaining energy to keep him from pointing at you. In high aspect, you concentrate on energy when you want to maintain a high turn rate over time, and cash in that energy for nose position when you want a small turn radius or an increased instantaneous turn rate to employ or deny ordnance. No matter what kind of fight you are in, at any given moment you should always know whether energy or nose position is more important.

4.3 BFM Concepts. BFM is not a set of canned maneuvers; rather, it is a dynamic combination of rolls, turns, and maneuvers to either create or solve a BFM problem. BFM problems can be created in range, angles, and closure. Each BFM selected is based on solving or creating a problem while maneuvering in relation to another aircraft. The time and amount of BFM required depends on ordnance load, threat reaction, and pilot skill. BFM concepts include terms, which provide a common baseline for BFM discussions.

4.3.1 **Geometry.** Understanding several key geometric terms and conditions are crucial in understanding one aircraft's position relative to another.

4.3.2 **Range.** Range is the distance by which the two aircraft are separated.

4.3.3 **Aspect Angle (AA) (Figure 4.1).** AA describes the relative position of the attacker to the target without regard to the attacker's heading. AA is defined as the angle measured from the tail of the target to the position of the attacker. From a defensive point of view, this angle is commonly regarded as the AOT.

4.3.4 **Heading Crossing Angle (HCA) (Figure 4.2).** HCA is the heading difference between two aircraft. With converging vectors HCA can be measured up to a maximum of 180° for a head-on pass. HCA is also referred to as "angle-off."

Figure 4.1. Aspect Angle.

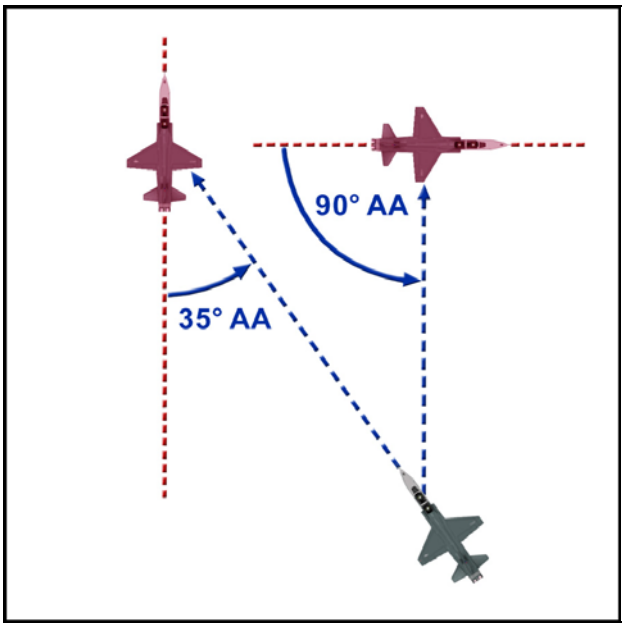
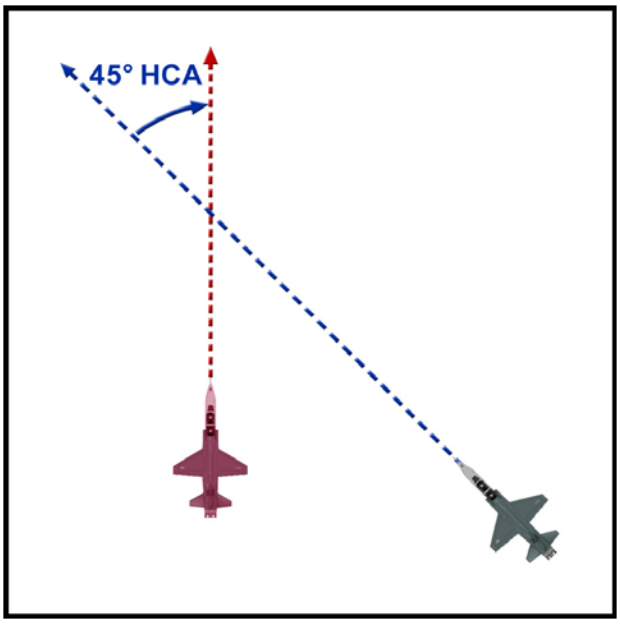


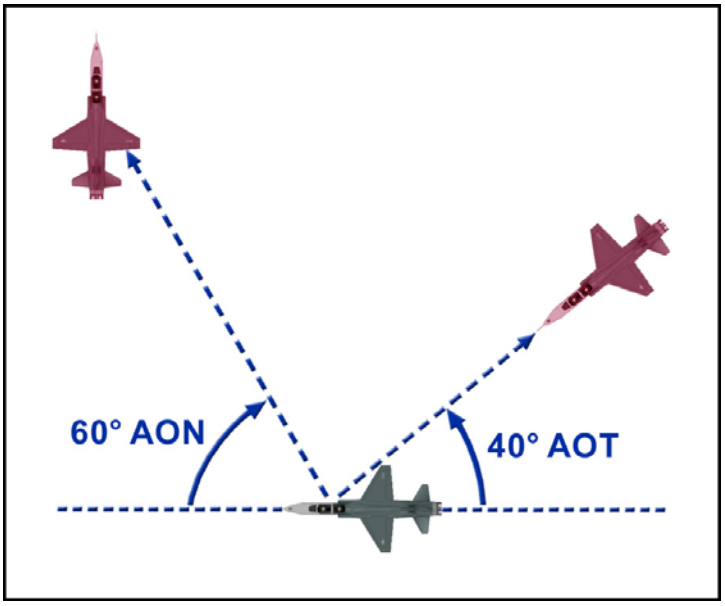
Figure 4.2. HCA.



4.3.5 **Antenna Train Angle (ATA) (Figure 4.3).** ATA is the angle measured from the nose of one aircraft to the position of the other aircraft. Like AA, ATA is independent of the heading/longitudinal axis of the other aircraft, and commonly referred to as "angle off nose (AON)."

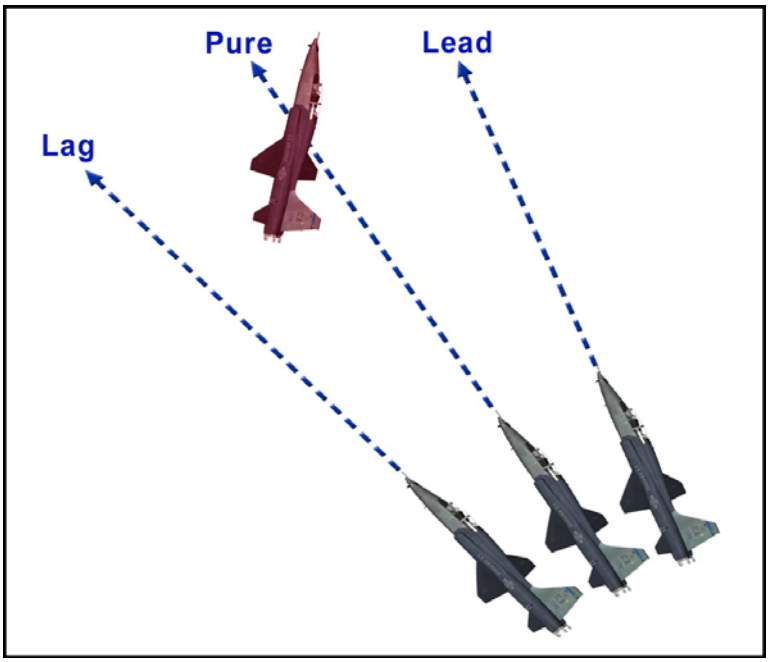
4.3.6 **Angle Off Tail. (Figure 4.3).** AOT is the angle from the longitudinal axis of your airplane to the Bandit, as measured from your tail. **Note:** When the fighter is defensive, AOT and the AA you are showing the Bandit are the same. IFF instructors will use these terms interchangeably when discussing assessment in the DBFM phase.

Figure 4.3. ATA (AON) and AOT.



4.3.7 **Pursuit Curves (Figure 4.4).** 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 4.3.11). 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 4.4. Pursuit Curves.



4.3.7.1 **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.

4.3.7.2 **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."

4.3.7.3 **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.

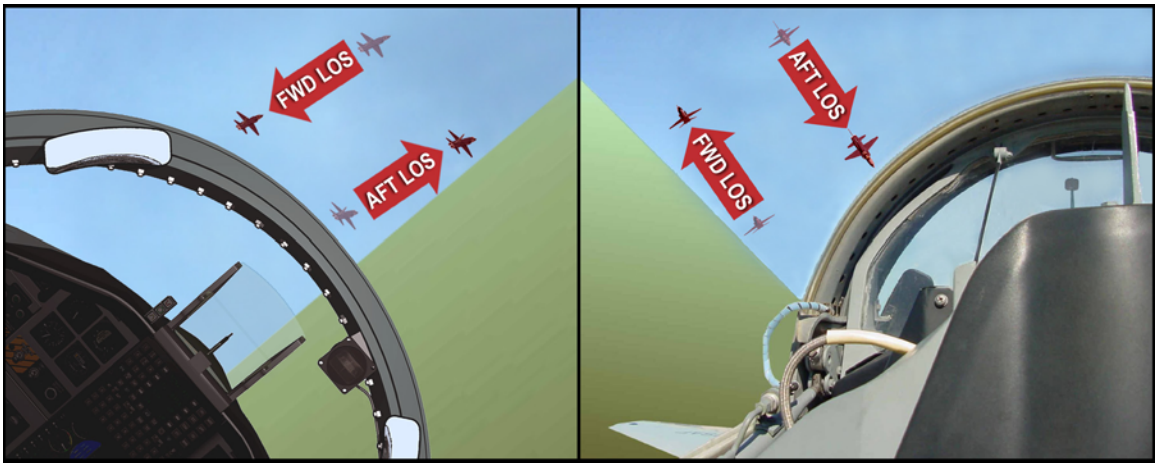
4.3.8 **Turn.** Turning allows the pilot to solve range, angle, and closure problems offensively, and to present the same problems defensively. For best turn performance, use available G to solve the problem with an acceptable specific power (Ps) bleed off. How well the aircraft can turn (turn rate and radius) is a function of TAS and available G. See paragraph 4.4 for a detailed discussion of power and energy management.

4.3.8.1 **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.

4.3.8.2 **Radius.** Radius is one-half the size of an aircraft's TC. All else being equal, the aircraft with the smaller turn radius is capable of creating/solving 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).

4.3.9 **LOSR.** LOSR is the speed with which the LOS is changing. Fighter pilots also use LOSR for assessment during BFM. LOSR 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 perpendicular to your flightpath and in front of you may have an LOS from left to right.

Figure 4.5. LOSR.



During BFM, we describe the LOS with regard to direction and rate. It is important to remember that LOSR is relative to your aircraft. LOS is also described with respect to rate. A Bandit that moves aft very quickly has a high LOSR aft, while a Bandit that moves slowly toward the front of your jet has a low forward LOSR. The actual motion of the airplane may be different than the LOSR (Figure 4.5). Use LOS direction and rate to determine where you are in relation to the TC, and also to determine what the Bandit is doing for the purposes of predicting what he 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 Bandit's apparent motion is from the back of your jet to

the front. That is to say, from the tail to the nose. Aft LOSR is just the opposite. The Bandit's apparent motion is from your nose to your tail. LOSR is not dependent on the Bandit's heading, pursuit curve, or AA.

4.3.10 **Control Zone (CZ) (Figures 4.6 and 4.7).** The CZ is defined as having 2,500 to 4,500 feet of slant range and within a 25° to 45° cone.

Figure 4.6. The Control Zone.

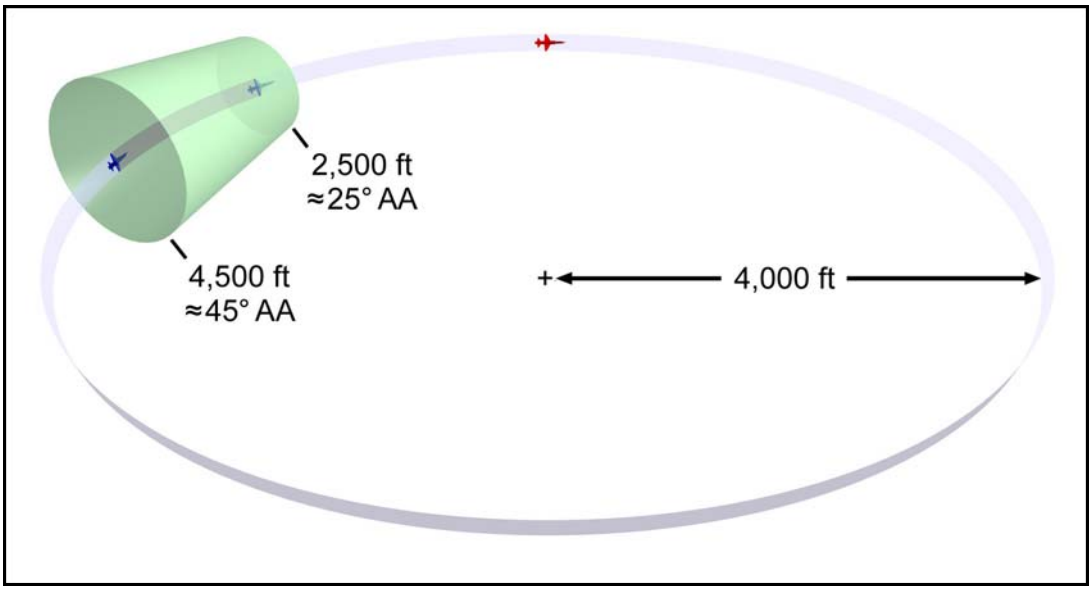
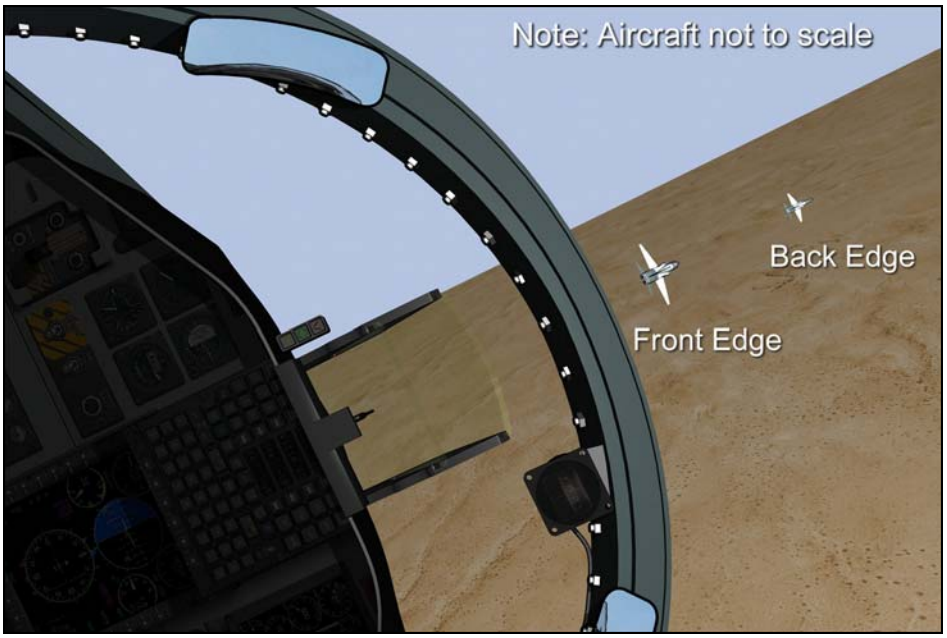
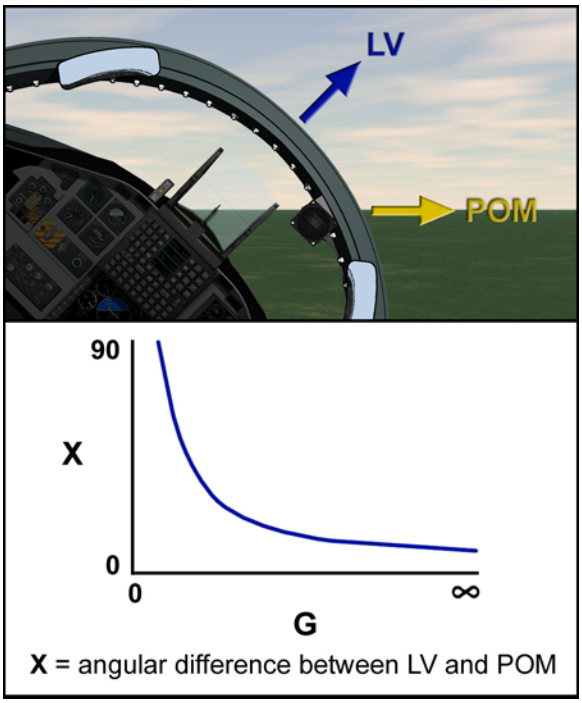


Figure 4.7. Control Zone Canopy Bow References.



4.3.11 **LV (Figure 4.8).** Roll and yaw allows 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 4.8. LV versus POM.



4.3.12 **Turning Room.** 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 (for example, 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).

4.3.12.1 **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.

4.3.12.2 **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 (for example, 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).

4.3.12.3 **High Aspect.** Premerge, high-aspect TR may be in the vertical, horizontal, or a combination of both. Turning room 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 (for example, take lead turn).

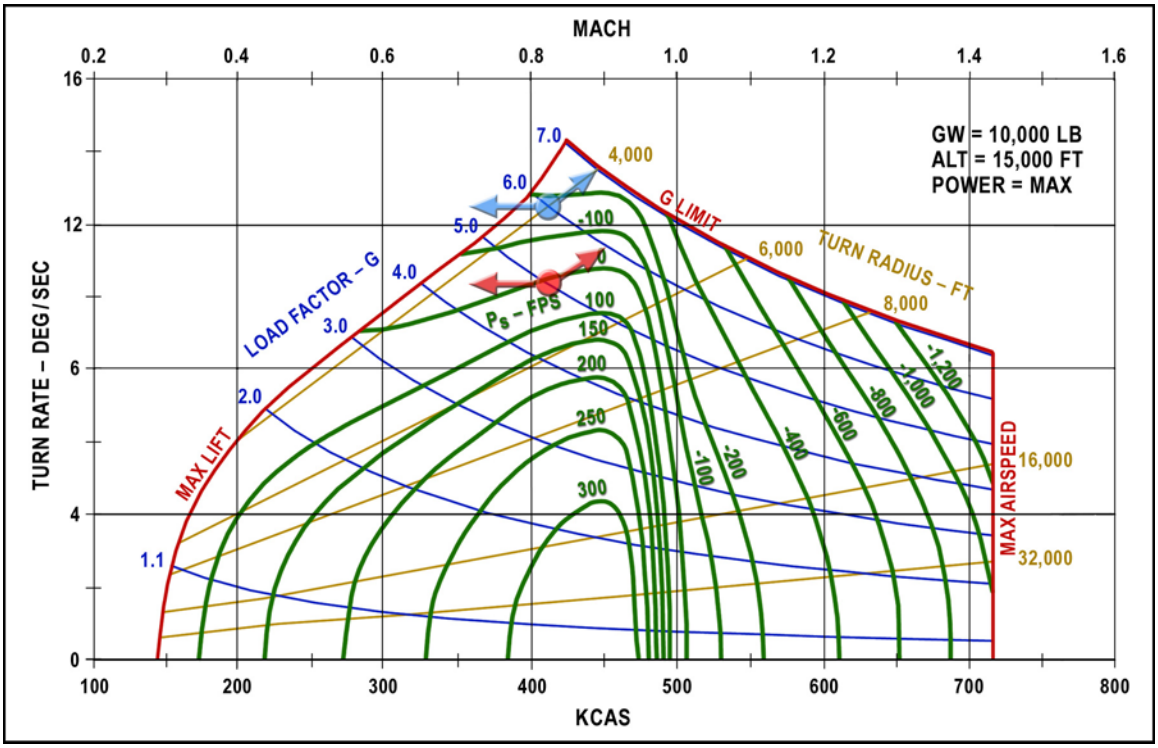
4.4 Power and Energy Management. Power affects airspeed and therefore turn radius and rate. Power is also used to control energy. Energy provides the potential to maneuver. Nonoptimal energy levels (usually expressed in airspeed) can result in degraded turn performance, reduced time in weapons parameters, or greater exposure to threat weapons. Expend available energy only as required for offensive advantage (that is, kill the Bandit), defensive necessity (that is, deny Bandit WEZ/CZ), or merge preparation. Otherwise, strive to maintain or gain energy as the situation allows.

