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Flying Operations

T-6 PRIMARY FLYING

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This instruction implements AFPD 11-2, *Aircraft Rules and Procedures,* and supports AFI 11-202, Volume 3, *General Flight Rules***.** Along with local procedures, this instruction prescribes standard procedures to be used by all aircrew operating Air Force T-6 aircraft. The MAJCOM/A3 is waiver authority for this instruction unless specified elsewhere. File a copy of all approved waivers with this instruction. This AFI applies to all Regular Air Force and Air Force Reserve Command pilots and all Air National Guard associate instructor pilots flying the T-6A. **Attachment 1** contains a glossary of references and supporting information used in this publication.

Forward unit supplements to HQ AETC/A3V for coordination prior to publication. Submit suggested improvements to this publication via AF Form 847, Recommendation for Change of Publication, through command Stan/Eval channels to AETC/A3VO.

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Chapter 1

GENERAL INFORMATION

1.1. General.

1.1.1. This manual provides the necessary procedures to safely and effectively employ the T-6. It provides the basis for development of the necessary physical skills and mental aptitude required to fly the aircraft. The skills developed in the T-6 are applicable to flying any military aircraft and provide the foundation for all follow-on flying training.

1.1.2. TO 1T-6A-1 contains detailed instructions for inspections, checks, and procedures. It also provides detailed information on aircraft systems and systems operation. The TO and this publication complement each other.

1.2. Using This Manual. In general, this manual is organized in an order that parallels the training flow in pilot training. The first five chapters cover topics applicable to every sortie, and the second five chapters cover topics by category of flight. While each chapter builds on skills and concepts introduced in previous chapters, the initial phase of training requires mastery of all concepts and skills introduced in **chapters 1** through 6. During subsequent stages of training, study centers on specific category chapters. Regular review of previous material is required.

1.3. Introduction. The concepts in **Chapter 1** apply to every kind of sortie flown in the T-6, and many are universally applicable to flight in every type of military aircraft. Full understanding of these general concepts is developed through study and flying experience; therefore, regular review of this chapter is required.

1.4. Safety. Safety is a critical component of successful mission accomplishment on every sortie. The safety mindset of each crew member is a key part in the overall safety of any flying operation. Each individual is responsible for minimizing risk to the people and assets under his or her control and identifying potential safety hazards.

1.4.1. **Ground Safety.** The flight line is an extremely busy environment. Moving aircraft, support equipment, and emergency vehicles create a hazardous environment. Extra diligence is required to prevent a tragic event.

1.4.1.1. Stay clear of the aircraft danger areas as depicted in TO 1T-6A-1, Section 2 (prop areas and/or the jet exhaust of running aircraft).

1.4.1.2. Secure loose items prior to entering the flight line to prevent foreign object damage (FOD).

1.4.1.3. Maintain constant watch for moving vehicles.

1.4.2. **Flying Safety.** Once airborne, safety assumes a more dynamic character. For example, a converging aircraft may unexpectedly appear, or a malfunction can cause distractions during a critical phase of flight. Safe operation requires an aggressive disposition toward gaining and maintaining situational awareness (SA). According to AFI 11-290, *Cockpit/Crew Resource Management Training Program*, SA is an “aircrew member’s 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 upon that perception." Methods to maintain SA include:

1.4.2.1. Clearing the airspace.

1.4.2.2. Monitoring aircraft systems.

1.4.2.3. Establishing and maintaining an emergency recovery plan before an emergency occurs.

1.5. Flight Discipline. Flight discipline is at the core of every flying operation. Maintaining the highest standards of integrity, professional military pilots must adhere to the spirit and intent of governing guidelines while executing the mission in the presence of temptation to do otherwise.

1.5.1. Flight discipline begins with mission preparation. Know the rules and procedures, study the profile, ensure crew rest requirements are met, and show up prepared to fly. One unprepared crewmember can jeopardize the mission.

1.5.2. Flight discipline continues with the briefing. Be on time, be ready to discuss the mission, and (or) be ready to brief. Ensure all questions are answered and mission requirements are understood.

1.5.3. Flight discipline is demonstrated in the air by executing the mission as briefed according to governing guidelines, from engine start to engine shutdown.

1.5.4. Flight discipline should be evaluated and specifically addressed during every mission debrief.

1.6. Checklist Discipline. TO 1T-6A-1CL, *The Pilot's Abbreviated Flight Crew Checklist,* is a condensed version of TO 1T-6A-1. The omission of a checklist item could lead to a dangerous situation. Therefore, positively confirm completion of all checklists regardless of how they are accomplished (for example, memory aid, mnemonic, approved unit-developed checklist [UDC] or flight crew checklist). One technique to ensure accomplishment of every step is to execute a few items from memory; then reference the checklist page to verify completion. Further guidance on checklist use follows:

1.6.1. UDCs may be published to further condense many of the checklists used during ground and flight operations. UDCs often include multiple checklists on a single sheet that can be conveniently referenced without having to manipulate the flight crew checklist. UDCs are commonly color coded for easy identification of steps that need to be highlighted for easy reference.

1.6.2. It is not necessary to refer to the checklist during critical phases of flight.

1.6.3. There will be only one pilot actively controlling the aircraft at any point in time. This pilot is referred to in the rest of this manual as the pilot flying (PF). The PF is responsible for completion of all checklists.

1.6.4. Checklist items marked "(BOTH)" must be completed in both the front cockpit (FCP) and rear cockpit (RCP) (if occupied). The PF will initiate a "(BOTH)" checklist item by challenging the pilot not flying (PNF). A "(BOTH)" item is not complete until a proper response is received from the PNF. The use of this method of accomplishment is why "(BOTH)" items are often referred to as "challenge and response" items.

1.6.5. Once started, attempt to complete checklists without interruption. If interrupted, or if it is discovered that an item was omitted, good techniques to get back on track include restarting at the first step of the checklist or restarting two to three steps prior to the missed or interrupted checklist step. Do not start a new checklist until completing the previous one.

1.6.6. Throughout your flying career many checklists and required items are memorized through mnemonics or standardized phrases. The purposes of these are to help you remember what needs to be done at a specific time. One caution is that you do not give lip service to performing a checklist when using a standardized phrase or mnemonic. You must perform the checklist item or required check.

1.7. Single-engine Mentality. The T-6 engine has an excellent record of reliability, but the potential for engine loss deserves special consideration. Two options exist for engine failure: ejection or recovery to a suitable airfield. Emergency landing pattern (ELP) practice increases the chances of successful recovery; however, the aircraft is fitted with a highly capable and proven ejection seat that should be used if there is any doubt about safe recovery. Special single-engine considerations include:

1.7.1. Maintain extra vigilance and a conservative response to unusual engine indications. With unusual engine indications, recover to a suitable airfield.

1.7.2. Maintain awareness of nearest suitable emergency airfields during all phases of flight.

1.7.3. Do not shut down the engine in flight if it is producing useable thrust unless it is confirmed to be on fire or is vibrating excessively with indications of impending failure.

1.7.4. Set a minimum ejection altitude when immediate ejection is not warranted. This altitude is based on energy level (altitude and airspeed), configuration, and position relative to a suitable emergency airfield.

1.7.5. Determine if engine restarts should be attempted. Consider the time delay and altitude lost between restart initiation and usable torque, the risk of fire, the presence of FOD and whether or not the engine is seized. (Often referred to as “fire, FOD, or frozen”.)

1.8. Cockpit/Crew Resource Management (CRM).

1.8.1. The following topics are covered in detail in AFI 11-290; however, a simplified explanation of the concepts is sufficient for the early stages of flying training. The CRM program is designed to develop aircrew skills in recognizing and responding to the conditions that lead to aircrew error. While flying, CRM is the effective use of all available resources to safely and efficiently accomplish mission objectives. CRM centers on the following six skills:

1.8.1.1. **Communication.** Communication is the sharing of information with others to cause action. Communications may direct, inform, question, or persuade.

1.8.1.2. **Crew/Flight Coordination.** Proper coordination includes crew/flight integrity and wingman consideration. Crew/Flight integrity requires the utilization of all members of a flight to accomplish the mission. Wingman consideration requires flight members to recognize each other’s limitations and plan or act accordingly.

1.8.1.3. **Mission Analysis.** Includes pre-mission analysis and planning, briefing, and post mission debrief.

1.8.1.4. **Risk Management.** Logic-based, common sense approach to decision making is based on human, material, and environmental factors. The goal is to match risk to the mission, not completely eliminate risk.

1.8.1.5. **Situational Awareness.** SA is the continuous perception of self and aircraft in relation to the dynamic environment of flight, threats, and mission. It also includes the ability to forecast, then execute tasks based upon that perception.

1.8.1.6. **Task Management.** Task management is the ability to establish priorities and alter a course of action based on new information. It includes management of automation, effective use of available resources, checklist discipline, and compliance with standard operating procedures.

1.8.2. CRM is designed to focus aircrew members on agencies, procedures, and resources available to enable mission success. To do this, locally developed CRM checklists describe behaviors to reinforce and others to avoid. A CRM topic will be included in the mission brief; it should be tailored to specific mission requirements or conditions; and it will be evaluated during the debrief.

1.9. Risk Management. Flying has inherent risks. RM is the process used to identify and reduce the risks of flying to an acceptable level. Locally developed RM processes balance training benefit and risk. Risk can often be minimized by mission changes that do not negatively impact training. Typical RM assessments include analysis in the following general categories:

1.9.1. Environmental conditions (for example, weather, bird status, index of thermal stress).

1.9.2. Mission profile (for example, formation, visual flight rules (VFR), low level, use of uncontrolled airfields).

1.9.3. Pilot factors (for example, experience level, fatigue, currency).

1.10. Mission Preparation. Mission success is directly related to mission preparation. Flying time is limited and solid preparation maximizes the effectiveness of limited airborne time. Mission preparation consists of the following four areas:

1.10.1. **General Study.** Study in general areas builds a foundation of knowledge for pilot training, other formal training courses, and operational missions. Some topics such as the flight manual are aircraft specific and other topics such as local area procedures are location specific. Areas of study including instrument rules and procedures (AFMAN 11-217, Volumes 1 and 2, *Instrument Flight Procedures*, and AFI 11-202, Volume 3), weather, aerodynamics, flight information publications (FLIP), and navigation, are generic because they apply to any aircraft, at any location, flying any type of mission. General study is a continuous process that is an integral part of a successful career in military aviation.

1.10.2. **Mission Selection.** Preparation can be focused only after a specific mission is identified. In formal training courses, a syllabus normally determines missions. However, in many cases, syllabi provide a basic framework, and missions are tailored to individual training needs and requirements by reviewing the student grade book or training folder. In the formal pilot training environment, mission selection consists of objective setting and then profile selection. Objectives focus training to specific areas that must be accomplished to make the mission successful. The profile is the exact list of maneuvers performed on a particular sortie. Consider the following when setting objectives:

1.10.2.1. The overall mission objective should give the big picture. What must occur for the sortie to be successful? These objectives are usually pulled from the syllabus in a formal training course.

1.10.2.2. Training objectives are specific and help determine success in relation to the syllabus, course training standards, continuation training requirements, etc. A valid objective is realistic, achievable, and measurable.

1.10.3. **Mission-specific Study.** Study in areas specifically related to the mission. This includes general study areas that are specifically related to the mission (for example, study of AFMAN 11-217, Volume 1, before an instrument training sortie). Mission-specific areas include, but are not limited to, operational restrictions (for type of sortie), initial approach plate (IAP) review, local area procedures (for that sortie), maneuver review, and daily study topics (for example, emergency procedure [EP] of the day).

1.10.3.1. **Chair-flying.** Specific study also includes chair-flying. This is an in-depth, mental rehearsal of the sortie. It is visualization of specific maneuvers and techniques, and mental review of checklists and specific tasks. Review individual maneuvers, in appropriate sections of the flight manual and this manual, before each sortie. Study should focus on the primary mission, but some time must be devoted to possible alternate missions.

1.10.3.1.1. To properly chair-fly, visualize each aspect of the sortie. When initially learning to fly, this should include all aspects of the mission to include preflight planning, stepping, pre-flighting life support equipment, ground operations, etc. Step through each phase of flight in sequence and visualize each action, switch position, and radio call. As you progress through the sortie in this manner, you will identify points during the sortie which require additional study. As experience is gained, chair-flying may only include new events or maneuvers, task intensive phases of flight, or events which have not been recently practiced. Though time consuming, properly chair-flying each sortie will pay dividends as training progresses and throughout your flying career.

1.10.4. **Mission Analysis.** The previous facets of mission preparation generally prepare the pilot for the mission, but there are tasks that must be accomplished to execute the specific mission on a specific day. Mission analysis includes all the tasks that turn the plan into reality. The following list includes many of the mission analysis steps:

1.10.4.1. Check notices to airmen (NOTAM), weather, and operations (ops) notes.

1.10.4.2. Sign off go/no-go (items that must be accomplished before flying).

1.10.4.2.1. Review flight crew information file (FCIF).

1.10.4.2.2. Review squadron or pilot read files.

1.10.4.3. Attend mass brief (some formal programs brief the entire class before individual mission briefings occur).

1.10.4.4. Check aircraft sign out data, local profile, call sign, etc.

1.10.4.5. Schedule or reserve airspace (limited special use airspace, low-level military training route [MTR], etc.).

1.10.4.6. Check bird hazard models.

1.10.4.7. Call destination if flying to an airfield other than the home airfield.

1.10.4.8. Review local restrictions (ramp freeze, construction, etc.).

1.10.4.9. Prepare briefing (briefing board, EP of the day, etc.).

1.10.4.10. Compute takeoff and landing data (TOLD).

1.10.4.11. Compute or check weight and balance.

1.10.4.12. Plan fuel, select route, file a flight plan.

1.11. Fuel Considerations. Unlike many operational and training aircraft, the T-6 is not fuel limited on most training sorties. Generally, syllabus directives, not available fuel, determine the duration of most sorties; however, regular fuel checks are still required and are an important part of each mission.

1.11.1. Bingo, joker, and normal recovery fuels are defined in AFI 11-2T-6, Volume 3, *T-6 Operations Procedures.*

1.11.2. AFI 11-202, Volume 3, defines fuel requirements for all sorties.

1.11.3. Bingo fuel is briefed on every mission. Joker fuel is briefed and set at preplanned transition points in the sortie, if applicable. A mission may require several joker fuels or none at all.

1.11.4. If bingo fuel is reached, recovery should be initiated to arrive at the intended destination with required fuel reserves. On most T-6 syllabus training sorties, recovery is normally initiated prior to reaching bingo fuel due to sortie duration limitations.

1.11.5. Mission priorities and flight conditions may change while airborne (for example, area assignment, weather conditions, alternate airfield requirements, etc.). The aircraft commander (AC) of a single-ship mission or the flight lead (FL) of a formation may adjust joker and (or) bingo fuels during flight to accommodate mission conditions.

1.12. Mission Briefing. The AC or FL may or may not be the actual briefer, but in every case will ensure that each mission is thoroughly briefed and debriefed.

1.12.1. Briefings set the tone for all missions. All crewmembers will be on time, prepared, and in possession of all required material and information. Complete all preflight administrative tasks (such as checking the weather and the NOTAMs) before the briefing.

1.12.2. As a minimum, locally established briefing guides will cover all required items. Discuss formal special interest items during all briefings.

1.12.3. Other crewmembers or formation members will be prepared to assist the AC or FL.

1.12.4. The briefing should focus on how to successfully accomplish the established objectives.

1.13. Debrief. The purpose of the debrief is to determine if mission objectives were achieved. From both administrative and tactical perspectives, the AC should:

1.13.1. Cover what went right or wrong, root causes of errors, and how to improve subsequent missions.

1.13.2. Address all questions, concerns, and address disagreements.

1.13.3. Debrief by objective, examining how well each objective was achieved.

1.13.4. Summarize the mission with emphasis on major learning points and considerations for improvement of deficient areas on future missions.

1.14. Tandem Seat Challenges. Limited visibility of the crewmember in the other cockpit makes it difficult to judge intentions, anticipate actions, and verify aircraft systems configuration. Verbal communication must compensate for the lack of intercockpit visibility. Most functions are controllable from either cockpit; however, some items can only be manipulated or directly checked in the front cockpit. To reduce the potential adverse impact of tandem seating:

1.14.1. Know which systems are controlled from the FCP or RCP, and how to monitor systems which can only be monitored or controlled from the opposite cockpit through verbal or visual coordination:

1.14.1.1. Activation of the auxiliary battery - FCP.

1.14.1.2. Manual fuel balance left/right (L/R) switch - FCP.

1.14.1.3. Environmental control system controls - FCP.

1.14.1.4. Parking brake position - FCP.

1.14.1.5. Emergency gear extension - FCP.

1.14.1.6. Power Management Unit (PMU)- FCP.

1.14.1.7. Firewall Shutoff Handle – FCP.

1.14.1.8. Gust Lock – FCP.

1.14.1.9. Interseat sequencing system (ISS) - RCP.

1.14.1.10. Interphone Hot/Cold mic switch – RCP.

1.14.2. Know which systems, although controlled from the FCP, can be checked from the RCP and how:

1.14.2.1. Check bleed air inflow by pressing the G-suit test button.

1.14.2.2. Confirm on board oxygen-generating system (OBOGS) is operating by momentarily turning off supply lever.

1.14.2.3. Confirm defog operation by sound or temperature of the defog outlet valves along the canopy rail.

1.14.2.4. Confirm external light operation (on the ground) by looking for reflections from adjacent aircraft or other surfaces.

1.14.3. Consider FCP pilot landing if RCP visibility is severely compromised.

1.14.4. Ensure all crewmembers thoroughly understand transfer of aircraft and (or) systems control.

1.15. Transfer of Aircraft and Systems Control. Only one pilot at a time can fly the aircraft. It is vital for flight safety to clearly establish who is the PF and who is the PNF as fatal accidents have occurred when two pilots attempted to fly the aircraft simultaneously. The PF is responsible for checklist completion and systems operation; however, the PF may task the PNF to operate systems. Due to the importance of proper transfer of aircraft control, the following rules apply:

1.15.1. Transfer of aircraft control:

1.15.1.1. The PF relinquishing control says, “You have the aircraft.”

1.15.1.2. The PNF assumes control and says, “I have the aircraft,” and noticeably shakes the control stick.

1.15.1.3. The order may be reversed as the AC always retains the authority to take aircraft control when required. The order of transfer is less important than each crewmember executing his or her role according to the procedures listed.

1.15.1.4. If the AC, as the PNF, says “I have the aircraft” and noticeably shakes the control stick, the PF must immediately relinquish control of the aircraft, and say “You have the aircraft.” This is an example of how the order is reversed, but the roles continue to be executed.

1.15.1.5. Using the exact words is critical to establish proper habit patterns that enhance swift, unambiguous transfer of aircraft control. Do not use other words such as “it” or “jet” in lieu of the term “aircraft” as they can be misunderstood, misheard, and create confusion.

1.15.2. In the event of intercom failure, the PF signals the desire to relinquish aircraft control by smoothly pushing the rudder pedals in a back-and-forth motion, and the PNF assumes control by vigorously shaking the control stick. The pilot relinquishing control raises both hands in the air for the other pilot to see either directly from the RCP or using mirrors from the FCP.

1.15.3. Never relinquish control of the aircraft until the other pilot has positively assumed control of the aircraft (shaken the control stick).

1.15.4. Do not hesitate to relinquish control when directed by the AC.

1.15.5. Immediately query the other crewmember in case of confusion.

1.15.6. The tandem seating setup of T-6 systems can be confusing if not managed properly. It is crucial to coordinate systems use to avoid inadvertent inputs. Systems that require crew coordination include: canopy, radio management unit (RMU), global positioning system (GPS), and electronic flight instrument system (EFIS) configuration. The PF controls all of the systems of the aircraft unless a transfer of that system has been clearly communicated between the crewmembers. The PNF should also communicate when transferring control of the system back to the PF.

1.16. Clearing. Each crewmember is responsible for collision avoidance regardless of rank, experience, or cockpit position, whether operating under instrument flight rules (IFR) or VFR. The three primary tools for clearing in the T-6 are eyes, radios, and the Traffic Advisory System (TAS). In addition, air traffic control (ATC) *shares* aircraft separation responsibility with the pilot and provides separation between IFR and participating VFR aircraft operating in controlled airspace. Pilots have the responsibility to clear the aircraft in all directions, and although the use of radar monitoring, assigned areas, or ATC separation can assist in ensuring clearance, it does not relieve pilots of the responsibility. The following principles apply to clearing regardless of flight conditions:

1.16.1. Visual detection is the most important factor in clearing for other aircraft. The following methods can help the pilot see other aircraft:

1.16.1.1. **Visual Scanning.** Search an area with an arc of approximately 20-30 degrees at a time and focus on a distant point (cloud, ground reference, etc.) within the arc for 3-5 seconds. After cross-checking instruments in the cockpit, it is necessary to refocus on a distant point because the eye will naturally focus at a distance of about 18 inches.

1.16.1.2. **Heading Changes.** When on a collision course, another aircraft appears stationary in the canopy and is difficult to see. The eye most readily detects line of sight (LOS) motion. Slight heading changes can create the relative movement required for detection of the other aircraft. This method is most effective when ATC or TAS provides traffic alerts for aircraft that are not acquired visually.

1.16.1.3. **Wing Flashes.** When an aircraft is known to be close but not visually acquired, a wing flash or rock can create the necessary movement for detection.

1.16.1.4. **Radios and TAS.** Position reports and TAS range or position information can help narrow visual clearing efforts to specific quadrants. Prioritize but do not channelize as the accuracy of the information provided can vary depending on specific conditions and capabilities. Knowledge of local area traffic can also cue crewmembers to the most likely areas of potential conflict.

1.16.2. If the PNF sees a hazard, point it out to the PF, indicate left or right, a clock position, and relationship to the horizon (high, level, or low). For example, “traffic, right 2 o’clock low, 2 miles, tracking right to left.” See **Figure 1.1, Figure 1.2, and Figure 1.3** for canopy code references.

Figure 1.1. Clock Positions.

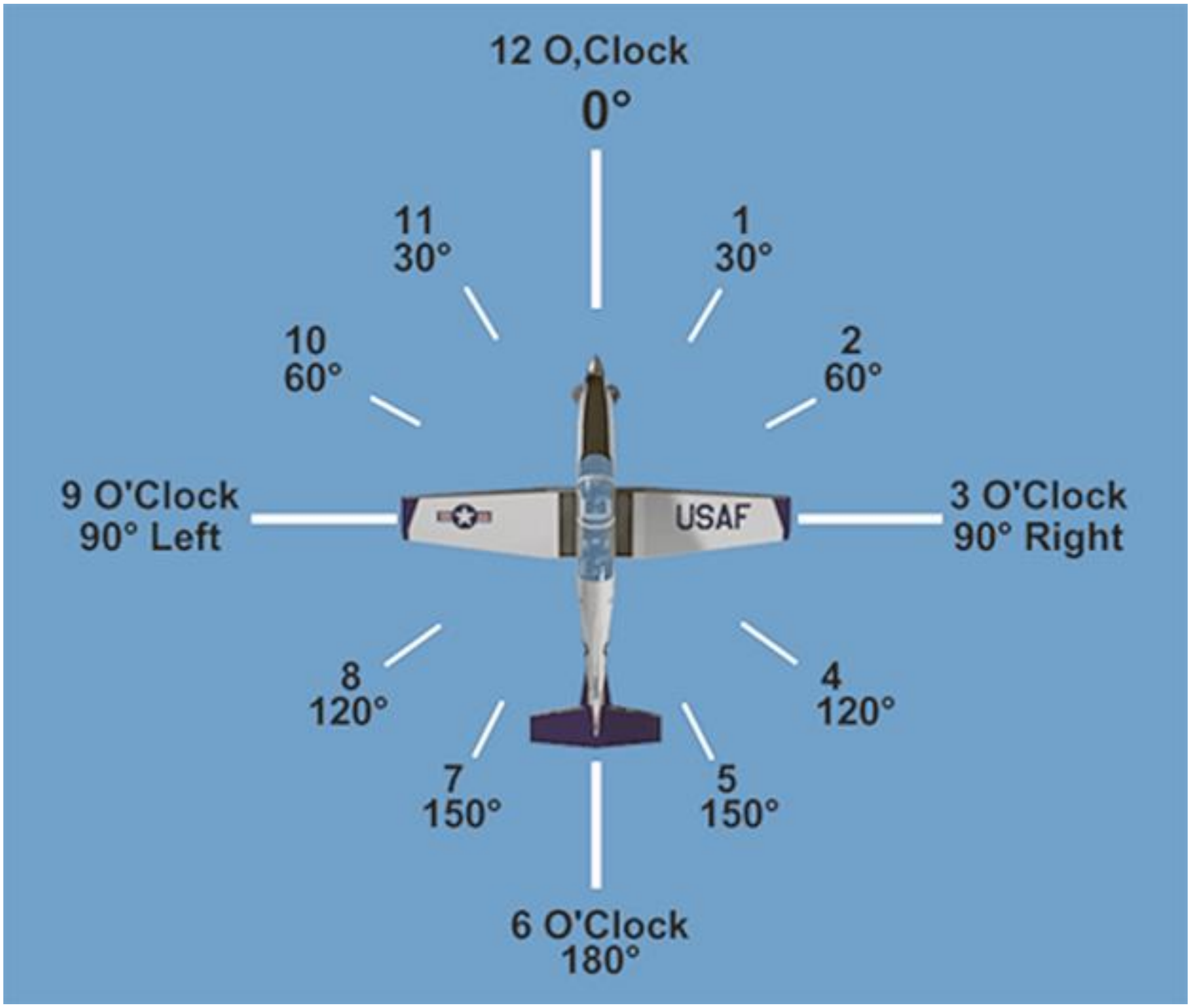
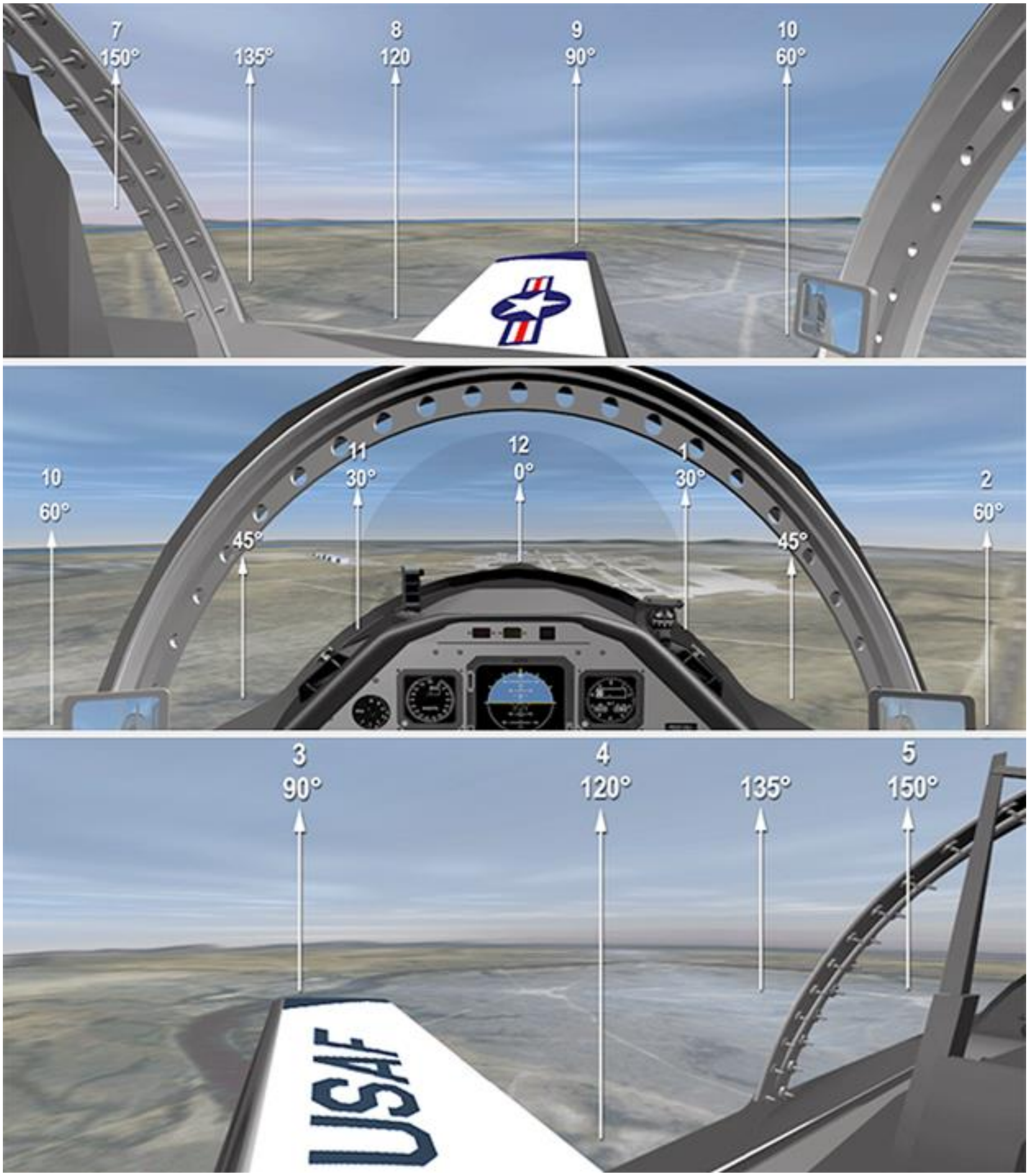


Figure 1.2. FCP Canopy Code, Elevation.

Figure 1.3. FCP Canopy Code, Azimuth.



1.16.3. If time is critical and collision is imminent, the PNF should take control of the aircraft and avoid the hazard. Ensure the intended flight path is well clear of other aircraft (500 feet minimum).

1.16.4. Be aware of the restrictions to visibility created by the canopy bows.

1.16.5. Use clearing turns when warranted to clear blind spots beneath the aircraft fuselage and wings, especially in training areas. Clearing turns can consist of turns that include high bank angles or turns of approximately 90 degrees off the established heading.

1.16.6. Local traffic patterns present the greatest collision potential. To reduce risk, military and civilian traffic patterns utilize standard procedures. While visual scans are vital in this environment, pattern procedures, including proper radio calls, are the primary means of deconfliction. The following can improve clearing in the pattern:

1.16.6.1. **Knowledge of Choke Points in the Pattern.** *Military:* 90-to-initial, VFR entry, closed downwind, high-to-low key, and the perch point. *Civilian:* pattern entry, downwind, and final.

1.16.6.2. **Proper Setting of the TAS.** Selection of a smaller range improves usability of TAS information in the pattern. Consider using the "above" function of the TAS when in a climb and the "below" function when in level flight or descent. This will increase the displayed detection envelope and thus provide better traffic awareness as compared to keeping the system in its "normal" function.

1.16.6.3. **Compliance with Mandatory Radio Transmissions.** They serve as position reports essential to pattern deconfliction. Likewise, other aircraft's radio transmissions help visually acquire aircraft in the pattern (commonly referred to as "clearing on the radios").

1.17. Radio Procedures. The PF is responsible for all radio calls. The PNF may transmit without transfer of aircraft control; however, the PF must be notified (see **paragraph 1.15.6**). **Exception:** instructors may immediately correct improper radio calls without first notifying the student. Radio procedures, definitions, and guidance are contained in the following publications: AETCI 11-204, *Runway Supervisory Unit (RSU) Operations*; AFMAN 11-217, Volume 1; FAA Aeronautical Information Manual (AIM); FLIP, *Flight Information Handbook*; and individual wing and (or) squadron instructions. Although these publications do not cover all situations, pilots should attempt to use standard phraseology as much as practical. Standard terminology minimizes radio congestion and facilitates effective communication.

1.17.1. **Clarity.** The single most important factor in pilot-controller communications is comprehension. Voicing what is required correctly through standard phraseology is paramount. Use of nonstandard and improvised phrasing, while common, only contributes to miscommunication and should be minimized. Nonstandard phraseology contributes to misunderstood clearances and aircraft mishaps. When uncertain of the meaning of standard phrases used by controlling agencies, clarify with plain language.

1.17.2. **Brevity.** Brevity is second only to clarity. Every second you are talking on the radio is a second that is unavailable to the controllers or other pilots. Provide controllers with the information needed, nothing more, nothing less, in the format expected. Likewise, do not omit needed information that may require the controller to query you for the missing information as this also wastes air time.

1.17.2.1. Do not depress the microphone button during other transmissions. Anticipate other party's replies to ATC and (or) pilot transmissions and do not interrupt. Try to avoid transmitting when another aircraft is in a critical phase of flight (for example, in the flare).

1.17.2.2. Whenever possible, format radio calls as follows: agency calling, call sign, location, and request. For example, *"San Antonio Approach, Texan 10, Area 8 low, request Auger low ILS with bravo."*

1.17.2.3. Adding verbiage that is not required clutters the radio frequency. Avoid meaningless phrases such as "with you," "checking in," "with a flash," "at this time," "be advised," on congested frequencies. Provide the controllers with the information needed simply and clearly in the format expected. Nonstandard radio calls take more time to understand.

1.17.2.4. Include all required information in calls to ATC to prevent the requirement for additional ATC queries. When making a detailed request, however, avoid confusion and frequency congestion by first getting the controller's attention (for example, *"Del Rio Approach, Texan 10, request"*). After the controller acknowledges, state the request.

1.18. GPS Usage. GPS usage is introduced early in primary training. It is used in conjunction with very high frequency omnidirectional range station (VOR) and distance measuring equipment (DME) information in a building block approach to navigation and area orientation. Using the GPS can offer a simple solution to area orientation and navigation in the early stages of training allowing the focus to be on learning to fly an Air Force aircraft.

1.19. Emergency Procedures. Three basic rules apply to all emergency procedures: (1) maintain aircraft control, (2) analyze the situation and take proper action, and (3) land as soon as conditions permit. If the aircraft cannot be recovered safely, ejection may be the only option.

1.19.1. **Maintain Aircraft Control.** In any abnormal or emergency situation it is imperative to "fly the aircraft first!" The PF flies the aircraft until the AC directs otherwise. Maintain an aircraft attitude that allows for an appropriate response to the emergency situation. Set power and trim to help maintain control. Aircraft control may include the initial turn and (or) climb to a recovery airfield. In the contact phase, this may involve a contact recovery or out-of-control flight (OCF) recovery. In low-level navigation, it may involve starting a climb to the top of the route. In formation, it may involve calling knock it off (KIO) and taking the number 1 position. A memory aid to help prioritize pilot action, that is applicable in normal and emergency situations, is, "*Aviate, Navigate, Communicate.*"

1.19.2. **Analyze the Situation and Take Proper Action.** Indications of a problem include aircraft performance, engine instrument readings, or the cockpit warning system (CWS). If dual, confirm suspect indications with the other crewmember. If the master warning/master caution light is illuminated, look at the panel before resetting the system by pushing the light to turn it off. Consider all indications when diagnosing the problem. Proper actions are dependent on the correct analysis and careful consideration of the circumstances. In many cases, the proper actions are clear, however, alternate courses of action may exist depending on the nature of the emergency, flight conditions, and pilot proficiency. Pilot actions may include:

1.19.2.1. **Critical Actions.** Boldface procedures are committed to memory and must be performed immediately to prevent aggravation of the emergency. Sufficient time may not exist to reference the checklist. After critical steps are performed, the checklist is referenced for noncritical cleanup steps. Additional noncritical checklists may be required for successful recovery.

1.19.2.2. **Noncritical Actions.** These checklist steps contribute to an orderly sequence of events and improve the chances for successful recovery. Warnings, cautions, and notes in the checklist must also be reviewed during checklist execution.

1.19.2.3. **Communication with the Supervisor of Flying (SOF), Top-3 or Operations Supervisor, or Runway Supervisory Unit (RSU) Crew.** These experts can read checklists, reference the flight manual, contact the aircraft manufacturer, check calculations, identify potential chase ships (airborne aircraft than can rejoin on a distressed aircraft to help with analysis and recovery), or offer advice on course of action and recovery plans.

1.19.2.4. **Communication with ATC.** ATC can help identify suitable recovery airfields, find required frequencies, aid navigation with vectors, alert emergency response assets, identify hazardous weather, or help find a chase ship.

1.19.2.5. **Evaluation of Possible Recovery Airfields.** The initial airfield selected may not always be the best. Changes to energy state may eliminate or expand airfield options. Additional research, once initial actions are complete, may identify a better option (based on weather, runway available, emergency response available, etc.).

1.19.2.6. **Request for Chase Ship.** Chase ships can be a tremendous asset during emergency situations. They can lead aircraft with instrument malfunctions through weather, provide assistance similar to ground-based experts, clear for task saturated emergency aircraft, or handle communications with ATC. See AFI 11-2T-6, Volume 3 for chase ship restrictions.

1.19.2.7. **Review of Approach/Landing and Post-landing Actions with Other Crewmember or Ground-based Agencies.** Crew coordination is essential for successful recovery and incident-free emergency termination. Clear communication with ground-based agencies is necessary to coordinate contingencies such as possible runway closure.

1.19.3. **Flight Manual Landing Recommendations.**

1.19.3.1. Land as soon as possible. A landing should be accomplished at the nearest suitable landing area considering severity of emergency, weather conditions, field facilities, ambient lighting, and command guidance. The TO-1T-6A-1 dictates that an emergency will be declared.

1.19.3.2. Land as soon as conditions permit (determined by nature of emergency and sound judgment).

1.19.3.3. Land as soon as practical. Emergency conditions are less urgent. The mission should be terminated; however, the degree of emergency is such that an immediate landing may not be necessary.

1.19.4. **CRM in an Emergency.** A successful conclusion to any emergency results from thorough systems knowledge, sound judgment, and effective CRM. Several resources are available to aid successful recovery.

1.19.4.1. **Inside the Cockpit.** The AC determines who flies the aircraft, based on pilot workload and the experience level and ability of both pilots. The PNF can read the checklist, monitor systems, provide advice, and maintain SA on the nearest suitable landing field. The flight crew checklist, in-flight guide, flight information handbook, or other FLIP can contain useful information.

1.19.4.2. **Outside the Cockpit.** Outside help can be essential whether dual or solo during an emergency. ATC agencies can alert emergency services and provide traffic priority. The SOF, Top-3 or operations supervisor, or RSU crew can provide assistance with checklists, recommend courses of action, and monitor the situation. A chase ship can provide inspection of aircraft areas which cannot be seen from either cockpit.

1.19.5. **Ejection.** If abandoning the aircraft becomes necessary, the AC will use the command "BAILOUT, BAILOUT, BAILOUT!" as the final directive. If time and conditions permit, discuss and accomplish ejection procedures with the other crewmember, using the term "ejection" rather than "bailout." In critical situations, do not delay an ejection waiting for the "BAILOUT" command, and do not delay an ejection once the command is given.

1.20. Tabletop and Standup EPs.

1.20.1. The purpose of tabletop EPs is to expose student pilots to as many different emergency situations as possible on the ground before they are faced with actually handling one while airborne. Standup EPs provide the same exposure; however, they have the added pressure of performing while people are watching over your decisions. This added pressure simulates the stress of an actual airborne emergency.

1.20.2. The objective of tabletop and standup EPs is to exercise your knowledge and available resources to formulate and execute a plan to get you safely on the ground. All the same principles outlined in paragraph **1.19.** apply to these practice situations.

1.20.3. Though there can be many techniques used to solve most problems, the use of the mnemonic A-A-B-C-D-E-F (**Figure 1.4.**) will help put the basic EP principles into logical steps.

1.20.3.1. **A —Aircraft Control.** ***"****Maintain aircraft control"* dictates that you continue to fly the aircraft and get to a stable flight condition that allows you time to analyze the situation. In the contact phase, this may involve a contact recovery or out-of-control flight (OCF) recovery. In low-level navigation, it may involve starting a climb to the top of the route. In formation, it may involve calling knock it off (KIO) and taking the number 1 position. During this step, describe how you will use the control stick, rudder, and power control level (PCL) to achieve a stabilized flight condition.

1.20.3.2. **A —Analyze the Situation.**

1.20.3.2.1. During this phase of the practice situation, time stands still because your eyes and brain work a lot faster in the aircraft than you can talk when asking questions about the status of different systems on the aircraft. At this point in time, ask your IP questions about the aircraft.

1.20.3.2.2. Acronyms can help you analyze the situation. A common one is a **FEVER** check for engine problems:

1.20.3.2.2.1. **F** stands for fluctuating fuel flow. A properly working engine, at a constant PCL setting should not have fuel flow jumping around more than 10 pounds per hour (PPH).

1.20.3.2.2.2. **E** stands for excessive interstage-turbine temperature (ITT). The PMU, if still online, should limit the ITT in range; if not, you have a problem.

1.20.3.2.2.3. **V** stands for visual signals. Smoke, flames, and oil on the windscreen are symptoms of engine problems.

1.20.3.2.2.4. **E** stands for erratic engine operations.

1.20.3.2.2.5. **R** stands for roughness. An engine making strange noises also indicate problems.

1.20.3.2.3. If at any time during *"analyze the situation"* step you realize there may be signs of an impending engine problem, perform the first four steps of the precautionary emergency landing (PEL) checklist (turn, climb, clean, check or "TCCC"). Do not allow airspeed to decrease toward a stall or spin while attempting to TCCC. Once pointed toward the nearest suitable airfield, attempt to get the aircraft on an ELP profile, and continue to analyze the situation for impending engine failure.

1.20.3.2.4. Other things to analyze during this step include, but are not limited to, avionics, lights and tones, circuit breakers, and outside aircraft structure (possibly via a chase ship). As the analysis continues, do not spend more time than necessary just to stall for time. If you think you know what is wrong with the aircraft, go with it. Remember, even though time stands still in the flight room, it does not in the aircraft.

1.20.3.3. **B —Boldface.** Once you have analyzed the situation, time resumes, and it is time to *"take the proper action"* and perform any boldface required. During this step, state the boldface steps then verbally execute them (for example, Green ring – pull [as required]. For example, "I will perform this step by pulling the green ring on the ejection seat with my left hand." Applying a boldface procedure should require you to do something with the aircraft. (For example, the engine failure during flight boldface will require you to trim the aircraft to 125 knots; the abort boldface will require you to use rudder to keep the aircraft near the centerline, etc.) Once the boldface is complete, ensure the aircraft is still under control and analyze your action. Did the boldface do what it was intended to do? (i.e., Did fuel flow go to zero? Is the firelight still illuminated? Is the fire out? Perform a post FEVER check.) After you have analyzed the situation, ask yourself if there is another boldface that applies. Engine failure during flight may lead to immediate engine start. Continue in this loop until there are no more boldface that apply.

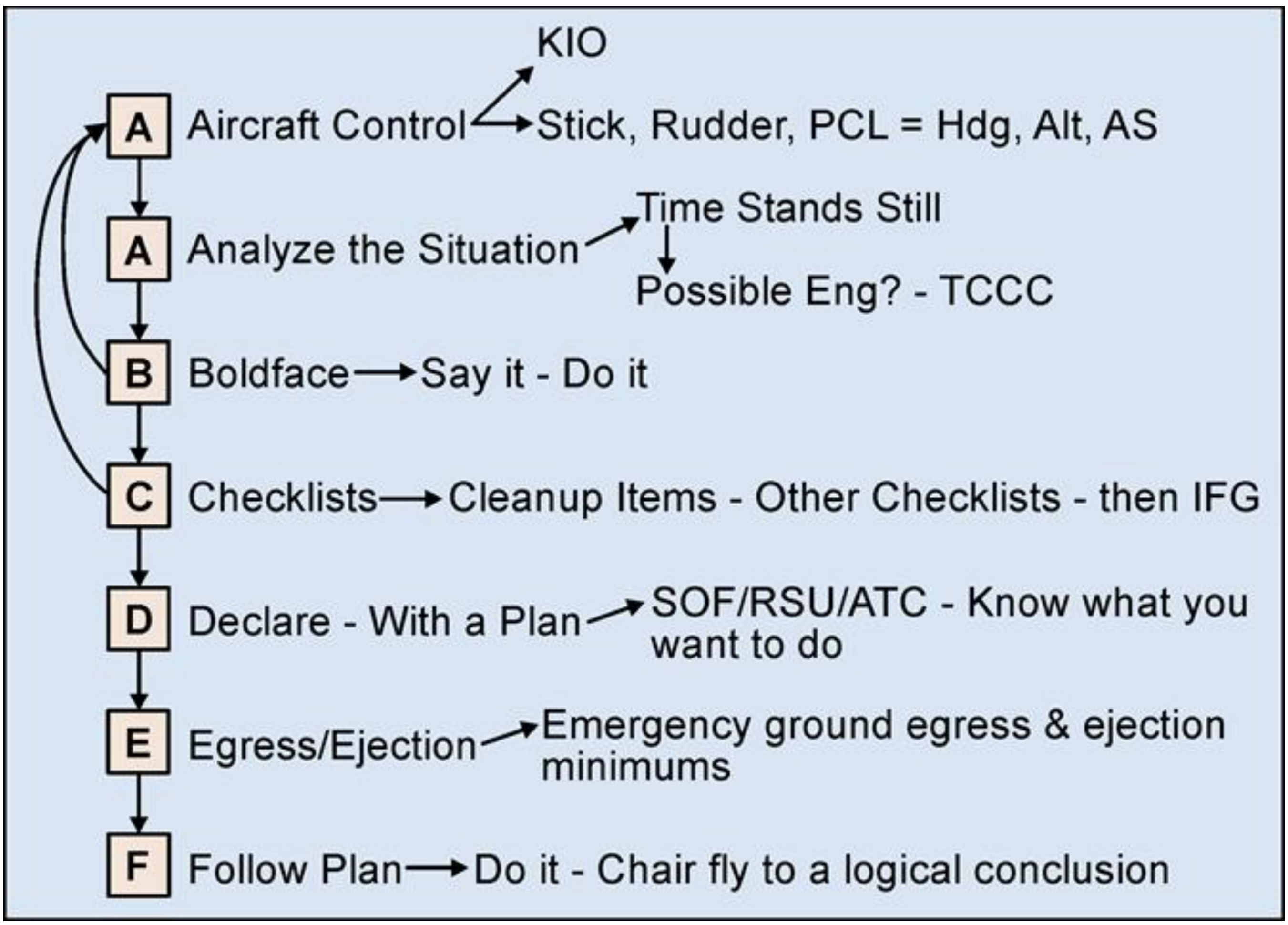
1.20.3.4. **C —Cleanup Items and (or) Checklists.** During this step, you will perform the cleanup items (the non-boldface steps) of the boldface checklists and accomplish other non-boldface checklists that may apply. Once you apply a checklist, refer back to aircraft control. Verbalize how you will use control surfaces to compensate for changes made to power settings. Continue to loop through the above steps until no more checklists are required. After all the flight manual EP checklists are performed, use the in-flight guide to help determine any other pertinent data required to recover the aircraft (for example, local no radio [NORDO] procedures).

1.20.3.5. **D —Declare, With a Plan.** Once you establish your game plan, let the appropriate authorities know what is wrong and what you plan to do. When you talk to ATC, the SOF or RSU crew, make sure you can tell them the nature of the emergency, fuel remaining (expressed in hours and minutes), souls on board, and your plan of action to include your estimated time until landing. Know what you are going to do in terms of pattern type (straight-in, ELP, overhead, instrument approach) and how you are going to stop the aircraft (stop on the runway and emergency ground egress, stop on a taxiway, or taxi back to parking). Be knowledgeable enough that you have most of the answers before the question is asked.

1.20.3.6. **E —Egress/Ejection.** Review emergency ground egress and controlled ejection checklists. Determine when you will eject if the situation deteriorates and leads to an ejection scenario.

1.20.3.7. **F —Follow the Plan.** This part of the tabletop or standup EP (land as soon as conditions permit) is where you continue to chair fly the emergency to a safe landing. In real life, this is where you execute your plan to get safely back to the flight room. During a tabletop or standup EP, talk your IP through all the steps—descent check, arrival and pattern procedures—and safely exit the airplane.

Figure 1.4. A-A-B-C-D-E-F Method of Accomplishing Practice EPs.



Chapter 2

BASIC T-6 FLIGHT PRINCIPLES

2.1. Introduction. This chapter discusses basic terms that apply to all aircraft. It explains concepts and terms associated with the T-6 as a single-engine, propeller-driven aircraft. Knowledge and understanding of these terms and their associated aerodynamic effects is essential to successfully fly the T-6.

2.2. Control Effects. Each flight control affects the attitude of the aircraft by controlling movement about one of three axes (**Figure 2.1.**). Control movements result in the same predictable aircraft responses regardless of the attitude of the aircraft. The pilot is the approximate pivot point about which all changes of attitude occur.

Figure 2.1. Control Axes.

2.3. Use of Controls. When a control surface is moved out of its streamlined position, air flowing past it exerts pressure against the control surface and tries to return it to neutral. These air forces on control surfaces are felt on the control stick and rudder pedals. Control forces are directly proportional to airspeed and control deflection and provide feedback to the pilot. This feedback, which is felt in terms of forces felt on the control stick and rudder pedals, identifies trim requirements. Air forces can impede positioning of the controls to the desired position.

2.3.1. **How to Use the Rudder.** When properly positioned, the heels of the feet rest upon the cockpit floor and the balls of the feet touch the rudder pedals, allowing full application of rudder. Rudder application should be smooth~~,~~ and commensurate with applications of power and or bank to maintain a consistent nose track. In order to optimize control feel, maintain firm but relaxed pressure on the rudder pedals.

2.3.2. **How to use the Brakes.** The feet need to be repositioned from heels on the cockpit floor to balls of the feet on the top of the rudder pedals. Smoothly press on the top of the rudder pedals with a rate similar to how you would generally apply the brakes in an automobile. Apply pressure on each individual brake pedal as required to maintain directional control.

2.3.3. **How to Use the Control Stick.** Although many maneuvers generate heavy control stick forces, a firm but light touch on the control stick optimizes control feel. Hands and arms should remain relaxed. Ideally, during cruise operations fingertips on the control stick are all that should be needed. Fingertips give the best feedback on minute changes of aircraft trim.

2.3.4. **How to Use the PCL.**

2.3.4.1. Known power settings provide a useful starting point for PCL position. Starting with power settings close to the desired setting minimizes torque and propeller effects. General power settings are listed in **Table 2.1.** These pitch and power settings are approximate, and vary from aircraft to aircraft based on factors such as aircraft weight, pressure altitude, and temperature.

Table 2.1. General T-6 Airspeeds and Power Settings.

Maneuver	**Airspeed**	**Gear**	**Flaps**	**Pitch**	**Power**	**Other**
Level flight	250	UP	UP	2° NL	93%	±1% torque per 1,000 feet
	200			0°	50% + altitude (see note)	
	150			2° NH	32%	
Takeoff	85	DOWN	TO	7-10° NH	MAX	
Tech climb	180	UP	UP	10° NH		
	160			12.5° NH		
	140			15° NH		

NOTE: Add mean sea level (MSL) altitude (for example, at 3,000 feet MSL, set 53 percent torque).

LEGEND:
NH--nose high
NL--nose low
TO--takeoff flaps

2.3.4.2. The PCL requires relatively little travel to change the power. A small movement of the PCL can result in a larger than desired power change. Because torque is computer controlled, the torque may change slightly after the PCL is set.

2.3.4.3. Proper hand placement on the PCL is critical to safe operations. Place the palm of the hand on the PCL. Never place your wrist on the PCL; there have been several instances of improper hand placement leading to contact with the finger lift while retarding the power to idle, leading to an inadvertent engine shut down.

2.3.5. **Other Devices.** Other devices controlled by the pilot that also affect aircraft handling are the flaps, landing gear, and speed brake. However, their effects, for the purposes of general aircraft handling, are incidental. Trimming sufficiently compensates for minor aerodynamic effects of these systems.

2.4. Trim.

2.4.1. There are many factors in various conditions of flight that affect the forces felt in the controls. Trim is needed to compensate for these control stick forces to prevent fatigue and increase smoothness and enable multitasking. When properly trimmed, an aircraft can and should be flown with just the fingertips on the control stick to allow slight out-of-trim conditions to be easily felt.

2.4.2. Trim tabs are small movable surfaces attached to the primary flight control surfaces (rudder and elevator) that act as levers to equalize pressure exerted on either side of the parent control surface. To equalize pressure, the rudder and elevator tabs move in opposite direction from the parent control (**Figure 2.2.**). The amount of trim tab displacement determines the magnitude of the parent surface deflection. When trimming the ailerons the entire control surface is moved to equalize the pressure.

Figure 2.2. Trim Tab Locations.

2.4.2.1. Trimming is a continuous process. When pressure on the controls is relieved and aircraft attitude is maintained, the aircraft is correctly trimmed. In the T-6, subtle power changes normally do not require large, immediate changes in control pressure. The need for trim, therefore, is evident only gradually as airspeed, power, and pitch change.

2.4.2.2. Without proper rudder trim, the aircraft flies in a slip or a skid as indicated by the turn-and-slip indicator (the ball is deflected while the needle is centered). The longitudinal axis of the aircraft is not aligned with the direction the aircraft is traveling. In effect, the aircraft is flying sideways through the air (proportional to the deflection of the ball). To correct this, first apply rudder to center the ball (while holding the turn needle centered) and then relieve pressure using rudder trim.

2.4.2.3. To correct either fore or aft control stick pressure or to maintain a stabilized attitude, use elevator trim.

2.4.2.4. To correct wing heaviness or rolling tendencies, adjust aileron trim. Note that aileron trim tabs are preset by maintenance personnel and do not adjust in flight. The aileron trim actually repositions the ailerons.

2.4.2.5. Trim in the following order: rudder, elevator, and aileron.

2.4.2.6. The trim aid device (TAD) assists rudder trim to help maintain coordinated flight during power and airspeed changes. Using engine torque, altitude, airspeed, and pitch rate, the TAD computes a desired rudder trim tab position and applies it to the rudder trim tab actuator. During large transitions of the four parameters, the TAD will lag the desired trim position requiring pilot input to ensure coordinated flight.

2.5. Coordination. No single control movement provides all the control input necessary for a successful maneuver. The various aircraft controls must be properly orchestrated and smoothly applied for coordinated flight. Rough, erratic use of any control causes the aircraft to react accordingly. Apply control pressure smoothly and evenly.

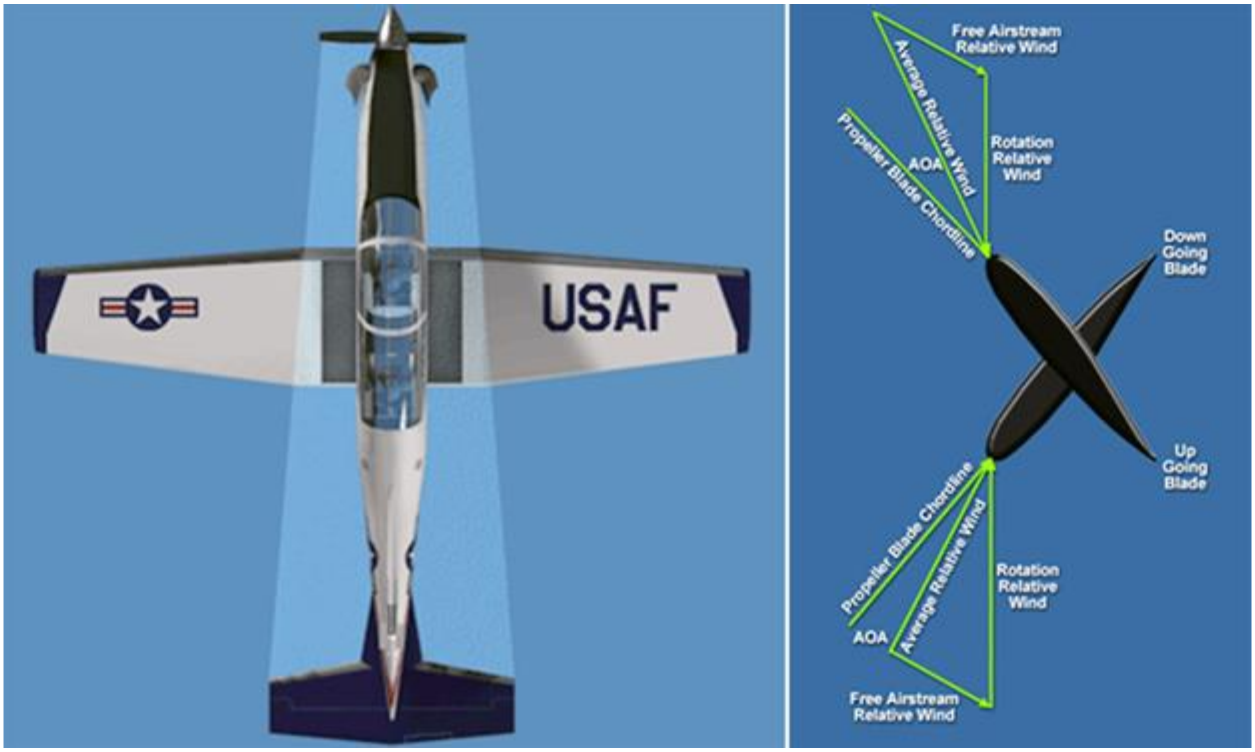
2.6. Power and Torque Effects.

2.6.1. **Slipstream Effect (Figure 2.3.).** The thrust generated by the rotation of the propeller induces a phenomenon called corkscrew slipstream effect. Specifically, the rotating prop produces a helical (or corkscrew) shaped airstream about the longitudinal axis. This slipstream strikes the wing root, fuselage, and tail surfaces with a constant high-energy force proportional to power setting and airspeed. The addition of power increases airflow over the tail surfaces and makes them more effective at slow speeds. In the T-6, the corkscrew slipstream induces a slightly higher angle of attack (AOA) on the left wing root and left tail surfaces, and slightly lowers AOA on the right wing root and right tail surfaces. This causes the aircraft to yaw to the left when power is increased, and requires right rudder input to counter the yaw and maintain coordinated flight. As the power is increased by moving the PCL forward with the left hand, the right foot must move forward to counter the yaw that is induced to the left. The amount of rudder movement is proportional to the amount and rate of PCL movement. The amount and rate of rudder movement can be determined by looking out the front of the aircraft and using the rudder to keep the nose from swinging either left (too little rudder application) or right (too much rudder application). A power reduction has the opposite effect requiring left rudder to maintain coordinated flight.

Figure 2.3. Slipstream Effect.

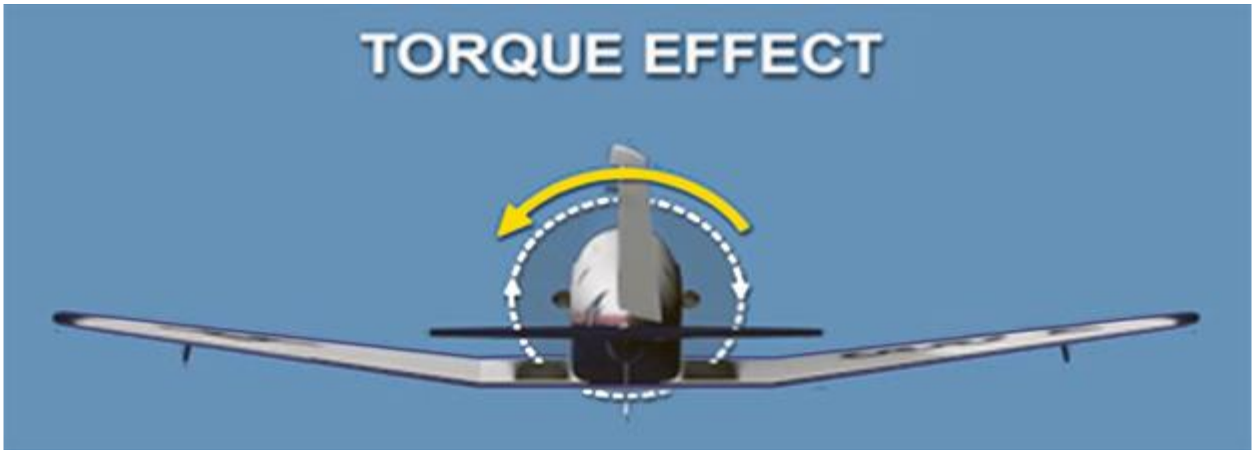
2.6.2. **P-factor (Figure 2.4).** P-factor is another effect of the propeller. It is caused by AOA being higher on the downward-moving propeller blade than on the upward-moving propeller blade. This occurs when the aircraft's thrust line is above the free airstream relative wind or at low speeds and high AOAs with power on. This moves the aerodynamic center of the propeller to the right of the shaft on a clockwise-rotating propeller causing the aircraft to yaw left as AOA or power is increased. This is why increasing right rudder is required to maintain coordinated flight as AOA is increased on the aircraft, such as in a pull-up for an over-the-top aerobatic maneuver. As the airspeed decreases and the AOA increases, the aerodynamic center of the propeller shifts to the right and right rudder is required to keep the aircraft in coordinated flight. The opposite is true when the thrust line is below the free airstream relative wind. The upward-moving propeller blade then has a higher angle of attack than the downward-moving blade. This moves the aerodynamic center of the propeller to the left of the shaft on a clockwise-rotating propeller, causing the aircraft to yaw to the right and requires left rudder to maintain coordinated flight. A right yawing situation seldom occurs since pushing over to the point of shifting the thrust line below the free airstream relative wind is rarely warranted.

Figure 2.4. P-Factor.



2.6.3. **Torque (Figure 2.5.).** Torque reaction in a propeller-driven aircraft acts opposite the direction of propeller rotation. In the case of the T-6, the aircraft tends to roll to the left as a result of torque when power is increased, and the aircraft tends to roll right when power is reduced. Rudder and the TAD are the primary means for compensating for engine torque.

Figure 2.5. Torque.



2.6.4. **Gyroscopic Effect (Figure 2.6.).** Gyroscopic reactions are called gyroscopic precession. This occurs when a force is applied to displace a spinning mass such as the propeller or, in the case of a spin, the aircraft as a whole. Gyroscopic precession causes an applied force to act in a plane 90 degrees from that in which it was applied (it is applied in the same direction as the rotation). The effect of gyroscopic precession depends on the rate of movement about the pitch or yaw axis. Increased rotation rates tend to increase the effect. This explains why a pilot, who abruptly corrects aircraft deviations (pitch, bank, and yaw), ends up frustrated with the adverse effects of precession. The relatively large propeller on the T-6 and high revolutions per (rpm) result in more precession effect than an aircraft with a lighter, smaller propeller turning at slower rpm. Typical reactions from a clockwise-turning propeller (as viewed from the pilot's seat) include:

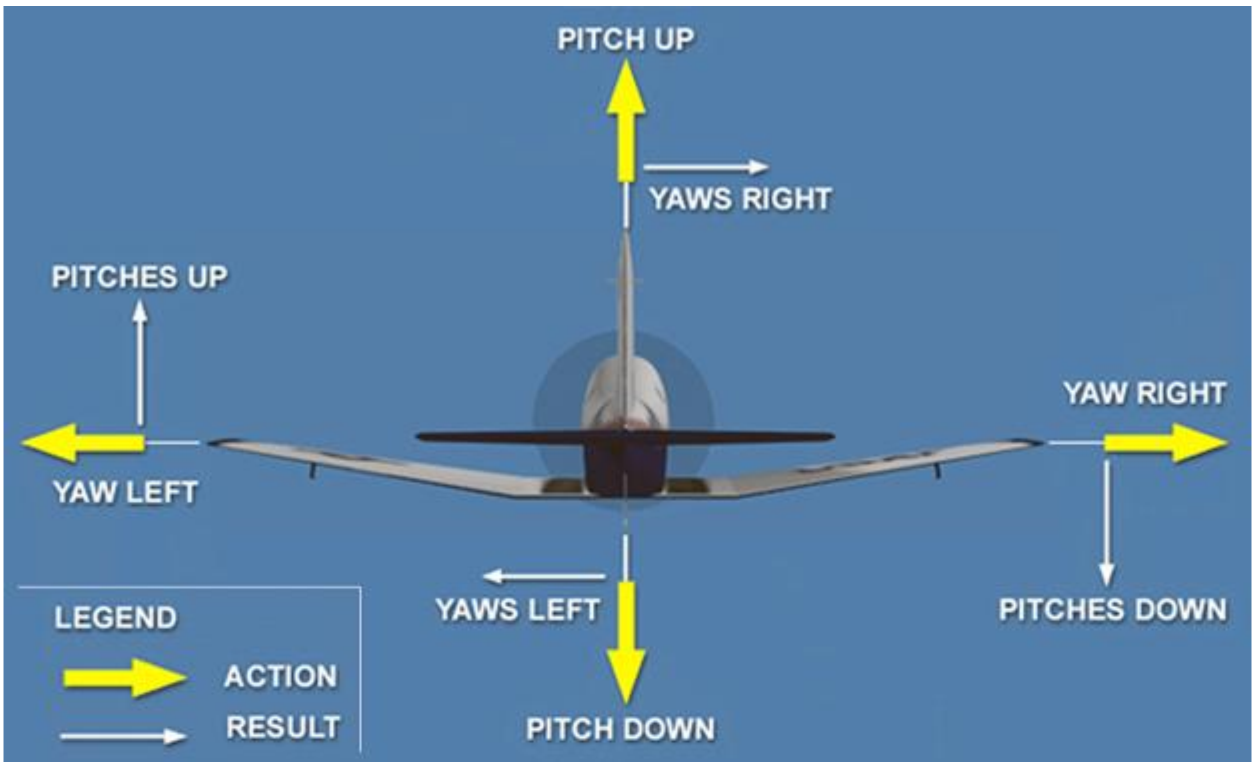
2.6.4.1. If the nose is yawed to the left, the nose tends to pitch up.

2.6.4.2. If the nose is yawed to the right, the nose tends to pitch down.

2.6.4.3. If the nose is pitched down, a left yaw tends to develop.

2.6.4.4. If the nose is pitched up, a right yaw tends to develop.

Figure 2.6. Gyroscopic Effects.



2.7. Composite Flight. Composite flight utilizes outside references, complemented by flight instruments, to establish and maintain desired flight attitudes.

2.7.1. Establish and maintain an attitude by positioning the nose and wings of the aircraft in relation to the horizon.

2.7.2. While maintaining this position, use trim to reduce or eliminate control pressures. A failure to adequately trim at this point in the cross-check will result in ineffective aircraft control. See paragraph **2.4.** for a discussion on trim technique.

2.7.3. Small changes in attitude may not be readily noticed by outside reference to the horizon but is indicated by the flight instruments. An over reliance on instrumentation to maintain aircraft attitude is a common error in composite flight and results in excessive head-down time that impedes ability to observe aircraft and other hazards.

2.7.4. Time spent looking at specific cues (horizon, flight instruments, etc) varies with flight conditions. Use the following basic rules to develop an effective cross-check:

2.7.4.1. Do not concentrate on one cue.

2.7.4.2. Clear vigilantly for other aircraft.

2.7.4.3. Check one parameter, make a correction using outside references (if available), and then check another parameter. Repeat this cycle.

2.7.4.4. A single pitch change can correct a deviation involving both altitude and airspeed. For instance, if the aircraft is 100 feet high, and approximately 5 knots slow in the traffic pattern, a minor pitch down should put the airplane close to desired parameters. This is often referred to as “trading altitude for airspeed.”

2.7.4.5. In clear flight conditions (for example, horizon clearly discernible), devote approximately 80 percent to outside references (and clearing) and 20 percent to inside references (flight instruments).

2.8. Basic Instrument Flight. As outside references deteriorate, the composite cross-check evolves into an instrument cross-check. General instrument procedures are found in AFMAN 11-217, Volume 1, and FLIP. T-6-specific guidance is found in the flight manual and **Chapter 7** of this manual.

2.9. Straight-and-level Flight (Figure 2.7.).

2.9.1. Straight-and-level flight requires familiarity with flight instruments and visual cues.

2.9.1.1. To fly in level flight, consciously fix reference points on the aircraft in relation to the horizon, and compare or cross-check this relationship with the flight instruments. In addition to outside references, refer to the electronic attitude director indicator (EADI), altimeter, and vertical speed indicator (VSI).

2.9.1.2. In straight-and-level, unaccelerated flight at 200 knots indicated airspeed (KIAS), the level flight visual pitch picture is approximately half-ground/half-sky with the wings equidistant from the horizon. At higher airspeeds, hold the nose at a lower attitude to maintain level flight; at lower airspeeds, hold the nose at a higher attitude.

Figure 2.7. Straight-and-level Flight.

NOTE: **Figure 2.7** depicts level flight at 200 KIAS (half-ground/half-sky).

2.9.1.3. Familiarity with the design, location, and purpose of flight instrumentation speeds up the composite cross-check and aids in detecting small deviations (while they are still small). Good aircraft control is a continuous succession of minor, almost imperceptible, corrections to keep the aircraft on the desired flight path.

2.9.1.4. When straight and level, trim the aircraft in all three axes. A trim change is necessary when continuous control stick or rudder pressure is required to maintain the desired attitude. Straight-and-level flight requires almost no pressure on the controls if the aircraft is properly trimmed and the air is smooth; however, when flying through turbulence, the flight attitude may change abruptly.

2.9.1.5. A properly trimmed aircraft is trimmed for a specific airspeed and power setting. It flies at the trimmed airspeed hands off, that is, with little or no force applied to the control stick or rudders. Changes to airspeed require additional trim input potentially in all three axes but predominantly in elevator and rudder (pitch and yaw) trim. For example, if the PCL is retarded to slow from 200 to 120 KIAS in level flight, the nose of the aircraft drops to seek 200 KIAS. Back stick pressure is required to maintain level flight until nose-up trim relieves the back stick pressure and left rudder will be necessary to accommodate the for the power decrease. A trimmed aircraft reduces pilot fatigue and allows the pilot to devote more attention to task management and development of SA on events occurring outside the cockpit. Large changes in airspeed in a short amount of time will require large changes in elevator trim and will require running the trim or holding the trim button forward or aft. After heavy forces are trimmed off, fine tune the trim by loosening grip on the control stick and note the direction that the nose or wings travel.

2.9.1.6. Apply trim in the opposite direction to nose or wing movement. For example, if the nose drops, apply aft elevator trim. If the aircraft rolls left, first confirm slip indicator is centered, then add right rudder trim as necessary for coordinated flight. If the slip indicator is centered and the aircraft still rolls left, apply right aileron trim.

2.9.2. A common error in straight-and-level flight is to apply force to the control stick inadvertently due to the weight of the pilot's arm. Minimize this by resting the forearm on the thigh.

2.10. Turns.

2.10.1. Turns involve coordination of all three controls: ailerons, rudder, and elevator. A shallow turn is a turn of approximately 30 degrees bank or less. A steep turn is a turn of approximately 45-60 degrees bank or greater.

2.10.1.1. Prior to turning, clear in the direction of the turn. Simultaneously apply pressure to ailerons and the rudder in the direction of the turn. The roll rate is governed by the amount and rate of pressure applied. Hold control pressure constant until at the desired angle of bank (AOB). Use outside references and the instruments to set bank angle.

2.10.1.2. As bank is introduced, a point on the windscreen directly in front of the pilot appears to pivot on the horizon. This is often referred to as the "bug" spot. To maintain level flight, the bug spot should remain on or near the horizon throughout the turn. As bank increases, increase back pressure to compensate for the loss of vertical lift (and raise the bug spot to slightly above the horizon). Dragging the TAS antenna, located just in front of the windscreen, across or slightly below the horizon (depending on seat height) is another T-6 reference commonly used to maintain a level turn. In shallow turns, the increase in pitch attitude required is small. As bank increases, the increase in pitch required is more pronounced. For steep turns, a power increase is required to maintain airspeed.

2.10.1.3. Just as in straight-and-level flight, outside references can be found in any direction. The best outside reference for measuring bank is the angle of the horizon across the windscreen. Approaching the desired AOB, return the ailerons and rudder to neutral but maintain the increased pitch attitude to maintain constant altitude.

2.10.1.4. To correct nose-low (or nose-high) attitudes in a steep turn, reduce (or increase) the AOB with coordinated aileron and rudder pressure. Simultaneously adjust back pressure to raise (or lower) the nose to the desired pitch attitude. After attaining the desired attitude, reestablish the desired AOB. Cross-check the VSI to detect nose-low or nose-high attitudes.

2.10.1.5. Rollout from a turn is much the same as the entry except control pressure is applied in the opposite direction. Apply aileron and rudder pressure in the direction of the rollout (toward the high wing). As bank decreases, release elevator pressure smoothly to maintain altitude. The bug spot should remain on the horizon. With decreasing bank, the effects of centrifugal force and loss of vertical lift are reduced.

2.10.1.6. Because the aircraft normally turns as long as there is bank, start the rollout before the desired heading. The aircraft continues to turn during the rollout until the wings return to the level position. The steeper the bank, the more lead is required to roll out on a desired heading. As a guide, during composite flight use a 10-degree lead point for turns with 45 degrees or greater bank. Use a 5-degree lead point for turns with less than 45 degrees bank.

2.10.2. Posture in the aircraft is very important. Do not constantly lean forward, backward, or side-to-side because this changes the relative position of aircraft references with respect to outside references. With a consistent position in the cockpit, outside references remain the same.

2.10.3. A precision turn consists of a constant AOB and a definite amount of turn. To make a precise 90-degree turn, align the aircraft with a road or section line on the ground, and turn perpendicular to it. In the absence of a ground reference, pick a point on the horizon directly off a wingtip.

2.10.4. A common error is to treat a steep turn differently from a shallow turn. The aerodynamic effects are more pronounced in a steep turn, but ultimately the effects are the same as in any turn. The difference between steep turns and shallow turns is the amount of back stick pressure and power needed to maintain level flight. Rapid and abrupt control inputs often result in excessive back pressure (causing a climb) or insufficient back pressure (causing a dive).

2.11. Adverse Yaw.

2.11.1. Adverse yaw is the tendency of the aircraft to yaw away from direction of aileron input. Increased lift on the up-going wing causes more induced drag, which retards forward movement of that wing. This results in the nose yawing or turning opposite the direction of the roll.

2.11.2. Adverse yaw is overcome by use of the rudder. As aileron pressure is applied, simultaneously apply rudder pressure in the same direction as the desired turn. Use rudder pressure as long as the bank is changing. The correct amount of rudder pressure depends on the aircraft speed and the amount of aileron deflection. To ensure the proper amount of rudder is used, cross-check the turn and slip indicator and attempt to keep the ball centered. "Step on the ball." This means to push on the rudder that is on the same side of centerline as the ball so as to put the ball back in the middle of the turn and slip indicator. Apply rudder and aileron pressure simultaneously, although the required amount of pressure differs depending on the amount of aileron used, airspeed, effect of drag, and design of the aircraft. Aileron drag effect is present during recovery from a turn as well as during the entry. The rudder must be used in the same direction as aileron control stick pressure to counteract adverse yaw in the rollout.