4.4.1 **Energy Maneuverability (EM) Diagram (Figure 4.9).** 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 4.9 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.

4.4.1.1 **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.

4.4.1.2 **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 knots, the rate increases with airspeed.

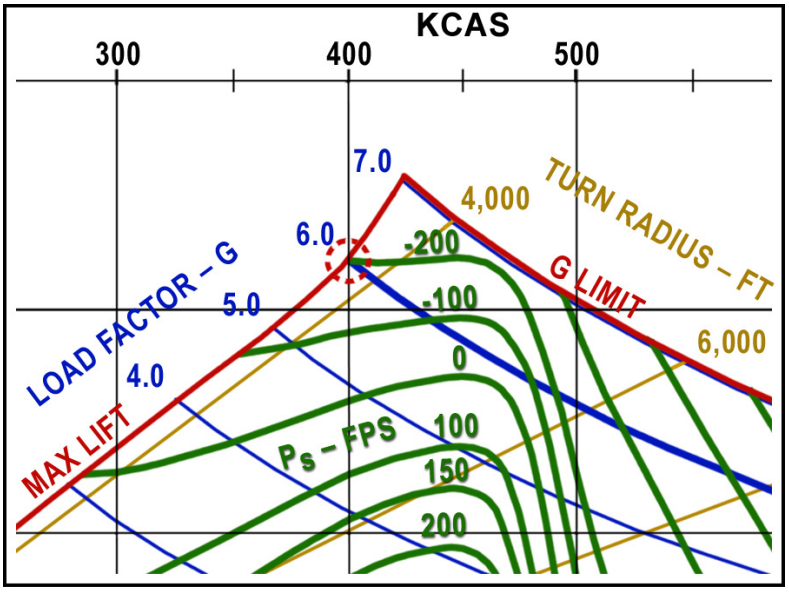
Figure 4.9. T-38 EM Diagram.



4.4.1.3 **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. 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.

4.4.1.4 **Corner Velocity (Figure 4.10).** 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 4.10). Instantaneous turn capability comes at a cost, however, in the form of negative Ps.

Figure 4.10. Corner Velocity.



4.4.1.5 **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 would 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 4.9 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.

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

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

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

4.6 Offensive BFM (OBFM). 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.

4.6.1 **OBFM Perch Setups.** The current IFF syllabus requires two basic perch setups for OBFM: 6,000-foot perch setups and 3,000-foot perch setups. The primary difference is the fighter starts outside the Bandit's TC on the 6,000 setup and inside the Bandit's TC on the 3,000 setup.

4.6.1.1 **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.

4.6.1.2 **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.

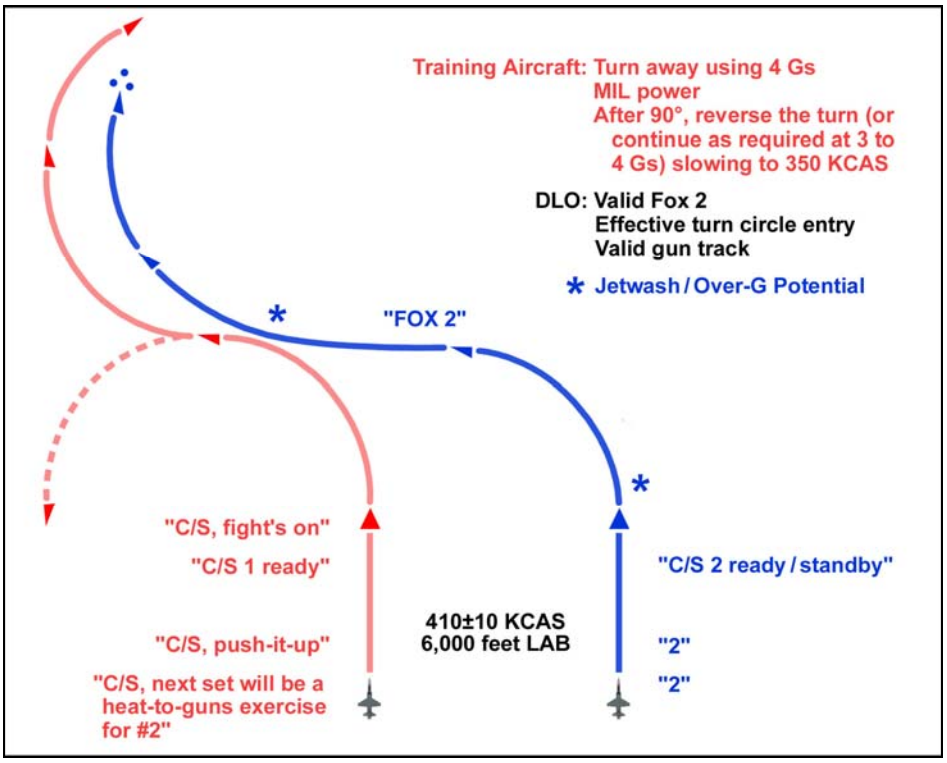
4.6.2 **OBFM Exercises:**

4.6.2.1 **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.

4.6.2.2 **Heat-to-Guns Exercise (Figure 4.11).** The objective of the heat-to-guns exercise is 100 percent valid weapons employment. Units will determine specific setup parameters and special instructions (SPINS) for the heat-to-guns exercise.

Figure 4.11. Heat-to-Guns Exercise.



4.6.2.2.1 **Communication.** Reference specific communications guidance in unit standards.

4.6.2.2.2 **Bandit.** At the "FIGHT'S ON" call, the Bandit will initiate a MIL power, 4- to 5-G level turn away from the maneuvering aircraft. At 90° of turn, roll out, and modulate power. As soon as a Fox 2 is called by the maneuvering aircraft, the Bandit will either immediately reverse the turn (if still checking away) or continue in the same direction and maintain 3 to 4 Gs while slowing to 350 KCAS and MIL power.

4.6.2.2.3 **Maneuvering Aircraft.** At the "FIGHT'S ON" call, select MAX afterburner, set the LV on the Bandit, start the AGSM, and perform best break turn. As the Bandit enters the HUD field of view (FOV), simultaneously relax the G, and attempt a valid AIM-9 shot. Call "FOX 2." Then prepare to enter the Bandit's TC.

4.6.2.2.4 **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 FOV.

With the target's heat source in the missile FOV, uncage the missile by depressing the 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.

4.6.2.2.5 **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 IN 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.

4.6.2.2.6 **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 "assessment window." 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.

4.6.2.2.7 **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 4.11.) 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.

4.6.2.2.8 **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.

4.6.2.2.9 **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 your 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 your 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, your 450 rounds of simulated bullets will be depleted in approximately 7 seconds.

4.6.2.2.10 **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.

4.6.2.2.10.1 **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.

4.6.2.2.10.2 **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.

4.6.2.2.10.3 **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.

4.6.2.3 **High-Angle Guns-to-Separation (HAGS) Exercise.** Begin the HAGS exercise from a 6,000-foot 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.

4.6.2.4 **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.

4.6.3 **OBFM Sets:**

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

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

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

4.6.3.1.3 **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.

4.6.3.1.4 **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 LOS RATE OCCURS AND THE AA OF THE BANDIT 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 6,000-foot setup with 30° to 40° of AA where the Bandit executes a 5G break turn.

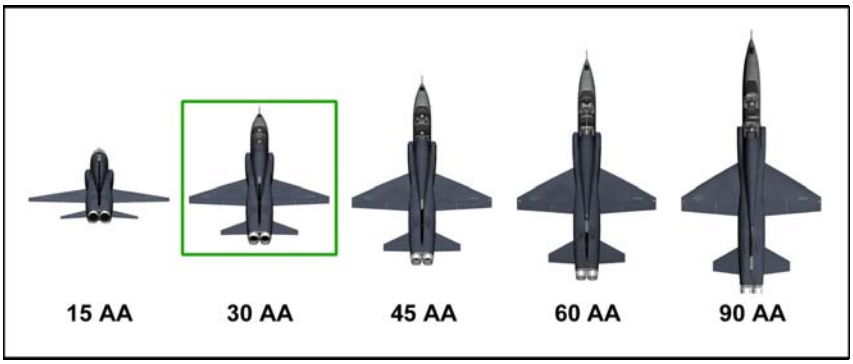
4.6.3.1.5 **TC Entry Mechanics.** Upon seeing the TC entry cues, begin the AGSM, select MAX afterburner, and use 1G roll to set the LV. An LV setting to slightly below the Bandit brings the fighter's nose below the horizon and sets up for an effective rate right. After setting the LV, return the stick 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.

4.6.3.1.6 **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. 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 as long as it is not occurring as a result of bleeding own ship knots. In the misaligned TC rate fight, this indicates apexing outside the TC and starting to point back inside the Bandit TC (See Figure 4.12). 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 or not 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 4.12. Estimating AA.



4.6.3.1.7 **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 4.13). 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 discussed in paragraph 4.2. 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 4.6.3.1.8. An ease repo will help solve range and aspect problems by realigning TCs.

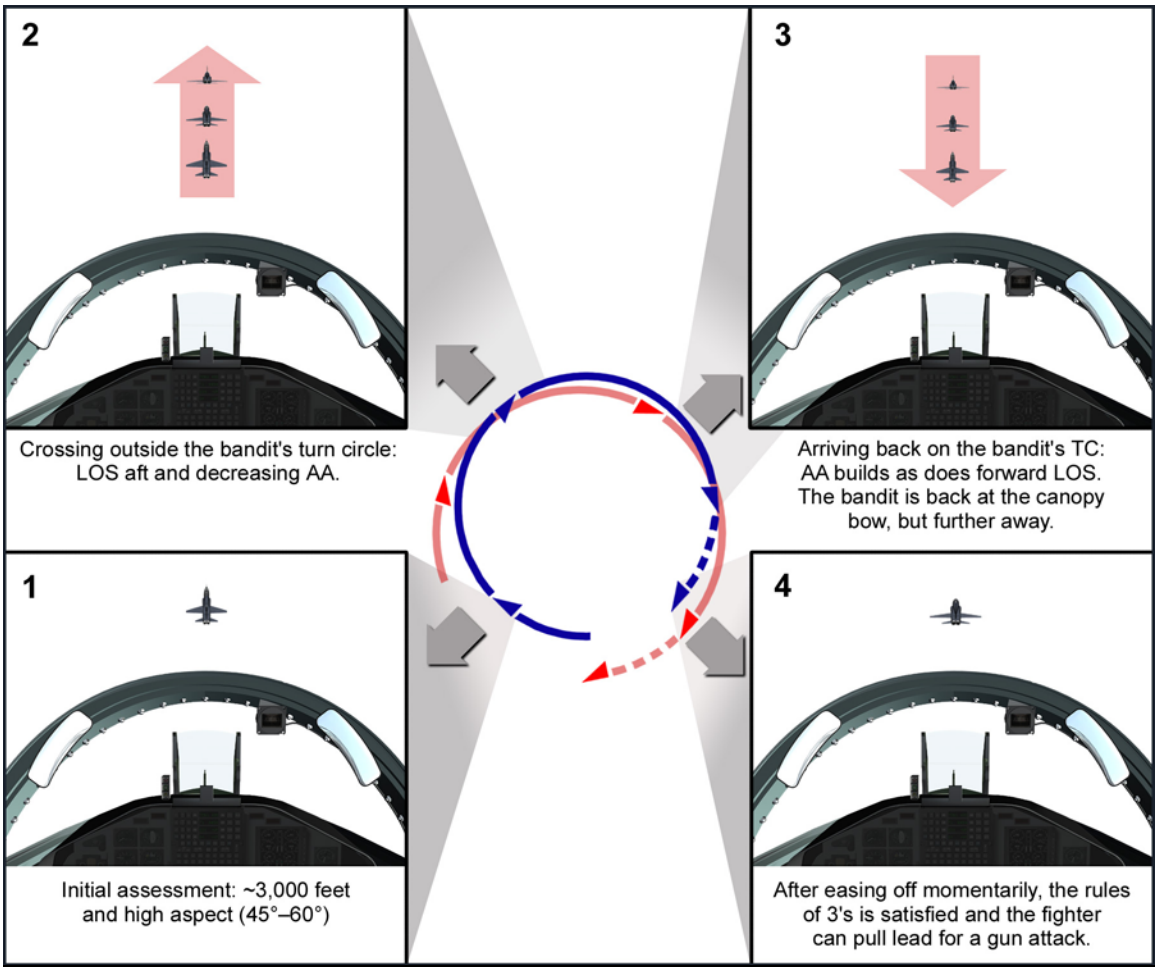
4.6.3.1.8 **Ease Repo.** If the range, aspect, and closure cues are not met at the assessment window, execute an ease repo to drive the range and aspect lower. An ease repo drives the fighter's jet back toward the Bandit's TC, reducing aspect in the process. Execute an ease repo by relaxing back-stick 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 in order to employ ordnance.

4.6.3.1.9 **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.

4.6.3.1.9.1 **POM.** Additionally, due to own ship maneuvering, the Bandit may actually be in a POM that requires a climb to position the Bandit in the HUD. In order

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



4.6.3.1.9.2 **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.

4.6.3.1.10 **Missile and Gun Mechanics.** Reference the detailed discussion on weapons employment in paragraph 4.6.2.2 (heat-to-guns exercise)**.**

4.6.3.1.11 **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 1G 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.

4.6.3.1.11.1 **Bandit Continues the Turn.** An effective repo at 1,500 feet to 1,800 feet will force a smart Bandit to continue his turn. Continue to pull to 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 1G 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.

4.6.3.1.11.2 **Bandit Reverses.** A Bandit reverses in an attempt to 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 1G, 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 scissors. Reference the DBFM section for scissors mechanics.

4.6.3.1.12 **6K OBFM Contingencies:**

4.6.3.1.12.1 **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.

4.6.3.1.12.2 **Bandit Tighten Down (TD).** A Bandit with available energy will TD as the fighter's nose approaches pure in order 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.

4.6.3.1.12.3 **Bandit Jinks.** Jinking Bandits are discussed in more detail in the 3K OBFM section (paragraph 4.6.3.2.11.3). 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.

4.6.3.1.12.4 **Floor Transition.** A smooth floor transition sustains energy for a fighter's floor fight while a floor save depletes energy in order 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.

4.6.3.1.13 **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.

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

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

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

4.6.3.2.3 **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.

4.6.3.2.4 **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.

4.6.3.2.5 **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.

4.6.3.2.6 **CZ Maneuvering.** Once established in the CZ, most of the BFM concepts from medium-range BFM apply (paragraph 4.6.3.1.6).

4.6.3.2.7 **Follow-on Maneuvering.** In addition to the concepts and considerations discussed in the medium-range section (paragraph 4.6.3.1), consider the following:

4.6.3.2.7.1 **Repos.** The repo is a lag maneuver designed to reduce AA, increase range, and decrease closure. Some reasons for executing a repo include: Bandit blows up, excessive closure, approaching briefed minimum slant range (i.e., bubble), or Bandit changes 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.

4.6.3.2.7.2 **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.

4.6.3.2.7.3 **Bandit Reversals.** During the quarter plane, the defender may reverse, placing his LV on or near you and executing a maximum performance turn. In this case, continue to analyze where the defender's CZ is and pull towards it so as to avoid the bubble. Your goal in this situation is to regain the offensive advantage by outperforming the Bandit and minimizing your 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 your 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. Greater than 120° of HCA at the overshoot will result in a scissors.

4.6.3.2.7.3.1 **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 knots in order to catch around 150 to 160 KIAS. 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.

4.6.3.2.7.3.2 **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.

4.6.3.2.8 **3K OBFM Contingencies:**

4.6.3.2.8.1 **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.

4.6.3.2.8.2 **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 end 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.

4.6.3.2.8.3 **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.

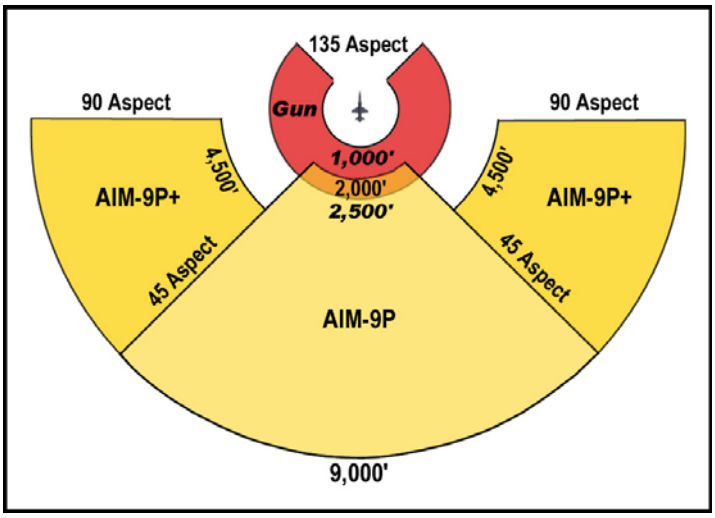
4.7 Defensive BFM (DFBM). The goal of DBFM is to train the fighter pilot to survive while maneuvering from a position of disadvantage. The correct mindset is critical to DBFM, and a will to survive is paramount. Unlike offensive, DBFM requires the pilot to max perform the aircraft, while spending increased time looking backwards. The focus should be on surviving for as long as possible and creating problems for the Bandit based upon your current situation. So long as you are still alive and have a working aircraft around you, you are winning. NEVER GIVE UP! In addition to the proper attitude, you must be able to visually identify (ID) the aircraft behind you ("is that a MIG-25 or an SU-27?"). Likewise, you must know both the threat aircraft and the pilot's capabilities. At what altitudes/airspeeds does your aircraft outperform his? What types and how many missiles does he carry? How far off-boresight can he shoot those

missiles? Is his gun canted up or down (or does he have a gun at all)? The fighter pilot must know this information ***before*** the engagement begins. The Bandit WEZ for IFF is depicted in Figure 4.14. Bottom Line: Know the threat before you fight it. In order of priority the objectives in DBFM are:

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

4.7.1 **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 you see the Bandit during the fight, you need to position your body to obtain the maximum rearward visibility. While on the ground, maneuver in the cockpit to ensure you can visually see the opposite horizontal stab. This will equate to the required body position under G in order to maintain the tally. During the setup, rotate your 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 in order to look back at the Bandit. Improper body positioning during G-onset can lead to a loss of tally and possibly even injury.

Figure 4.14. IFF Bandit WEZ.



4.7.1.1 **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 you to start

your DBFM cross-check during the fight setup. While looking backwards, assess and correct AOT (Figure 4.15). 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, your time will be divided equally between looking backwards and glancing at the HUD. However, the closer you get to the "FIGHT'S ON," the more time you should spend looking at the Bandit, ready for the initial move.

4.7.1.2 **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 knots and arriving at the "FIGHT'S ON" with less than 320 knots 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 knots; then allow the jet to decelerate the last 5 to 15 knots with throttle modulation after you have reversed your turn and have set the desired AOT.

4.7.2 **DBFM Exercises:**

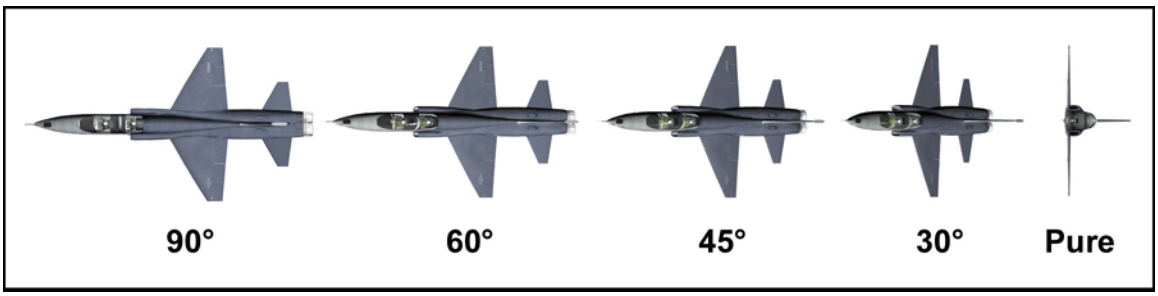
4.7.2.1 **Defensive Ranging Exercise.** Start from a standard 6K perch setup with the following exception: the Bandit will pull pure from 9,000 feet to 6,000 feet and then call "FIGHT'S ON" at 6,000 feet. At this point, the Bandit will roll out momentarily showing a "lag" pursuit curve. Then the Bandit 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.

4.7.2.1.1 **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 4.14). The Bandit will show "lag, pure, lead," and drive all the way to the bubble. See Figure 4.16 for defensive assessments of Bandit pursuit curves.

4.7.2.1.2 **Mechanics.** After the check away, reverse back when offender is pure to maintain tally/altitude/airspeed. Power modulate to slow from 415+10 knots to 350 knots 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, he will repo to lag. Roll out, wings level and quickly move your visual scan from to the opposite side of the aircraft. You will see the Bandit 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 KIO call.

Figure 4.15. Setting the "FIGHT'S ON" AA.

Figure 4.16. Bandit Lag Assessment.



4.7.2.2 **Reversal/Scissors Exercise:**

4.7.2.2.1 **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.

4.7.2.2.2 **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.

4.7.2.2.3 **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 4.17 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.

Figure 4.17. Two Common Reversal Pictures.

4.7.2.2.4 **Reversal Mechanics.** Simultaneously use an unloaded roll to reverse your turn and move your 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 you can initially place your POM to use as much of the in-plane TR as possible. With low HCA and LOS, you must ensure POM is not on the Bandit to prevent pressing the bubble. In this case, whether you place your POM above or below the Bandit will depend on his 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).

4.7.2.3 **Jink Exercise:**

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

4.7.2.3.2 **Mechanics.** Prior to the "FIGHT'S ON," maintain setup parameters. Primary emphasis should be on assessing Bandit range for WEZ (Figure 4.14). 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. You must break the AOA prior to resetting the LV. Be careful not to push forward on the stick as you reset your 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.

4.7.3 **DBFM Sets:**

4.7.3.1. **Medium-Range DBFM (6,000-Foot Perch Setup).** The Bandit begins slightly inside of your TC and outside the CZ.

4.7.3.1.1 **Objective.** The objective is to survive.

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

4.7.3.1.3 **Initial Move (The Break Turn).** To survive this engagement, the first thing you must do is Defeat the Initial Attack. You do this by rotating your WEZ away from the Bandit's WEZ. Execute a defensive break turn, looking over your shoulder at the Bandit to assess his pursuit curve. Select MAX afterburner, set the LV on or slightly below the Bandit, and pull to target G; 5.0 to 5.5. 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, minimize vertical TR for the Bandit, and maintain airspeed. Figure 4.9 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 will 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.

4.7.3.1.4 **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 he is only moments away from employing ordnance. In this case, you 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 you slow down. You 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. Your 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 snap shot at a closer range. Mechanics for these pictures will be IAW paragraph 4.7.2.2 (Reversal/Scissors Exercise).

4.7.3.1.4.1 **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).

4.7.3.1.4.2 **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 Bandit is below you and you're looking at the top of his jet, 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 your follow-on game plan.

4.7.3.1.4.3 **Assess and Select a Game Plan.** Assessment must occur during the OOP. If you see high LOS due to high HCA and/or close range, reverse (Figure 4.18). If you don't, or are in doubt, continue with the turning fight and transition to a min radius game plan.

Figure 4.18. Reversal Cue, Lead Bandit.

With timely assessment, the fighter has already started the reversal.

4.7.3.1.4.4 **Reversal.** Versus a Bandit that pulls excessive lead for a high-aspect gun attempt, you will see high HCA and can afford to initially roll your 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 4.7.2.2.4.

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

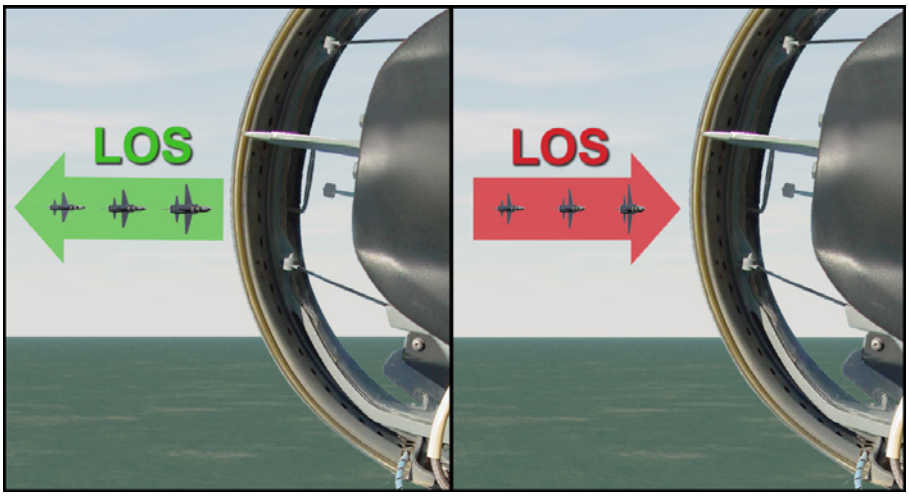
4.7.3.1.6 **Bandit Assessment.** Continue to assess the Bandit; you will either be winning or losing the rate fight (Figure 4.19). Winning cues include: forward LOSR with range and HCA increasing (as you pull the Bandit into deeper lag). Losing cues include: aft LOSR with range and HCA decreasing.

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

4.7.3.1.7.1 **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 your airspeed error. Take caution readjusting LV to prevent an asymmetric over-G.

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

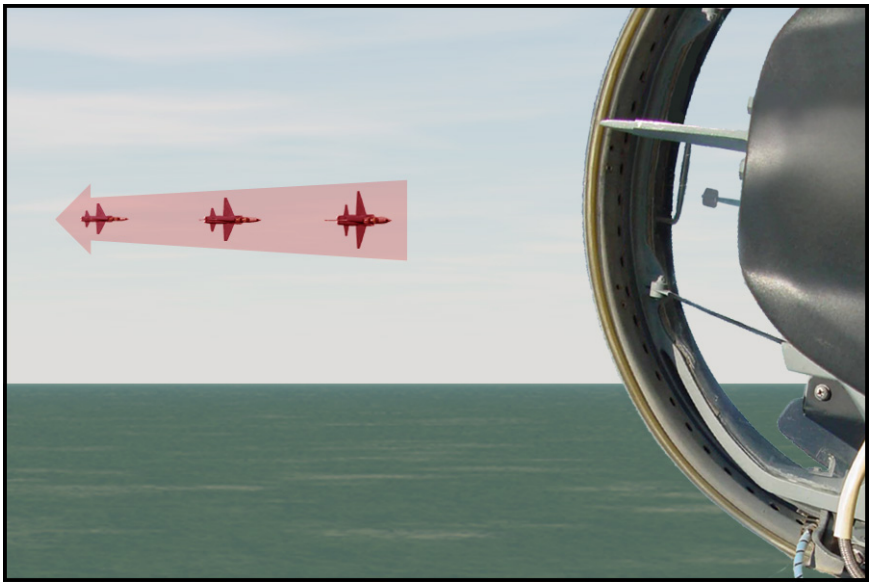
Figure 4.19. Winning and Losing LOS Cues.



4.7.3.1.7.3 **Getting Too Slow.** The LV is too high, but in this case you have already traded your airspeed for G in an attempt to keep target G or better. Deliberately lower your LV towards the game plan pitch picture, or lower. You must include altitude in your BFM cross-check to build floor awareness. See Floor Transition (paragraph 4.7.3.3.5). Additionally, cross-check engine operation and throttle placement.

4.7.3.1.8 **Separation (Figure 4.20).** Whether out of ordnance or fuel, or in a multi-bogey environment, the overall tactical circumstances may demand that you leave the fight. Regardless, none of these reasons is worth giving the Bandit an easy AIM-9 opportunity. Make sure your assessment is accurate and, if in doubt, don't attempt the separation.

Figure 4.20. Separation Cues.



4.7.3.1.8.1 **Separation Decision.** If the Bandit is trending ***towards*** 90° of HCA (approximately 45° AOT and 45° plan form) and greater than 6,000 feet, consider separating. Trend information is important; you should see the Bandit getting smaller over time and lag increasing (Figure 4.20). 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.

4.7.3.1.8.2 **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 1G 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 nose position and dispense countermeasures as required to defend against potential weapons employment from the Bandit.

4.7.3.1.9 **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.

4.7.3.1.9.1 **OOP Maneuver.** The first priority is to recognize the Bandit 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. Assuming you execute an effective TD and

get AA to greater than 45°, expect to force the Bandit's nose off with one OOP maneuver. If AA is less than 45°, you will likely need a series of jinks before the Bandit is forced to repo. Airspeed will also be a factor in game plan selection; full-up jink mechanics above 320 knots will increase over-G potential. (Reference paragraph 4.7.3.2 for jink mechanics.)

4.7.3.1.9.2 **Post OOP/Jink.** When the Bandit's nose is forced to lag, look for reversal cues. If you see rapid LOS with high HCA and a 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.

4.7.3.2 **Short-Range DBFM (3,000-Foot Perch Setup):**

4.7.3.2.1 **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. In order 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 pointed at you, a follow-on jink up is required while the Bandit is attempting to adjust to your 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.

4.7.3.2.2 **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.

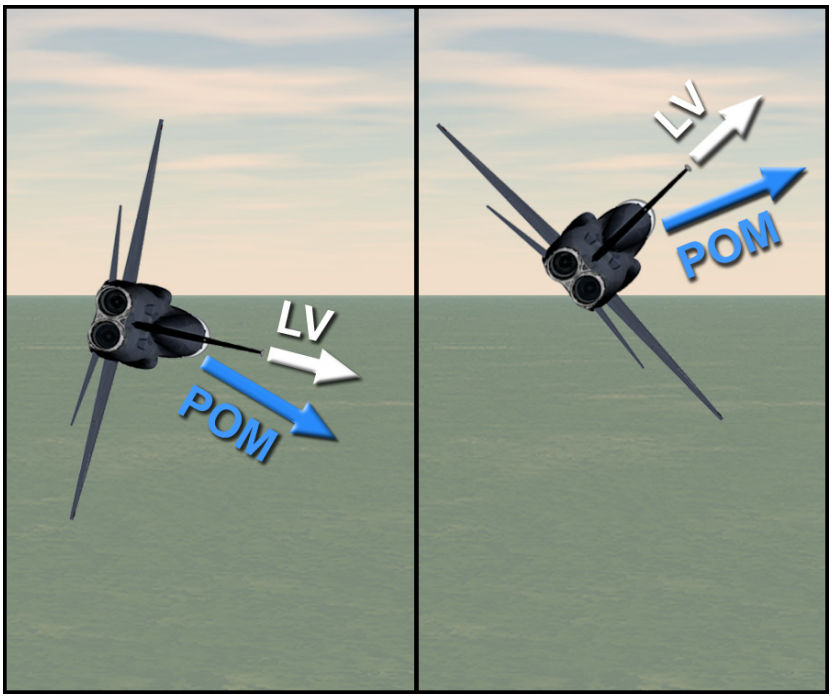
4.7.3.2.3 **Setting the LV.** As the Bandit gets closer, POM adjustments must be further away from the Bandit. Remember that POM will always fall below the LV—as the aircraft slows down in subsequent jinks, the difference between the two will increase. The T-38 does not fly well with the nose buried 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 4.21).

4.7.3.2.4 **Don't Give Up.** While the number 1 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.

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

4.7.3.2.6 **The Reversal.** See paragraph 4.7.2.2.4 for specifics on cues and reversal mechanics. Be aware if you do reverse, HCA will probably be low, requiring your new LV towards the Bandit's high CZ. You can quickly update it with a tally on the other side of the canopy if LOS, HCA, and/or range allow.

Figure 4.21. 3K DBFM Jink Lift Vector.



4.7.3.2.7 **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 at all depending on if you were jinking above or below the Bandit when he repositioned.

4.7.3.2.8 **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, you should concentrate on the tally.

4.7.3.2.9 **Maintain the Tally.** Effective jinks followed by a quick transition to the min radius fight will allow you to maintain the tally. You should see plan form 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.

4.7.3.3 **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 4.7.3.1.9.)

4.7.3.3.1 **Future WEZ Expectations.** Given the offset TCs, expect the Bandit to transition to another WEZ. As soon as you see the Bandit's nose, 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 that you are able to keep his nose in lag over time. In this case,

there MAY be consideration for transitioning from your 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 in order to gain energy (i.e., airspeed), but keep the Bandit from reentering a WEZ.

4.7.3.3.2 **Keep The Tally.** You will have aft LOS towards your 6 o'clock, but it will slow down and stagnate near the tail and/or canopy bow (possibly under it). Reference Figure 4.22. Given the Bandit's high offensive potential, if you lose the tally at this point, you stand a good chance of allowing 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 AFI 11-214, *Air Operations Rules and Procedures*, you are allowed to TD with respect to "remain predictable" while "no joy." The TD maneuver will help to reacquire the tally by pulling the Bandit forward on the canopy.

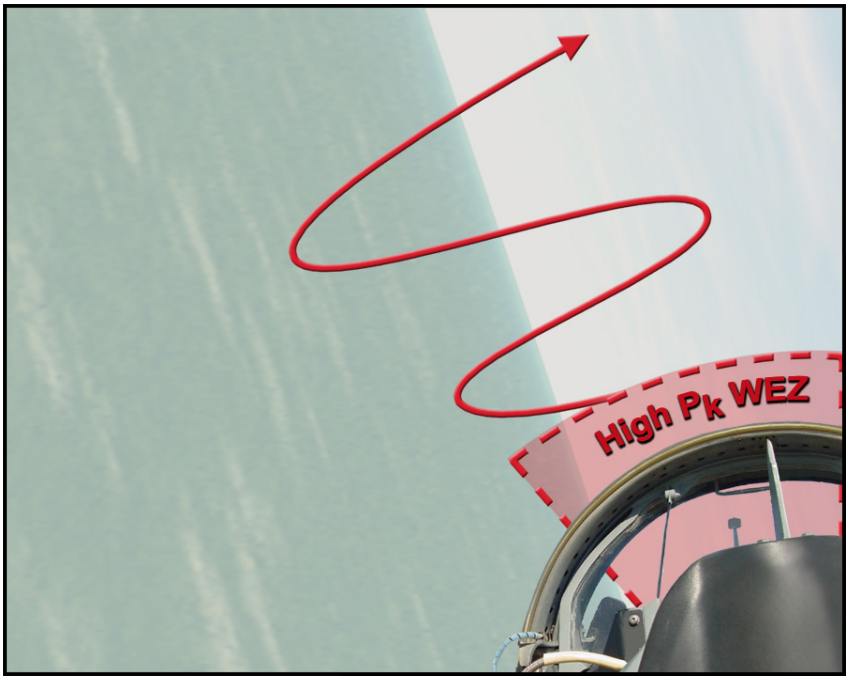
4.7.3.3.3 **No-Sight Defense.** The primary goal of no-sight defense is to recover the tally while executing a min radius game plan. Make sure you spend the majority of your time scanning for the Bandit while maintaining a frequent cross-check to the HUD for altitude and attitude SA. MAX performing the 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 4.22. Keeping the Tally.

4.7.3.3.4 **Tally Recovery.** SA on the Bandit's HCA when he flies behind your seat will help you recover it. If HCA was low, look first and longest in the high Pk WEZ (Figure 4.23). If HCA was higher as the Bandit crossed your 6 o'clock, offset TCs will develop and as time goes on move your scan from the WEZ forward on your canopy, zigzagging both high and low.

4.7.3.3.5 **Floor Transition.** The fight will be going downhill. Your goal is to slowly adjust your LV during a floor transition to eventually level off before reaching the floor. Without a floor transition, you will be forced to roll wings-level in a floor save, which is energy depleting and will straight-line your TC. This could be the difference between keeping the Bandit's nose in lag or allowing him 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, you 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, you 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 you must fight Ps=0 BFM. Referencing the T-38 EM diagram, you can still see that at Ps=0 you won't be able to sustain the same G as during the descending, rate fight. (The jet will feel smoother as you are further away from the lift limit line; reference EM diagram, Figure 4.9.)

Figure 4.23. Regaining the Tally.



4.8 High-Aspect BFM (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 ground controlled intercept (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

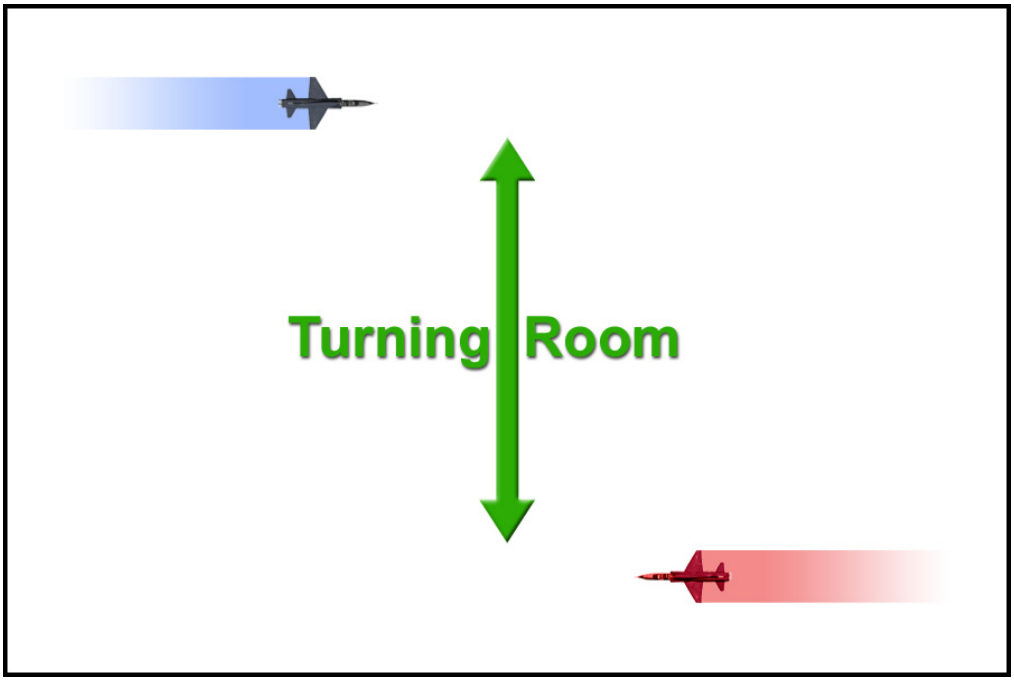
lose the opportunity for a lead turn. Remember that TR for you is typically TR for the Bandit. The Bandit may have a tally, and may attempt to achieve TR also.

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

4.8.1.1 **Premerge Turning Room.** TR is displacement in any plane (vertical, lateral, or a combination) from an adversary's flightpath (Figure 4.24). 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, we 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. If he does, he will impact the terrain. Thus, the lower fighter enjoys exclusive use of this TR.

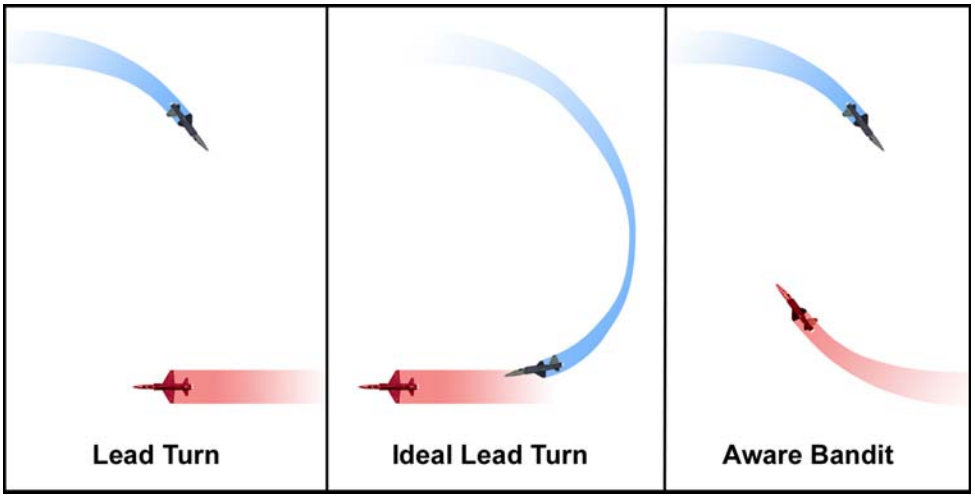
4.8.1.2 **Merge Entries.** The decision to merge above or below the Bandit is dependent on several considerations to include environmental factors, current energy, and the surrounding tactical situation. Weigh all the factors and execute a decisive game plan.