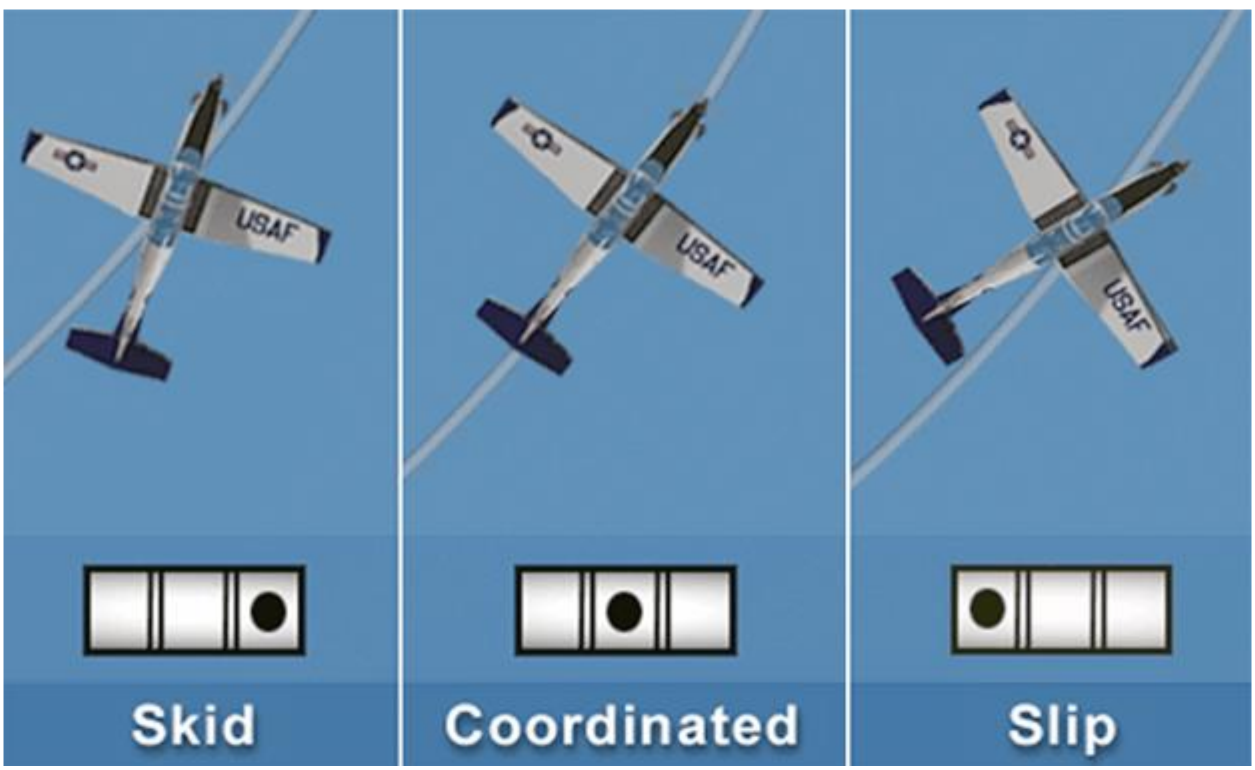
2.12. Coordinated and Uncoordinated Flight.

2.12.1. In a coordinated level turn (**Figure 2.8.**) with constant bank and airspeed, the flight path of the aircraft is a true circle (no wind). Variation in the circular flight path is also caused by uncoordinated control (improperly trimmed rudder), erratic bank, or changes in airspeed.

2.12.2. A skid is caused by insufficient bank angle in relation to the turn rate of the aircraft. Excessive bottom rudder (rudder deflection to the inside of the turn) during the turn causes a skid. A skid also occurs in level flight if the nose of the aircraft rotates sideways about the vertical axis when the wings are held level due to improper rudder input. The result is a slow turn caused by the rudder only. The turn-and-slip ball shows a slip by displacing to the outside of the turn. Skids are dangerous due to the possibility of inadvertent roll at slow airspeeds. The impending stall is known as a skidded turn stall.

2.12.3. A slip is caused by too much bank angle in relation to the turn rate of the aircraft. When in a turn, insufficient bottom rudder pressure in relation to the aileron pressure results in a slip. A slip can be induced by holding opposite rudder in a turn. Indication of a slip is when the slip indicator ball displaces to the inside of the turn. Slips are used to align the aircraft with the runway for landing during crosswind conditions. Slips are also useful for depleting excessive energy by increasing descent rates while maintaining airspeed.

Figure 2.8. Coordinated and Uncoordinated Flight.



Chapter 3

GROUND OPERATIONS

3.1. Introduction. Mastery of ground ops is an important first step toward mastery in the air.

3.2. Preflight Check. Preflight checks start before reaching the aircraft. Survey taxi routes for potential hazards such as foreign objects, repair work, stray equipment, vehicles, or personnel. Take note of fueling or other aircraft servicing that may impact preflight checks or engine start. Inform maintenance of special requirements as soon as possible (for example, oil requirements for cross-country, seat tieup for solo, position in formation, etc.).

3.2.1. **Aircraft Forms.** AFTO Forms 781, *ARMS Aircrew/Mission Flight Data Document;* 781A, *Maintenance Discrepancy and Work Document;* 781B, *Communication Security Equipment Record;* 781C, *Avionics Configuration and Load Status Document;* 781D, *Calendar and Hourly Item Inspection Document;* 781E, *Accessory Replacement Document;* 781F, *Aerospace Vehicle Flight Report and Maintenance;* 781G, *General Mission Classifications—Mission;* 781H, *Aerospace Vehicle Flight Status and Maintenance;* 781J, *Aerospace Vehicle—Engine Flight Document;* 781K, *Aerospace Vehicle Inspection, Engine Data, Calendar Inspection and Delayed Discrepancy Document;* 781L, *Record of Removal/Installation of Controlled Cryptographic Items (CCI);* 781M, *Status Symbols and Functional System Codes;* 781N, *J-9 Engine Run-up Record;* and 781P, *Support General Documentation Record*, are the official log of aircraft operation, servicing, and maintenance. *Check the forms before any aircraft inspection, other action, or checklist is initiated.* Contact maintenance to report discrepancies in the forms or for clarification. Do not accept the aircraft until the forms are accurate and there is *no question* regarding the acceptability of the aircraft.

3.2.2. **Before Exterior Inspection.** After opening the canopy, ensure that both seat pins are installed and the ISS is in solo before proceeding with the inspection. Before turning on the battery, ensure that cockpit switches are positioned properly and that the prop area is clear. After the seat is moved to the desired height, pre-adjust straps and pre-position personal equipment and publications to expedite strap-in. Take precautions when pre-positioning or stowing equipment or publications in the cockpit.

3.2.2.1. Care should be taken when moving the seat to ensure straps and oxygen hoses are not jammed between the bulkhead and seat. This can cause significant damage to the seat belt, hoses, ejection seat, or circuit breaker panel.

3.2.2.2. Do not place anything on the canopy glass to prevent damage.

3.2.2.3. Do not stow clothing or miscellaneous personal items in the cockpit. Stow personal gear not required to execute the mission in the baggage compartment. Use caution when stowing items to prevent interference with the ejection or any other system.

3.2.3. **Exterior Inspection.** Commonly referred to as a “walkaround”, this inspection is a critical part of each mission. Maintenance performs detailed inspections, and prepares the aircraft for flight; however, the pilot’s walkaround serves as a last look before flight.

3.2.3.1. The walkaround checklist begins behind the left wing and moves about the aircraft in a clockwise direction. It is not necessary to refer to the checklist for each item, but reference the checklist to ensure all items are completed.

3.2.3.2. Carefully check for fluid leaks in the wheel well, speed brake, and engine bay areas. Fluid along fairing doors, seams, and line couplings may indicate potential leaks. Check the general condition of trim tabs, hinges, and control surfaces; however, do not manhandle control surfaces. Ensure that tire condition is acceptable for the planned mission. If you are unsure about the condition or operation of any system, check with qualified maintenance personnel. The pilot in command has final authority to accept or reject an aircraft.

3.3. Seating Position in the Aircraft. Seating position should be the same on every flight. When sitting comfortably, the upper part of the EADI display should be visible just below the glare shield. A clenched fist between the top of the helmet and the canopy ensures adequate clearance for the canopy breaker during ejection. Adjust the rudder pedals to allow full travel of the rudder and associated wheel brake with the heel raised slightly off the floor. During strap-in, ensure there is enough length with minimal slack in the leg restraint lines for full rudder deflection.

3.4. Cockpit Organization. The T-6 cockpit has limited storage space, so good cockpit organization is essential. Cockpit organization varies by mission and personal preference. In-flight publications or FLIP should be readily available. It is common practice to organize them in the order in which they will be used. Large checklists or other items on the left leg may cause interference with PCL movement or cause inadvertent radio transmissions.

3.5. Interior Inspection. Ensure the prop area is clear before turning the battery on or starting/motoring the engine. Pre-solo student pilots will verbalize each item in the interior inspection checklist. During the flight controls check, it is common practice to visually confirm the neutral elevator stick position.

3.6. Engine Start.

3.6.1. Ensure the canopy fracture system (CFS) pin storage box located over the left shoulder of the pilot in the RCP is closed and the pilots' visors are down before closing the canopy.

3.6.2. During engine start, closely monitor ITT, gas generator speed (N1), and the start ready light. Occasionally glance outside to detect possible aircraft movement or signals from the crew chief.

3.6.3. If necessary to motor the engine before engine start, inform the crew chief and ensure the prop is clear. While all starts are made with the canopy closed and locked, motoring may be done with the canopy open.

3.6.4. Inform the crew chief before activating any system (engine start, speed brake, flaps, etc.) that could endanger ground personnel. When ground intercom is not used, use visual signals according to AFI 11-218, *Aircraft Operations and Movement on the Ground*, and this manual. The crew chief repeats the signal when it is safe to operate the system.

3.7. OBOGS Check. It is critical to check oxygen connections to ensure system integrity from the supply to the mask. Don the oxygen mask and verify that the supply lever is on and the concentration lever is normal. Check the mask seal by selecting EMERGENCY and momentarily holding your breath. A good mask seal is indicated by a no-flow indication on the regulator (black).

3.8. Radio Procedures. Monitor Air Terminal Information System (ATIS) before taxi. If reported conditions are significantly different than forecast, consider using actual conditions to recompute TOLD. Include ATIS identifier in taxi call, *"Texan 11, taxi with Charlie."* Listen carefully to taxi instructions. Read back the ATC clearance as required locally. In general, read back instructions if they appear to be different than standard or appear unusual.

3.9. Taxi.

3.9.1. When the before-taxi checklist is complete, clear to the front and rear; then signal the crew chief when ready to taxi IAW local procedures. Before leaving the parking area, clear for taxiing aircraft. Use caution for personnel, ground equipment, foreign objects, and sun shelters. Select nose wheel steering (NWS), release brakes, and increase power as necessary. Follow the marshaller's (if available) signals, taxi straight ahead, and check the brakes. When parked under sun shelters, slowly pull out from the shelter before checking brakes. After a successful brake check, the PF states, "My brakes check, check yours." No formal transfer of aircraft control is required for the brake check. Normally, the taxi checklist including NWS, brakes, and heading, turn, or slip indicators is completed on the first turn out of parking. Taxi no faster than 5-7 knots or a fast walk in congested areas, and always be prepared to stop.

3.9.2. To turn with NWS selected, simultaneously apply rudder in the desired direction and reduce power (normally to idle). If a sharper turn is required, deselect NWS (the nose wheel will freely caster) and use the inside brake to turn. Apply the brakes smoothly, evenly, and cautiously at all times. Differential braking with the NWS engaged could damage the nose gear.

3.9.3. Use power to keep the aircraft rolling at a moderate speed. Once the aircraft is rolling, idle power should provide sufficient thrust. Use the brakes as necessary to control taxi speed; however, do not ride the brakes. Normal taxi speed should not exceed 15 knots in uncongested areas, or IAW locally established procedures. NWS is more sensitive as taxi speed is increased.

3.9.4. Taxi on the centerline unless local procedures direct otherwise. If local procedures direct staggered taxi, align the appropriate main wheel with the taxi line. The main wheel is approximately underneath the start of the wing dihedral. The most common reference to establish this stagger is to line up an exhaust stack on the taxi line.

3.9.5. Avoid taxiing over cables to preclude aircraft damage. If a cable must be crossed, taxi as slowly as possible to prevent damage to the aircraft. Steer to avoid nose and main gear contact with cable support donuts.

3.9.6. Maintain obstacle clearance and taxi interval distance according to AFI 11-2T-6, Volume 3.

3.9.7. Prepare for takeoff and departure while taxiing in uncongested areas. Review and intercockpit briefings may include, but are not limited to, weather, winds, departure routing, navigational aid (NAVAID) setup, and takeoff emergencies. A widely used acronym is **R-NEWS**:

3.9.7.1. **R —Receiver Autonomous Integrity Monitoring (RAIM).** Check RAIM and fault detection and exclusion (FDE) on the STAT 2 page as directed in AFI 11-2T-6, Volume 3 and AFMAN 11-217, Volume 1.

3.9.7.2. **N —NAVAIDs/Needles.** Ensure electronic horizontal situation indicator (EHSI) is set for departure (including NAVAIDs, course selected, and heading set marker).

3.9.7.3. **E —Emergencies.** Review actions for abort or engine failure on takeoff. Consider emergency return options for existing conditions.

3.9.7.4. **W —Weather/Winds.** Consider weather impact on departure and emergency recovery options. Analyze effect of wind on takeoff and planned patterns, and anticipate pattern corrections. Determine direction the control stick needs to be deflected based upon crosswind component.

3.9.7.5. **S —Standard Instrument Departure (SID)/Departure Procedure (DP).** Review departure, open in-flight publications to required page.

3.10. Overspeed Governor Check. Ensure area immediately in front of and behind the aircraft is clear. During engine run-up for the overspeed governor check, the PNF guards and is ready to assume control of the brakes in case of rudder pedal rod end failure. Clear outside the aircraft during this check. If the aircraft moves, reduce power, pump up the brakes, and reattempt. Power should be advanced smoothly and slowly only as high as required to verify proper function of the overspeed governor. Keep the control stick in the neutral to slightly aft position to prevent the nose gear strut from compressing during the check.

3.11. Before Takeoff and Lineup Checks. Review TOLD. In addition to normal checklist items, it is common technique to scan the cockpit to check various items such as switch positions, systems indications, security of in-flight pubs, etc.

3.12. After Landing. Do not begin the after landing checklist until reaching normal taxi speed and clear of the active runway. Unless local procedures dictate otherwise, obtain clearance before crossing active runways and (or) proceeding back to the ramp. Stay alert and taxi with caution. Do not get complacent, the sortie is not complete until the aircraft is parked, the engine is shutdown, and all required checklist items are complete.

3.13. Full Stop and (or) Taxi Back. More than one full-stop landing may be accomplished during a mission to achieve training objectives. Anticipate a longer than normal landing roll due to higher fuel weight. Complete the full stop/taxi back checklist.

3.14. Engine Shutdown and Before Leaving Aircraft. Do not rush engine shutdown in a hurry to get out of the aircraft. However, keep ground personnel in sight and shut down immediately if the prop safety zone is violated. If there is no marked prop safety zone (for example, off station), do not hesitate to shut down if ground personnel move too close. After exiting the cockpit, perform the before leaving aircraft checklist. Ensure the ejection and CFS pins are installed, the ISS is in SOLO, the battery switch and OBOGS lever are both off, the gust lock is engaged and the parking brake is set before stepping down from the aircraft wing.

3.15. Postflight Inspection. After local sorties, ground personnel accomplish a thorough postflight inspection. However, pilots should accomplish a postflight walkaround and report any abnormalities (for example, missing panels, damaged tires, leaking fluids, bird strikes, tail strikes) to maintenance. The flight manual also contains detailed strange-field procedures that contain postflight and preflight inspections for pilots to accomplish off station if trained maintenance personnel are unavailable.

3.16. Abnormal Procedures. Malfunctions are handled according to flight manual and other applicable directives. As soon as possible, notify the controlling agency (ground or tower) if assistance is required. If maintenance or fire personnel must inspect the aircraft, set the parking brake and raise both hands (hands clear) to signal that it is clear to inspect the aircraft. Do not actuate switches without informing the ground crew.

3.16.1. Perform the emergency ground egress in a systematic, deliberate manner. When necessary to egress the aircraft due to an emergency, bring the aircraft to a complete stop and set the parking brake. Shut down the engine, ensure the ISS is in SOLO, and install both cockpit seat pins. Turn the battery and generator to OFF just before egress to preserve intercom with the other cockpit. CRM is critical to a successful ground egress.

3.16.2. If returning to parking without taking off, complete the after landing checklist to ensure all systems are appropriately set.

Chapter 4

TAKEOFF, CLIMB, AND LEVEL OFF

4.1. Introduction. This phase of flight is very dynamic and can be as complicated as any other part of the mission. Complex departure procedures may be required immediately after takeoff in the low altitude environment, and communications can be very busy leaving the terminal area. Emergency situations, when they occur in this phase of flight, require forethought and quick correct action. Solid preparation is essential to success.

4.2. Lineup Check.

4.2.1. **Objective.** Accomplish checklist items in preparation for takeoff.

4.2.2. **Description.** This check is normally accomplished while taxiing onto the active runway. The PF must ensure that all items are complete and "BOTH" items are confirmed with the PNF.

4.2.3. **Procedure.** Clear final prior to crossing the runway hold short line and accomplish the lineup check.

4.2.4. **Technique.** A common technique to remember the checklist steps is the acronym **TP PLAN**:

4.2.4.1. **T** – **TAS.** Set TAS to NORM (if applicable).

4.2.4.2. **P** —**Panel.** CWS panel shows normal lights.

4.2.4.3. **P** —**Probes.** Turn on the anti-ice probes.

4.2.4.4. **L** —**Lights.** Ensure all exterior lights are on.

4.2.4.5. **A** —**ALT.** Select the ALT mode on the transponder.

4.2.4.6. **N** —**NWS.** Deselect NWS after the aircraft is aligned with the runway.

4.3. Takeoff.

4.3.1. **Objective.** Safely get the aircraft airborne.

4.3.2. **Description.** Two takeoff options exist: static and rolling. The static takeoff is used early in training because it provides more time to accomplish required checks and verify proper engine operation. A static takeoff is also required at night and for solo students. A rolling takeoff aids traffic flow in a busy pattern and is a smooth transition from taxi to takeoff roll. Rolling takeoffs have a negligible effect on TOLD and no recalculation is required.

4.3.2.1. Airspeed – rotate at 85 KIAS no wind. Add one-half the gust up to a maximum of 10 knots with gusty winds.

4.3.2.2. Power – MAX.

4.3.2.3. Pitch – 7-10 degrees nose high at rotation.

4.3.2.4. FCP visual reference – spinner on, or slightly below the horizon.

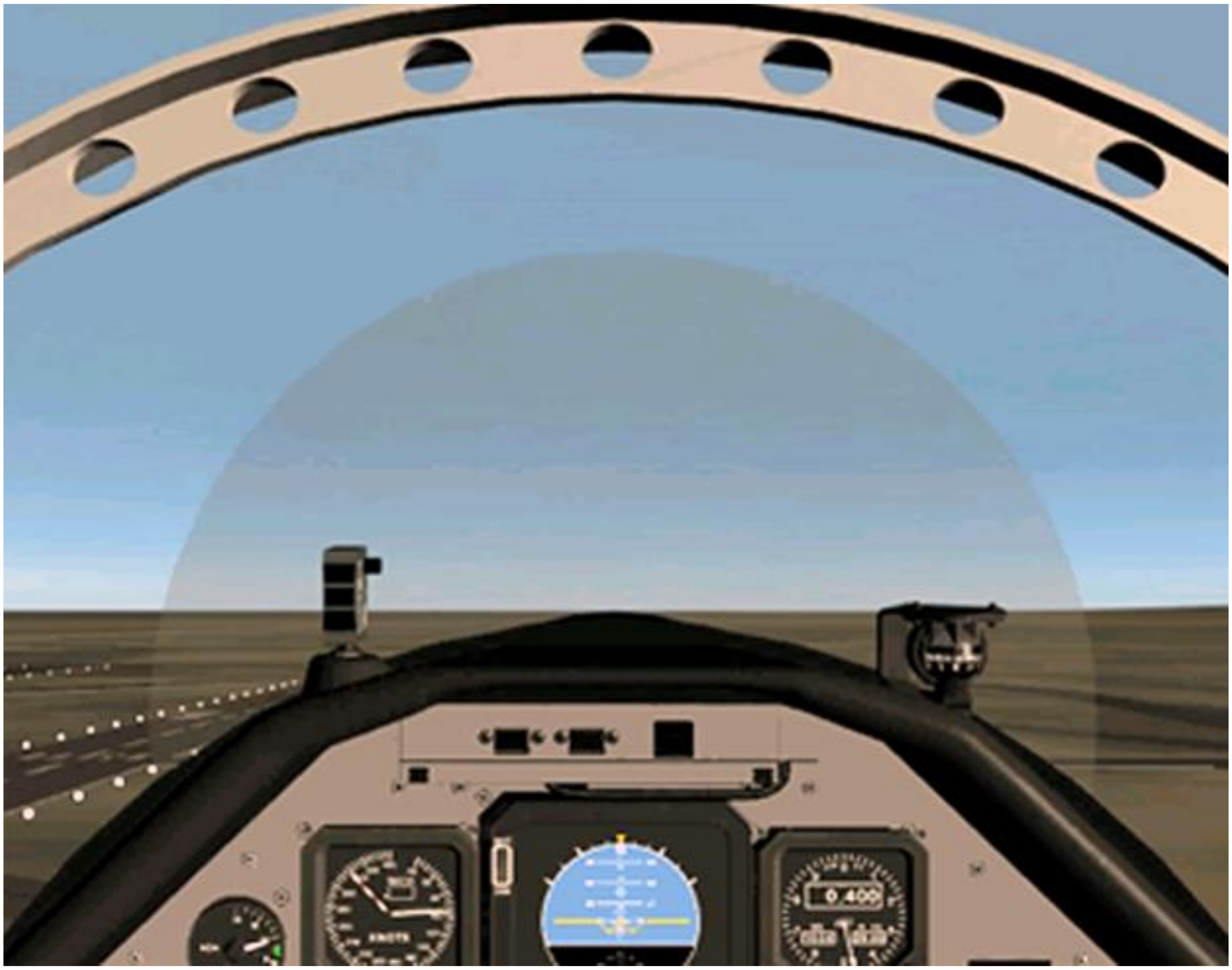
4.3.3. **Procedure.** Do not accept takeoff clearance until ready for takeoff and the departure. Check the windsock and take note of winds reported by the RSU or tower controller. Anticipate takeoff clearance by listening to the position reports of other aircraft in the pattern. When cleared for takeoff, do not delay taking the runway, ensure proper spacing behind aircraft on landing roll, and complete the lineup check.

4.3.3.1. **Static Takeoff.** Stop when the aircraft is aligned with the runway and the nose wheel is centered. Pump up the brakes to prevent creep during engine run-up. The PNF guards the brakes (without touching rudder pedals) ready to assume control. Clear down the runway and advance the PCL to 25-30 percent torque. Cross-check outside to detect creep and check engine instruments. Release brakes to begin the takeoff roll and smoothly advance PCL to MAX. Check engine instruments when stabilized at maximum power (approximately 3 seconds after PCL reaches MAX) to ensure proper operation.

4.3.3.2. **Rolling Takeoff.** Once the aircraft is aligned with the runway and the nose wheel is centered, disengage NWS and smoothly advance the PCL to MAX. Check engine instruments when stabilized at maximum power (approximately 3 seconds after PCL reaches MAX) to ensure proper operation.

4.3.3.3. **Takeoff Roll.** Without any crosswind, you will need to deflect the control stick to the right slightly to compensate for the torque generated at MAX power. When a crosswind is present, deflect the control stick in the direction of the crosswind component to keep the upwind wing from lifting (see **paragraph 4.4**). Position the elevator approximately neutral to prevent the nose gear from digging in during takeoff roll. Power application causes the aircraft to yaw to the left. Counteract this yaw by using right rudder. Place heels on the floor and the balls of the feet on the bottom of the rudder pedals to prevent accidental brake application and use rudder for directional control throughout the takeoff roll. The flight controls become more effective as airspeed increases, so progressively smaller control inputs are required to maintain aircraft control. At 60 knots, check that actual torque at least matches minimum power calculated during the Before Takeoff checklist. At rotation speed, smoothly apply back stick pressure to establish the takeoff attitude (7-10 degrees nose high, **Figure 4.1**). Without wind gusts, rotation speed is 85 knots. If gusty winds are present, increase rotation speed by one-half the gust factor (up to 10-knot increase).

Figure 4.1. FCP Takeoff Pitch Attitude.



4.3.4. **Technique.** Cut the pitch picture in half (placing the spinner slightly below or on the horizon) to attain the takeoff attitude. Use control stick pressure as necessary to hold this attitude. Immediately after take-off and safe gear retraction it will be necessary to apply right rudder trim in order to counteract adverse yaw and “center the ball”.

4.4. Crosswind Takeoff. The procedures for a takeoff with a crosswind are the same as for a no-wind takeoff except aileron is held into the wind to keep the wings level. Aileron deflection is necessary because the upwind wing develops more lift, causing it to fly (begin rising) before the downwind wing. If the upwind wing rises, skipping may result (**Figure 4.2**). Skipping is a series of very small bounces caused when the aircraft attempts to fly on one wing and settles back onto the runway. During these bounces, the aircraft moves sideways and increases stress on the landing gear. Anticipate aileron requirement due to the crosswind and either pre-position aileron into the wind or apply aileron into wind as required during takeoff roll. Use rudder to keep the aircraft from weathervaning (for example, crabbing or turning into the wind). The flight controls become more effective as airspeed increases, so progressively smaller control inputs are required to maintain aircraft control.

Figure 4.2. Skipping on Takeoff.

4.5. After Becoming Airborne.

4.5.1. **Objective.** Transition the aircraft from takeoff roll to climb.

4.5.2. **Description.** Control inputs change significantly as the aircraft leaves the ground. Rudder requirements change as the wheels leave the ground and airspeed increases.

4.5.2.1. Airspeed – Accelerate to climb airspeed (140-180 KIAS).

4.5.2.2. Power – MAX.

4.5.2.3. Pitch – As required to fly desired airspeed (normally 10-15 degrees).

4.5.3. **Procedures.** Retract the gear and flaps when safely airborne with a positive climb rate, the engine is stabilized in MAX, and the engine instruments are checked within limits. Gear and flap retraction should be a conscious, deliberate act. Before moving the gear handle, the PF makes an intercockpit "gear clear" call and pauses momentarily. On student pre-solo contact sorties, the IP must acknowledge the "gear clear" call with "clear" before the student pilot raises the gear. On all other sorties, "gear clear" is an advisory call only. After gear and flap retraction, verbally confirm the landing gear warning lights are extinguished and the flaps are up before limiting speed. In addition, check that the engine instruments are within limits. As airspeed increases, nose-down trim is necessary to relieve pressure on the control stick.

4.6. After Becoming Airborne (Crosswind). Control inputs change significantly as the aircraft leaves the ground. Crosswind controls must be released after takeoff, as the aircraft is allowed to crab into the wind, to prevent the upwind wing from dipping toward the ground. Rudder requirements change as the wheels leave the ground, airspeed increases, and the aircraft crabs into the wind. Climb in coordinated flight and maintain runway alignment on takeoff leg (**Figure 4.3**).

Figure 4.3. Crabbing Into Crosswind After Takeoff.

4.7. Abnormal Procedures.

4.7.1. **Takeoff Aborts.** If there is reason to ABORT the takeoff, do not hesitate to do so. If the PNF sees something hazardous, inform the PF. If the AC is not flying during a time-critical situation that requires immediate action and there is no time to relay this to the PF, the AC should take control of the aircraft and accomplish the appropriate procedures.

4.7.2. **Wake Turbulence/Prop Wash.** Anticipate wake turbulence or prop wash when taking off behind other aircraft on the same or parallel runways, especially if the wind is calm or straight down the runway. Wake turbulence is formed when an aircraft is creating lift, therefore plan to take off at a point prior to the preceding aircraft's takeoff point or after their point of touchdown. The T-6A is very susceptible to rolling motion if within a preceding aircraft's prop wash.

4.8. Turns After Takeoff. Climb straight ahead until past the departure end of the runway (EOR) (or as directed). Attain a minimum of 140 KIAS and 400 feet above ground level (AGL) (or per local directives) before the first turn after takeoff. The 400-foot restriction does not apply to the VFR pattern.

4.9. Climbs.

4.9.1. **Objective.** Establish the aircraft in a climb as required by local directives or published departure.

4.9.2. **Description.**

4.9.2.1. Airspeed – Accelerate to climb airspeed 140-180 KIAS according to local directives.

4.9.2.2. Power – As required, normally MAX.

4.9.2.3. Pitch – As required to fly desired airspeed (normally 10-15 degrees).

4.9.3. **Procedures.** Climbout airspeeds below 160 KIAS are permitted by the flight manual but not normally recommended due to high-pitch attitudes that limit forward visibility, however, any airspeed between 140-180 knots is acceptable after consideration of all climb factors including, obstacle clearance, local procedures, traffic, forward visibility, etc. Pilots are not required to make a significant pitch change in order to achieve standard climb speeds when conducting intermediate/small altitude changes (approximately 1000-2000 feet) as this normally leads to an abrupt level off. Initiate the climb check according to the flight manual passing 10,000 feet MSL.

4.9.3.1. **Straight Climb from Level Flight.** Advance PCL and allow the aircraft pitch to increase. If above the desired climb speed, initially set the pitch to achieve the desired airspeed. After reaching the desired airspeed, lower the nose to keep airspeed constant as altitude increases. Make all pitch changes using outside references when available. Maintain heading by using section lines, a prominent point or object near the horizon, or other outside references, cross-checked with the heading on the EHSI. Maintain wings-level attitude by outside references cross-checked with the attitude indicator. Trim after power is set and the climbing attitude is established. Trimming is a continuous process throughout the climb and level off. A climb attitude of 12.5 degrees nose high results in a climb gradient of approximately 1000 feet per nautical mile (NM) (or what is referred to as a 1:1 ratio). This climb gradient is determined by using the formula that 1 degree is equal to 100 feet per NM. Level flight for 160 knots is about 2-3° degrees nose high. Therefore a pitch attitude of 12.5 degrees is about 10 degrees above level flight resulting in 1000 feet per NM climb rate.

4.9.3.2. **Climbing Turns.** If standard bank angles are not required to comply with published routings, use shallow-banked turns to maintain a higher rate of climb. Trim used in the turn must be taken out during the rollout.

4.9.3.3. **Level off.** Start the level off at a lead point that allows a smooth transition to the desired level-off altitude. The standard method to achieve a smooth level off is to use a lead point that is approximately 10 percent of the VSI. For example, if climbing at a rate of 2,000 fpm, start the level off 200 feet below the desired altitude. At the lead point, smoothly lower the nose of the aircraft to level flight. Approaching the desired airspeed, adjust the PCL to obtain the desired airspeed and trim the aircraft.

4.9.3.3.1. **Operations Check.** Conduct an Operations Check (ops check) at initial level-off and periodically throughout the flight IAW the Flight Manual.

4.9.3.3.2. Technique. Perform an ops check approximately every 15 minutes while accomplishing area work. Using the stopwatch feature of the clock or accomplishing a check on the quarter hour (for example, 1415, 1430, 1445, etc.) can help ensure checks are accomplished in a timely manner.

Chapter 5

TRAFFIC PATTERNS AND LANDINGS

5.1. Introduction. In any traffic pattern, the runway is the primary visual reference. Each airfield has specific procedures designed to help prevent conflicts, assign traffic priority, and maximize training. Base-specific traffic pattern diagrams and ground references are contained in the local in-flight guide.

5.2. Letdown and Traffic Entry.

5.2.1. **Objective.** Descend and enter traffic pattern.

5.2.2. **Description.** Letdown is the transition from the enroute structure to the traffic pattern. In busy environments, detailed procedures are used for traffic sequencing and deconfliction. Strive to make all radio calls at the proper location. However, if deviations occur, always report actual location.

5.2.2.1. Airspeed - 200-250 KIAS according to local directives.

5.2.2.2. Power - As required.

5.2.2.3. Speed brake - As required.

5.2.2.4. Pitch - As required to meet altitude restrictions.

5.2.3. **Procedures.**

5.2.3.1. Comply with published routing and altitude restrictions.

5.2.3.2. Monitor ATIS, if available.

5.2.3.3. Clear pattern entry route.

5.2.4. **Techniques.**

5.2.4.1. Clearing turns during a visual meteorological conditions (VMC) letdown can improve clearing, control rate of descent and appropriately place a dedicated focus on outside visual references.

5.2.4.2. Before the traffic pattern entry point, use the **GUTS** check:

5.2.4.2.1. **G** —GPS - Select useful waypoint and omni-bearing selector (OBS) to runway heading.

5.2.4.2.2. **U** —UHF/VHF - Set to proper frequencies.

5.2.4.2.3. **T** —TAS - Set to range that aids clearing.

5.2.4.2.4. **S** —Squawk appropriate code.

5.3. Aircraft Configuration. Three configurations are used in the T-6. Normally, touch-and-go landings are practiced with flaps takeoff. Full stop landings may be performed at any flap setting, but normally flaps takeoff or landing are used. Crosswinds and gusty winds affect flap setting. When flying in gusty winds, add one-half the gust up to a maximum of 10 knots to final approach and touchdown speeds.

5.3.1. **Gear - Down, Flaps – Landing.**

5.3.1.1. Final turn/maneuver airspeed - 110 KIAS or on speed AOA, whichever is higher. Final airspeed - 100 KIAS. In the final turn, cross-check airspeed with AOA. At higher aircraft weights, higher airspeed may be required to maintain AOA on speed indication.

5.3.1.2. Landing flaps are normally used for full-stop landings. Landing flaps should be used when heavy weight flaps up landing distance is equal to or greater than 80 percent of runway length. Not recommended in gusty wind conditions. Landing flaps are discouraged with crosswinds greater than 10-knots due to the potential stresses the side loads impart on the landing gear. If landing flaps are appropriate for the existing conditions (i.e., runway length, required training objectives, etc.), the crosswind limit for landing flaps is 25 knots.

5.3.1.3. Generates significantly more drag than takeoff flaps. Requires lowest pitch attitude and highest power setting of the three configurations to maintain level flight.

5.3.1.4. Decreases stall speed. Permits slower approach and landing speeds (see flight manual, Appendix A), resulting in reduced landing distance.

5.3.2. **Gear - Down, Flaps - Takeoff.**

5.3.2.1. Final turn/maneuver airspeed - 115 KIAS or on speed AOA, whichever is higher. Final airspeed - 105 KIAS. In the final turn, cross-check airspeed with AOA. At higher aircraft weights, higher airspeed may be required to maintain AOA on speed indication.

5.3.2.2. Normally used for touch-and-go landings. May also be used for full-stop landings if landing distance not a factor.

5.3.2.3. Recommended for full stop landings with 10-knot or greater crosswind. May be used for full-stop landing in gusty winds.

5.3.2.4. Generates slightly less lift, but much less drag compared to landing flaps. Slightly lower power and slightly higher pitch required to maintain level flight compared to landing flaps.

5.3.2.5. Stall speed slightly higher than landing flaps. Slightly longer landing distance than landing flaps.

5.3.3. **Gear - Down, Flaps - UP.**

5.3.3.1. Final turn/maneuver airspeed - 120 KIAS or on speed AOA, whichever is higher. Final airspeed - 110 KIAS. In the final turn, cross-check airspeed with AOA. At higher aircraft weights, higher airspeed may be required to maintain AOA on speed indication.

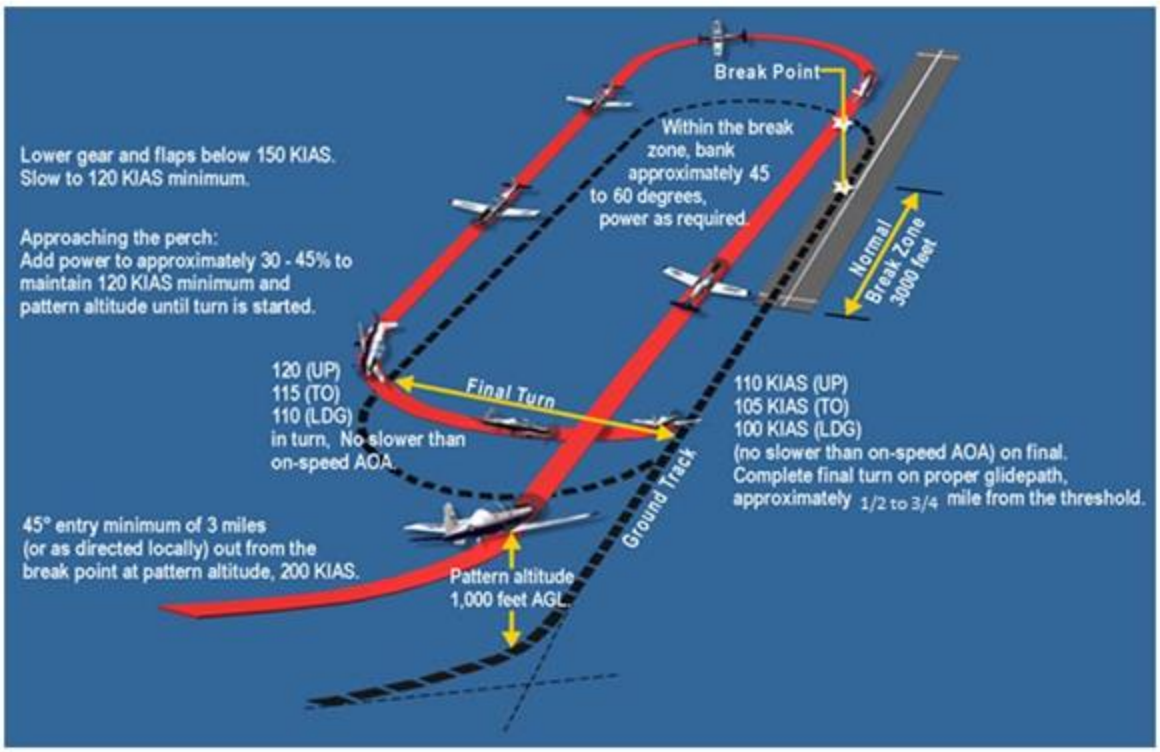
5.3.3.2. May be used for full-stop landings with high crosswinds (greater than 20 knots) if landing distance not a factor.

5.3.3.3. Generates least lift. Lowest power, but highest pitch attitude required of three configurations.

5.3.3.4. Stall speed higher than TO flaps. Significantly longer landing distance than landing or takeoff flaps.

5.4. Overhead Pattern and Landing. The 360-degree overhead pattern is used to safely accommodate a maximum number of aircraft with minimum congestion. Adjust pattern spacing for wind conditions. See **Figure 5.1** depicting a normal traffic pattern and **Table 5.1** listing overhead pattern parameters.

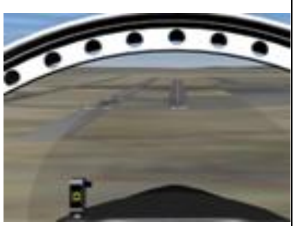
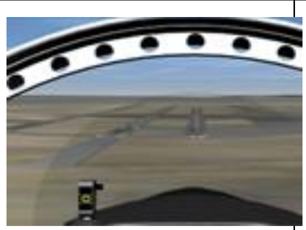
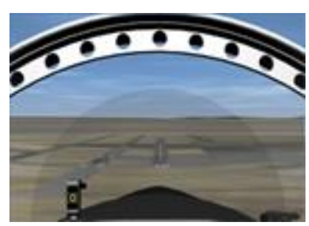
Figure 5.1. Normal Traffic Pattern.



NOTE: When flying in gusty winds, add one-half the gust up to a maximum of 10 knots to final approach and touchdown speeds.

Table 5.1. Overhead Pattern Parameters.

Configuration	Gear Down, Flaps landing	Gear Down, Flaps Takeoff	Gear Down, Flaps UP
INSIDE DOWNWIND			
KIAS (min)	120	120	120
Torque	45%	35%	30%
Pitch attitude (level flight)	1/4 Ground, 3/4 sky	1/4 Ground, 3/4 sky	Spinner on horizon

Runway spacing (No wind)			
FINAL TURN			
KIAS (min)	110 (or on speed AOA)	115 (or on speed AOA)	120 (or on speed AOA)
Torque	Approx 18%	Approx 15%	Approx 12%
Pitch Picture			
Pitch Attitude	2/3 Ground, 1/3 sky	2/3 Ground, 1/3 sky	one-half Ground, one-half sky
FINAL			
KIAS (Min) (note 1)	100 (or on speed AOA)	105 (or on speed AOA)	110 (or on speed AOA)
Torque	Approx 16 to 18%	Approx 14 to 16%	Approx 12 to 14%
Pitch Attitude	Aim point 1/2 up windscreen	Aim point 1/2 up windscreen	Aim point 1/3 up windscreen
Pitch Picture			
TOUCHDOWN			
KIAS (notes 1 and 2)			
Target	80	85	90

Range	75-90	80-95	85-100
Target touchdown zone (note 3)	1st 1,000 feet	1st 1,000 feet	1st 1,500 feet

NOTES:

1. Add one-half the gust factor up to 10 KIAS to final approach and touchdown speeds.

2. Factors such as aircraft weight, crosswind, and outside air temperature may raise these speeds slightly.

3. This does not mean that routinely landing in the first few feet or the very end of the target touchdown zone is desirable. A proper touchdown point has an adequate safety margin against landing short, yet allows the aircraft to easily stop within the available runway.

5.5. Initial.

5.5.1. **Objective.** Align aircraft with landing runway.

5.5.2. **Description.**

5.5.2.1. Airspeed - 200 KIAS.

5.5.2.2. Power – 50 percent + 1 percent per 1,000 feet MSL altitude.

5.5.2.3. Pitch - As required for level flight.

5.5.2.4. Altitude – 1,000-1,500 feet AGL or according to local directives.

5.5.2.5. FCP visual reference – one-half ground, one-half sky.

5.5.3. **Procedure.** Follow depicted pattern ground track. On initial, align with the runway centerline (or as directed). Make required radio call.

5.6. Break.

5.6.1. **Objective.** Transition from initial to inside downwind.

5.6.2. **Description.** 180 degrees level decelerating turn.

5.6.2.1. Airspeed - Slow from 200 KIAS to 120-150 KIAS.

5.6.2.2. Power - As required (approximately 10 percent).

5.6.2.3. FCP visual reference - Drag TAS antenna across horizon. Expect required pitch to increase slightly throughout the break.

5.6.3. **Procedure.**

5.6.3.1. The break zone is between the approach end and 3,000 feet down the runway. Wind conditions and traffic spacing will affect the actual point where you start the break. RSU or tower controllers may direct you to break at a certain point within or outside the break zone.

5.6.3.2. Clear in the direction of turn. Smoothly roll into approximately 45-60 degrees of bank and simultaneously adjust the PCL as required (approximately 10 percent). AOB and back pressure vary with wind conditions. Fly a level, decelerating turn to inside downwind trimming control stick forces as the airspeed decreases.

5.6.3.3. On inside downwind continue to slow to 120-150 KIAS.

5.6.3.4. As airspeed decreases, vary bank angle and/or G-loading to maintain level flight. Setting and maintaining a constant bank angle requires increasing aft stick deflection to remain level.

5.6.3.5. If required to break beyond normal break point, maintain airspeed according to local directives until mid-field downwind to aid traffic pattern spacing.

5.7. Inside or Closed Downwind.

5.7.1. **Objective.** Maintain proper spacing and a ground track parallel to the runway. Apply drift correction and offset inside/closed downwind ground track into the wind to account for the effects of wind on the final turn. Arrive at perch point at 120 KIAS minimum, properly configured, and ready to perform a planned 30-degree bank final turn.

5.7.2. **Description.** Airspeed - 120 KIAS minimum or according to local directives.

5.7.3. **Procedures.**

5.7.3.1. On inside downwind, with airspeed below 150 KIAS, make an intercockpit “gear clear” call and pause momentarily before moving the gear handle. On student pre-solo contact sorties, the IP must acknowledge the “gear clear” call with “clear” before the student pilot lowers the gear. On all other sorties, “gear clear” is an advisory call only.

5.7.3.2. Lower the landing gear and flaps as required. As the flaps are lowered, the nose of the aircraft pitches up slightly due to the increase in lift. Maintain level flight by slightly increasing forward control stick pressure and trim for zero control stick forces. (The objective is to be trimmed-up, hands-off as described in **paragraph 2.9.1.5.**)

5.7.3.3. Adjust power between approximately 30% – 45% depending upon flap setting to maintain airspeed (120 KIAS minimum) and pattern altitude.

5.7.3.4. Adjust spacing and perch point for winds. No wind spacing is approximately 0.7 - 1.0 mile. Drift correction is approximately twice the correction used on initial. Visual references are given in **Table 5.1**.

5.7.3.5. PF verbally confirms completion of Before Landing Checklist. PNF physically checks the gear handle down (if in the FCP) and acknowledges the aircraft configuration IAW local directives.

5.7.4. **Technique.**

5.7.4.1. Upon arrival on inside downwind, commonly applied techniques are the pneumonics:

5.7.4.1.1. **T** -Torque (10-20% verify)

5.7.4.1.2. **T** – Track (adjust for wind)

5.7.4.1.3. **T** – Talk (radio call)

5.7.4.1.4. **T** – Trim (as required when slowing)

5.7.4.2. Alternatively.

5.7.4.2.1. **S** – Speed

5.7.4.2.2. **S** – Spacing

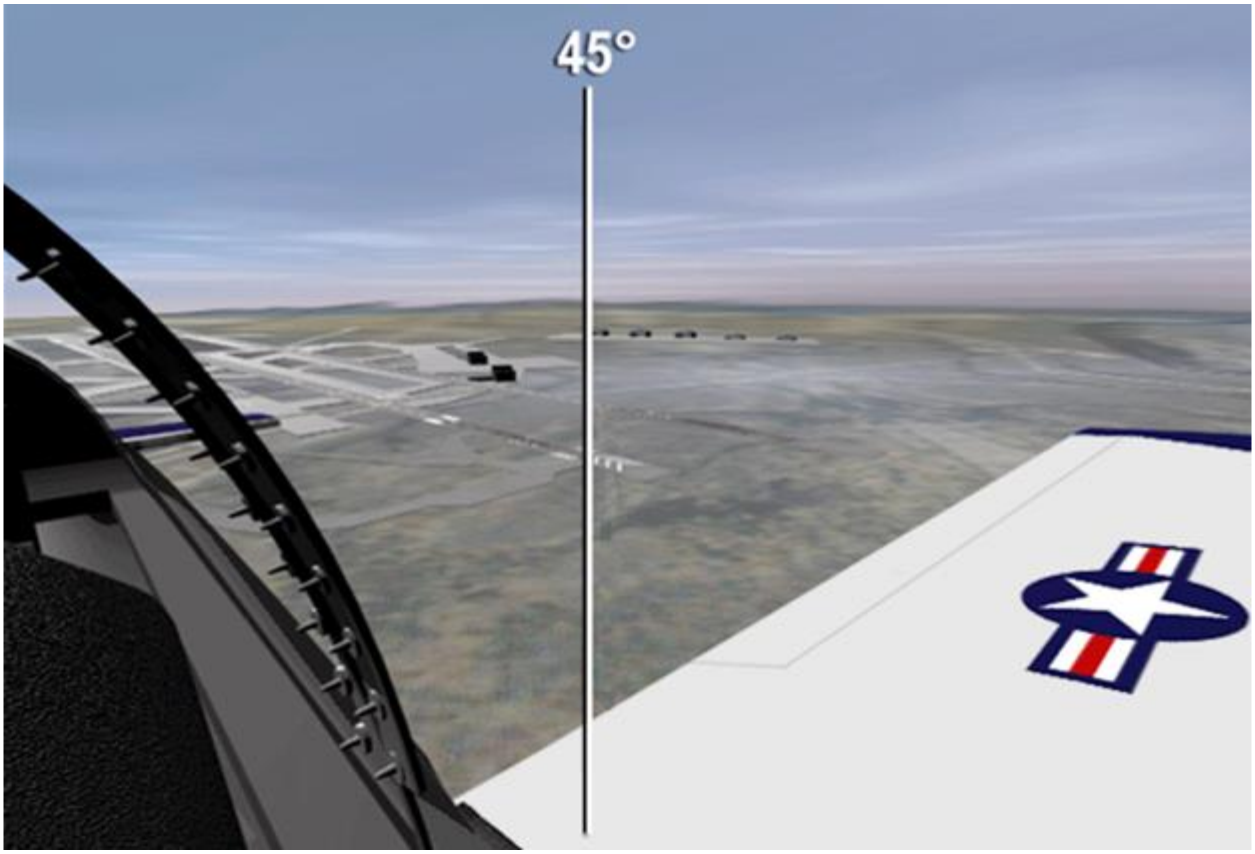
5.7.4.2.3. **S** - Speak

5.8. Perch and Final Turn.

5.8.1. **Objective.** Use a descending 180-degree turn to align aircraft with the runway. The final turn is complete when wings level on final.

5.8.2. **Description.** For a no-wind pattern, the desired perch point occurs when the runway threshold is approximately 45 degrees off your shoulder (**Figure 5.2**). See **Table 5.1.** for parameters.

Figure 5.2. Perch Point Reference.



5.8.3. **Procedure.**

5.8.3.1. Confirm aircraft configuration prior to the perch.

5.8.3.2. Begin final turn (perch point) to allow for a one-half to three-quarter mile final. Correct for winds. For example, with a strong headwind on final, begin the final turn earlier than for a no-wind pattern. Displace the perch point into the wind which is affecting the final turn to rollout on a one-half to three-quarter mile final.

5.8.3.3. Clear visually and with the radios. Do not start the final turn if conflicts exist or if potential conflicts are not in sight. Break out from inside downwind (pattern status permitting) using local procedures if:

5.8.3.3.1. Another aircraft in the final turn is not in sight.

5.8.3.3.2. A straight in is inside 2 miles and not in sight.

5.8.3.3.3. An ELP is inside low key and normal spacing cannot be maintained.

5.8.3.3.4. Pattern spacing cannot be maintained within the normal ground track.

5.8.3.3.5. Not properly configured by the perch point.

5.8.3.4. Start the final turn by adjusting power, lowering the nose, and rolling into 30 degrees of bank.

5.8.3.5. When able after starting the final turn, make a gear down call.

5.8.3.6. Cross-check airspeed with AOA. At higher aircraft weights, higher airspeed may be required to maintain AOA on-speed indication.

5.8.3.7. Plan to use no more than 30 degrees of bank, but do not exceed 45 degrees of bank during final turn as stall speed increases with increasing bank angle. If greater than 45 degrees of bank is required to complete the final turn, initiate a go-around. Correct spacing on subsequent patterns to allow for 30 degrees bank in the final turn.

5.8.3.8. Roll out on extended runway centerline, approximately one-half to three-quarters of a mile from the runway on a 3-to 4-degree glide path as you slow to final approach airspeed.

5.8.3.9. If any doubt exists about the safety of continuing the approach, go around. Do not hesitate to disregard the ground track and use traffic pattern stall recovery procedures if required.

5.8.4. **Techniques.**

5.8.4.1. A commonly applied technique is the mnemonic: Power, Pitch, Roll.

5.8.4.1.1. Upon reaching intended perch point, set pitch 2/3 ground, 1/3 sky for normal and ½ ground, ½ sky for no flap while simultaneously reducing power initially to 15% torque for normal and 12% torque for no flap, roll to 30 degrees of bank initially and cross check airspeed, adjust power as required, reference aimpoint, adjust pitch accordingly and visualize extended runway centerline and adjust bank angle to meet, not exceeding 45 degrees of bank.

5.8.4.2. Pick a rollout point on final before beginning the final turn. Visualize the pitch and bank required to hit the rollout point. A good composite cross-check is critical to smoothly flying the final turn, and as a minimum should include the intended landing point, the rollout point, and airspeed.

5.8.4.3. Halfway through the final turn (perpendicular to the runway), cross-check aircraft altitude which should be approximately 600 feet AGL for a 1,000-foot pattern. This allows for aircrew to intercept final at ½ mile at approximately 200 feet AGL.

5.9. Final. Final provides the opportunity to stabilize airspeed and glide path before entering the landing phase. Stable airspeed, proper glide path, and a fixed aim point provide the consistency required for successful landing. Airspeed is based on configuration and winds, glide path is 3-4 degrees, and, under normal conditions, the aim point is the runway threshold.

5.9.1. **Objective.** Maintain runway alignment, proper glide path, and correct airspeed.

5.9.2. **Description.** Final begins when wings level after the final turn and ends when the flare begins. See **Table 5.1** for parameters.

5.9.3. **Procedure.** Begin slowing from final turn speed to final speed when beginning to roll out of bank by initially reducing power (approximately 5-10 percent) and maintaining or slightly adding backstick pressure to prevent the nose from dropping.

5.9.3.1. Maintain proper spacing with preceding aircraft. If spacing is insufficient, go around. After rolling out on final, initially use crab to maintain runway alignment.

5.9.3.2. On final, use a cross-check of aim point, airspeed to focus attention on the most critical items. The aim point is usually about 500 feet short of the intended touchdown point and is usually the runway threshold but could vary based on headwinds. Visualize a constant glide path to the aim point.

5.9.3.3. **Crab.** Crab allows the aircraft to maintain runway alignment by weathervaning into the wind. The amount of crab required on final indicates the amount of control deflection needed to transition to the wing-low method. Do not land the T-6 with crab. See **paragraph 5.11.3.5.** for crosswind landing considerations.

5.9.3.4. **Airspeed and AOA.** Cross-check airspeed with AOA. At higher aircraft weights, higher airspeed may be required to maintain an on-speed (amber donut) AOA indication. Above 700-800 pounds of fuel weight, approximately 3-5 knots above final turn and final airspeed may be required. Be alert and stop excessive sink rates with pitch and power. Heavy aircraft are less responsive to both pitch and power changes and develop sink rates quicker than light aircraft.

5.9.3.5. **Gusty Wind Conditions.** Increase final approach airspeed by one-half the gust factor up to a 10-knot increase. (Gusty winds do not affect final turn speeds.) The aircraft may float farther than normal before touchdown due to the extra airspeed.

5.10. Straight-in Approach.

5.10.1. **Objective.** Land with minimum maneuvering and gradual airspeed changes.

5.10.2. **Description.** Visual maneuver that aligns the aircraft with the runway for a constant speed, constant rate descent and landing. Situations that may require a straight-in approach include flight control malfunction, pitot-static problem, structural damage, or an unlocked canopy.

5.10.3. **Procedure.**

5.10.3.1. Request straight-in approach according to local directives.

5.10.3.2. Descend to 500 feet AGL before the 5-mile or 5-mile radar point or according to local directives.

5.10.3.3. Configure prior to 2-mile point.

5.10.3.4. Slow to final approach speed once configured and before starting descent on glide path.

5.10.4. **Technique.**

5.10.4.1. With flaps landing or takeoff, begin the descent when the threshold of the runway (aim point) is in the lower one-third of the windscreen. For flaps UP, begin the descent when the spinner reaches the threshold (aim point).

5.10.4.2. Use actual distance from threshold (aim point) from GPS to determine proper point to begin descent. Begin descent between 1.25 and 1.67 miles from the aim point (3-4 degrees glide path from 500- feet AGL). This can help develop ability to visually determine start descent point.

5.10.4.3. Use straight-in to practice transition from crab to wing-low crosswind controls. A longer final affords more time to practice multiple transitions.

5.11. Normal landing.

5.11.1. **Objective.** Land in proper landing zone, in proper landing attitude and on speed (**Table 5.1**).

5.11.2. **Description.** The landing is divided into three phases: (1) roundout, (2) flare and touchdown, and (3) landing roll. Each of these phases serves as a transition from the previous phase to the next. The roundout serves as the transition from final to the flare. The flare is used to reduce energy in the transition from final to landing airspeed. The landing roll serves as the transition from landing to taxi. Groundspeed is reduced straight ahead on the runway until at safe taxi speed.

5.11.3. **Procedure.**

5.11.3.1. **Roundout.** Use slight backstick pressure to reduce decent rate to a near horizontal flight path. Start a smooth power reduction to slow from final approach speed as aim point is shifted further down the runway. At the threshold, airspeed should be approximately 10 knots below final airspeed.

5.11.3.2. **Flare and Touchdown.** In the flare, back stick pressure is slowly increased as power is reduced to idle and airspeed further decreases. The aircraft will be in a slight descent or level flight depending on altitude, airspeed, power setting, and rate of deceleration.

5.11.3.2.1. Use caution to avoid excess back stick which could lead to a climb in the flare. Flare at a rate proportional to the rate of descent. For example, higher descent rates require faster application of back stick to attain normal descent rate prior to touchdown and prevent a firm landing. Similarly, a lower than normal descent rate requires slower control stick movement to prevent a high flare.

5.11.3.2.2. As the nose rises, forward visibility is reduced and peripheral vision becomes the key factor in height and drift assessment. Continue back stick pressure to increase the pitch attitude until the proper landing attitude is reached. As descent rate and airspeed decrease, the aircraft gently settles onto the runway. Touchdown is simply an end to the flare and should occur as landing speed is attained. Ensure PCL is idle at touchdown.

5.11.3.2.3. In the flare, power can compensate for errors in judgment. Faster or slower power reductions can compensate for errors made in the roundout and early flare. While a momentary actuation of the stick shaker may occur just prior to touchdown, apply power and go around any time control effectiveness is lost, the aircraft experiences an approach-to-stall indication during a high flare, balloon, or at any phase of the roundout or flare where the aircraft is not in a position to safely touchdown.

5.11.3.2.4. Go around if an excessively long touchdown will occur.

5.11.3.2.5. Ensure feet are not on brakes when aircraft touches down.

5.11.3.3. **Landing Roll.** After touchdown and below approximately 80 KIAS on a full-stop landing, slowly relax back stick pressure to smoothly lower the nose gear to the runway. Avoid banging the nose gear.

5.11.3.3.1. With the nose gear on the runway position the feet so the balls of the feet are on the top of the rudder pedals and smoothly apply brakes and increase back stick pressure. This increases weight on the main gear and helps prevent the nose gear from digging in, however, do not allow the nose gear to lift off the runway. Continually increase back stick and brake pressure as the aircraft decelerates. Always brake in a straight line; do not turn and brake. Maintain directional control with rudder and (or) brakes. Use caution to avoid over controlling when applying brakes.

5.11.3.3.2. At speeds below 80 KIAS, the chances of approaching optimum braking action are greatly increased. Use caution when braking at speeds above 80 KIAS. The physical limitations of the tire and brake system make it extremely difficult to consistently achieve maximum braking action, particularly at high speeds, as lift reduces the weight component. A single, smooth application, with increasing pressure as airspeed decreases, offers the best braking potential. Do not allow the wheels to lock during braking. Once a wheel is locked, it may be necessary to completely release brake pressure to allow wheel rotation.

5.11.3.3.3. Confirm N1 reduction from 67 to 60-61 percent shortly after main gear touchdown (approximately 4 seconds).

5.11.3.3.4. A good technique is to check for airspeed below 60 KIAS with 2000 feet of runway remaining and below 40 KIAS with 1000 feet of runway remaining to alleviate the need for excessive braking at the end of the runway.

5.11.3.3.5. Select NWS when the aircraft is at a normal taxi speed and the rudder pedals are centered. Center rudder pedals before selecting NWS. At higher speeds, NWS is extremely sensitive and should only be used if directional control cannot be maintained with rudder and brakes. Intercept taxi line to transition from the runway to the taxiway.

5.11.3.3.6. If you encounter nose wheel shimmy during the landing roll, apply backstick pressure to relieve weight on the nose wheel, and then gently release pressure to reestablish contact with the runway. If condition persists reapply back stick pressure.

5.11.3.3.7. A low runway condition reading (RCR), such as wet or icy runway will influence controllability after landing.

5.11.3.4. **Landing on Alternate Sides of the Runway.** When landing on alternate sides of the runway, plan to land near the center of the runway (main gear to wingtip on the centerline). The side of the runway closest to normal turnoff routes is known as the cold side; the side away from the normal turnoff is the hot side. Landing in the center of the runway is permissible if traffic and local procedures permit.

5.11.3.5. **Landing Considerations with Crosswinds.** Introduce crosswind controls (wing-low) as required on short final. This requires rudder deflection to align the nose of the aircraft with the runway and aileron deflection into the wind to stop drift. Crosswind controls increase drag, rate of deceleration, and stall speed. A small addition of power is necessary to counter these effects.

5.11.3.5.1. If power is used during the flare, retard the PCL to idle at touchdown. Crosswind controls must be held through touchdown and landing roll to prevent the upwind wing from rising and the aircraft from skipping. With significant crosswinds, expect one main gear to touchdown before the other.

5.11.3.5.2. As the airspeed decreases, crosswind control deflection must increase to achieve the same effect. Proper use of aileron prevents a crosswind from lifting the upwind wing. When rudder effectiveness is lost, full aileron deflection may be necessary. In crosswinds greater than 10 knots, plan to use TO flaps and touchdown at approach speed minus 10 knots. The aircraft may float farther than normal before touchdown due to the extra airspeed.

5.11.3.5.3. When introducing crosswind controls (wing-low), a common memory aid is the acronym **RAP**:

5.11.3.5.3.1. **R** - Rudder to align the nose with the runway.

5.11.3.5.3.2. **A** - Aileron into the wind to prevent drift.

5.11.3.5.3.3. **P** - Power to counteract increased drag (uncoordinated flight).

5.11.4. **Techniques.**

5.11.4.1. **Roundout.**

5.11.4.1.1. Approximately 1000 feet short of the aim point, reduce power to approximately 10 percent torque (about a knob width). Increase back stick pressure slightly and apply nose-up trim.

5.11.4.1.2. Approximately 2 seconds after power is reduced (500 feet from aim point), start to shift aim point to the EOR.

5.11.4.1.3. Begin further power reduction as aim point is shifted. The earlier power reduction, the slower the rate will be.

5.11.4.2. **Flare and Touchdown.**

5.11.4.2.1. Apply back stick pressure at the same rate that the aircraft settles toward the runway, ultimately achieving the takeoff pitch picture. This allows for controlled deceleration and loss of altitude.

5.11.4.2.2. Continue power reduction throughout flare. Base the rate of reduction on total energy (height, sink rate, and airspeed).

5.12. Touch-and-go landing.

5.12.1. **Objective.** Accomplish multiple landings on a single sortie.

5.12.2. **Description.** Normal landing followed by normal takeoff. After touchdown, power is advanced to MAX to execute takeoff. Lift off at approximately 85 KIAS.

5.12.3. **Procedure.**

5.12.3.1. Accomplish a normal landing. At main gear touchdown, smoothly apply power to MAX. As the PCL is advanced, slightly lower the nose to attain the takeoff pitch picture, but maintain sufficient back stick pressure to keep the nose gear off the runway. Do not pull the aircraft off the runway below normal takeoff speed.

5.12.3.2. Maintain desired ground track with crosswind controls (as necessary) throughout touchdown and takeoff roll. Control stick deflection for proper crosswind control constantly changes between flare and takeoff as airspeed, power, and weight on wheels change. Use the rudder for directional control to compensate for engine torque. As the torque increases after the PCL is advanced, the nose will tend to yaw to the left, and more right rudder will be required to keep the aircraft nose tracking straight down the runway.

5.12.3.3. Perform the after takeoff checklist when safely airborne with good engine indications, expected torque, and a visual climb from ground.

5.12.3.4. The elevator trim required for final and landing may cause premature lift-off as power is applied. Forward control stick pressure may be required to compensate for the tendency of the nose to pitch up. This forward pressure can be significant depending on the amount of trim used for landing. Trim as necessary during the takeoff portion of touch-and-go to alleviate the pressure.

5.13. Closed Traffic (Closed Pull-up) (Figure 5.3.).

5.13.1. **Objective.** Maneuver the aircraft to closed downwind to perform multiple practice patterns and landings.

5.13.2. **Description.** A climbing turn to closed downwind from initial takeoff, touch-and-go landing, or go-around. Minimum airspeed is 140 KIAS; maximum bank is 90 degrees.

5.13.2.1. Airspeed - 140 KIAS minimum.

5.13.2.2. Bank - 90 degrees maximum.

5.13.2.3. Power - As required (normally MAX initially).

Figure 5.3. Closed Pull-up.

5.13.3. **Procedure.**

5.13.3.1. At 140 KIAS minimum and according to local directives, request clearance for a closed traffic pattern.

5.13.3.2. When approved, clear and advance the PCL smoothly as required and start a climbing turn to the closed downwind leg, initially using approximately 45-60 degrees of bank. Closed downwind leg displacement should be the same as established with an overhead break.

5.13.3.3. Approaching pattern altitude, reduce power to prevent acceleration.

5.13.3.4. On closed downwind reduce power to maintain 140-150 KIAS until mid-field or as directed locally.

5.13.4. **Technique.**

5.13.4.1. Begin a climbing turn and pull the nose up until horizon is between the rudder pedals.

5.13.4.2. Lead the level-off on inside downwind by retarding the PCL to approximately 20 percent torque. As a guide, begin power reduction 100 feet below pattern altitude for every 10 KIAS in excess of 140 KIAS. For example, if airspeed is 180 KIAS, start power reduction 400 feet below pattern altitude.

5.13.4.3. Bank may be increased to 90 degrees to affect level off, if vertical speed is excessive. A small amount of rudder in the direction of the turn will help bring the nose back to the horizon.

5.14. Abnormal Pattern Procedures. Recognition of abnormal situations in the traffic pattern is critical. Traffic conflicts or poorly flown patterns or landings can lead to dangerous situations. If a potential traffic conflict is not in sight or a landing attempt looks or simply feels wrong, do not hesitate to breakout or go around. If in doubt about the location of traffic, query the RSU or tower controller. If at any time stall indications are observed, perform stall recovery procedures and disregard ground track.

5.14.1. Straight Through on Initial. To discontinue a pattern before the break, continue (carry) straight through at pattern altitude and 200 KIAS (according to local directives). At end of normal break zone, make radio call according to local directives (for example, "*Texan 11, break point straight through*"). At the departure end (or according to local directives), turn crosswind. Clear for aircraft turning crosswind, pulling closed, or established on inside downwind.

5.14.2. Breakout from Overhead Pattern.

5.14.2.1. At the home station, follow the local procedures for breaking out. In general, to perform a breakout, add power to MAX, while starting a climbing turn away from the conflict. Then raise the gear and flaps, and confirm a clean aircraft prior to 150 knots. Level off at breakout altitude and fly toward the VFR entry point. Make the appropriate radio call when able. After clear of all pattern ground tracks, descend and maneuver in accordance with local guidance to arrive wings level at pattern altitude at the VFR entry point.

5.14.2.2. Use initiative and judgment when deciding to break out of the pattern. If directed to break out by the RSU, tower, or your instructor pilot, follow instructions without hesitation, however; do not wait to be directed to break out if you see a dangerous situation is developing.

5.14.2.3. Use caution when breaking out from the inside downwind leg due to slow airspeed and configuration. Be cognizant of other aircraft breaking out at the same time. Never break out from the final turn; execute a go-around instead.

5.15. Go-around.

5.15.1. **Objective.** Safely discontinue pattern from final turn, final, or landing.

5.15.2. **Description.** A go-around is termination of an approach after the aircraft is configured. Power is used to accelerate and the aircraft is deconfigured when appropriate. At low altitudes, a climb is established. At higher altitudes a continued descent may be required according to local directives.

5.15.3. **Procedures.** Do not delay the decision and do not try to salvage a bad approach. Safety is enhanced by an early decision to go around if required. There should be no need for a controller to direct a go-around for a poorly flown pattern.

5.15.3.1. **Final Turn, Final Approach and Landing Go-around.**

5.15.3.1.1. Above 500 feet AGL, use power as required. Raise the gear and flaps, and accelerate to normal pattern airspeed. Continued descent may be required (normally to 500 feet AGL) to comply with local directives.

5.15.3.1.2. At or below 500 feet AGL, use power as required. When certain the aircraft will not touch down and with a positive climb indication, retract the landing gear and flaps.

5.15.3.1.3. If the go-around is initiated in the landing phase, advance the PCL to MAX. Following a balloon or bounce, a touchdown (or second touchdown) may occur. Maintain the landing attitude; do not over-rotate in an attempt to avoid a touchdown (or second touchdown) as a tail strike may occur. Do not raise the gear until a positive rate of climb is established and the aircraft is assured of not touching down.

5.15.3.1.4. As flaps retract, raise the nose slightly to offset tendency of the aircraft to sink.

5.15.3.1.5. Clear the runway (offset), if necessary, to avoid overflying aircraft on the runway performing an initial takeoff or a touch and go. To offset, attain safe airspeed and altitude; then smoothly roll into a shallow-banked, coordinated turn. Turn approximately 20 degrees away from the runway. When well clear of the runway (enough to see traffic on takeoff roll and (or) departure leg), execute another shallow turn to parallel the runway. Normally offset is performed toward the same side of the runway as inside downwind. Comply with local procedures. Add “offset” to callsign for RSU requests.

5.15.3.1.6. Allow the aircraft to accelerate to between 140 and 200 KIAS, then climb or descend to 500 feet above the terrain until past the departure end of the runway or according to local directives.

5.16. Final Irregularities. Depending on nature and magnitude of irregularity and aircraft flight parameters, correction and continued final may be possible. However, a go-around is always acceptable.

5.16.1. **Low (Drug-in) Final.** Aircraft below proper glide path.

5.16.1.1. Causes.

5.16.1.1.1. Early descent on straight-in approach.

5.16.1.1.2. Long perch coupled with normal pitch and descent rate. Altitude rolling out on final is as planned, but long perch leads to longer than desired final.

5.16.1.1.3. Excessive altitude loss from diving final turn.

5.16.1.1.4. Failure to maintain proper glide path.

5.16.1.2. Effects. Normal power settings are too low to maintain airspeed on shallower glide path. Airspeed and (or) altitude may decrease.

5.16.1.3. Recovery.

5.16.1.3.1. If too low or slow, go around. Avoid obstacles.

5.16.1.3.2. Add power, level off, and intercept proper glide path.

5.16.2. **Steep Final.** Aircraft above proper glide path:

5.16.2.1. Causes.

5.16.2.1.1. Too close to runway on inside downwind.

5.16.2.1.2. Early perch.

5.16.2.1.3. Level final turn.

5.16.2.2. Effects. High descent rate with low power setting. Low power setting, coupled with the pitch change required to intercept normal glide path, could result in rapid decrease in airspeed and high sink rate. If not corrected, this power-deficient situation could result in a stall or firm touchdown.

5.16.2.3. Recovery.

5.16.2.3.1. Go around if sink rate is too high or if it is not practical to intercept normal glide path with a normal descent rate.

5.16.2.3.2. Use slightly higher than normal descent rates as soon as deviation is recognized. Use power as required to control airspeed in descent and maintain airspeed when on normal glide path.

5.16.3. **Slow Final.** Increased pitch attitude is required to maintain lift as airspeed is reduced.

5.16.3.1. **Cause.** Improper glide path and (or) power setting.

5.16.3.2. **Effects.**

5.16.3.2.1. Higher than normal pitch attitude. Inaccurate perception of the proper glide path.

5.16.3.2.2. Increased AOA and increased likelihood of stall, especially in gusty wind conditions.

5.16.3.2.3. Increasing pitch leads aim point to shift down the runway.

5.16.3.3. **Recovery.**

5.16.3.3.1. Apply power at an altitude high enough to reestablish the correct airspeed and attitude. If altitude is insufficient, go-around.

5.16.3.3.2. Correct aim point and glide path to reestablish proper airspeed.

5.17. Landing Irregularities. Airspeed in the flare is just above stall airspeed. Even at slow airspeeds, the elevator is still very effective. Any abrupt change in pitch could result in a balloon, a bounce, or even a stall. When any of these conditions are encountered, apply MAX power, adjust the pitch attitude, and initiate a go-around if it is unsafe to continue the landing. If power is applied and the aircraft continues to settle, do not try to hold it off by raising the nose above the landing attitude. A touch down with too high of a nose attitude could result in a tail strike. Hold the landing attitude and let the aircraft touch down. MAX power cushions the contact. In case of a hard landing, do not raise the gear.

5.17.1. **High Flare.**

5.17.1.1. **Cause.** Roundout performed too early or with excessive pitch up.

5.17.1.2. **Effects** . Airspeed decay and or hard, long landing.

5.17.1.2.1. Possible premature touchdown of nose gear caused by abrupt pitch down to compensate for high flare.

5.17.1.2.2. Stall if flare continued with excess altitude.

5.17.1.2.3. Hard landing due to high sink rates as airspeed decreases at higher than normal altitude.

5.17.1.3. **Recovery.**

5.17.1.3.1. With adequate airspeed and runway remaining, release a small amount of back pressure to increase descent rate. As aircraft approaches normal altitude, increase back pressure to reestablish normal flare.

5.17.1.3.2. If in a landing attitude and excess altitude would require an end swap to land, do not attempt landing, and initiate a go-around. Remember, as landing attitude is attained, the aircraft is rapidly approaching a stall and there is insufficient margin of error for radical pitch changes in the flare.

5.17.2. **Late and Rapid Roundout.**

5.17.2.1. **Cause.** Higher than expected descent rate or misjudged altitude.

5.17.2.2. **Effects.** Possible incomplete flare, ballooned flare, hard touchdown.

5.17.2.2.1. Firm touchdown due to higher than normal descent rates or insufficient time to complete flare.

5.17.2.2.2. Abrupt roundout to prevent premature or firm touchdown may lead to an accelerated stall. This is a dangerous situation that may cause an extremely hard landing and damage to the main gear. This may or may not be a controllable situation, depending on airspeed.

5.17.2.3. **Recovery.** Immediately position the controls to attain the takeoff attitude and simultaneously advance the PCL to MAX, to initiate a go-around. The main gear may contact the ground a second time, but if recovered properly, the second contact is usually moderate.

5.17.3. **Porpoising.**

5.17.3.1. Cause. Incorrect landing attitude and airspeed. At touchdown, the nose gear contacts the runway before the main gear.

5.17.3.2. Effects. The aircraft bounces back and forth between the nose gear and main gear. Without immediate corrective action, the porpoise progresses to a violent, unstable pitch oscillation. Repeated heavy impacts on the runway ultimately cause structural damage to the landing gear and airframe.

5.17.3.3. Recovery.

5.17.3.3.1. Immediately position the controls to the takeoff attitude to prevent the nose wheel from contacting the runway, simultaneously advance the PCL to MAX, and initiate a go-around.

5.17.3.3.2. Do not attempt to counteract each bounce with opposite control stick movement. The combined reaction time of pilot and aircraft is such that this control movement aggravates the porpoise. Hold the controls in the recovery position to dampen the oscillations. Power increases control effectiveness by increasing airspeed.

5.17.3.3.3. Do not raise the landing gear after a porpoise. Structural damage may prevent normal gear operation.

5.17.4. **Floating.**

5.17.4.1. Cause. Late power reduction, excessive airspeed, or improper flap setting.

5.17.4.2. Effects. Long landing. Possible balloon or bounce.

5.17.4.3. Recovery. Dependent on magnitude of float and runway remaining.

5.17.4.3.1. For a slight float, airspeed permitting, gradually increase pitch attitude as airspeed decreases and landing speed is approached.

5.17.4.3.2. Avoid prolonged floating, especially in strong crosswinds. If a long landing is inevitable, initiate a go-around.

5.17.5. **Ballooning.**

5.17.5.1. Cause. Rapid roundout or flare. Raising the nose to the landing attitude before lift has decreased sufficiently.

5.17.5.2. Effects. Altitude gain (dependent on airspeed and pitch rate).

5.17.5.3. Recovery.

5.17.5.3.1. Landing may be completed from a slight balloon. Hold landing attitude as the aircraft settles to runway. Maintain wing-low crosswind controls through the balloon and landing.

5.17.5.3.2. Go-around from a pronounced balloon. Do not attempt to salvage the landing.

5.17.6. **Bouncing.**

5.17.6.1. Causes.

5.17.6.1.1. Firm or hard touchdown causes aircraft to bounce off runway.

5.17.6.1.2. Contact with ground before landing attitude is attained.

5.17.6.1.3. Late recognition that aircraft is settling too fast, combined with excessive back stick pressure.

5.17.6.2. Effects. Height reached depends on the force with which the aircraft strikes the runway, the amount of back stick pressure held, and the speed at touchdown.

5.17.6.3. Recovery. Same as a balloon, depending on severity of bounce.

5.17.7. **Slight Bounce.** Continue the landing. Maintain direction with wing-low crosswind controls and smoothly adjust pitch to the landing attitude just before touchdown.

5.17.8. **Severe Bounce (Aircraft Rising Rapidly).** Do not attempt a landing from a significant bounce, go-around immediately.

5.17.8.1. Simultaneously apply MAX power, maintain direction, and lower nose to a safe pitch attitude.

5.17.8.2. Continue go-around even if another bounce occurs.

5.17.8.3. Leave the landing gear extended if a hard landing is encountered.

5.17.9. **Bouncing in Crosswinds.** Use extreme caution. When one wheel strikes the runway, the other wheel touches down immediately after. The crosswind correction is lost and the aircraft drifts. Reestablish crosswind controls to stop the drift and either continue the landing or go-around, depending on the situation.

5.17.10. **Landing in a Drift or Crab.** Aircraft contacts the runway in a crab or drifting sideways. Throughout final, flare, and touchdown, in a crosswind, the aircraft should track in a straight line down the runway. With wing-low crosswind controls, align the fuselage with the runway. Insufficient wing-low crosswind controls result in landing with a drift, in a crab, or a combination of both.

5.17.10.1. Cause. Failure to apply sufficient wing-low crosswind corrections.

5.17.10.2. Effects. Excessive side loads on landing gear, potential gear damage.

5.17.10.3. Recovery. Go-around if unable to apply proper crosswind controls before touchdown.

5.17.11. **Wing Rising After Touchdown.**

5.17.11.1. Cause. Lift differential combined with rolling moment. During crosswind landing, air flow is greater on the upwind wing because the fuselage reduces air flow over the downwind wing. This causes a lift differential. The wind also strikes the fuselage on the upwind side, and this causes a rolling moment about the longitudinal axis which may further assist in raising the upwind wing. When effects of these two factors are great enough, one wing may rise even though directional control is maintained.

5.17.11.2. Effect. Depending on the amount of crosswind and degree of corrective action, directional control could be lost. If no correction is applied, one wing can raise enough to cause the other wing to strike the ground.

5.17.11.3. Recovery. Use ailerons to keep the wings level. Use rudder and (or) asymmetric braking to maintain directional control. Aileron is more effective if applied immediately. As the wing rises, the effect increases as more wing area is exposed to the crosswind.

5.18. Emergency Landing Patterns (ELP). The ELP is a 360-degree pattern designed to position the aircraft for landing when the possibility of a power loss exists, power is not available, or only partial power is available. If an engine failure or malfunction in flight requires an ELP, a thorough understanding of T-6 flight performance, emergency procedures, ELPs, and ejection system capabilities, is critical in the decision to eject or attempt an ELP. An ELP might be warranted for a fire warning in flight, engine failure (after takeoff or during flight), or any indication of impending engine failure or unusual engine operation. If there is any doubt about engine performance or there is benefit to remaining in the ejection envelope longer, consider recovering via an ELP. The time available to decide whether to recover via ELP or eject depends on the phase of flight and the severity of the engine malfunction. In the event of an actual engine failure, time available can range from a few seconds (engine failure on takeoff) to over 20 minutes for a high-altitude power loss (HAPL). **Figure 5.4** provides a graphic depiction of factors affecting the decision to continue an ELP attempt or eject. ELPs are only flown to suitable landing areas (hard surface runway, taxiway, under run, or overrun) of sufficient length. Landing on an unprepared surface should only be attempted if ejection is not possible.

5.18.1. **ELP Types.** There are two types of actual ELPs: the forced landing (FL) and precautionary emergency landing (PEL). The primary difference between the two is the availability of power. The ELP profile depicted in **Figure 5.6** is used for both the FL and PEL. The FL is flown with the engine inoperative (no power) and the PEL is flown with power available, although engine failure may be imminent or power available may be less than normal. For training, simulate a feathered prop on simulated forced landings (SFLs) by setting 4-6 percent torque. Likewise on a PEL, when the aircraft is established on proper energy profile, fly the maneuver with 4-6 percent torque. If flown correctly, the FL and PEL look the same.

5.18.2. **ELP Operational Risk Management**

5.18.2.1. **FL.**

5.18.2.1.1. In an actual engine failure scenario, the methodology to descend below the minimum controlled ejection altitude employs the use of the acronym **ORM 3-2-1**.

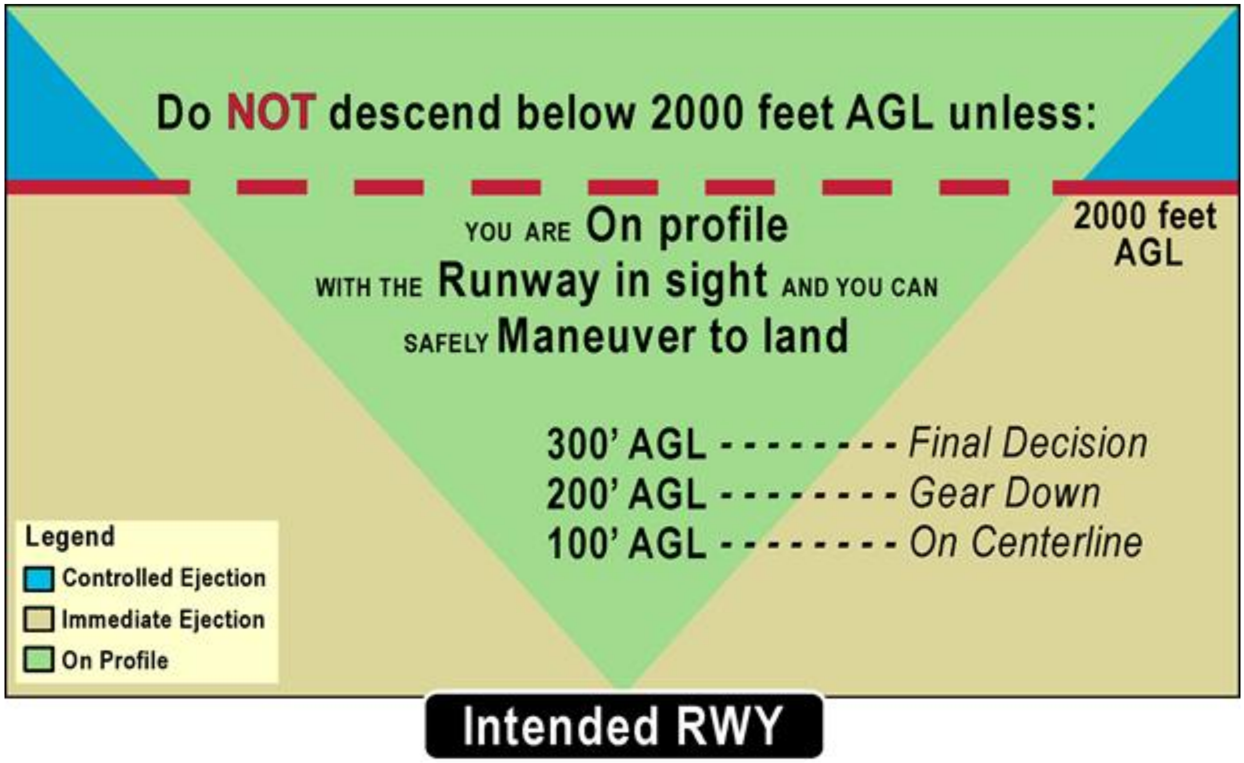
5.18.2.1.2. ORM 3-2-1 means that with an engine malfunction requiring a FL, T-6 aircrews will not descend below 2000 feet AGL unless they are (**O**) on profile for the field of intended landing, with the (**R)** runway in sight and in a position to safely (**M**) maneuver to land. Three hundred feet AGL (3) is the point to make the final decision to continue or eject. At 200 feet AGL (2), the gear will be confirmed and reported down, and at 100 feet AGL (1) the aircraft should be on centerline.

5.18.2.2. **PEL.**

5.18.2.2.1. The recommended minimum ceiling for a PEL is also 2000 feet; however, ORM 3-2-1 is not applicable to PELs.

5.18.2.2.2. In an impending engine failure or unusual engine operation scenario requiring a PEL with questionable weather, the inability to be clear of clouds by 2000 feet AGL does not necessitate immediate ejection. Depending on actual weather conditions, a normal overhead, visual straight-in, or instrument approach may be flown as an alternate means of recovery

Figure 5.4. Forced Landing ORM 3-2-1.



5.18.3. **Initial Actions.** Initial reaction to an engine-related malfunction at low altitude should be to trade excess airspeed for altitude (zoom) according to emergency procedures. If engine failure is suspected above 150 KIAS, initiate a zoom climb using a 2-G pull-up to a 20-degree climb angle until approaching 20 KIAS above the desired glide airspeed, then lower the nose to maintain the desired glide speed. At higher altitudes, the requirement to zoom or simply decelerate to glide speed is based on distance to the selected recovery field. The PEL checklist in the flight manual offers an organized approach to recovery with an engine malfunction, and some of the steps are equally useful for an engine failure in flight. A good memory aid for these steps (PEL checklist) is; "Turn, Climb, Clean, Check, and Boost Pump, Ignition, and Plan (BIP)." Never sacrifice aircraft control in order to TCCC.

5.18.3.1. **Turn.** Turn immediately to the nearest suitable field based on aircraft condition, weather, airfield conditions, altitude, and gliding distance available. In most PEL situations (chip light, low oil pressure, etc.), time is the most critical element. The longer the engine runs, the greater the chance for complete failure.

5.18.3.2. Choosing the Most Suitable Field. Pilot judgment may lead to selection of an airfield that is NOT necessarily the nearest. For example, a usable airfield with a less than 4,000-foot runway may be only a few minutes away, but the situation may warrant a longer glide or use of the engine longer to reach a field that is familiar or has a significantly longer runway, crash crew support, or medical assistance. In no case should the engine-out glide range for the nearer field be exceeded until the aircraft is within engine-out glide range of the desired field. Being at sufficient altitude to be able to make an airfield using an engine-out glide is referred to as "being on profile" or "being in the bubble." Being on profile for a near field and climbing so as to be on profile for a further, but more desirable, field is called "bubble hopping." Winds, weather, and the risks associated with remaining airborne for a longer period of time with potential aircraft problems all need to be weighed before making the decision to bubble hop. In most cases, landing with an operational engine is preferred to performing a forced landing.

5.18.3.2.1. Factors for Consideration. In the event of engine malfunction or failure, there may be more than one airfield within glide distance.

5.18.3.2.2. Select the most suitable based on these factors.

5.18.3.2.3. Distance to airfield.

5.18.3.2.4. Terrain around airfield.

5.18.3.2.5. Runway length, width, direction, and condition.

5.18.3.2.6. Weather.

5.18.3.2.7. Fire or rescue support.

5.18.3.2.8. Emergency oxygen and electrical power supply. Time required for glide from high altitude with engine inoperative may exceed emergency oxygen supply.

5.18.3.2.9. Threat to the public if aircraft must be abandoned.

5.18.3.3. Distance Calculations. A VFR map, conventional NAVAIDs, and GPS airfield, user-defined, and (or) terminal waypoints can be used when judging distance to the selected recovery airfield. The NRST function on the GPS is extremely helpful in providing accurate distance information. Two primary methods used to determine energy state relative to emergency fields are:

5.18.3.3.1. DME Method. A memory aid is "Half-DME + Key."

5.18.3.3.1.1. "Half-DME". Determine distance to field (GPS NRST function). Divide distance by 2. (This is the minimum AGL altitude to reach the field via straight-in glide, no wind, in thousands of feet.)

5.18.3.3.1.2. "+ Key". Add 3,000 feet (high key) or 1,500 feet (low key) to determine AGL altitude required to arrive at the desired key.

5.18.3.3.1.3. Add field elevation to determine MSL altitude required (no wind).

5.18.3.3.2. Altitude Method.

5.18.3.3.2.1. Determine max glide distance: Subtract desired key altitude (3,000 feet for high key or 1,500 feet for low key) from current MSL altitude. Next, subtract field elevation. Finally, multiply this number by 2.

5.18.3.3.2.1.1. This can be expressed as: (Current MSL altitude – desired key altitude – field elevation) x 2.

5.18.3.3.2.2 . Divide by 1000 to determine max glide distance to desired key (no wind). (GPS NRST function).

5.18.3.4. **Climb.** Climb to intercept ELP profile to recovery airfield. Climb (zoom) to trade excess airspeed (greater than 150 KIAS) for altitude and minimize turn radius. If not within engine-out glide distance of high key, use the highest suitable power setting and 140 KIAS to climb (best rate). Once altitude is sufficient to make high key, reduce power to 4-6 percent torque and trim for a 125-knot (minimum) descent. When climbing, do not lose SA or visual contact (if acquired) with the intended landing runway. When determining altitude required for ELP, be sure to account for winds and required turns.

5.18.3.4.1. The preferred method to gain energy is a climb; however, weather conditions may prevent a climb to the required altitude. If unable to climb due to clouds, icing, etc., increase energy by accelerating to a higher airspeed. Remain clear of clouds until in position to descend and (or) decelerate to enter the ELP.

5.18.3.4.2. Ten knots of extra airspeed can be traded for approximately 100 feet of increased altitude. For example, 175 KIAS and 6,000 feet is approximately the same energy level as 125 KIAS and 6,500 feet.

5.18.3.4.3. Ten knots of extra airspeed can also be traded for approximately 1,000 feet of horizontal distance using level deceleration with a feathered propeller (or 4-6 percent torque). For example, a level deceleration from 185 KIAS to 125 KIAS will yield approximately 6,000 feet (or 1 nm) of forward travel.

5.18.3.5. **Clean.** Clean up the aircraft by raising landing gear, flaps, and speed brake (as appropriate for the emergency) as soon as possible. Retraction may not be possible if the engine fails. Remember that excess drag inhibits the climb and greatly reduces gliding range. At optimum glide airspeeds, the drag of extended landing gear reduces the glide ratio (NM divided by 1,000 feet of altitude) from 2:1-1.5:1.

5.18.3.6. **Check.** Check the aircraft. Look at all indications. Continue analyzing the situation and take the proper action while intercepting or maintaining the ELP profile.

5.18.3.7. **Boost Pump, Ignition, and Plan (BIP).**

5.18.3.7.1. Turn boost pump and ignition switches on (as required) for fuel related malfunctions.

5.18.3.7.2. "Plan". The above considerations and energy state should lead to one of four decisions:

5.18.3.7.2.1. Intercept the ELP profile at or above high key.

5.18.3.7.2.2. Intercept the ELP profile at a point other than high key with the appropriate configuration and airspeed.

5.18.3.7.2.3. For FL scenarios, eject when it becomes clear that the aircraft cannot be recovered safely (ORM 3-2-1).

5.18.3.7.2.4. With an engine malfunction, depending on actual weather conditions, a normal overhead, visual straight-in, or instrument approach is highly recommended as an alternate means of recovery.

5.18.4. **HAPL.**

5.18.4.1. **Objective.** Identify the nearest suitable airfield and safely maneuver the aircraft to intercept ELP profile. Arrive at high key aligned with the landing runway. If high key cannot be reached, intercept profile at a point before low key. Make a timely decision to continue or terminate the ELP and eject.

5.18.4.2. **Description.** Loss of power at any altitude above high key altitude.

5.18.4.3. **Airspeed.** Maintain 125 KIAS minimum clean or 120 KIAS minimum with landing gear.

5.18.4.4. **Power.**

5.18.4.4.1. **SFL.** 4-6 percent torque (simulates PCL off).

5.18.4.4.2. **PEL.** Adjust as required until on profile**,** 4-6 percent torque once on profile.

5.18.4.5. **Procedure.** Maintain aircraft control and analyze the situation. Accomplish boldface procedures.

5.18.4.5.1. Carefully manage energy to arrive at high key on altitude. Attempt to dissipate excess energy prior to high key to minimize disorientation and allow the profile to be flown normally. To lose energy, slip, S-turn, lower the gear early, or use a combination of all three. Another method to lose the excess altitude is to make 360-degree turns prior to high key. This is generally accomplished very near or directly over the intended landing destination. Approximate altitude loss for 360-degree turns:

5.18.4.5.1.1. 30-degree bank - 2,000 feet.

5.18.4.5.1.2. 45-degree bank - 1,500 feet.

5.18.4.5.1.3. 60-degree bank - 1,000 feet.

5.18.4.6. **Glide Performance.** A clean glide at 125 KIAS approximates best glide range. For no-wind planning, a clean aircraft (prop feathered or 4-6 percent torque set) at 125 KIAS should glide 2 miles for every 1,000 feet of altitude lost (2:1 glide ratio), with a VSI of approximately 1,350-1,500 fpm.

5.18.4.6.1. Check the descent rate after setting 4- to 6-percent torque (clean configuration). If the VSI is greater than 1,500 fpm, increase torque to achieve a 1,350 fpm descent. If power is insufficient to achieve a descent rate less than 1,500 fpm, consider shutting down the engine to improve glide performance. If Np is less than 100%, traditional torque values are no longer a valid indicator of thrust. Crews will need to find what torque will give them a rate of descent of 1350-1500 fpm then utilize that torque during the PEL.

5.18.4.6.2. If time permits, use DME or GPS to confirm the actual glide ratio. Consider winds and required turns. Adjust the plan if actual glide distance varies from expected.

5.18.5. **Slips.**

5.18.5.1. **Objective.** Dissipate energy to achieve ELP profile while proceeding in a desired direction.

5.18.5.2. **Description.** A slip is uncoordinated flight used to increase the sink rate and lose altitude with a constant airspeed and ground track.

5.18.5.3. **Procedure.** May be used at any point in an actual ELP; however, it is potentially dangerous in a configured T-6 close to the ground. Caution must be exercised, since stall speed is greatly increased in this uncoordinated flight condition. The slip must be taken out with enough altitude remaining **(**300 feet for training) to slow the rate of descent and ensure positive control of the aircraft during the final moments of the maneuver. Lower one wing and apply opposite (top) rudder pressure. Monitor airspeed closely and adjust nose attitude as necessary to maintain 125 KIAS (120 KIAS configured). Monitor the VSI and note the increased rate of descent. In a full slip, the rate of descent may be in excess of 2,000 fpm. As a guideline, keep the nose below the horizon in a full slip. During aggressive slips, a fuel low light may come on but should extinguish after the slip maneuver is terminated. If the pilot reverses the control inputs (opposite rudder and aileron), without first neutralizing controls to reverse the turn direction, the aircraft may depart controlled flight. Use extreme caution when reversing control inputs during slip maneuvers.

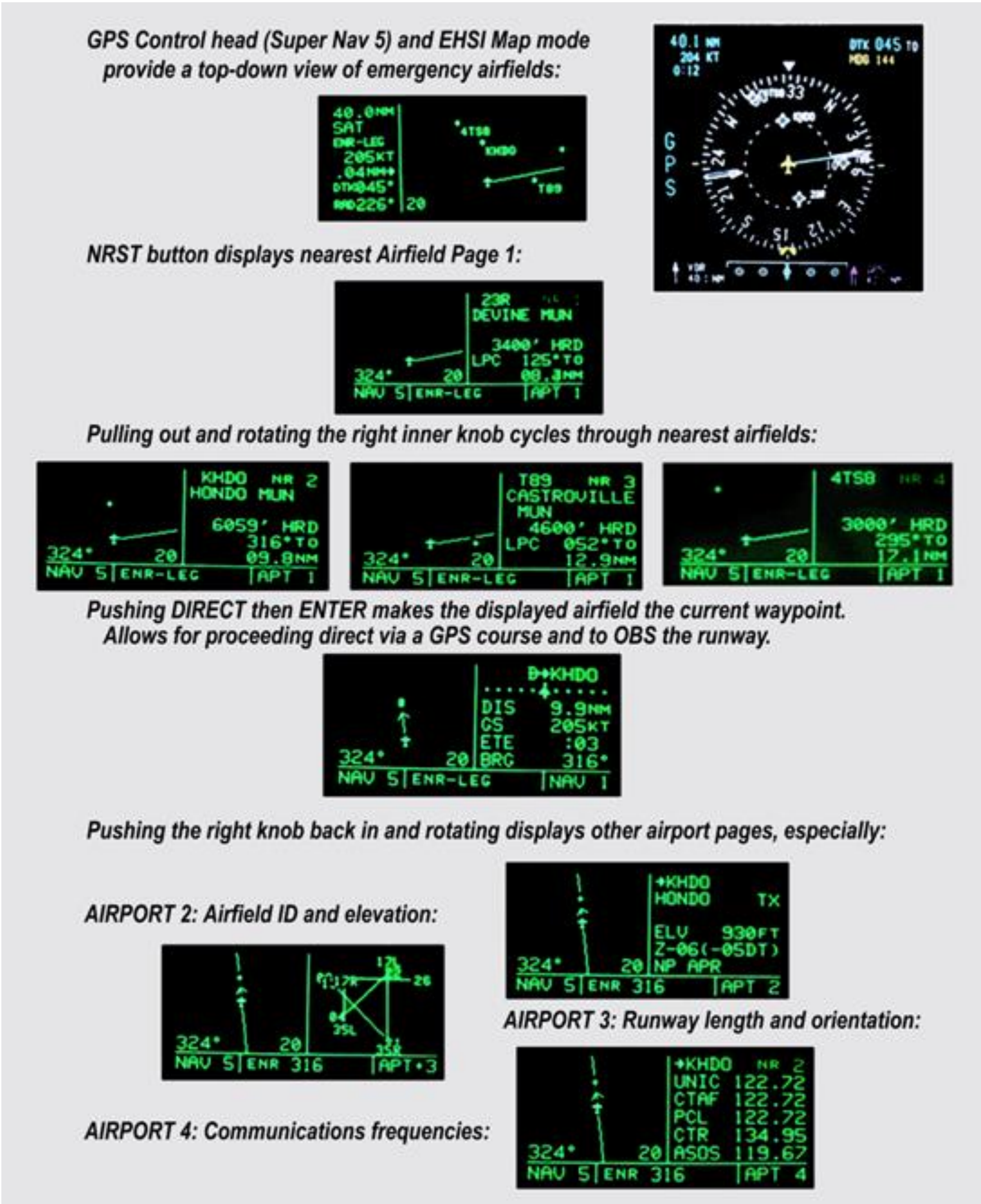
5.18.5.3.1. **Straight Ahead.** Select a reference point on the horizon and adjust rudder pressure and (or) the AOB to keep the nose on the point.

5.18.5.3.2. **Turning.** Lower the inside wing while increasing opposite (top) rudder pressure. It is necessary to vary the AOB and rudder pressure to maintain the desired ground track.

5.18.5.3.3. **Recovery.** Smoothly roll the wings toward level while reducing rudder pressure. The slip must be taken out with enough altitude remaining to slow the rate of descent and ensure positive control of the aircraft during the final moments of any maneuver in which it is used.

5.18.6. **GPS Use on HAPL/ELPs (Figure 5.5).** The GPS can provide vital information, but do not sacrifice aircraft control or profile maintenance in an attempt to get GPS information that you do not need to safely recover the aircraft. Although the NRST function may provide quick information about an airfield, other resources such as the In-Flight Guide may also provide the required executable data.

Figure 5.5. GPS Use During HAPL/ELPs.



5.18.7. **Flying an ELP.**

5.18.7.1. **Objective.** Safely land from high key or low key.

5.18.7.2. **Description.** The ELP is a 360-degree pattern designed to position the aircraft for landing for an FL, SFL, or PEL. See **Figure 5.6** and **Table 5.2.**

5.18.7.3. **Airspeed.** Maintain 125 KIAS (minimum) clean or 120 KIAS (minimum) configured. A higher airspeed may be used while flying the ELP to increase drag and decrease energy, but caution must be used to adhere to gear and flap limiting speeds.

5.18.7.4. **Power.**

5.18.7.4.1. **SFL.** 4-6 percent torque. Do not adjust power throughout the profile unless safety of flight is jeopardized.

5.18.7.4.2. **PEL.** Adjust power as required according to the flight manual until on profile, 4-6 percent torque on profile.

5.18.7.5. **Procedures.**

5.18.7.5.1. Planning. The primary reference during an ELP is the runway. Cross-check energy level (altitude, airspeed) with position. Look outside to maintain or attain proper ground track. Predict energy level (altitude/airspeed) at known reference points (cross key, low key, base key, etc.) and anticipate required corrections.

5.18.7.5.2. Energy Corrections.

5.18.7.5.2.1. High Energy.

5.18.7.5.2.1.1. For an (S)FL, correct for high energy by modifying ELP ground track, slipping the aircraft, and/or adding drag devices early.

5.18.7.5.2.1.2. For a PEL, correct with a power reduction or utilize any of the options applicable to an FL.

5.18.7.5.2.2. Low Energy.

5.18.7.5.2.2.1. For an (S)FL, correct for low energy by delaying landing gear or flap extension, intercepting the ELP at some point other than high key (low key, base key, final), and (or) adjusting pattern ground track.

5.18.7.5.2.2.2. For a PEL, use power to correct for a low-energy state as soon as it is recognized (if the severity of an actual engine malfunction allows). After correcting back to profile, reset 4-6 percent torque. **Note:** Emphasis should be on safely maneuvering the aircraft on proper profile and airspeed, versus precisely resetting 4-6 percent torque.

5.18.7.5.3. Ground track management. Look outside to maintain or attain proper ground track. Position deviations can occur due to poor planning, imprecise aircraft control, or improper wind analysis. Trim throughout the ELP to minimize airspeed deviations. Make all corrections smooth and expeditious to avoid stall.

5.18.7.6. **High Key Placement.**

5.18.7.6.1. Offset Method. Use approximately one-quarter wingtip distance (WTD) displacement from the runway, away from the intended ELP turn direction. For example, if making a right turn out of high key, displace to the left of the runway approaching high key. Place the runway just above the canopy rail as an approximation for one-quarter WTD. The exact amount of displacement is not critical, but the goal is to be able to see the runway to determine high key position.

5.18.7.6.2. Overhead Method. Establish high key position directly over the runway. If a bank is required to check for position relative to the runway, use caution to avoid drifting in the direction of any potential traffic conflicts.

5.18.7.7. **High to Low Key.**

5.18.7.7.1. If on profile at or prior to high key, lower the landing gear.

5.18.7.7.2. Turn and use AOB as necessary toward low key.

5.18.7.7.3. If using offset method: Approximately 20-degree bank - no wind.

5.18.7.7.4. If using overhead method: Approximately 30-degree bank - no-wind.

5.18.7.8. **Cross Key.** Check for 2,200-2,300 feet AGL, with the aircraft approximately perpendicular to the landing runway. If excessively high or low, check for proper power setting and (or) configuration. Otherwise, evaluate airspeed, bank angle, and winds to determine cause of altitude deviation.

Figure 5.6. Emergency Landing Pattern (Typical).

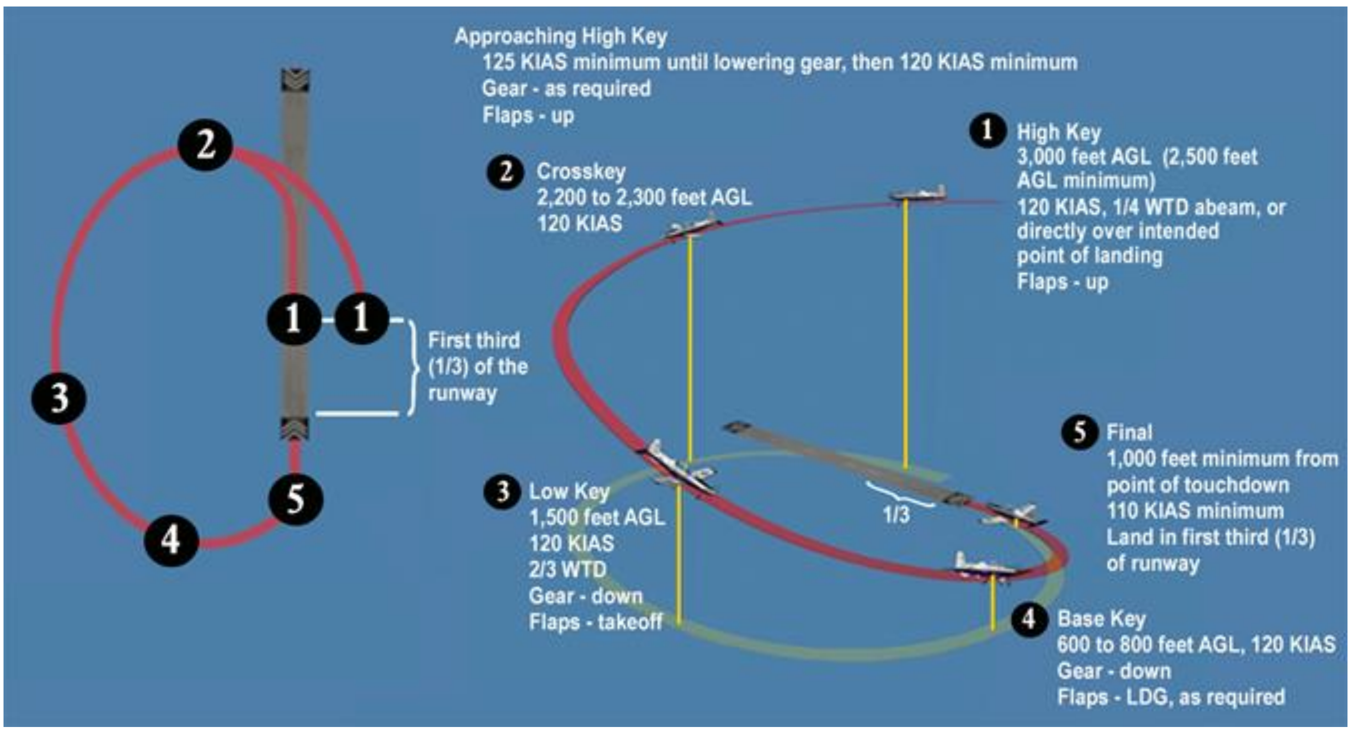


Table 5.2. Checkpoints for ELP.

Checkpoint	Target Altitude	Airspeed	Target Configuration (Note 1)	Position Description
High key	3,000 feet AGL (note 2)	120 KIAS **minimum** (note 3)	Gear down	1/3 down planned RWY. 1/4 WTD abeam, or directly over intended point of landing. RWY heading or aligned with landing direction. Wings level (note, 4)

Cross key	2,200-2,300 feet AGL	120 KIAS **minimum** (note 3)	Gear down	Halfway from high key to low key, approximately perpendicular to the landing runway.
Low key	1,500 feet AGL	120 KIAS **minimum** (note 3)	Gear Down, flaps TO (as required)	2/3 WTD abeam intended point of touchdown. Fuel cap on RWY (note 4)
Base key	600-800 feet AGL	120 KIAS **minimum** (note 3)	Gear down, flaps LDG (as required) (note 5)	Halfway between low key and final
Final	N/A	110 KIAS (**minimum**)	Gear down, flaps LDG as required (note 5)	Plan for 1,000-foot (minimum) final prior to the intended point of touchdown. (Note 6)

Notes:

1. If below target altitude on an FL or SFL, delay configuration changes only until on profile. If below target altitude on a PEL, immediately add power to get back on profile (if the severity of an actual engine malfunction allows) prior to extending gear or flaps. The goal is to correct deviations early to arrive at checkpoints on target altitude and in the proper configuration.

2. 3000 feet AGL is ideal; however, high key may be as low as 2500 feet AGL.

3. Or on-speed AoA, whichever is higher.

4. All WTDs are approximate and based on 10 knot headwind conditions.

5. Strive to set LDG flaps, but use flaps as required to ensure aircraft will not touch down short of the runway. Flaps can be lowered after landing is assured or after touchdown if stopping distance is critical. Not recommended in gusty wind conditions unless an actual emergency condition exists. Landing flaps are discouraged with crosswinds greater than 10-knots due to the potential stresses the side loads impart on the landing gear. If landing flaps are appropriate for the existing conditions (i.e., runway length, required training objectives, etc.), the crosswind limit for landing flaps is 25 knots.

6. The intended point of landing is within the first one-third of the RWY with landing flaps extended, on centerline, touching down on-speed.

5.18.7.9. **Low Key.**

5.18.7.9.1. Low key is located approximately two thirds WTD (fuel cap on runway), abeam the intended point of touchdown with approximately 10 knots of headwind, however, the pilot must adjust the low key position based on wind, runway length, presence of additional suitable landing area (taxiway, under/overrun). In any case, plan on arriving at the selected low key at approximately 1,500 feet AGL and 120 KIAS minimum.

5.18.7.9.2. Approaching low key, cross-check the runway to evaluate spacing. Estimate wind and plan accordingly.

5.18.7.9.3. At low key, level the wings momentarily and check for proper spacing and altitude. Avoid excessive wings level time and use caution if past abeam to the last usable landing surface. This is especially important if there will be a strong headwind component on final. If energy is assessed to be adequate to make the runway, lower TO flaps.

5.18.7.9.4. For low to base key, maintain 120 KIAS minimum. The descent rate is normally greater than for a normal pattern. Fly the aircraft perpendicular to the runway (base key) at 600-800 feet AGL. Altitude is not the only indication of proper energy management; the distance from the runway must also be assessed and the effect of winds taken into account. When landing is assured, lower flaps to LDG.

5.18.7.9.5. Hold the aim point (500-1,000 feet short of intended landing point--no wind) and observe the airspeed. If the airspeed is increasing above 120 KIAS, it is a good indication that the energy state is sufficient to reach the landing point. Consider the winds and lower LDG flaps.

5.18.7.10. **Final.** Attempt to intercept final a minimum of 1,000 feet from the intended point of touchdown. This allows time for stabilization of descent rate and evaluation of the runway. Aircraft may be slowed to 110 KIAS (minimum) on final. Maintain 110 KIAS (minimum) on final until transition to landing. The transition to landing may begin well prior to the intended point of touchdown.

5.18.7.11. **Landing.** Adjust the nose attitude in the roundout to transition to a normal landing. Touchdown on the main gear and then gently lower the nose wheel as in a normal landing. Apply braking based on runway remaining.

5.18.7.11.1. **FL.** Anticipate a longer flare and touchdown due to reduced drag. Use caution when applying brakes to prevent blown tires. If the aircraft cannot be stopped before the EOR, execute the aircraft departs prepared surface checklist or eject.

5.18.7.11.2. **SFL.** Anticipate a longer flare and touchdown because the PCL is not reduced to idle when landing is assured. Reduce the power to idle upon touchdown during full-stop landings.

5.18.7.11.3. **PEL.** Reduce power to idle after carefully determining that landing is assured. If runway remaining after touchdown is insufficient to stop, go around. If sufficient power is available to obtain low key, reattempt PEL. If power is insufficient or the engine is not reliable, consider ejection.

5.18.8. **ELP Wind Analysis.** Winds can cause ELPs to differ significantly from standard. An unanticipated strong wind or one for which there is no appropriate correction made can result in an unsuccessful ELP, even if it was otherwise flawlessly flown.

5.18.8.1. Determining Winds. Surface winds, winds at 1,000 to 3,000 feet, winds at 5,000 feet and winds aloft should be obtained from weather forecasts and serve as a good starting point for building SA about actual wind conditions. The winds at 1,000 to 3,000 feet can vary significantly from surface winds and significantly alter required ELP ground track. At tower or RSU-controlled runways, actual surface winds are known. Other ways to determine the winds include:

5.18.8.1.1. Radio calls to other aircraft, a fixed base operator (FBO) on the field, etc.

5.18.8.1.2. Without access to actual observations, use winds briefed by weather forecaster in the preflight briefing as a starting assumption.

5.18.8.1.3. If performing an ELP at a non-towered airfield without weather observation capability, assume that in the local area, surface winds will be similar to those at the home field.

5.18.8.1.4. Observation of surface conditions: smoke, waves on lakes, wind tetrahedron, windsock, etc.

5.18.8.1.5. Double the surface wind velocity to estimate winds at high key as wind is typically stronger at altitude than at the surface.

5.18.8.1.6. Use GPS groundspeed and cross-track error (flying an OBS course).

5.18.8.2. Techniques for Wind Correction.

5.18.8.3. Crosswinds. If there is an option to turn in either direction, consider the following:

5.18.8.3.1. Turning Away from the Wind at High Key. Adjust low key spacing. Although there is a tailwind initially, the headwind departing low key allows more time for decision making during the last, critical stages of the ELP, but could result in a low energy situation. Remember, "base, wind in your face."

5.18.8.3.2. Turning into the Wind at High Key. Adjust low key spacing. The turn from low key will be aided by the crosswind component. Although this compresses the time from low key to final and can result in an overshoot, it can provide an extra energy cushion.

5.18.8.4. Headwinds. Move the high key position into the wind 1,000 feet for every 10 knots of wind. Start the turn from low key to base key earlier than normal and use an aim point closer to the intended point of touchdown. Expect a shorter and steeper final. Consider delaying lowering of full flaps longer than you would for no-wind conditions.

5.18.9. **ELPs Through Weather.**

5.18.9.1. **Objective.** Perform an ELP through the weather.

5.18.9.2. **Description.** Descending through the clouds for an FL requires an evaluation of reported ceiling and visibility, runway length, familiarity with the field, local obstructions, minimum safe altitudes, and pilot proficiency. Anytime a weather penetration is required, give serious consideration to ejecting instead of attempting an FL through the weather. If attempting an FL through the weather, first plan to go to high key for a normal ELP if the weather allows for VMC at high key. If the weather will not allow for VMC at high key, two methods to use are the standard ELP from high key and the high-speed ELP.

5.18.9.3. **Procedures.**

5.18.9.3.1. ELP from High Key. The concept behind this method is to fly the ELP as normally as possible, using the GPS rather than visual references for ground track control. Use the GPS to navigate to high key (**Figure 5.5**). Use the standard 125-knot glide and turns as necessary to achieve the appropriate altitude upon reaching high key. Assuming there is weather all the way down to 2,000 feet AGL, attempt to maintain the standard ELP ground track by turning to achieve a displacement of 0.7-1.0 miles when abeam high key after completing the turn. If VMC is not encountered until low key, this method should still place the aircraft fairly close to the proper ELP ground track. However, it does not provide any maneuvering capability to correct if you are not on the proper ground track. Once VMC is encountered, attempt to intercept and maintain the proper ground track visually.

5.18.9.3.2. High-speed ELP. The concept behind this method is to arrive just below the weather with excess airspeed, which will allow maneuvering to intercept the ELP at or prior to an appropriate low key position. Establish a standard 125-knot glide toward the GPS data point representing high key and maintain 125 knots until reaching a 1:1 glide ratio, which is an altitude equal to distance to the field + low key (MSL). For example, if the field elevation is 1,000 feet, look for 12,500 feet at 10 miles. Use "DME + Low Key (MSL)" for a high speed ELP memory aid. Upon reaching the target altitude, set 10 degrees nose low and descend at 1000 feet per nautical mile until breaking out of the weather. The resulting airspeed could be as high as 230 knots. Once in VMC conditions, level off at a point to stay clear of clouds, assess position, and maneuver to intercept the ELP at an appropriate ground track point and altitude. If not clear of clouds by low key altitude on a PEL, seriously consider discontinuing the ELP.

5.18.9.4. **Techniques.** If there is a published GPS approach for the runway selected, consider loading that approach and OBS off the missed approach data point to estimate high key. (Use runway bearing as the OBS course.) If no approach is available, estimate high key using the airfield as the data point.

5.18.10. **Additional Options for ELP Training**

5.18.10.1. **Break to Low Key.**

5.18.10.1.1. **Objective.** A method to practice an ELP starting at low key; usually performed when weather precludes starting the maneuver from high key or to expedite training.

5.18.10.1.2. **Description.** An intentional climbing break turn, commenced in the normal break zone, arriving at the low key position, in the normal low key configuration.

5.18.10.1.3. **Procedure.** On initial, make a radio call to the RSU/tower requesting a break to low key.

5.18.10.1.3.1. When approved by RSU/tower, and IAW local procedures, reduce power as necessary to make a decelerating, climbing turn toward low key.

5.18.10.1.3.2. After decelerating below 150 KIAS, lower gear and TO flaps. Use power as required to maintain 120 KIAS (minimum) until arriving at low key. At low key, set 4-6 percent torque and continue with normal ELP procedures.

5.18.10.1.4. **Technique.**

5.18.10.1.4.1. Break closer to the end of the break zone to allow for ELP task management. For energy management purposes, consider leaving torque set at approx. 52% until half way through the break turn, then set 4-6%. Done properly, energy should be appropriate at low key.

5.18.10.2. **Closed Pull-up to Low Key.**

5.18.10.2.1. **Objective.** A method to practice an ELP starting at low key; usually performed when weather precludes starting the maneuver from high key, or to expedite training.

5.18.10.2.2. **Description.** A climbing turn to 1500 feet AGL from initial takeoff, touch-and-go landing, or go-around, flown similarly to a closed pull-up. Minimum airspeed is 140 KIAS; maximum bank is 90 degrees. Arrive at the low key position, in the normal low key configuration.

5.18.10.2.3. **Procedure.**

5.18.10.2.3.1. At 140 KIAS (minimum) and according to local directives, request clearance for low key. When approved, clear for traffic, advance the PCL smoothly to MAX, and start a climbing turn toward low key, initially using approximately 45-60 degrees of bank.

5.18.10.2.3.2. Upon reaching 1500 feet AGL, use power as required, confirm proper spacing, and report high downwind per local guidance.

5.18.10.2.3.3. After decelerating below 150 KIAS, lower gear and TO flaps. Use power as required to maintain 120 KIAS (minimum) until arriving at low key. At low key, set 4-6 percent torque and continue with normal ELP procedures.

5.18.10.3. **Zero-torque ELPs.** An ELP flown with excessive prop drag (greater than that of a feathered prop) will require more nose-down pitch to maintain airspeed, resulting in excessive descent rates and altitude loss. Excessive prop drag may be caused by (1) inadvertently setting the PCL to less than 4 percent torque during a PEL or simulated FL training, (2) a mechanical malfunction resulting in an unfeathered prop after engine shutdown, or (3) excessive prop drag from a propeller malfunction with a running engine. Practicing an ELP with zero torque simulates these conditions.

5.18.10.3.1. **Objective.** Demonstrate the effects of excessive prop drag on an ELP, and stress the importance of cross-checking power setting during ELP training.

5.18.10.3.2. **Description.**

5.18.10.3.2.1. Airspeed - 120 KIAS (minimum).

5.18.10.3.2.2. Power.

5.18.10.3.2.2.1. High key. Zero percent torque; then power as required to arrest descent to low key.

5.18.10.3.2.2.2. Low key. Zero percent torque; then power according to go-around procedures.

5.18.10.3.2.3. Gear - Down.

5.18.10.3.2.4. Flaps - Up at high key; TO at low key.

5.18.10.3.3. **Procedure.**

5.18.10.3.3.1. This demonstration may be conducted by starting from high key or low key.

5.18.10.3.3.2. Fly to normal high key altitude, configure with gear, and set the PCL to idle. Notice the pitch attitude required to maintain 120 knots. At the halfway point between high key and low key, altitude loss should normally be approximately 750 feet. Note the actual loss. If allowed to continue, the altitude loss at low key would be excessive, potentially resulting in an energy deficient situation. For training purposes and to allow the demonstration to safely continue, add power to arrive at low key on altitude.

5.18.10.3.3.3. Fly to a normal low key, lower flaps to TO, and set power to idle. Notice the pitch required to maintain 120 knots and rapid altitude loss. The pitch attitude required to maintain 120 knots from low key to final will be significantly lower than normal. Due to excessively nose low pitch attitudes and descent rates throughout the maneuver, initiate a go-around with a minimum of 200 feet AGL in accordance with AFI 11-2T-6, Volume 3.

Chapter 6

CONTACT

6.1. Introduction. Contact flying develops the skills and techniques necessary for success in every other type of flying. The use of outside references emphasizes the composite cross-check. Basic skills, such as checklist use, systems operation, task management, and cockpit organization are introduced and developed in preparation for more complex sorties. The basic maneuvers learned and practiced in contact are the basis for all other flying. Furthermore, understanding the difference between approach to stall conditions and a full aerodynamic stall increases safety—both in the traffic pattern and during area work. Instrument training in the aircraft is only accomplished after the basics of flight are learned in the contact phase. Formation cannot be learned without an understanding of the advanced maneuvering concepts developed through aerobatic practice. Energy awareness, position awareness, and overall SA developed in three dimensional contact maneuvering are universally applicable.

6.2. Checks. Accomplish appropriate checks before performing maneuvers. Checks are not required between individual maneuvers if flown in a series.

6.2.1. Tactically, a FENCE check is typically performed when entering or exiting a hostile area. It ensures aircraft systems are set for combat. To instill an easily transferable habit pattern, during T-6 training, a FENCE check is performed when entering the MOA (FENCE-in) and again when leaving the MOA (FENCE-out). **FENCE** in the T-6 stands for:

6.2.1.1. **F** - Fuel (balance and quantity).

6.2.1.2. **E** - Engine (within limits); **E** - Review emergency airfield operations

6.2.1.3. **N** - NAVAIDs (GPS/EHSI set)/TAS (check range setting and clear the airspace).

6.2.1.4. **C** - Communication (frequencies set, radio call according to local directives); **C** - Checks complete (climb, ops, pre-stall, spin, aerobatic, descent).

6.2.1.5. **E** - Equipment (G-suit test (as required), loose items stowed). Emergency airfield options reviewed.

6.2.2. A **CLEF** check is an excellent memory aid for checklist steps required prior to stalling, spinning, or aerobatic maneuvers.

6.2.2.1. **C** - Clear the area (also CWS panel clear).

6.2.2.2. **L** - Loose items stowed.

6.2.2.3. **E** - Engine (within limits).

6.2.2.4. **F** - Fuel balance (within 50 pounds).

6.3. Maneuvering at Increased G Loading. During contact flying, especially during aerobatics, G loading changes constantly. To avoid gray out, blackout, or G-induced loss of consciousness (GLOC), an effective anti-G straining maneuver is essential. Physical fitness, adequate rest, and proper hydration can improve G tolerance. The most intense G loading changes occur during maneuvers that start in a very nose-down attitude at relatively low airspeed but transition to high G at increasing airspeeds, such as nose-low recoveries, spin recoveries, and split-S maneuvers. An effective anti-G straining maneuver (AGSM) is essential. Perform a G-awareness exercise or AGSM demonstration before accomplishing any maneuver that may require three or more Gs.

6.3.1. **Anti-G Straining Maneuver (AGSM).** Accomplish the AGSM by firmly contracting muscles of the legs, abdomen, and chest. As the amount of G increases, increase the intensity of the strain, and attempt to exhale through a closed airway. Continue to strain and simultaneously breathe approximately every 2-3 seconds. Think of the AGSM as a continuum. As the amount of G increases, increase the intensity of the strain and pay careful attention to proper breathing technique. Do not hold the strain too long (more than 3 seconds) without breathing as this reduces G tolerance. If gray out occurs at the onset of G forces, application of the AGSM may not eliminate the gray out. If altitude and (or) airspeed are not critical, return to 1 G flight, reapply the anti-G strain, and then continue maneuvering. Use caution not to exceed aircraft or personal G limits.

6.3.1.1. **AGSM Effectiveness.** It is important to start the AGSM before the onset of G forces and maintain the strain throughout the period of increased G loading. The amount of strain required varies with the amount of applied G force. An effective AGSM uses full muscle contraction and keeps constant breathing cycles. Lower G situations still require all elements of a full AGSM but at a lower level of strain intensity.

6.3.1.2. **AGSM Demonstration.** The AGSM demonstration allows practice of the anti-G strain technique and familiarization with increased G loading in a controlled setting. The demonstration consists of a series of turns, each at a constant G level, with a break between turns for critique and rest. The maneuver is flown at gradually increasing G levels, starting at 2 Gs and increasing to 4 Gs, depending on proficiency. If, at any time, personal G-tolerance limits are approached, inform the other crewmember. The demonstration should be of sufficient duration to ensure a proper AGSM. The AGSM cycle should last from 10-15 seconds with at least 4 to 5 breathing cycles.

6.3.2. **G-awareness Exercise.** Accomplish a G-awareness exercise on sorties that include maneuvers that require or may result in 3 or more Gs.

6.3.2.1. The G-awareness exercise should be a level or slightly descending turn, using maximum power. Begin the maneuver with sufficient airspeed to sustain 4 Gs. (For planning purposes, use approximately 200-220 knots minimum for a level to slightly descending turn where the nose remains within 10 degrees of the horizon.) The G-onset rate should be slow and smooth, allowing sufficient time to evaluate the effectiveness of the AGSM and determine G tolerance. Increase Gs to approximately 4 Gs and maintain for approximately 4-5 breathing cycles in order to allow full cardiovascular response.

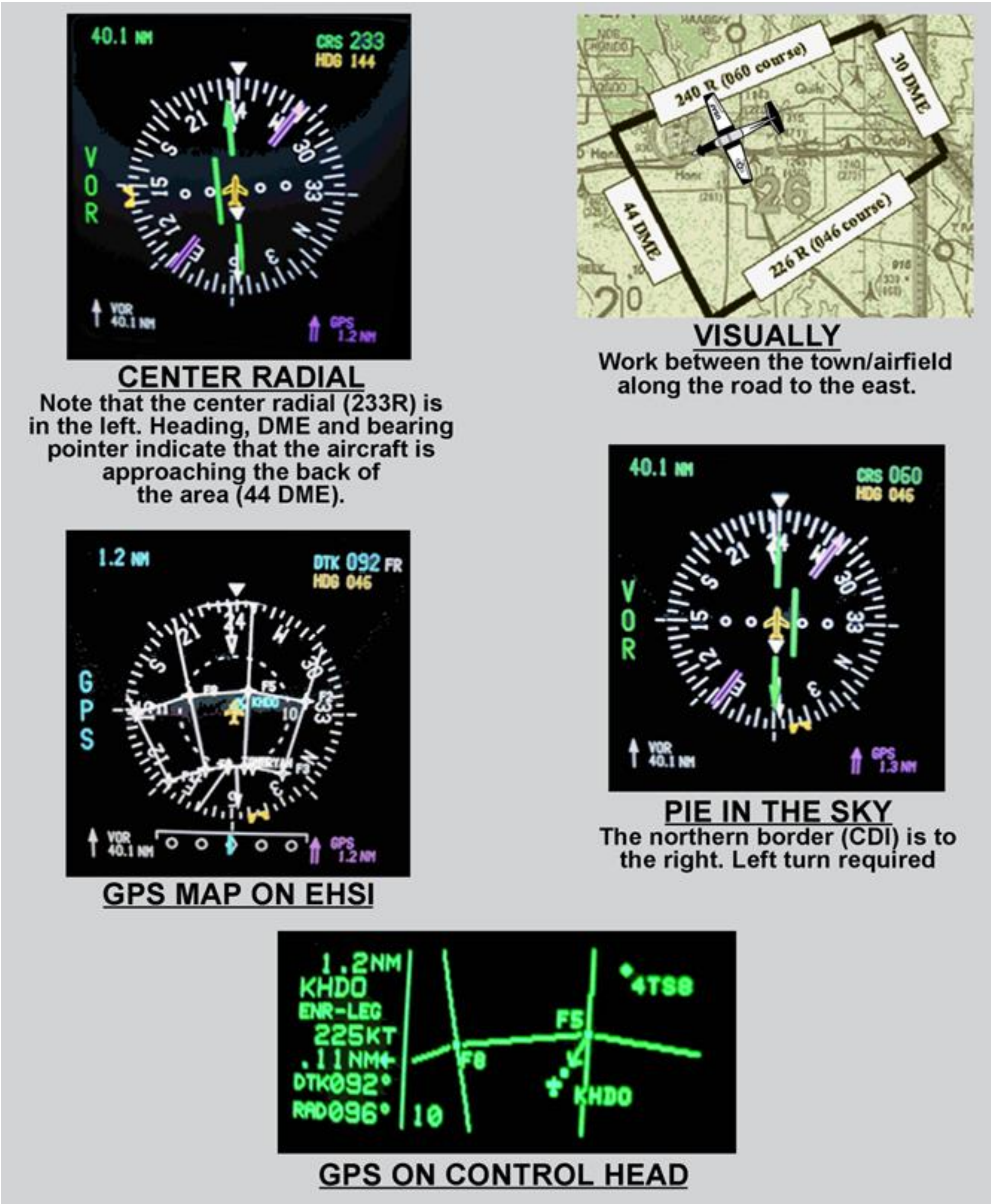
6.3.2.2. For advanced aerobatic and formation training, the G-awareness exercise should be flown to G loads of 4-5 Gs.

6.3.2.3. If gray out begins during the demonstration, return to 1 G flight, reevaluate the strain, and then smoothly reenter the G-awareness exercise.

6.3.2.4. If personal G tolerance is deemed insufficient for the sortie, terminate high-G maneuvering and consider terminating the mission.

6.4. Area Orientation (Figure 6.1.). Visual ground references such as cities, lakes, road intersections, terrain, etc., are the primary means of maintaining area orientation. When visual references are inadequate, or to augment visual orientation, the GPS or VOR with DME may be used. A good composite cross-check of ground references verified by instruments is an effective way to maintain or build SA.

Figure 6.1. Area Orientation.



6.4.1. **VOR/DME.** Area boundaries are sometimes defined with VOR radial and DME. There are two primary methods to maintain area orientation that utilize VOR or DME.

6.4.1.1. **Center Radial (Course) Method.** Set the center radial or center course of the area in the course selector window (CSW) of the EHSI. When center radial is set, the course arrow points away from the NAVAID; when center course is set, the course arrow points toward the NAVAID. The center of the area (laterally) is always toward the course deviation indicator (CDI). This method is best suited for areas that are 20 radials wide or less.

6.4.1.2. **Pie-in-the-sky Method.** Best used in wide areas (20 radials wide or more). Set one boundary (course) in the CSW and mark the other boundary (course) with the heading marker. Keep the head of the bearing pointer, which always falls, between the head of the course arrow and the heading marker. In **Figure 6.1**, if heading remains constant, the aircraft will exit the area due to the DME range. A left turn to approximately 130 degrees makes the bearing pointer fall toward the 046-degree course and makes the DME decrease.

6.4.2. **EFIS and GPS Display Options.** There are various possible configurations for the EFIS and GPS. Normally, a typical display setup is used until proficiency is demonstrated (the Super Nav 5 page of the GPS control head in conjunction with the VOR and visual references). After demonstrating proficiency, other display options may be used to optimize SA and precise control of the aircraft. These include using the EFIS GPS map mode on the HSI. The arc mode may also be utilized to provide a more detailed picture.

6.5. Energy Management. Efficient energy management allows the sortie profile to be accomplished with minimum wasted time and fuel. Energy level is defined by airspeed (kinetic energy) and altitude (potential energy) and is manipulated with power, drag, and G loading. Plan maneuvers in an order that minimizes the requirement for deliberate energy changes, and make use of the inherent energy gaining or losing properties of individual maneuvers.

6.5.1. **Altitude and Airspeed Exchange.** Potential energy (altitude) and kinetic energy (airspeed) can be traded; for example, 1,000 feet of altitude equals approximately 50 knots of airspeed with the canopy bow on the horizon and power at maximum. Techniques include:

6.5.1.1. Altitude for airspeed - MAX power with the canopy bow on the horizon.

6.5.1.2. Airspeed for altitude - MAX power, wings level, and clock on the horizon.

6.5.2. **Optimum Energy Level.** In a typical MOA, optimum energy for aerobatic maneuvering is 180-200 KIAS at an altitude midway between the top and bottom area limits. Energy planning may need to be altered if the airspace is limited by weather, ATC restrictions, or other limiting factors.

6.5.3. **Losing Energy.** Energy may be decreased with low power settings, increased drag (for example, speed brake), or increased AOA (G loading). A simple way to lose energy is to perform a constant speed descent until the desired energy level is reached.

6.5.4. **Gaining Energy.** Energy gain is enhanced with low AOA (avoid flight near zero G) and high power. The best method to gain large amounts of energy is a climb at 140-160 KIAS with MAX power.

6.5.5. **Energy Planning.** Individual maneuvers are energy gainers, energy losers, or neutral. Energy losers include spin, traffic pattern stalls, cloverleaf, split-S, nose-low recovery ELP stalls, and high G turns with lower power settings. Energy gainers include power-on stalls, nose-high recovery, stability demonstration, and Chandelle. Constant awareness of total energy state aids in correct maneuver selection and effective profile management which allows a smooth flow between maneuvers with minimum delay. For example, airspeed exiting a Cuban Eight will be very close to entry airspeed for a loop. Another example: if trying to exit the area for return to base (RTB) at the bottom of the area, have sufficient energy near the end of the profile to accomplish ELP stalls as the last item. ELP stalls lose energy, and the lower altitude and slow airspeed at the completion of the maneuver may help expedite recovery.

6.6. Power-on Stalls.

6.6.1. **Objective.** Proper recognition of a full aerodynamic stall. Proper recovery with minimum loss of altitude. Recognizing secondary stall if entered and properly recovering.

6.6.2. **Description.** Aircraft pitch and bank angle held constant until control effectiveness lost indicated by uncommanded nose drop or unplanned rolling motion. Recover to a wings level, climbing attitude. An entry speed of 160 KIAS results in about 1,500-2,000 feet altitude gain.

6.6.2.1. Airspeed - As required to achieve desired pitch, power, and bank.

6.6.2.2. Power – Entry: 30-60 percent torque. Recovery: MAX.

6.6.2.3. Pitch – Entry: 15-40 degrees nose high.

6.6.2.4. Bank - 0 degrees for straight-ahead stall, 20-30 degrees for a turning stall.

6.6.2.5. FCP visual reference – Entry: crook of front windscreen on horizon.

6.6.2.6. FCP visual reference - Recovery: initially firelight on horizon, then as required to MAX perform aircraft.

6.6.3. **Procedure.** Clear the area. Pay particular attention to the area above and in front of the aircraft.

6.6.3.1. **Straight-ahead Stall.** Raise the nose to a pitch attitude between 15 degrees and 40 degrees. Adjust the PCL to 30-60 percent torque prior to first indication of stall. Maintain attitude using increasing back pressure. Keep the wings level with coordinated rudder and aileron. Initiate recovery when control effectiveness is lost. An uncommanded nose drop, despite increased back pressure, or an uncommanded rolling motion indicates loss of control effectiveness. Do not attempt to maintain pitch attitude or bank angle after control effectiveness is lost. In almost all cases, full aft stick will not occur before recovery is required. While it is possible under certain conditions to maintain a nose high pitch attitude and counteract a rolling motion with aileron inputs, if the stick has reached the aft stop and the aircraft is losing altitude (aft stick stall), the aircraft is fully stalled and a recovery should be initiated.

6.6.3.1.1. To recover, simultaneously and smoothly relax back stick forces as necessary to break the stall, advance the PCL to MAX, and use coordinated rudder and aileron to level the wings. As AOA decreases and stall is broken, positive pressure is felt in the controls. Minimize altitude loss by maintaining recovery AOA until recovery is complete. While the recovery AOA is approximately 15.5-18 units, the primary reference for maintaining recovery AOA is a positive, vertical nose track. Recover with a minimum loss of altitude. Recovery is complete when the aircraft is wings level, safely climbing and not decelerating.

6.6.3.1.2. **Note** : At lower pitch attitudes (between 15 and 30 degrees), the aircraft stalls at a higher airspeed and regains flying airspeed faster. At higher pitch attitudes (between 30 and 40 degrees), the stall speed is slower and a greater pitch reduction is necessary to regain flying airspeed.

6.6.3.2. **Turning Power-on Stall.** Setup is the same as the straight-ahead stall, except 20-30 degrees of bank in either direction is added. Hold the bank angle with rudder and aileron pressure until control effectiveness is lost. Recovery is the same as for the straight-ahead stall. A precision entry is not as important as proper recognition and recovery from the stall.

6.6.4. **Techniques.**

6.6.4.1. Use "MAX, Relax, Roll," to guide initial recovery actions.

6.6.4.2. After actions to break the stall, pull nose up until the firelight is on the horizon. If the nose begins to stop tracking before the firelight reaches the horizon, release back pressure slightly momentarily to let airspeed increase to avoid a secondary stall. As power and airspeed increase, increased back pressure is needed to establish a climb.

6.7. ELP Stalls. ELP stalls are flown to practice recovery from potentially dangerous low airspeed conditions before high key and during the ELP. Speed may decrease for various reasons including inattention, task saturation, and attempts to stretch the glide to regain profile. A full series of ELP stalls may take approximately 4,000 feet.

6.7.1. **Objective.** Proper recognition and recovery from approach-to-stall indications during an ELP--without the ability to use power to facilitate recovery.

6.7.2. **Description.** Inadvertent airspeed decay is simulated at three points in the ELP: enroute to high key, between high and low key, and between low key and runway.

6.7.2.1. Airspeed - Clean, 125 KIAS. Configured, 120 KIAS.

6.7.2.2. Power - 4-6 percent torque.

6.7.2.3. FCP visual reference (recovery) – Clean, one-half prop arc on the horizon. Configured, prop arc on the horizon.

6.7.3. **Procedure.**

6.7.3.1. **Glide to High Key.** Establish glide at 125 KIAS with wings level and power set 4-6 percent torque. Raise the pitch attitude slightly and allow airspeed to decay until the gear warning horn sounds (approximately 120 KIAS). Recover by lowering the pitch attitude slightly below the normal glide picture (half-prop arc on the horizon, approximately 4 degrees nose low). Reestablish glide at 125 KIAS. Altitude loss is approximately 300 feet.

6.7.3.2. **Glide Between High and Low Key.** Configure with gear down and flaps UP. Establish a 120 KIAS glide with 30 degrees bank and power set to 4-6 percent torque. Raise pitch attitude (approximately level flight turn picture) and allow airspeed to decay until the stick shaker is activated or an approach-to-stall indication is noted. Maintain the turn or profile ground track and recover by lowering the pitch attitude to put the prop arc on the horizon (approximately 8 degrees nose low) until 120 KIAS regained. Altitude loss is approximately 800 feet.

6.7.3.3. **Glide Between Low Key and the Runway.** Configure with gear down and flaps TO. Establish a 120 KIAS glide with 30-degree bank turn and power set to 4-6 percent torque. Raise pitch attitude (approximately level flight turn picture) and allow airspeed to decay until the stick shaker is activated or an approach-to-stall indication is noted. Maintain the turn or profile ground track and recover by lowering pitch attitude to put the prop arc on the horizon (approximately 8 degrees nose low) until 120 KIAS regained. Altitude loss is approximately 900 feet. **Note:** Due to altitude loss during the recovery, if an ELP stall between low key and the runway is encountered during an actual FL, consideration should be given to ejection.

6.8. Traffic Pattern Stalls. In the traffic pattern, unrecoverable stall or sink rate situations can occur before indications become obvious. If a stall indication occurs in the traffic pattern, disregard ground track, and recover as described below. If in the pattern, do not hesitate to eject if recovery appears unlikely.

6.8.1. **Objective.** Proper recognition of, and recovery from, approach-to-stall conditions in the traffic pattern. Training emphasis is on recognition of approach-to-stall indications and appropriate recovery procedures, not on setup or flow from one stall to the next. However, much like power-on stalls, the smoother the entry, the cleaner the stall will be.

6.8.2. Description. This exercise simulates five possible traffic pattern errors and practices the appropriate recovery actions: an overshooting (nose low), accelerated stall simulating overshooting crosswinds or improper perch spacing; an undershooting stall simulating a combination of inadvertently placing the PCL to idle (zero torque) and poor airspeed crosscheck; a landing attitude stall simulating an improper landing assured decision (PCL to idle) or improperly flown roundout and flare; a break turn stall simulating an exaggerated aggressive break; and a closed pull-up stall simulating an exaggerated, aggressive pull-up with poor airspeed and altitude crosscheck. The latter two stalls, the break turn and closed pull-up stalls are to be practiced in the simulator only.

6.8.2.1. **Airspeed.**

6.8.2.1.1. Final turn setups; 120 KIAS (minimum).

6.8.2.1.2. Landing attitude setup: 5-10 knots above final approach airspeed commensurate with flap setting.

6.8.2.2. **Power.**

6.8.2.2.1. Final turn setup: 10-15 percent torque.

6.8.2.2.2. To induce stall: zero percent torque.

6.8.2.2.3. Recovery: MAX.

6.8.2.3. **Gear.** Down.

6.8.2.4. **Flaps.** LDG, TO, and UP.

6.8.2.5. **Bank.**

6.8.2.5.1. Initial turn: 30 degrees.

6.8.2.5.2. Landing attitude stall: 0 degrees.

6.8.3. **Procedures.** For all traffic pattern stalls, recover at approach-to-stall indication, which is considered to be activation of the stick shaker or aircraft buffet, whichever occurs first.

6.8.3.1. **Overshooting (Nose Low) Final-turn Stall.** Fly a simulated downwind leg, configure for an overhead pattern, and perform the before-landing checklist. At 120 KIAS minimum, initiate a normal final turn. After the turn is established, retard the PCL to idle, steadily increase bank and back pressure to simulate an overshooting final turn, inducing an approach to an accelerated stall. To recover, simultaneously and smoothly advance the PCL to MAX, relax back stick pressure, and use coordinated rudder and aileron to roll the wings level. Disregard pattern ground track. The objective is to *minimize altitude loss* and max perform the aircraft by maintaining recovery AOA until recovery is complete without stalling. It is permissible, but not required, to momentarily "come out of the stick shaker" during recovery, however, if recovery is initiated due to buffeting, alleviate the buffeting condition. While the recovery AOA is approximately 15.5-18 units, the primary reference for maintaining recovery AOA is a positive, vertical nose track. Recovery is complete when the aircraft is wings level and safely climbing.

6.8.3.2. **Undershooting (Nose High) Final-turn Stall.** Fly a simulated downwind leg, configure for an overhead pattern, and perform the before landing checklist. At 120 KIAS minimum, initiate a normal final turn. After the turn is established, retard the PCL to idle, raise the nose slightly, and shallow out the bank. Continue the turn until achieving an approach-to-stall indication. Recovery is the same as for the overshooting final-turn stall; however, since airspeed is initially lower, recovery takes slightly longer.

6.8.3.3. **Landing Attitude Stall.** Establish a simulated final approach at 5-10 knots above final approach airspeed commensurate with flap setting. Retard the PCL to idle and execute a simulated roundout for landing. Hold the landing attitude constant until an approach-to-stall indication occurs. Recovery is similar to the final turn stalls. While it is appropriate to relax back stick pressure, use caution to ensure that the aircraft would not touch down in a three-point attitude or nose gear first.

6.8.3.4. **Closed Pull-up Stall (Simulator Training Only).** On departure leg, with 140 KIAS, roll and pull, simulating an overly aggressive closed pattern. At the first approach-to-stall indication, recover by reducing back stick pressure and rapidly rolling wings level with rudder and aileron. A reduction in power may be necessary during a left closed pattern. If the aircraft departs controlled flight, eject.

6.8.3.5. **Break Stall (Simulator Training Only).** At 200 KIAS, retard the PCL to approximately 10 percent torque and enter a 60-degree bank turn. Midway through the turn, increase the bank and back stick pressure until an approach-to-stall indication is recognized. Recovery by using stick forces as necessary to decrease the AOA. Adjust the bank angle as necessary and continue the turn to a simulated downwind leg.

6.8.4. **Technique.**

6.8.4.1. Use "MAX, Relax, Roll" to guide initial recovery actions.

6.8.4.2. Pull nose up until the firelight is on the horizon. If the nose begins to stop tracking before the firelight reaches the horizon, release back pressure slightly momentarily to let airspeed increase to avoid a secondary stall. As power and airspeed increase, increased back pressure is needed to establish a climb.

6.8.4.3. Propeller and gyroscopic effects will force the nose to the left when the power is increased from idle to MAX at slow speed. Counter the tendency of the nose to move to the left by using right rudder as torque increases. Find a point far in front of the aircraft and use right rudder to keep the nose from moving left. Anticipate left nose movement to start approximately two seconds after moving the PCL to MAX. The slower the airspeed at recovery, the more pronounced the yaw will be at engine spool up.

6.9. Secondary Stall. During stall training, a common recovery error is entering a secondary stall. This is the effect of an overly aggressive return to level flight after a stall or spin recovery. Encountering a secondary stall demonstrates the value of smooth back pressure and the importance of obtaining flying airspeed during the stall recovery. Avoid secondary stalls, but if encountered, release back pressure slightly to decrease AOA, allow the airspeed to increase, and then resume the recovery.

6.10. Slow Flight.

6.10.1. **Objective.** Familiarization and proficiency with aircraft performance and characteristics at minimum flying airspeed. Demonstrate importance of smooth control application at slow speeds. Validate the concept of coordinated turns.

6.10.2. **Description.**

6.10.2.1. Airspeed - Flaps landing: 80-85 KIAS. Flaps TO: 85-90 KIAS. Flaps UP: 90-95 KIAS.

6.10.2.2. Gear – Down.

6.10.2.3. Flaps - As desired.

6.10.3. **Procedure.** Slow flight is conveniently flown before or after traffic pattern stalls; however, slow flight may be performed at any time. Slow below 150 KIAS, configure the aircraft as briefed, and perform the before landing checklist. Maintain altitude as airspeed decreases. When target slow-flight airspeed is reached, adjust power to maintain airspeed and altitude. Trim as required. Execute any SCATSAFE maneuver(s) as described in **paragraph 6.10.3.1**. Approach-to-stall indications (stick shaker or light buffet) are common while executing slow flight; however, if the aircraft actually stalls during slow flight, recover the aircraft by alleviating the condition that caused the stall (decrease the AOA, lower the flaps, decrease bank, etc.). This is not the primary method of stall recovery and is used only during slow flight. If the stall condition is not immediately corrected, or if an approach-to-stall indication occurs at any other time, initiate traffic pattern stall recovery procedures.

6.10.3.1. **SCATSAFE Maneuver.**

6.10.3.1.1. **S - Straight and Level.** During operation on the back side of the power curve, increased AOA results in increased drag and a stall if not carefully flown. Note the pitch attitude, torque, and rudder deflection required to maintain straight-and-level flight. This is the picture a pilot should see at rotation during takeoff or just prior to touchdown during landing.

6.10.3.1.2. **C – Coordination Exercise.** Conduct a series of left and right turns, using 15- to 20-degrees of bank. Keep the ball centered using coordinated rudder. Approximately two inches of right rudder is required to maintain straight-and-level, coordinated flight. Right turns require approximately twice the rudder deflection to maintain coordination. Left turns require approximately one-half inch of right rudder to maintain coordination.

6.10.3.1.3. **A - Adverse Yaw.** A lack of coordinated rudder during a turn results in weaving or “S-ing” on final. Select two points: one directly in front of the aircraft, and one approximately 20 degrees to the right of the nose. Without applying rudder, initiate a rapid right turn with 20-degree bank. Note the initial tendency of the nose to yaw left. After approximately 20 degrees of turn, roll out rapidly without using rudder. The nose continues past the selected rollout point then comes back. Next, initiate a right turn, using coordinated rudder. Notice that the nose immediately tracks in a coordinated manner. After 20 degrees of turn, roll out using properly coordinated rudder and note that the nose stops on the selected rollout point.

6.10.3.1.4. **T - Torque and Turns.** The T-6 initially tends to pitch up, yaw, and roll left if positive control is not maintained during full power takeoffs and landings. To demonstrate this, quickly increase power to MAX from straight-and-level, coordinated slow flight and release the controls. The nose tracks up, yaws, and rolls left, and approaches a stall. Recover from the buffet, prior to stall. Reestablish slow flight and increase power to MAX again. This time, hold proper takeoff pitch and apply coordinated rudder to maintain a proper nose track. Positive control of the aircraft ensures safe takeoffs, touch-and-go landings, and go-arounds.

6.10.3.1.5. **S - Steep Turns.** High angles of bank at slow airspeeds increase stall speed and cause rapid turn rates. Slowly increase bank toward 60 degrees while adding power and back pressure to maintain level flight. Look at a point on the ground and watch the wingtip appear to pivot around the selected point. The AOA quickly increases, progressing into a stall. Roll out of the bank to recover from the impending stall.

6.10.3.1.6. **A - Abrupt Control Movement.** Fixation on the aim point during landing can cause an abrupt flare. Late recognition of the rapidly approaching runway causes the pilot to abruptly raise the nose of the aircraft, causing an approach-to-stall condition, a hard landing, or both. The stick shaker activates, but there is no decrease in sink rate. To demonstrate this, abruptly apply back stick pressure to 20 degrees nose high to simulate snatching the control stick in the flare. The AOA rapidly increases and the aircraft progresses toward a full stall. Release back pressure to recover. To avoid this condition on landing, view the total landing environment and apply controls in a smooth, positive manner.

6.10.3.1.7. **F - Flap Retraction.** Flap retraction prior to the recommended airspeeds causes the aircraft to lose lift and develop a sink rate. From straight-and-level coordinated slow flight, raise the flaps from landing to UP without pausing at the TO position. While retracting the flaps, increase the pitch attitude to maintain altitude. Initially airspeed increases (due to reduced drag as flaps begin to retract), but as flaps retract toward UP, the AOA increases and a stall results. Recover from the stall by selecting landing flaps.

6.10.3.1.8. **E – Effectiveness of Controls.** Rapid control inputs, especially in the flare, often do not give the aircraft sufficient time to respond. Move the ailerons with small, rapid movements. Notice that even with aileron movement, there is little effect on heading or bank during slow flight. In slow flight, smooth, positive inputs are required to effectively control the aircraft as there is less airflow over the control surfaces at slow airspeeds.

6.11. Stability Demonstration. The stability demonstration shows the low speed flight characteristics of the aircraft in extreme attitudes. Although airspeed is below level-flight stall speed, the aircraft will not stall if there is no attempt to attain level flight. In addition, the aircraft will not depart controlled flight (for example, spin) if not stalled.

6.11.1. **Objective.** Demonstrate that the aircraft will not stall, regardless of airspeed, if there is no demand placed on it.

6.11.2. **Description.**

6.11.2.1. Airspeeds – Entry: 160 KIAS. Recovery: 80 KIAS or stick shaker.

6.11.2.2. Power – Entry: 60 percent torque. Recovery: idle.

6.11.2.3. Attitude - Raise the nose to 40-45 degrees pitch attitude wings level.

6.11.2.4. Altitude Required - 2000 feet above entry.

6.11.2.5. Recover – Select idle power and neutralize controls, avoid 0 +/- 0.25 Gs.

6.11.3. **Procedure.** Perform pre-stall (CLEF) checks. Accelerate to 160 KIAS, set 60 percent torque, and clear the area. Raise the nose to a 45-degree pitch attitude. Maintain coordinated wings-level flight. Hold this attitude until flying airspeed is depleted to approximately 80 KIAS, or stick shaker activation, whichever occurs first. Recover by selecting idle power and neutralizing all controls. Allow the nose to lower until positive pressure is felt on the controls. This indicates the aircraft is regaining flying airspeed. Recover to level flight without stalling the aircraft. The maneuver is complete when the aircraft is returned to level flight. Avoid near zero-G flight for greater than 5 seconds due to engine operating limitations.