Figure 4.24. Turning Room.



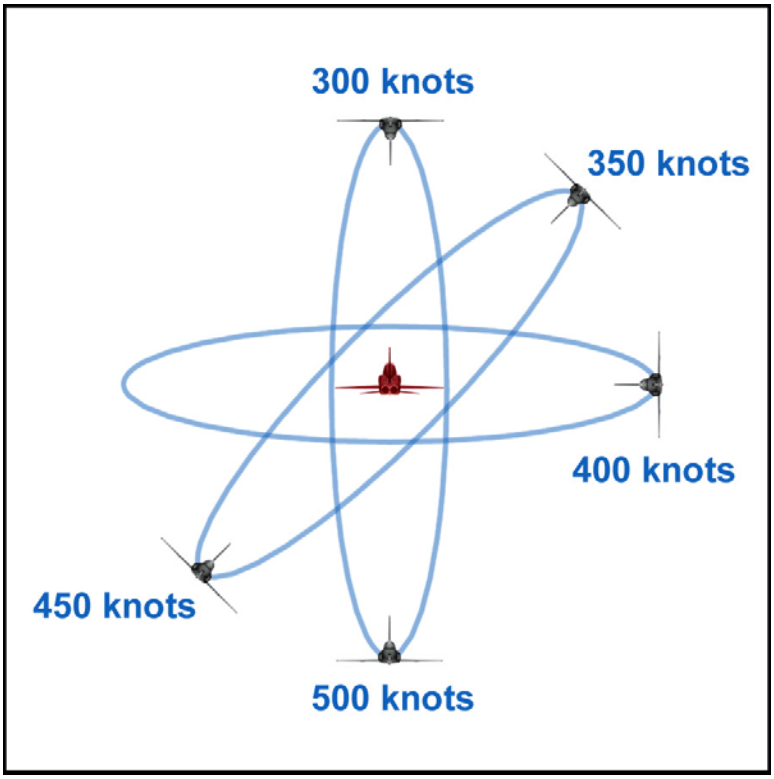
4.8.1.3 **Lead Turn (Figure 4.25).** The lead turn is an attempt to use TR to decrease HCA prior to passing the opponent's 3/9 line. In an ideal situation, against an unaware, nonmaneuvering Bandit, the initial lead turn will result in the fighter rolling out in a WEZ at the Bandit's 6 o'clock. If both aircraft are aware and simultaneously use the TR, the result will be a close aboard, neutral pass. In general, you want to gain TR before the merge or the Bandit becomes aware and begins to turn into you. 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 4.25. Lead Turn.



4.8.1.4 **Energy Atom (Figure 4.26).** 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 4.26. Energy Atom.

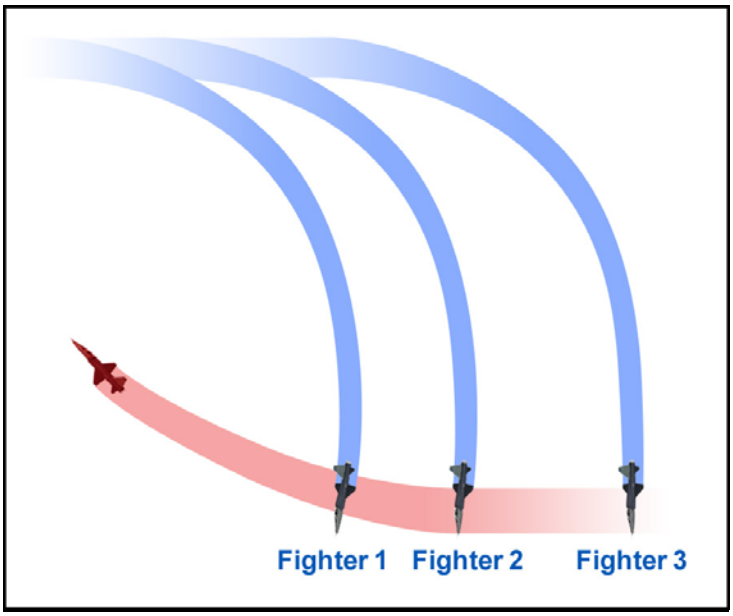


4.8.1.5 **Use of the Vertical.** Hypothetically, to execute a pure vertical lead turn from high to low, you would want approximately 300 knots. If you have more than this, it will be difficult for you to control your airspeed. As airspeed builds, so does the over-G potential. Additionally, the turn radius at high speeds may make the floor more of a threat than the Bandit. Conversely, if you are converting from low to high, purely in the vertical, you want closer to 500 knots. Starting at this airspeed, using target G, the fighter will easily be slowing through 400 knots in less than 90° of turn. The more co-altitude you are, the closer to 400 knots you should strive to be.

4.8.2 **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, he 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 his 3/9 line. Refer to Figure 4.27. The fighter should strive to cross through the Bandit's CZ (Fighter 2) with airspeed between instantaneous corner and sustained-rate velocity (380-420 knots). 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.

Figure 4.27. Merge Objective.



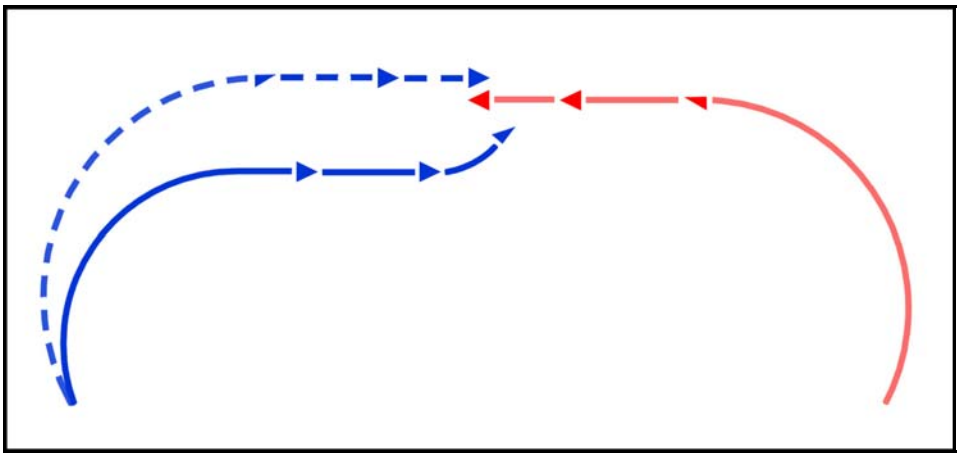
4.8.2.1 **Prior to the Check Away.** Determine if you will use vertical TR above or below the Bandit. There are several factors that will affect your HABFM game plan selection of whether to use a high-to-low or low-to-high conversion. However, the most important and therefore overriding factor is ease 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.

4.8.2.2 **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 that favors more attention to the Bandit the further away the two aircraft get. 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."

4.8.2.3 **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 4.28). 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. You will be looking at a T-38 rotating towards pure pursuit more than 2 NM away. If you are not padlocked on the Bandit, you will lose the tally. DO NOT LOOK

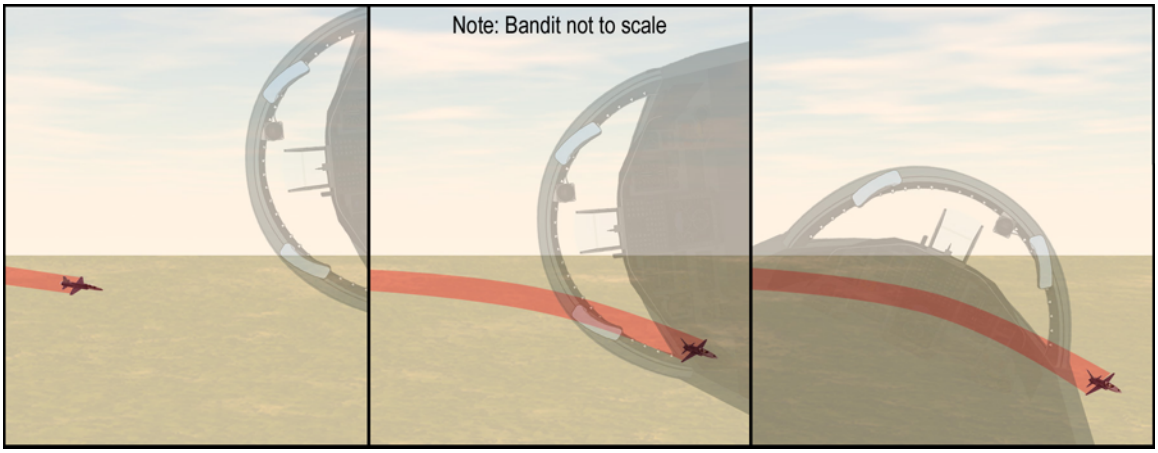
IN THE COCKPIT DURING THE TURN IN. The fighter's second priority is a max performance turn that gains lateral TR and doesn't use up too much of the vertical TR already gained.

Figure 4.28. Get to the Inside at the Turn In.



4.8.2.4. **High-to-Low Turn In Mechanics.** Start the AGSM, set throttles to MAX afterburner, stare at the Bandit while overrotating 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 your nose for approximately 2 seconds (Figure 4.29). You may momentarily lose sight of the Bandit as he passes under your nose. Regardless, continue to pull the Bandit across your 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. Your goal now is to manage energy and assess LOSR cues for initiating the lead turn. Even after a well-executed turn in, you won't have longer than 1 to 2 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 4.8.1.4) for desired airspeed based on the ratio of lateral to vertical TR available. Generally, 350 to 400 knots is a good target airspeed for the lead turn. You will have little more than just enough time for one quick BFM cross-check in the HUD prior to starting the lead turn.

Figure 4.29. High-to-Low Turn In.



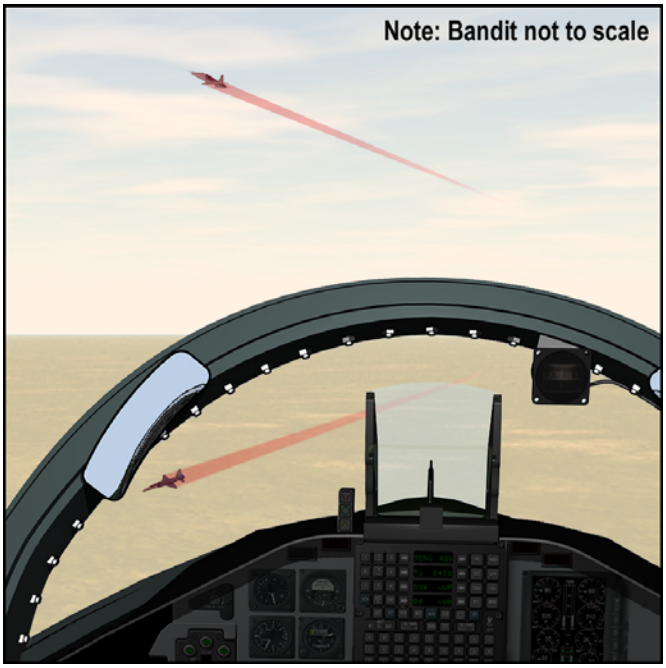
4.8.2.5 **Low-to-High Turn In Mechanics.** Start the AGSM, select power as required, and set the LV to bring the nose up to the Bandit's low CZ. For the turn in, blend the G into the SRB or moderate buffet, whichever occurs first. As a default, select MAX afterburner during the pull. However, if you encounter the SRB with little to no buffet, sustain the SRB and delay increasing power. Similar to the turn in for a high-to-low conversion, you will 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 you and tally maintenance will be easier. Given a max performance turn in, you'll need to gain airspeed. Leave the throttles in MAX as a default and if circumstances allow, glance at your parameters (with the Bandit against a blue sky background, you won't be able to). Depending on how quickly you approach your game plan airspeed you may need to reduce power. Attempt to have 420 to 450 knots for a typical low-to-high conversion. Use caution for the floor. Depending on altitude at the check away and your descent rate prior to the turn in, you may have to adjust you LV before or during the turn in to stay above the floor.

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

4.8.3.1 **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 4.30). 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.

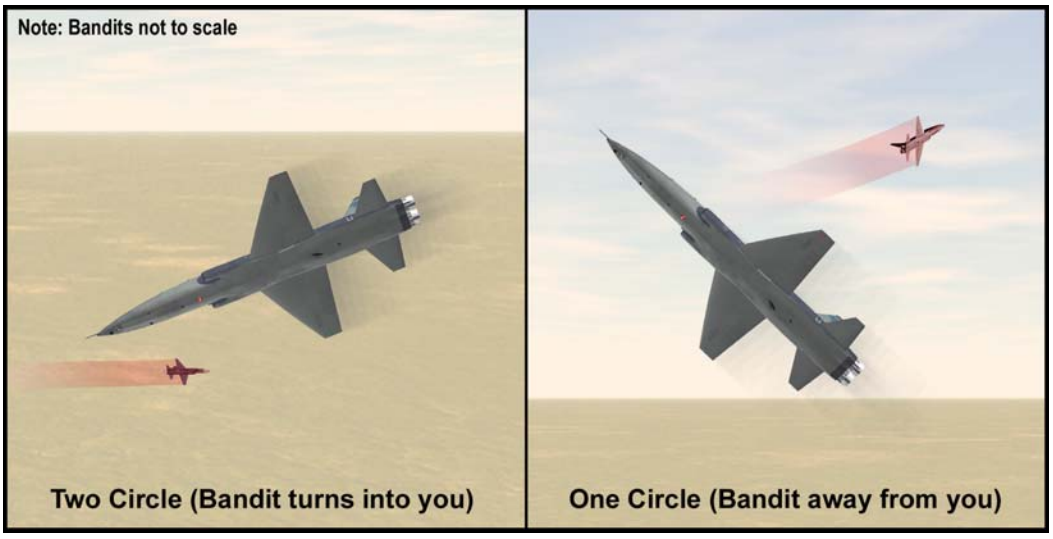
4.8.3.2 **Lead Turn Assessment.** If you start your lead turn late, there is nothing you can immediately do; you have built in a BFM problem you will have to solve later. If you start your lead turn early, the LOSR will slow down or freeze on the canopy. In this case, you must ease off the G momentarily to let the LOSR increase again

Figure 4.30. Lead Turn Cues.



4.8.3.3 **Bandit Turn Direction.** During the lead turn, you must also evaluate the Bandit's game plan in order to develop your own. The Bandit will be the last to turn and therefore will determine whether you initially enter a one or two-circle fight. If, as you cross the Bandit's 3/9, he turns into you, he has established a two-circle fight. On the other hand, if he turns away from you, you 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 4.31 illustrates the cues to identify a two-circle and one-circle fight respectively.

Figure 4.31. Bandit Turn Direction.



4.8.4 **HABFM Post-Merge:**

4.8.4.1 **Two-Circle Fight:**

4.8.4.1.1 **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.

4.8.4.1.2 **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 your lead turn, readjust LV slightly below the Bandit and sustain the best rate airspeed the Bandit will allow. Immediately assess your 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.

4.8.4.1.3 **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 knots.

4.8.4.1.3.1 **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. If accelerating to or through your 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).

4.8.4.1.3.2 **Low-to-High Conversion.** As you cross through the Bandit's CZ and he turns into you, your airspeed will be decreasing and your nose may be above the horizon. 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 you perceive a two-circle fight developing, quickly move your 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, you 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.

4.8.4.1.4 **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.

4.8.4.1.5 **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.

4.8.4.1.5.1 **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 you) 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.

4.8.4.1.5.2 **When to Execute the TCX (Figures 4.32 and 4.33).** 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 Bandits 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 4.32. When to Extend Part 1.

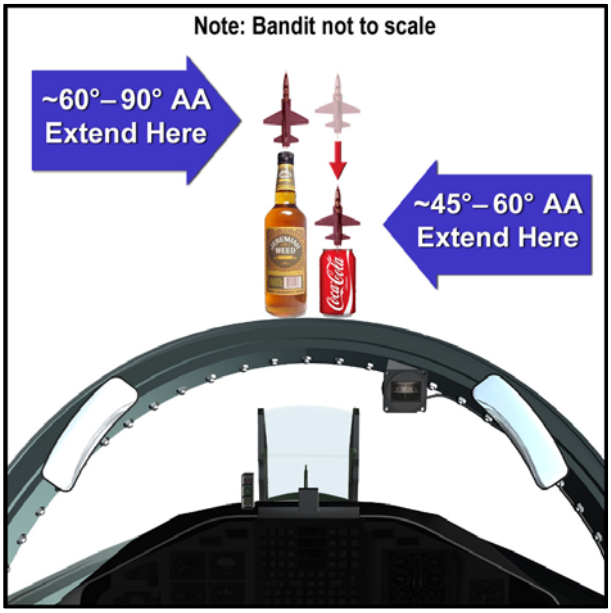
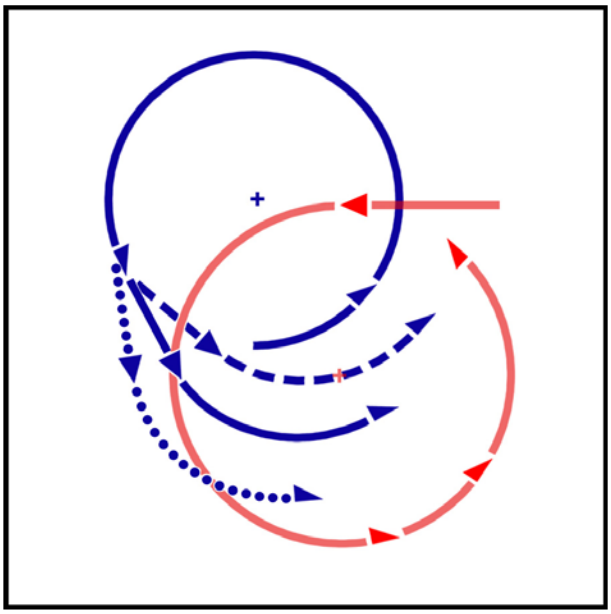


Figure 4.33. When to Extend Part 2.



4.8.4.1.5.3 **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 your target airspeed and G, you 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 you don't extend for long enough and G is applied too soon, you will see immediate LOSR towards the canopy bow; 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 you erroneously cross too close behind the Bandit, he may reverse and transition to a one-circle fight.

4.8.4.1.6 **Transition to OBFM.** Eventually, you will see range and aspect pictures that look similar to 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 you 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 you will have to let G taper off slightly at the floor; you will feel less buffet as you are further away from the lift limit line (Reference Figure BFM 8). Be patient, and be deliberate with your BFM cross-check and Bandit assessment.

4.8.4.2 **One-Circle Fight:**

4.8.4.2.1 **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.

4.8.4.2.2 **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.

4.8.4.2.3 **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).

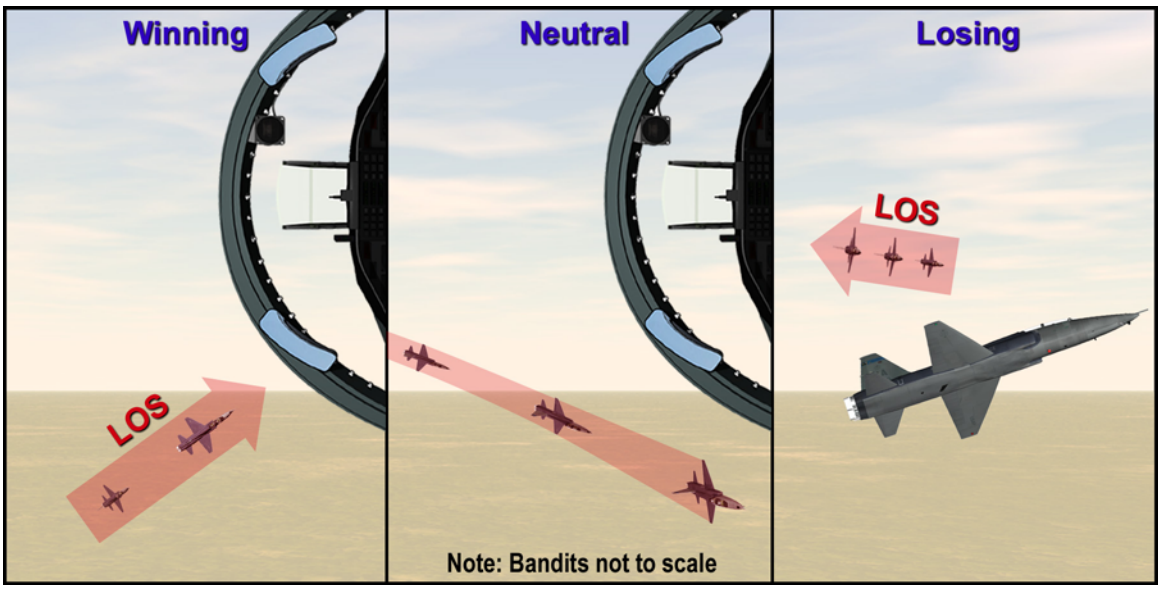
4.8.4.2.3.1 **Low to High.** Given you have the desired airspeed relative to merge geometry, leave the power in MAX and pull with POM on the Bandit. As you slow down, SRB will BE replaced by buffet (assuming constant pull); the aircraft is transitioning from the G limit to the lift limit. Approaching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

4.8.4.2.3.2 **High to Low.** If airspeed is high, immediately select IDLE power. As your nose will be below the horizon, quickly reset the LV to get POM on to slightly above the Bandit (use caution if you are in the SRB). As the nose tracks to or above

the horizon you should be slowing towards instantaneous corner; put the power back in MAX and continue a moderate buffet pull.