6.11.4. **Technique.** Estimate 45 degrees nose high by visualizing the feet on the horizon. Use memory aid, “idle-ize, neutralize” to guide recovery actions at 80 KIAS (or stick shaker). Cross-check the G meter and maintain slightly more than 0.25 Gs with a small amount of back pressure on the control stick to avoid exceeding engine operating limits. To avoid near zero-G flight for greater than 5 seconds, start a mental count once the control stick is neutralized. Before reaching the “5” count, ensure the pilot flying is putting positive-G (backstick pressure) on the aircraft. Visually confirm the neutral elevator stick position when checking the flight controls on the ground during pre-flight.

6.12. Inadvertent Departure from Controlled Flight. Section VI of the flight manual contains detailed information about departures from controlled flight. Additional information and details on the recovery procedure are found in section III of the flight manual. In the flight manual, departures from controlled flight are also referred to as OCF (out of control flight), the term used in this manual. Eject if it appears the aircraft is not recovering by minimum uncontrolled ejection altitude (6,000 feet AGL).

6.12.1. The aircraft is in OCF if it does not respond immediately and in a normal manner to control inputs. If in OCF, apply the boldface recovery procedure (OCF recovery) to return the aircraft to level flight. In all cases, observe the minimum uncontrolled ejection altitude. The OCF recovery is accomplished by simultaneously reducing the PCL to idle, positively neutralizing the flight controls, and checking the altitude to ensure that the aircraft is above the minimum uncontrolled ejection altitude. After the controls are neutralized, expect the nose to lower as the aircraft seeks to regain flying airspeed. Initially, aircraft control authority is minimal, but it returns to normal as airspeed increases in the dive. Allow the nose to lower until positive control pressure is felt. The nose may near the vertical during this stage of the recovery. Upon regaining flying airspeed, recover the aircraft to level flight. An unloaded recovery may result in considerable altitude loss.

6.12.2. The OCF recovery is also used when the aircraft is in a nose-high unusual attitude, and SA is lost to the point of disorientation. Depending on flight parameters when SA is lost, the initial steps of the OCF recovery procedure either start the recovery or prevent departure. In either case, the OCF recovery provides a guaranteed predictable method to return to level flight and regain SA.

6.13. Intentional Spin Entry (Emphasizing Departure Recognition and Recovery). The emphasis in primary pilot training is on departure from controlled flight recognition and recovery. On most contact sorties where OCF recoveries are performed, recovery will be initiated within one turn of the application of rudder. Recovery will utilize OCF recovery procedures.

6.13.1. **Objectives.** Recognize what it looks and feels like when an aircraft departs controlled flight. Practice the OCF recovery from an intentional departure from controlled flight. Increase confidence in ability to recover from the OCF condition in case of inadvertent OCF. Maintain SA and ability to function effectively in unusual attitudes.

6.13.2. **Description. Note:** Due to the potential for aeration of the oil system during spin entry, do not push to less than 1 G or allow the aircraft to sink before intentionally entering a spin. Allow 5 seconds of stabilized 1-G flight prior to spin entry.

6.13.2.1. Airspeeds - Initiate entry: 120 KIAS (minimum). Spin entry: approximately 80 KIAS.

6.13.2.2. Power - Idle.

6.13.2.3. Pitch - 15 to 40 degrees.

6.13.2.4. Flight controls at spin entry:

6.13.2.4.1. Rudder - Full deflection in spin direction.

6.13.2.4.2. Elevator - Full aft stick.

6.13.2.4.3. Ailerons - Neutral.

6.13.3. **Procedure.**

6.13.3.1. Accomplish pre-spin (CLEF) checks and adhere to restrictions according to AFI 11-2T-6, Volume 3.

6.13.3.2. Attain level flight at a minimum of 120 KIAS. Raise the nose to 15 to40 degrees nose high, reduce the PCL to idle, and maintain approximately 1 G. Silence the gear warning horn during deceleration.

6.13.3.3. At spin entry airspeed (approximately 80 KIAS), the pitch attitude should be 15 to 40 degrees nose high. Apply full rudder in the desired direction of spin. Position the control stick full aft, ailerons neutral, and apply full rudder in the direction of spin.

6.13.3.4. Initiate OCF recovery procedure within one turn of the application of rudder.

6.13.3.4.1. Ensure the PCL has been reduced to idle.

6.13.3.4.2. Position all flight controls to neutral position.

6.13.3.4.3. Check altitude.

6.13.3.4.4. Recover from dive to level flight.

6.13.4. **Technique.**

6.13.4.1. Use memory aid, “idle-ize, neutralize,” to guide recovery actions.

6.13.4.2. Verbalize oil pressure before advancing the PCL.

6.14. Intentional Spin Entry (Emphasizing Near Steady State Spin Recognition and Recovery). Recoveries from these spins will utilize OCF recovery procedures and be initiated from a near steady state spin (between two and four turns from rudder application).

6.14.1. **Objectives.** The purpose of this spin training is to experience the characteristics of, and recovery from, an aircraft in near steady state spin. The emphasis should be on spin characteristics (18+ AOA, turn needle deflection, almost constant airspeed and rotation rate) not just counting turns. Additional objectives are to increase confidence in the ability to recover from a spinning condition in case of inadvertent OCF, maintain SA and function effectively in unusual attitudes.

6.14.2. **Description.** Due to the potential for aeration of the oil system during spin entry, do not push to less than 1 G or allow the aircraft to sink before intentionally entering a spin. Allow 5 seconds of stabilized 1-G flight prior to spin entry.

6.14.2.1. Airspeeds - Initiate entry: 120 KIAS (minimum). Spin entry: approximately 80 KIAS.6.14.2.2. Power - Idle.

6.14.2.2. Pitch - 15 to 40 degrees.

6.14.2.3. Flight controls at spin entry:

6.14.2.3.1. Rudder - Full deflection in spin direction.

6.14.2.3.2. Elevator - Full aft stick.

6.14.2.3.3. Ailerons - Neutral.

6.14.3. **Procedure.**

6.14.3.1. Accomplish pre-spin checks and adhere to restrictions according to AFI 11-2T-6, Volume 3.

6.14.3.2. Attain level flight at 120 KIAS (minimum). Raise the nose to 15 to 40 degrees nose high, reduce the PCL to idle, and maintain approximately 1 G. Silence the gear warning horn during deceleration.

6.14.3.3. At spin entry airspeed (approximately 80 KIAS), the pitch attitude should be 15 to 40 degrees nose high. Apply full rudder in the desired direction of spin. Control stick should be full aft (ailerons neutral) and rudder should be full in the direction of spin.

6.14.3.4. Initiate OCF recovery procedure within two to four turns of the application of rudder.

6.14.3.4.1. Ensure the PCL has been reduced to idle.

6.14.3.4.2. Position all flight controls to neutral position.

6.14.3.4.3. Check altitude.

6.14.3.4.4. Recover from dive to level flight.

6.14.4. **Technique.**

6.14.4.1. Use memory aid, “idle-ize, neutralize,” to guide recovery actions.

6.14.4.2. Verbalize oil pressure before advancing the PCL.

6.15. Contact Recoveries from Abnormal Flight. Recovery may be required due to an improperly flown maneuver, disorientation, area boundaries (lateral or vertical), an aircraft malfunction, or traffic conflicts.

6.15.1. **Nose-high Recovery.**

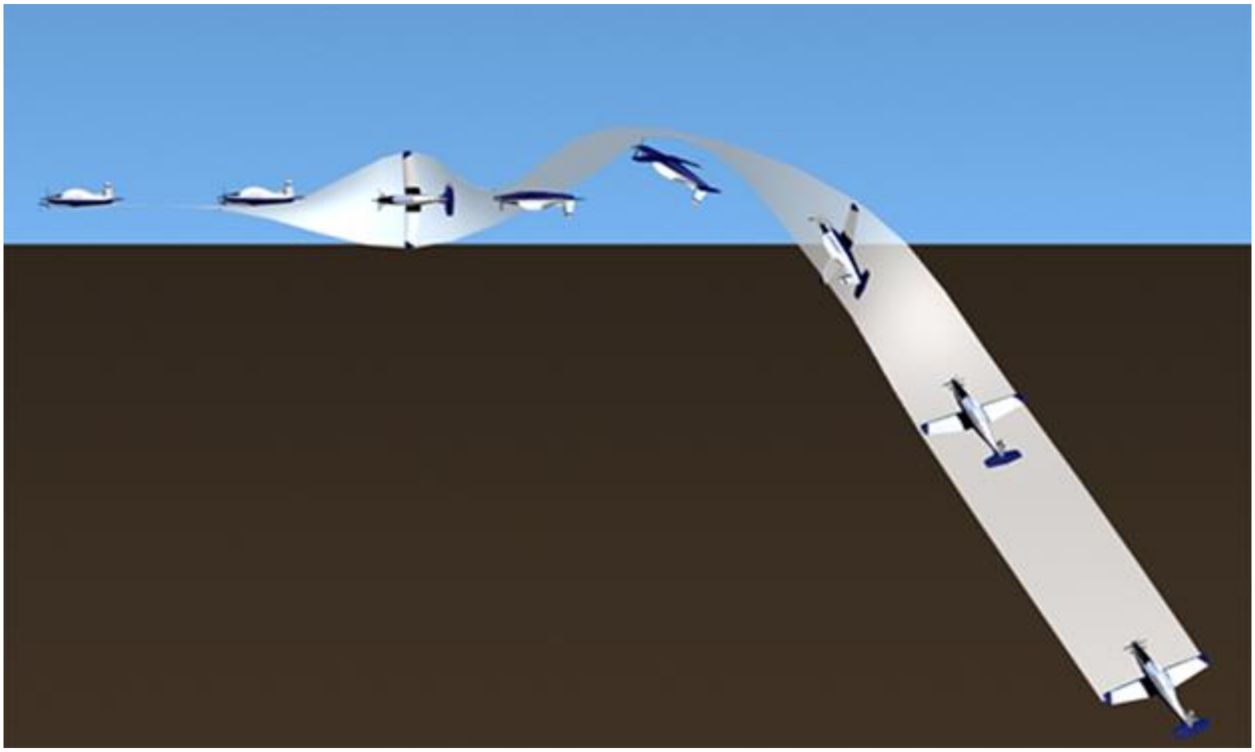
6.15.1.1. **Objective.** Expeditious return to level flight from a nose-high attitude, without departing controlled flight or exceeding aircraft limits.

6.15.1.2. **Description.** T-6 aerobatics require nose-high attitudes. An improperly flown over-the-top maneuver (i.e., starting below entry airspeed and/or not expeditiously achieving recommended G-loading to begin maneuver) may result in rapidly decaying airspeed. A nose-high attitude can be encountered with insufficient airspeed to continue the maneuver. Immediate and proper recovery procedures prevent aggravated stall and spin.

6.15.1.3. **Procedure.** Set power to MAX (or as required for low airspeed situations) and initiate a coordinated roll towards the nearest horizon. Add back pressure once past 90 degrees of bank to bring the nose of the aircraft down to the nearest horizon. Depending on initial airspeed and aircraft attitude, a wings-level, inverted attitude may be reached. As the nose approaches the horizon (approximately canopy bow on horizon), roll to an upright attitude (**Figure 6.2**).

6.15.1.3.1. During some nose-high, low-airspeed situations, when the aircraft responds to inputs slowly due to low airspeed or torque effect, a reduction in power may be required (usually below 60 percent torque) and all available control authority may be required to smoothly return the aircraft to level flight. If the aircraft does not respond normally, or if SA is lost, an OCF recovery should be accomplished.

Figure 6.2. Nose-high Recovery.



6.15.1.3.2. If the airspeed is low, the rollout may be delayed until the nose is definitely below the horizon. In some cases, the nose has to be flown well below the horizon to regain enough airspeed to feel positive pressure on the controls. When airspeed is sufficient, roll wings level, raise the nose, check for normal oil pressure, and use power as required to recover to level flight.

6.15.1.3.3. Do not be too aggressive when pulling to the horizon or pulling up from a nose-low attitude. The stick shaker and airframe buffet indicate a potential for stall. Decrease back stick pressure before entering a stall.

6.15.1.3.4. In all cases, observe system limitations when operating near zero G.

6.15.1.3.5. Do not recover by pushing the nose down towards the horizon. This could induce a state of near zero-G flight, causing the oil pressure to decrease below operational limits. Furthermore, this improper action may delay the time it takes to get the nose below the horizon and airspeed increasing again, leading to a possible loss of controlled flight with the torque at MAX and rapidly decreasing airspeed.

6.15.2. **Nose-low Recovery.**

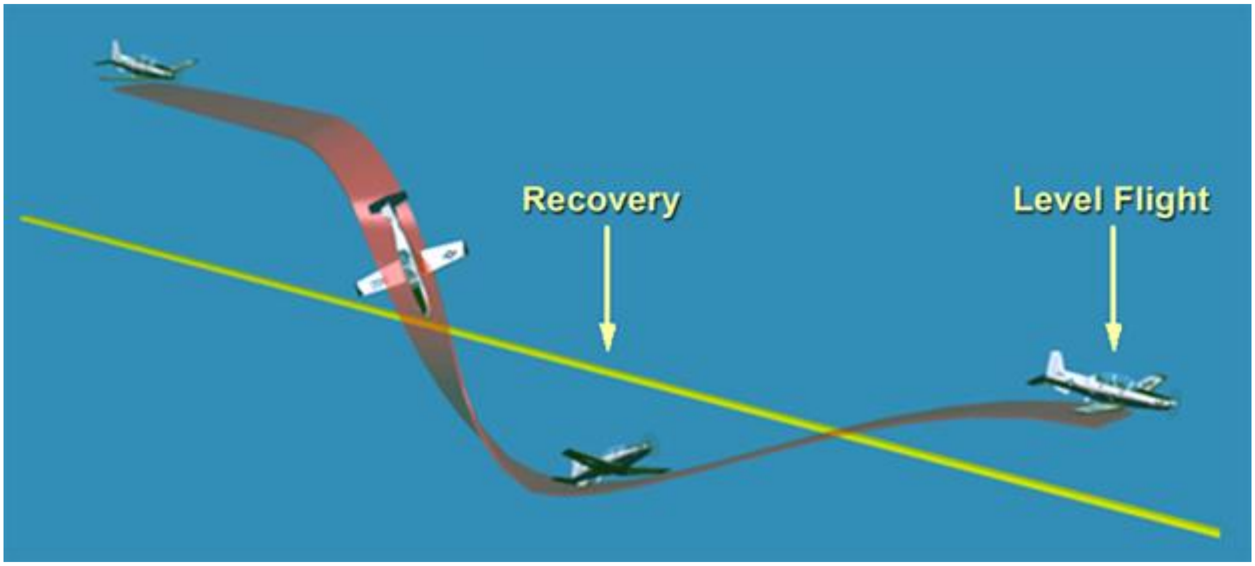
6.15.2.1. **Objective.** Expeditious recovery to level flight from a nose-low attitude with minimum altitude loss and without exceeding aircraft limits.

6.15.2.2. **Description.** T-6 aerobatics require nose-low attitudes. Immediate and proper recovery procedures prevent a high-speed dive or excessive G forces.

6.15.2.3. **Procedure .** Roll the aircraft toward the nearest horizon, level the wings, then pull-up to obtain level flight using up to the maximum allowable G force (**Figure 6.3**). Use power and speed brake as required. Do not exceed maximum allowable airspeed (316 KIAS). Airspeed may continue to increase as the nose is raised, and maximum airspeed can occur just before level flight is attained. G loading increases during recovery. Accomplish a proper AGSM as required.

6.15.2.4. **Technique.** Approaching 200 KIAS or greater, select idle and speed brake.

Figure 6.3. Nose-low Recovery.



6.15.3. **Inverted Recovery.** When inverted, or near an inverted position, recover by rolling in the shortest direction to set the aircraft in an upright, wings-level attitude, adding power as required.

6.15.3.1. **Technique.** Roll to the "nearest blue".

6.16. Aerobatics.

6.16.1. Aerobatic maneuvers develop techniques for obtaining maximum flight performance from the aircraft. Aerobatics explore the entire performance envelope of the aircraft and should be smoothly executed. Aerobatic practice improves feel for the aircraft and the ability to coordinate the flight controls, while remaining oriented, regardless of attitude. Aerobatics increase confidence, familiarize the pilot with all attitudes of flight, and increase the ability to fly an aircraft throughout a wide performance range. The concepts learned from aerobatic practice are applicable in formation maneuvering and other advanced missions.

6.16.2. Training emphasis is on smoothness and proper nose track during the maneuver**.** Strive to use the briefed entry parameters, but power and airspeed adjustments may be made to enhance energy planning or expedite the profile flow. Normally, the left hand is on the PCL, and the right hand is on the control stick. Avoid using a two-handed control stick technique to maintain a wings-level attitude. Indicated torque varies relative to altitude and airspeed without changing the PCL position. See **Table 6.1** for a summary of entry airspeeds and power settings for aerobatics.

Table 6.1. Summary of Entry Airspeeds and Power Settings for Aerobatics.

Maneuver	KIAS	Torque	Altitude Required	Energy Gain/Loss
Aileron Roll	180-220	80% to MAX	+1,000 feet	Neutral
Barrel Roll	200- 220	80% to MAX	+2,000 feet -1,000 feet	Neutral
Chandelle	200-250	MAX	+3,000 feet	Gaining
Cloverleaf	200-220	80% to MAX	+3,000 feet -1,000 feet	Slightly losing
Cuban Eight	230-250	MAX	+3,000 feet	Neutral
Immelmann	230-250	MAX	+3,000 feet	Gaining
Lazy Eight	200-220	50 to 60%	+2,000 feet -1,000 feet	Neutral
Loop	230-250	MAX	+3,000 feet	Neutral
Split-S	120-140	Idle to 80%	+500 feet - 2,000 feet (75%) -2,500 feet (IDLE)	Losing

6.17. Aileron Roll (Figure 6.4.).

6.17.1. **Objective.** Complete a 360-degree roll with a constant roll rate.

6.17.2. **Description.** The aileron roll is a 360-degree roll about the longitudinal axis of the aircraft. The maneuver is complete when the wings are again parallel to the horizon.

6.17.2.1. Airspeed – 180 to 220 KIAS.

6.17.2.2. Power – 80 percent to MAX power.

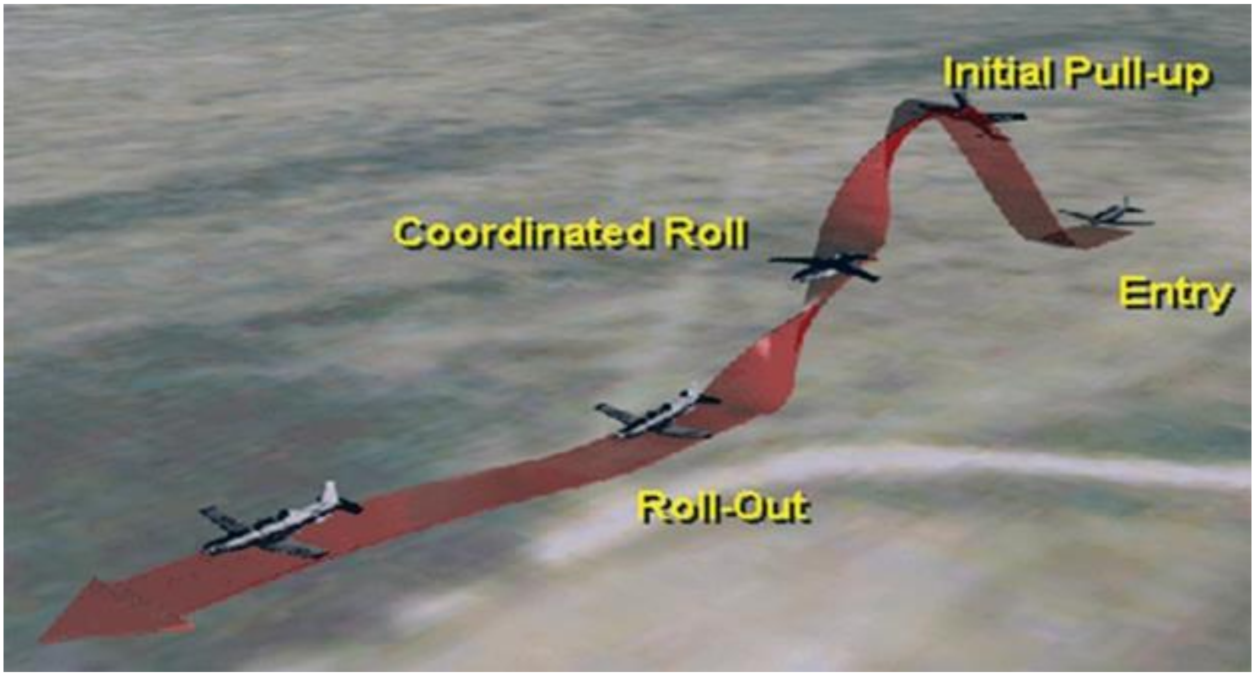
6.17.2.3. Attitude – Wings-level entry, 20-30 degrees nose-high pitch attitude.

6.17.2.4. FCP visual reference - Corner of front windscreen on the horizon to start roll.

6.17.3. **Procedure.** Attain briefed entry parameters. Smoothly raise the nose to 20-30 degrees nose-high pitch attitude. Relax back stick pressure and stop nose track, then roll the aircraft left or right using coordinated aileron and rudder. The nose of the aircraft does not roll around a specific point in the roll. As the aircraft approaches wings level, neutralize the rudder and aileron, and return to level flight. In the T-6, an aileron roll to the left requires less rudder and aileron deflection than a roll to the right due to engine torque.

6.17.4. **Technique.** Visual references help keep focus outside. At 20 degrees nose high, the clock is approximately on the horizon. At 30 degrees nose high, the STBY airspeed indicator is on the horizon.

Figure 6.4. Aileron Roll.



6.18. Lazy Eight (Figure 6.5.).

6.18.1. **Objective.** Maintain coordinated flight through two successive, symmetric, opposite direction turns that define the maneuver.

6.18.2. **Description.** This is a slow, lazy maneuver that describes a horizontal figure eight at the horizon. The horizon line bisects this figure eight lengthwise. Pitch, bank, and airspeed constantly change. The maneuver is complete after two 180-degree turns with the aircraft in level flight.

6.18.2.1. Airspeed – 200-220 KIAS.

6.18.2.2. Power –50-60% torque.

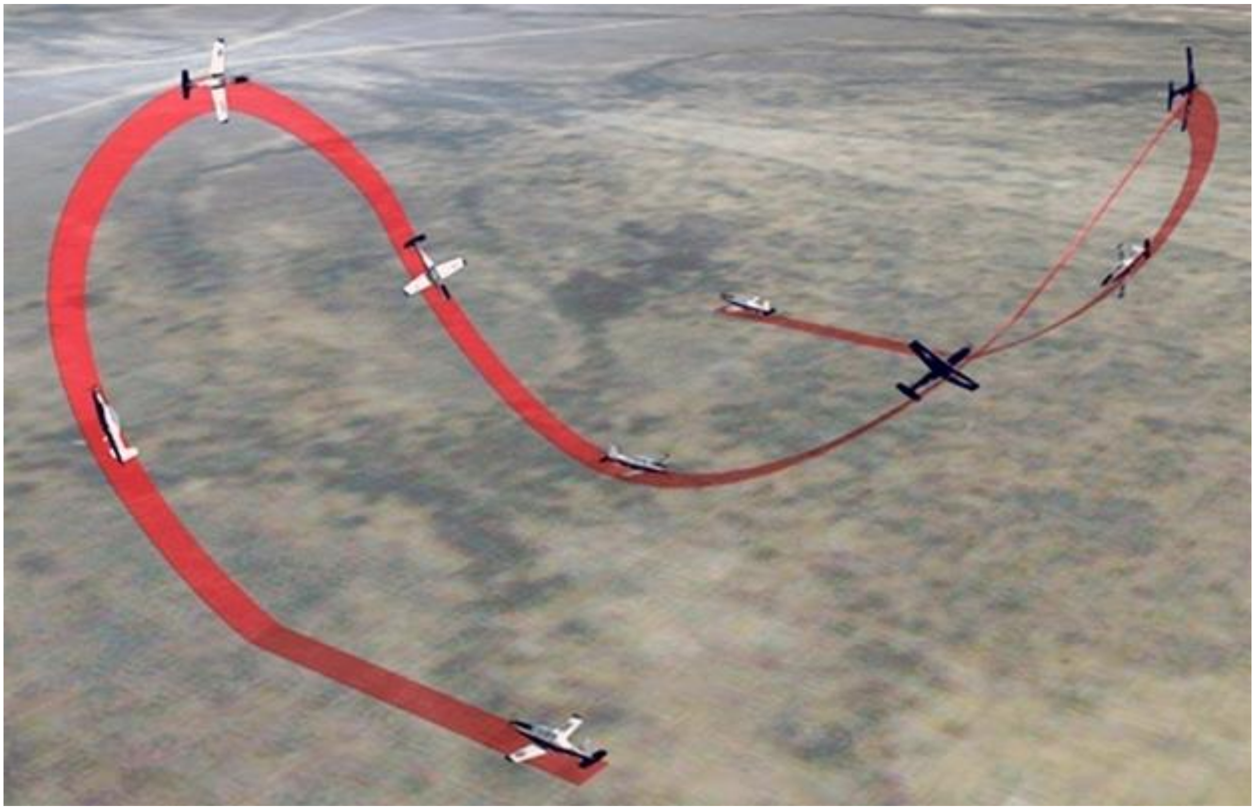
6.18.2.3. Attitude – Entry: wings level, 90 degrees MAX bank, 45 degrees MAX nose-high pitch.

6.18.2.4. Altitude - Approximately 2,000 feet above and 1,000 below entry altitude.

6.18.2.5. FCP visual reference - Bottom foot on or slightly above horizon at top of leaf, feet splitting horizon as you come through horizon, top foot on horizon at bottom of leaf.

6.18.3. **Procedure.** Control pressure constantly changes due to changing bank, pitch, and airspeed. To help fly symmetrical leaves, select a prominent point on the horizon (90 degrees off aircraft heading, for example, off the shoulder) or a ground reference, such as a section line or road (perpendicular to aircraft). Selected points should be far enough from the aircraft (not beneath the wing) so you don't fly over it. Mentally project an imaginary line from the aircraft to the horizon. Look in the direction of flight turn and clear throughout the maneuver.

Figure 6.5. Lazy Eight.



6.18.3.1. Begin in straight-and-level flight with briefed entry airspeed and power setting. Select the desired reference point on the horizon or ground, and align the aircraft so the reference point is directly off a wingtip. Blend aileron, rudder, and elevator pressures simultaneously to start a gradual climbing turn in the direction of the reference point. The initial bank should be very shallow to prevent excessive turn rate. As the nose is raised, the airspeed decreases, causing the rate of turn to increase. Time the turn and pull-up so the nose reaches the highest pitch attitude (approximately 45 degrees) when the aircraft has turned 45 degrees or halfway to the reference point. Use outside references and the attitude indicator to cross-check these pitch-and-bank attitudes. Bank continues to increase as the nose falls. The aircraft should be pointed at the reference point as a maximum bank of 80-90 degrees is reached and the nose reaches the horizon. The lowest airspeed occurs just as the nose reaches the horizon (approximately 100 knots below entry airspeed).

6.18.3.2. Avoid freezing the pitch or bank at the horizon. Passing the horizon, let the nose fall, and begin rolling out of bank. The second half of the leaf (nose below horizon) should be symmetric and approximately the same size as the first half (nose above the horizon). The bank should change at the same rate as during the nose-up portion of the leaf. When the aircraft has turned 135 degrees, the nose should be at its lowest attitude and the bank should be 45 degrees. Continue blending control stick and rudder pressure to simultaneously raise the nose and level the wings. Monitor the progress of the turn by checking the outside reference point (off opposite shoulder from maneuver start). The aircraft should be wings level at entry airspeed as the nose reaches the horizon, having completed 180 degrees of turn. Without pausing, begin the second leaf in the opposite direction of the first.

6.18.4. **Technique.**

6.18.4.1. Set up perpendicular to a long road or section line. Visualize the road as the straight line part of a dollar sign ($). The two turns of the maneuver complete the “S” portion of the dollar sign. If ground references are unavailable, the heading bug can be set to the initial heading and used to monitor the progress of the turns.

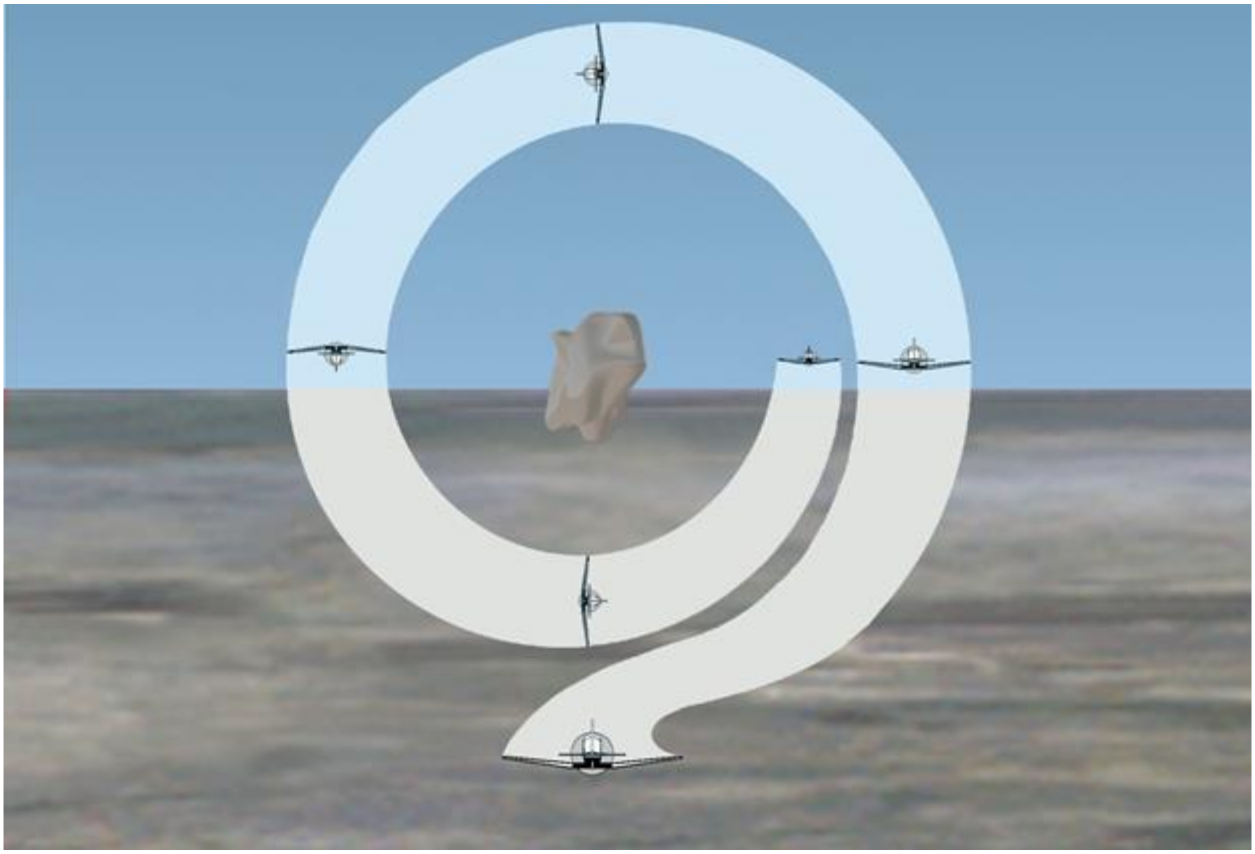
6.18.4.2. During the nose-up part of turns, pull to put the bottom foot (foot on inside of turn) on top of the horizon and roll around it until reaching approximately 60-degree bank. The nose will begin to fall at 60- to 90-degrees of bank. Use bank to control the lift vector and achieve the desired nose low pitch attitude without freezing at 90-degrees of bank. It is permissible to vary the roll rate to control the lift vector without stagnating. Proper lift vector control is the key to a successful lazy eight.

6.18.4.3. When bringing the nose back to the horizon from a nose-low attitude, the number of knots below wings level airspeed should be approximately equal to the number of degrees nose low. For example, if the desired wings-level airspeed is 220 knots, the airspeed should be approximately 190 knots at 30 degrees nose low, 200 knots at 20 degrees nose low, etc.

6.19. Barrel Roll (Figure 6.6).

6.19.1. **Objective.** Maintain coordinated flight through a 360-degree roll that describes a circle around a point near the horizon.

Figure 6.6. Barrel Roll.



6.19.2. **Description.** A barrel roll is a coordinated roll in which the nose of the aircraft describes a circle around a point on or near the horizon. Definite seat pressure should be felt throughout the roll. Practice in both directions. The maneuver is complete when the aircraft is wings level, abeam the reference point on the original side, at approximately entry airspeed.

6.19.2.1. Airspeed – 200-220 KIAS.

6.19.2.2. Power – 80 percent to MAX power.

6.19.2.3. Attitude – Entry: wings level.

6.19.2.4. Altitude - Approximately 2,000 feet above and 1,000 feet below entry altitude.

6.19.2.5. FCP visual reference - Reference point at or near the corner of front windscreen.

6.19.3. **Procedure.** Select a reference point, such as a cloud or landmark, up to 45 degrees off the nose of the aircraft, on or slightly above the horizon. Set briefed power and attain briefed entry airspeed with the nose of the aircraft below the horizon. Begin a coordinated turn in the opposite direction of the desired roll, as necessary, to place the aircraft up to 45 degrees to the side of the reference point, as required. The distance from the reference point defines the size of the barrel roll, and it should remain constant throughout the maneuver. From level flight, increase pitch and bank. As the bank reaches 90 degrees, the aircraft should be directly above the reference point.

6.19.3.1. Passing 90 degrees of bank, relax some back pressure and increase aileron deflection to continue the roll with reduced airspeed. Back pressure must be reduced compared to the first quarter of the roll because gravity is now in the same direction as the lift vector (downward) when inverted. Plan the roll so the wings become level just as the aircraft reaches the inverted level-flight attitude. The aircraft should be displaced from the reference point the same distance as at the beginning of the maneuver.

6.19.3.2. Continue the roll and apply increased elevator pressure. As the bank again reaches the 90 degrees at the bottom of the maneuver, the nose track should continue to arc around the reference point. In this last quarter of roll, increase back stick pressure because gravity is now working against the lift vector. Maintain coordinated control pressure to continue the roll so the nose completes the circle around the reference point, ending up wings level at the horizon.

6.19.4. **Technique.** Choosing a reference point above the horizon and within the canopy bow helps ensure reasonable displacement and barrel roll size.

6.20. Loop (Figure 6.7.).

6.20.1. **Objective.** Complete a 360-degree turn in the vertical with constant nose track.

6.20.2. **Description.** The loop is a 360-degree turn in the vertical plane with constant heading and nose track. Because it is executed in a single plane, the elevator is the principle control surface. Ailerons and rudder are used to maintain directional control and coordinated flight. The maneuver is complete when wings are level at the horizon on the same heading as at entry.

6.20.2.1. Airspeed – 230-250 KIAS.

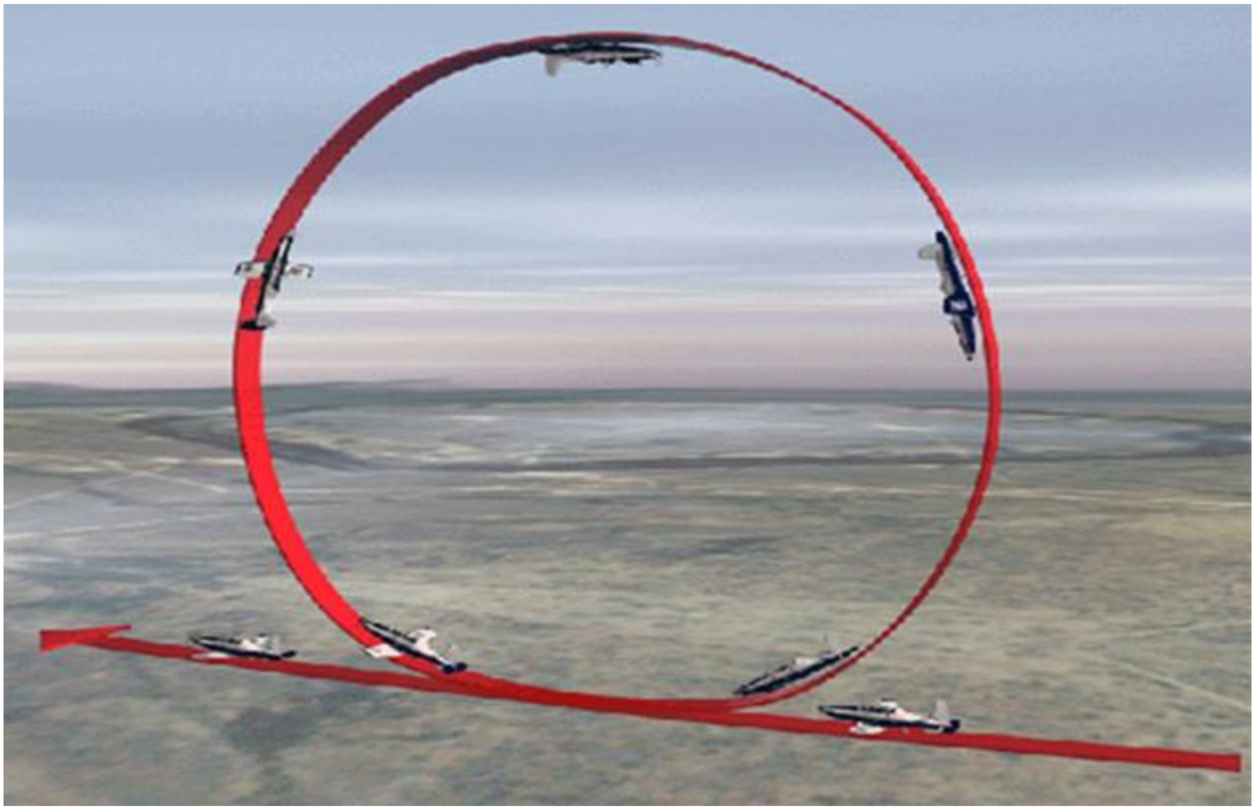
6.20.2.2. Power - MAX.

6.20.2.3. Attitude - Wings level to horizon throughout maneuver.

6.20.2.4. Altitude - Approximately 3,000 feet above entry altitude.

6.20.2.5. FCP visual reference -- Wingtips equidistant from horizon in pull-up.

Figure 6.7. Loop.



6.20.3. **Procedure.** Begin straight-and-level to 20 degrees nose low, with briefed entry airspeed and power setting. Smoothly pull the nose up using 3-4 Gs. When the forward view of the horizon disappears in the pull-up, maintain wings level (straight pull) by keeping the wingtips equidistant from the horizon. Back stick pressure and G loading decrease to maintain a constant nose track as airspeed decreases; however, aft control stick displacement increases. Right rudder pressure is required to keep the aircraft coordinated as airspeed decreases. Insufficient rudder, as airspeed decreases, may allow the nose to deviate up to 30 degrees off desired track. Airspeed should be approximately 100-120 KIAS wings level inverted (over the top). Pull straight through the vertical and increase G loading to maintain a constant nose track until a level flight attitude is reached. Maintain coordinated rudder as the airspeed increases in the dive.

6.20.4. **Technique.** Align the aircraft with a road or section line to provide a visual reference for a straight pull. Keep aligned with selected reference throughout the loop. If a ground reference is not available, the heading bug may be used to ensure a straight pull. Accelerate to entry airspeed with canopy bow on the horizon. Anticipate entry by 20 KIAS (an attitude of 20 degrees nose low requires a 20 KIAS lead point to hit the desired target airspeed by the time the nose is back to level flight). Imagine pulling to the “zipper” to ensure a straight pull. As the horizon disappears, use the cross-check of “wingtip, wingtip, ball” to keep the wings level and flight coordinated. Make sure the wingtips are equidistant from the horizon. Roll away from the wingtip that has the most ground above it to level the wings. As the airspeed slows near the top of the loop, due to propeller effects, the nose will tend to yaw to the left, which can be detected by cross-checking the ball on the turn and slip indicator. Use the memory aid of "step on the ball" to push on the rudder coinciding with the side the ball is deflected to. Near vertical, tilt the head back and try to locate the horizon as early as possible. If the wings are not level, improper rudder application is most likely the problem.

6.21. Immelmann (Figure 6.8.).

6.21.1. **Objective.** Complete a vertical, climbing, 180-degree turn with constant nose track.

6.21.2. **Description.** The Immelmann is a half loop followed by a half roll, all flown in the same vertical plane. The maneuver is complete after a momentary pause in level flight with wings level on an opposite heading from entry.

6.21.2.1. Airspeed - 230-250 KIAS.

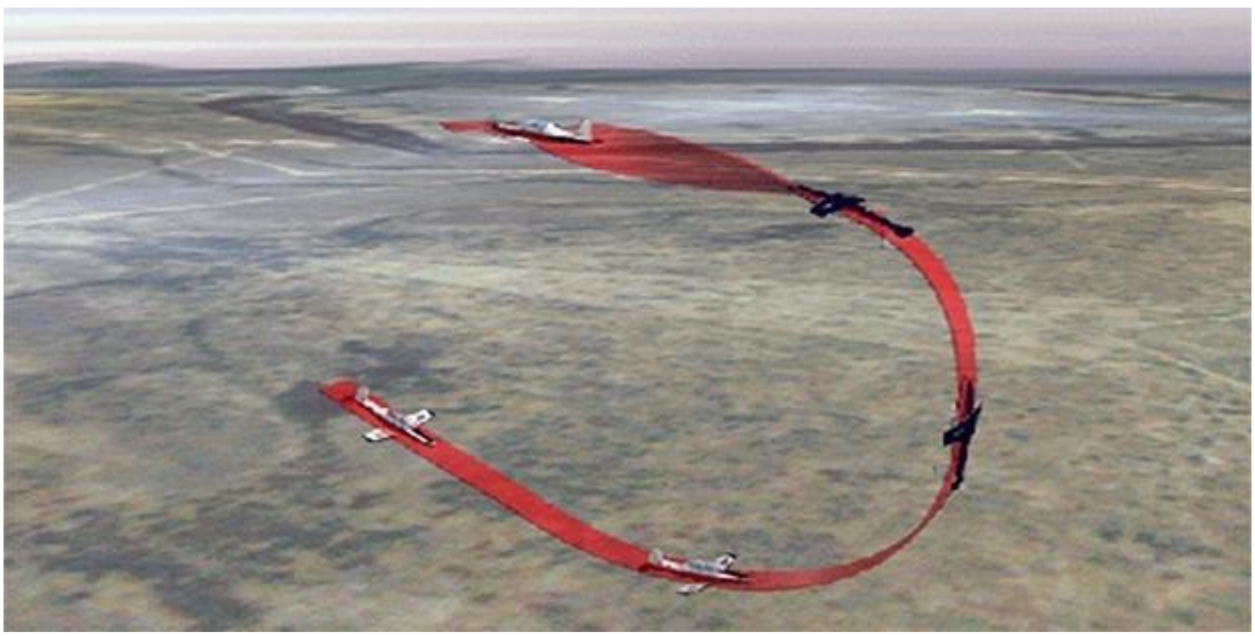
6.21.2.2. Power - MAX.

6.21.2.3. Attitude - Wings level to horizon before and after half roll at top.

6.21.2.4. Altitude - Approximately 3,000 feet above entry altitude.

6.21.2.5. FCP visual reference - Wingtips equidistant from horizon in pull-up.

Figure 6.8. Immelmann.



6.21.3. **Procedure.** Begin in straight-and-level flight, with briefed entry airspeed and power setting. Smoothly pull the nose up using 3-4 Gs. When the forward view of the horizon disappears in the pull-up, maintain wings level (straight pull) by keeping the wingtips equidistant from the horizon. Back stick pressure and G loading decrease to maintain a constant nose track as airspeed decreases; however, aft control stick displacement increases. Moderate right rudder pressure is required to keep the aircraft coordinated as airspeed decreases. Insufficient rudder, as airspeed decreases, may allow the nose to deviate up to 30 degrees off desired track. As the aircraft reaches a point approximately 10 degrees above the horizon inverted (FCP canopy bow on the horizon), relax back stick pressure and apply aileron with coordinated rudder in either direction to initiate a roll to level flight. Airspeed should be approximately 100-120 KIAS. The maneuver is complete after a momentary pause in level flight following the rollout.

6.21.4. **Technique.** Reference the technique for the first half of the loop.

6.22. Split-S (Figure 6.9.).

6.22.1. **Objective.** Complete a max performance, 180-degree descending turn in the pure vertical.

6.22.2. **Description.** The split-S combines the first half of an aileron roll with the last half of a loop. It demonstrates how much altitude is lost if recovery from inverted flight is attempted by pulling through the horizon. The aircraft climbs during entry and descends during recovery. The maneuver is complete when the aircraft returns to level flight.

6.22.2.1. Airspeed - 120-140 KIAS.

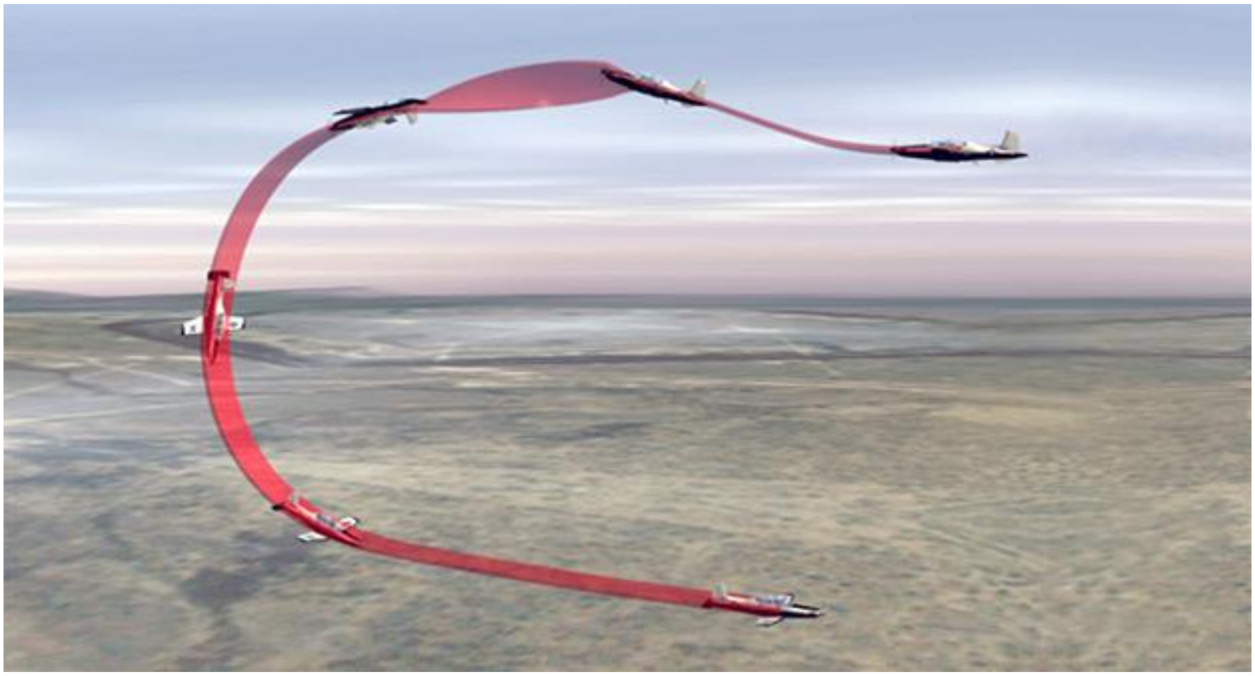
6.22.2.2. Power - Idle to 80 percent.

6.22.2.3. Attitude - Entry: 20 degrees nose high. Wings level before and throughout pull.

6.22.2.4. Altitude - Approximately 2,500 feet below entry altitude.

6.22.2.5. FCP visual reference - Corner of forward windscreen on horizon to start roll.

Figure 6.9. Split-S.



6.22.3. **Procedure.** Begin in straight-and-level flight approximately 40 KIAS above briefed entry airspeed. Briefed power setting may be established any time before or during the half roll. Raise the nose to an approximately 20-degree pitch attitude (FCP clock on the horizon). When the airspeed is approximately 20 KIAS above briefed entry airspeed, roll the aircraft to the wings-level, inverted attitude. Apply back pressure to bring the nose through the horizon. To avoid excessive G and airspeed at the bottom, attempt to max perform once the nose passes the horizon. Airspeed and G loading (approximately 3-4 Gs) increase during the pullout. Perform a proper anti-G strain.

6.22.4. **Technique.** Attempt to set up the maneuver over a road or section line. Ensure wings are level- inverted before starting pull. Imagine pulling to the "zipper" to ensure a straight pull. Looking at successive points above the canopy bow (as described on the back half of the loop) that lead in a straight line from below the aircraft out to the horizon can also help ensure a straight pull.

6.23. Cuban Eight (Figure 6.10.).

6.23.1. **Objective.** Maintain coordinated flight through two successive loop-type turns in the vertical.

6.23.2. **Description.** Each half of this maneuver is a combination of a slightly modified loop and Immelmann. The first portion of each leaf is approximately the first five-eighths of a loop followed by a half roll. The pull and roll is then repeated in the opposite direction. The maneuver looks like an "8" on its side. The maneuver is complete at level flight, with entry airspeed and on original heading.

6.23.2.1. Airspeed - 230-250 KIAS.

6.23.2.2. Power - MAX.

6.23.2.3. Attitude - Wings level to horizon throughout maneuver.

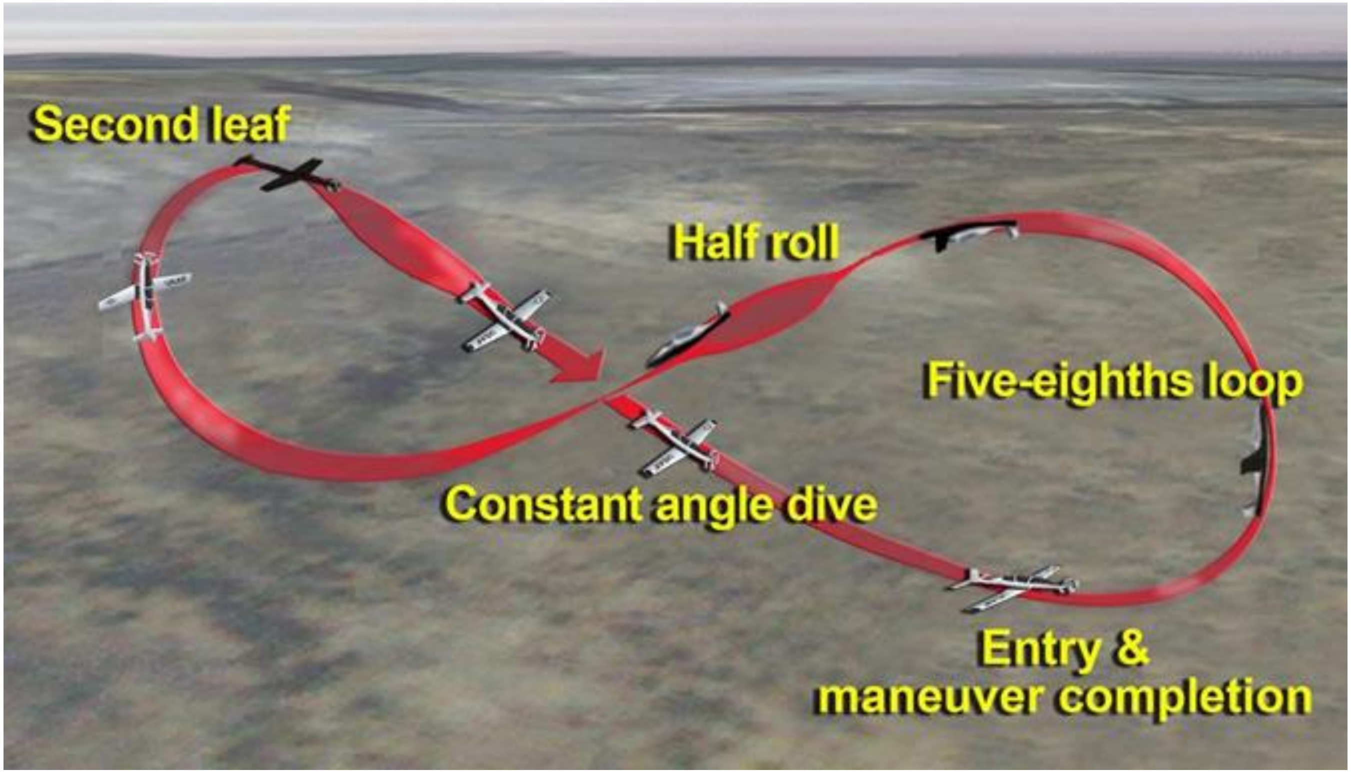
6.23.2.4. Altitude - Approximately 3,000 feet above entry altitude.

6.23.2.5. FCP visual reference:

6.23.2.5.1. Wingtips equidistant from horizon in pull-up.

6.23.2.5.2. Seat on horizon when 45 degrees nose low, inverted.

Figure 6.10. Cuban Eight.



6.23.3. **Procedure.** Begin in straight-and-level flight, with briefed entry airspeed and power setting. Perform the first part of a loop until over the top, inverted. After passing through inverted-level flight, continue the loop until approaching 45 degrees nose low, inverted. Execute a coordinated half roll in either direction. Relax the elevator pressure to keep the nose track in the same vertical plane. After completing the half roll, maintain 45 degrees nose low until beginning the pull-up for the second half of the maneuver. Plan to initiate the pull-up to attain briefed entry airspeed at the horizon (passing through level flight). To accomplish this, begin the pull-up approximately 35-40 KIAS below briefed entry airspeed (the airspeed lead point is approximately equal to number of degrees of nose-low pitch). Continue the pull-up into another loop entry. The second half of the Cuban Eight is identical to the first except the roll is in the opposite direction.

6.23.4. **Technique.** Use ground references, or the heading bug, as in other over-the-top maneuvers. Upon reaching 45 degrees nose low, inverted flight (seat on the horizon), momentarily freeze the control stick before the coordinated roll. To maintain 45 degrees nose low, pick a point on the ground and freeze it in the windscreen. Verbalizing the roll direction on the first half of the maneuver will help ensure the roll on the second half of the maneuver is in the correct direction.

6.24. Cloverleaf (Figure 6.11.).

6.24.1. **Objective.** Combine elements of the loop, roll, and split-S into a fluid maneuver.

6.24.2. **Description.** The cloverleaf is composed of four identical maneuvers, each of which changes heading by 90 degrees. The pull-up is similar to the loop, although with less G loading. The top part is a rolling pull to the horizon 90 degrees displaced from the original heading. The pulling roll resembles a nose-high recovery. The lower part or pull through is flown like a split-S. The maneuver is complete in level flight after four leaves in the same direction. Fewer than four leaves may be performed when practicing the maneuver.

6.24.2.1. Airspeed – 200-220 KIAS.

6.24.2.2. Power –80% to MAX.

6.24.2.3. Attitude - Wings level for pull-up and pull through.

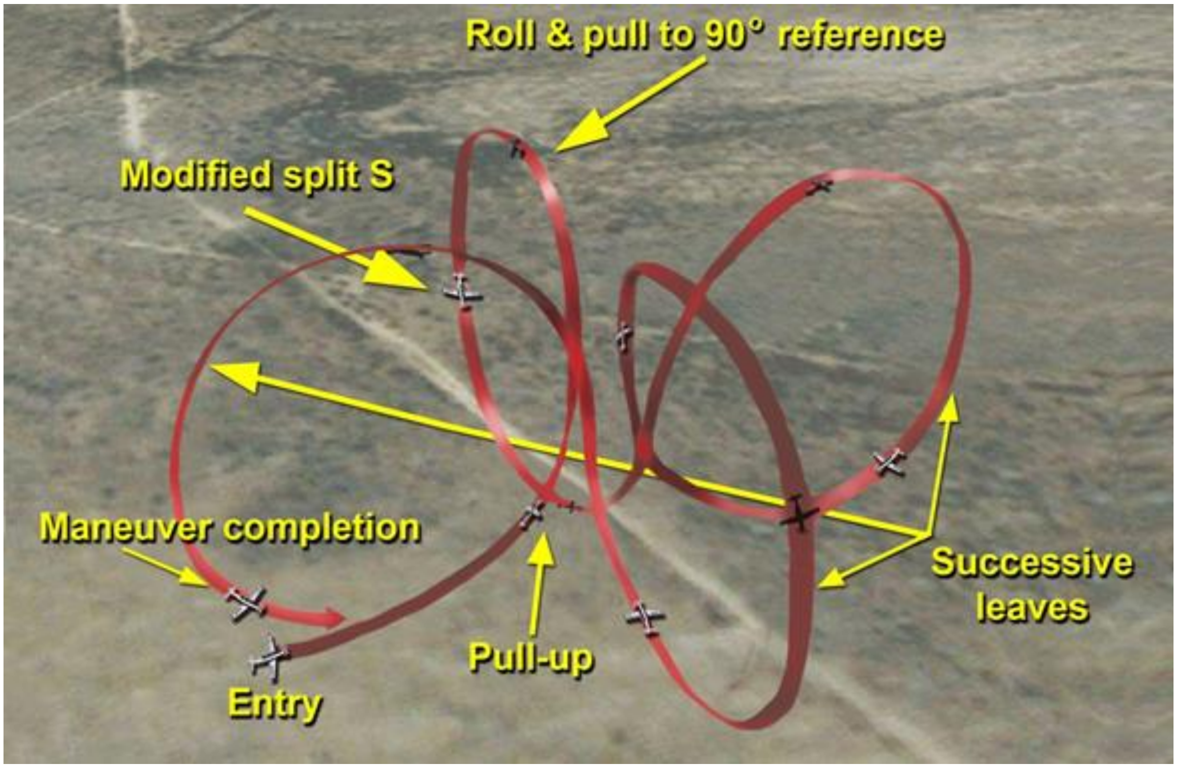
6.24.2.4. Altitude - Approximately 3,000 feet above and 1,000 feet below entry altitude.

6.24.2.5. FCP visual reference:

6.24.2.5.1. Wingtips equidistant from horizon in pull-up.

6.24.2.5.2. Feet on horizon when 45 degrees nose high.

Figure 6.11. Cloverleaf.



6.24.3. **Procedure.** Begin in straight-and-level flight, with briefed entry airspeed and power setting. Pick a reference point 90 degrees off the nose in the desired direction. The initial part of the maneuver is a straight pull-up, similar to a loop, except utilizing a lower G loading (2-3 Gs). As the aircraft reaches 45 degrees nose high (feet on the horizon), begin a coordinated roll toward the 90-degree reference point. Allow the nose to continue climbing during the roll so the maneuver is fairly slow and lazy. Coordinate the pull and roll so the nose passes through the reference point with the aircraft wings level, inverted, and at a relatively low airspeed (approximately 120 KIAS). Do not stare at the airspeed indicator, but note the airspeed at the inverted point. Consider discontinuing the maneuver if airspeed is above approximately 150-160 KIAS. Keep the wings level and pull through the bottom of the maneuver as in the split-S. To avoid excessive G and airspeed at the bottom, attempt to max perform (as in the split-S) once the nose passes the horizon. Approaching the horizon in the pull- through, reduce back pressure to allow acceleration to entry airspeed at the horizon. Complete three additional leaves in the same direction.

6.24.4. **Technique.** Use section lines or prominent roads off of the wingtip in the direction of turn to visually identify 90-degree points. Begin roll when feet are on the horizon. A combination of roll and pull is necessary to be inverted, wings level over the reference point. Cross-check G load at the horizon after each pull through the bottom. Reaching 200-220 knots at the horizon, G may then have to be reduced to the 2-3 Gs required for the initial pull-up by releasing back stick pressure.

6.25. Chandelle (Figure 6.12.).

6.25.1. **Objective.** Gain maximum altitude during a 180-degree turn.

Figure 6.12. Chandelle.

6.25.2. **Description.** The Chandelle is a precision, constant bank 180-degree steep climbing turn that achieves a maximum gain of altitude for a given power setting. The maneuver is complete after 180 degrees of turn.

6.25.2.1. Airspeed – 200-250 KIAS.

6.25.2.2. Power - MAX.

6.25.2.3. Attitude – Entry: wings level, 15 degrees nose low. Exit: wings level, 45 degrees nose high.

6.25.2.4. Altitude - Approximately 3,000 feet above entry altitude.

6.25.2.5. FCP visual reference:

6.25.2.5.1. Bottom edge of canopy on horizon at entry.

6.25.2.5.2. Feet on horizon (45 degrees nose high) at exit.

6.25.3. **Procedure.**

6.25.3.1. Begin wings level, 15 degrees nose low with briefed power setting but below briefed entry airspeed. When airspeed reaches briefed entry airspeed, blend rudder, aileron, and elevator pressure simultaneously to begin a climbing turn, applying approximately 3 Gs. Increase bank to 60 degrees and keep the nose track rising at a uniform rate. The nose should describe a straight line diagonal to the horizon. The nose should pass through the horizon at approximately 60 degrees bank with 30-45 degrees of turn complete. Check the amount of turn by using outside references. Once the nose is above the horizon, changes in pitch angle, airspeed, and the vertical component of lift require constant changes in control pressures and considerably more back stick pressure is required to keep the nose rising at a uniform rate. Aileron and/or rudder pressure opposite the direction of turn will be required in order to prevent overbanking. At the 135-degree point in the turn, start the rollout but keep the nose rising. Monitor the amount of turn remaining before reaching the 180-degree point by checking outside references. Time the rollout so the wings become level as the nose reaches the highest pitch attitude (approximately 40-45 degrees) at the 180-degree point. When the maneuver is complete (180 degrees of turn), lower the nose to the horizon or perform a nose-high recovery.

6.25.3.2. If the rate of climb is too fast, and the aircraft approaches stall before turning 180 degrees discontinue the maneuver by performing a nose-high recovery. If the rate of pitch change is too slow, the 180-degree point may be reached before the maximum pitch attitude is attained. When starting the maneuver, the rate of roll-in is faster than the rate of pull-up (60 degrees bank change, 15 degrees pitch change).

6.25.4. **Technique.** Use perpendicular and parallel roads or section lines visually to monitor progress of turns. Inside the cockpit, the heading marker can be a good cross-check tool in addition to cross-checking bank and pitch on the main attitude indicator (ADI). Outside the cockpit, pick a reference point and place it 90 degrees off either shoulder. Begin a turn away from the reference point. Once the reference point becomes visible again off the other shoulder, you will have completed approximately 135 degrees of turn, prompting the rollout to achieve 180 degrees of turn. Visualizing the Chandelle as similar to climbing a spiral staircase can help with maneuver execution.

Chapter 7

INSTRUMENT FLYING

7.1. Introduction. Instrument flight in Air Force aircraft is governed by standardized rules and procedures. Most of the standardized guidance is found in sources other than this manual. AFMAN 11-217, Volumes 1 and 3 are the main sources of guidance for instrument flight. They contain detailed information on most of the topics presented in this chapter and must be studied to ensure success. This chapter provides T-6-specific considerations for instrument flight and presents information on training rules, basic and advanced instrument maneuvers, spatial disorientation, and the application of basic principles to instrument mission execution. You should also refer to Flight Information Publications *(FLIP)*(for example, *Flight Information Handbook*, *IFR Supplement*, *General Planning*, etc.); AFI 11-202, Volume 3; Federal Aviation Regulation *(*FAR)/AIM; and the flight manual for additional instrument flight guidance.

7.2. RCP Instrument Procedures. For instrument flight, the RCP is functionally the same as the FCP. When a PPT student pilot occupies the RCP, the instructor performs all landings.

7.3. Use of Vision-Restricting Device (VRD). To enhance instrument training, a VRD is used during student instrument training sorties. The VRD (commonly called the hood) is used to restrict peripheral vision and force dependence on instruments for SA. When under the hood, focus on the instrument cross-check as if in actual IMC. Use the VRD according to AFI 11-202, Volume 3; AFI 11-2T-6, Volume 3; and the appropriate syllabus. The VRD will not be worn by pilots in the FCP.

7.4. EFIS and GPS Display Options. There are multiple configurations for the EFIS and GPS. Normally, a standard display setup (established locally) is used until proficiency is demonstrated. After demonstrating proficiency, other than standard display options may be used to optimize SA and precise control of the aircraft.

7.5. Task Management. Unlike contact flying, the horizon is not used to determine pitch and bank. Instrument flight uses the EADI for attitude information. As visual cues become less prominent, a greater percentage of attention must be focused on the EADI. Time-consuming tasks such as approach plate review, chart manipulation, and NAVAID setup or GPS programming should be accomplished as the workload allows with control of the aircraft attitude always maintained as first priority. Complex tasks that divert attention from basic instrument flight should be broken down into subtasks; complete a subtask then return full attention to the instruments. Alternate attention between subtasks and the instruments until the full task is complete. Effectively trimming the aircraft significantly reduces workload in controlling the aircraft and is the key to successfully accomplishing other subtasks. Anticipate and begin required actions as early as practical such as putting anticipated frequencies and NAVAIDs into the queue or STBY function of the RMU.

7.6. Cockpit Organization. An organized approach to cockpit setup is essential due to the additional publications, such as charts and approach plates, required on most instrument sorties. Consideration for cockpit organization during mission analysis can pay big dividends when it gets busy in the aircraft. In general, strive to find ways to get ahead and prepare for upcoming tasks. The following examples are just a few of the techniques that can help improve task management and cockpit organization:

7.6.1. Pre-fold all charts before strap-in. Store them in the order they will be used.

7.6.2. Use AF Form 70, *Pilot's Flight Plan and Flight Log*, VFR chart (when flying a VFR leg), or lineup card to annotate information that is likely to be required in flight.

7.6.3. Fold flight plan or other paperwork so it is easy to read. Store in order of use.

7.6.4. Use a self-adhesive tab or rubber band to mark required pages in the IFR supplement and IAP.

7.6.5. Write down radio frequencies as they are assigned.

7.6.6. Print and highlight applicable NOTAMs.

7.6.7. Use the STBY frequency function of the RMU to anticipate radio changes.

7.7. Control and Performance Concept. Proper use of the control and performance concept (described in AFMAN 11-217, Volume 1) makes basic aircraft control much easier and frees attention for other tasks. T-6 control instruments are the EADI and the primary engine data display (specifically, engine torque). Performance instruments are the altimeter, airspeed indicator, VSI, AOA, and EHSI (heading). When possible, start with the known pitch and power settings (See **Table 7.1**). These power settings vary slightly between aircraft depending on fuel load and temperature. Use of known pitch and power settings helps to minimize power changes. Excessive or continual power changes in the T-6 cause heading, pitch, and trim deviations which make precise instrument flight more difficult.

Table 7.1. Common Instrument Pitch and Power Settings.

Maneuver	Airspeed	Gear	Flaps	Pitch (degrees)	Torque (note 1)	VSI
Vertical-S up	150	UP	UP	5-6 NH	55%	1,000 fpm
Vertical-S down				1-2 NL	15%	
45 steep turn				3 NH	45%	
60 steep turn				4 NH	60%	
Wingover	220				80% to MAX	
Aileron roll				15-25 NH		
Penetration (note 2)	200	UP	UP	8 NL 10 NL	5% 25 % and speed brake	
En route descent	200	UP	UP	5 NL	20%	
				7.5 NL	8%	
Final approach (level/configured)	110	DOWN	TO	3 NH	35%	
Precision final				LOL	21%	600 fpm
Non-precision final				1 NL	16%	1,000 fpm
Non-precision final (circling)	120	DOWN	TO	1 NL	21%	1,000 fpm
Holding	150	UP	UP	2 NH	35%	

Notes:

1. All torque settings are approximate and vary slightly depending on density altitude and aircraft weight.

2. An 800-1000 ft/NM penetration descent (8-10 degrees nose-low) ensures you remain within protected airspace on a penetration approach. See AFMAN 11-217 vol 1.

LEGEND:
AR: As required
LOL: Line-on-line
NH: Nose high
NL: Nose low

7.8. Instrument Flight Maneuvers. Instrument flight is simply a series of basic instrument maneuvers flown in a sequence that depends on the route, weather, air traffic congestion, and other factors. The following basic maneuvers are the building blocks for advanced concepts described later in this chapter.

7.9. Turns and Turns To Headings.

7.9.1. **Objective.** Maintain smooth, coordinated flight in turns to specific headings.

7.9.2. **Description.** Normally, bank is no greater than 30 degrees to reduce the chances of spatial disorientation.

7.9.3. **Procedure.** Apply coordinated aileron and rudder in the direction of the turn. Refer to the EADI for bank information. In level turns, maintain constant altitude and airspeed by cross-checking the EADI and performance instruments. Increase the pitch attitude, as necessary, to counteract the loss of lift when the aircraft is banked. Apply corrections when the flight instruments indicate a deviation. When the desired bank is reached, it may be necessary to exert slight aileron pressure in the opposite direction to prevent over-banking. Maintain the desired AOB. Adjust power to hold a constant airspeed. As the bank is established, a small increase in power is usually required. Reverse these procedures to return to straight-and-level flight.

7.10. Airspeed Changes.

7.10.1. **Objective.** Smooth, controlled, deliberate change of airspeed.

7.10.2. **Description.** Change of power setting to affect change in airspeed. At completion of airspeed change, power is set to maintain new airspeed. Aircraft trimmed during airspeed change and fine-tuned at target airspeed. Normally practiced between 110 and 250 KIAS.

7.10.3. **Procedure.** To increase airspeed in straight-and-level flight, advance the power beyond the setting required to maintain the new airspeed. As airspeed increases, lift increases so there is a climb tendency. Adjust pitch attitude to maintain altitude. Approaching target airspeed, reduce power to a setting estimated to maintain the new airspeed. Reduce airspeed in the same manner but use an opposite power schedule.

7.10.4. Adjustments to trim will be required almost continually during airspeed changes. Do not neglect the need for rudder trim. An increase in torque generally requires nose-right rudder trim. Likewise, a reduction in torque requires nose-left rudder trim. Speed brake may be used for rapid airspeed reductions; however, use caution as the susceptibility for spatial disorientation increases with use of the speed brake in IMC.

7.11. Constant Airspeed Climbs and Descents.

7.11.1. **Objective.** Maintain constant airspeed during climb or descent.

7.11.2. **Description.** Climb or descend at a specific airspeed. Normally practiced at 110-250 KIAS.

7.11.3. **Procedure.** To climb, simultaneously increase power and raise pitch to maintain desired airspeed. To descend, simultaneously reduce power and lower pitch to maintain desired airspeed. The amount of pitch change varies with airspeed and power setting. Although airspeed is constant, trim is required due to power change.

7.12. Constant Rate Climbs and Descents.

7.12.1. **Objective.** Maintain constant vertical speed during climb or descent.

7.12.2. **Description.** Climb or descend at constant rate, normally at constant airspeed. Usually practiced between 110-250 KIAS and 500–4,000 fpm.

7.12.3. **Procedure.** Simultaneously advance or reduce power and change pitch to affect desired climb or descent rate. When vertical speed stabilizes, adjust pitch and power to maintain target vertical speed and airspeed.

7.12.4. **Application.** Initially use known pitch and power setting, then fine tune when vertical speed stabilizes. The 60-to-1 rule can be used to calculate pitch change required for target vertical speed: 1 degree of pitch change = 100 feet per NM. For example, at 240 knots true airspeed (KTAS) (4 NM/min), 2 degrees of pitch change (4 NM/min multiplied by 200 ft/NM) results in 800 fpm vertical speed. For example, at 240 KTAS, 2 degrees of pitch change results in 800 feet per minute vertical speed (4 NM/min multiplied by 200 ft/MN=800 feet per minute). If airspeed and target vertical speed are fixed, the formula to solve for required pitch change is: VSI divided by NM per minute, divided by 100 = pitch change. For example, target vertical speed 1,000 fpm at 150 KTAS (2.5 NM/min) = 4-degree pitch change.

7.13. Instrument Slow Flight.

7.13.1. **Objective.** Familiarization with handling characteristics in approach configuration at approach airspeeds.

7.13.2. **Description.**

7.13.2.1. Airspeed - 110-120 KIAS.

7.13.2.2. Gear – Down.

7.13.2.3. Flaps – TO.

7.13.2.4. Attitude – 3 degrees nose high; 0-30 degrees AOB.

7.13.3. **Procedure.** Slow and configure as for an instrument approach. Practice level flight, turns, and descents.

7.13.4. **Techniques.** Use known pitch and power settings. Use 60-to-1 to determine pitch change for target descent rate on simulated approaches. Practice level, shallow bank turns at

110 KIAS to simulate corrections on final. Practice level off at simulated minimum descent altitude (MDA). Practice 30-degree bank turns at 120 KIAS to simulate maneuvering on a circling approach.

7.14. Steep Turns.

7.14.1. **Objective.** Maintain smooth, coordinated flight in turns to specific headings at steeper than normal bank angles.

7.14.2. **Description.**

7.14.2.1. Airspeed - 150 KIAS normally, other airspeeds permissible.

7.14.2.2. Attitude - 45- degree and 60-degree bank.

7.14.3. **Procedure.** Enter a steep turn in the same manner as a normal turn. Anticipate the addition of power to maintain a constant airspeed. Pitch required, in the turn, is higher than wings level flight. Anticipate pitch change as VSI lags behind actual aircraft performance. Use a constant AOB during steep turns, and attempt to correct altitude deviations by adjusting the pitch attitude; however, if altitude gain or loss is excessive, a decrease or increase in bank can help correct the pitch attitude.

7.14.4. **Technique.** "Bug, Turn, Talk." Use the known pitch and power settings in **Table 7.1**. Add power passing 30 degrees of bank. To roll out on the desired heading, as a starting point, lead the rollout by approximately 15 degrees for a 45-degree bank turn and 20 degrees for a 60-degree bank turn. Lead points should be adjusted as necessary if consistently rolling out short or past the desired heading.

7.15. Vertical-S.

7.15.1. **Objective.** Practice instrument cross-check.

7.15.2. **Description.** As described in AFMAN 11-217, Volume 1. Climb or descent at 1,000 fpm and 150 KIAS. Type flown (A-B-C-D) based on proficiency. Target pitch and power settings are found in **Table 7.1.**

7.15.3. **Procedure.** Use procedures for constant rate climbs and descents.

7.15.4. **Technique.** Begin with aircraft completely trimmed (trimmed hands-off, see paragraph **2.9.1.5.**) for level flight at 150 KIAS. Lead the change at the top or bottom of the maneuver by 100 feet (10 percent of VSI). Lead pitch reversal with power. Generally, control VSI with pitch; control airspeed with power.

7.16. Confidence Maneuvers.

7.16.1. **Objective.** Gain confidence in the use of the attitude indicator in extreme pitch and bank attitudes.

7.16.2. **Description.** Wingover (similar to one-half lazy eight) and aileron roll flown with EADI as the primary reference. Each maneuver is complete when stabilized in level flight.

7.16.2.1. Airspeed - 220 KIAS.

7.16.2.2. Power: 80 percent to MAX .

7.16.3. **Procedure.** Begin in straight-and-level flight, with briefed entry airspeed and power setting.

7.16.3.1. **Aileron Roll.** Begin in straight-and-level flight, at entry airspeed and power setting. Maintain wings level and raise the nose 15 to 25 degrees on the EADI. Use aileron and rudder to perform a coordinated roll. Start with a moderate roll rate. Unlike the contact aileron roll, a constant roll rate is not the goal. Adjust the roll rate to pass through the horizon in a wings-level, inverted attitude. Do not unload, when inverted, to hit the horizon. Continue rolling to wings-level upright, as the nose continues to drop to approximately 15 to 25 degrees nose low at about 220 KIAS. Smoothly return to level flight.

7.16.3.2. **Wingover.** Begin in straight-and-level flight, at entry airspeed and power setting. The wingover is a slow and precise maneuver with a constant roll rate. Increase back pressure and start to roll such that the low wingtip of the EADI fixed aircraft symbol remains on the horizon bar. Back pressure increases as bank increases to 60 degrees. Pitch is approximately 10 degrees nose high at 30 degrees bank. At 60 degrees bank, pitch is approximately 20 degrees nose high. As the nose falls, continue to roll. At the horizon, bank should be 90 degrees. Begin to roll out passing the horizon. Increase back pressure and approaching 60 degrees-bank, catch the high wingtip on the horizon bar. Pitch is about 20 degrees nose low. Keep the wingtip on the horizon bar until wings level.

7.17. Unusual Attitude Recoveries.

7.17.1. **Objective.** Recover to normal attitude with reference to instruments only.

7.17.2. **Description.** An unusual attitude is any unexpected or inadvertent attitude encountered during normal instrument flight. Generally, in IMC conditions, bank should be limited to 30 degrees and pitch limited to 10 degrees nose low to 15 degrees nose high. Possible causes of unusual attitudes include slow cross-check, spatial disorientation, channelization on a subtask, and transition from VFR to IFR. The recovery is complete when desired attitude, for normal instrument flight, is reached.

7.17.3. **Procedure.** Perform recoveries as described in AFMAN 11-217, Volume 1. Use the EADI as the main recovery instrument after proper operation is verified and it is confirmed that an unusual attitude exists. Compare the EADI indication with the STBY attitude indicator and performance instruments to confirm an unusual attitude.

7.17.3.1. If operating properly, the EADI is used to recover. The horizon bar is always visible, but in extreme nose-high or nose-low attitudes it may be very near the bottom or top of the EADI. In these cases, red recovery chevrons point to the horizon and may be used to determine attitude.

7.17.3.2. Bank interpretation and control response are most important in recovering from unusual attitudes. In high performance aircraft, an inverted (beyond 90 degrees of bank), diving attitude is the most critical situation. Correction to an upright attitude (less than 90 degrees bank) is the priority and must be initiated before pitch correction.

7.17.3.3. If the aircraft is diving, roll toward wings level and start pull-up when bank is less than 90 degrees. Reduce power and extend the speed brake if required.

7.17.3.4. If the aircraft is climbing, use power as required to maintain desired airspeed. As the fuselage dot of the miniature aircraft approaches the horizon bar, adjust bank to establish a wings-level attitude. If airspeed is low, the nose may continue below the horizon. Only use as much bank as required to recover; it is not necessary to use 90 degrees in all recoveries.

7.17.4. **Technique.** “Recognize, Confirm, Recover”:

7.17.4.1. Recognize - Identify potential unusual attitude with EADI and aircraft performance.

7.17.4.2. Confirm - Verify actual attitude with standby (STBY) ADI and performance instruments.

7.17.4.3. Recover - Apply appropriate recovery procedure.

7.18. Spatial Disorientation Demonstrations. The following maneuvers simulate three common types of spatial disorientation illusions. They reaffirm the requirement to rely on instruments during instrument flight instead of seat-of-the-pants sensations. These maneuvers will only be practiced with an IP on board and only conducted in VMC. The purpose of these demonstrations is to help a student pilot understand the real threat of spatial disorientation and the importance of trusting flight instruments. See AFMAN 11-217, Volume 1, for further information.

7.18.1. **Leans.** An illusion experienced due to the effects of aircraft motion about the longitudinal axis (roll) on the semi-circular canals. There are three phases – roll entry, roll sustainment and roll-out. Each elicits a sensation that may be correct or false with regards to aircraft motion. This is commonly experienced while maneuvering or being vectored in the weather or at night and can be particularly problematic during sustained or slow rate turns.

7.18.1.1. **Demonstration.** The PNF closes eyes while the aircraft is in a straight-and-level attitude. PF executes a well-coordinated instrument turn, which the PNF should sense correctly with eyes closed. As the PF sustains the constant rate turn for 8 to 10 seconds, the PNF should experience a ‘straight-and-level’ sensation. At roll-out to straight-and-level flight, the PNF should experience the illusion of roll in the opposite direction of the original bank. In the absence of a good instrument crosscheck, this may lead to re-entry into the original roll at often more severe bank angles in an attempt to “feel” straight and level during instrument flight conditions.

7.18.2. **Coriolis Effect.** An illusion experienced when more than one angular plane of motion is stimulated in the inner ear. This is usually accomplished through the simultaneous motion of the head and aircraft but in different planes, e.g., looking down at an approach plate or checklist during a turn in instrument flight conditions. The result can be a sense of motion in the form of tumbling or vertigo and loss of orientation awareness. Compensatory eye movements in the form of nystagmus may occur and make aircraft instrument recovery much more difficult.

7.18.2.1. **Demonstration.** The PF executes a well-coordinated instrument turn while the PNF closes their eyes and rotates their head position from facing forward to facing downward towards their lap, then back to facing forward while the aircraft is banking or rolling out of bank. The PNF will experience the Coriolis illusion and have difficulty in distinguishing orientation even after the PNF re-opens their eyes and focuses on their instruments. This demonstrates the danger of not only excessive head movement during aircraft motion in instrument flight conditions but also difficulty in determining correct instrument recovery procedures due to the severity of the illusion.

7.18.3. **Pitch and Elevator Illusions.** A false sensation of pitch created by the effects of acceleration on the otolith organs. During instrument flight conditions positive acceleration can lead to a sense of nose-up pitch while deceleration can result in a sensation of nose-down pitch. Normally associated with take-off at night or in the weather, the combination of positive acceleration and pitch required for takeoff rotation can lead to a sense of over pitch and cause aggressive pitch-down control inputs to compensate. Go-arounds and missed approaches at night or in instrument conditions are also common scenarios where this illusion can result in inappropriate aircraft control inputs. Sudden climbs and dives or abrupt changes to climbs and dives such as sudden level-offs can lead to a sensation of excessive vertical motion or the continuation of a climb or dive, as if in an elevator, even after vertical motion has stopped.

7.18.3.1. **Demonstration.** PF configures the aircraft normally for an instrument approach while the PNF closes their eyes. Once established at final approach speed, the PF executes a simulated missed approach using normal procedures, allowing the aircraft to accelerate to a normal climb speed. PNF should sense a pitch in excess of actual aircraft performance. After climbing approximately 1000 feet, PF levels the aircraft at moderate rate (faster than what would be normally desired). The PNF should experience the sensation of continuing to climb (elevator illusion). The demonstration warns pilots of the tendency to compensate with a pitch-down response in degraded visual conditions.

7.19. Application of Instrument Flight Maneuvers. The basic maneuvers and principles of instrument flight are basis for safe instrument flight. Skills developed in practice are used alone, or in combination, to perform an instrument sortie from takeoff through the enroute portion to descent and landing.

7.20. Instrument Takeoff (ITO) and Climb.

7.20.1. **Objective.** Safely transition to IMC from a normal takeoff (VMC).

7.20.2. **Description.** Normal takeoff based on visual cues with transition to instruments on departure leg at the same rate as the loss of visual cues.

7.20.3. **Procedure.** Perform a normal takeoff. After lift-off, use outside references and the EADI to control attitude. Transition to instruments at the same rate as visual cues are lost. Unless otherwise directed, do not turn until at a minimum of 140 KIAS and 400 feet AGL. Initially raise the nose to 7-10 degrees nose-high indication on the EADI to establish a definite rate of climb. Trim and verify climb with altimeter and VSI. Maintain initial attitude until target climb speed. Nonstandard climb gradients, on published departures, may require adjustments to the climb profile. See AFMAN 11-217, Volume 1, for additional information.

7.20.4. **Technique.** Consider a static takeoff to allow for a thorough check of all systems prior to brake release and takeoff into IMC. Before takeoff, review impact of IMC on emergency recovery options.

7.21. Level Off.

7.21.1. **Objective.** Smoothly level off at desired altitude with power set to attain or maintain desired airspeed.

7.21.2. **Description.** Change of pitch to reduce vertical speed at a specific altitude combined with power adjustment to meet desired airspeed.

7.21.3. **Procedure.** To level off at airspeed below climb speed, lower the nose to level flight and reduce power below the setting required to maintain the lower airspeed. To level off at a higher airspeed, leave the PCL at MAX or set power above the setting required to maintain the greater airspeed. Adjust power approaching target airspeed, and apply trim. Use similar procedures for a level off from a descent.

7.21.4. **Technique.** Use 10 percent of vertical speed (from VSI) as a lead point to begin level off; for example, begin level off 200 feet below desired altitude when VSI indicates 2,000 fpm. At the lead point, cut the pitch in half, and then continue pitch change to smoothly level off. If intermediate level offs are required, it is permissible to maintain climb airspeed or accelerate to the appropriate cruise speed for that altitude.

7.22. Instrument Departures.

7.22.1. **Objective.** Comply with departure procedures and safely transition from takeoff to the enroute structure.

7.22.2. **Description.** Departure routes and altitudes are designed to provide clearance from obstacles or efficient traffic flow. Consult AFMAN 11-217, Volume 1 and AFI 11-202, Volume 3, for detailed information on instrument departures.

7.22.3. **Procedure.** Consult AFMAN 11-217, Volume 1, and AFI 11-202, Volume 3, for detailed procedures for instrument departure. Minimum obstacle and ATC climb gradients must be met.

7.22.4. **Technique.**

7.22.4.1. Review the entire departure procedure to include surrounding terrain, hazards, and climb gradient requirements during preflight planning. The departure review during the "R-NEWS" check is not a substitute for thorough preflight review.

7.22.4.2. Set NAVAIDs and displays, as required, to fly the departure.

7.22.4.3. Thoroughly review the airfield diagram (strange field).

7.22.4.4. Develop a plan for emergency return. Have an instrument approach plate open with the primary recovery approach displayed in case immediate return to the departure base is required. A common technique is to develop specific course of action for each section of the departure. For example, review potential actions for problems before gear retraction, after gear retraction but VMC, and in IMC. Review surrounding terrain for effects on emergency recovery.

7.22.4.5. Review NORDO procedures.

7.23. Course Intercepts. See AFMAN 11-217, Volume 1, for course intercept procedures with an HSI. See **Figure 7.1.** and **Figure 7.2.** for examples with T-6 instrumentation.

7.23.1. **Objective.** Intercept a radial inbound or outbound from a station.

7.23.2. **Description.** Turns to intercept specific courses to comply with published or assigned departure, in route, or arrival routing.

7.23.3. **Procedures.** See AFMAN 11-217, Volume 1, for course intercept procedures with an HSI. See **Figure 7.1.** and **Figure 7.2.** for examples with T-6 instrumentation.

7.23.4. **Technique.**

7.23.4.1. Set the heading bug on the intercept heading. Lead points are dependent on the CDI rate of movement and turn radius.

7.23.4.2. To intercept a course inbound, "Charlie Brown plus 30, not to exceed 90" is a common memory aid. Start at the course arrow (Charlie) on the EHSI, move up the case to the bearing pointer (Brown), and finally continue 30 degrees past the bearing pointer to identify the intercept heading.

7.23.4.3. To intercept a course outbound, "Top Cat plus 45, not to exceed the head of the bearing pointer" is a common memory aid. Start on the tail of the bearing pointer (Top), move up the case to the course arrow (Cat), and finally continue 45 degrees past the course arrow, but not to exceed the head of the bearing pointer, to identify the intercept heading. Bird's-eye-view awareness of aircraft location in relation to the NAVAID (radial/DME) as well as the desired radial to be intercepted will serve as a sanity check that the chosen intercept heading makes sense.

7.23.4.4. To maintain a course and correct for winds, divide the crosswind component of the wind by the true airspeed in NM/min. For example, if flying at 240 KTAS (4 NM/min) with 40 knots of crosswind, approximately 10 degrees of drift correction (40 knots/4 NM/min) into the wind are required to maintain a course.

Figure 7.1. Inbound Course Intercepts.

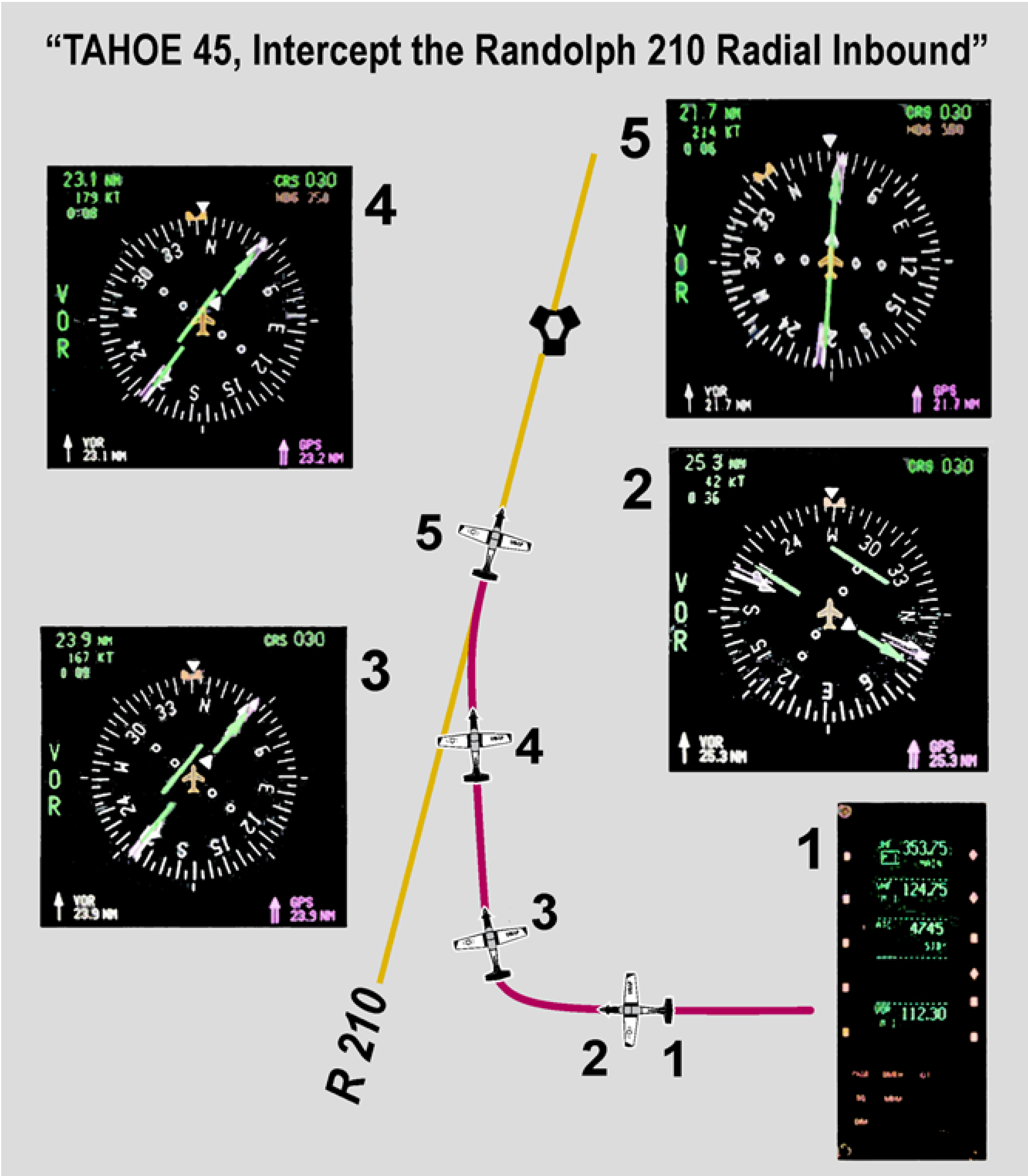
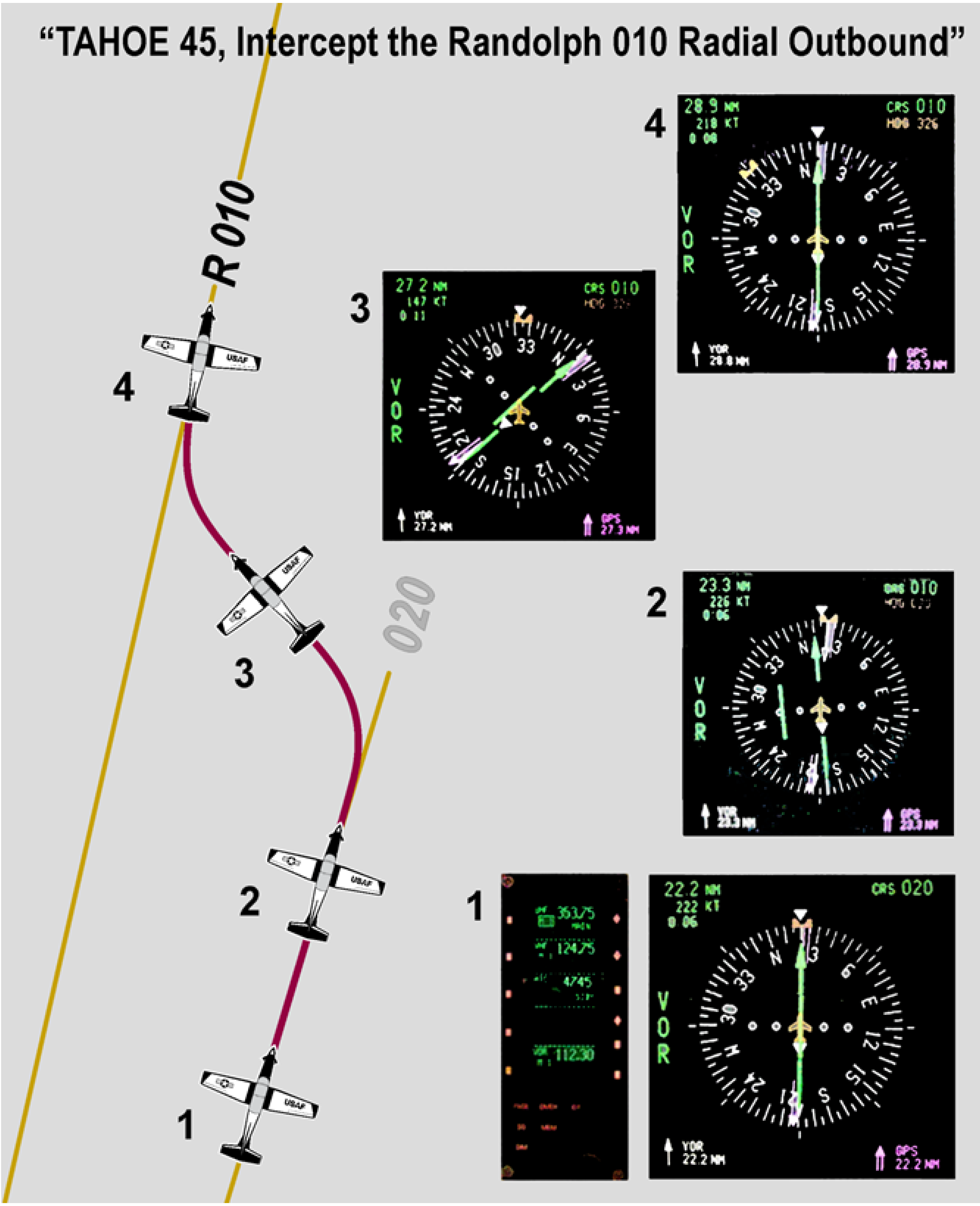


Figure 7.2. Outbound Course Intercepts (Away from the Station).



7.24. Arc and Radial Intercepts. See AFMAN 11-217, Volume 1, for detailed information on arc and radial intercepts. At normal T-6 airspeeds, lead points are not large, and the rate of CDI movement during the intercept can be used to determine the lead point.

7.25. Fix-to-fix. Proceed directly to a point defined by radial/DME, and/or RNAV waypoint using onboard navigational equipment. See AFMAN 11-217, Volume 1 for procedures.

7.25.1. **Objective.** Proceed directly to a point defined by radial and DME, using onboard navigational equipment.

7.25.2. **Description.** Specific points on the EHSI represent location and target radial or DME. The relative positions of current and desired position enable determination of the course between them.

7.25.3. **Procedure.** See AFMAN 11-217, Volume 1.

7.25.4. **Technique.**

7.25.4.1. Tune, identify, monitor (TIM) NAVAID and confirm the correct frequency is selected. Set radial of the desired fix in the CSW.

7.25.4.2. Turn in the shorter direction to a heading between the head of the bearing pointer and the head of the course arrow (which is the desired radial). Favor the head of the bearing pointer (which brings you closer to the selected station) if destination DME is less than current DME. Favor the head of the course arrow if destination DME is greater than current DME. **Note:** A heading (in a no-wind condition) exactly between the head of the bearing pointer and the head of the course arrow results in arrival at the target radial at the same DME as current DME. If both the bearing pointer and the head of the course arrow are in the upper half of the EHSI, the DME will initially get smaller than the current position DME before increasing to the target DME (referred to as cutting the arc).

7.25.4.3. After turning to an initial heading, fine tune and update the fix to fix by envisioning the aircraft's current position and the targeted fix superimposed on the EHSI as if it were a map. Use the DME of the position (current aircraft location or desired fix) furthest from the station as the distance to the outer ring of the EHSI bezel. The ground station is then located at the center of the EHSI. The current aircraft position is always somewhere on the tail of the bearing pointer, and the targeted fix is always somewhere between the center and the head of the course arrow. The relationship between the two points allows determination of turn direction and an estimate of the initial heading. **Figure 7.3.** and **Figure 7.4.** depict a fix-to-fix heading computation from the current aircraft position (180 radial at 60 DME, heading 360 degrees) to the targeted fix (090 radial at 30 DME). Current position is 60 NM south of the station, heading north. The target fix is 30 NM east of the station. The resultant heading to the fix under no wind conditions is approximately 025 degrees.

7.25.4.4. The following simple facts can prevent confusion. Current aircraft position is always somewhere between the tail of the bearing pointer and the center of the EHSI. The target fix is always somewhere between the center of the EHSI and the course arrow. The distance from the center to the outer edge of the compass card is always equal to the larger DME; therefore, *either* the current position or target fix is located on the outer edge of the compass card.

7.25.4.5. The pencil method may be used to determine heading from current position and target fix. A pencil can be used (or just visualize straight line) to connect the two positions with an imaginary line (**Figure 7.3**, photo C). Then imagine a parallel line through the center of the compass card. This line through the center of the compass card intercepts the no-wind heading to the target fix (**Figure 7.3**, photo D). A pencil is not necessary but may help develop the ability to imagine the proper lines.

7.25.4.6. The plumb bob can supplement the pencil method to determine heading to the target fix. As in the pencil method, imagine a line between current position and target fix. Turn to put the line in a vertical orientation (fixes aligned vertically).

7.25.4.7. Apply known wind drift corrections. A requirement for significant heading changes during updates can indicate approximate windspeed and direction. Proper wind drift correction can be determined by dividing the crosswind component by the true airspeed in NM/minimum min. For example, if the no-wind heading is 360 degrees, the crosswind component is 30 knots out of the west, and the airspeed is 3 NM/minimum min (180 NM/hour divided by 60 sec/minimum = 3 NM/minimum), the drift correction is 10 into the wind (30 divided by 3 = 10 degrees) for a resulting heading of 350 degrees to proceed toward the fix.

7.25.4.8. Regularly update the required heading to the target fix. Simply repeat the steps used to determine the initial heading (always use current DME). It can be helpful to schedule updates at distances that form simple ratios with the target DME. For example, if going from 60 DME to 15 DME, plan updates at 45 DME (1:3 ratio), 30 DME (1:2 ratio), and 20 DME (3:4 ratio). Mathematical ratio methods may also be used to determine heading. A heading midway between the bearing pointer and course arrow results in hitting target radial at DME same as current DME. A heading midway between the midpoint and course arrow results in hitting target radial at DME twice the current DME. Likewise, heading midway between the midpoint and the bearing pointer results in hitting target radial at DME one-half the current DME.

7.26. In-flight Checks.

7.26.1. **Objective.** Accomplish in-flight checks and other actions required during instrument flight.

7.26.2. **Description.** In-flight checks performed according to flight manual and other required actions such as IAP review accomplished in a timely fashion throughout the sortie.

7.26.3. **Procedure.** Accomplish required in-flight checks. Perform actions required by AFMAN 11-217, Volume 1, including review of IAP for planned approaches, re-check destination weather, and coordination of lost communication instructions, if required. See AFMAN 11-217, Volume 1, for detailed requirements.

Figure 7.3. Fix-to-fix Example.

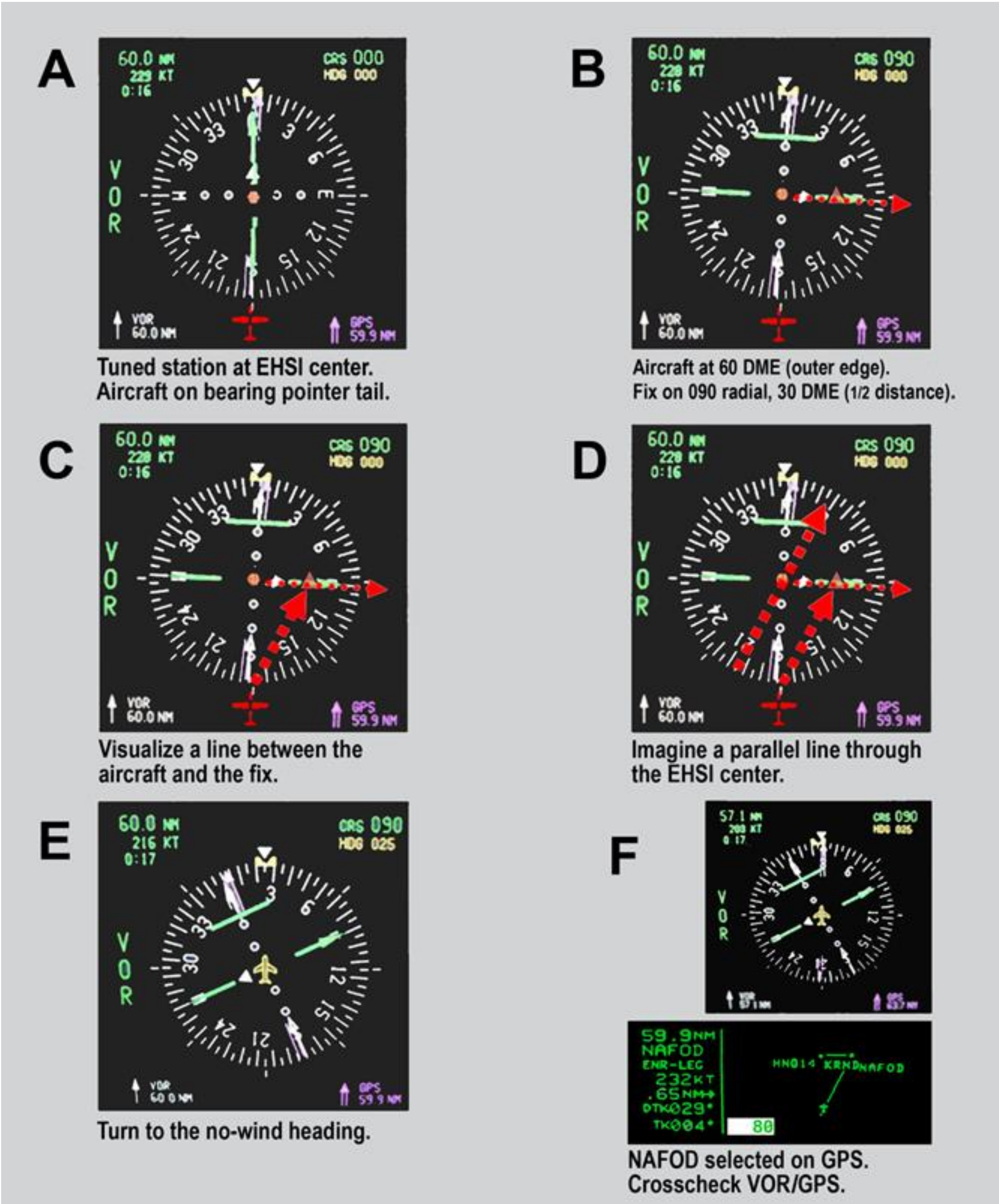
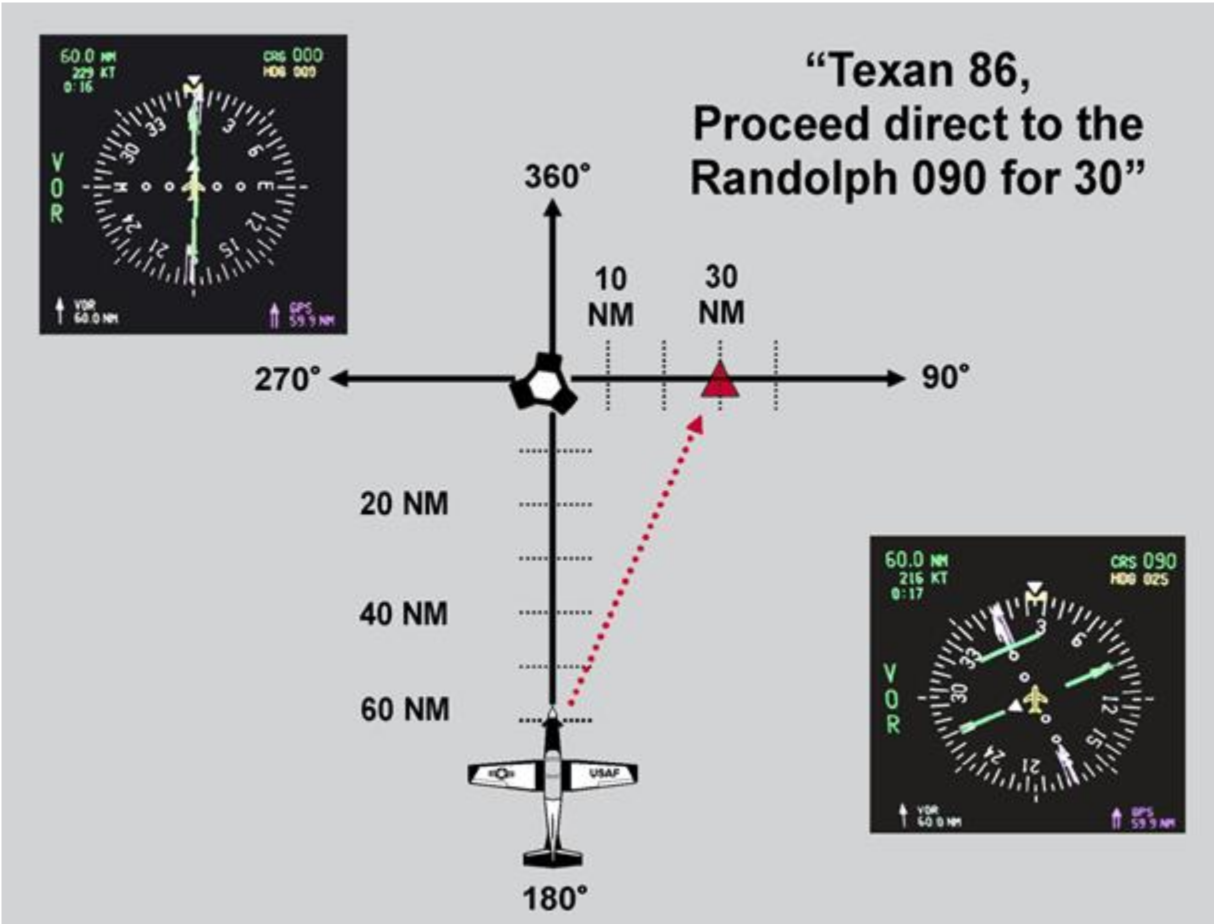


Figure 7.4. Visualize the HSI.



7.26.4. **Techniques.** Many useful acronyms are found in the AETC TRSS Handout 11-1, *Navigation for Pilot Training*. Following are some commonly used memory aids:

7.26.4.1. One of two methods is used prior to descent from cruising altitude.

7.26.4.1.1. **WHOLDS** .

7.26.4.1.1.1. **<u>W</u>** - **W**eather, check prior to IAF or beginning enroute descent.

7.26.4.1.1.2. **<u>H</u>** - **H**olding, coordinate holding instructions, if required.

7.26.4.1.1.3. **<u>O</u>** - **O**btain clearance for the approach.

7.26.4.1.1.4. **<u>L</u>** - **L**et down plate (approach) review (see below).

7.26.4.1.1.5. **<u>D</u>** - **D**escent check.

7.26.4.1.1.6. **<u>S</u>** - **S**peed, slow down for holding, or low altitude procedure.

7.26.4.1.2. **DRWHO** .

7.26.4.1.2.1. **<u>D</u>** - **D**escent check.

7.26.4.1.2.2. **<u>R</u>** - **R**eview IAP (see below).

7.26.4.1.2.3. **<u>W</u>** - **W**eather, check prior to the IAF or beginning enroute descent.

7.26.4.1.2.4. **H** - **H**olding, coordinate holding instructions if required.

7.26.4.1.2.5. **O** - **O**btain clearance for the approach.

7.26.4.2. Let down plate review:

7.26.4.2.1. **NMAILMAN.**

7.26.4.2.1.1. **N** - **N**AVAIDS, set for position awareness.

7.26.4.2.1.2. **M** - **M**inimum altitudes (on approach, minimum/emergency safe, etc.), weather minimums.

7.26.4.2.1.3. **A** - **A**ltimeter.

7.26.4.2.1.4. **I** - **I**nitial descent rate.

7.26.4.2.1.5. **L** - **L**ost communication instructions, if required.

7.26.4.2.1.6. **M** - **M**issed approach and (or) climbout.

7.26.4.2.1.7. **A** - **A**erodrome sketch.

7.26.4.2.1.8. **N** - **N**AVAIDS, set, and review changes for approach.

7.26.4.3. Before commencing final approach or between approaches:

7.26.4.3.1. **LIDS** .

7.26.4.3.1.1. **L** - **L**ocalizer, set correct frequency.

7.26.4.3.1.2. **I** - **I**nbound course, set if required.

7.26.4.3.1.3. **D** - **D**ME, check frequency.

7.26.4.3.1.4. **S** - **S**peed for approach.

7.26.4.3.2. **NORM** .

7.26.4.3.2.1. **N** - **N**AVAIDS set and TAS checked.

7.26.4.3.2.2. **O** - **O**btain clearance.

7.26.4.3.2.3. **R** - **R**eview approach and (or) RMU set.

7.26.4.3.2.4. **M** - **M**inimum and (or) missed approach.

7.26.4.3.3. **LDROD** (for GPS approach):

7.26.4.3.3.1. **L** - **L**oad the approach.

7.26.4.3.3.2. **D** - **P**roceed direct.

7.26.4.3.3.3. **R** - **R**AIM check (predictive).

7.26.4.3.3.4. **O** - **O**BS if required.

7.26.4.3.3.5. **D** - **D**isplay setup as desired or required.

7.26.4.4. When crossing any approach or holding fix to maintain SA and aid task management:

7.26.4.4.1. **Six Ts** .

7.26.4.4.2. **T** – **T**ime for the approach or holding leg.

7.26.4.4.3. **T** - **T**urn to specific heading or to intercept a desired course.

7.26.4.4.4. **T** - **T**orque set to hold desired airspeed.

7.26.4.4.5. **T** - **T**wist desired course into the CSW.

7.26.4.4.6. **T** - **T**rack the selected course.

7.26.4.4.7. **T** - **T**alk (make appropriate radio call). **Note**: this is intentionally the last step.

7.27. Holding.

7.27.1. **Objective.** Maneuver to properly enter holding and remain within holding airspace.

7.27.2. **Description.** Turn at entry to enter published or assigned holding pattern. Fly wind-corrected headings to remain within protected airspace.

7.27.3. **Procedure.** Procedures for holding entry, holding, and holding exit are described in FLIP, *General Planning;* AFMAN 11-217, Volume 1; and the flight manual. Normally hold at 150 KIAS. Airspeeds as low as 120 KIAS (or MAX endurance AOA, whichever is higher) may be flown in holding.

7.27.4. **Techniques.** Use the GPS to determine winds. Compare aircraft heading to actual aircraft track to determine crosswind correction required. Use techniques for the vertical-S when climbing or descending in a holding pattern.

7.28. Penetration Approach.

7.28.1. **Objective.** Transition from the enroute structure directly onto a published instrument approach.

7.28.2. **Description.** A steep instrument approach procedure with specific altitudes and courses, flown by military aircraft for tactical considerations.

7.28.2.1. Airspeed - 200-250 KIAS.

7.28.2.2. Power - As required. (See **Table 7.1**) Typically for 200 KIAS: 8 degrees nose low and 5 percent torque.

7.28.2.3. Speed brake – As required.

7.28.3. **Procedure.**

7.28.3.1. Lower nose and set power to maintain 200 KIAS. Airspeed may be adjusted to comply with published altitude restrictions. (Do not exceed 250 KIAS below 10,000 feet MSL.) Plan descent to allow configuration before final approach fix (FAF).

7.29. Enroute Descents.

7.29.1. **Objective.** Smoothly transition from the enroute structure to a (low) instrument approach.

7.29.2. **Description.** Descent according to assigned routing and altitude restrictions issued by ATC. The more commonly used method to descend for an instrument approach.

7.29.2.1. Airspeed - 200-250 KIAS.

7.29.2.2. Power - As required. (See **Table 7.1**) Typically for 200 KIAS: 5 degrees nose low and 20 percent torque.

7.29.2.3. Speed brake - As required.

7.29.3. **Procedure.**

7.29.3.1. Lower nose and set power to achieve desired airspeed and rate of descent. Plan descent to allow configuration before the FAF.

7.29.4. **Techniques.**

7.29.4.1. If given the option of a descent at pilot discretion, a 5-degree descent is comfortable and controllable. To determine when to start down using a 5-degree descent, multiply the altitude to lose in thousands of feet by 2 and add 10 miles. For example, if the altitude to lose is 20,000 feet, start down approximately 50 NM from the destination (20 multiplied by 2 = 40 plus 10 = 50 NM). The extra 10 miles allows for an instrument approach into the destination.

7.29.4.2. Given an altitude to be at within a specified range, determine the pitch attitude by one of two methods:

7.29.4.2.1. 60-to-l rule:

7.29.4.2.1.1. Pitch change = Altitude to lose (hundreds of feet) divided by NMs. For example, lose 5,000 feet in 10 NM; 50 divided by 10 = 5 degrees nose low.

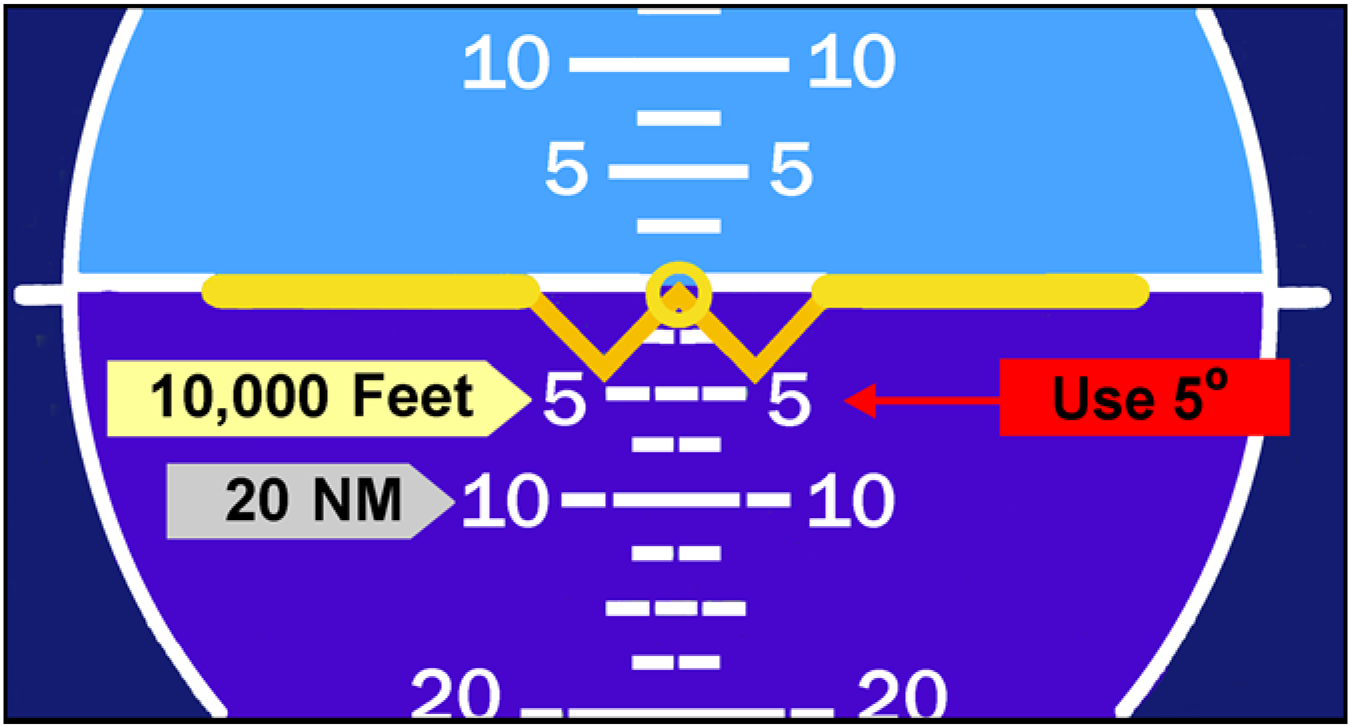
7.29.4.2.1.2. Every 1 degree of pitch equals descent (or climb) of 100 feet per NM.

7.29.4.2.2. EADI technique (**Figure 7.5.**).

7.29.4.2.2.1. The 10 degrees nose-low line on the EADI represents NM to descend.

7.29.4.2.2.2. Lower the nose, based on this scale, to altitude to lose (in thousands). For example, lose 10,000 feet in 20 NM. Set scale with **20** at 10 degrees nose-low line. Descent of **10** (thousand feet) is one-half of 20; therefore, pitch required is 5 degrees nose low.

Figure 7.5. EADI Descent Calculation.



7.29.4.3. Verify descent gradient by cross-checking VSI. Calculate descent rate from airspeed and pitch (descent gradient).

7.29.4.3.1. VSI = Groundspeed (NM/minute) multiplied by pitch (descent gradient) multiplied by 100. For example, 4 NM/minute (240 GS) multiplied by 5 degrees descent gradient multiplied by 100 = 2,000 fpm on VSI.

7.29.4.3.2. Use caution when calculating VSI with IAS or TAS. Significant winds change desired VSI for selected descent gradient. Headwinds result in lower VSI and tailwinds in higher. For example, descent above calculated with 240 TAS; expected VSI is 2,000 fpm; to maintain 5-degree descent gradient with a 60-knot headwind (180 GS); VSI is 1,500 fpm. Likewise, with a 60-knot tailwind (300 KGS), VSI is 2,500 fpm.

7.29.4.4. Use GPS and/or NAVAIDs to maintain SA.

7.30. Final Approach.

7.30.1. **Objective.** Transition from IMC to VMC via instrument approach procedure.

7.30.2. **Description.** Straight-in approach flown using EADI and GPS or NAVAIDs to control aircraft attitude, altitude, and route of flight. Weather minimums allow transition to visual cues for landing.

7.30.2.1. Airspeed - 110 KIAS (120 KIAS may be used if a circling approach is planned).

7.30.2.2. Gear - Down.

7.30.2.3. Flaps - TO.

7.30.3. **Procedure.** See AFMAN 11-217, Volume 1, and AFI 11-202, Volume 3, for approach procedures, rules, restrictions, and approach system information. See AFI 11-2T-6, Volume 3, for weather and approach minimum restrictions.

7.30.3.1. Before glide path intercept (precision) or FAF (non-precision) approaches, configure, slow to approach speed, and complete the before-landing checklist.

7.30.3.2. With crosswinds or gusty winds, configure using appropriate flap settings and increase airspeed, as required.

7.30.3.3. GPS-specific approach procedures include:

7.30.3.3.1. The GPS approach procedure must be loaded from a current database.

7.30.3.3.2. Check waypoint names, sequence, courses, and distances prior to commencing the approach (may be accomplished during preflight).

7.30.3.3.3. Check P-RAIM before initiating any GPS approach procedure (STAT page 5 or **http://sapt.faa.gov**).

7.30.3.3.4. Ensure course indicator set to proper tolerance (+/-1 mile on MODE page or APPR ARM any time terminal area procedures are flown).

7.30.3.3.5. Ensure no deviations while on the approach.

7.30.3.3.6. If deviations are noted, immediately terminate the procedure, and switch to backup options.

7.30.4. **Technique.**

7.30.4.1. Configuring 2 to 3 NM prior to the FAF in the T-6 allows for stabilization of airspeed and trim prior to descending at the FAF.

7.30.4.2. Compare aircraft track on the GPS to aircraft heading. The difference approximates the drift correction. Set heading bug to wind corrected heading for final. Update as necessary; wind speed and direction are rarely constant during the descent.

7.30.4.3. When deviations are noted, set specific headings to make corrections. If possible, limit heading changes to 5 degrees when making a course correction. Set heading bug to final approach course for additional visual cue for size of heading deviations. Because the heading bug is approximately 10 degrees wide (5 degrees either side of the bugged heading), limiting heading changes to the area beneath the heading bug will reduce the tendency to overcorrect. Limit pitch changes to 2 degrees (approximately 400 feet/minimum on the VSI) for glide slope corrections. Avoid large power corrections (unless required for excessively low or high airspeed).

7.31. Transition to Landing.

7.31.1. **Objective.** Safely transition from IMC to VMC to land the aircraft using visual cues.

7.31.2. **Description.** Transition to landing begins when visual cues for the runway environment are available. The transition from IMC to VMC is similar to the transition during an ITO, except transition from the instruments to visual cues at the same rate as they appear.

7.31.3. **Procedures.** See AFMAN 11-217, Volume 1, for detailed guidance.

7.31.3.1. Maintain instrument glide path or transition to a visual glide path for landing. Use visual approach slope indicator (VASI) or other visual glide path guidance when available.

7.31.3.2. Ensure adequate visual references (runway environment) are available before starting transition to landing. Some weather phenomenon, such as ground fog, may require missed approach even after initially breaking out from IMC to VMC.

7.31.3.3. Do not correct to visual glide path with a high sink rate, which may result in a short or hard landing. See AFMAN 11-217, Volume 1, for further information on "duck-unders" and landing illusions.

7.31.3.4. Thoroughly review the airport diagram (IAP). Pay particular attention to runway lighting, runway dimensions, runway slope, and charted obstructions.

7.31.4. **Technique.** With the field in sight and the decision made to land, the pilot may slow to 105 KIAS. If flaps landing are selected for landing, slow to 100 KIAS.

7.32. Circling Approach.

7.32.1. **Objective.** Safely maneuver to align with the landing runway.

7.32.2. **Description.** Visual flight maneuver used to align with runway if approach does not meet requirements for a straight-in approach or an approach to a runway different than the landing runway must be flown. Circling is performed with the runway environment in sight at all times.

7.32.2.1. Airspeed - 120 KIAS recommended; 110 KIAS minimum while circling until on a visual final.

7.32.2.2. Gear - Down.

7.32.2.3. Flaps - TO.

7.32.3. **Procedure.** See AFMAN 11-217, Volume 1, for detailed information.

7.32.3.1. Fly the instrument approach at 110 KIAS and accelerate to recommended airspeed of 120 KIAS when commencing the circle or fly the entire instrument approach and circle at recommended airspeed of 120 KIAS. In no case allow the aircraft to slow below 110 KIAS during any portion of the circling maneuver. If visibility permits, attempt to maintain lateral spacing that allows for a 30-degree bank turn to final, and begin the base turn to allow for normal length final (approximately one-half mile). Normally, fly the T-6 to Category B circling minimums based on its maneuvering airspeed of 120 KIAS, however, a higher circling category may be selected to increase circling radii as long as that category's minima are observed. Do not exceed the obstacle clearance distance of the selected circling category during the circling maneuver.

7.32.3.2. Landing flaps may be extended on base or final if landing distance is critical. Descend from MDA when in position to intercept a normal glide path. Airspeed may be reduced from 120 KIAS to approach speed appropriate for flap setting (110 KIAS flaps UP; 105 KIAS flaps TO; 100 KIAS flaps landing) when transitioning to final.

7.32.4. **Technique.**

7.32.4.1. If electing to fly the circling approach at 120 KIAS, approximately 1 degree nose low and 21% torque (remember "non-precision pitch and precision power"; see **Table 7.1**) will hold 120 KIAS until the MDA. At the MDA, approximately 3 degrees nose high and 40% power will hold level.

7.32.4.2. At circling MDA, visual cues for runway displacement appear considerably different than those commonly used in the overhead pattern. Because of the lower altitude, proper displacement on a circling approach appears to be much wider than for an overhead pattern. A good visual reference for proper downwind spacing at 500 feet AGL is wingtip on the landing runway.

7.32.4.3. Practice circling approaches at the MDA. However, under actual conditions, increase altitude above the MDA as weather conditions permit, up to normal overhead pattern altitude (1,000 feet AGL).

7.33. Missed Approach.

7.33.1. **Objective.** Safely discontinue an instrument approach and comply with published procedures or ATC instructions.

7.33.2. **Description.** Climb away from the airfield similar to ITO. May be performed in IMC with reference to instruments only, or may require transition to instruments (as in ITO). See AFMAN 11-217, Volume 1, for missed approach guidance.

7.33.3. **Procedure.** Smoothly advance the PCL to MAX, set attitude to 10-15 degrees nose high on the EADI, check VSI and altimeter to verify climb and raise gear and flaps. Once at targeted pitch and between 140-180 KIAS, pitch and power may be reduced as necessary to preclude excessive attitude and associated disorientation in IMC. If missed approach instructions direct a climbing turn, accelerate to 140 KIAS (minimum) before turning. Ensure that a minimum 200 feet per nautical mile climb gradient (or published, whichever is greater) is met. Maintain 150-200 KIAS (or according to local directives) on vectors for an additional approach. Maintain appropriate cruise airspeed if diversion is necessary.

7.34. Climbout.

7.34.1. **Objective.** Safely transition from departure leg to the radar pattern (for additional instrument approaches) or continue the sortie on a departure procedure.

7.34.2. **Description.** The transition from a practice instrument approach to the radar pattern or departure procedure. Similar to the applicable portions of an ITO.

7.34.3. **Procedure.** See ITO. Follow departure procedures if departing to the enroute structure. Power may be reduced to control acceleration and climb rate if entering the radar pattern for multiple instrument approaches; maintain 150-200 KIAS (or according to local directives).

7.34.4. **Technique.** If not otherwise directed by ATC, local directives, or unusual circumstances (weather, traffic, etc.), maintain 200 knots on radar downwind and slow to 150 knots on radar base.

Chapter 8

NAVIGATION

Section 8A—General

8.1. Introduction. Navigation training covers techniques and procedures used to fly from one location to another. Additional topics such as use of unfamiliar airfields, decision making outside the local area, task management, cockpit organization (complicated by charts and additional FLIP), and VFR mission analysis are covered in this chapter. AFPAM 11-216, *Air Navigation*, AETC TRSS Handout 11-1, and AFMAN 11-217 are primary sources for information on navigation.

8.2. General . Mission preparation may begin several days before departure. Destinations and routes may be selected any time in the planning process; however, some flight planning tasks, such as wind computations, fuel calculations, and weather briefings, must be completed shortly before departure. Note the distinction between IMC and IFR. IFR and VFR refer to rules and procedures while IMC and VMC refer to conditions. VMC generally refers to the ability to fly using references outside the aircraft while IMC generally refers to conditions where instruments inside the cockpit are used as the primary references. Conditions must generally be VMC to fly using VFR, but conditions can be either IMC or VMC to fly using IFR. Although there are differences between IFR and VFR flight, there are common planning steps and tasks. The following general guidelines apply to the planning and execution on any type of navigation mission (for example, IFR, VFR, or VFR low level).

8.3. Mission Analysis.

8.3.1. **Choosing a Destination.** Basic considerations to determine if an airfield is acceptable for use include runway length, servicing capability, command restrictions, operating hours, and instrument approach availability. Strange fields are those with which the pilot is unfamiliar and requires additional planning effort. There are several other significant considerations for training missions. Excessive distance (time and (or) fuel required) can preclude completion of required approach training. Weather conditions may not allow completion of major training objectives (for example, VFR low level) or use of an otherwise excellent airfield (weather below minimums). When significant weather is a factor (for example, winter weather to the north), it is good technique to develop multiple plans, such as a west option and an east option, for individual navigation missions or cross countries.

8.3.2. **NOTAM.** See FLIP, *General Planning*, for detailed information on the NOTAM system. An initial scan of the NOTAMs can identify issues that eliminate potential destinations from planning consideration and prevent wasted effort. Performing a flight path search on the NOTAMs homepage will identify possible emergency airfields that may not be used due to runway closure.

8.3.3. **Airfield Suitability and Restrictions Report (ASRR).** See AFI 11-202, Volume 3, for detailed information about use of the ASRR. Though originally designed for larger aircraft, the ASRR contains information about potential restrictions for T-6 operations and information that will enhance general SA.

8.3.4. **Weather.** Actual and forecast weather conditions are a huge part in the planning of a navigational sortie or cross country. Study long-range forecasts several days in advance to determine the suitability of potential destinations and impact of weather on the probability of meeting training objectives. AFI 11-202, Volume 3, lists authorized weather sources and describes weather minimums. Check weather and winds for emergency fields along the route.

8.3.5. **Flight Plan.** There are several ways to input a flight plan into the ATC system (a flight plan indicates aircraft type, aircrew, routing, airspeed, special handling requirements, etc., for a planned mission). At military bases, the DD Form 175, *Military Flight Plan*, may be completed and filed at base ops. This can be done in person, using a facsimile machine or through a Web site. Flight plans may also be filed via telephone with a local flight service station (for example, 1-800-WX-BRIEF). This is a convenient option for stopovers at civil fields. Consult FLIP, *General Planning*, **Chapter 4**, for guidelines on completion of the DD Form 175. Use "TEX2/G" as aircraft designator and TD code.

8.3.6. **TOLD.** Compute TOLD with the abbreviated checklist when off station.

8.3.7. **Navigation Checklists.** Most units have excellent navigation planning checklists and (or) briefing guides that contain detailed information about the mission analysis process. A common memory aid to ensure completion of major planning steps is **WANTS**.

8.3.7.1. **W** - **W**eather (departure, enroute, destination).

8.3.7.2. **A** - **A**ctivate flight plan (complete and file).

8.3.7.3. **N** - **N**OTAMs (check for destination and drop-in airfields).

8.3.7.4. **T** - **T**OLD (compute).

8.3.7.5. **S** - **S**ID (review departure procedure); **S** – **S**TAR (plan for destination).

8.4. Radio Procedures. Standard radio calls used at home station simplify communications and reduce radio congestion in the highly regulated local flying environment. Outside the local area, radio calls may not be as standardized, but efficient communication is still the goal. **Note:** using VHF with civilian ATC outside the local area minimizes the chances of "stepping on" other aircraft radio calls.

8.5. Task Management and (or) Cockpit Organization. The principles for instrument sorties apply to navigation sorties (see **paragraphs 7.5. & 7.6.**); however, navigation sorties may be more complex and require more organization. For example, a navigation sortie could include an IFR portion to a VFR low level followed by VFR point-to-point navigation to the destination and concluded with practice instrument approaches. In general, strive to find ways to get ahead and prepare for upcoming tasks.

8.6. Ground Ops.

8.6.1. At strange fields, use caution for other transient aircraft. Use the airfield diagram during taxi. Some civilian fields are not accustomed to operations with military aircraft. It is the pilot's responsibility to ensure the safety of civilian ground personnel.

8.6.2. After engine shutdown, complete the before-leaving aircraft checklist, and conduct a thorough postflight inspection of the aircraft. Ensure transient maintenance personnel are thoroughly familiar with all servicing requirements, as outlined in the flight crew checklist, strange field procedures section. Stay with the aircraft until refueling is complete and ensure the aircraft is properly secured.

8.6.3. Provide transient maintenance or FBO personnel with contact information in the event that questions or unusual situations arise after leaving the aircraft. The aircrew is ultimately responsible for the aircraft when off station. Even after careful preflight planning, unforeseen circumstances may result in degraded transient servicing capability, such as absence of proper servicing fluids and (or) equipment. If any doubt exists as to transient maintenance's ability to properly and safely service the aircraft, contact the home station before servicing the aircraft.

8.6.4. Other off-station considerations include:

8.6.4.1. Before departing the aircraft, ensure at a minimum the main gear is chocked.

8.6.4.2. Before leaving base ops or the FBO, check the overnight and next day's weather. If strong winds are in the forecast, triple chock the aircraft. Tie down ropes may also be used to anchor the aircraft down. Section one of the flight manual states that, "wing and tail points provide sufficient mooring in normal conditions. However, when windy or extreme conditions are anticipated, the nose gear should also be secured." History has shown that the parking brake system will bleed over time, and with strong winds at night, a pilot may find their T-6 has moved, if not chocked.

8.6.4.3. If thunderstorms are forecast, attempt to hangar the aircraft.

8.6.4.4. Always have a ground observer and fire bottle available for engine starts.

8.6.4.5. Don't allow a change in the off-station airfield environment to negatively affect normal habit patterns. For example, the absence of ground personnel to confirm proper configuration (i.e., T.O. flap setting, lights, panels, covers, etc.) is no excuse for lack of checklist discipline in ensuring those items are accomplished.

Section 8B—IFR Navigation

8.7. Introduction. Missions conducted under IFR rely on NAVAIDs and aircraft instrumentation for navigation, SA, and aircraft control. The enroute IFR structure is very different from the local pattern, MOA, or stereo routes. **Paragraphs 8.8.** through **8.13.** provide guidelines for missions conducted under IFR.

8.8. Mission Analysis.

8.8.1. **Choosing a Destination.** The general considerations apply. A leg length of approximately 300 miles allows for multiple approaches at the destination.

8.8.2. **Weather.** If IMC conditions are anticipated, give special attention to the weather brief. Review weather minima and requirements in AFI 11-202, Volume 3, to determine takeoff and landing minimums. Use caution for enroute hazards, such as embedded thunderstorms, icing, and turbulence, especially if IMC is anticipated.

8.9. Route Planning.

8.9.1. Training sorties are typically flown on airways. GPS routing may also be used.

8.9.2. Determine cruising altitude based on leg length. As a guide, use 10 percent of the distance for cruise altitude (for example, cruise at 15,000 feet MSL on a 150 NM leg).

8.9.3. When authorized for use, computerized tools (DUATS, PFPS/Falcon View, etc.) can aid the planning process. Check the results for reasonability and accuracy before flight, as bad input can lead to bad output.

8.9.4. The AF Form 70, *Pilot's Flight Plan and Flight Log,* is an approved flight log (according to AFI 11-202, Volume 3). Use of all columns on the AF Form 70 can help ensure accurate time and fuel planning. Exact methodology for use of the AF Form 70 is technique. **Figure 8.1.** shows a typical IFR leg from Randolph AFB TX to San Angelo TX.

8.9.5. AF Form 70 assumptions include:

8.9.5.1. As a starting point, use 50 pounds for start, taxi, and takeoff (STTO).

8.9.5.2. Use a double-entry climb calculation if field elevation is more than 5,000 feet.

8.9.5.3. Average TAS has a negligible effect on climb calculations.

8.9.5.4. Level-off distance approximately equals level off altitude (up to FL 250).

8.9.5.5. Use approximately 15 minutes and 100 pounds for initial penetration and approach.

8.9.5.6. Use approximately 50 pounds and 10 minutes for subsequent approaches if being vectored to final.

8.9.5.7. Track frequencies, NAVAIDs, and clearances in appropriate blocks.

Figure 8.1. AF Form 70 Example.

PILOT'S FLIGHT PLAN AND FLIGHT LOG

CLEARANCE	TAKE-OFF, CLIMB, CRUISE DATA
C________ S________ H________ A________ D________	↗ 16,000/6 min/60#/15nm → 16,000/189 KIAS/245 TAS/387 pph

FREQUENCIES
ATIS:______ GND:______ TWR:_____ CLRNCE:_____

DEP FIELD DATA	TOTAL DIST	TOTAL ETE	TOTAL FUEL
	156	0+42	2+03

ROUTE / FIX	IDENT / FREQ	LAT/IDENT / LONG/FREQ	MAG CRS	DIST	GRD SPD	ETE	ETA/ATA	FUEL	ACTUAL FUEL
STTO								50	
								1050	
D→			287°					60	
L/O				15		0+06		990	
D→	CSI		287°					65	
Center Point	117.5			40		0+10		925	
V-68	JCT		314°					85	
Junction	116.0			51		0+13		840	
V-68	SJT	IAF	315°					85	
San Angelo	115.1	VOR 21		50		0+13		755	
								100	
PAL						0+10		655	
								100	
11-202						0+20		555	
								555	
Reserve						0+51		0	
D→	ABI		014°					120	
Abilene		Alternate		73		0+18			

AF IMT 70, 19781001, V1 PREVIOUS EDITION WILL BE USED.

8.9.6. Review the approach plate to determine takeoff restrictions, for example, departure procedure (Trouble T), SID, etc. Plan to use preferred routings, if applicable, to avoid significant route changes when issued the clearance.

8.9.7. Review planned approaches during preflight planning.

8.9.8. If required, choose an alternate; use the same factors as when choosing a primary location.

8.10. Ground Ops.

8.10.1. IFR clearance is generally received on a clearance delivery frequency (found on the approach plate). The clearance should mirror what was filed on the DD Form 175; however, clearances may be changed by ATC. The clearance can include, but is not limited to, routing, heading after takeoff, altitude, departure frequency, squawk, etc.

8.10.2. Example radio calls.

8.10.2.1. *"Peterson Clearance Delivery, Texan 69, IFR to Amarillo, ready to copy."*

8.10.2.2. *"Texan 69, cleared as filed; on departure fly runway heading, climb and maintain ten thousand, expect FL 310, 10 minutes after departure, departure frequency 120.5, squawk 3456."*

8.10.3. Review the airfield diagram before taxi request. Request progressive taxi instructions if necessary (to receive specific directions on where and when to turn from parking spot to the takeoff runway).

8.11. Departure. Review departure routing and altitude restrictions before takeoff. Set NAVAIDs and GPS before takeoff. The departure routing and altitudes may change just before takeoff or while on departure. An approach plate for the departure airfield should be readily available and reviewed for critical details in case of emergency return. Solid planning increases flexibility and ability to maintain SA when changes occur to the original plan.

8.12. Enroute.

8.12.1. Generally, the busiest portions of off-station sorties are from the clearance call to level off and from descent to engine shutdown. Predictably, this is also where the majority of safety incidents occur. There are less external demands during the enroute or cruise portion; however, there is still a requirement to accomplish many tasks including required checklists, analysis of fuel efficiency, and preparation for arrival. Sound task prioritization during the enroute portion of the flight is essential to good training and successful completion of the mission.

8.12.2. Without the cues associated with the local training environment, it is easy to forget required in-flight checks. Stay busy and use memory aids, as necessary, to comply with all requirements.

8.12.3. At level off, keep climb power until approaching the planned IAS, then set the planned fuel flow to hold the IAS. Adjust the PCL as needed to maintain the mission planned IAS. Accomplish a groundspeed check to determine the effects of winds and use the actual fuel flow on the electronic instrument display (EID) to calculate fuels. GPS is the easiest, most convenient way to determine groundspeed. Groundspeed can also be read off the EHSI (if selected) when flying directly to or from a NAVAID. Alternatively, timing can be used to calculate groundspeed when flying directly to or from a station if altitude is greater than the range from the station. Simply note the DME change over one minute to determine groundspeed in miles per minute. Use groundspeed and fuel flow to predict fuel at future points on the route. Compare planned, updated (with groundspeed and fuel flow), and actual fuel at these points. Significant deviations may require changes to the flight plan. Modifications to the planned routing, altitude, winds, temperature, or excessive delays can drastically change the actual fuels from the planned fuels.

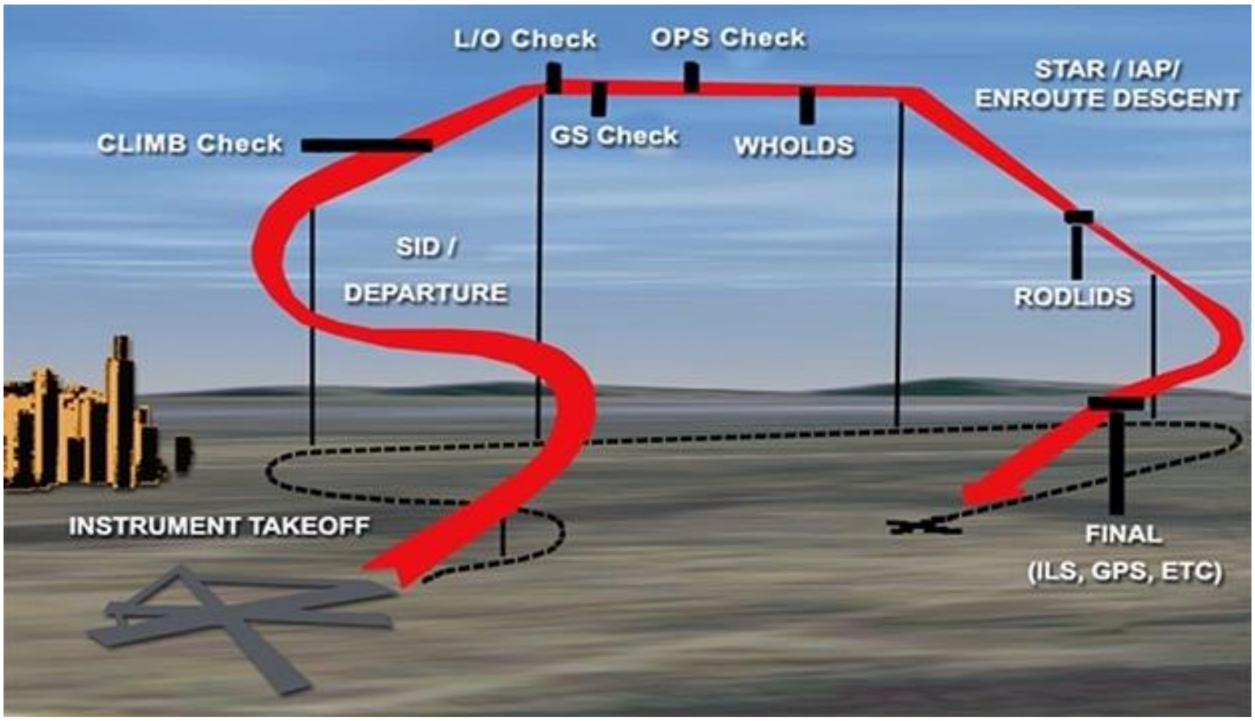
8.12.4. Maintain positional awareness at all times with NAVAIDs, GPS, VFR chart, and enroute chart. Periodically identify suitable emergency airfields. Use of the GPS nearest function can be a valuable tool.

8.12.5. If an enroute descent is planned, determine the desired start-down point and attempt to get an ATC clearance that matches the desired descent profile. (See planning technique, paragraph **7.29.4.**)

8.12.6. Prepare for arrival according to AFMAN 11-217, Volume 1. Pre-arrival tasks are the same as for instrument sorties.

8.13. Arrival. See AFMAN 11-217, Volume 1, and **Chapter 7** for detailed information about IFR arrival (**Figure 8.2**).

Figure 8.2. Typical IFR Navigation Flight.



8.13.1. Navigation sorties typically terminate at other than the home field. Previous experience at an airfield may simplify preparation for arrival. Likewise, arrival at a strange field (neither pilot familiar) takes additional planning effort. From prior review, the pilot should be familiar with airfield layout, approach lighting, type of glide path guidance, field elevation, runway data, tower and ground control frequencies, etc. However, airfield information must be reviewed before arrival and landing.

8.13.2. Match the planned arrival to the training objectives for the sortie. Some approach procedures, that require extensive cruise at lower altitudes, may not be desirable because of excessive fuel consumption. Coordinate requests for additional approaches as early as possible with ATC (approach control) and be flexible.

Section 8C—VFR Navigation

8.14. Introduction. VFR navigation can be more demanding than IFR navigation. Compared to IFR, the VFR pilot has more freedom to maneuver but also has more responsibility to maintain SA and safe separation from aircraft and obstacles. Generally speaking, under VFR rules, pilots are their own clearance authority and are responsible for weather updates, traffic avoidance and separation, route planning, terrain avoidance, and airfield suitability. The goal of VFR navigation training is to get from one point to another by dead-reckoning (DR) techniques and procedures.

8.15. Mission Analysis. Mission success starts with thorough mission analysis. Planning for VFR missions can be time-consuming; it is good technique to start at least one day prior to the mission. Local IFGs normally contain detailed step-by-step guidance.

8.15.1. **Choosing a Destination.** A leg length of approximately 200-250 miles allows completion of additional training requirements (ELP at non-towered airfields, instrument approaches, etc.) enroute or at the destination.

8.15.2. **Weather.** VFR missions require better weather than IFR missions (See AFI 11-202, Volume 3). In general, the minimum weather to takeoff and land under VFR is a 1,500-feet ceiling and 3 miles visibility. Additionally, enroute weather must allow compliance with minimum VFR cloud clearance requirements and completion of the mission at VFR altitudes. At times, weather conditions may not allow the flight to be accomplished solely under VFR. In this case, a composite flight plan with VFR and IFR portions must be filed.

8.16. Route Planning.

8.16.1. **Chart Selection.** Choose a chart that gives the most usable detail for the planned altitude, distance, and speed. In general, use a tactical pilotage chart (TPC) (1:500,000) or VFR sectional.

8.16.2. **Start Point.** It is good technique to pick a route start point outside the terminal area. Vectors or traffic conflicts may preclude an immediate turn on course. Also, airspeed and altitude should be stabilized before DR begins.

8.16.3. **Chart Construction.** DR is flight on a calculated course for a specified airspeed and time. Translated to pilot actions, it means flying a specific groundspeed on a specific heading for a specific time. A properly prepared chart provides enough information to ensure safe DR in-flight navigation. As a minimum, circle turn points, draw the route between points, insert timing marks, and compute magnetic headings. Including other information, such as fuel calculations, planning factors, and airfield data, on the chart may eliminate the requirement for another type of fuel log (for example, AF IMT 70).

8.16.4. **Chart Marking.** Consider highlighting the chart or annotating it with the following information:

8.16.4.1. Planned fuels.

8.16.4.2. Emergency divert airfields and tower frequencies.

8.16.4.3. NAVAIDs for additional SA.

8.16.4.4. Obstacles.

8.16.4.5. Spot elevations.

8.16.4.6. Air route traffic control center frequencies.

8.16.4.7. Restricted airspace.

8.16.4.8. Class B or Class C airspace.

8.16.4.9. Expected frequencies (approach control, tower, etc.).

8.17. VFR Departure. VFR departures differ significantly from IFR departures. Although a flight plan is still required (IAW AFI 11-202, vol 3), an ATC clearance for the route of flight is not required. A radio call to ground or tower controllers stating direction of flight and initial altitude may be sufficient before VFR departure. However, in busy areas, an initial heading and altitude may be assigned for traffic separation.

8.18. Flying the Route.

8.18.1. **Flight Following.** Flight following is a service provided at ATC's discretion (for example, workload permitting) under which advisories are given for traffic conflicts along the route of flight. These advisories do not include vectors to eliminate conflicts unless requested. Flight following does not change the pilot's responsibility to see and avoid other traffic; however, it is an excellent tool used to help prevent a midair collision. Request flight following with ATC. Expect assignment of a transponder code with flight following.

8.18.2. **Route Entry.** The first few minutes of a VFR leg can be very challenging. Many tasks must be performed including getting established on the desired route at the appropriate altitude and airspeed. Additional tasks include in-flight checks, communication with ATC, clearing, and finding the first point. Proper planning and a solid review of the planned departure ground track make route entry tasks more manageable. Backup DR navigation with NAVAIDs, including GPS.

8.18.3. **Route Basics.** At cruise altitude, set power to maintain the preplanned airspeed and check groundspeed. Compare actual and planned groundspeed to determine the effect of winds. At preplanned points (typically turn points), compare actual fuel burned and elapsed time to planned data. Significant deviations may require changes to the flight plan. Flying the correct groundspeed, on the correct heading, and for the correct amount of time is primarily accomplished through the "Clock-to-Map-to-Ground" method. First, look at the clock to determine time. Second, look at the map to determine where you should be on the map, (based on timing) and what visual cues should be in view 30 seconds to one minute in front of the aircraft. Last, look at the ground and visually acquire the predetermined ground references. Do not reverse the order of "Clock-to-Map-to-Ground." Reversing the order generally leads to poor SA.

8.18.4. **In-flight Checks on the Route.** Without the cues associated with the local training environment, it is easy to forget required in-flight checks. It is common practice to mark the chart with preplanned points to accomplishing the required in-flight checks. For example, route entry might include an annotation for the level-off check or selected turn points might be marked with reminders for an ops check.

8.18.5. **VFR Arrival.** VFR arrival at an unfamiliar airfield can be challenging. Factors such as runway length, runway alignment, terrain features, airspace classification, traffic congestion, and weather can impact arrival. As with every other aspect of navigation, prior planning and organization is essential to success. One common technique is to write arrival information, such as frequencies, pattern information, or airfield restrictions, near the destination airfield on the VFR chart.

8.19. Abnormal Procedures.

8.19.1. **Lost Procedures.** GPS and VOR or DME can be useful in maintaining or regaining positional awareness. If lost, follow the three "Cs":

8.19.1.1. **C** limb - Visibility, fuel efficiency, and radio range improve.

8.19.1.2. **C** onserve - Slow to maximum endurance airspeed.

8.19.1.3. **C** onfess - Call ATC (help with current position, get a vector, etc.).

8.19.2. **Weather Along the Route.** Weather may not be as forecast along the route and continued flight under VFR may not be possible. Do not continue when conditions deteriorate and proper cloud and terrain clearance cannot be maintained. When unable to maintain the planned route of flight under VFR:

8.19.2.1. Alter the course to maintain VFR to the destination.

8.19.2.2. Obtain an IFR clearance and continue to the destination.

8.19.2.3. Maintain VFR and land at an alternate destination.

8.19.3. **Emergency.** Constant positional awareness is critical to successful recovery if an aircraft emergency prevents continued flight to the planned destination. Two common techniques to increase SA and reduce workload in the event of an emergency are:

8.19.3.1. Circle emergency airfields in red circle. Annotate tower or common traffic advisory frequency frequencies.

8.19.3.2. Use EHSI (airports displayed) or nearest function on the GPS to provide constant display of airfields near the route of flight.

Section 8D—Low-Level VFR Navigation

8.20. Introduction. Only about 10 percent of USAF flight is conducted at low level, yet over half of total mishaps occur there. Flying high performance aircraft on low-level missions significantly increases exposure to risk. Reaction times and margin for error are greatly reduced when operating close to the ground. Thorough preflight planning and preflight briefings are imperative for safe and effective low-level training. In the T-6, operation at or below 3,000 feet AGL is considered low-level navigation. The goal of low-level navigation is to fly a selected ground track and arrive at a designated time over target.