4.8.4.2.4 **Bandit Assessment Across the Circle (Figure 4.34).** As you and the Bandit are approximately coheading across the circle from each other, start to assess whether you are winning, neutral, or losing the min radius fight (Figure 4.34). At the second merge, expect the fight to transition to a scissors, a two-circle (energy fight), or continue in a min radius fight.

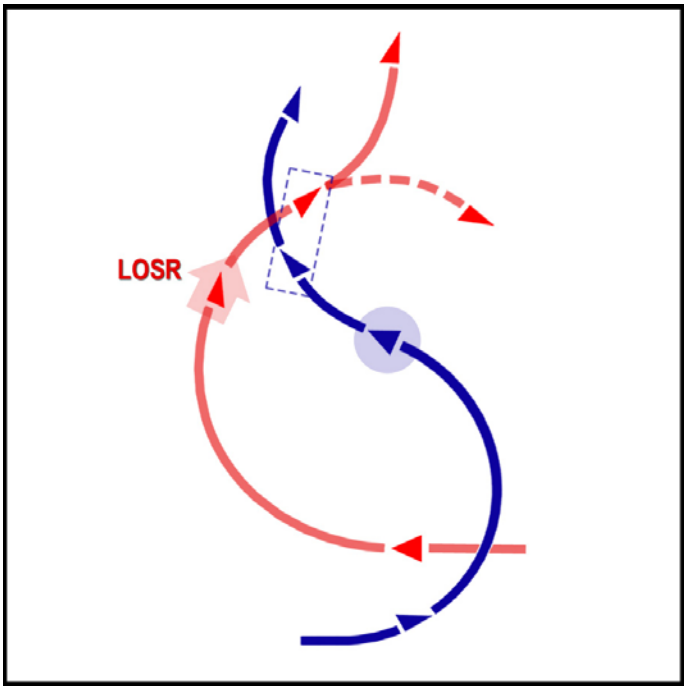
Figure 4.34. One-Circle Assessment.



4.8.4.2.4.1 **Winning Cues.** With AA stagnant or decreasing, you see LOSR forward begin to develop. With winning cues, execute a lead turn to minimize HCA. Use LOSR towards and then across your nose as the cue to execute the lead turn. At this second merge, you must assess Bandit turn direction just like you did at the initial merge (dashed rectangle in Figure 4.35).

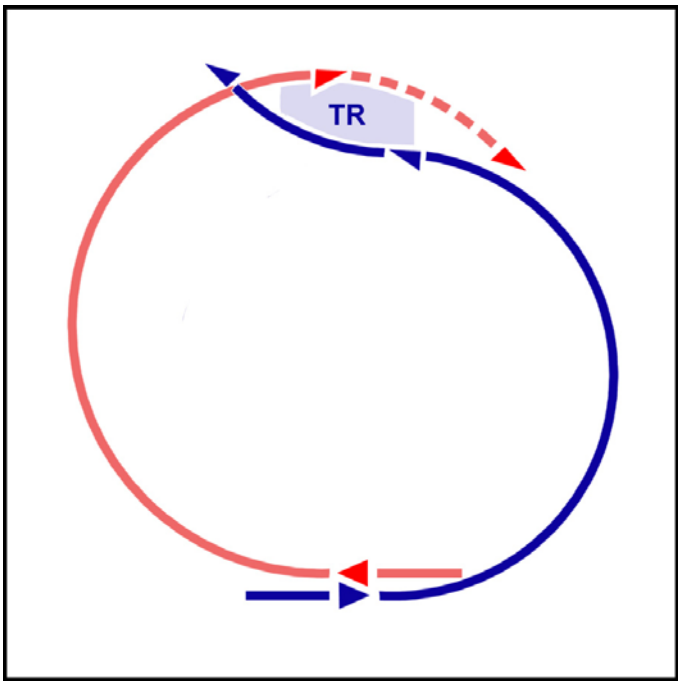
4.8.4.2.4.1.1 **Scissors.** If the Bandit reverses his turn (the solid red arrow in Figure 4.35), you will transition to a scissors. Your game plan is to lead turn to align fuselages and slow down as required to gain weapons separation.

Figure 4.35. One-Circle – Winning.



4.8.4.2.4.1.2 **Two-Circle Fight.** If the Bandit continues his turn (with his LV and nose dropping below the horizon), he is 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 4.36. Use the Turning Room.



4.8.4.2.4.2 **Neutral Cues.** LOSR is forward, but Bandit aspect steadily increases towards pure as he approaches 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, you will end up in a second merge where neither the fighter nor Bandit 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.

4.8.4.2.4.2.1 **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! In Figure 4.36, if the fighter continues the turn (solid blue line) the TR between him and the Bandit (green hashes) becomes exclusive TR for the Bandit. Instead, the fighter should use the TR (dotted blue line). As you do so, assess Bandit turn direction and continue the min radius fight or transition to the two-circle fight.

4.8.4.2.4.2.2 **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 knots 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.

4.8.4.2.4.3 **Losing Cues.** 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 you find yourself assessing losing cues, make sure you are 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!!!

4.9 Air Combat Maneuvering (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. You now have to bring your element mate into your cross-check along with the normal Bandit assessment. ACM is the first mission where you 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 his 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 his 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.

4.9.1 **ACM Roles:**

4.9.1.1 **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.

4.9.1.2 **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***.

4.9.1.3 **Engaged Fighter Role and Responsibilities.** The engaged fighter executes his 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.

4.9.1.4 **Support Fighter Roles and Responsibilities.** The support fighter's primary responsibility is to deconflict from the engaged fighter. In order 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.

4.9.1.5 **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:

- Most defensive fighter.
- Most offensive fighter.
- Flight lead.

4.9.1.5.1 **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."

4.9.1.5.2 **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.

4.9.1.5.3 **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.

4.9.1.5.4 **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 TWO, PRESS.” The wingman responds with, “EAGLE TWO'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.

4.9.1.6 **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.

4.9.1.6.1 **Engaged Fighter Is Offensive/Neutral.** The support fighter does not require permission to employ ordnance as long as 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 4.9.3 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.

4.9.1.6.2 **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.

4.9.1.6.3 **Weapons Employment and Deconfliction (Figure 4.37).** 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 4.37. Weapons Deconfliction Zone.

4.9.2 **ACM Communications:**

4.9.2.1 **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.

4.9.2.2 **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.

4.9.2.2.1 **Engaged/Support Communication:**

4.9.2.2.1.1 **"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 ONE ENGAGED, DEFENSIVE."

4.9.2.2.1.2 **"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.

4.9.2.2.1.3 **"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 TWO, UNABLE, DEFENSIVE/BLIND." Roles are not swapped.

4.9.2.2.1.4 **"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

4.9.2.2.2 **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 ONE, 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).

4.9.2.2.3 **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 ONE, 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

4.9.2.2.4 **Informative SA Building Communication.** Additional examples of descriptive communication that informs the other flight members of intentions include "EAGLE TWO...

- OFFENSIVE/DEFENSIVE”
- ANCHORED”
- IN/OUT”
- Bandit SWITCH”
- SPLIT”
- FOX 2”

4.9.2.2.5 **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.

4.9.3 **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.

4.9.3.1 **Threat Detection.** In order 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 multiquadrant attacks. The complete attention of both element members cannot be focused on a single threat attacking them. The support fighter, in particular, 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.

4.9.3.2 **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 in a position 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.

4.9.3.3 **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 TWO, 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 ONE, 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.

4.9.3.4 **Formation.** The element should attempt a bracket with both vertical and lateral offset in order 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.

4.9.3.5 **Visual Pickup in the Front Quarter:**

4.9.3.5.1 **High-Aspect Bracket Game Plan.** The element should attempt a bracket with both vertical and lateral offset in order 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 4.38 for an example of the merge flow. Both fighters should maneuver for TR if able and force the Bandit to pass between 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) in order 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 4.39). 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 4.38. High-Aspect Bracket.

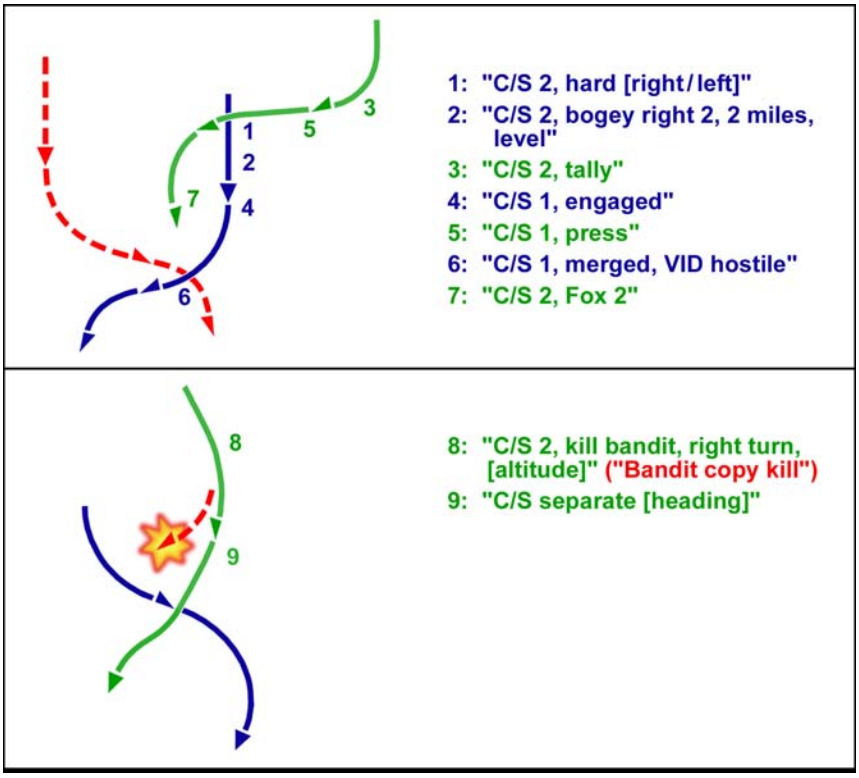


Figure 4.39. Filming the Merge.

4.9.3.5.2 **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/support roles. If the wingman is unsure, then lean forward with an "ENGAGED" call, and the flight lead can easily veto with "NEGATIVE, EAGLE ONE ENGAGED."

4.9.3.5.3 **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.

4.9.3.5.4 **Visual Identification (VID).** If a VID is being accomplished and all ROE have been met, make the call in the following format: "EAGLE ONE, 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 (VIPER)."

4.9.3.5.5 **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.

4.9.3.5.6 **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, single-circle fights put more pressure on an adversary than two-circle fights. Single-circle fights force the Bandit to get anchored and low on energy, allowing for an unobserved rear-hemisphere WEZ entry by the support fighter.

4.9.3.5.7. **Status Calls.** If unsure of which aircraft is which, the support fighter should query with a radio call: "EAGLE ONE, 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 he was asked, and then any other SA enhancing parameters of Eagle 1's aircraft. As an example, "EAGLE ONE IS HIGH MAN, OFFENSIVE."

4.9.3.5.8 **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 TWO, 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.

4.9.3.5.9 **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 in order 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 0.5G. This gets the formation back to an acceptable energy state and gets the formation low to decrease possible WEZ's from other Bandits.

4.9.3.6 **Visual Pickup in the Beam:**

4.9.3.6.1 **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 he 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.

4.9.3.6.2 **Merge.** As stated above, the inside fighter is best suited to be the engaged fighter (first to merge). Lack of proper ID 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.

4.9.3.6.3 **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 4.40 for an example of the fight flow.

4.9.3.6.4 **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 call sign, 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 4.41 for an example of the fight flow.

4.9.3.7 **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 of time. 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 coaltitude, 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 4.40. Bandit Turns with the Lead Fighter.

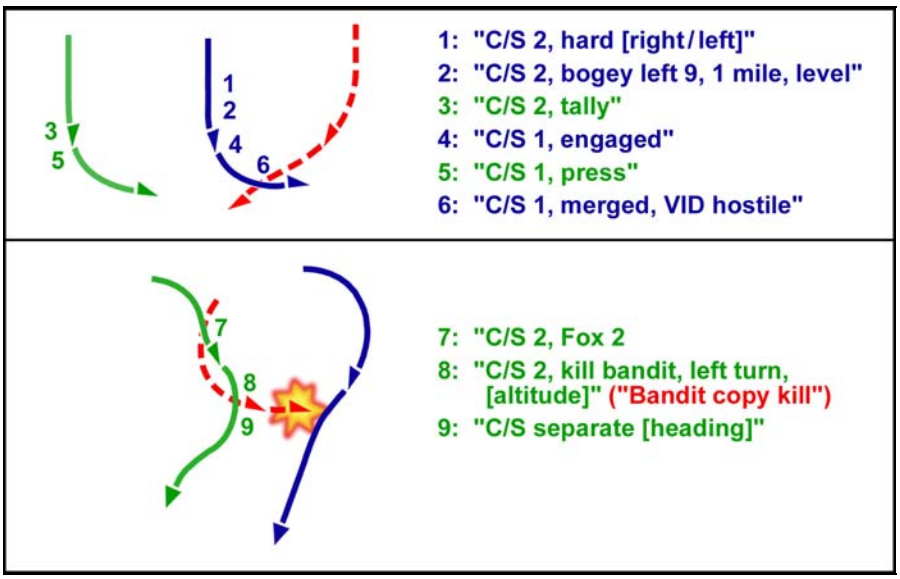
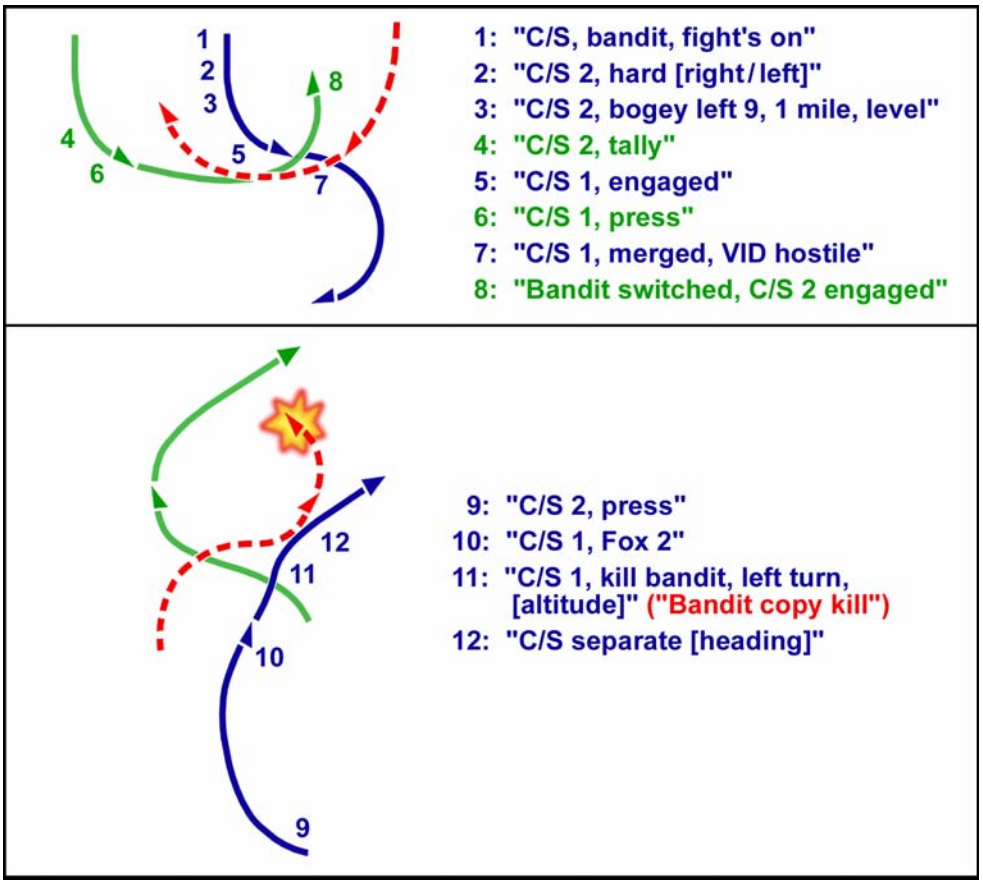


Figure 4.41. Bandit Extends to the Trail Fighter.



4.9.3.7.1 **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. Generally speaking, 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 ONE BREAK LEFT AND UP.” The element should execute their best DBFM and infrared missile defense (IRMD) while continuing to deconflict from each other.

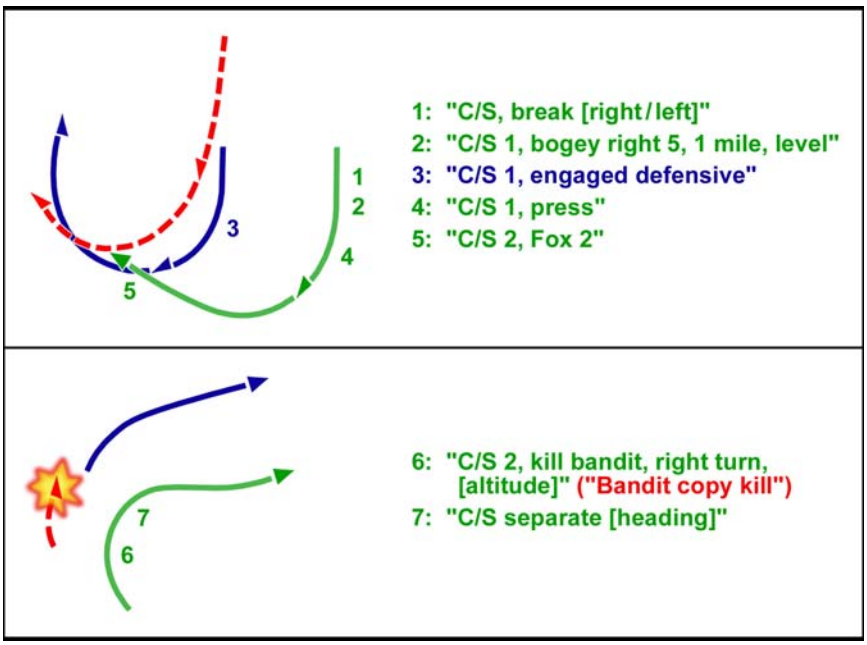
4.9.3.7.2 **One Fighter Tally.** The fighter with the tally must provide descriptive commentary to get the other pilot's eyes on the Bandit. This requires descriptive calls that isolate the Bandit in a portion of the other fighter's canopy and includes range. For example, if Eagle 2 were pointing out the threat to Eagle 1: “EAGLE ONE, 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 ONE, BANDIT LEAN ON YOU” OR “EAGLE TWO ENGAGED, DEFENSIVE.” This way, the engaged and support roles are established even if only one fighter has tallyho.

4.9.3.7.3 **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.

4.9.3.7.3.1 **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 4.42 for an example of the fight flow.

Figure 4.42. Defensive Perch (No Switch).