8.21. Mission Analysis. A successful low-level mission begins with meticulous and extensive mission analysis. The first step is to become familiar with route requirements and all applicable guidance (FLIP, *Area Planning/1B [AP/1B]*, and chart update manual [CHUM]). Select a groundspeed that is easily converted to miles per minute but allows for airspeed corrections (180, 210, or 240 knots GS). Normally, plan to use 210 knots GS. Planned airspeed below 160 KIAS is not recommended due to decreased maneuverability. Check the forecast weather for the route. Use the forecast temperature, pressure altitude, and winds to compute indicated airspeeds. Use flight manual charts to determine the fuel flow for the planned true airspeed. See AETC TRSS Handout 11-1 for detailed information on mission analysis calculations. It is absolutely critical to schedule the route and call the scheduling agencies for all crossing or conflicting routes to reduce midair collision risk.

8.21.1. **Chart Preparation.** Use a 1:500,000-scale map (TPC or sectional chart) to fly low-level MTRs or VFR legs below 5,000 feet AGL. A 1:250,000-scale map (joint operations graphic [JOG]) may also be used for route study and on short low-level routes; however, JOG charts are normally too cumbersome for use in the aircraft. Each pilot in the aircraft should have an identical chart.

8.21.1.1. Draw the route corridor, and then update the chart with the latest information from the CHUM. This step is imperative for flight safety. Next, identify all significant obstacles and high terrain within the route corridor.

8.21.1.2. Check FLIP for mandatory turn points. Select easily recognizable points. Normally, it is preferable to use natural features to identify the target and turn points, as they seldom change. Choose turn points for uniqueness, vertical development, funneling features, and surrounding terrain. Avoid features that may be hidden by high terrain or trees. When picking turn points, consider the turning room required to remain within route corridor. Remain clear of any FLIP-directed, noise-sensitive areas or airfields.

8.21.1.3. Choose the target first, then the initial point (IP), turn points, and entry point. Choose an IP about 1 to 3 minutes from the target. An IP is an easily identifiable point used to fine tune navigation and increase the probability of target acquisition. Minimize the heading change at the IP in order to increase the accuracy of the IP-to-target leg. The start point must be within the route corridor, but it is not necessarily the published entry point.

8.21.1.4. Begin timing measurement at the route start point. Timing runs continuously from start point to target.

8.21.1.5. A thorough and detailed chart study is an essential part of mission analysis. A JOG may help analyze both man-made and natural features. Visualize key points on the route and the general features around them to minimize the requirement for constant reference to the map.

8.21.2. **Chart Marking.** In addition to the information recommended in AETC Handout, *Navigation for Pilot Training*, the following should be included on the map:

8.21.2.1. The MTR corridor from entry to the planned exit point.

8.21.2.2. Route lines and circles around turn points. Do not obscure critical details with the black line or turn circles.

8.21.2.3. Timing lines along the planned ground track. Marks at a 1- or 2-minute interval are sufficient.

8.21.2.4. Information boxes aligned with each leg that include heading, leg time, and any other relevant information.

8.21.2.5. Highlighted obstacles or high terrain along the route.

8.21.2.6. Fuel calculations. Calculate average fuel flow using tab data. Determine fuel flow per minute by dividing pounds per hour (pph) by 60 and round up to the nearest whole number to make in-flight calculations easier. (**Example:** Tab data indicates a fuel flow of 450 pph, which is 7.5 pounds (lb) lb/minute, so use 8 lb/minute for in-flight updates and (or) predictions.)

8.21.2.7. Continuation fuel for the start point and other selected points along the route. Continuation fuel is the minimum fuel required to complete the route at planned speeds and altitudes and to return to base with required fuel reserves.

8.21.2.8. Bingo fuel from the most distant point on the route to the recovery airfield. Bingo fuel is calculated for the most practical means of recovery (route and altitude). Consider factors such as cloud ceilings, winds, freezing level, and forecast icing.

8.21.2.9. Compute an Emergency Route Abort Altitude (ERAA) for the planned portion of the low-level route and clearly annotate it for easy in-flight reference. Compute this altitude to provide 1,000 feet (2,000 feet "mountainous"[FLIP]) clearance above the highest obstacle within 25 nm either side of the route.

8.21.2.10. Circles around emergency and alternate airfield locations. Additional information as necessary to expedite emergency recovery or divert.

8.21.2.11. Route and timing to and from the low-level route.

8.22. Scheduling and Filing. Schedule MTRs with the scheduling agency. Deconflict entry times with other scheduled users. See FLIP for filing instructions.

8.23. Briefing. A thorough brief is essential and ensures awareness of possible hazards (for example, crossing routes, towers, birds, terrain) and other potential threats in the low-level environment. A solid briefing also reviews sortie objectives and prepares the crew for effective training.

8.23.1. Detailed study must precede the brief. Recognize features that identify turn points and other update points. Review route hazards and restrictions. Calculate planned altitudes. Review emergency recovery options. Many more details may be studied and typically time required for preparation is always greater than time available.

8.23.2. Place emphasis on low-level emergencies and recovery contingencies. Use caution to avoid spending excessive time on the route briefing; extensive route study is understood. *The briefing is not a substitute for chart study.* Likewise, the route may be briefed after completion of briefing guide items.

8.24. Flying the Route. With proper planning, DR (flying accurate headings and airspeeds) should result in a ground track close to black line and accurate timing.

8.24.1. **Departure.** Attempt to fly planned route to the entry point. If the route is a long distance away or IFR flight is required to the entry point, identify a point short of the entry point from which DR can begin. The point may be visual, a GPS waypoint, or a VOR radial or DME. The easier it is to identify, the more accurate DR navigation will be.

8.24.2. **Route Entry.** Before the entry point, accomplish a descent check and compare the EHSI heading with the magnetic compass to verify accuracy. Prepare the clock and review the hack procedure with the other pilot. Identify the entry point as early as possible. Maneuver to hit the entry point on the correct first leg heading. Use "ready, ready, hack" to initiate timing. Regardless of the timing or cadence of the calls, "hack" always follows the second "ready." Inside the route structure, accelerate to planned airspeed.

8.24.3. **Route Basics.** Sound task prioritization and an organized approach are essential to a successful low-level mission. On the route, there are three distinct mission elements that must be integrated. These mission elements, listed in priority order, follow:

8.24.3.1. **Safety.** Stay clear of terrain, obstacles, and other aircraft. Focus on terrain clearance is most critical during turns. While turns only make up 10 percent of flying in the low-level environment, they make up about 50 percent of the accidents.

8.24.3.2. **Systems Operation.** Perform required checks. Monitor systems and fuel consumption.

8.24.3.3. **Navigation.** Follow route and identify required points. Meet timing goal.

8.24.3.4. **Mission.** Pay sufficient attention to safety and systems operation to ensure survival; these needs must be met first. Therefore, accomplish navigation with the attention capacity remaining after survival priorities are maintained. The challenge is to work efficiently, so sufficient time is available for success in all mission elements.

8.24.3.5. **Priority.** The highest priority task is clearing the ground, obstacles, other aircraft, and birds. The neutral position during low level where 80 percent of time should be spent is “head up and eyes out.” Always return focus to clearing after momentary diversions to accomplish other tasks or subtasks. Bring the map up to eye level to read it; don’t move the eyes and (or) head down. During turns, fly the aircraft and clear; do nothing else.

8.24.3.6. **Fly Accurately.** Successful DR is based on solid planning and accurate flying. Failure to maintain heading and airspeed can corrupt the entire process. Visual navigation with the chart is based on being close to the expected position.

8.24.3.7. **Trim the Aircraft.** Trim the aircraft and set the proper IAS or power setting for the planned groundspeed. A stable platform makes navigation much easier.

8.24.3.8. **Clock-to-Map-to-Ground.** Use the “Clock-to-Map-to-Ground” method as previously described in this chapter to maintain course and timing.

8.24.3.9. **Identify.** Start trying to identify turn points about 1 to 1-1/2 minutes out (approximately 3.5 to 5 miles at 210 knots GS). If possible, verify the point with multiple features. If the point is not identified, turn on time. Turns at low altitude require extra emphasis on clearing and aircraft control. Clear in the direction of the turn. Clearing is enhanced by selection of a visual rollout reference; turn to the visual reference, then fine tune heading.

8.24.4. **Big Picture.** Keep an eye on the big picture. Use major terrain features (mountains, lakes, obvious geological formations, etc.) to improve positional awareness.

8.24.5. **Altitude Control.** Visually assess the height above the ground. Occasionally cross-check the altimeter against the known elevation of towers, lakes, airfields, and peak elevations. Visual navigation is easier as altitude increases. When in doubt, climb early if the route structure allows it.

8.24.6. **Heading Control.** Pick a ground reference in the distance and fly to it. Set the heading bug on the wind-corrected heading. ARC mode on the EHSI can be helpful. Heading deviations occur often during low level (obstacle avoidance, poor wind analysis, etc.). One method to correct to course is to aim for a distant feature on the route. Landmarks that parallel the route or funnel toward the route (roads, rivers, drainage patterns, etc.) are also useful. See *Navigation for Pilot Training* for course correction methods based on the 60-to-1 rule. At 210 knots GS, a heading change of 17 degrees held for 1 minute causes a 1-mile course shift.

8.24.7. **Timing.** Accurate DR relies on a good clock "hack" started at the actual start point. Features perpendicular to the ground track, such as roads, rivers, power lines, and pipelines, are good timing update points. For every second early or late, increase or decrease indicated airspeed by 1 knot, and hold that change for the number of minutes equal to the NMs per minute you are flying. For example, if flying at 210 knots GS (3.5 miles per minute) and 10 seconds late, increase indicated airspeed by 10 KIAS and hold for 3.5 minutes.

8.24.8. **In-flight Checks.** Perform normal in-flight checks during low-level missions. Compare actual fuel to planned fuel. Do not perform checks during turns. Primary techniques to update required items before or after turn points include the "SHAFT" check or a variation of the "six Ts":

8.24.8.1. SHAFT.

8.24.8.1.1. **S** - **S**peed for new leg.

8.24.8.1.2. **H** – **H**eading for new.

8.24.8.1.3. **A** - **A**ltitude for new leg.

8.24.8.1.4. **F** - **F**uel at turn point. Compare to plan.

8.24.8.1.5. **T** - **T**iming at turn point. Compare to plan, determine correction/**T**hreats for new leg.

8.24.8.2. Six Ts.

8.24.8.2.1. **T** - **T**ime ahead or behind.

8.24.8.2.2. **T** - **T**urn to specific heading for new leg.

8.24.8.2.3. **T** - **T**orque set to hold desired airspeed, check fuel, and fuel flow.

8.24.8.2.4. **T** - **T**wist heading bug or course arrow to proper heading.

8.24.8.2.5. **T** - **T**rack course centerline at desired altitude.

8.24.8.2.6. **T** – **T**hreats for new leg/**T**alk if at a required reporting point.

8.24.9. **Route Exit and Recovery.** Comply with FLIP, *AP/1B*, local procedures, and ATC instructions. Perform in-flight checks. Prepare for training enroute or at destination.

8.25. Abnormal Procedures.

8.25.1. **Emergencies.** The first reaction to any emergency encountered at low level is to abort the route and climb as high as necessary (at least to the ERAA) to safely analyze the situation.

8.25.2. **Engine Malfunctions.** If the engine fails on a low-level MTR, recovery is unlikely unless a suitable landing field is within approximately 3 miles. Normally, airfields within an arc circumscribed by the wingtips can be reached with an immediate turn and climb in the direction of the airfield. Map study for potential emergency diverts before the mission will greatly enhance chances for success. A zoom from 210 knots GS gains approximately 1,000 feet. Do not delay ejection to attempt an air start below 2,000 AGL or if no airfields are within engine-out range.

8.25.3. **Route Aborts.** Route aborts occur for various reasons (insufficient fuel to complete the route, aircraft malfunction, bird hazards, and weather). Low-altitude flight increases the danger of distraction and complicates recovery. Use the map, GPS, and NAVAIDs to maintain positional awareness or to find the nearest suitable recovery airfield. After aborting the route, do not re-enter.

8.25.3.1. **VMC.** Maintain safe separation from the terrain, comply with VFR altitude restrictions (if possible), squawk an appropriate transponder code, maintain VMC, and attempt contact with a controlling agency, if required.

8.25.3.2. **IMC.** An abort into IMC is an emergency. Execute an immediate climb to the emergency route abort altitude (minimum). Attempt contact with the appropriate ATC agency. Fly the proper VFR altitude until an IFR clearance is received.

Chapter 9

TWO-SHIP FORMATION

Section 9A—General

9.1. Introduction.

9.1.1. **Purpose.** The primary purpose of flying formation is mutual support. Formation skills and procedures are intended to turn the potential liability of two aircraft flying close together into the benefit of mutual support, but only through precise compliance with the obligations of the "number 1" and "number 2" aircraft, as presented in this chapter. Formation, more than any other type of flying, builds confidence, develops teamwork, teaches self-discipline, and promotes the proper application of aggressiveness to military flying. While the dynamics of working with and being responsible for another aircraft are new, the maneuvers are not. Formation maneuvering is an extension and combination of skills learned in other categories.

9.1.2. **Flight Discipline.** Flight discipline requires an in-depth knowledge of flight rules, unit standards, and the procedures in this manual. Additionally, it requires strict adherence to the plan given in the preflight brief and any real-time alterations directed by number 1 during flight. It begins with mission preparation and continues through briefing, ground ops, flight, and debrief. Number 2 must speak up rather than allow the flight to enter an unsafe or unauthorized situation. If the directed tasks are beyond number 2's ability, he or she must immediately inform number 1. Flight discipline means flying in the proper parameters for the formation position directed by the flight lead with no tolerance for remaining out of position. As number 2, always strive to fly within the proper formation position parameters. As number 1, correct any wingman deviations immediately by directing number 2 to the proper position if appropriate corrections are not being made. Number 2 will query number 1 immediately if unsure of assigned position. Uncompromising flight discipline is absolutely essential for successful mission execution.

9.1.3. **Aggressiveness.** Aggressiveness in formation flying is a state of mind, an attitude not to be confused with the speed of flight control movement. As number 1, thinking ahead of the aircraft and profile while anticipating the need for changes and adjustments before they actually occur is an indication of the proper aggressive attitude for number 1. As number 2, correcting for positional deviations while mentally anticipating the next phase of flight or maneuver indicates proper aggressiveness. Do not act until directed by number 1. A smooth and timely response to number 1's directives demonstrates the proper aggressive attitude for number 2.

Section 9B—Formation Missions

9.2. Introduction. This section contains general concepts applicable to all formation missions.

9.3. Responsibilities.

9.3.1. **Flight Lead.** The flight lead is ultimately responsible for the safe and effective conduct of the mission. This position gives both the authority and the responsibility of ensuring mission success to one individual who will be clearly identified prior to the mission. The flight lead is responsible for the planning, briefing, execution, and debriefing of the flight. The flight lead may delegate some or all of these mission elements but retains overall responsibility. The flight lead must focus on mission accomplishment, achievement of objectives, and safety. Consideration of the capabilities and experience levels of all flight members will help the flight lead plan a mission that optimizes training, and ensures accomplishment of objectives. The designated flight lead does not change during a mission under normal circumstances.

9.3.1.1. **NAV Lead.** This may be used when the flight lead wants the wingman to navigate and clear. The flight lead will fly the wing position, deconflict within the flight, and keep the radios (for example, battle damage [BD] check).

9.3.1.2. **Administrative (Admin) Lead.** This is used to pass lead responsibilities to another member of the flight. The 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. However, the flight lead still retains ultimate authority for the formation.

9.3.2. **Number 1 and Number 2.** Within a two-ship formation (also referred to as an element), there are two distinct roles with well-defined responsibilities: number 1 and number 2. As described in the preceding paragraph, the designated flight lead does not change during the mission, however to enhance training opportunities, numbers 1 and 2 will often swap formation positions during a sortie. The mutually understood procedures, standards, and briefed tasks form a contract between number 1 and number 2 that results in a safe operating environment. (**Note:** Do not confuse the terms “flight lead” and “number 1”; they are not the same.)

9.3.2.1. **Number 1.** Number 1 is responsible for executing mission elements while in flight. Number 1’s top priorities include clearing for the formation, planning, and monitoring number 2. Plan all maneuvers to keep the flight well within the assigned working airspace. Use power to manage energy in a manner similar to contact flying. High performance and high-G maneuvers require smooth and deliberate control inputs to keep number 2 from exceeding G limitations. Monitor number 2 to ensure the correct position before the next maneuver. Before directing a maneuver, always consider number 2’s position and ability to safely perform such a maneuver. Execute each maneuver smoothly, allowing number 2 to maintain position without undue difficulty. It is appropriate to fly safely with minor excursions from perfect performance parameters than to be overly concerned with smoothness and compromise safety. Basic number 1 responsibilities include:

9.3.2.1.1. **Clear for the Formation.** Maneuver the formation away from other aircraft and maintain a safe altitude above the ground or any obstacles.

9.3.2.1.2. **Plan Ahead of the Aircraft.** Altering the profile and (or) maneuvers as appropriate and ensure fuel and time are used judiciously to accomplish mission and training objectives.

9.3.2.1.3. **Monitor Number 2.** Ensure number 2 is properly maintaining the assigned position. This also includes assessing parameters during maneuvers and ensuring number 2 is in a safe position prior to executing a new maneuver. Furthermore, this includes ensuring in-flight checks are completed by the entire formation in a timely manner.

9.3.2.1.4. **Navigation.** Ensure the formation is at the proper altitude, airspeed, and position relative to NAVAIDs, routing, instrument approaches, obstacles, airfields, etc.

9.3.2.1.5. **Communication.** Transmit and receive information for the formation. To the air traffic controller, a formation is treated as a single entity with a single voice: number 1. Unless prebriefed or included in unit standards, radio frequencies will not be changed unless directed by number 1.

9.3.2.2. **Number 2.** Number 2's primary responsibility is to maintain flight path deconfliction and proper position as directed by number 1. This includes providing mutual support and maintaining formation integrity by executing the plan as briefed, and accomplishing the tasks as directed by number 1 without compromising safety. Number 2's top priorities include flight path deconfliction, maintaining proper position relative to number 1, and executing additional tasks as directed by number 1. During initial stages of formation skill development, number 2 will focus almost entirely on deconfliction and position maintenance. Use all of number 1's aircraft as a reference; do not focus on just one spot. As skill at maintaining proper position improves, other lower priorities (like clearing for the formation by scanning the area around and beyond number 1) may be cross-checked but never at the expense of flight path deconfliction and proper position. Basic wingman responsibilities include:

9.3.2.2.1. **Do Not Hit Number 1.** Flight path deconfliction is paramount. Unless number 2 has called "blind", number 2 is responsible to deconflict flight paths and prevent a collision.

9.3.2.2.2. **Keep Number 1 in Sight.** Collisions within formations often occur when number 2 has lost sight of number 1. Hitting number 1 is much less likely when number 2 can see number 1. Losing sight is not uncommon and is only a problem if number 2 fails to call "blind" with their altitude (this concept will be described later in this chapter).

9.3.2.2.3. **Be in Position and on Frequency.** This is commonly referred to as "being there." If number 2 is in position and on frequency, it is much easier to keep number 1 in sight and for number 1 to monitor number 2. Being in position is also a requirement for mission accomplishment.

9.3.2.2.4. **Clear for the Formation.** Number 2 is able to clear quadrants that are impossible for lead such as number 1's 6 o'clock. Number 1 should put number 2 in route or fighting wing, as appropriate, whenever possible as it allows number 2 to clear more effectively.

9.3.2.2.5. **Back Up Number 1.** A good wingman is ready to take the lead at a moment's notice to accomplish any tasks assigned by lead. Number 2 should strive to actively monitor navigation, communication, fuel state, mission accomplishment, etc. When number 2 is able to consistently back up number 1, it usually shows a readiness to become a flight lead. Never let these duties interfere with the higher priority responsibilities. If clearing, being in position or keeping lead in sight is degraded by "backing up lead," immediately reprioritize in the order shown above.

9.3.3. **Collision Avoidance.**

9.3.3.1. Although numbers 1 and 2 are both responsible for adequate separation, generally number 2 has ***primary*** responsibility for flight path deconfliction within the element unless number 2 is unable to maintain visual. In that case, number 2 conveys a blind status to number. This responsibility does not transfer to number 1 unless number 2 calls "blind." See paragraph **9.16.** for further information on blind scenarios.

9.3.3.2. Although not number 1's primary responsibility when number 2 is visual, number 1 is still expected to monitor number 2. Periodic cross-check of number 2's position will ensure that number 1 does not execute a maneuver that will compromise safety should number 2 be out of position.

9.3.3.3. The following factors contribute significantly to the potential for a midair collision:

9.3.3.3.1. Failure of number 1 to properly clear or visually monitor number 2 during a critical phase of flight, such as a rejoin or the extended trail (ET) exercise. Number 1 must monitor number 2, either directly or with the mirrors. Number 1 must be directive or take evasive action if number 2 loses sight. If number 1 loses sight and is uncertain of number 2's position, query number 2 by requesting "posit" ("*Texan 2, posit*"). The "posit" call is a question as to the position of number 2 relative to number 1. Number 2 responds with his position as in the example: *"Texan 2, 5 o'clock, low, 500 feet".*

9.3.3.3.2. Failure of number 2 to execute lost wingman procedures promptly and correctly if visual contact is lost in IMC. In IMC, if number 2 cannot maintain the close formation position (hereafter referred to as "fingertip" and specifically defined in paragraph **9.21.**), using normal visual references, or loses sight of number 1, initiate appropriate lost wingman procedures as described in this manual.

9.3.3.3.3. Failure to recognize excessive overtake. During rejoins, compare actual airspeed with the directed airspeed. Use power and (or) speed brake as necessary. Number 1 should direct an overshoot or breakout if necessary.

9.3.3.3.4. Failure to maintain lateral or vertical separation. For turning or straight-ahead rejoins, number 2 must maintain lateral or vertical separation until closure rates are under control and stabilized in route.

9.3.3.3.5. Failure to consider the effects of wingtip vortices. Number 2 may encounter vortices when maneuvering too close to number 1. Control difficulties associated with wingtip vortices are very dangerous. Fly within the parameters described in this chapter to avoid them. If encountered, control the aircraft, maneuver away from number 1 or perform a break out as necessary.

9.3.4. **Call Signs.**

9.3.4.1. Aircrew of each aircraft in the formation will be assigned a call sign that has a unique word prefix and a two-digit numeric suffix. For example, Texan 11 (pronounced

"*Texan one-one"*) and Texan 12 would be members of Texan 11 flight. No two airborne formations should have the same word prefix in their call sign.

9.3.4.2. During the preflight briefing, the designated flight lead will be given the call sign that ends in 1, and the other flight member will be given the call sign that ends in 2. Under normal circumstances, if the formation breaks up, the aircraft will assume the call signs given in the preflight briefing.

9.3.4.3. All radio calls to an agency outside the formation should begin with the full call sign which includes the word prefix and the double-digit suffix; for example, "*Texan 11 level, one-five thousand*." When directing other members of the flight, it is also common to use the full word prefix and single digit suffix of their position in the flight, for example, "*Texan 2, break out*." When immediately responding to an in-flight directive, number 2 may simply use "2" to predicate or concisely answer radio transmissions. For example, number 2 simply responds to the directive to breakout with: *"2."*

9.3.5. **Radio Discipline.**

9.3.5.1. Clear, concise, correct communications are a good indicator of flight discipline. Minimize and combine radio calls on common-use frequencies to reduce radio congestion. Unless otherwise briefed or directed, when communicating with agencies outside the formation, number 1 will speak for the flight until the formation splits up.

9.3.5.2. Number 1 owns the radios; which means number 2 will only change frequencies when directed by number 1 or when written unit standards dictate. If number 1 uses the term "go" for a frequency change, number 2 will acknowledge before changing the frequency (for example, "*Texan, 11 go channel 5*"; acknowledged with " *2*"). If number 1 uses the term "push," number 2 should change to the new frequency without acknowledging ("*Texan 11, push channel 5*"; no acknowledgment). Number 1 adds the suffix "victor" for the VHF radio calls (for example, "*Texan 11, push channel 2 victor*").

9.3.5.3. If number 1 sends number 2 to the wrong frequency, number 2 should go to that frequency and wait. Number 1 will get number 2 on the proper frequency either using the radio or using visual signals. Number 2 should never change frequencies without being directed by number 1 or written unit standards, and number 2 should not go hunting for number 1 (if number 1 and number 2 end up on different frequencies).

9.3.5.4. When in fingertip formation, wingmen should automatically move to the route position when number 1 directs a channel change, and they will return to fingertip after being checked in on the new frequency. If in a position wider than fingertip, wingmen will remain in that position unless directed otherwise by number 1. If in IMC, wingmen will maintain fingertip spacing and use the crew concept to accomplish frequency changes. (The PF talks on the radio and the PNF accomplishes the frequency change.) If solo in IMC, change the frequency when workload permits. Wait until VMC, if necessary, and use the discrete frequency to communicate within the formation.

9.3.5.5. When filling the number 1 position, do not use the term "lead" when referring to own ship parameters. Use "one," (for example, "*Texan, ops check, one is 600, 4 Gs*"). The only time the term "lead" should be used over the radio is when executing a lead change (for example, "*Texan 2, you have the lead on the right*").

9.3.5.6. Wingmen will normally respond to all directive calls unless briefed otherwise or if the action is obvious. If a radio call is unclear, number 2 will query number 1.

9.3.5.7. For traffic calls, transmit call sign, traffic direction (left or right), clock position, elevation (low, level, or high), and an approximate distance. For example, number 2 obtains visual contact with a potential traffic conflict: *"Texan 1, traffic right, 2 o'clock, 3 miles, slightly high.*"

9.3.5.8. Military aviators use brevity code words to achieve clear, concise, correct, and effective communication. These code words are listed and defined in AFTTP(I) 3-2.5, *Multiservice Brevity Codes*. Common brevity code words which aid in collision avoidance include blind, visual, no joy, tally ho, and padlocked. When referring to aircraft within the formation, use the terminology blind (lack of visual contact) or visual (positive visual contact) as appropriate. When referring to aircraft outside of the formation, use the terminology no joy (lack of visual contact) or tally ho (positive visual contact). Padlocked indicates that the pilot cannot take his or her eyes off an aircraft or ground object without losing sight of that aircraft or object.

9.4. Visual Signals.

9.4.1. **Objective.** Relay information between flight members or direct maneuvers.

9.4.2. **Description.** Visual signals are used when radio transmissions are inappropriate or difficult to make. Visual signals are described in AFI 11-205, *Aircraft Cockpit and Formation Flight Signals*, and this manual.

9.4.3. **Procedure.** As number 2, acknowledge with a head nod when number 1 gives a signal. If unsure of a signal, number 2 should not acknowledge or change position. Number 1 repeats the signal until an acknowledgment is received. Use the radio, if necessary, to immediately clear up any confusion. Only the pilot at the controls will give visual signals to another aircraft or acknowledge signals from another aircraft in the formation. Visual signals must be clear, appropriate, and proportional to range. For example, a slight wing rock to reform to fingertip from two-ship-width route versus a large wing rock to signal a reform from a 500-foot route. Brief any nonstandard visual signals before they are used.

9.5. In-flight Checks.

9.5.1. **Objective.** Ensure the flight is making periodic checks of aircraft systems during departure, in special use airspace, while maneuvering, and on recovery.

9.5.2. **Description.** Number 1 and number 2 perform the checklist appropriate for the phase of flight (ops check, descent check, etc.).

9.5.3. **Procedure.** Use the intraflight radio to initiate checks if practical. Use visual signals if formation spacing allows or if radio traffic inhibits the use of the intraflight radio. If forced to turn during a check, number 1 should call the turn and ensure number 2 is attentive before turning. Number 2 resumes the check after the turn is complete. In-flight checks are normally accomplished in the following manner:

9.5.3.1. **Number 1.** Allow enough time for number 2 to complete the check. Check number 2 in with a visual signal or a radio call. On the radio, check in by transmitting call sign and OBOGS status for the climb check and total fuel for ops checks and descent check (for example, "*Texan 1, OBOGS good"* or *"Texan 1, 800*").

9.5.3.2. **Number 2.** Number 2 will acknowledge number 1's visual signal or radio call to initiate checks, move to route spacing (if the check was directed while in fingertip and weather allows), and perform the appropriate checklist items. Accomplish the check one item at a time, checking position on number 1 between each item. Prioritize tasks. Fly formation first and accomplish checklist items as workload permits. During turns, fly the aircraft and resume the check after the turn is complete.

9.6. Fuel and G Awareness.

9.6.1. **Objective.** Maintain fuel awareness of other aircraft and ensure all formation members are capable of continuing the mission after high-G maneuvering.

9.6.2. **Description.** All flight members must understand the factors and assumptions used to determine joker and bingo fuels. Flight members should increase the frequency of fuel checks during high fuel flow ops (ET, low altitude) and when approaching joker and bingo fuels.

9.6.3. **Procedure.** Number 1 must continually monitor the flight's fuel state and adjust the profile, frequency of ops checks, and joker or bingo as necessary.

9.6.3.1. Unless already on the recovery, number 2 will inform number 1 when reaching joker and (or) bingo fuel, and number 1 will acknowledge the call.

9.6.3.2. It is number 1's responsibility to monitor the fuel state and G loading of the entire formation. Number 1 must also take action when any aircraft exceeds G limitations, reaches joker or bingo fuel, or reports an abnormal fuel condition. Number 1 initiates a fuel and G check after the G-awareness exercise, periodically during the sortie and following each set of extended trail. Number two responds with "same" if his fuel is within 50 pounds, and Gs are within .5 of number 1. For example*, "Texan 1, 800, 4.5"*. If number two has approximately 750 pounds and shows 4 Gs, the response is *"Texan 2, same.")*

9.6.3.3. Any time number 2 is maneuvering behind number 1, number 2 must use caution to avoid areas of prop wash or wake turbulence. This is especially important in number 1's six o'clock. Any time wake turbulence or prop wash is encountered, number 2 should unload to approximately 1 G, exit the area of turbulence, and check the G meter. If the aircraft G limits have been exceeded, the formation will terminate maneuvering and conduct a controllability check, as required. In the case of an over G, the G meter is not reset until the aircraft is inspected by a certified maintenance technician.

9.7. FENCE Check. Number 1 directs "FENCE-in" when entering the MOA. Number 1 directs "FENCE-out" when exiting. See **Chapter 6** for details on the FENCE check.

9.8. Battle Damage (BD) Check.

9.8.1. **Objective.** Using mutual support, members of a formation inspect all aircraft in the formation.

9.8.2. **Description.** Aircraft within a formation maneuver to inspect each other for damage, leaks, missing panels, or irregularities. Generally performed after aggressive maneuvering (i.e., extended trail, fluid maneuvering, or tactical) or combat ops.

9.8.3. **Procedure.** Number 1 initiates the BD check using a radio call or the "check mark" visual signal. If in fingertip, Number 2 automatically moves to the route position (approximately two ship widths) and climbs to see the opposite wingtip of number 1's aircraft, descends back to route position and performs a crossunder to look at the other side in the same fashion. Number 2 must maintain nose-tail separation while inspecting number 1. Number 2 looks for any damage, leaks, missing panels, or irregularities. Upon completion of the check, number 2 will return to route on the opposite side of number 1 from which the check was initiated.

9.8.3.1. If there are no discrepancies on number 1's aircraft, number 2 passes a thumbs-up to number 1, indicating a "clean" BD check. If number 1 is not clean, number 2 will use the radio to describe any discrepancies. Number 1 then initiates a lead change and number 2 assumes navigational (nav) lead while clearing for the flight. Number 1 then inspects number 2. Procedures for accomplishing lead changes, to include nav lead changes, are described in paragraph **9.17.** of this manual.

9.8.3.2. **.** If time or fuel is critical and the number 1 aircraft contains two pilots, the option exists to conduct the BD check without a nav lead change. In this case, the PNF in the number 1 aircraft inspects number 2 as number 2 maneuvers to inspect number 1, and the PF in the number 1 aircraft clears the flight path for the formation. This option must be briefed or directed before employed.

9.9. Mission Analysis. The FL establishes priorities for mission analysis and delegates tasks to flight members to ensure thorough planning without duplication of effort. All flight members should be involved in the mission preparation. The level of planning detail is dictated by mission specifics and pilot experience level, but all necessary mission analysis must be completed in time to conduct a concise, comprehensive mission briefing.

9.10. Mission Briefing.

9.10.1. **Objective.** The FL (or designated briefer) ensures all flight members are briefed on start, taxi, takeoff, recovery, and relevant special subjects.

9.10.2. **Description.** The briefing sets the tone for the entire mission. The briefing should set objectives, establish goals and set the standard used to measure successful performance during the mission.

9.10.3. **Procedure.** All formation members will be present for the preflight briefing. The briefing will be conducted in a professional manner and will be clear and concise. The majority of the preflight brief should be spent describing the "how to" of the mission. Elements of the mission which are to be conducted according to written unit standards or procedures in this manual may be briefed as standard. Minimum time should be spent on written standards as all formation members will have them committed to memory.

9.10.3.1. **Individual Crew Briefings.** The briefer must allow time for each crew to discuss intercockpit responsibilities, emergency procedures, and other crew coordination issues. Lead should plan to allow 5 minutes as a minimum.

9.10.3.2. **Mission Debriefing.** The debrief should cover areas that need improvement. The mission should be reconstructed in only enough detail to debrief issues affecting the formation as a whole. Conduct the debrief in a business-like atmosphere and critiques of execution should not be taken personally. Receive instruction openly; use the debrief as a tool for improvement.

9.11. G-awareness Exercise. Perform a G-awareness exercise or AGSM demonstration (as described in **Chapter 6**) before accomplishing any maneuver that may require three or more Gs. Brief the exercise with an emphasis on deconfliction procedures. Sufficient visual cues must be available to perform this maneuver. Number 1 should consider sun angle and position prior to the maneuver to preclude possible loss of sight due to the sun. If poor weather conditions prevent safe accomplishment of the G-awareness exercise, number 1 should modify the flight mission profile and limit maneuvering accordingly.

9.12. KIO and Terminate Procedures.

9.12.1. **Objective.** Cease tactical maneuvering.

9.12.2. **Description.** KIO is used when safety of flight is a factor or when doubt or confusion exists. KIO is transmitted when any of the training rules listed in AFI 11-2T-6, Volume 3, are violated. The terminate call is used to direct a specific aircraft or flight to cease maneuvering and proceed as briefed or directed. Terminate is used when safety of flight is not a factor.

9.12.3. **Procedure.** The procedures for KIO and terminate are very similar.

9.12.3.1. **KIO.** The KIO drill is normally initiated over the radio. Aircraft with radio failure signal KIO with a continuous wing rock. The aircraft observing a continuous wing rock should transmit KIO and provide required assistance. Any member of the formation may initiate a KIO. For example either aircraft transmits, *"Texan, knock-it-off."* Number 1 acknowledges, *"Texan 1, knock-it-off,"* followed by number 2 stating, *"Texan 2, knock-it-off"*. Under normal circumstances, the aircraft initiating the KIO briefly states the reason for initiating the drill in order to enhance situational awareness and eliminate confusion for the formation. Number 2 should then await directions from number 1.

9.12.3.1.1. At the KIO call, number 1 continues the current maneuver without changing power setting. This ensures predictability and aids in flight path deconfliction, which should be the primary concern for all aircraft. If any aircraft loses sight, the aircraft losing sight should make the appropriate "blind" radio call. Upon hearing a KIO call or observing a continuous wing rock, all participating aircraft will:

9.12.3.1.2. Clear the flight path.

9.12.3.1.3. Cease maneuvering.

9.12.3.1.4. Acknowledge with a call sign in order of position in formation, or with a wing rock if the radios have failed.

9.12.3.1.5. Obtain verbal clearance before resuming maneuvers.

9.12.3.2. **Terminate.** Used to direct a specific aircraft or flight to cease maneuvering, clear the flight path, and proceed as briefed or directed. Any aircraft in the formation may initiate "terminate." Use "terminate" to cease maneuvering when number 2 has met the desired learning objectives, or if number 2 is outside position parameters (desired learning objectives are not achievable). The terminate call is acknowledged in the same manner as a KIO call. For example, *"Texan terminate; Texan 1 terminate."* Number 2 promptly replies with, *"Texan 2 terminate."* Number 1 smoothly transitions to a shallow turn or level flight until number 2 has attained the desired formation parameters. Once back in position, number 2 may signal for continued maneuvering by calling "in" (*"Texan 2, in"*). At this point, number 1 may continue maneuvering or direct the formation, as desired.

9.13. Lost Wingman Procedures.

9.13.1. **Objective.** Gain immediate separation of aircraft when number 2 loses sight of number 1 in the weather.

9.13.2. **Description.** In IMC when visual contact with number 1 is lost or if unable to maintain position due to disorientation, number 2 simultaneously executes the applicable lost wingman procedure while transitioning to instruments. Smooth application of control inputs is imperative to minimize the effects of spatial disorientation.

9.13.3. **Procedure.** When executing lost wingman procedures, number 2 notifies number 1, who coordinates with the controlling agency and requests a separate clearance for number 2. If required, the controlling agency can help establish positive separation.

9.13.3.1. **Number 1.** Number 1 should immediately perform the appropriate procedure, acknowledge number 2's radio call, and transmit aircraft attitude, which is acknowledged by number 2. Number 1 should transmit other parameters such as heading, altitude, and airspeed as necessary to aid in maintaining safe separation.

9.13.3.2. **Wings-Level Flight (Climb, Descent, or Straight and Level).** The lost wingman turns away, using 15 degrees of bank for 15 seconds and informs number 1. After 15 seconds, number 2 resumes heading and proceeds on a separate clearance.

9.13.3.3. **Turns (Climb, Descent, or Level).** When outside the turn, the lost wingman reverses the direction of turn, using 15 degrees of bank for 15 seconds, and informs number 1. After 15 seconds, number 2 rolls out, continues straight ahead, and ensures positive separation before resuming the turn and obtaining a separate clearance. When inside the turn, the lost wingman momentarily reduces power to ensure nose-tail separation and tells number 1 to roll out of the turn. Number 2 maintains AOB to ensure lateral separation, and then proceeds on a separate clearance. Number 1 may resume turning only when separation is ensured.

9.13.3.4. **Precision and Non-Precision Final Approach.** The lost wingman momentarily turns away from number 1 to ensure separation and starts a climb to either the FAF or glide slope intercept altitude, as appropriate. While proceeding to the missed approach point, number 2 informs number 1 and obtains a separate clearance from approach control. Comply with the new clearance received or fly the published missed approach, as appropriate.

9.13.3.5. **Missed Approach.** The lost wingman momentarily turns away to ensure clearance, informs number 1, and continues to the published missed approach while climbing 500 feet above the missed approach altitude. Number 2 obtains a separate clearance from approach control.

9.13.4. **Responsibility.** Lost wingman procedures do not guarantee obstacle clearance. It is the responsibility of all the pilots in the formation to be aware of terrain and obstacles along the flight path. Use good judgment when executing lost wingman procedures.

9.14. Practice Lost Wingman Procedures.

9.14.1. **Objective.** Apply lost wingman procedures in a training exercise.

9.14.2. **Description.** The below procedures outline the basis of how practice lost wingman will be performed. Practice lost wingman procedures in VMC to prepare for actual lost wingman situations in IMC.

9.14.3. **Procedure.** Number 1 directs practice lost wingman with a radio call, *"Texan 2, go practice lost wingman."* Number 2 acknowledges *"2,"* but does not begin execution. This acknowledgement simply verifies that number 2 knows a practice lost wingman exercise has been directed. When ready, number 2 executes the appropriate lost wingman procedures and makes the appropriate radio call *("Texan 1 roll out; Texan 2 lost wingman"*). At a minimum, number 1 will respond with attitude, to include bank angle. Number 2 will acknowledge this radio call "2." Number 1 will monitor number 2 to ensure adequate separation is maintained and is primarily responsible for flight path deconfliction while number 2 is heads down during the procedure. After executing the appropriate lost wingman procedure, number 2 will initiate the end of the lost wingman exercise by conveying "visual" with a radio call, *"Texan 2, visual."* Number 1 will direct a rejoin or other position.

9.15. Formation Breakout.

9.15.1. **Objective.** Ensure immediate separation and avoid midair collision.

9.15.2. **Description.** The **HITS** acronym describes when a breakout is required. Perform a breakout immediately when: number 2 constitutes a **H**azard to the formation, is **I**n front of/under number 1, directed (**T**old) to break out, or has a loss of **S**ituational awareness of his position relative to number 1.

9.15.3. **Procedure.** When breaking out, the wingman clears in the direction of the break and maneuvers away from number 1's last known position (or in the direction that ensures immediate separation). Use power and (or) speed brake as required to maintain safe maneuvering airspeed to expedite separation. When able, the wingman informs number 1. For example, *"Texan 2, breaking out"* when self-initiating the breakout, or simply*"2"* when complying with a directive from number 1. Number 1 continues to fly predictably and, if the wingman is in sight, maneuvers to maintain sight and deconflict flight paths. Number 1 will direct a rollout when safe separation is achieved; however, if visual with number 1 the wingman may roll out regardless of who initiates the breakout. The aircraft breaking out should anticipate disorientation and must use caution if passing under number 1 or viewing number 1 through the top of the canopy.

9.15.3.1. On final approach, use caution as a rapid increase in back stick pressure can quickly result in a stall. Also, abrupt application of excessive rudder or abrupt application of MAX power can cause the aircraft to roll past the desired bank angle, which can further aggravate the slow speed condition and reduce the chances of a successful recovery.

9.15.3.2. During a breakout, it is possible to lose sight. All flight members must remain vigilant to ensure deconfliction. A breakout does not always require an abrupt, high-G turn away from number 1.

9.15.3.3. If a wingman initiates the breakout, it is that aircraft's responsibility to maintain safe separation until number 1 acknowledges the breakout, confirms visual contact, or establishes altitude separation. If number 1 directs the breakout, number 1 is responsible for safe separation and deconfliction until acknowledgement, visual contact, or altitude separation.

9.15.3.4. After number 2 achieves safe separation and visual contact with number 1, a radio call is made to advise number 1: *"Texan 2, visual."* Number 1 then directs a rejoin as appropriate. Do not rejoin until directed by number 1, however, number 2 may parallel number 1's flight path in-order to control a divergent vector.

9.16. Lost Sight Procedures.

9.16.1. **Objective.** Flight path deconfliction and notification of a lost sight condition.

9.16.2. **Description.** When one aircraft loses sight of another (usually number 2 loses sight of number 1), the formation achieves at least vertical separation then completes rejoin when visual contact is regained.

9.16.3. **Procedures.** If visual contact with number 1 is lost, number 2 will notify number 1 and state current altitude *("Texan 2, blind, one-seven thousand")*. If there is no timely acknowledgement of the "blind" call, number 2 will maneuver away from the last known position of number 1 and alter altitude. In some cases, heading or turn information may also be appropriate for this call (*"Texan 2, blind, one-seven thousand, right turn through heading 130"*).

9.16.3.1. If number 1 maneuvers into the sun, number 2 may lose sight. Although visual contact is usually regained within moments, a momentarily blind condition could pose a great hazard for midair collision. A sun-blind condition is an actual lost-sight case; apply proper procedures immediately.

9.16.3.2. The formation member with visual contact transmits a relative position from the "blind" aircraft; for example, *"Texan 1, visual, right, 2 o'clock, high."* If number 1 is "blind," but number 2 has number 1 in sight, number 1 has the option to direct a rejoin. In this case, number 2 does not rejoin closer than a route position until number 1 calls "visual." If number 2 is "blind," and number 1 has number 2 in sight, and the situation requires immediate aircraft separation, number 1 maneuvers to ensure separation between the two aircraft.

9.16.3.3. If both aircraft have lost sight of each other, number 1 must immediately direct a minimum of 1,000 feet altitude separation. Until visual contact is regained, number 1 must take positive action to ensure flight path deconfliction. Both formation members maintain this separation until either visual contact is regained and a rejoin is initiated or clearance to recover separately is received.

9.17. Lead Changes.

9.17.1. **Objective.** In-flight formation position change.

9.17.2. **Description.** Number 1 and number 2 exchange formation positions. As previously explained, the designated flight lead retains his responsibility and authority throughout the mission. That role is not affected by a lead change.

9.17.3. **Procedure.** Lead changes can be made with the formation in many flight attitudes. Number 1 will call or signal for the lead change. If in fingertip, number 2 will move out to route, then assume a route position near line abreast (LAB) and approximately two ship widths. If the formation is already in route or greater spacing, number 1 may use the radio to transfer the lead. Number 2 will acknowledge the lead change and become the new number 1 regardless of the method of lead transfer (visual signal or radio call). If number 1 uses a visual signal, number 2 will acknowledge with visual signals. If number 1 uses a radio call to initiate the lead change, the new number 1 accepts the number 1 position with a radio call.

9.17.3.1. Lead changes accomplished with visual signals should be expeditious to minimize the time without a leader actively clearing for the formation. If limited visibility is an issue, use the radio to execute the lead change.

9.17.3.2. When a lead change is initiated from fingertip, number 2 moves out and forward to ensure wingtip separation. Number 2 accepts the lead after reaching a position abeam number 1 and immediately assumes responsibility as the new number 1. The old number 1 will assume wingman responsibilities. Unless changed by the new number 1, the formation will remain in the position from which the lead change was initiated. For example, if the lead change was initiated from route, the flight will remain in route. If number 1 uses a radio call to initiate the lead change, the new number 1 accepts the number 1 position with a radio call. If the old number 1 uses a visual signal, the new number 1 accepts the number 1 position with a head nod.

9.17.3.3. The new number 1 turns on the TAS and switches the transponder to ALT after assuming the number 1 position. The new number 2 will turn off the TAS and switch the transponder to STBY following the lead change but must prioritize tasks. Wingman consideration dictates that after completing the lead change, the new number 1 utilizes a power setting that allows the new number 2 to stabilize in the assigned position.

9.17.3.4. Nav Lead. Procedures for a nav lead change during the BD check are the same as a standard lead change, with the exception that the number 1 aircraft maintains control of the radios, squawk and TAS while inspecting the number 2 aircraft. The aircraft in the nav lead position (the aircraft being inspected) must clear for the formation and comply with all clearances.

9.18. Speed Brake Exercise.

9.18.1. **Objective.** Practice maintaining position as number 2 when the speed brake is operated.

9.18.2. **Description.** Utilizing the speed brake is an effective method for number 1 to slow the formation or achieve a desired descent profile while maintaining a higher power setting, which is highly advantageous to number 2. The speed brake exercise is normally practiced during the formation recovery.

9.18.3. **Procedure.** Number 2 lowers or raises the speed brake, as required, to match number 1's configuration and remain in the assigned formation position.

Section 9C—Maneuvering Fundamentals

9.19. Introduction. Common terminology and concepts applicable to formation flight are used throughout the Air Force. The following are fundamental concepts:

9.19.1. **Stabilized.** In control and able to complete the maneuver safely within the pilot's capabilities. In this manual, number 2 is often directed to stabilize before continuing a maneuver. For example, number 2 must stabilize in route before continuing to fingertip during a rejoin. "Stabilize" does not mean stop; it means "under control."

9.19.2. **Heading Crossing Angle (HCA) (Figure 9.1.).** The angular difference between the longitudinal axes of two aircraft. (HCA is also synonymous with the term angle off.)

9.19.3. **Aspect Angle (AA) (Figure 9.1 and Figure 9.2.).** Aspect is expressed in degrees off the tail of the reference aircraft, commonly expressed in multiples of 10. For example, at 6 o'clock to the reference aircraft, the aspect is zero. At 40 degrees left, the aspect is "4L." AA is not a clock position and is independent of aircraft heading. Two important AAs used extensively in T-6 training are 30 and 45 degrees (**Figure 9.3.**). (Note position of the vertical stabilizer on the outside wing.)

9.19.4. **Closure.** Overtake created by airspeed advantage and (or) angles; the rate at which range decreases. Closure can be positive (decreasing range) or negative (increasing range), and is usually measured by the velocity rate (knots) at which the range increases/decreases.

Figure 9.1. HCA and AA.

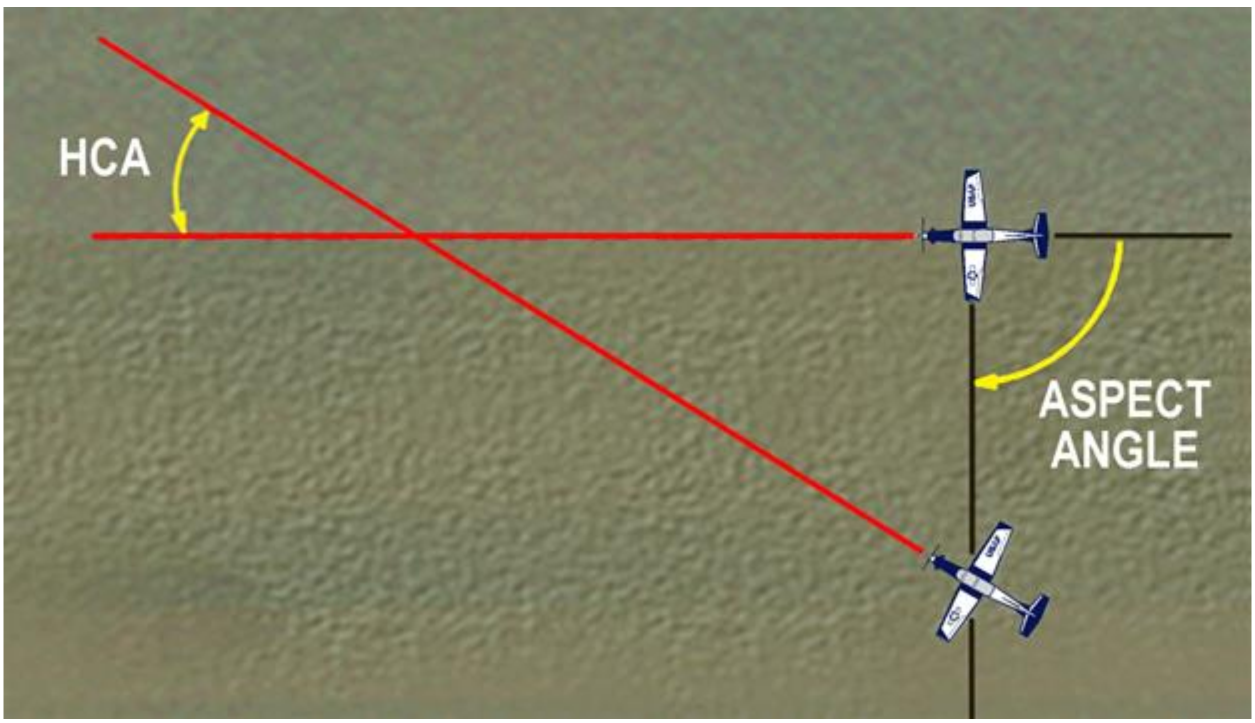


Figure 9.2. AA.

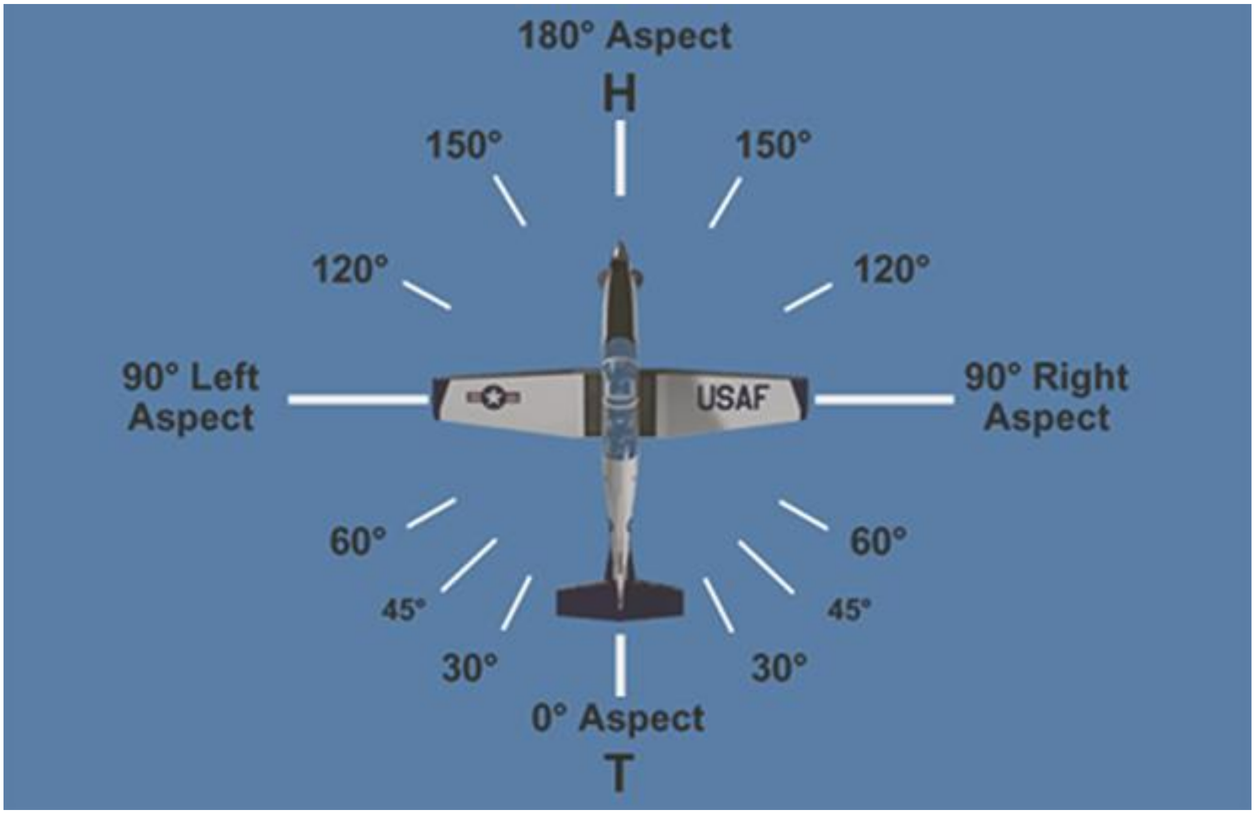
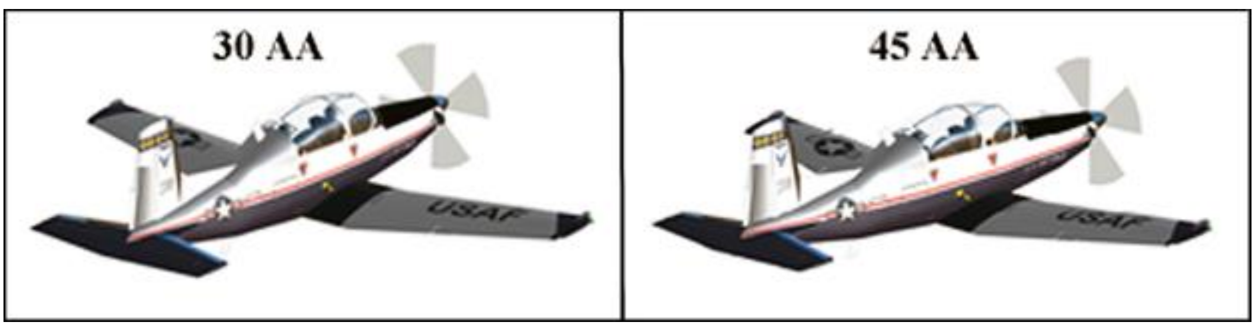


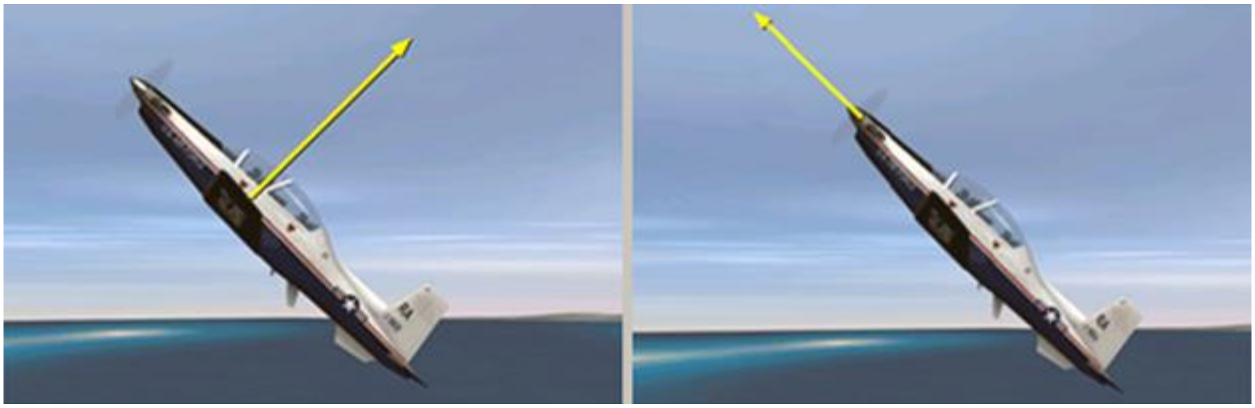
Figure 9.3. 30 and 45 AA.



9.19.5. **Lift Vector (Figure 9.4.).** The vector that is always positioned straight through the top of the canopy. The magnitude is based on G loading. In the T-6, use the CFS cord as a reference to indicate where the lift vector is pointed.

9.19.6. **Velocity Vector (Figure 9.4.).** Where the aircraft is going. The magnitude of the velocity vector is controlled by changing airspeed.

Figure 9.4. Lift and Velocity Vectors.

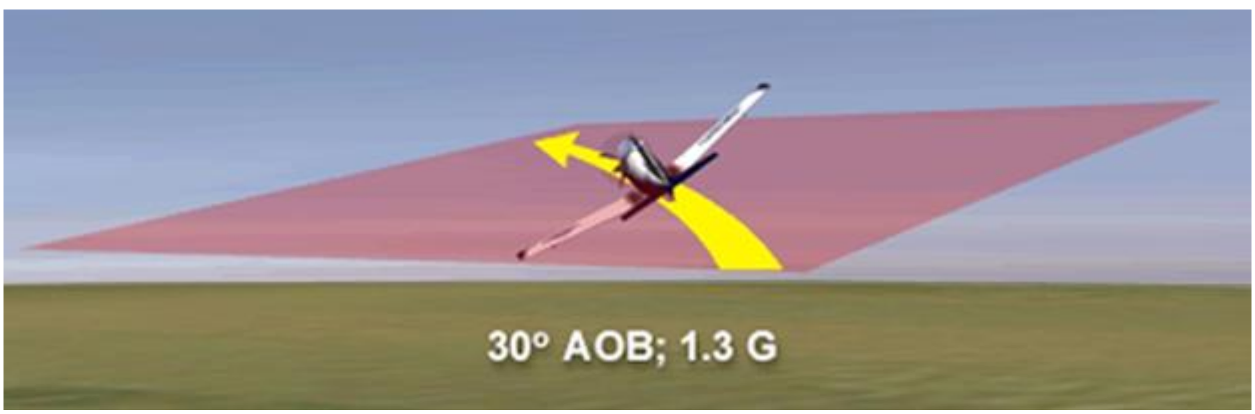


9.19.7. **Line of Sight (LOS).** A straight line from the pilot's eye to another aircraft. Commonly expressed as "forward LOS" (other aircraft moving forward on canopy toward the nose) and "aft LOS" (other aircraft moving aft on the canopy toward the tail).

9.19.8. **LOS Rate.** The speed at which forward or aft LOS is occurring, expressed with adjectives rather than a unit of measurement. (For example, "*rapid*, aft LOS.")

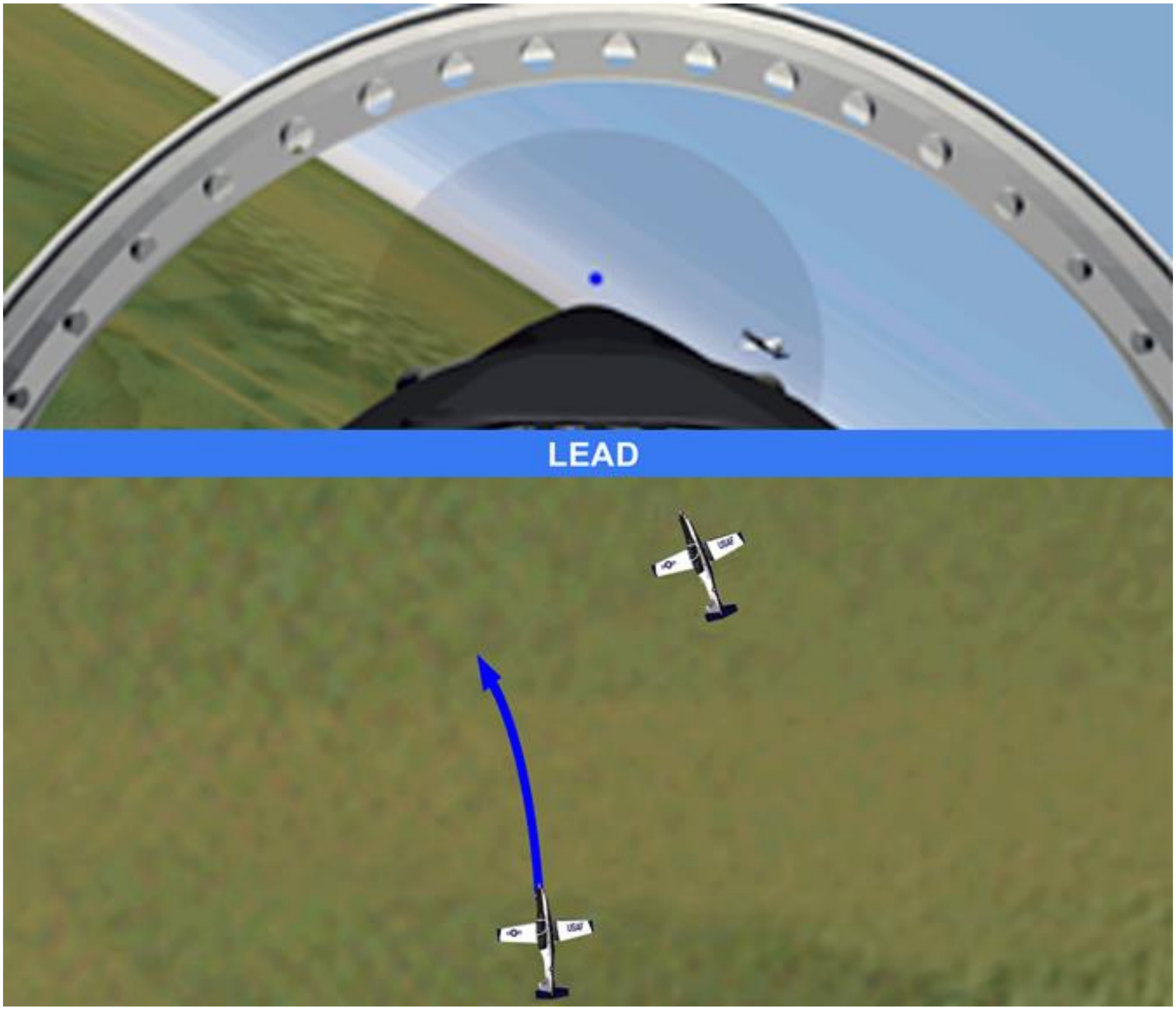
9.19.9. **Plane of Motion (POM).** The plane containing the aircraft flight path. In a level turn the aircraft's POM is parallel to the ground, regardless of bank angle. In a loop the POM (**Figure 9.5.**) is perpendicular to the ground.

Figure 9.5. POM.



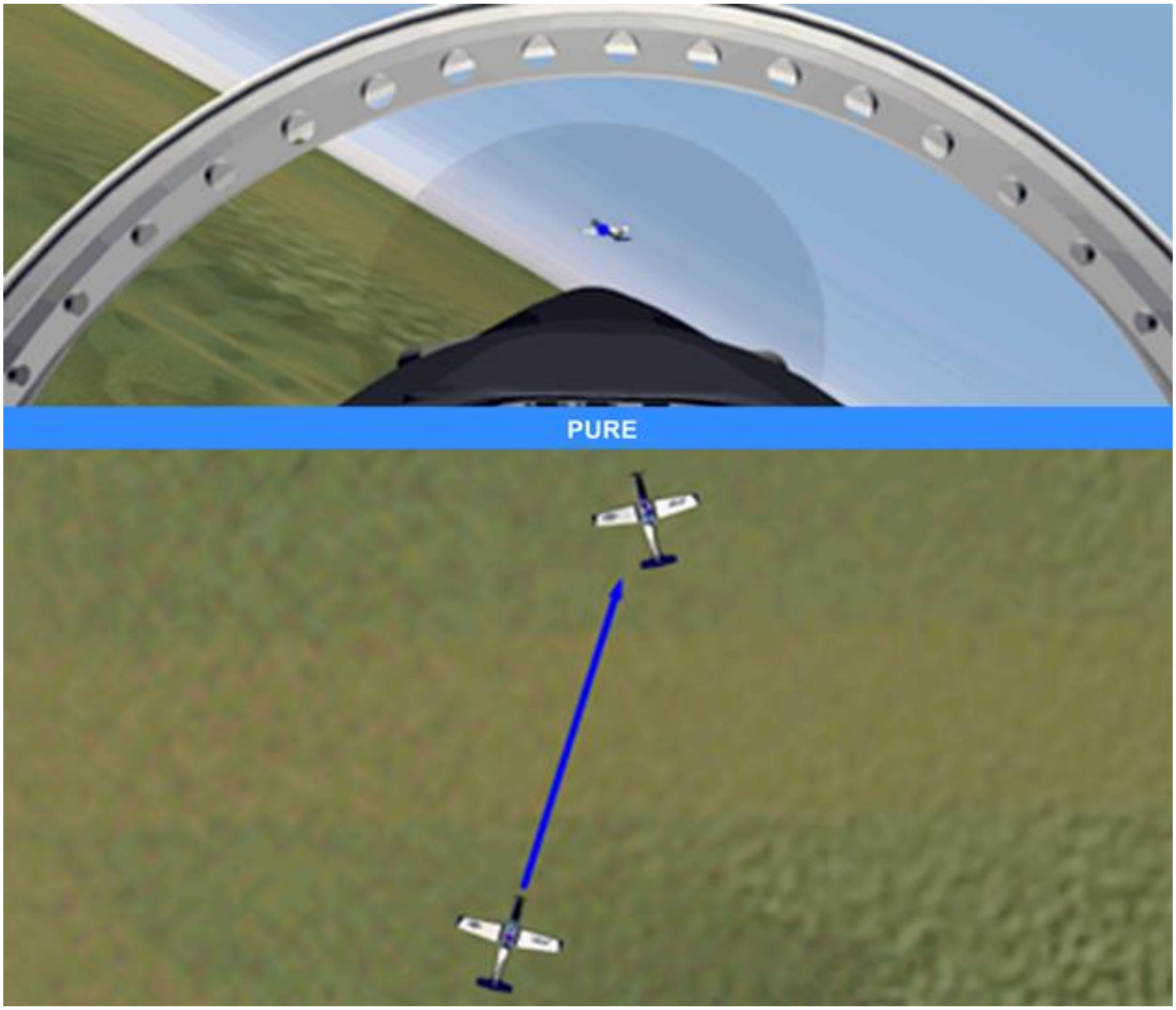
9.19.10. **Lead Pursuit (Figure 9.6.).** Number 2 aims the aircraft nose in front of number 1's flight path. With enough lead pursuit, AA and closure will increase, and HCA will decrease. Various lead pursuit pictures may result in aft LOS, no LOS, or minimal forward LOS depending on the magnitude of lead pursuit and other parameters such as relative airspeed and G.

Figure 9.6. Lead Pursuit.



9.19.11. **Pure Pursuit (Figure 9.7.).** Number 2 aims the aircraft nose directly at number 1. In pure pursuit there is initially no LOS; the other aircraft remains fixed at 12 o'clock in the canopy. A pure pursuit picture initially creates closure that diminishes over time. AA equals HCA, which also both diminish over time. If both aircraft are co-airspeed, an attempt to sustain pure pursuit eventually evolves into lag pursuit, resulting in increasing range and a decreased AA.

Figure 9.7. Pure Pursuit.



9.19.12. **Lag Pursuit (Figure 9.8.).** Number 2 aims the aircraft nose behind number 1's flight path. Although there may still be some closure initially, closure soon decreases, AA decreases, and HCA increases.

Figure 9.8. Lag Pursuit.

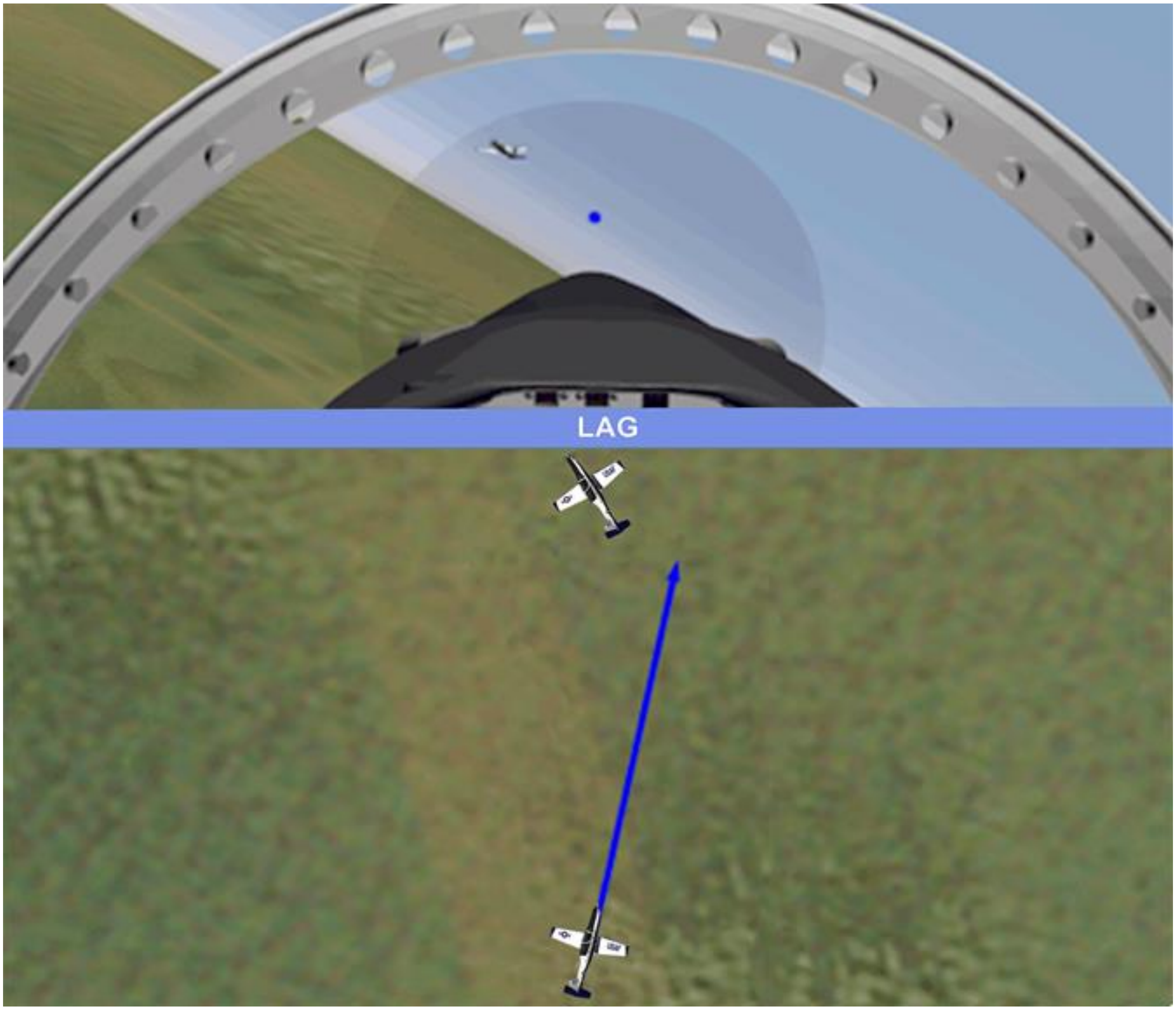
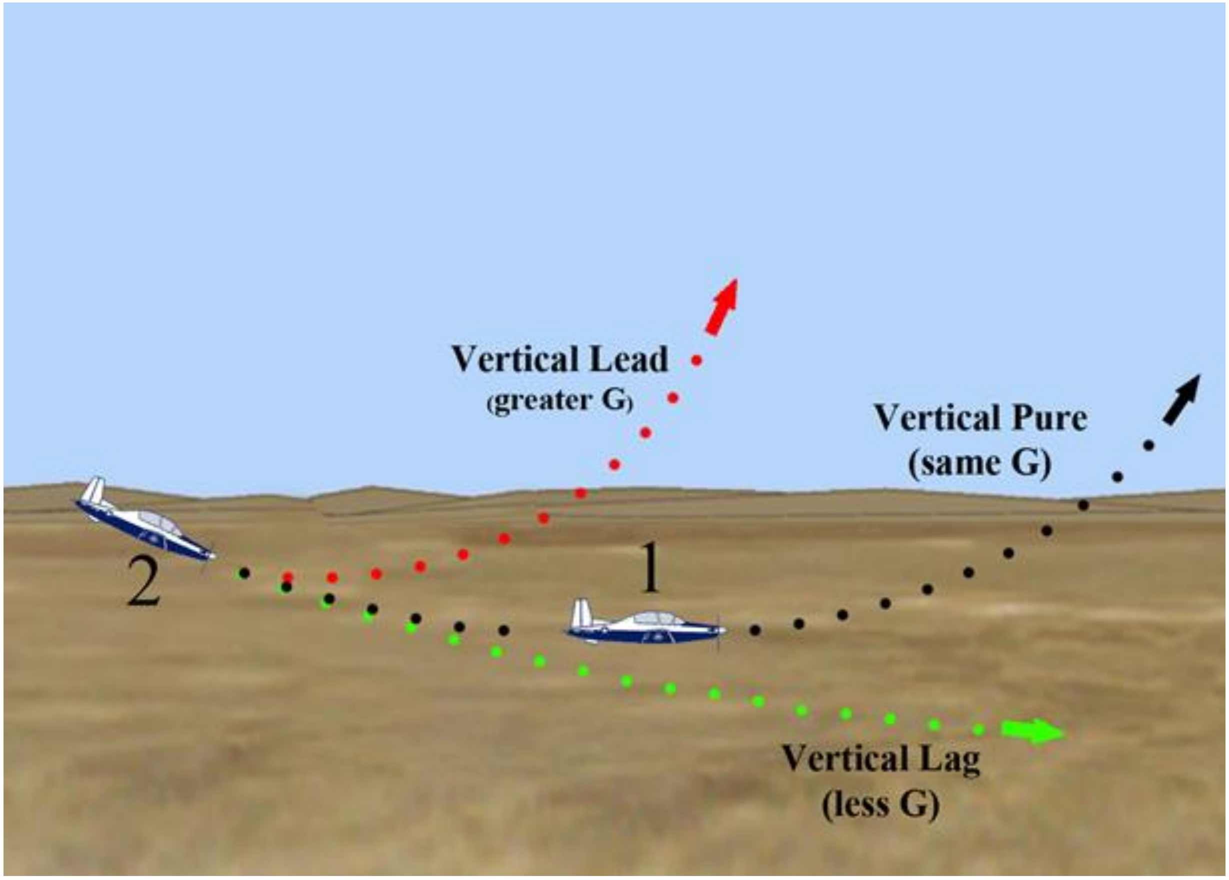
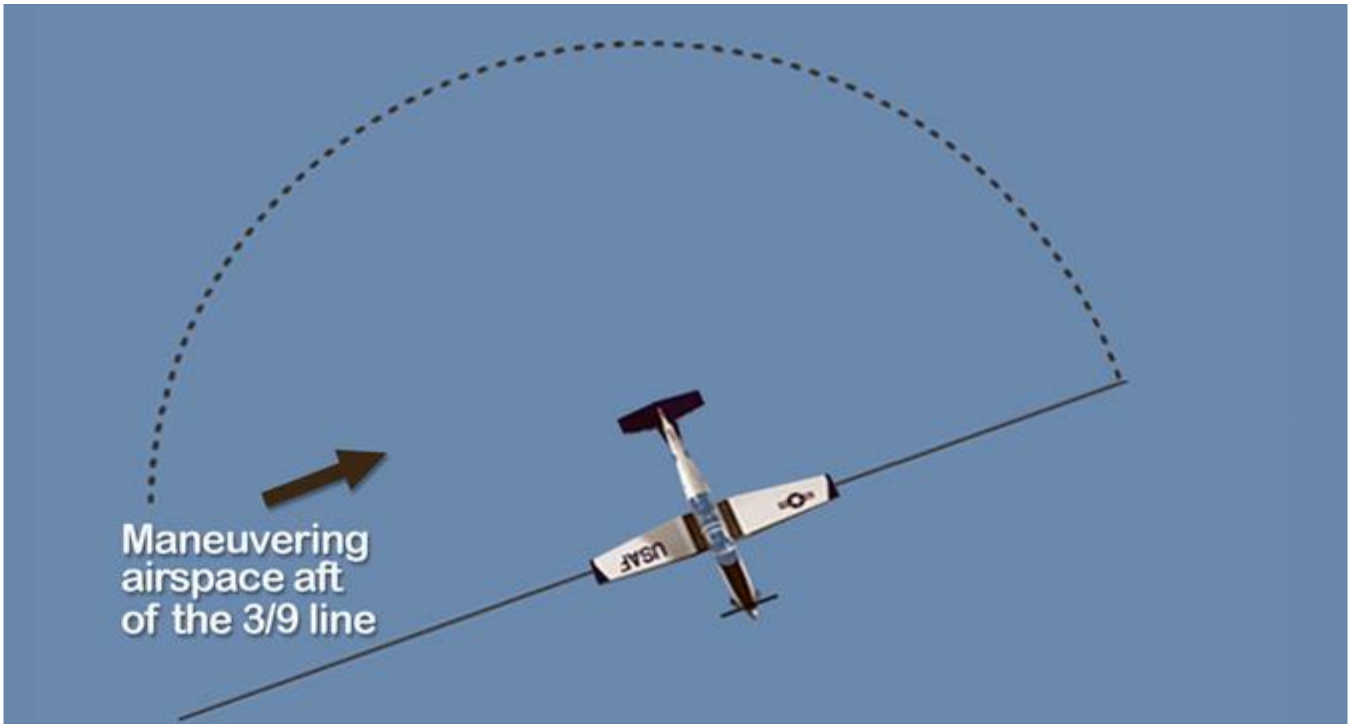


Figure 9.9. Lag Pursuit - Continued.