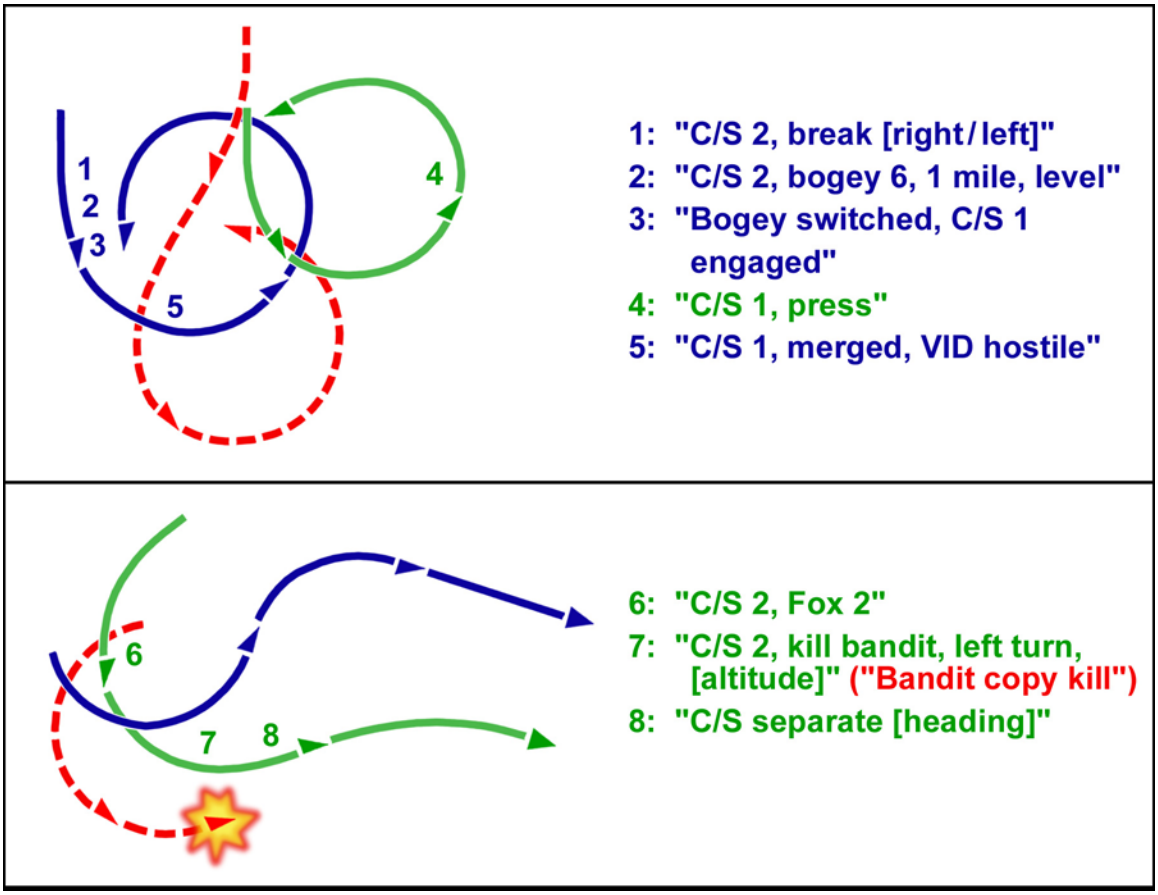


4.9.3.7.3.2 **Bandit Switch.** A Bandit who stern converts on two fighters, both of which are seen, will usually attempt to switch to the fighter on the outside of the turn at some point after the fighters initiate their break. This could happen immediately ("Early Switch") or after the Bandit pursues 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 TWO, BANDIT SWITCH," "EAGLE TWO, ENGAGED," "EAGLE TWO, 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.

4.9.3.7.3.2.1 **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 ONE, MERGED, VID HOSTILE, 1'S ENGAGED" followed by "EAGLE ONE, PRESS" from Eagle 2. Eagle 1 as the engaged fighter should execute his 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 his 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 of the horizon, so that as the Bandit's nose turns toward him, it will be difficult for the Bandit to see him. If the Bandit does see him, this maneuver ensures that the Bandit will not threaten him with his nose because it will allow the engaged fighter an easy WEZ opportunity if he does. This maneuver will also slow the support fighter's forward ground track (in the same way scissors do) so that he 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 4.43 for an example of the fight flow.

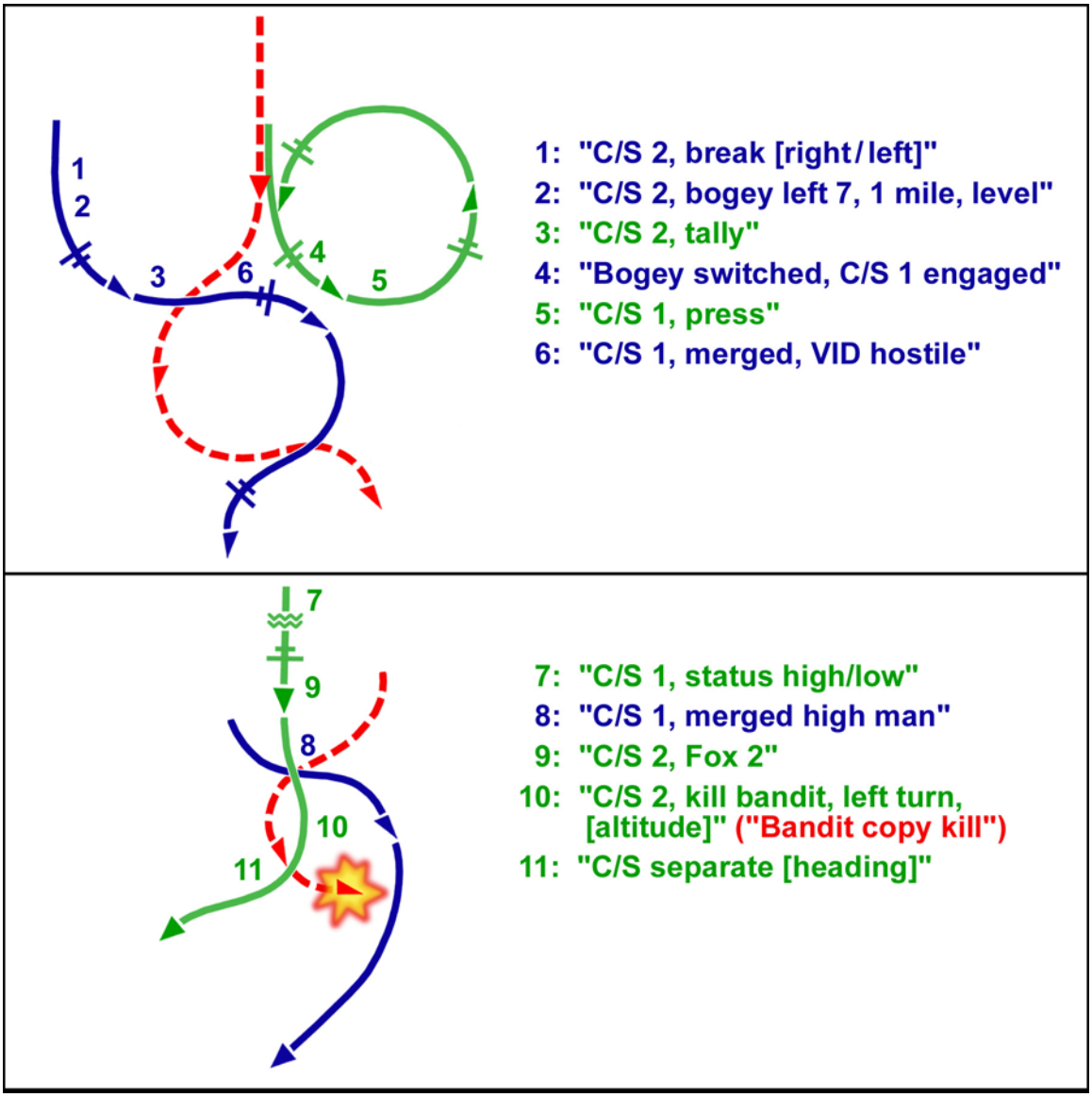
Figure 4.43. Defensive Perch (Early Switch).



4.9.3.7.3.2.2 **Late Switch.** A late switch will almost always allow the merging fighter to gain some TR and lead turn on the Bandit as he executes his 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 ONE, MERGED, VID HOSTILE, 1'S ENGAGED" followed by "EAGLE ONE, 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 his 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, overrotate 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 his 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 TWO, BLIND." It should be rather easy for Eagle 2 to maintain the tally on the Bandit throughout this turn. He 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 TWO, BLIND" call. If Eagle 2 sees two aircraft but is

unclear of which aircraft is which, his next job is to figure out which aircraft is friend or foe. 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 (he knows who is who), he 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 knots, he can cause excessive closure, including the possibility of flying out in front of the fight prior to missile impact. See Figure 4.44 for an example of the fight flow.

Figure 4.44. Defensive Perch (Late Switch).



Chapter 5

BASIC SURFACE ATTACK (BSA)

5.1 Introduction. BSA is the building block for all air-to-ground missions. This chapter addresses surface attack definitions, premission 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, *Air Crew Weapon Delivery 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 **t**he 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 mill radian (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 fuze 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).** Percent BFL is an alternate HUD track reference. In principle, it is exactly the same as IAA and serves the same purpose. The only difference is that 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 amount of mils below the target.

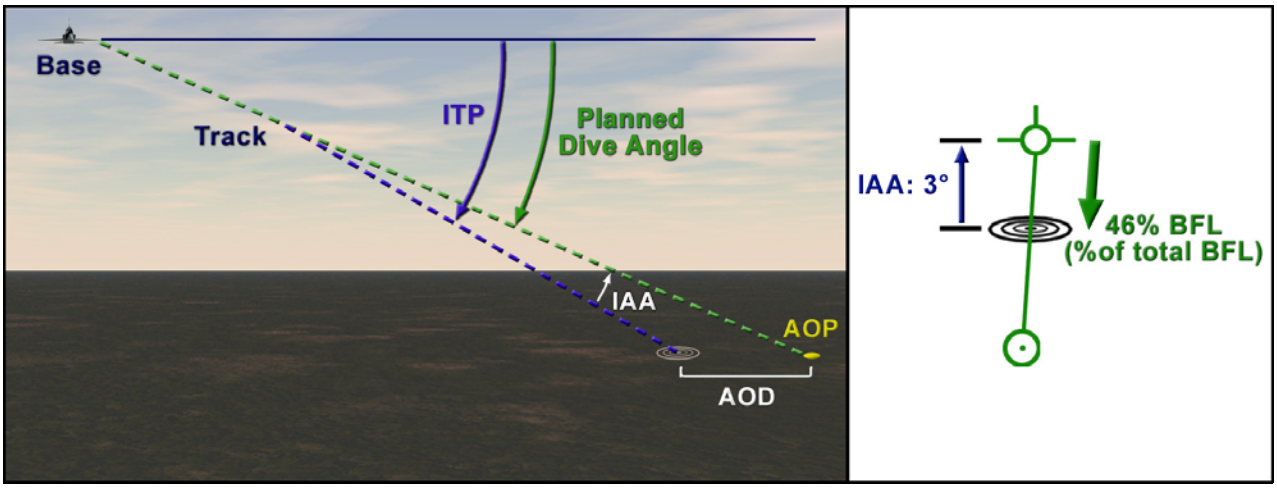
5.2.11 **Release Altitude.** Release altitude is the altitude above the ground at which weapons delivery is accomplished.

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 AFI 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 that you 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 you used to plan your attacks. As you approach 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 air-to-ground (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 (A/A TACAN, IFF, and CMD IAW the brief). Set up NAVAIDs to aid in SA on the range course deviation indicator (CDI to run-in heading, captain's bar on 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 your 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. (AFI 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 en route or 2 seconds in tactical will provide for sufficient spacing behind the preceding aircraft.

5.6 Range Comm. With the exception of safety of flight calls (say position or KIO), full call signs will be used when communicating on the range (for example, "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 call sign or formation position as briefed. The calls should be made at the moment you crack your wings to start the turn. 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 you rolled in with intent to drop but ended up not pickling. Add the reason for not dropping ordnance to the off-dry call (for example, “EAGLE 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, (for example, “C/S 3’S OFF, TWO AIRCRAFT IN SIGHT…”) and begin the rejoin. If not all of the preceding aircraft are in sight, transmit the number of aircraft you do see and continue to fly the briefed ground track, leveling off at your briefed “sanctuary” altitude. Once visual with all of 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 safed, 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 you 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 your current pattern altitude and flow them in to 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 that you are trying 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 TR’s 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 **No Radio (NORDO).** The NORDO aircraft should remain high and dry in the pattern and rock his 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/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 who you’re looking at after rolling out on crosswind, cross-check 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 your 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 you have high SA for which you have adequate deconfliction, call "CONTINUE." If on final and not directly involved in a "say position" situation, you 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 (for example, "NEXT PASS HOT" or "GREEN'M UP").

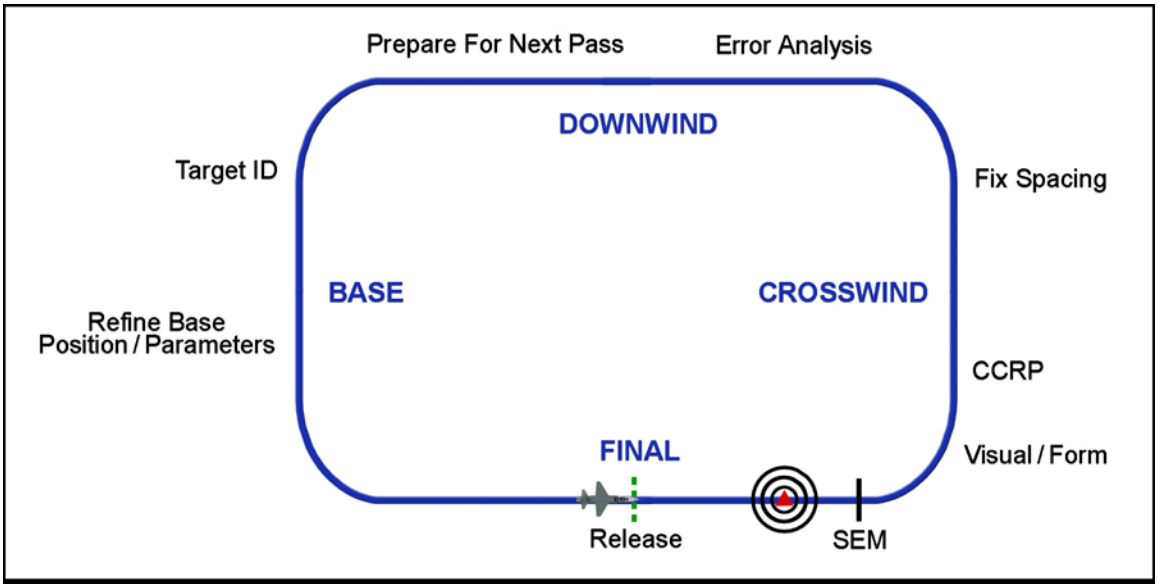
5.9.6 **Fouls.** Two fouls or one dangerous foul on range will usually result in that flight member either holding high and dry or being directed to return to base (RTB). Use judgment based on the severity of the problems. Since the T-38C does not physically drop anything, it will be hard for anyone 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. You 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 you may be turning inside the preceding aircraft (the "coffin corner"). Look outside as well as inside your turn until you are sure your turn is clear.

5.10.5 **Check Spacing.** After finding the aircraft in front of you, assess your pattern spacing; you should be 6,000 to 9,000 feet behind the preceding 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 you are close or wide, then adjust your turn to downwind to either increase or close range. If you are adjusting your downwind turn, orient your downwind leg so that you will arrive over the briefed ground track at your turn to base. If you are Number 2 or Number 3 of a four ship, avoid airspeed deviations as they will affect the aircraft behind you; instead use geometry. Prior to "cutting" any corners, you must be visual or have SA with comm with all of 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.

5.10.6.1.1 **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).

5.10.6.1.2 **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.

5.10.7 **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 you can see in Figure 5.3, there are nine places you can be, eight of which are not correct 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 cause you to devote excessive time on final to airspeed corrections. Shack your 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, you will have to use canopy codes to visually assess your base position. If a ground reference is available, select a lead point to begin the base turn so as 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 1 1/2 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 your 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 you are excessively close to the preceding aircraft, consider using a normal base position and go through dry on final. Subsequently, adjust your 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 your turn to base, the base position itself, and the heading to hold that ground track. For a headwind (on final), you 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 your 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 of 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, you 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 aircraft in front of them for timing the turn to base.

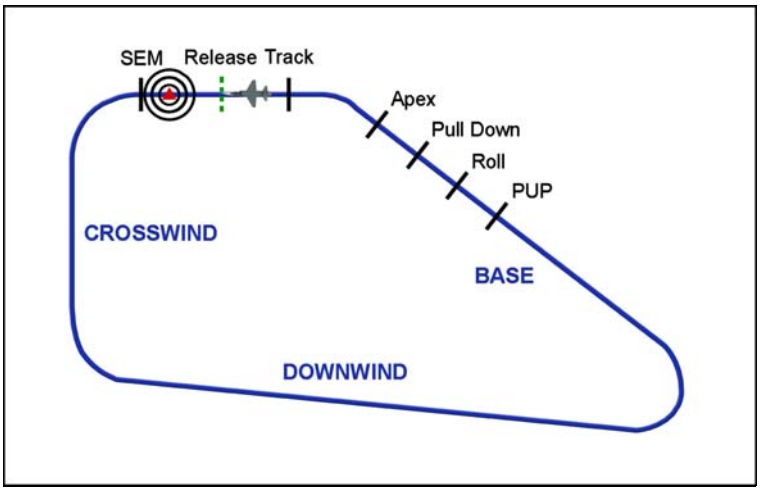
5.11.4 **Downwind.** After completion of your SEM, turn to crosswind. Priorities and tasks during this turn remain the same as during the conventional pattern. Once turning on downwind, complete your error analysis. Basic analysis of your position on final relative to the planned wire remains the same 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 your planned parameters as possible. For a direct popup attack, roll out with the TD 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, keep your attention outside the cockpit as you will be 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 your 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 you are 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.** Your pulldown LV should be placed to keep your 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, you will have to overrotate further to about 135° of bank.

5.11.9.2 **Apex Cross-Check.** Approaching the apex of the pulldown, a quick cross-check in the HUD is warranted to build airspeed SA. If it appears the aircraft will approach or slow below 300 knots, modulate the pulldown G to stay above 300 knots, 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 with the exception of 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 half way 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 so as 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 knots 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.** You should use the target as your reference for when to roll in; attempt to lead turn so as 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 your 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)

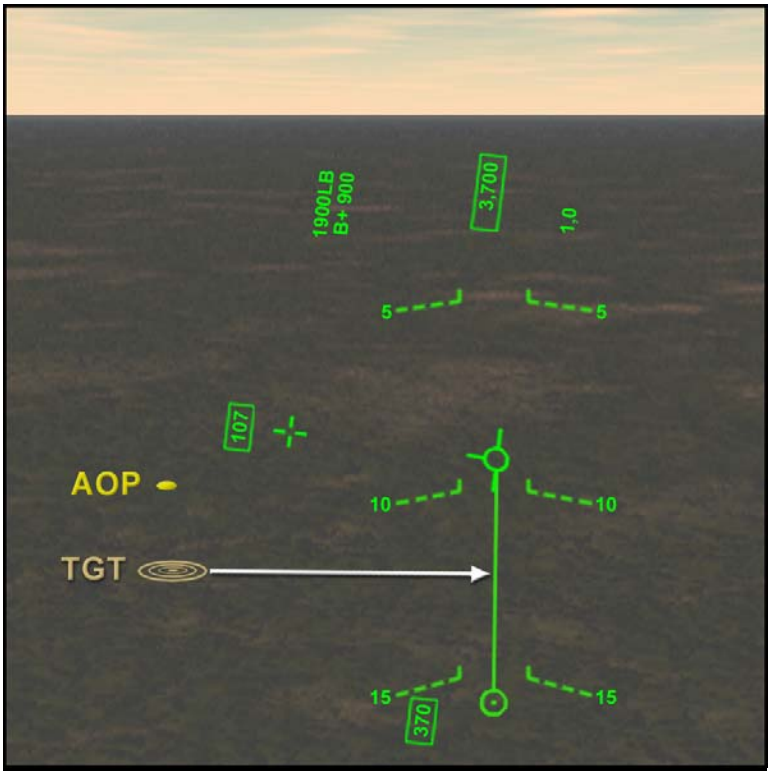
Note: These references are good for understanding where the LV should be for an accurate POM; however, in execution your attention should be on the AOP. Concentrate on pulling the gun cross or FPM toward the AOP and not directly to the target. Precise base parameters followed by a repeatable roll in 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 overrotating toward the AOP. If the base position appears too tight, slightly overrotate (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 make adjustments to 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: overrotate 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 of 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, you will be setting 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 in an attempt 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 knots:

10°: 400 KCAS (half-way down final)
20°: 380 to 390 KCAS (half-way down final)
30°: 350 KCAS (at roll out)
45°: as you start 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 your AOP.