9.19.13. **Aircraft 3/9 Line (Figure 9.10.).** This is an imaginary line extending from the aircraft's lateral axis (parallel to the wings and perpendicular to the fuselage). The numbers "3" and "9" have reference to clock position. Number 2 should normally remain aft of number 1's 3/9 line during maneuvering. This line equates to a 90-degree AA (9 aspect).

Figure 9.10. Aircraft 3/9 Line.



9.19.14. **Turn Circle.** As an aircraft maneuvers in a turn, the flight path describes an arc, referred to as a turn circle.

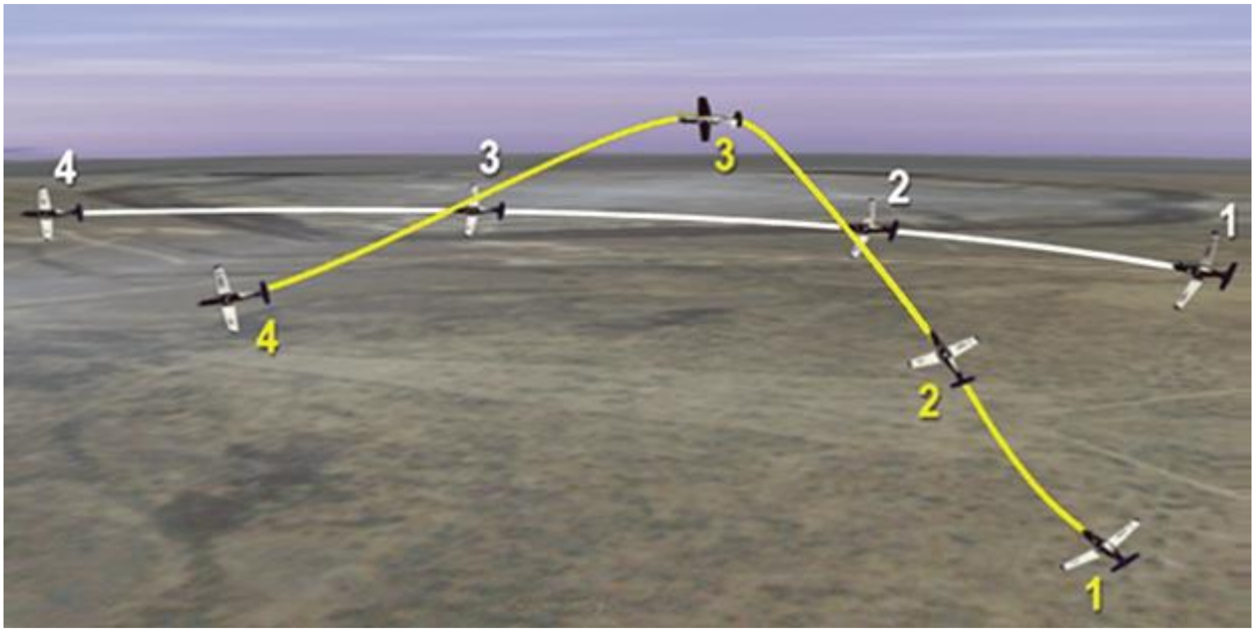
9.19.15. **Turn Rate.** This is the rate of heading change (nose track), normally measured in degrees per second. At about 10,000 feet MSL, at 30-degree bank, 180 KIAS (for example, a normal rejoin), the T-6 turn rate is approximately 3 degrees per second.

9.19.16. **Turning Room.** This is the volume of airspace (vertical and horizontal) that is available to execute maneuvers that change aspect, angle off, and closure. In the T-6, turning room is mostly used aft of the 3/9 line.

9.19.17. **Safe Airspace.** Generally, this is an area where any immediate threat of collision is unlikely if an out-of-plane maneuver is initiated. Pulling toward number 1's high six o'clock is a common example of safe airspace for number 2.

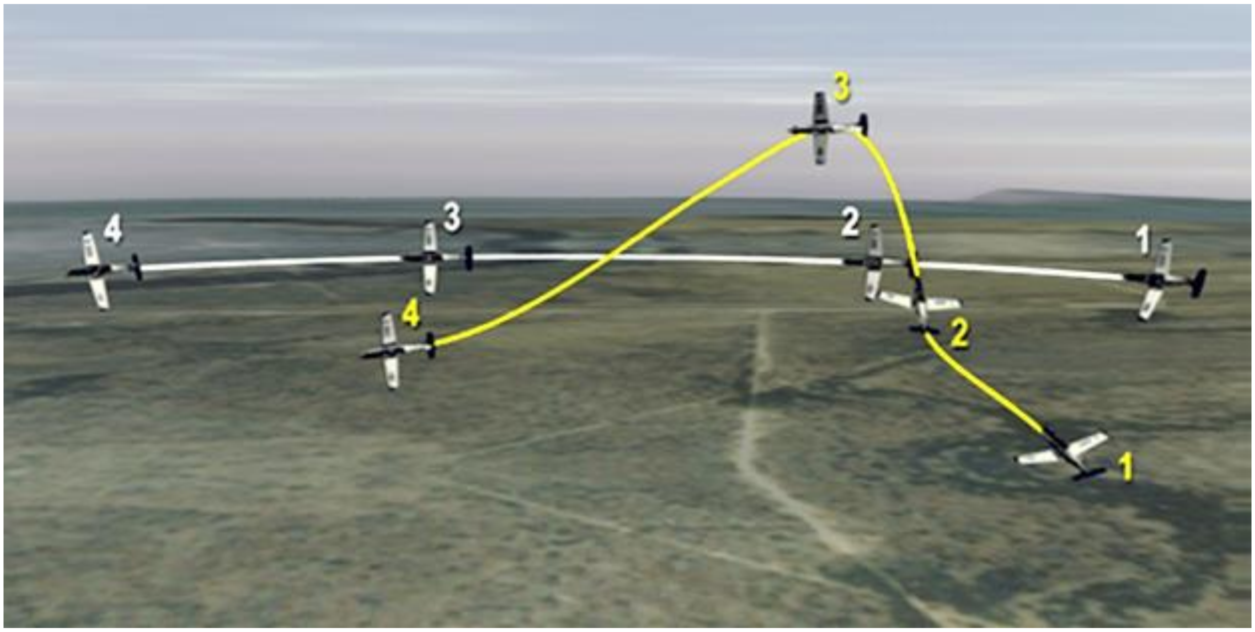
9.19.18. **Lag Reposition (High Yo-Yo) (Figure 9.11.).** A high yo-yo is a reposition of number 2's aircraft that uses various combinations of pursuit and a move out-of-plane above number 1's POM to control closure and aspect to prevent a potential 3/9 line overshoot. It creates turning room by using the vertical POM (out-of-plane). Creating a large HCA will result in a rapid increase in range.

Figure 9.11. High Yo-Yo.



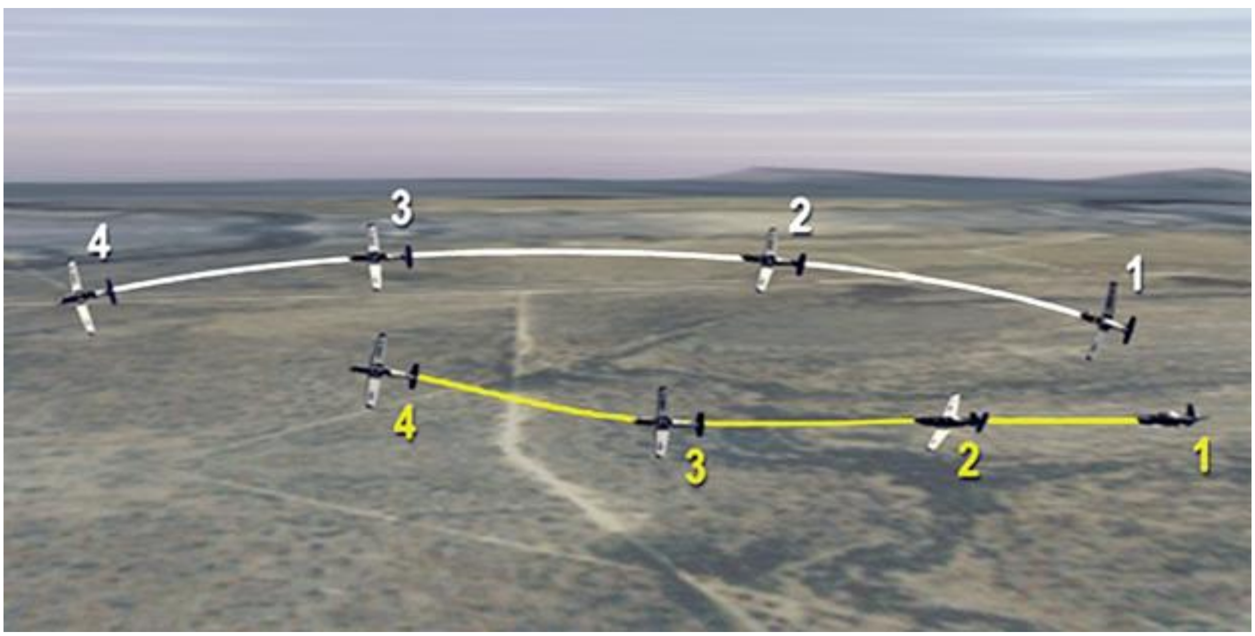
9.19.19. **Quarter Plane (Figure 9.12.).** A quarter plane is an aggressive, last ditch, out-of-plane lag maneuver used to control closure and aspect in order to preserve the 3/9 line. In a true quarter plane, number 2 establishes a POM that is 90 degrees to number 1's POM. This situation may be caused by a late decision (or no decision) to execute a high yo-yo or a failure to control closure and aspect. Indicators that a quarter plane is needed are similar to those of a high yo-yo. However, aspect, HCA, range, and closure cues are more significant and require a much more aggressive maneuver than a lag reposition. A large HCA will result in a rapid increase in range. Caution should be used to maintain visual contact with number 1 throughout the reposition maneuver.

Figure 9.12. Quarter Plane.



9.19.20. **Lead Reposition (Low Yo-Yo) (Figure 9.13.).** A low yo-yo is a reposition of number 2's aircraft, using various combinations of pursuit and a move out-of-plane below number 1's POM to increase closure and AA.

Figure 9.13. Low Yo-Yo.



Section 9D—Formation Fundamentals

9.20. Introduction. This section describes the basic positions and maneuvers used in T-6 formation. Positions are defined with regard to the formation position and the formation spacing.

The basic formation positions are fingertip and echelon. The basic spacing options are close and route.

9.20.1. **Fingertip.**

9.20.1.1. **Objective.** Maintain close formation spacing for weather penetration, airfield arrival, departure, flyovers and (or) aerial demonstration formations.

9.20.1.2. **Description.** The fingertip position is flown on an angle approximately 30 degrees aft of the 3/9 line (equates to a 6 AA), with approximately 10 feet of wingtip separation. It is the closest that number 2 will be to number 1 during formation flying. Therefore, maintaining the proper position is critical to flight path deconfliction. See **Figure 9.14.**

Figure 9.14. Fingertip Turn-into and Turn-away Positions.

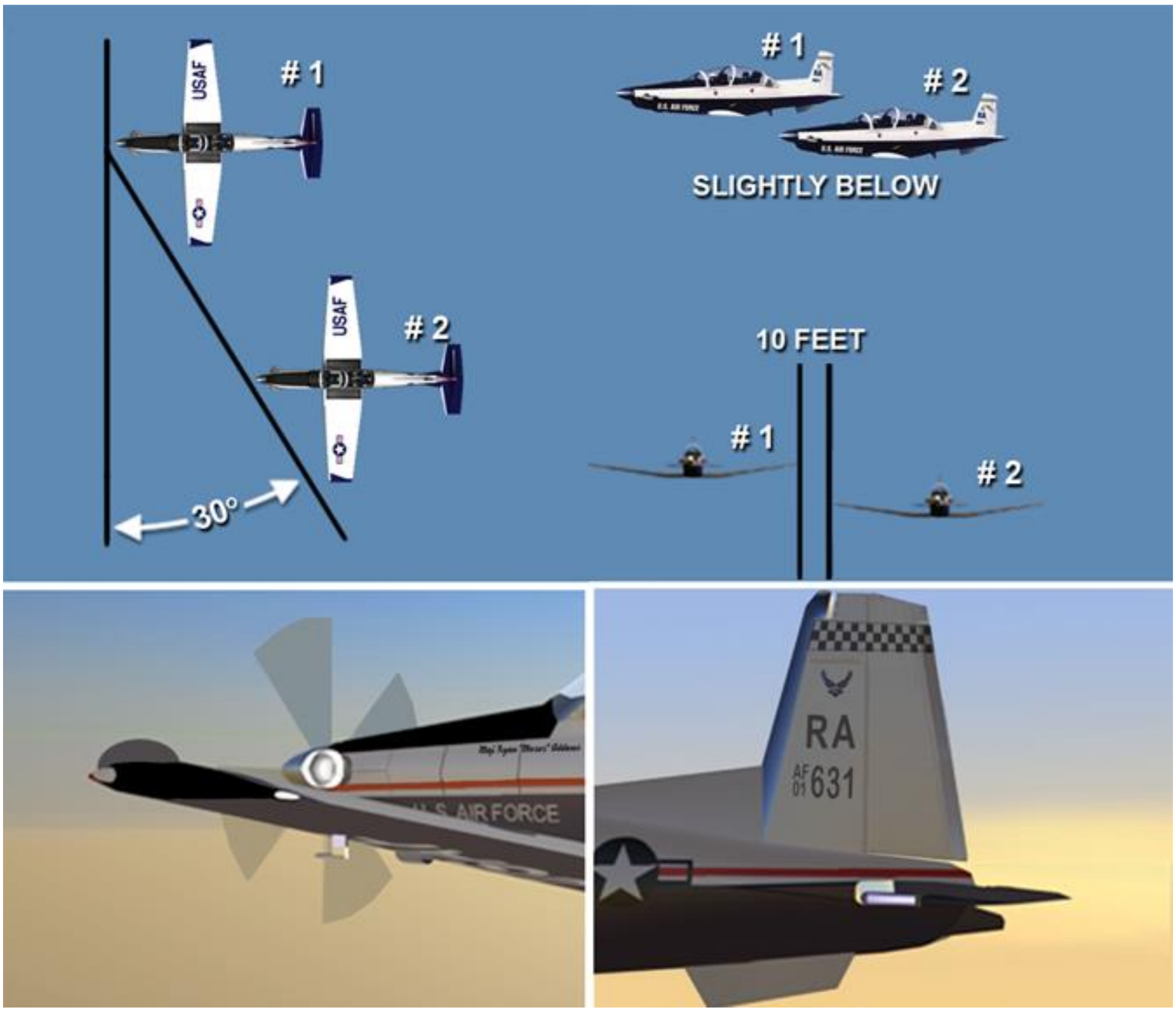
9.20.1.3. **Procedure.** In fingertip, the contract is that number 1 will fly a smooth aircraft, and number 2 will adjust to maintain proper position. Number 2's primary FCP reference to maintain proper vertical (up and down) position is to place the exhaust stack on top of number 1's closest wing. Number 2's primary reference to maintain proper longitudinal (fore and aft) position is to center number 1's aft position light on the front edge of the engine exhaust stack opening and align number 1's pitot tube with the aft edge of the engine exhaust stack opening (which should be visible above the wing). Number 2's primary reference to maintain proper lateral spacing (distance between number 1 and number 2) is when number 2's FCP pilot is aligned with the forward edge of number 1's horizontal stabilizer and the rudder hinge (**Figure 9.15.**). This lateral reference maintains approximately 10 feet of wingtip spacing between the aircraft.

9.20.1.3.1. Good fingertip position is the result of recognizing deviations, anticipating required control inputs, and applying deliberate corrections. Make continuous, small, and controlled corrections to stay in position. Keeping the aircraft trimmed and coordinated decreases workload and generally makes it easier to maintain position. Number 1 should maintain a constant power setting or make smooth power changes, so number 2 can make small, precise power changes instead of large changes. Power corrections usually require three PCL movements: one to start the correction, one to stop the aircraft, and finally one to stabilize the aircraft in the proper position.

9.20.1.3.2. When a deviation is recognized, initially correct one reference at a time. Correct the vertical position or stack first, correct fore and aft second, and finally adjust the lateral spacing in or out. Push (forward control stick pressure) or pull (aft control stick pressure) to move the aircraft vertically up or down with respect to number 1. Increase power to move the aircraft forward and decrease power to move the aircraft back. Finally, make small (almost imperceptible) bank angle changes toward or away from number 1 to move the aircraft laterally in or out.

9.20.1.3.3. Number 1 executes a shallow wing rock to direct number 2 to fingertip from route.

Figure 9.15. Fingertip Spacing References.



9.21. Route Formation.

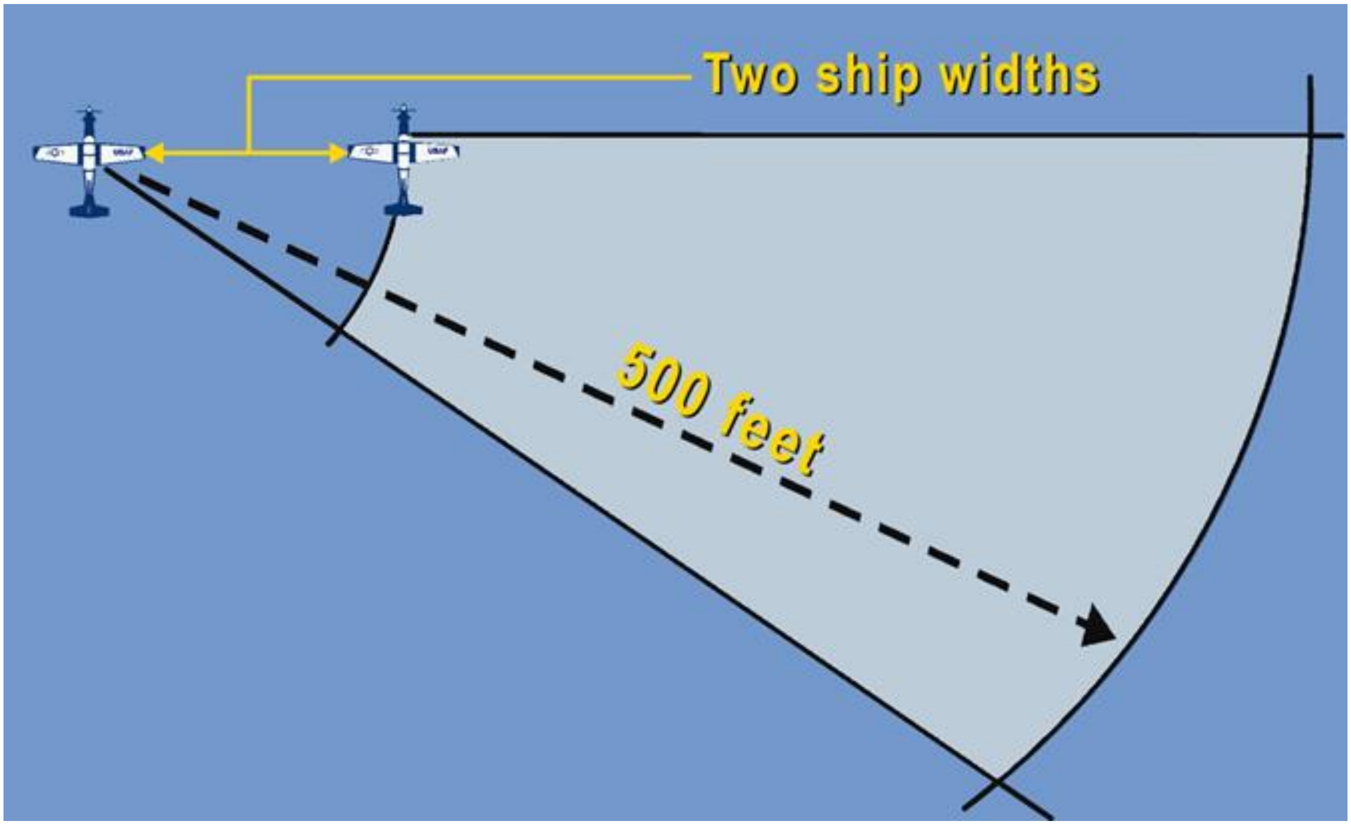
9.21.1. **Objective.** Increase flight maneuverability while enhancing clearing and visual lookout.

9.21.2. **Description.** Route (**Figure 9.16.**) is a wider extension of close formation spacing and is flown to enhance clearing and visual lookout, increase flight maneuverability, and ease the completion of in-flight checks, radio changes, other cockpit tasks, or simply to allow number 2 to relax. Number 1 sends number 2 to route with a radio call or visual signal. With the formation in route, number 1 should restrict maneuvering to moderate turns and pitch changes. Maximum bank angle in route is approximately 60 degrees.

9.21.3. **Route Spacing.** Route spacing is from two-ship widths to no further than approximately 500 feet. Route is flown no further forward than LAB and no further aft than the extended 30 degree fingertip line. When not in a turn, number 2 generally maintains a position level with number 1 (a level stack) by keeping the helmet of number 1's FCP pilot on the horizon. Although the formal definition of the route position has fairly wide tolerances, number 2 should strive to maintain a specific position when in route. Number 2 should exercise judgment when selecting a route position. If weather is a factor or a reform to fingertip is anticipated, select a position toward two ship widths and 30 degrees aft. If weather is not a factor and a long cruise is anticipated, select a position toward 500' and LAB to aid in clearing and performing cockpit duties.

9.21.4. **Route LAB.** When LAB, strive to remain between the extended 3/9 line and approximately 10 degrees aft of LAB. Typically, route is flown LAB and out toward the 500-foot limit when weather conditions are not a factor, and when visual clearing, flight path deconfliction and maneuvering are formation priorities. LAB at 2-4 ship widths is typically flown when anticipating a turn away while in route (echelon turn).

Figure 9.16. Route.



9.21.5. **Turns In Route.** When inside a turn, number 2 maneuvers below number 1's POM only as necessary to keep number 1 in sight just above the canopy rail. On the outside of a turn, number 2 maintains the same vertical references used in echelon turns. As in fingertip, number 2 will not cross to the opposite side unless specifically directed to do so verbally or by a crossunder signal from number 1.

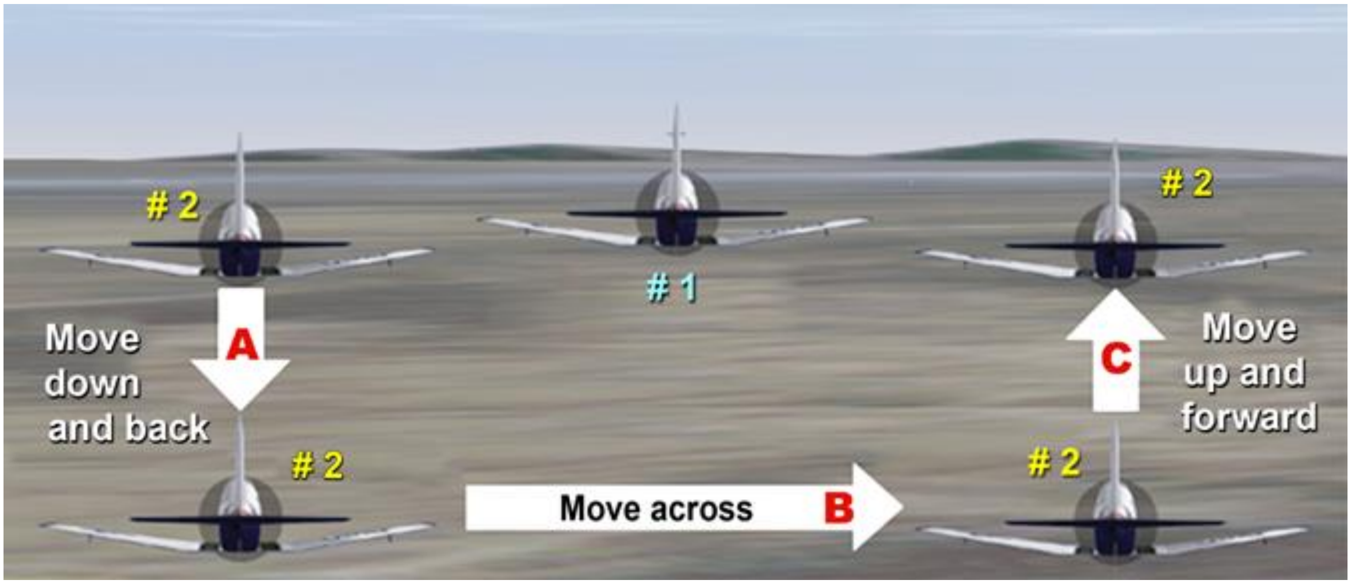
9.21.6. **Procedure.** Number 2 stabilizes in route before diverting attention to change radio channels, accomplish in-flight checks, or execute other cockpit tasks.

9.22. Crossunder (Figure 9.17.).

9.22.1. **Objective.** A crossunder is used to reposition number 2 from one side of the formation to the other.

9.22.2. **Description.** A crossunder may be accomplished with the formation in fingertip or route formation. Number 2 maintains nose-tail separation while crossing under. Number 1 directs a crossunder with a radio call or visual signal. The visual signal is a rapid, shallow wing dip in the desired direction of the crossunder. The size of the wing dip should be proportional to number 2's spacing. Anticipate each power change and make small changes in pitch and bank.

Figure 9.17. Crossunder.



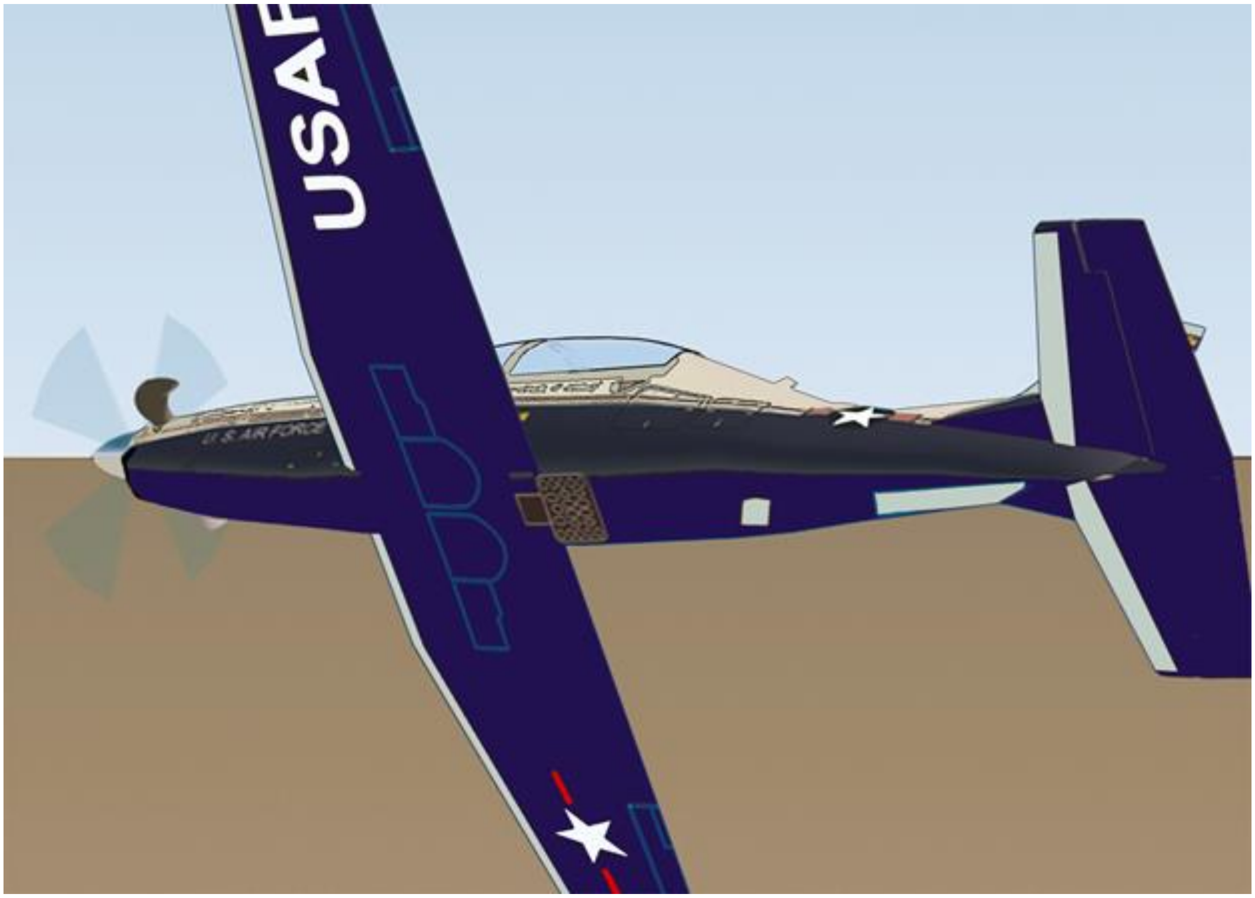
9.22.3. **Procedure.** To accomplish a crossunder, reduce power as required to establish a small forward LOS rate. Move back and down below number 1's POM to establish nose-tail clearance, and then add power slightly to stop rearward movement. If in a climb, keep the power reduction small to avoid excessive rearward movement. Bank slightly toward the new side to change aircraft heading a few degrees (create small HCA). Roll wings level and fly across and behind number 1. Add power as required to maintain proper nose-tail separation. Typically, a slight power increase is required. Number 2's canopy bow should appear to be superimposed on the trailing edge of number 1's elevator. Reestablish number 1's heading when in the desired position on the new side. Add power to move forward and up into position. Reduce power to stabilize in position on the opposite side of number 1 from which the crossunder was started.

9.23. Echelon Turn (Figure 9.18.).

9.23.1. **Objective.** Turn the formation while in close or route formation using other than fingertip references.

9.23.2. **Description.** A turn in which number 2 remains in the same POM as number 1. Echelon turns may be accomplished from fingertip or route. All turns while in route position will be echelon turns (echelon signal not required). When in fingertip, however, turns are only flown as echelon turns if indicated by number 1.

Figure 9.18. Echelon Turn.



9.23.3. **Procedure.** Instead of maintaining fingertip references, number 2 remains in the same POM as number 1. Number 1 should roll smoothly into bank (approximately 60 degrees) and maintain appropriate back pressure. Slight variations in bank angle to control undesired climbs and descents are smoother and easier for number 2 than variations in back pressure. Number 1's roll rate should approximate that used during instrument conditions. Number 2 matches number 1's roll rate and uses back pressure to maintain spacing. In a level turn, the horizon bisects number 1's fuselage. In the FCP, approximately one-half of the yellow rescue door should be visible (resembles a triangle) behind the aft edge of number 1's wing and one wingspan spacing will exist between he aircraft. If out of position, use bank to correct vertical (to keep number 1's fuselage bisected by the horizon), power to correct fore and aft position, and back pressure to maintain spacing. During rollout, number 1 should use a smooth roll rate and gradually reduce back pressure. Number 2 matches number 1's roll rate to maintain position. Upon rolling back to wings level, number 2 should be re-established in the fingertip position.

9.24. Reforms.

9.24.1. **Objective.** Move number 2 from one formation position to a closer one.

9.24.2. **Description.** Reforms are commonly used when number 1 desires to bring number 2 in from close trail, fighting wing, or route. Reforms may be to route or fingertip.

9.24.3. **Procedure.** Number 1 directs a reform with a radio call or visual signal (wing rock). The size of the wing rock is based on distance between aircraft and may use slight climbs or descents when necessary for energy management or area orientation. The procedure for accomplishing a reform varies based on number 2's position and distance relative to number 1. To reform from route to fingertip, maneuver as necessary to stabilize at a 2-ship width route position on the fingertip line, and then slowly move up the line to fingertip. Guidance on reforms from fighting wing and close trail are found in their respective sections of this chapter.

9.25. Rejoins.

9.25.1. **Objective.** Get the flight back together safely and efficiently.

9.25.2. **Description.** Rejoins are commonly practiced from pitchouts and after number 2 has taken spacing. They are also accomplished after breakouts, practice lost wingman, instrument trail departures, and lost-sight situations (anytime the formation is split).

9.25.3. **Procedure.** Number 1 initiates rejoin with radio call or visual signal and may use slight climbs or descents during a rejoin when necessary for energy management or area orientation. Number 1 should consider using a radio call to initiate a rejoin when number 2 is not in sight. All rejoins are to fingertip unless directed otherwise by number 1. Unless otherwise briefed, rejoin airspeed in the T-6 is 180 KIAS. Number 1 calls out current airspeed if it differs more than 10 knots from briefed or expected rejoin airspeed. The size of the wing rock is based on distance between aircraft. Number 1 should monitor number 2 closely during all rejoins. If number 1 perceives an unsafe situation developing at anytime during the rejoin, take positive action immediately to prevent a midair collision.

9.25.3.1. **Straight-ahead Rejoin.** Use straight-ahead rejoins when a turn is not possible or practical. Airspeed closure is used to effect a straight-ahead rejoin. Number 1 should maintain a stable platform (level, climbing or descending), clear and monitor number 2 during the rejoin.

9.25.3.1.1. **Number 1.** Direct the rejoin. If a turn is required after a straight-ahead rejoin is initiated, inform number 2 and clear. Do not turn into number 2 if it would exceed number 2's capabilities or prevent a safe rejoin. Due to the location of number 2 behind and below number 1, number 2 will be difficult to see until the final stages of a straight-ahead rejoin.

9.25.3.1.2. **Number 2.** Rejoin to the left side unless directed otherwise. Increase airspeed to generate closure (initially use 20 to 30 knots of overtake). Establish a position behind and slightly below number 1 with a vector toward number 1's low 6 o'clock position. Placing number 1 slightly above the horizon will help maintain separation from number 1's wake turbulence. Continue to close until approximately 500 feet (when details on number 1's aircraft, such as the pitot tubes, can be seen). At this point, bank slightly away from number 1 ("make a bid"), toward a position two to four ship widths out from number 1's wingtip. The velocity vector should angle away from number 1. Decrease overtake with a power reduction, and plan to arrive in the route position with the same airspeed as number 1. As a technique, reduce the power such that the PCL moves aft to match number 1's aft LOS in the windscreen. After stabilized in route, move into fingertip. If number 1 turns during a straight-ahead rejoin, transition to a turning rejoin, and be alert for possible overshoot situations.

9.25.3.2. **Turning Rejoin.** Use a combination of airspeed and angular closure to effect a turning rejoin.

9.25.3.2.1. **Number 1.** Direct the rejoin. If using a wing rock, attempt to make the first wing dip in the direction of the rejoin. Maintain 30 degrees of bank unless otherwise briefed. After a pitchout, delay long enough for number 2 to roll out in trail. Establish a turn, maintain bank angle, and rejoin airspeed in level flight. Bank and pitch may be varied if required for area orientation. A slight climb or descent is acceptable for energy management. Monitor number 2's AA and closure. Be ready to take evasive action if required.

9.25.3.2.2. **Number 2.** Base closure and desired aspect on energy and aircraft position relative to number 1. When number 1 starts to turn, begin a turn in the same direction to intercept the desired aspect. Simultaneously establish desired vertical separation (place number 1 within approximately two widths of the horizon) and closure. Manage aspect with minor adjustments to bank angle. Number 1 must be visible to pilots in both cockpits.

9.25.3.2.2.1. Begin with approximately 20-30 knots of closure and a moderate lead pursuit picture (pull nose in front of number 1) to increase aspect. As number 2 moves inside of number 1's turn circle, the vertical stabilizer appears to move toward number 1's outside wingtip as AA increases. When the vertical stabilizer approximately bisects the outside wing (3 aspect/30 degrees AA), reduce bank angle to maintain this relative reference line. When stable, there is no LOS.

9.25.3.2.2.2. If the vertical stabilizer appears to move toward the wingtip, AA is increasing. If the vertical stabilizer appears to move toward the wing root, the AA is decreasing. Use varying degrees of bank angle to manage aspect during a rejoin. Shallow the bank angle to decrease aspect and increase the bank angle to increase aspect. As range decreases inside route toward close spacing, the vertical stabilizer will appear to move toward the outside wingtip.

9.25.3.2.2.3. Number 1 should appear slightly above the horizon. Maintain number 1 within approximately two relative ship widths above the horizon. The star on the left wing (or the "SA" in USAF on the right wing) should be directly over the star on the aft fuselage. This is referred to as the "saddle" between where the leading edge of the vertical stabilizer meets number 1's fuselage and the aft portion of number 1's canopy.

9.25.3.2.2.4. The critical stage of the rejoin begins approximately 500 feet from number 1. Inside 300 to 500 feet, the normal close (fingertip) fingertip references will become visible. Descend slightly and move forward (increase aspect with lead pursuit) onto an extension of the fingertip reference line. Begin decreasing closure with a power reduction and speed brake as necessary. Monitor bank and overtake closely during the last few hundred feet to ensure aspect and closure are under control. Plan to stabilize in route with slight positive closure but approximately co-airspeed with number 1, and then move into fingertip at a controlled rate.

9.25.3.2.2.5. During two-ship formation ops, unless prebriefed or directed otherwise, number 2 normally rejoins to the inside of the turn. To rejoin to the outside of the turn (number 3 position), the event will either be prebriefed or directed. Number 2 may request to rejoin to number 3, and number 1 may consent on the radio. Rejoins to the outside of the turn (number 3 position) are initially flown exactly like rejoins to the inside of the turn. In the later portion of the rejoin, number 2 will cross below and behind number 1 with at least nose-tail separation to get outside of number 1's turn circle. Maintain enough positive closure (about 10-15 knots) to facilitate this move to the outside. Stabilize in route echelon on the outside and then move into fingertip at a controlled rate.

9.26. Overshoots.

9.26.1. **Objective.** Safely dissipate excessive closure and (or) aspect.

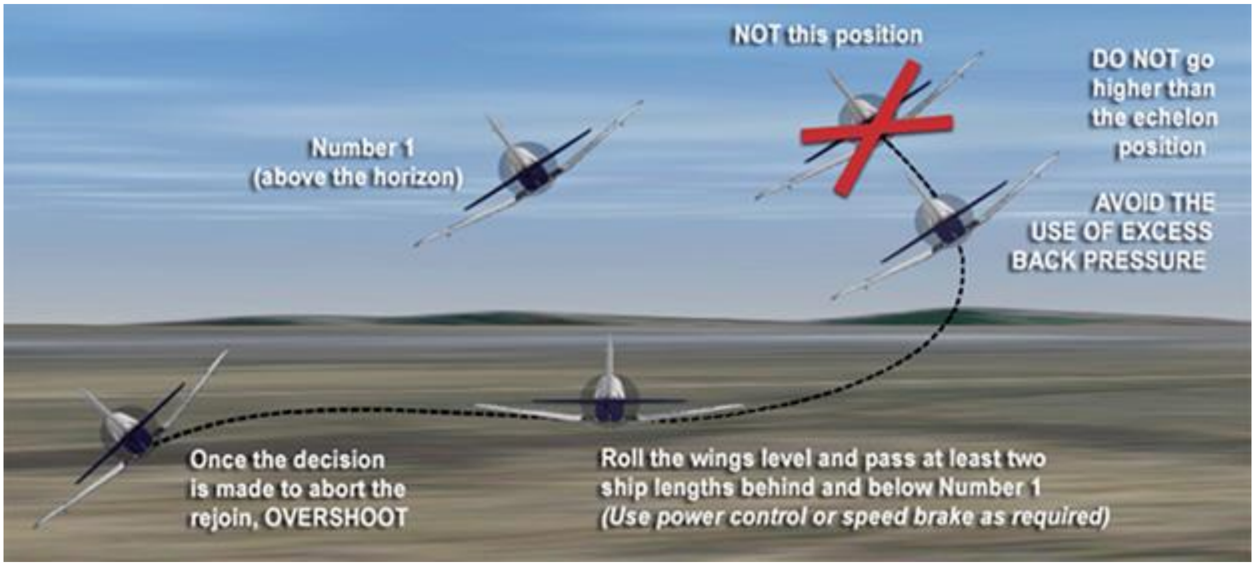
9.26.2. **Description.** A properly flown overshoot will safely dissipate excessive closure and (or) aspect during a rejoin. Number 2 must not delay an overshoot with an unusually aggressive attempt to save a rejoin.

9.26.3. **Procedure.** Keep number 1 in sight at all times during any overshoot. Reduce power and use speed brake (if required) as soon as excess overtake is recognized.

9.26.3.1. **Straight-ahead Rejoin Overshoot.** A straight-ahead rejoin with excessive closure results in a pure airspeed overshoot. Maintain lateral spacing on a parallel or divergent vector to number 1. Do not turn into number 1, which is a common error while looking over the shoulder at number 1's aircraft. This can cause a vector into number 1's flight path and create a dangerous situation requiring a breakout. A small, controllable 3/9 line overshoot is easily managed and can still allow an effective rejoin. There is no need to breakout if flight paths are not convergent and visual contact can be maintained. After beginning to slide back into formation, retract the speed brake and increase power prior to achieving co-airspeed (no LOS) to prevent excessive aft movement.

9.26.3.2. **Turning Rejoin Overshoot.** A turning rejoin with excessive closure airspeed results in a combination airspeed-aspect overshoot in a POM about 50 feet below number 1. Attempt to overshoot early enough to cross number 1's 6 o'clock with a minimum spacing of two ship lengths. Breakout if unable to maintain nose-tail separation. Reduce power and use speed brake as required. Once outside the turn, use bank and back stick pressure as necessary to stabilize in route echelon position. Fly no higher than route echelon. Excessive back pressure causes closure. A co-airspeed overshoot due to excess aspect may not require maneuvering outside of number 1's turn circle. Instead, there may be sufficient space in number 1's low 6 o'clock to align fuselages and stop the overshoot. When under control with no aft LOS, complete a crossunder to the fingertip position (or as directed) on the inside of the turn. If aft LOS is not adequately controlled, #2 may need to reestablish the rejoin line inside #1's turn and complete the turning rejoin.

Figure 9.19. Overshoot.

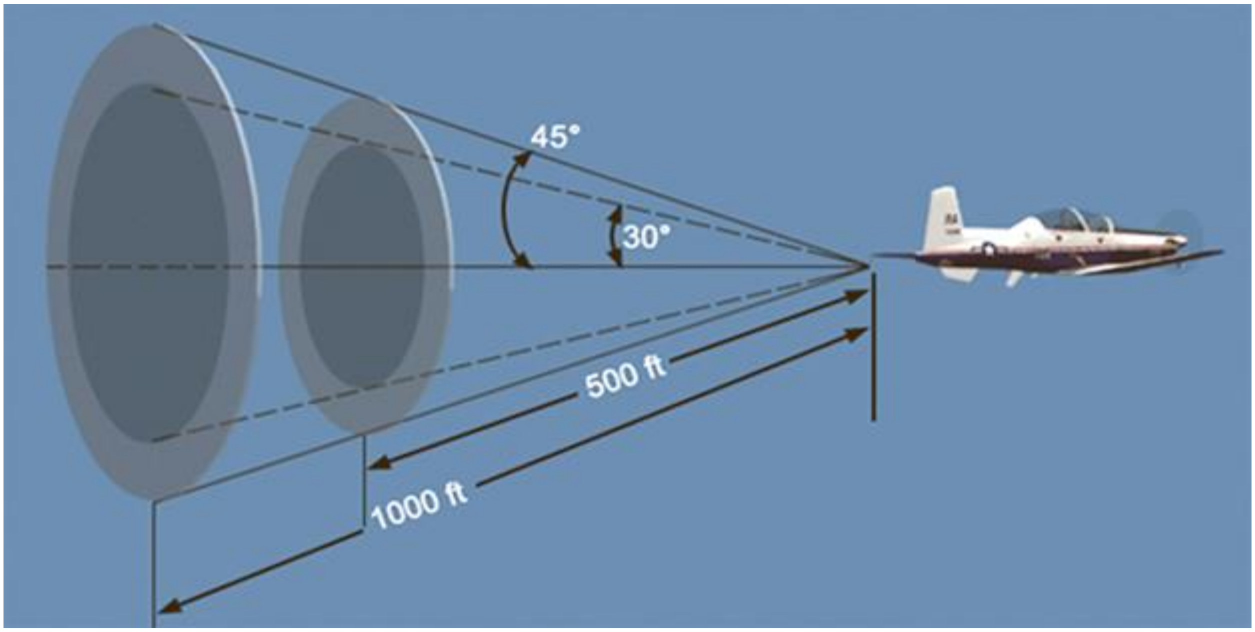


9.27. Fighting Wing.

9.27.1. **Objective.** Enhance formation flexibility or maximize clearing.

9.27.2. **Description.** Fighting wing is a fluid position defined by a 30 to 45-degree cone, 500 to 1,000 feet aft of number 1 (**Figure 9.20.**).

Figure 9.20. Fighting Wing Cone.



9.27.3. **Procedure.** Number 1 directs the wingman to fighting wing with a radio call (*"Texan 2, go fighting wing"*). Number 2 acknowledges "2" and maneuvers into the cone. Do not call "in" unless performing the ET exercise.

9.27.3.1. Number 2 maneuvers into and maintains the cone with a combination of pursuit selection and lift vector placement. An initial turn away from number 1 (lag pursuit) increases lateral spacing and causes a slight movement aft of number 1 (forward LOS). The rate of aft movement can be increased with use of power, speed brake, or a vertical move out-of-plane. It requires constant analysis of AA and closure to apply the proper amounts of lead and lag pursuit and stay within the cone. Number 2 should not stagnate in number 1's high or low 6-o'clock while maneuvering within the cone because it is difficult for number 1 to monitor number 2 in this position. While flying in the fighting wing position, be aware it may be possible for number 2 to be outside standard formation parameters (for example, plus or minus 100 feet vertical of number 1).

9.27.3.2. Reform from fighting wing. Number 1 signals a reform or directs Number 2 to another formation position. If number 1 desires number 2 to reform to a particular side, the reform is directed with a radio call or wing rock. For example, *"Texan 2, reform right side."* Lacking direction from number 1, number 2 reforms to the side currently occupied.

9.27.4. Visually, the aft (30AA) line of the cone is the same as for the basic rejoin: number 1's vertical stabilizer bisects the opposite wing. The forward (45AA) line of the cone is approximately when number 1's vertical stabilizer is superimposed over the opposite wingtip or the inside wingtip strobe light just forward of the spinner.

9.28. Chase.

9.28.1. **Objective.** Used for performance assessment and assistance during an emergency.

9.28.2. **Description.** IAW 11-2T-6, Volume 3, a chase aircraft will maneuver as necessary to observe performance, but is primarily responsible for aircraft separation. Generally, a chase aircraft will maneuver in a 30- or 60-degree cone out to 1,000 feet from which the pilot can effectively clear and/or provide assistance. The chase aircraft will not stack lower than lead aircraft below 1,000 feet AGL.

9.28.3. **Procedure.** When flying chase to provide assistance during an emergency, both the chase pilot and the emergency aircraft pilot should seriously consider the nature and severity of the emergency (flight control malfunction, structural damage, controlled ejection, etc.) when determining how close and exactly where to fly the chase formation position.

Section 9E—Mission Execution

9.29. Introduction. This section describes formation mission execution and advanced formation maneuvering. The basics of departure, en route, area, and recovery procedures are the same as for single-ship missions; however, accommodations must be made for the additional aircraft in a formation.

9.30. Ground Ops.

9.30.1. **Engine Start.** Formations normally start engines on a visual signal, either pilot-to-pilot or relayed through the crew chiefs. If aircraft are parked beyond visual range, the FL sets a start time. If starting without visual contact between pilots or crew chiefs, number 1 will normally check number 2 in on the radio at start time. If required, number 2 will inform number 1 of any difficulties that may delay start or taxi at this time.

9.30.2. **Before Taxi.**

9.30.2.1. All flight members will check the ATIS before check-in. When ready to taxi, number 2 gives a thumbs-up signal to number 1. If not in visual contact, number 2 awaits check-in.

9.30.2.2. Number 1 normally checks the flight in on VHF, then UHF. If more time is needed by one of the crews, advise the other crew during the post-start check-in. For example, *"Texan 2 needs (x) minutes."* Number 1 responds with *"1".* After check-in with all members ready, number 1 calls for taxi clearance. Number 2 responds with *"2,"* after number 1's clearance acknowledgement indicating that the clearance is understood. If number 2 does not understand the clearance, ask for clarification.

9.30.3. **Taxi.** The formation normally taxis together as a two ship. If another aircraft attempts to taxi between members of the formation, Number 1 asks that aircraft to hold. Formations may taxi staggered when taxiway width and local procedures allow. Number 1 should stagger on the downwind side.

9.30.4. **Before Takeoff.** The overspeed governor and before-takeoff checks are completed automatically at the EOR at the normal locations for single-ship missions. When complete, number 2 gives a thumbs-up signal to number 1. On other than instrument trail departures, number 2 places the TAS to STBY and selects STBY on the transponder prior to takeoff.

9.31. Formation Departures (Figure 9.21.). Environmental or training factors determine takeoff method. Number 1 will ensure all members of the formation understand the takeoff option being executed. See AFI 11-2T-6, Volume 3, for formation takeoff restrictions.

Figure 9.21. Formation Takeoff.

9.31.1. **Objective.** Safely get the formation airborne.

9.31.2. **Description.** There are three options for getting a T-6 formation airborne. Option 1, formation takeoff, commonly referred to as a "wing takeoff," is the most common; option 2, interval takeoff, is generally driven by wind requirements; and option 3, instrument trail departure, is used when WX (ceiling and visibility) does not allow an interval or formation takeoff. See AFI 11-2T-6, Volume 3 for formation takeoff restrictions.

9.31.3. **Procedure.** Details regarding the three T-6 formation departure options follow:

9.31.3.1. **Wing Takeoff.**

9.31.3.1.1. Place number 2 on the upwind side for takeoff when the crosswind component exceeds 5 knots to keep number 2 from entering number 1's wake turbulence in the event number 2 falls behind. If crosswinds are not a factor, number 1 should consider placing number 2 on the outside of the first turn if entering IMC. If crosswinds and IMC are not factors, number 1 should consider placing number 2 on the inside of the 1st turn.

9.31.3.1.2. Number 1 takes the center of one-half of the runway and taxis a sufficient distance down to allow number 2 room to maneuver into position.

9.31.3.1.3. Number 2 lines up on the fingertip line with a minimum of 20 feet of lateral wingtip clearance. Number 2 gives a head nod to signify ready for run-up. Number 1 gives the run-up signal and looks at number 2. Number 2 acknowledges the signal with a head nod.

9.31.3.1.4. Both aircraft smoothly increase the PCL to approximately 30 percent torque and check the engine. During the engine run-up, continue to primarily focus attention outside the aircraft with only short glances inside the cockpit. Ensure the aircraft does not creep forward.

9.31.3.1.5. Number 1 looks at number 2. When ready for takeoff, number 2 gives a head nod.

9.31.3.1.6. Number 1 signals for brake release with a downward head nod. Both aircraft then smoothly add power, with number 1 targeting 85-95 percent torque to give number 2 a slight power advantage.

9.31.3.1.7. Number 2 uses power as required to maintain position on the takeoff roll. Number 2 uses peripheral vision to detect lateral movement on the runway and matches number 1's pitch attitude. Stack level (helmet on the horizon) until the gear and flaps are raised. If unable to maintain fore or aft position with normal power settings, number 2 selects MAX power and performs an individual takeoff. Number 1 directs a rejoin when conditions permit.

9.31.3.1.8. When the formation is safely airborne with a minimum of 110 KIAS, number 1 retracts both gear and flaps. Number 2 raises gear and flaps when climbing, and number 1's gear begins to retract. If overrunning number 1, number 2 may delay retracting the gear. Number 2 never raises the gear before number 1. Number 2 performs the after takeoff check and assumes fingertip.

9.31.3.1.9. The first turn out of traffic is not initiated until a safe airspeed and altitude.

9.31.3.2. **Interval Takeoff.**

9.31.3.2.1. Interval Takeoff. The interval takeoff may be accomplished from a static lineup or a rolling takeoff.

9.31.3.2.2. Static Interval Takeoff. There is no visual signal for interval takeoff. After number 2 gives a head nod that the run-up check is complete, number 1 releases brakes and performs a MAX power takeoff. When ready for takeoff, lead will release the brakes and perform a MAX power takeoff. Wingmen will ensure a minimum of 6 seconds spacing following lead, then perform a MAX power takeoff. Each aircraft should steer toward (but not cross) the center of the runway after the start of the takeoff roll. When airborne at a minimum of 160 KIAS, number 1 reduces power to 85 to 95 percent (or as required for an intermediate level-off) and maintains airspeed of 160 KIAS.

9.31.3.2.3. Rolling Interval Takeoff. . When cleared for takeoff on a rolling interval takeoff, number 1 will taxi onto the runway (centerline or offset) and perform a MAX power rolling takeoff. As number 1 begins his takeoff roll, the wingman will taxi to the runway (centerline or offset) and perform a MAX power rolling takeoff. Wingmen will ensure a minimum of 6 seconds spacing after the preceding aircraft. The remainder of the takeoff is the same as the static interval takeoff.

9.31.3.2.4. The rejoin may be a turning rejoin, a straight-ahead rejoin or, in some cases, a combination of both. Number 2 must be alert for transitions from one type of rejoin to another as number 1 follows the departure route. Unless briefed otherwise, number 2 will rejoin to the inside of the first turn out of traffic. If necessary, coordinate for an intermediate level off to maintain VMC until wingmen are joined. Wingmen should maintain MAX power until sufficient overtake is achieved.

9.31.3.3. **Instrument Trail Departure.**

9.31.3.3.1. Same as wing takeoff through engine run-up.

9.31.3.3.2. During trail departures in IMC, sound instrument flying is the first priority and must not be sacrificed to perform secondary tasks.

9.31.3.3.3. All formation members must strictly adhere to the briefed climb speeds, power settings, altitudes, headings, and turn points.

9.31.3.3.4. If task saturated or disoriented, number 2 ceases attempts to maintain trail, immediately concentrates on flying the instrument departure, and notifies number 1.

9.31.3.3.5. Takeoff spacing is no less than 20 seconds.

9.31.3.3.6. Each aircraft climbs at MAX power at 160 KIAS and uses 30 degrees bank for all turns.

9.31.3.3.7. Until join up or level off, both number 1 and number 2 call when passing even-numbered thousands of feet (for example, 2,000, 4,000, etc.) and when initiating heading changes. In order to maintain lateral separation, number 2 will delay all turns/heading changes as announced by number 1 by the number of seconds delayed on the takeoff (no less than 20 seconds). Acknowledgments are not required, but both aircraft should monitor radio transmissions and the progress of the other member of the formation. Immediately correct any deviations from the departure route.

9.31.3.3.8. During the climb and through level off, each aircraft maintains positional awareness using NAVAIDs and all available aircraft systems, including the clock, TAS, and GPS.

9.31.3.3.9. Number 2 will maintain a minimum of 1,000 feet of altitude separation from number 1 until visual. If number 2 cannot maintain 1,000-foot separation and comply with the minimum safe altitude, number 1 may reduce the vertical separation to 500 feet.

9.31.3.3.10. If a visual join up cannot be accomplished by level off, number 1 requests 1,000 feet of altitude separation between the aircraft in the formation until number 2 is visual.

9.31.3.3.11. Number 2 rejoins only after visually acquiring number 1 and receiving permission. After the rejoin, number 2 sets TAS and transponder to STBY.

9.32. Wing Work Exercise (WW Ex).

9.32.1. **Objectives.**

9.32.1.1. **Number 1.** Develop judgment and skill necessary to lead a formation through varying flight regimes. Use a combination of smooth changes in pitch, bank, and wing loading (Gs) to provide a stable platform with consistent, predictable roll rates, and no sudden changes in back pressure. Clear visually while planning for the formation (navigation, next maneuver, etc.) and monitor number 2. Clear, plan, and monitor.

9.32.1.2. **Number 2.** Maintain or constantly correct back to fingertip. Make proper power and flight control inputs using small, smooth, deliberate inputs. Trim should be used to allow ease in maintaining position. Avoid tendency to focus or stare at any single reference. Practice visually scanning all of number 1's aircraft for position references and visually clear through number 1.

9.32.2. **Description.** The WW Ex is typically flown as series maneuvers in a targeted airspeed range. Eventually maneuver up to 2 to 3 Gs and approximately 90 degrees AOB as proficiency improves. Initially, proficiency may limit both number 1 and number 2 to lower levels of the WW Ex. Practice at the lower levels of the WW Ex gives number 2 a reduced pitch, bank, and G environment to learn to recognize deviations and develop the ability to correct. This allows number 2 to build the skills necessary to effectively and efficiently correct and maintain fingertip. See **Table 9.1**.

Table 9.1. T-6 WW Ex Training Levels and Parameters.

Level	Bank Angle	Pitch	G Loading	Airspeed
I	~ 0º – 30º	~ +/- 10º	~ 1 – 2 G	120 KIAS minimum
II	~0º – 60º	~ +/- 25º	~ 1 – 2 G	120 KIAS minimum
III	~ 0º – 90º	~ +/- 35º	~ 1 – 3 G	120 KIAS minimum

9.32.3. **Procedure.** Levels provide a measure of difficulty of the exercise. They provide a building-block approach to develop fingertip flying skills and proficiency. Levels also provide a way to set training objectives.

9.32.4. **Number 1.**

9.32.4.1. **Power Control and (or) Energy.** Target energy level is the middle of the area altitude block between approximately 180 to 200 KIAS. Normally, number 1 sets power to maintain desired energy level. As a guide, use approximately 50 to 55 percent torque in a low area (~8,000 to 10,000 feet MSL) and approximately 55 to 60 percent torque in a high area (~16,000 to 18,000 feet MSL). Weather or other environmental conditions may affect the actual energy level in the area. Avoid extremely low or high power settings during the WW Ex as it limits the ability of number 2 to adjust for deviations.

9.32.4.2. **Maneuvering.** During initial training, use smaller bank angles and conservative climbs and/or descents (Level I WW Ex) to stay within number 2's capabilities. As number 2's proficiency allows, increase to Level II or Level III. Avoid advancing to higher levels too quickly; develop and master proficiency at lower levels first. For Levels II and III, initially blend pitch with roll to the desired bank angle. Hold the bank angle as the nose of the aircraft drops through the horizon. As the nose approaches the desired nose-low pitch attitude, begin the rollout and reverse direction while maintaining positive G. Attempt to pull through the horizon in a near wings-level attitude. Use bank angle to aid pitch control.

9.32.4.2.1. Do not stair-step or ratchet roll rates into or out of turns. Initiate changes in bank smoothly then continue using moderate, positive movements. Remain predictable. Do not begin a rollout and suddenly roll back into the bank. If a turn must be continued for area orientation, stop the roll, pause momentarily to allow number 2 to adjust, then begin the roll smoothly back into the turn.

9.32.4.2.2. Visually clear the flight path before commencing the turn. The WW Ex may be started with either a blend of pull and roll into a climb or descent, depending on energy level. If starting from a low kinetic or high potential energy level, smoothly increase bank angle, and allow the nose of the aircraft to slice to the desired nose-low attitude, and then begin the WW Ex with a vertical pull-up as stated above.

9.32.4.2.3. Consider environmental conditions, such as sun angle and cloud layers, and plan formation maneuvering to avoid them as able.

9.32.4.2.4. Do not stare at number 2, but continually monitor number 2's position and status. Use the mirrors if necessary, and communicate with the other crewmember when required to assist monitoring number 2. Be ready to take evasive action and (or) direct a breakout, if required.

9.32.5. **Number 2.**

9.32.5.1. **Power Control and (or) Energy.** The ability to fly well in close formation is the result of recognizing, anticipating, and applying small corrections. Make continuous, small, and controlled corrections to stay in position. Always keep the aircraft trimmed and coordinated. Make small, precise power changes instead of using large power bursts.

9.32.5.2. **Maneuvering.** To remain in proper position, changes in bank (roll), backstick pressure (pull), and power must be blended as necessary into one simultaneous action.

9.32.5.2.1. **Turns Away.** When number 1 turns away, number 2's aircraft is out side number 1's turn circle. If corrections are not made, AA decreases (number 2's aircraft moves aft of the fingertip line) and range increases (lateral spacing increases). Number 2 must match number 1's roll rate, increase back pressure and climb to maintain vertical position. This requires an increase in power to maintain airspeed and position. When number 1 stops the roll-in, number 2 must reduce power as the relative climb is complete.

9.32.5.2.2. **Turns Into.** Add slight forward pressure to maintain vertical position and reduce power. Be aware of collision potential at all times. The collision potential increases in turbulence or while flying maximum performance maneuvers or maneuvers that are not frequently flown.

9.33. Close Trail Exercise (Figure 9.22.).

9.33.1. **Objective.** Practice maneuvering with number 2 in a position below and behind number 1. Number 1 will maneuver similarly to the WW Ex.

9.33.2. **Description.** Close trail spacing is one to two aircraft lengths (nose to tail) behind number 1, just below number 1's wake turbulence and prop wash. To prevent encountering wake turbulence, avoid flying high in the close trail position. Number 1 may direct close trail from fingertip, route, or echelon.

Figure 9.22. Close Trail.

9.33.3. **Procedure—Number 1.** Close trail maneuvering limitations are the same as the WW Ex. Direct number 2 to the close trail position with a radio call *("Texan 2, go close trail)*. Wait for number 2 to call "in" before maneuvering. Maneuver in a smooth, predictable manner similar to the WW Ex using combinations of turns and lazy-eight-type maneuvers. Maintain positive G at all times. Avoid sudden releases of back stick pressure, rapid or inconsistent turn rates, and rapid turn reversals. Power and maneuvering requirements are identical to fingertip formation.

9.33.4. **Procedure—Number 2.** Acknowledge number 1's directive with a radio call, *"2."* Maneuver into the close trail position. Once established in the close trail position, advise number 1 with a radio call (*"Texan 2, in")*.

9.33.4.1. Maintain position primarily with power. As number 1 maneuvers, anticipate power changes. Additionally, during turns at higher G, a small amount of lead or lag pursuit may be necessary to maintain position.

9.33.4.2. Use the relationship between the tips of number 1's horizontal tail and the underside of number 1's wing to estimate nose-tail separation. At approximately two ship lengths, the tips of number 1's elevator line up about one-third of the way out the wings (just past the dihedral break in the wing). As a vertical reference, the engine exhaust stacks should be visible directly on top of the wing. Any space between the engine exhaust stacks and the wing is too high, and the possibility of encountering wake turbulence increases. Other references include making a "T" out of the aft edge of the speed brake and the UHF/VHF antenna, or placing number 1's wingtips between the AOA indexer and magnetic compass.

9.33.4.3. Closure rates are difficult to recognize and correct when directly behind and below number 1. If excessive spacing develops, do not attempt to correct forward with power alone. Add power and establish a small amount of lead pursuit if in a turn. If in a wings-level attitude, move off to one side to obtain a better visual perspective of number 1's aircraft. The two most important points to remember are to remain below number 1's wake turbulence and always keep number 1 in sight.

9.33.5. **Reform from Close Trail.** Number 1 may direct number 2 to fingertip with a shallow wing rock (visual) or radio call. Unless directed otherwise, number 2 goes to fingertip on the left side if number 1 is in a wings-level attitude or to fingertip on the inside of the turn. Number 1 may also direct number 2 to route or fighting wing with a radio call. Number 1 maneuvers in a smooth, predictable manner and avoids significant power changes until number 2 is in the directed formation position.

9.34. Pitchout.

9.34.1. **Objective.** Provide spacing for rejoin practice.

9.34.2. **Description.** Normally a level turn, approximately 180-degrees, performed sequentially, to provide spacing between the aircraft.

9.34.3. **Procedure.**

9.34.3.1. **Number 1.** Direct a pitchout with a visual signal or radio call. Clear in the direction of the desired turn and begin a turn away from number 2, using approximately 60 degrees of bank and sufficient G to establish the desired airspeed. Slight climbs or descents are acceptable for energy management. The degrees of turn may be adjusted for weather, area orientation, and (or) energy management. Do not sacrifice clearing to maintain precise altitude control or an exact 180-degree turn. Allow enough time for number 2 to complete the pitchout and then direct the rejoin with a radio call or visual signal.

9.34.3.2. **Number 2.** Stay visual. Delay 2 to 3 seconds or as briefed, which should provide approximately 500 to 1,000 feet of separation at rollout, then turn to follow number 1. Delaying 5 to 7 seconds will result in approximately 1,500 to 2,000 foot spacing. After approximately 90 degrees of turn, vary bank and back stick pressure to attain desired spacing and roll out behind and slightly below number 1. Place number 1 approximately one to two ship widths above the horizon. Rejoin when directed.

9.35. Take Spacing. "Take spacing" is used to put number 2 in a trail position when a pitchout is not practical. Number 1 directs number 2 to take spacing with a visual signal or radio call

("Texan 2, take spacing"). Spacing can be achieved with a combination of maneuvering and deceleration by number 2 and (or) acceleration by number 1. Do not exceed the limits of standard formation (100 feet vertical and 6,000 feet horizontal) if outside the MOA.

9.35.1. One technique is for number 1 to accelerate and direct number 2 to take spacing. Number 2 reduces power and (or) uses speed brake to slow and increase spacing. Another technique is for number 2 to take spacing by performing a series of "S" turns behind and below number 1's prop wash.

Table 9.2. Summary of Formation Position Descriptions, References, and Flight Control Inputs.

Formation Position	Description/ References/Flight Control Inputs	Vertical Stack	Angle (Line)	Distance (Spacing)
Fingertip	Description	Slightly low	30˚ aft of LAB	10 feet
	References	Exhaust stack on top of wing	Lead's exhaust stack bracketed by pitot tube and aft position light	FCP pilot look down lead's horizontal stabilizer leading edge <u>or</u> visualize 10 feet between wingtips
	Flight Control	Elevator	PCL	Ailerons
Route	Description	Level with lead	30˚ aft of LAB up to LAB	2 ship widths out to 500 feet (stable)
	References	FCP pilot helmet on horizon	Strobe on spinner up to strobe on FCP pilot helmet	2 ship widths out to 500 ft
	Flight Control	Elevator	PCL	Ailerons
Echelon	Description	Co-altitude unless route turn into which requires just low enough to maintain visual	LAB to 30˚ aft	~40 feet
	References	Lead bisects horizon	Half of CFS door showing	Imagine 1 x T-6 wingspan between aircraft
	Flight Control	Ailerons	PCL	Elevator
Turning Rejoin	Description	2 ship widths below	3 aspect/30˚AA	Decreasing distance until at fingertip position
	References	Put lead 2 ship widths above horizon	Tail bisecting outer wing until you can see the star or "SA" in the saddle (corrects vertical	Check airspeed, 20–30 knots overtake until 500 feet

			AND angle)	
	Flight Control	Elevator	Ailerons	PCL

Section 9F—T-6 Extended Trail and Preparatory Exercise Procedures

9.36. General. This section introduces formation exercises and procedures to enhance formation training and ET maneuvering. It applies the building-block approach to ET training based on fundamental formation concepts discussed in section 9C, *Maneuvering Fundamentals*, of this manual.

9.37. Range Estimation. **Table 9.3.** gives suitable range estimation cues. Some of the cockpit tools used to compare aircraft size includes the AOA indexer and the standby magnetic compass. Externally, the anti-collision strobe light flash guard on the leading edge of the wingtip also provides a good fixed reference to estimate range.

Table 9.3. Range Estimation.

Range	**Other aircraft is:**	**Other**
300 feet	Width of AOA indexer turned sideways or standby magnetic compass. 	Detail visible (canopy details, pilots). Tail flash easily readable (letters more clear than numbers).
500 feet	2/3 width of AOA indexer turned sideways or 2/3 width of standby magnetic compass. Aircraft size approximates four times the size of the wingtip anti-collision strobe flash guard.	Normal fingertip references apparent. Canopy detail discernible. Letters on tail are discernible (numbers barely discernible).
1,000 feet	Approximately twice the size of the wingtip anti-collision strobe flash guard.	Tail flash not visible.

9.38. Blind Exercise.

9.38.1. **Objective.** Demonstrate the correct lost sight procedures in the event one or both aircraft lose sight of each other.

9.38.2. **Description.** The exercise exposes pilots to a real lost sight situation in a scripted setup to practice the procedures, including verbal coordination, required to facilitate safe separation and an expeditions rejoin. The ensuing possibility for a high aspect rejoin can effectively demonstrate lateral and vertical turning room requirements in relation to turn circle geometry, range, closure, AA, LOS, HCA, pursuit options, and out-of-plane maneuvering.

9.38.3. **Procedure.**

9.38.3.1. **Altitude** . As required, 100 feet.

9.38.3.2. **Airspeed** . 180 5 KIAS.

9.38.3.3. **Heading** . Reference heading 5 degrees.

9.38.3.4. **Power** . Approximately 50 percent torque (as required to maintain 180 5 KIAS).

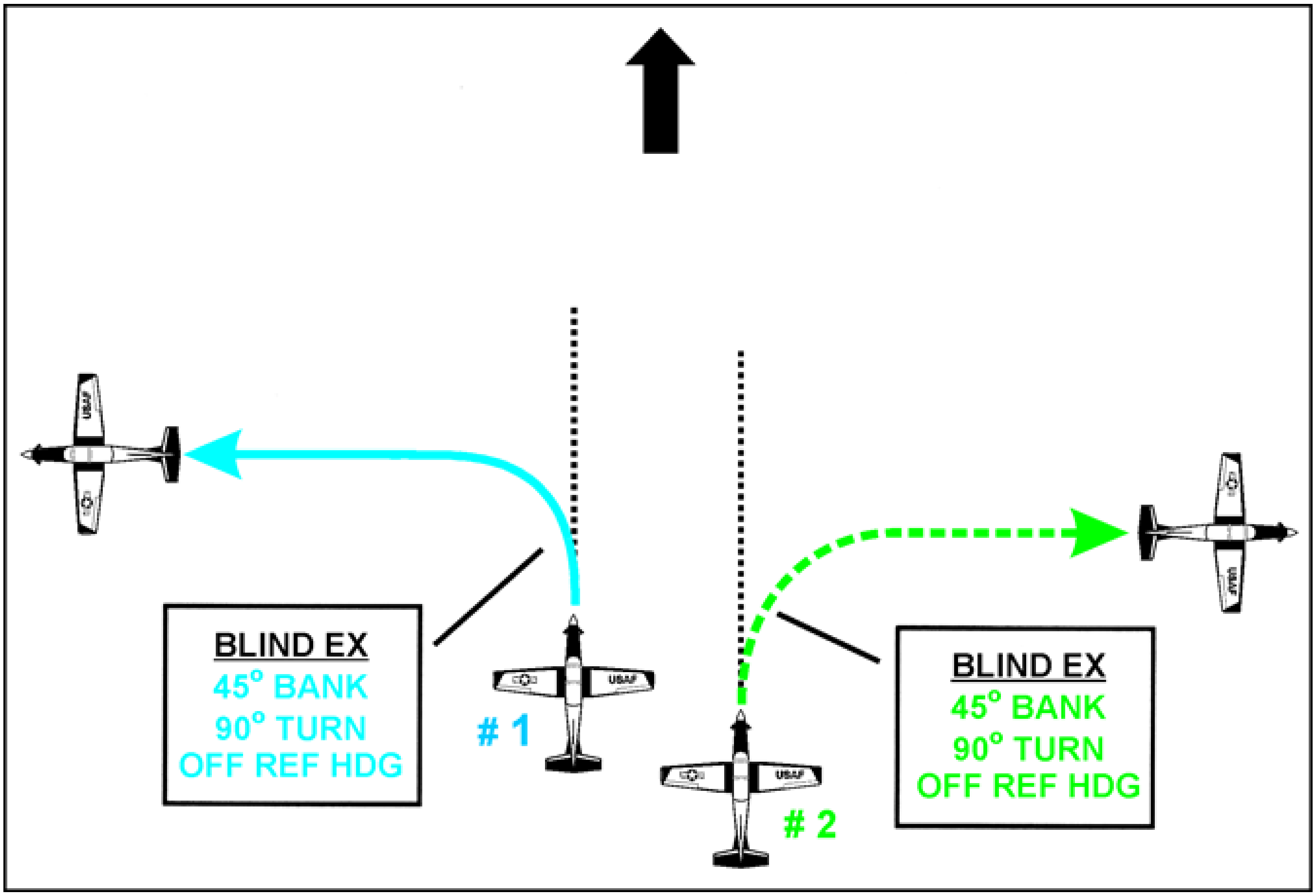
9.38.3.5. **Exercise Setup.** Setup the exercise from fingertip or route formation. Before the exercise begins, number 1 announces the exercise, *"Texan, standby blind exercise, reference heading xxx."* Number 2 acknowledges *"2."* When ready to begin, number 1 gives the execution command, *"Texan, turn away,"* and number 2 acknowledges *"2."* Both aircraft then turn away from each other using 45 degrees of bank to a heading 90 degrees from the reference heading. Number 2 calls blind with altitude after losing sight. For example, *"Texan 2, blind, nine thousand."* Because number 2 is assumed to be visual unless calling blind, number 2 conveys the situation with a minimum of "blind" and "altitude". The immediate concern must be to establish altitude separation between the aircraft. When number 1 is also blind, number 1 calls blind and immediately establishes altitude separation of at least 1,000 feet for each aircraft. For example, *"Texan 1, blind, nine thousand; Texan 2 maintain eight thousand."*

9.38.3.6. **Altitude Deconfliction.** Once altitude deconfliction is established and acknowledged, the potential for collision within the formation has been effectively eliminated as long as both aircraft remain at the assigned altitude. Only after altitude assignments are established and acknowledged will number 1 begin coordination to rendezvous the flight. Number 2 must inform number 1 if unable to expeditiously attain and maintain the assigned altitude. It is assumed that number 2 is complying with the altitude assignment unless informing number 1 otherwise.