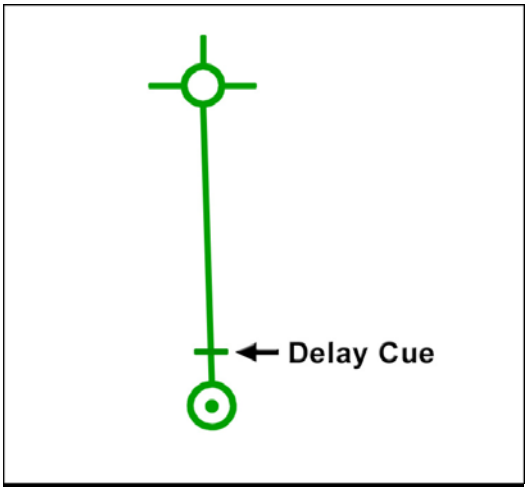
5.13.2.6 **Make Adjustments a Track Altitude.** IAA and %BFL are only valid at track altitude. Track altitude is planned to occur shortly after rolling out on final. With experience, you will be able to maintain awareness of track altitude as you dive through it by precisely using your HUD track reference right at track altitude. Until then, using your 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 of 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, you 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.

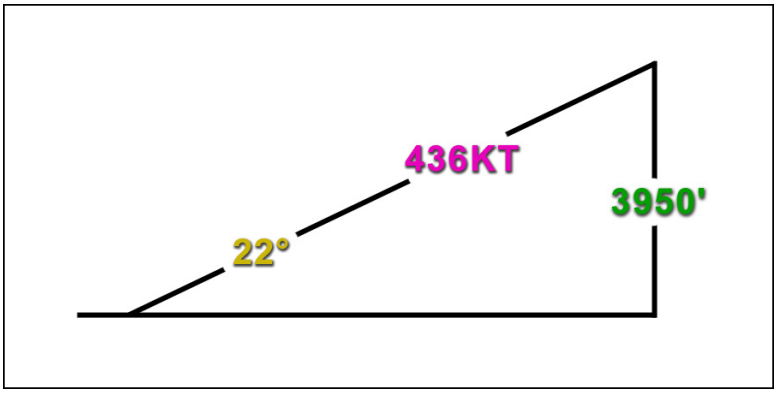
Figure 5.7. Delay Cue.



5.14 Error Analysis. Once established on downwind, with SA on the aircraft in front of you, assess your last 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, you may need to move your base position, 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 your delivery (Figure 5.8). Dive angle, altitude, and airspeed at release will be displayed. If you're confident that your roll in and weapons-delivery mechanics were executed IAW your plan, consider moving your 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 you built your plan.

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).** You 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).** You 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).** You 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).** You rolled out below the wire but likely found the correct wire with an accurate AOP.

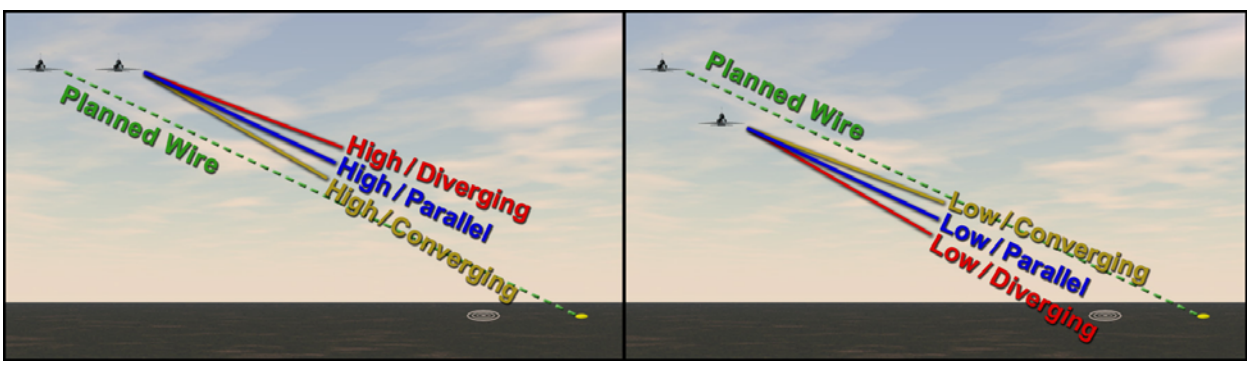
5.14.2.5 **Low/On Planned Dive Angle (Low, Parallel Wire).** You rolled out below the wire but did not set the AOP. (MRA was probably a factor.)

5.14.2.6 **Low/Steep (Low, Diverging Wire).** You 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 you have started flying good parameters, you can begin to assess where you pickled. Did you pickle where you intended? 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 that you 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 typically use 20°; F-16s use 25°; and A-10s use 30° or greater. The minimum recovery altitude is 500 feet AGL day time 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 so as 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.

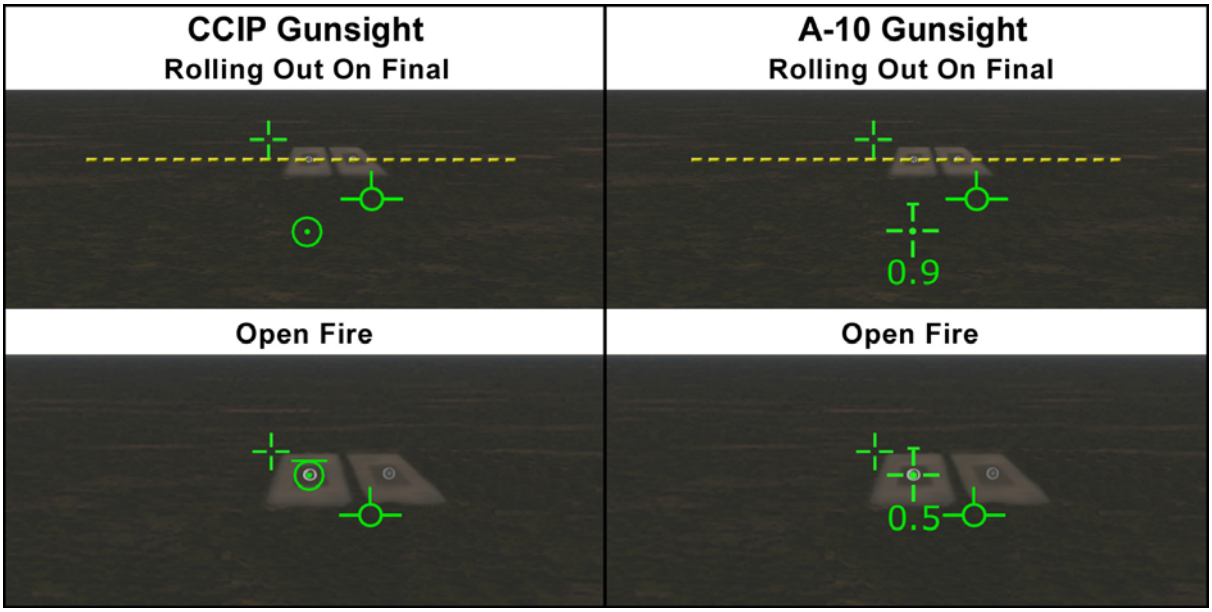
5.15.4.1 **Initial Aiming References.** Initially, pull the gun cross towards the target and set the bottom of the gun cross on the target. If there are crosswinds on final, put the target laterally halfway between the gun cross and FPM. Hold this picture (bottom of the gun cross on the target's 3/9, 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 knots.

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 6500 feet slant range in order 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" (TST); 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 pulloff; 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 foot 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 so as 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 6-9 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 knots.

5.16.4.3 **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 may be inside of planned open fire range for LAS, so it may be of little use.

5.16.5 **Open Fire/Cease Fire.** Use the slant range indicated below the CCIP gunsight 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 in order 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; attempt to "track – shoot – track"; there should be enough time 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 if directly over the foul line or the break "X" starts to flash. The only requirement is to avoid a lazy pulloff; however, because of close proximity to the ground, it is generally briefed to treat the recovery similarly to a climbing SEM.

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 your "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 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, you and your IP will discuss a kill container type scenario. You 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 your 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 handy 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, your flight lead's contracts, and attack geometry. Know the range regulations and the A/S training rules.

6.3 Ground Ops. The majority of the changes to your avionics and UFCP can and should be made on the ground. The EGI steer-point plan should match your flight lead (the card) in order 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. You will also be simulating weapons other than BDU-33s, so you will update the weapons menu on the MFD to reflect your simulated weapons. Your flight lead will also be directive as to what weapons program will be assigned to each bomb type and delivery parameters. Because you will probably have more products than you are used to, a good discussion on cockpit organization is warranted.

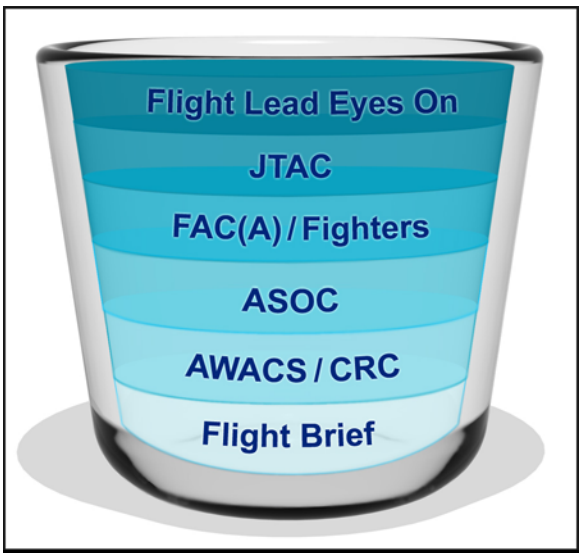
6.4 Departure. Flight plans to and from the range will be standard. A low level that can lend itself to low-altitude ingress may also be used. Expect to fly only a few legs of the low-level to save gas for the SAT. Flying a stereo and canceling early enough to ingress the range at hold altitude may also 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 TACS coord can be done on the ground, and some en route 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 we do in IFF is a building block to get to this point. You 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. Your flight lead will brief you on how the flight is going to provide and maintain mutual support throughout the entire sortie.

6.6 Theater Air Control System. The TACS provides the commander the capability to plan and conduct joint air operations. The purpose of this document is to provide an introduction to TACS for the pilot and 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 indepth reading on TACS, reference Joint Publication 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 premission 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, your flight lead or you, if so tasked, will provide them with the following information: call sign, mission number, and position relative to bull's-eye (B/E). Expect that they will want to authenticate you with a known code. Information that is provided to you is a sweet-and-sour check of your IFF/selective identification feature (SIF) system (covered more in your MDS) and the picture of the airspace. They can provide you 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 you contact the ASOC, you will provide them with call sign and mission number. Once again, expect authentication procedures. They should provide you with an AO update consisting of: threats, targets, friendlies, artillery, clearance authority, and possibly target area weather. They should also give you the call sign and frequency of the forward air controllers (airborne) (FAC(A)) or joint terminal attack controllers (JTAC) in your assigned area of responsibility (AOR). During the SAT phase, you may not get all of this information due to training limitations. The ASOC is also where you will provide an in-flight report

upon exiting the AO. The in-flight report consists of: call sign, mission number, location (coordinates), time on target, results, and any other remarks (for example, weather, threats, significant sightings).

6.6.3 **FAC(A)/Fighters.** Once in the AO and if present, your flight will contact the FAC(A) or the fighters that are leaving before you. You can always ask them for any updates to the AO. Usually, these players will have good SA and information about your AOR. If a FAC(A) is present, expect to work with him throughout your 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 in order 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, you will likely not talk to or have a simulated JTAC. Having a JTAC on the ground in your scenario generally implies that there are other friendly forces in the area. This situation requires detailed coordination with ground forces in order 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). He 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 has to 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 in order to facilitate left-hand roll ins, you should strive to see both right- and left-hand wheels. In the future, your main sensor will be the targeting pod, and your wheel directions will depend on which side of your jet the pod is mounted. Other holding options are offset figure 8, bone holding, and random holding. Depending on the tactical situation,

your 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 AGL regimes. As such, your 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 you 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.

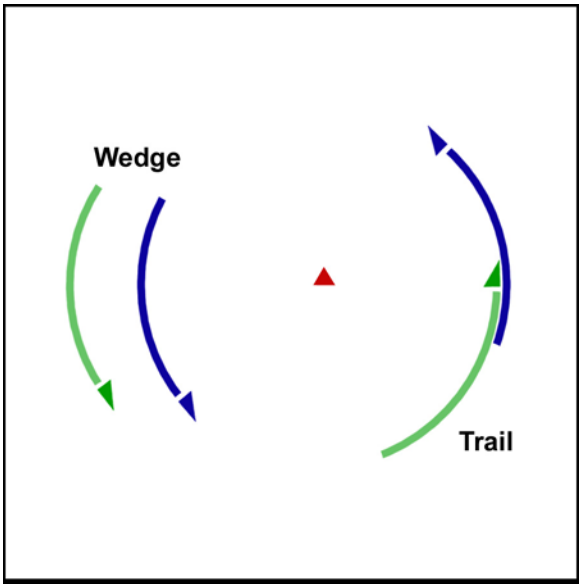
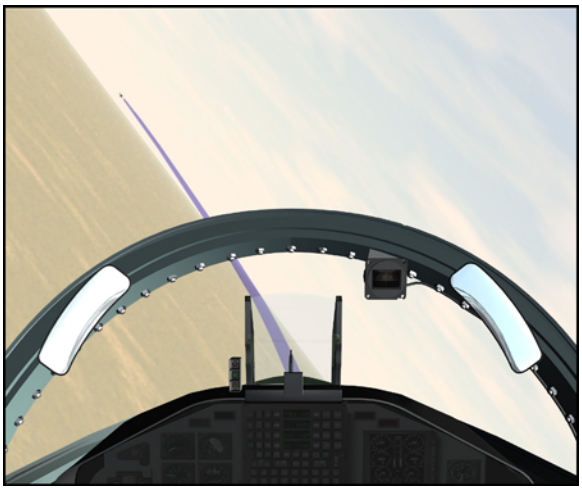


Figure 6.3. Wheel Canopy Reference.



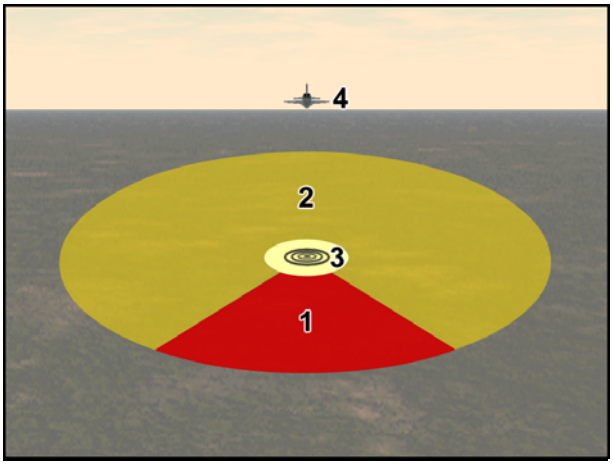
6.7.3.1 **Attack Roles.** While established in the AO, you will spend a great deal of time looking outside and listening to the radio to gather all the information you need about the next attack and to find the target. For each attack, you will have a specific role. Your flight lead will brief you on exactly what is expected of you for each of his attacks. As a result, in the air he will pass the Fighter-to-Fighter brief over interflight radio. Typically, it will be in the format: Formation, Role, Ordnance, Timing, In and Off Directions, and a Sort. Your contract/responsibilities for each of these roles will be briefed. Here are some examples of the types of roles you might 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 (you are always recce)

From medium altitude, you can expect your flight to run either Shooter/Cover or Shooter's attacks. With this in mind, your job leaving the hold will be to maneuver your jet to a good base position for the delivery or to a mutually supportive formation while your flight lead employs.

6.7.3.1.1 **Cover.** If you are tasked to the cover roll, you will stay in the wheel at altitude while providing your flight lead with visual lookout and comm mutual support. Continue to fly the same ground track while lead rolls in. You will be almost looking down your flight lead's tail pipes as he pickles. This position will build your SA on the target, as well as give you a great view of the section of earth he can't see, behind and underneath his jet. Your lookout priorities are 1) underneath flight lead, 2) the area around the target, 3) the immediate target area, and 4) your flight lead (Figure 6.4). Your flight lead will recover from the attack with the following priorities: SEM, clearing his six with 3D maneuvers, and then finding you. Typically, lead is assumed to be blind off target, while you are 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 establishing himself in the hold. Even prior to lead regaining the visual, you may see the need to maneuver to regain your position. Always strive to use ***geometry*** to fix your spacing verses just power.

Figure 6.4. Lookout Priorities.



6.7.3.1.2 **Shooter.** When you are directed to drop, lead will assume the mutual support and deconfliction contracts that are normally your responsibility. You should, however, strive to stay close to the briefed formation position until you start maneuvering to a good base.

6.7.3.1.2.1 **Finding Base.** While accelerating to base airspeed, you should maneuver to the correct base altitude and distance. Your primary reference for base distance is the canopy references that you learned on your 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 in order to see it better will often lead you to be in a banked turn while establishing your known canopy reference. This results in being too steep to employ due to the 5° steep TR stop. In an effort to combat this problem, most pilots will 'square off' the last portion of their base turn in order 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 your horizontal situation indicator (HSI). You should be in the blue EGI mode during these sorties with the target coordinates plugged into the current steer point. Cross-check your blue bearing needle and start your roll-in when the bearing pointer is about 15° from getting to 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 your 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 you will probably not be perfect when trying to find the right base position on your first few attempts. Don't be afraid to 'BFM the wire' when you realize you are close or wide of the planned base distance just as you 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 your target is small or difficult to break out based on surrounding features, using the EGI target designator

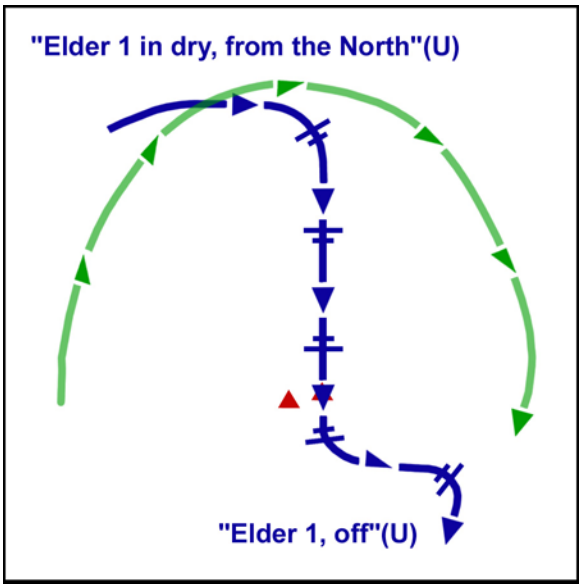
container (TDC) is a viable target acquisition aid. With these types of targets, it is common to pull directly to the target since you are padlocked on it, putting you on a low wire. Remember to pull your FPM long and upwind of the target initially. Your best guess for an approximate AOD will get you in the right ballpark, and using ITP halfway through roll-in can help, then you can refine your 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.** If you have no attack heading restrictions, and there is a significant wind aloft, consider rolling in based on the wind direction. As a general rule, tail winds are best because they push your 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, you should fly your 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 your jet into a position that gives you a good view of the ground underneath lead. Continue to fly in the same wheel and altitude while lead rolls in. As he completes his SEM, adjust your wheel to end up in a mutually supportive formation on him once again. Be ready to build his SA about your position if he asks for you posit. (Figure 6.6). Notice that you will use dry, JCAS 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 yourself into a good base position. Stay in position in the wheel until you are about 90° out from your desired run-in heading. Square off the last 90° before you roll in to make your base canopy references familiar and valid. Adjust your base distance as appropriate with your wings level when you check your canopy reference. Remember the technique that you 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 your 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 ordinance. 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.

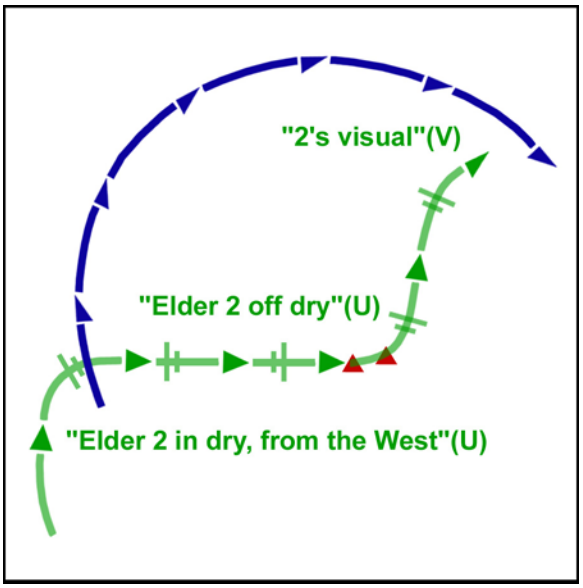
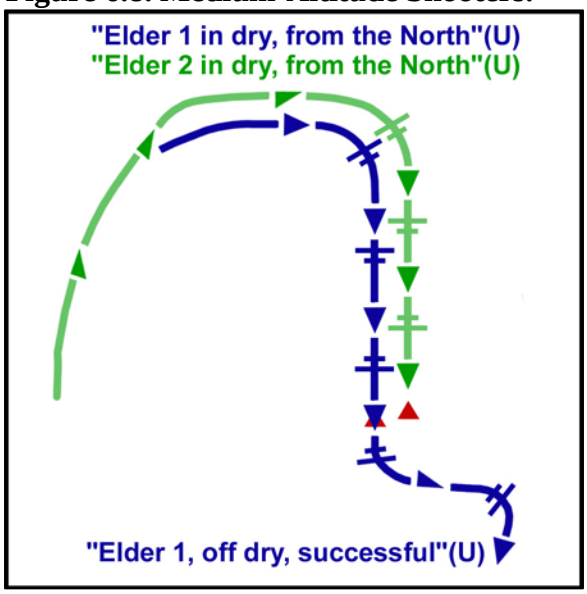


Figure 6.8. Medium-Altitude Shooters.



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

6.7.3.3.1. **Valid Climbing SEM.** Your first 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 you safe from the ground, the frag of your own weapon, and to get you away from threats in the area as quickly as possible. In the IFF SAT environment, there are no simulated threat reactions, but you should start practicing clearing your 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 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, your climbing SEM will

already have you moving in two dimensions; some minor check turns left and right while you climb back to hold altitude will suffice. Be sure not to bleed too much airspeed and get yourself to a low-energy state so that if a threat does become a factor, you have some energy to react to it.

6.7.3.3.3 **Find Your Flight Lead.** Expect lead to be between your 10 and 2 once you have turned 60° to 90° off of the attack heading. You will be assumed blind off target. Your lead will typically give you a few seconds following your SEM to move your jet IAW the contracts and to find him. If you don't find him (or don't call it) in a timely manner, he will talk your eyes back on. He should also give you a basic altitude deconfliction plan in the brief if you are blind for an extended period of time. Remember to continue flying the geometry briefed even if you don't see 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, you will find yourself low on energy when trying to get back into formation on lead. Remember that a good SEM will increase your energy. Beyond that, the best you 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, you 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, you as the wingman should always strive to be in wedge outside of your flight lead looking through him to the target and threat area. Also, whenever possible, your flight lead will attempt to make his holding turns towards the target area. The main reasons for this are target area SA and target ID. By swinging your nose through the target area you keep your visual lookout up and, if able, build your target area SA via a quick steer-point diamond check as the target area passes through your HUD. During low-altitude holding, you must be eyes outside the cockpit during any turns.

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

6.8.2.2 **Race Track (Figure 6.10).** In the racetrack, you will be outside of your flight lead in line or wedge formation. Your flight lead will turn as required to keep the flight in the hold; your job is to use geometry so that you always end up on the outside of flight lead, opposite of the threat and target area.

Figure 6.9. Low-Altitude Wedge Figure 8.

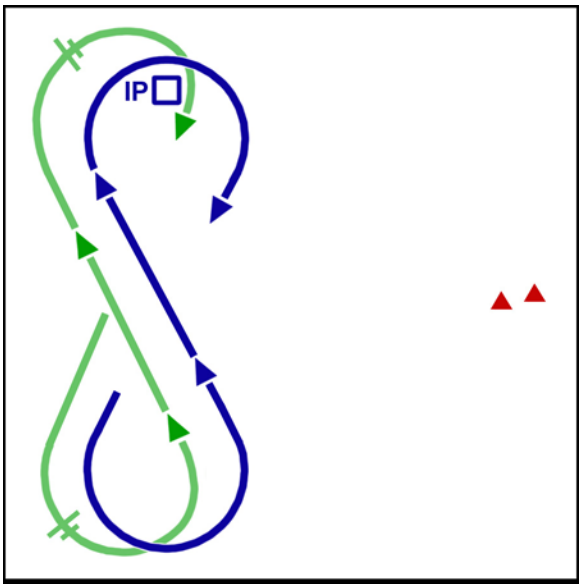
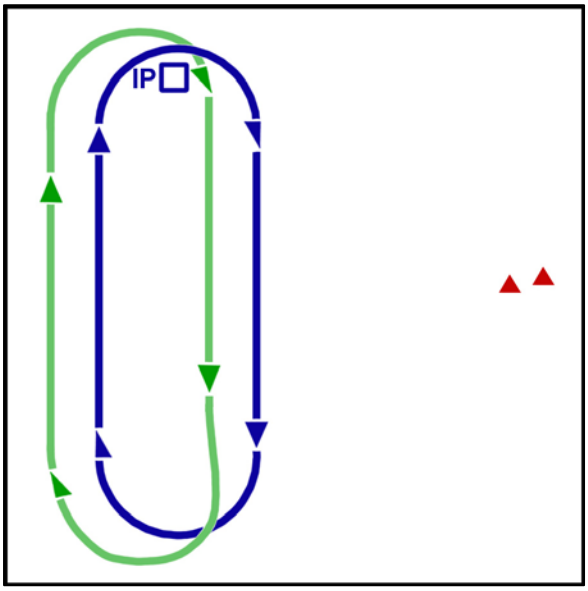


Figure 6.10. Low-Altitude Wedge Racetrack.



6.8.3 **Low-Altitude Execution.** Most likely, you will only execute shooters attacks in a low-altitude (high-threat) environment. The concept is that you are not going to stick your nose into the bee's nest without being offensive in some way. So walking out of the brief you already know your role to be shooter; now your biggest concern is flying the briefed geometry and employing valid ordnance. Remember, the first time you pop your toughest task will be target ID, so good target area study in the brief is key. Although you will see other formations in the future, most attacks low altitude are done from wedge or trail. Below, you will see wedge attacks as common examples of the attacks that you will execute in IFF SAT/CAS missions.

6.8.3.1 **Exiting the Low Altitude-Hold.** Since you should be on the outside of the hold looking through lead, he will most likely be turning away from you and, therefore, you must be ready to take advantage of the geometry and your 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 as a whole will be descending to 500 foot AGL and accelerating to 420 knots. Fly off of your flight lead, remembering to not fly below his altitude, and you will end up pretty close to your desired parameters. Cross-check your RALT, AAT, and KCAS as required.

6.8.3.2.2 **Action With/In the Same Direction as Lead.** At the appropriate range for his attack, your flight lead will action to pop. When you see his wings crack for this

maneuver, you should also begin your action. How much you action will depend on the attack.

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

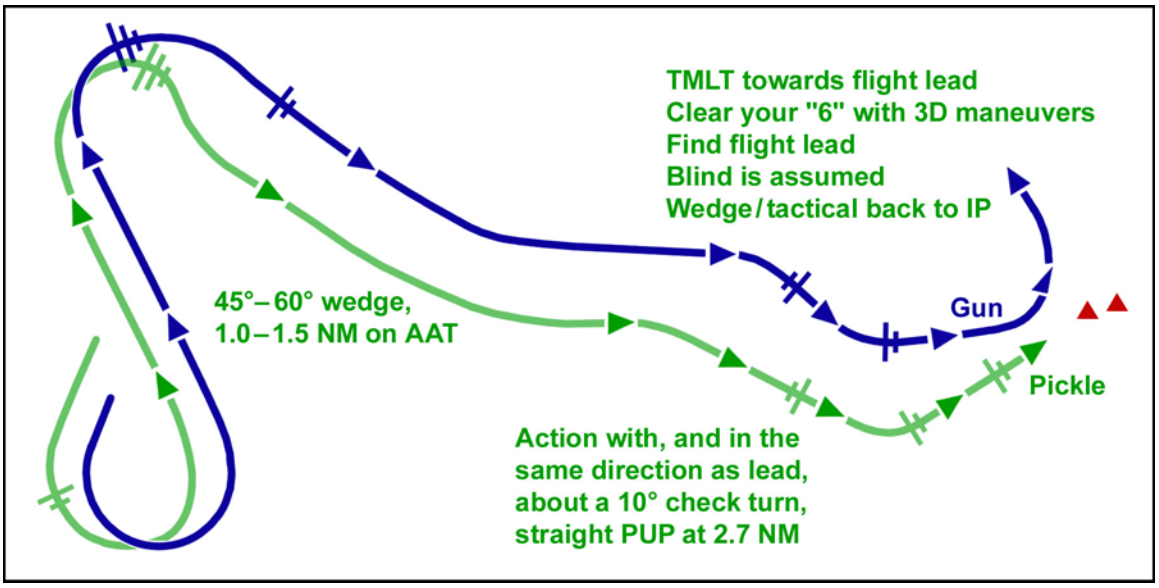
6.8.3.2.4 **Ensure CFOF.** If you didn't maintain at least 1 NM spacing between the jets, you may find yourself rolled out on final ready to shoot with lead still in the HUD. In all cases, you must comply with applicable ROE regarding CFOF. If you cannot, come off dry.

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

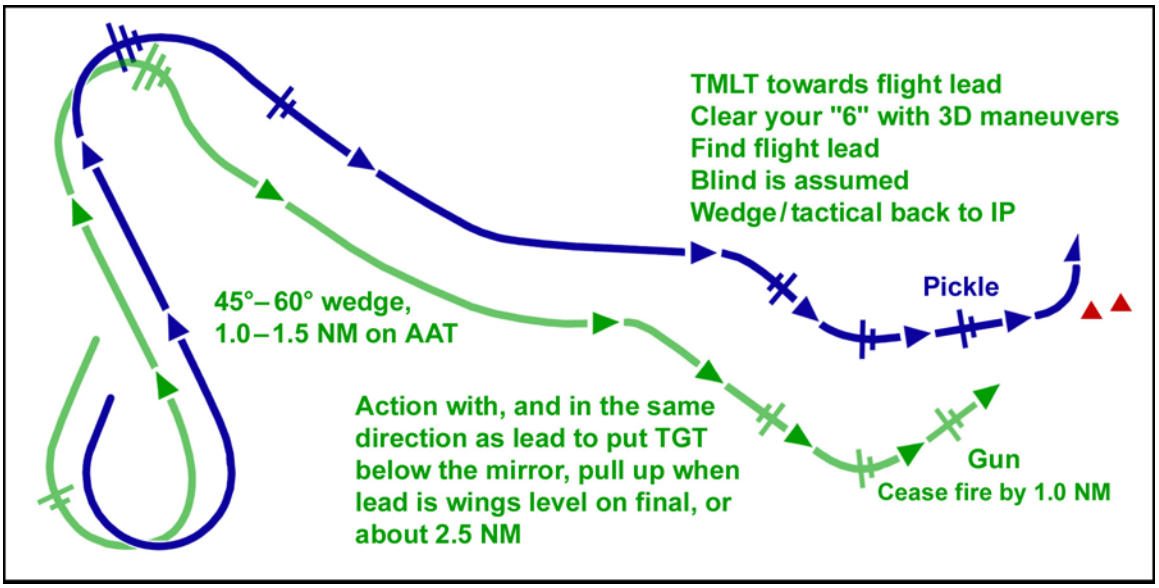
6.8.3.3.1 **Gun/Bomb.** This is one of the more flexible attacks from low altitude because it allows flight lead to find and "mark" the target while you drop bombs to destroy it. The attack geometry will be built around the bomb pass since the delivery parameters are more restrictive. You should arrive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

Figure 6.11. Low-Altitude Gun/Bomb.



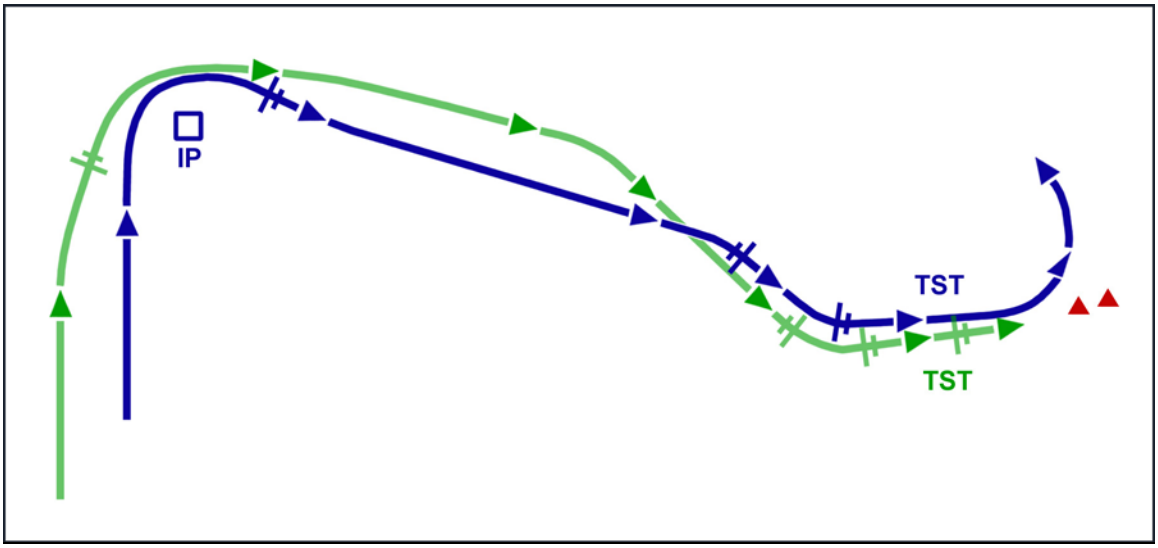
6.8.3.3.2 **Bomb/Gun.** When it's time for your lead to drop his bombs, you will follow him into the target area and kill with the gun or suppress the enemy defenses while he egresses. The primary concern on your pass should be effectively employing the gun and remaining clear of leads frag cylinder. Remember that the frag cylinder of a basic MK-82 is about 3,000 feet in height and diameter. As a general ROT, if you fire by 1.3 NM slant range (under the gun cross) and start your recovery, you 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 your gun shots is that if you have a valid solution in the HUD, the bullets will hit where you are aiming; how much damage/penetration you get from those bullets 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 you are employing, you 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 you have pickled. Be sure to prioritize flying the jet first as always.

6.8.3.4.1 **Turning Maneuver Level Turn SEM.** Your first 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 keep you safe from the ground, the frag of your own weapon, and to get you 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, you should keep your jet moving and use CMD to decoy IR and radar threats. In all cases, your primary defense against AAA is 3D maneuvers. In a low-altitude (high-threat) scenario, following your TMLT you will be slightly below pickle altitude, approximately 600 to 800 feet AGL. With a minimum altitude of 500 feet AGL, you are left with not much maneuvering room below you. You must move the jet in three dimensions, but realize the biggest threat is the ground. While accomplishing this, you should also preemptively CMD to defeat any MANPADS.

6.8.3.4.3 **Find Your Flight Lead.** After concentrating on attack geometry, valid weapons employment, and your off-target priorities, finding lead turns out to be much easier low altitude. Lead will give you a rough idea of where he will be upon completion of your off-target maneuvers, but you will be assumed to be blind off target. You must call visual as you egress 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, you can find yourself low on energy when trying to get back into wedge on lead. Remember to use geometry/cutoff to regain correct distance/AA from number one.

6.9 Adopted Forms:

AF Form 847, *Recommendation for Change of Publication*

RICHARD T. DEVEREAUX, Brig Gen, USAF
Director of Intelligence and Air, Space,
and Information Operations

Attachment 1
GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

Joint Publication 3-09.3, *Close Air Support*, 8 July 2009

AFTTP 3-1.1, *General Planning and Employment Considerations*, 1 May 2006

AFI 11-205, *Aircraft Cockpit and Formation Flight Signals*, 19 May 1994

AFI 11-214, *Air Operations Rules and Procedures,* 22 December 2005

AFPAM 11-419, *G-Awareness for Aircrew*, 1 December 1999

AFMAN 11-251, Volume 1, *T-38C Flying Fundamentals*, 17 March 2008

AFTO 1T-38C-34-1, *Air Crew Weapon Delivery Manual*, 15 May 2006

Abbreviations and Acronyms

3D—three dimensional

%BFL—percent bomb fall line

A/A—air-to-air

AA—aspect angle

AAT—air-to-air tactical air navigation

A/G—air-to-ground

AB—afterburner

ACM—air combat maneuvering

ACMI—air combat maneuvering instrumentation

admin—administration

AGL—above ground level

AGSM—anti-G straining maneuver

AHAS—avian hazard advisory system

AO—area of operations

AOA—angle of attack

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

ATC—air traffic control

AWACS—Airborne Warning and Control System

BFL—bomb fall line

BFM—basic fighter maneuvers

BRI—briefing room interactive

BSA—basic surface attack

C/S—call sign

CAF—combat air forces

CAS—close air support

CCIP—constantly computed impact point

CCRP—constantly computed release point

CDI—course deviation indicator

CF—contributing factors

CFOF—clear field of fire

CMD—countermeasures dispenser

comm—communication

CRC—Control Reporting Center

CRM—cockpit resource management

C/S—call sign

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)

FENCE—fire control, **e**mitters, **N**AVAIDs, **c**ommunications, and **e**lectronic countermeasures (as in FENCE check)

FOV—field of view

FPM—flightpath marker

FPS—feet per second

GCI—ground control intercept

GE-min rel—gross error-minimum release

GLOC—G-induced loss of consciousness

HABFM—high aspect basic fighter maneuvers

HAGS—high-angle guns to separation

HAS—high-angle strafe

HCA—heading crossing angle

HOTAS—hands on throttle and stick

HSI—horizontal situation indicator

HUD—heads up display

IAA—initial AIM off angle

IAW—in accordance with

ID—identification

IF—instructional fixes

IFF—identification, friend or foe

IMC—instrument meteorological conditions

IP—instructor pilot, initial point

IR—instrument route

IPP—initial pipper placement

ITP—initial target placement

JTAC—joint terminal attack controllers

KCAS—knots calibrated airspeed

KIAS—knots indicated airspeed

KIO—knock-it-off

LAB—line abreast

LAS—low-angle strafe

LL—lessons learned

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

NOTAM—notice to airman

OBFM—offensive basic flight maneuver

OOP—out of plane

Pk—probability of kill

PIO—pilot induced oscillation

POM—plane of motion

Ps—power

PTP—points to ponder

PUP—popup procedure

RALT—radar altimeter

RCO—range control officer

repo—reposition

ROE—rules of engagement

ROT—rule of thumb

RTB—return to base

RWR—radar warning receiver

SA—situational awareness

SAT—surface attack tactics

SEM—safe escape maneuver

SRB—single-rate beeper

SSO—single-side offset

TACAN—tactical air navigation

TACS—Theater Air Control System

TC—turn circle

TCAS—traffic collision avoidance system

TCX—turn circle extension

TD—tighten down

TGT—target

TMLT—training maneuver – level turn

T.O.—technical order

TOF—time of flight

TR—turning room

TST—track - shoot - track

UFCP—up front control panel

UHF—ultra high frequency

VHF—very high frequency

VC—closure velocity

VID—visual identification

VMC—visual meteorological conditions

VMS—visual mutual support

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 (for example, changing the bingo fuel with a change in the alternate). With an admin lead change, the call signs 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.

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.

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 call signs do not change.

Terminate—Training term used to stop maneuvers in progress for nonsafety 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 (for example, call signs or flight composition) or cluttering the frequency.