9.38.3.7. **Vertical Buffer.** Once a vertical buffer is established, number 1 may begin to coordinate for a rejoin by establishing common headings and (or) a rendezvous point according to the preflight briefing (for example, center radial or DME, orbits over a ground reference, etc.). The key to expeditious visual acquisition in a blind situation is effective communication from both aircraft within the formation (heading, radial, DME, ground references, etc). Number 1 is responsible for coordinating the rejoin. Avoid *unnecessary* radio communication, while remaining cognizant that extended pauses on the radio may lead to lack of positional awareness and excess time trying to achieve visual acquisition.

9.38.3.8. **Regain Visual.** Whoever regains visual first should talk the other pilot's eyes onto the other aircraft by using relative clock position (bearing) from the blind aircraft, elevation (in degrees) and range. For example, *"Texan 2, visual is at your 10 o'clock, 20 high, 2 miles."* If number 2 is visual but number 1 is still blind, number 2 may provide recommended actions to facilitate visual between both aircraft (for example, "*Texan 1, recommend reference 090 heading, visual will be at your right 3 o'clock, slightly low, 3,000 feet*"). The FL must ensure the preflight briefing includes a thorough discussion of visual cues and ways to accomplish a high aspect rejoin. **Figure 9.23.** shows a graphical depiction of the blind exercise.

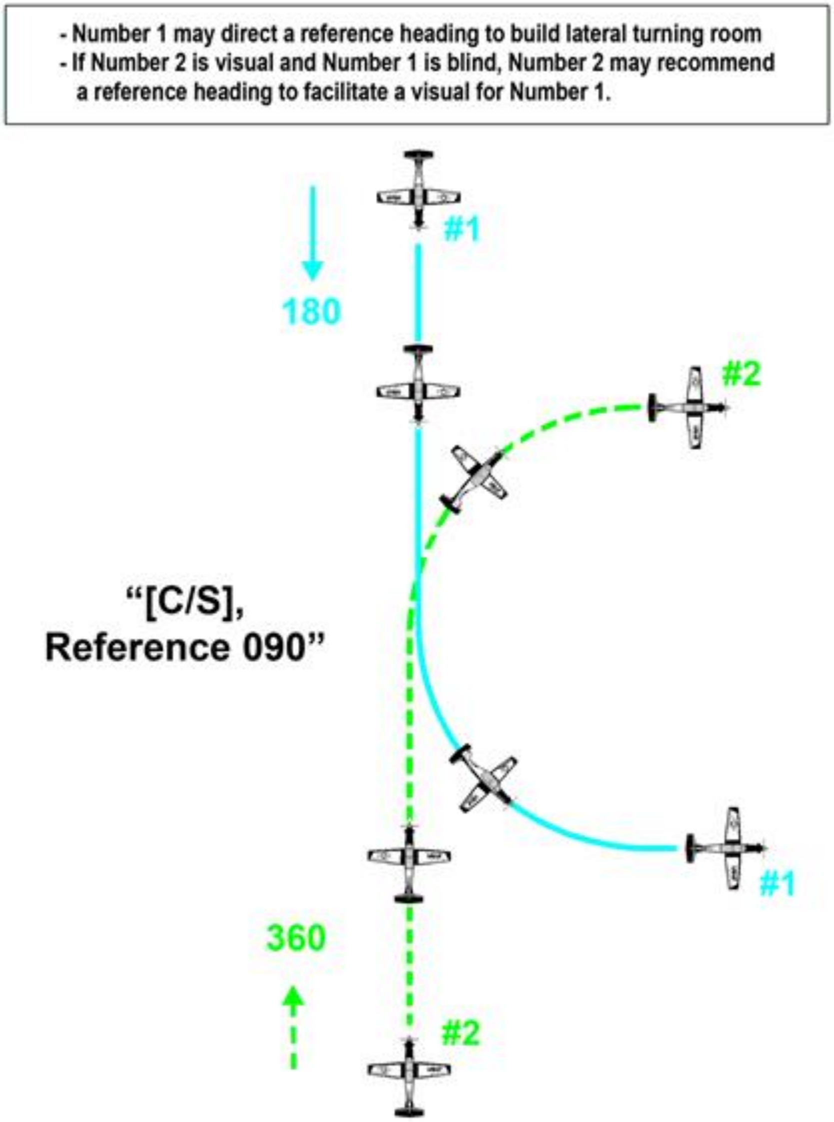
Figure 9.23. Blind Exercise.



9.38.3.9. The exercise concludes with both aircraft visual, and number 1 directing a rejoin or another position before proceeding to the next exercise or profile event. A terminate communication drill is not necessary because visual calls effectively signal an end to the blind situation and a transition to visual formation. If at any point after calling visual, visual contact is lost and not quickly regained, apply the appropriate blind procedures again to ensure separation.

9.38.4. **Technique. Figure 9.24.** shows a recommended technique to turn a high aspect rejoin scenario into a more normal rejoin situation.

Figure 9.24. High Aspect Rejoin Technique.



9.39. Extended Trail (ET). ET is divided into three distinct levels that demonstrate practical application of the fundamental formation concepts in a building block approach.

9.39.1. **Objectives.** Use lead, lag, and pure pursuit options, combined with lift vector placement to practice three-dimensional maneuvering in relation to another aircraft.

9.39.1.1. **Number 1.** Provide a stable platform with consistent, predictable roll rates and no sudden changes in back stick pressure.

9.39.1.2. **Number 2.** Maneuver within the fighting wing cone through proper pursuit curve and lift vector application with a fixed power setting.

9.39.2. **Description.** ET is flown from the fighting wing position. The process of analyzing and solving angular, range, closure, and LOS problems requires an understanding of the consequences of flying each pursuit option and lift vector placement.

9.39.3. **Procedures.**

9.39.3.1. **General Training Rules.**

9.39.3.2. The Bubble. A spherical safety airspace buffer surrounding each aircraft. The 300-foot bubble is a safety of flight limit that surrounds each aircraft. If an aircraft is inside the 300-foot bubble during ET, call "knock-it-off."

9.39.3.2.1. The ET maneuvering limit is 500-foot slant range. Momentary deviations within 500 feet are acceptable if it is quickly recognized and remedied. If unable to quickly regain the fighting wing cone, call "terminate."

9.39.3.2.2. Abrupt turn reversals by number 1 are prohibited. Abrupt turn reversals are turns in one direction followed by a rapid, unanticipated roll in the opposite direction.

9.39.3.2.3. ET is flown two-ship only.

9.39.3.2.4. Do not maneuver over-the-top in Level III if number 1 is blind or number 2 is not in a position to go over-the-top. Instead, number 1 transitions to Level II maneuvering until both of these requirements are satisfied prior to initiating an over-the-top maneuver (see **Table 9.4.**).

9.39.3.2.5. Minimum airspeed for extended trail is 100 knots. High power settings (greater than 60 percent torque), combined with high AOA (stick shaker), and slow airspeed (less than approximately 40 KIAS), can result in an unintentional torque roll. If airspeed, G, and AOA are not sufficient to continue a maneuver, terminate or knock-it-off as appropriate.

Table 9.4. ET Exercise Training Levels and Parameters.

Level	**Maneuvers**	**Bank**	**G loading**	**Power Setting**
I (initial proficiency)	Stable Turn	30 to 60 degrees	~ 2-Gs	~50% (fixed)
II (limited proficiency)	Turns, Modified Lazy 8	~120 degrees Maximum	Moderate	85% (low area); MAX (high area)
III (desired proficiency)	Modified Cuban Eight, Loop, Cloverleaf, Barrel Roll	As required	As required	85% (low area); MAX (high area)

9.39.3.3. **ET Entry.** At an appropriate energy level (180 to 200 KIAS and approximately the middle of the altitude block), number 1 directs the ET with a radio call, *"Texan 2, go ET level 1/2/3."* Number 2 responds with *"2."* Number 1 makes a moderate G turn away from number 2 at MAX power. Number 2 maneuvers into the fighting wing cone and calls, *"Texan 2, in"* before number 1 begins maneuvering. Both aircraft then set and maintain the briefed power setting throughout the exercise.

9.39.3.4. **ET Transition or Termination.** When the desired learning objectives are met, number 1 may direct a transition to another level of maneuvering or terminate.

9.39.3.4.1. To transition to another level of maneuvering, number 1 calls the new level, *"Texan, go ET level 3,"* and number 2 acknowledges *"2."* Set the new, briefed power setting if required after number 2 acknowledges the transition.

9.39.3.4.2. If number 2 wants number 1 to discontinue maneuvering (for example, loss of spacing), notify number 1 with a "terminate" call and state the reason. Number 1 directs the formation as required and may subsequently resume maneuvering or initiate a reform/rejoin.

9.39.3.4.3. To end the exercise, number 1 or number 2 calls *"terminate."* Number 1 may reduce power when number 2 is in sight or when number 2 acknowledges the terminate call. Number 2 will then maintain the fighting wing position until Number 1 directs a reform or another formation position.

9.39.4. **Post-ET Check.** After each ET exercise, number 1 conducts a fuel and G check using the radio. For example, number 1 states *"Texan, ops check; Texan is 800, 4 Gs,"* and number 2 responds, *"Texan 2 same"* (if within 50 pounds and .5 Gs) or *"Texan 2, 800, 5 Gs."* Report the maximum G reading on all G checks. Reset the G meter if no over-G observed.

9.39.5. **Flying ET—General.** Each pilot is responsible for taking the necessary action to avoid a collision; however, it is number 2's primary responsibility not to hit number 1. Because of the dynamic nature of ET, the potential for collision is increased, and flying ET requires uncompromising flight discipline. Any pilot in either aircraft must call "terminate" or "knock-it-off" if appropriate.

9.39.5.1. **Number 1.**

9.39.5.1.1. Number 1 is a training platform for number 2. Continually monitor G loading, and remember that number 2 typically requires more G than number 1 to maintain position. Generally, look for number 2 behind the wing in the 4 to 5 o'clock or 7 to 8 o'clock position, and be more vigilant if number 2 strays from the cone parameters. If necessary, terminate or transition to the next lower level of ET until number 2 can maintain the fighting wing cone. Monitor number 2's aspect, range, closure, HCA, and LOS for the possibility of an inadvertent 3/9 line or bubble violation. Do not delay calling KIO if it is evident one of these situations is about to occur. It is far more desirable to KIO prior to the excursion than to see the situation developing and wait for it to happen.

9.39.5.1.2. Tight, high-G maneuvers are of little value if number 2 is unable to maintain proper position. Never maneuver in an unpredictable or abrupt manner that may force number 2 inside the bubble or forward of the 3/9 line.

9.39.5.2. **Number 2.** Generally, use varying degrees of lead pursuit to maintain the fighting wing cone during ET. Closure, range, aspect, HCA, and LOS rate changes can occur rapidly, so be prepared to maneuver accordingly. Pause momentarily to see how rapidly number 1 is moving in the canopy (LOS/LOS rate), predict number 1's flight path, and then maneuver by selecting the appropriate pursuit option and proper lift vector placement. Use pure and lag pursuit judiciously to avoid high aspect, HCA, and LOS rates. Normally, little time is spent in lag pursuit. Use terminate procedures to cease maneuvering if unable to maintain position.

9.39.6. **Flying ET (Level I).**

9.39.6.1. **Number 1.** Begin ET Level I with a radio call *(“Texan 2, go ET, level 1”)*. After number 2 acknowledges the Level I call, enter a moderate G turn of approximately 2 Gs. Set power to maintain a 30- to 60-degree bank turn with approximately 50% power.

9.39.6.2. **Number 2.** As number 1 turns away after calling for the exercise, maneuver to the fighting wing cone, call *“Texan 2 in”* and attempt to use the same power setting as number 1 to explore and maneuver within the fighting wing cone using the appropriate pursuit geometry and lift vector placement. Notice how difficult it is to stabilize in any one position without use of power. Use pursuit options and lift vector placement to stay within parameters and explore the quadrants of the fighting wing cone.

9.39.7. **Flying ET (Level II).**

9.39.7.1. **Number 1.** Begin ET Level II with a radio call (*“Texan 2, go ET level 2”*). After number 2 acknowledges the Level II call, select MAX power, and turn away from number 2. After number 2 transmits that they are established in the fighting wing cone, reset the power at 85 percent torque. For low and medium altitudes, 85 percent torque is a good power setting to maintain energy. Higher altitudes and air temperatures or a low initial energy state may require the use of MAX power during maneuvering. In these instances, number 1 makes a radio call directing the use of a higher power setting if not previously briefed. Once the desired learning objectives have been met, transition to Level III maneuvering or terminate the maneuver.

9.39.7.2. **Number 2.** As number 1 turns away after calling for the exercise, maneuver to the fighting wing cone, call *“Texan 2 in”* and set 85 percent torque (unless briefed or directed otherwise). During maneuvers, predict number 1’s flight path and maneuver in relation to it. This requires constant analysis of number 1’s POM as well as relative aspect, range, closure, HCA, and LOS. Realize that pursuit curves exist in both the vertical and horizontal planes.

9.39.7.2.1. Sometimes, exaggerated pursuit curve adjustments are required to remain in position. Normally, these type of corrections are only required for a short period of time. A move toward lag pursuit may generally be the best solution to mitigate these problems, but most of the time merely using less lead pursuit will adequately solve the problem.

9.39.7.2.2. Intentional lag rolls are generally not required to maintain the cone. Transitory periods in number 1’s high or low 6 o’clock position are acceptable; however, avoid stagnating in the 5 to 7 o’clock position. Attempt to maintain the 30- to 45-degree cone away from number 1’s high or low 6 o’clock position.

9.39.8. **Flying ET (Level III).**

9.39.8.1. **Number 1.** Begin ET Level III with a radio call (*“Texan 2, go ET, level 3”*). After number 2 acknowledges the Level III call, select MAX power, and turn away from number 2. After number 2 transmits that they are established in the fighting wing cone, reset the power at 85 percent torque. For low and medium altitudes, 85 percent torque is a good power setting to maintain energy. Higher altitudes and air temperatures or a low initial energy state may require the use of MAX power during maneuvering. Maneuvers are not flown with the precise parameters of contact flying. Attitudes and airspeeds vary for effective training, area orientation, visual lookout, and smoothness. Consider number 2's skill level while maneuvering to prevent exceeding number 2's capabilities, but challenge with hard turns, modified lazy eights, barrel rolls, and over-the-top maneuvers. Number 1 will not attempt to force number 2 to overshoot. Ensure adequate airspeed is available for over-the-top maneuvers.

9.39.8.2. **Number 2.**

9.39.8.2.1. As number 1 turns away after calling for the exercise, maneuver to the fighting wing cone and call *"Texan 2 in"* and set 85 percent torque (unless briefed or directed otherwise). Energy conservation becomes more critical at higher G and in vertical maneuvering. There is a balance between the demands placed on the aircraft to maintain position; either nose track or energy is more desirable during ET maneuvering in order to maintain relative position on number 1. High AOA, buffet, and (or) stick shaker indicate that the aircraft is losing energy. When encountering these cues, prioritize between nose track and energy (airspeed). If nose track is more important, sacrifice airspeed by pulling enough back stick pressure to facilitate continued nose track. Realize that sacrificing airspeed for nose track may eventually result in excessive spacing due to airspeed differential. If number 1 is in a hard turn, relaxing back stick pressure may preserve energy or increase airspeed but can result in excessive spacing. Conservation of energy is critical during Level III of the ET exercise; the key is to maneuver in relation to number 1, and balance the need for nose track or energy through proper pursuit selection and lift vector placement.

9.39.8.2.2. The concepts used in Levels I and II maneuvering apply equally to Level III; however, the addition of over-the-top maneuvering makes the effect of gravity more noticeable. If number 1's nose position (longitudinal axis of the aircraft) remains stationary below the horizon, the aircraft is likely to be accelerating for an over-the-top maneuver. To properly manage this situation, it is generally prudent to "lag at the bottom, lead at the top." "Lagging at the bottom" means number 2 should delay pulling up into the vertical until noticing LOS in the vertical (this will put number 2's nose in lag) to gain airspeed after number 1 has already started tracking up in the vertical. At the apex of the maneuver, unless increased range is desired, generally sacrifice airspeed for nose track and attempt to beat number 1's nose through the horizon ("lead at the top"). If range and plane are satisfactory, attempt to hit over-the-top with the nose through the horizon before, or at the same time as number 1, with fuselages aligned (zero HCA or angle off).

Section 9G—Formation Recoveries

9.40. Objective. Lead the formation to landing in a safe and efficient manner.

9.40.1. **Description.** Formation recoveries are similar to single-ship recoveries; however, operational restrictions (for example, weather minimums, runway condition, winds, etc.) can significantly change recovery options.

9.40.2. **Procedure.** Weather can significantly complicate the recovery. In-flight checks may be difficult to perform in the weather (especially solo), and otherwise simple tasks such as changing radio frequencies can be challenging. Number 1 must consider number 2's capabilities when developing the recovery plan. In general, number 1 should avoid low power settings (less than 20 percent torque). Instead of reducing power below 20 percent torque, the speed brake coupled with a higher power setting may be used.

9.40.3. **Split-up in the Area.**

9.40.3.1. If single ship recovery is required, number 1 verifies number 2 has positional awareness, coordinates a new clearance for number 2, and clears number 2 off at the appropriate time.

9.40.3.2. Number 1 normally coordinates the split-up in the MOA to minimize confusion and radio transmissions on the recovery.

9.40.3.3. Number 2 will not depart the formation until number 1 has directed the formation to split up. Even if the controller gives vectors to number 2, number 2 is part of the formation and will not comply with or acknowledge air traffic controller directions until number 1 splits the formation with a radio call *"Texan 2, you are cleared off."*

9.40.4. **Descent to VFR Pattern.**

9.40.4.1. If weather allows, number 1 can direct number 2 to a position (route or fighting wing) that enhances clearing and allows greater maneuverability.

9.40.4.2. Once established at pattern altitude inside the entry point for the VFR pattern, all turns away from number 2 are echelon unless briefed otherwise.

9.40.4.3. Prior to initial, number 1 should position number 2 on the side opposite the direction of the break. Number 1 should ensure the initial ground track is long enough to allow number 2 to stabilize before the break.

9.40.4.4. At the break point, number 1 smoothly turns to the downwind and delays power reduction until the turn is initiated.

9.40.4.5. After number 1's break, number 2 waits a minimum of 5 seconds before turning. Attain spacing in the break and on downwind. On downwind, number 2 should be slightly outside number 1's ground track.

9.40.4.6. Number 1 and 2 fly normal contact patterns. Perch points should be the same; however, number 2 should not follow a poorly flown pattern. Go-around or breakout if required.

9.40.4.7. In crosswinds, number 1 normally lands on the downwind side of the runway. If crosswinds are not a factor, number 1 will land on the cold side of the runway (the side that both aircraft will turnoff of after the aircraft is slowed sufficiently). Number 2 will land on the hot side and clear cold when the aircraft has slowed sufficiently.

9.40.4.8. If splitting in the pattern after a formation low approach, the aircraft on the inside of the pattern pulls closed or turns crosswind first. If number 2 is on the inside, number 1 must visually clear in the turn direction, obtain clearance, and make a radio call clearing off number 2. For example, *"Texan 2, you are cleared off"*. Number 2 replies, *"2"* and proceeds as a single ship.

9.40.5. **Formation Approach.** Formation instrument procedures are the same as for a single ship. Before starting an instrument penetration, number 1 determines if number 2 can be crossed under after the penetration or if it is necessary to position number 2 on the upwind side prior to penetration.

9.40.5.1. Number 1 should position number 2 on the upwind side of the landing runway.

9.40.5.2. Number 1 directs configuration with a radio call or visual signal. Use a radio call in IMC. The gear and flaps are normally lowered with only one signal unless briefed otherwise. Formation approaches are flown with TO flaps.

9.40.5.3. After internal confirmation, number 2 checks number 1's configuration and gives a thumbs-up signal. Number 1 checks number 2 and returns a thumbs-up if the configuration looks good.

9.40.5.4. Number 1 transmits a "gear down" call for both aircraft after configuration confirmation. Maintain 110 KIAS minimum, 120 KIAS recommended on the instrument approach unless winds dictate otherwise.

9.40.6. **Formation Landing.** When out of the weather with the runway in sight, number 1 lines up on the center of one side of the runway and plans the touchdown approximately 1,000 feet down the runway.

9.40.6.1. Stack level no earlier than glide path intercept and when able to maintain VMC throughout the landing, but no later than one-half mile from the runway. To stack level vertically, place the pilot's helmet in the corresponding cockpit on the horizon. To stack level laterally, use the same references as on a formation takeoff. The increased lateral spacing increases the margin of safety if problems occur during touchdown or landing roll. (See **Figure 9.25.**)

Figure 9.25. Stacked Level on Final.

9.40.6.2. Approaching the overrun, number 2 should cross-check the runway. Number 2 uses number 1 as the primary reference during the flare and landing, but monitors the runway and flight parameters to ensure a safe landing.

9.40.6.3. Number 1 gradually reduces power during the round out. Number 2 must reduce power gradually to avoid falling out of position during the round out and flare.

9.40.6.4. On the runway, both aircraft maintain their side of the runway. Normal braking technique is used regardless of the other aircraft's deceleration rate. If number 2 passes number 1 on landing roll, do not attempt to maintain position by over-braking.

9.40.6.5. On landing roll, if the trailing aircraft is on the cold side, that aircraft will clear the preceding aircraft to the cold side when separation is established at a safe taxi speed (*"Texan 1, cleared cold"*). If the trailing aircraft is on the hot side, the aircrew clears themselves to cross.

9.40.7. **After Landing.** Following a formation landing, the formation normally clears the runway, checks in on ground frequency, and then taxis back as a formation. If the flight was split, either on recovery or in the VFR pattern, flight members normally taxi back single ship.

9.40.8. **Formation Go-around.**

9.40.8.1. Number 1 smoothly adds power to approximately 75 percent torque, follows normal formation takeoff, and single-ship go-around procedures.

9.40.8.2. If required to offset during the go-around, number 1 should confirm number 2's position and ensure number 2 has safe altitude and airspeed during maneuvering.

9.40.9. **Formation Missed Approach.** The potential for lost wingman and for spatial disorientation is high. Smoothly advance power to approximately 75 percent, as in the formation go-around, and slowly and smoothly establish the missed approach pitch attitude. Use the radio to direct gear and flap retraction. Ensure the minimum climb gradient is maintained. Radio calls to number 2, stating current aircraft attitudes, can help avoid spatial disorientation.

Section 9H—Abnormal Procedures

9.41. Introduction. Ultimately, each crew must deal with abnormal procedures within his or her own cockpit. Other formation members can either complicate situations or provide valuable mutual support. The key to dealing with abnormal situations is to maximize the positive aspects of formation without letting the distractions hinder successful recovery.

9.42. Formation Takeoff Abnormalities.

9.42.1. **Number 2 Passing Number 1.** It may be difficult for number 2 to determine if number 1 is experiencing a problem (loss of power, etc.) that requires an abort. If number 2 overruns number 1, number 2 selects MAX power and makes a separate takeoff while maintaining their side of the runway. Follow number 1's directions.

9.42.2. **Number 2 Falling Behind Number 1.** If number 2 falls behind on takeoff, number 2 may not have sufficient airspeed to rotate with number 1. In this case, number 2 cross-checks engine instruments and the airspeed indicator, and aborts (if there is a problem) or performs a separate takeoff. For a separate takeoff, number 2 assumes proper formation position after becoming safely airborne.

9.42.3. **Formation Takeoff Abort (One Aircraft).** If an abort becomes necessary, maintain aircraft control, ensure separation from the other aircraft (maintain the respective side of the runway), and make a radio call as soon as practical (*"Texan 2 aborting"*). During an abort situation, the aircraft continuing the takeoff maintains its side of the runway and executes a normal single-ship takeoff in max power.

9.42.4. **Interval Takeoff Abort.** If number 1 aborts, make a radio call when practical. It may be difficult for number 2 to recognize an abort using only visual cues. If number 2 has not released brakes, number 2 reduces power and holds position until number 1 clears the runway. If number 2 is rolling but below abort speed, an abort should be considered as there may not be sufficient spacing to takeoff behind number 1. If number 2 is above abort speed, continue the takeoff.

9.42.5. **Element Abort.** During a formation takeoff, there are normally no sympathetic aborts after brake release. Sympathetic aborts can create situations in which the good aircraft risks making the situation worse by adding another aircraft into the high-speed abort situation when risk of collision, hot brakes, or blown tires increases. If it is necessary for the formation to abort, each aircraft *must* maintain its respective side of the runway and make every effort to stop prior to the end of the runway. Number 1 directs a formation abort with a radio call, *"Texan Flight: abort, abort, abort!"* The operative word "flight" indicates both aircraft should abort.

9.43. Airborne Emergencies (General). Maintain formation integrity to the maximum extent possible during airborne emergencies. Mutual support is one of the primary reasons for formation flight. If either member of the formation must return to the airfield prematurely, the other aircraft should normally return and provide assistance. The FL may make exceptions to this if the problem is minor and the field is in sight or if the weather conditions would complicate a safe formation return. If an aircraft malfunction occurs while in fingertip, increase aircraft separation before handling the emergency if weather allows. The formation member with an abnormal situation advises other members in the formation of the problem, intentions, and assistance required. In VMC, without engine problems, the emergency aircraft generally leads back to a straight-in. In IMC, the emergency aircraft generally leads back to an instrument approach. Modify as appropriate based on the type of problem (for example, a PEL may be the best recovery option).

9.43.1. **Number 1.** When a malfunction is discovered, call KIO and inform number 2 of the problem as soon as practical. In general, the aircraft with a malfunction should be given the number 1 position. This allows the affected aircraft to handle the emergency without the requirement to maintain position. The number 1 position should be offered three times: (1) when the emergency occurs, (2) on recovery when below the weather and able to navigate VFR to the field, and (3) when on final with the field in sight. Except in IMC, avoid flying closer than route formation as number 2. If number 2 refuses the number 1 position at any time, offer it at each successive point as described above. Except in very unusual circumstances, do not attempt to land in formation with a disabled aircraft.

9.43.2. **Number 2.** When a malfunction is discovered, call KIO, and inform number 1 of the problem as soon as practical. Normally, take the number 1 position when offered if able to communicate and navigate. Generally, avoid flying in the number 2 position with an emergency. If the situation dictates flying as number 2, avoid flying closer than route spacing when possible.

9.44. Engine Problems. With engine problems, the emergency aircraft leads back to an ELP. If weather or field conditions at the intended recovery runway are unknown, the good aircraft may be sent ahead to report on airfield conditions and radio back to the emergency aircraft.

9.45. Physiological Incident. The bad aircraft typically leads back. The unaffected formation member uses caution and good judgment, especially if penetration of IMC is required.

9.46. Bird Strike. If a bird strike appears imminent, do not attempt evasive maneuvers into the other aircraft in an effort to miss the bird. The primary concern is midair collision avoidance and aircraft separation. If a bird strike does occur, ensure aircraft separation before handling the emergency. Consider executing a wing landing if forward visibility is severely restricted.

9.47. Midair Collision. If a midair collision occurs between formation members, they will not act as chase ships for each other. Number 1 coordinates separate clearances and chase ships.

9.48. Spatial Disorientation.

9.48.1. **Number 1.** If suffering from spatial disorientation, immediately tell number 2, and transfer aircraft control to the other pilot if practical. If transfer of aircraft control is not an option, confirm attitude with the other crewmember or number 2. If symptoms persist, terminate the mission and recover by the simplest and safest means possible.

9.48.2. **Number 2.** If suffering from spatial disorientation, immediately tell number 1, and transfer aircraft control to the other pilot if practical. Number 1 advises number 2 of aircraft attitude, altitude, heading, and airspeed. If symptoms persist and conditions permit, number 1 should establish straight-and-level flight for 30-60 seconds. If possible, number 1 may try to get the formation to VMC conditions. If the condition persists, consider offering the number 1 position. If unable to maintain position, and number 2 becomes a threat to number 1, a lost wingman should be initiated. As number 2, be cautious when initiating lost wingman procedures as this could trigger further spatial disorientation. If necessary, terminate the mission and recover by the simplest and safest means possible.

9.49. Aircraft Strobe Lights. At times, number 1's strobe lights may distract number 2, which could lead to spatial disorientation. Number 2 advises number 1 if the strobes are a hazard and number 1 turns them off.

9.50. Icing. If number 2 experiences icing, notify number 1. Number 1 climbs or descends to avoid cruising in icing conditions.

9.51. NORDO.

9.51.1. When a member of the formation has total radio failure, the NORDO aircraft normally receives or retains number 2 position. The flight member with the operative radio leads the NORDO aircraft into the overhead pattern, notifies the RSU or tower, and makes a low approach to the landing runway. The NORDO aircraft flies a normal pattern and landing. If weather prevents an overhead pattern, execute a straight-in or instrument approach as appropriate for the weather. When number 1 clears number 2 off with a visual signal, number 2 assumes landing clearance and lands normally.

9.51.2. With total radio failure while in fingertip, number 2 should maneuver to route, attract the attention of number 1, and give the appropriate visual signals. Terminate the mission as soon as practical, and lead the NORDO aircraft to the base of intended landing.

9.51.3. If in other than fingertip or route when radio failure occurs and a rejoin is not anticipated, the NORDO aircraft should cautiously attempt to rejoin (no closer than route). Rock wings (attention in the air) and move no closer than route until directed. Once joined, the NORDO aircraft gives the appropriate visual signals. Number 1 should terminate the mission as soon as practical, and lead the NORDO aircraft to the base of intended landing.

9.51.4. If diversion is necessary with a NORDO aircraft, number 1 shows the pink pages in the in-flight guide followed by the number of the diversion base. Number 2 repeats the number to signal understanding.

9.52. Ejection. If ejection is required, the other aircraft acts as the on-scene commander until relieved or bingo fuel is reached. Local in-flight guides will outline local specifics.

Chapter 10

NIGHT FLYING

10.1. Introduction. The techniques and procedures for night flying are basically the same as for day flying, but vigilance must be increased, mostly due to visibility restrictions. The reduction in visibility hampers the ability to see inside the cockpit (checklists, instruments, etc.) and outside the cockpit (horizon, landmarks, etc.). These limitations can cause frustration and discomfort, but practice and use of basic night flying techniques aid in adaptation to the night environment in the T-6 and follow-on aircraft.

10.2. Briefing. Emphasize visibility restrictions. Include a discussion of night considerations, foreground operations, taxi, takeoff, spatial disorientation, arrival (instrument approach or overhead), landing, and abnormal procedures.

10.3. Night Flying Techniques.

10.3.1. Ensure all transparencies are clean. Make certain ground personnel remove spots and dirt on the windshield. Scratches and dirt cause reflections and can be disorienting during night ops.

10.3.2. During ground ops, ensure all required exterior and interior lights are operational.

10.3.3. Keep cockpit lights turned down to a comfortable level. As vision adapts to night conditions, turn lights down to the lowest possible level that still allows instruments to be easily read. This is especially important in the traffic pattern as canopy glare from excessively bright interior lights can seriously restrict visibility.

10.3.4. Know the location of all important switches and control levers by touch. Use caution to prevent operation of the wrong switch in a dim or dark cockpit.

10.3.5. Always carry an operable flashlight. With electrical failure, a flashlight may be the only means of checking STBY instruments, checklists, and maps. Store the flashlight in a readily accessible place.

10.3.6. The T-6 lighting system consists of red and white lights for the cockpit and instrument panel. These lights can be adjusted for intensity and are used separately or in combination to optimize cockpit lighting. To avoid eyestrain and keep canopy reflections to a minimum, adjust instrument lights to the minimum level necessary. As eyes adapt to the dark, even a momentary glance at a bright light can destroy this adaptation. It can be difficult to distinguish objects outside the cockpit until the eyes readapt.

10.4. Inspections and Checks. Cockpit organization is more important at night. The instruments may not generate enough light to see items in a G suit hold-down strap or kneeboard. The glare shield finger lights (if installed) can be manipulated, or the utility light may be placed on the right canopy rail for increased lighting in the cockpit. It is important for night adaptation to keep the intensity of the interior light as low as practical to prevent degrading night vision and to minimize the possibility of spatial disorientation.

10.5. Taxiing. Review the airfield diagram before taxiing. Form a good mental picture of the taxi route to the runway. Pilots have made wrong turns on strange fields at night. Taxi at slower speeds due to reduced visibility. Use a minimum of 300 feet spacing and taxi on the taxiway centerline. When taxiing toward a landing runway, taxi and landing lights can interfere with the vision of pilots landing or taking off. It is common to extinguish the taxi and landing lights while awaiting takeoff. Always stop if an area cannot be visually cleared or there is any doubt about the safety of continued taxi.

10.6. Takeoff. Line up on the centerline of the runway and perform a static run-up. After brake release, look down the runway. Avoid fixation to one side (at the runway lights). Immediately after takeoff there may be a tendency to pitch over due to lack of forward lighting and a desire for forward visibility. Do not hesitate to use ITO procedures if visual references are poor. Ensure a positive climb before retracting the gear.

10.7. Optical Illusions. Misinterpretation of the altimeter at night may cause accidents. Careful interpretation of the altimeter is absolutely necessary for safe flight at night as actual height above the ground is difficult to confirm visually. Compensate for lack of visual references at night by using a reduced descent rate or by calling out altitudes when descending close to the ground. At altitude, the ability to see distant objects (for example, lights) is typically much better at night than in the day. The ability to see lights at great distances causes several problems with judging distances. A bright light on the ground can be seen as a star if far enough away. Conversely, bright stars can often be mistaken for lights on the ground, especially in sparsely populated areas. Lights displayed by other aircraft are usually easy to detect, but direction of flight, distance, and closure rate are difficult to determine. Navigation and strobe lights can help determine the direction of flight of other aircraft.

10.8. Spatial Disorientation. Pilots are much more susceptible to spatial disorientation at night than during the day. See AFMAN 11-217, Volume 1, and paragraph **7.18.** in this manual for detailed information on causes and hazards of spatial disorientation.

10.9. Area Orientation. Use contact (visual) and instrument procedures and (or) techniques for area orientation at night. Prominent landmarks, cities, or towns can sometimes be seen at night, especially with high moon illumination. Review local hazards and minimum safe altitudes before night flying.

10.10. Unusual Attitudes. Unusual attitudes are generally caused by a loss of SA but can also be caused by weather phenomena. Use instrument unusual attitude recovery procedures to recover from unusual attitudes at night.

10.11. Night VFR. Night VFR flight uses a combination of instrument and visual references and procedures. The degree of darkness and horizon clarity determine the ratio of attention given to flight instruments and outside references. On bright moonlit nights, it may be possible to fly visually with only occasional glances at the instruments to confirm visual references. On dark nights, with little or no horizon, the instruments are the primary reference, and available visual references are used to cross-check aircraft position. After takeoff, gradually transition from instruments to outside references when above 500 feet AGL.

10.11.1. Reduced ability to see at night creates other hazards. Clouds can be difficult or even impossible to see. Flying into a cloud at night can be surprising and very disorienting. After inadvertent flight into clouds at night, quickly transition to instruments to minimize disorientation. If strobes cause disorientation when in the weather, it is acceptable to turn them off.

10.11.2. During darkness, an unlit landmark may be difficult or impossible to see. Lighted landmarks can be confusing because of optical illusions; large cities can often be recognized by their shapes. Many small towns are dark at night and make poor references. Highways, which are usually discernible at night due to automobile headlights and airfield rotating beacons, which can be seen up to 100 miles away, make useful visual navigation points.

10.12. Night Overhead Patterns. At night the traffic pattern is unchanged. Ground references are more difficult to see, and although it is easy to see other aircraft, distance can be harder to judge. A common practice is to verify final turn pitch with the EADI. A normal "2/3 ground, 1/3 sky" picture is approximately 2-3 degrees nose low.

10.13. Night Landings. When wings level on final, concentrate on the descent, and plan to touch down within the first 1,000 feet of the runway. Do not fixate on any single runway reference or stare at bright lights. Plan to touch down on centerline.

10.14. Abnormal Procedures. Procedures and techniques to handle emergency situations do not change significantly, but limited visibility at night complicates every scenario. The reduction in visual references may significantly reduce the ability to successfully accomplish an ELP, especially if not at the home field, to the point that it may be eliminated as an option for aircraft recovery altogether.

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Nuclear Integration

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

AFTTP(I) 3-2.5, *Multiservice Brevity Codes*, February 2002

AFPD 11-2, *Aircrew Operations*, 19 January 2012

AFI 11-2T-6, Volume 1, *T-6A Aircrew Training*, 9 October 2014

AFI 11-2T-6, Volume 2, *T-6A Aircrew Evaluation Criteria*, 21 April 2015

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AFI 11-215, *USAF Flight Manual Program (FMP)*, 22 December 2008

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TO IT-6A-1, *Flight Manual, USAF/USN Series T-6A Aircraft*, 24 January 2006

TO 1T-6A-1CL, *The Pilot's Abbreviated Flight Crew Checklist*, 24 January 2006

AETCI 11-204, *Runway Supervisory Unit (RSU) Operations*, 8 May 2014

AETC TRSS Handout 11-1, *Navigation for Pilot Training*, March 2005

Prescribed Forms

This instruction does not prescribe forms

Adopted Forms

DD Form 175, *Flight Plan, Military*

AF Form 70, *Pilot's Flight Plan and Flight Log*

AF Form 847, *Recommendation for Change of Publication*

AFTO Form 781, *ARMS Aircrew/Mission Flight Data Document*

AFTO Form 781A, *Maintenance Discrepancy and Work Document*

AFTO Form 781B, *Communication Security Equipment Record*

AFTO Form 781C, *Avionics Configuration and Load Status Document*

AFTO Form 781D, *Calendar and Hourly Item Inspection Document*

AFTO Form 781E, *Accessory Replacement Document*

AFTO Form 781F, *Aerospace Vehicle Flight Report and Maintenance*

AFTO Form 781G, *General Mission Classifications—Mission*

AFTO Form 781H, *Aerospace Vehicle Flight Status and Maintenance*

AFTO Form 781J, *Aerospace Vehicle—Engine Flight Document*

AFTO Form 781K, *Aerospace Vehicle Inspection, Engine Data, Calendar Inspection and Delayed Discrepancy Document*

AFTO Form 781L, *Record of Removal/Installation of Controlled Cryptographic Items (CCI)*

AFTO Form 781M, *Status Symbols and Functional System Codes*

AFTO Form 781N, *J-9 Engine Run-up Record*

AFTO Form 781P, *Support General Documentation Record*

Abbreviations and Acronyms

AA—aspect angle

AC—aircraft commander

ADI—attitude indicator

AETC—Air Education and Training Command

AGL—above ground level

AGSM—anti-G straining maneuver

AHC—Advanced Handling Characteristics

AIM—Aeronautical Information Manual

alt—alternate

AOA—angle of attack

AOB—angle of bank

AR—as required

ASSR—Airfield Suitability and Restrictions Report

ATC—air traffic control

ATIS—air terminal information system

BD—battle damage

BIP—boost pump, ignition, and plan

CDI—course deviation indicator

CFS—canopy facture system

CHADS—clearance, heading, altitude, departure frequency, squawk

CHUM—Chart Update Manual

CRM—cockpit/crew resource management

CSW—course selector window

CT—critical tasks

DME—distance measuring equipment

DR—dead reckoning

EADI—electronic attitude indicator

EFIS—electronic flight instrument system

EHSI—electronic horizontal situation indicator

ELP—emergency landing pattern

EOR—end of the runway

EP—emergency procedures

ET—extended trail

ETA—estimated time of arrival

FAF—final approach fix

FBO—fixed base operator

FCP—front cockpit

FL—flight lead

FLIP—flight information publication

FOD—foreign object damage

fpm—feet per minute

GPS—global positioning system

GND—ground

GS—groundspeed

HAPL—high altitude power loss

HCA—heading crossing angle

HDG—heading

HSI—horizontal situation indicator

IAF—initial approach fix

IAP—instrument approach plates

IAS—indicated airspeed

IFR—instrument flight rules

ILS—instrument landing system

IMC—instrument meteorological conditions

IP—instructor pilot/initial point

ISS—interseat sequencing system

ITO—instrument takeoff

ITT—interstage-turbine temperature

JOG—joint operations graphic

KIAS—knots indicated airspeed

KIO—knock it off

KTAS—knots true airspeed

LAB—line abreast

lb—pound

LDG—landing flap setting

LOL—line-on-line

LOS—line of sight

MAX—maximum thrust position

MDA—minimum descent altitude

min—minimum

MOA—military operations area

MSL—mean sea level

MTR—military training route

nav—navigational

NAVAID—navigational aid

NH—nose high

NL—nose low

NLT—not later than

NM—nautical mile

NORDO—no radio

NOTAM—notice to Airmen

NRST—nearest airfield

NWS—nose wheel steering

OBOGS—Onboard Oxygen-Generating System

OBS—omnibearing selector

OCF—out-of-control flight

ops—operations

ORM—operational risk management

PCL—power control lever

PEL—precautionary emergency landing

PF—pilot flying

PNF—pilot not flying

POM—plane of motion

pph—pounds per hour

PPT—primary pilot training

RAIM—receiver autonomous integrity monitoring

RCP—rear cockpit

REF—reference

RMU—radio management unit

rpm—revolutions per minute

RSU—runway supervisory unit

RWY—runway

SA—situational awareness

SID—standard instrument display

SFL—simulated force landing

SOF—supervisor of flying

stan/eval—standardization and evaluation

STBY—standby

STTO—start, taxi, and takeoff

TAD—trim air device

TAS—Traffic Advisory System

TCT—terrain clearance tasks

TIM—tune, identify, monitor

TO—technical order/takeoff flaps

TOLD—takeoff and landing data

TPC—tactical pilotage chart

TSS—time stands still

TWR—tower

UDC—unit developed checklist

UHF—ultra high frequency

VFR—visual flight rules

VHF—very high frequency

VMC—visual meteorological conditions

VOR—very high frequency omnidirectional range station

VRD—vision-restricting device

VSI—vertical speed indicator

WHOLDS—**W**eather, **H**olding, **O**btain, **L**et down plate (approach) review, **D**escent check, **S**peed

WTD—wingtip distance

WW Ex—wing work exercise

WX—weather

Attachment 2

THREE- AND FOUR-SHIP FORMATIONS

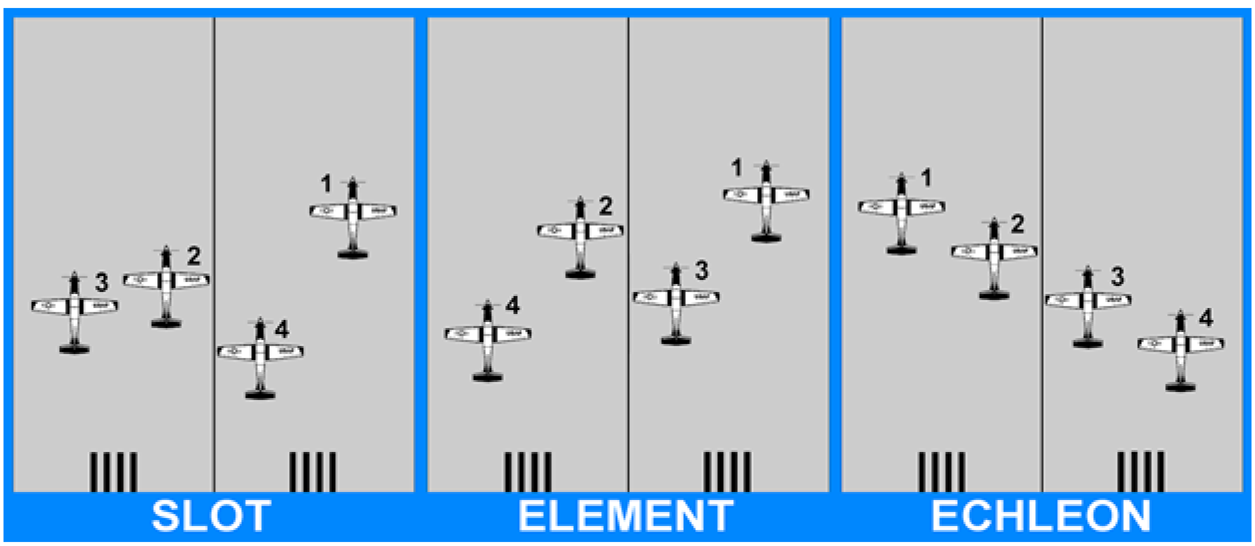
A2.1. Guidelines. Four-ship formation flying requires thorough planning and attention to detail from preflight through postflight. All members of the formation will be briefed and thoroughly familiar with the proposed profile and procedures. The basic formation positions, references, techniques, and procedures described for a two-ship formation also apply to three- and four-ship formations. Airspeed for rejoins will normally be 180 KIAS or as briefed.

A2.2. Three-ship Formation Briefing. Normally, you will not plan to fly a three-ship formation. A three-ship formation is usually the result of a ground or takeoff abort by a member of a four-ship formation. Brief a three-ship plan for all four ships.

A2.3. Runway Lineup.

A2.3.1. **Figure A2.1.** depicts the runway lineups for a four-ship takeoff. See AFI 11-2T-6, Volume 3, for runway width restrictions for each lineup.

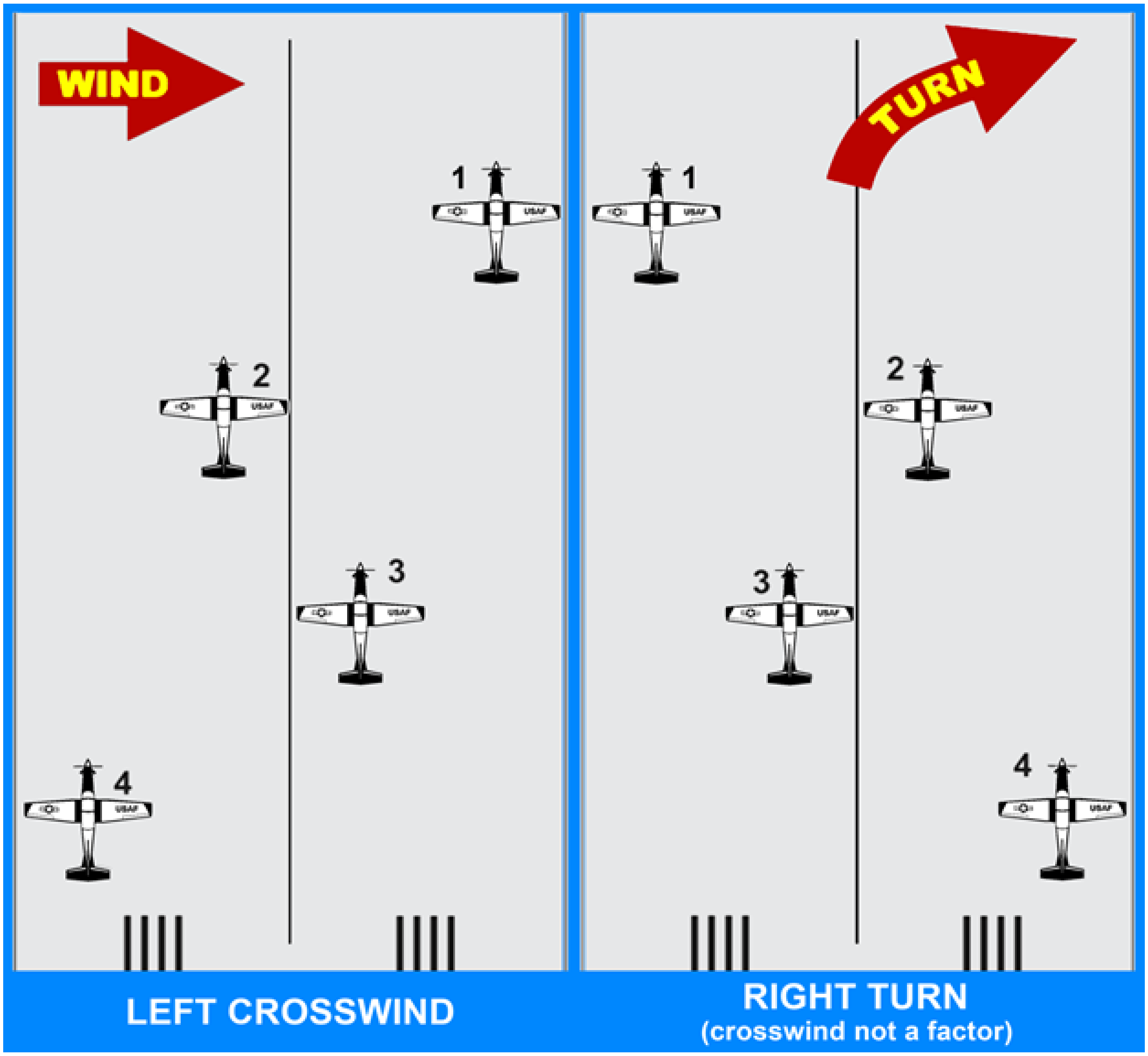
Figure A2.1. Four-ship Runway Lineup.



A2.3.2. Normally, a formation will use the element lineup depiction. Place number 2 on the upwind side of the runway just like a two-ship formation. If crosswinds are not a factor, number 1 will place the number 2 on the inside of the first turn out of traffic (**Figure A2.2.**). If runway length is not a factor, 500 feet of space between elements can also be used as an option.

A2.3.3. To establish the slot lineup, lead will be as far to the side of the runway as practical. Number 2 will place the wingtip closest to lead on the centerline, ensuring a minimum of 35 feet wingtip clearance. Number 3 will line up with 10 feet of wingtip clearance on number 2 in echelon position (helmets of numbers 1 and 2 aligned). Number 4 will pull in between numbers 1 and 2 with wingtip clearance, aligning to the appropriate formation position on number 3. Number 4 will pull forward enough to see number 3's helmet but before it is blocked by number 2's rudder. Number 4 will not run up power until numbers 1 and 2 roll.

Figure A2.2. Four-ship Element Lineup.



A2.4. Runups and Takeoffs.

A2.4.1. When all aircraft are in position, number 1 will direct the engine run-up, using the same run-up procedures as in a two-ship formation. During individual takeoffs, numbers 2, 3, and 4 may delay their run-up a few seconds.

A2.4.2. A three- and four-ship formation takeoff may be accomplished by single-ship takeoffs with individual rejoins out of traffic or by element takeoffs. Use 6-second (minimum) spacing between individual aircraft departures. Use 10-second (minimum) spacing between elements. However, if weather necessitates an element instrument trail departure, use spacing criteria specified in **chapter 9** in combination with any local directives. Each aircraft maintains at least 1,000 feet of vertical separation from the preceding aircraft or element except where departure instructions specifically prevent compliance.

A2.5. Takeoff Aborts. Each aircraft must be prepared to react to any situation if a preceding aircraft aborts. Options available are: (1) hold position, (2) abort, or (3) continue the takeoff as safety dictates.

A2.6. Rejoins (From Takeoff). The type of rejoin will depend on the local departure procedures. It may consist of a turning rejoin, a straight ahead, or a combination of both. Normally, for rejoins following element takeoffs, number 3 will send number 4 to a route position with a minimum spacing of 100 feet prior to rejoining on the lead element. Number 4 will fly a position off number 3 and will monitor the lead element throughout the rejoin. During the rejoin, number 3 must avoid sudden power changes and abrupt flight control inputs. Each aircraft will maintain a minimum of 100 feet of separation until the preceding aircraft has stabilized in route.

A2.7. Turns (From Takeoff). Number 1 will start a turn and maintain briefed power and airspeed until the formation is joined. Wingmen will begin the turn no earlier than the departure end of the runway. Following element takeoffs, number 1 will ensure number 2 is positioned on the inside of the turn, allowing numbers 3 and 4 to join to the outside. If required, number 1 may roll out and call for a straight-ahead rejoin.

A2.8. Straight Ahead (From Takeoff). Number 1 will maintain briefed power and airspeed until the formation is joined. Following element takeoffs, number 1 will ensure number 2 is positioned on the left, allowing numbers 3 and 4 to join to the right side.

A2.9. Formation Positions. The following positions are approached primarily from the wingman's point of view:

A2.9.1. **Fingertip.** Determine number 4's position using the normal fingertip references relative to the number 3 aircraft. If number 3 is rough, number 4 should fly a stable position on number 1 and constantly monitor number 3's position (**Figure A2.3.** and **Figure A2.4.**).

Figure A2.3. Four-ship Fingertip Formation.

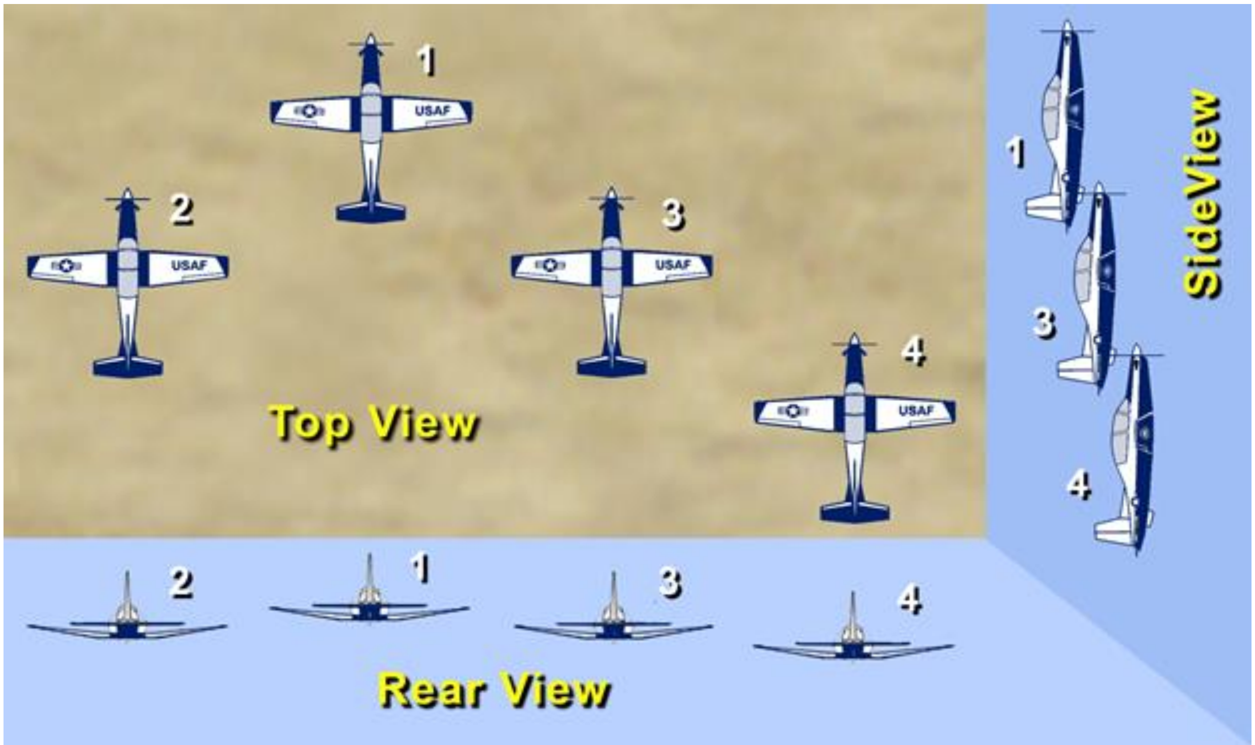
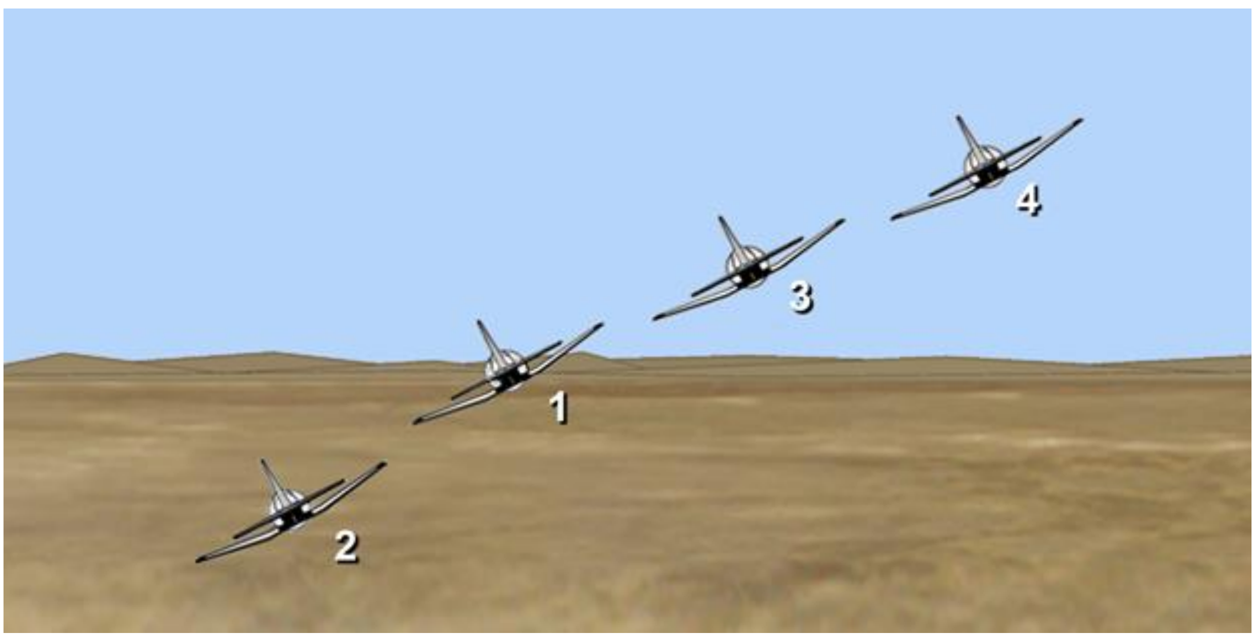


Figure A2.4. Four-ship Fingertip Formation in a Turn.



A2.9.2. **Echelon.** Echelon is a variation of fingertip formation in which the second element aligns itself on the same side as number 2 or vice versa (**Figure A2.5.** and **Figure A2.6.**).

Figure A2.5. Four-ship Echelon.

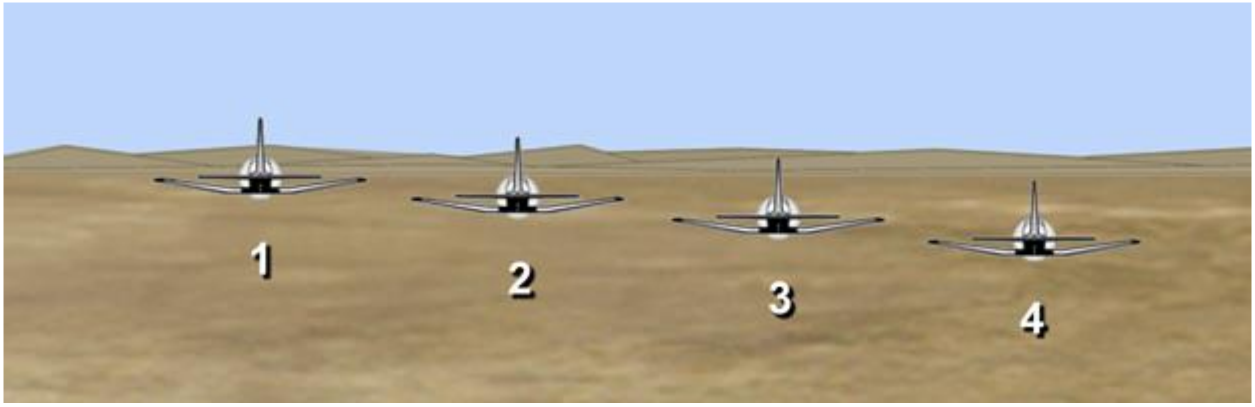
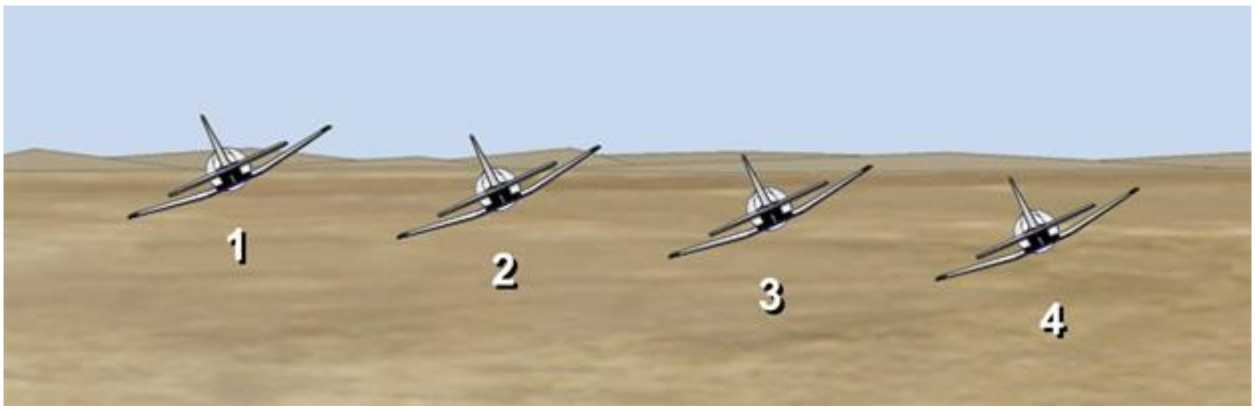
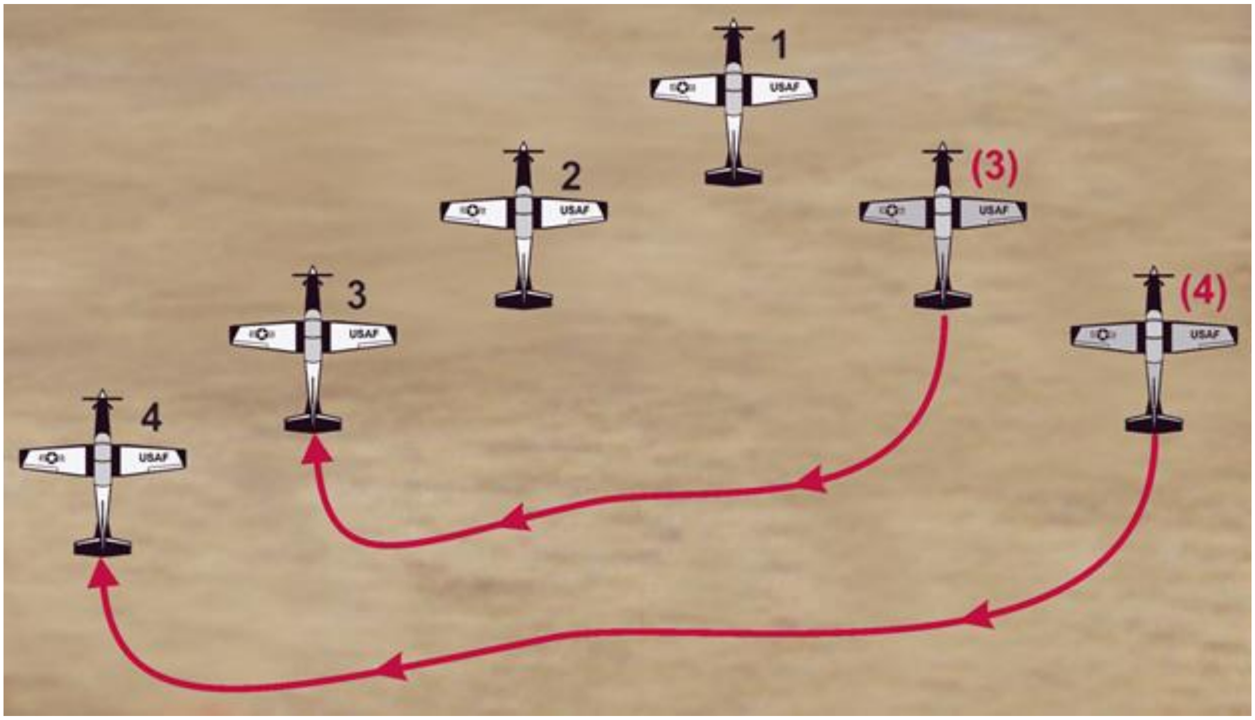


Figure A2.6. Four-ship Echelon Turn.



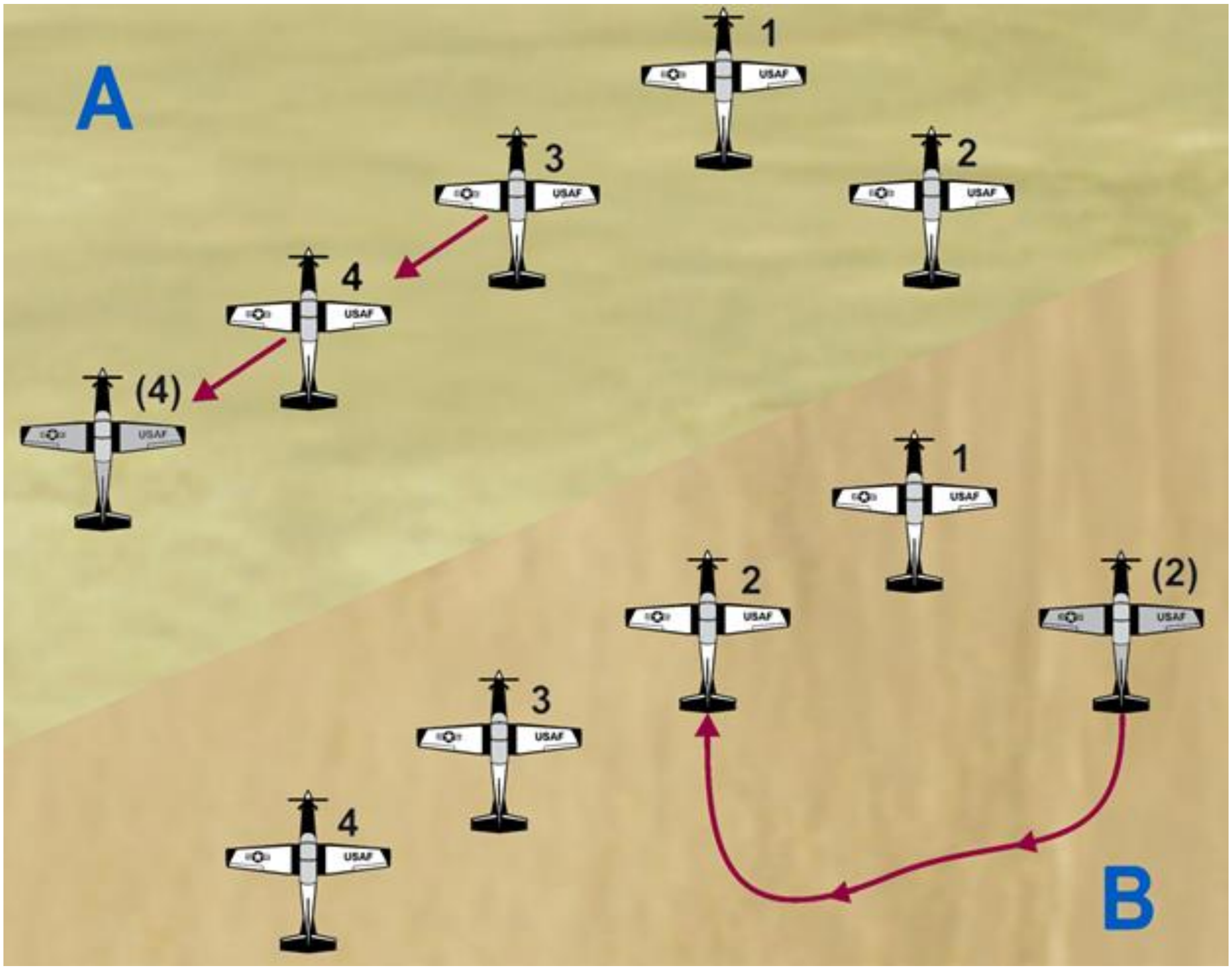
A2.9.2.1. Number 1 will signal for echelon by dipping a wing in the desired direction. If number 1's wing dips toward number 2, that aircraft will hold position. Numbers 3 and 4 will move back and down to provide adequate clearance from the lead element. Number 3 (with number 4 on the wing) will then begin to cross to an echelon position on the wing of number 2, keeping safe clearances. As number 3 crosses behind number 1, number 4 will cross under to the new position on the other wing of number 3 (**Figure A2.7.**).

Figure A2.7. Echelon Crossunder for Numbers 3 and 4.



A2.9.2.2. If the echelon signal is given toward the side of the second element, number 3 (with number 4 on the wing) will move out and back and slightly down to make room for number 2. Number 2 will maintain position until the element has spread out. Once number 2 has determined the second element has made sufficient room, number 2 will execute a normal crossunder keeping the element in sight until moving forward on number 1. Numbers 3 and 4 will align themselves with number 2 and number 1. Smooth technique by numbers 2 and 3 will prevent a crack-the-whip on number 4 (**Figure A2.8.**).

Figure A2.8. Echelon Crossunder for Number 2.



A2.9.2.3. Except for very gentle turns into the echelon, always make turns away from the echelon. Number 3 will fly off number 2 and number 4 will fly off number 3, using normal echelon references.

A2.10. Route. The purpose and parameters of a four-ship route are the same as for a two-ship route. Due to the decreased maneuverability of a four-ship route, the wingman should favor the extended fingertip line in level flight, and may maneuver behind the line to maintain spacing and sight of lead.

A2.11. Rejoins.

A2.11.1. **Turning Rejoins.**

A2.11.1.1. During four-ship turning rejoins, wingmen will relay the wing rocking signal to the aircraft behind them. Number 2 always joins to the inside of number 1's turn. Rejoin procedures for number 2 are identical to the procedures described in **Chapter 9**. If number 2 is slow to rejoin, it will complicate the rejoin for numbers 3 and 4, who will have to decrease airspeed and (or) cutoff to maintain proper spacing on the preceding aircraft.

A2.11.1.2. Number 3 will always join to the outside of number 1's turn. The basic rejoin techniques used by number 3 are the same as those used by number 2. However, number 3 has the additional responsibility of monitoring number 2 and remaining aware of number 4.

A2.11.1.3. Number 3 should establish an AA no greater than that used by number 2. Number 3 should accelerate to gain an airspeed advantage on number 1 and maintain a 100-foot clearance (minimum) on the lead element until number 2 is stabilized in route.

A2.11.1.4. Number 3 should plan the rejoin to pass with a minimum of nose-tail separation behind and below the lead element as he or she moves to the outside of the turn, stabilizing in route, and slowly moving into fingertip position on number 1. Number 3 will avoid abrupt control pressure and rapid PCL movements if number 4 has closed to minimum distance (approximately 100 feet).

A2.11.1.5. Number 4 will also always join to the outside of number 1's turn, and basic rejoin techniques will still apply. However, number 4 must monitor number 3 as well as the lead element during rejoin. After receiving the rejoin signal, number 4 will begin a turn to establish an AA no greater than number 3 or 2, while accelerating to gain airspeed advantage. As number 4, maintain this AA on the lead element and number 3, and plan your rejoin to pass with a minimum of nose-tail separation behind and below the first element and number 3 as you move to the outside of the turn. Stabilize in route and slowly move into fingertip position on number 3. Number 4 must monitor all aircraft in the formation as the rejoin progresses.

A2.11.2. **Straight-ahead Rejoins.** After completing the pitchout, number 1 will signal for a rejoin by rocking the wings or making a radio call. Wingmen will pass along the wing-rocking signal to the aircraft behind them. Number 2 will rejoin to the left side unless otherwise directed. The second element will always join to the side opposite of number 2, and maintain a minimum of 100-foot clearance on number 3 until number 3 is stabilized in route.

A2.12. Overshoot. As a member of a four-ship formation, you must recognize an overshoot situation as soon as possible and make positive corrections. If an overshoot is appropriate, follow previously established procedures. In addition, the following considerations apply based on your position in the formation:

A2.12.1. As number 2, announce your overshoot to alert number 3 that you are encroaching on his or her side of number 1, *"Texan 2 is overshooting."* Clear to ensure sufficient spacing on number 3 before returning to the inside of the turn, reestablish yourself on the rejoin line, and complete the rejoin.

A2.12.2. As number 3, if number 2 overshoots, modify your rejoin by decreasing your airspeed and adjusting your pursuit option to ensure adequate clearance as number 2 returns to the inside of number 1's turn. If you extend the speed brake or remain in zero torque to rapidly bleed your airspeed, notify number 4, *"Texan 3, idle* (or) *speed brake."*

A2.12.3. As number 4, follow number 3 whether number 3 is overshooting or adjusting for a number 2 overshoot. If number 3 is overshooting, use good judgment and a combination of trail and rejoin techniques to stay with number 3. Maintain a 100-foot clearance (minimum) until number 3 is in route.

A2.12.4. When executing an overshoot as number 3 or 4, use the same procedures as described for a number 2 overshoot. However, when stabilized on the outside of the turn, you must determine whether it is more appropriate to remain on the outside of the turn or return to the inside to complete the rejoin.

A2.13. Leaving Formation (Breaking Out). Leaving formation is the same in three- and four-ship formations as in two-ship formations, ***except*** as follows:

A2.13.1. If number 2 or 4 breaks out of fingertip formation, the remaining aircraft will maintain their original positions on number 1. If number 3 leaves formation, number 4 will follow number 3 at a safe distance to maintain element integrity.

A2.13.2. Number 1 will direct the rejoin to the desired formation. An aircraft that has left formation will not rejoin until directed by number 1.

A2.14. Speed Brakes. Speed brakes are lowered or raised on verbal signal by number 1 or element lead if required. Visual signals are generally not used in four-ship formations. Speed brakes will not be raised or lowered when the formation is in an echelon turn.

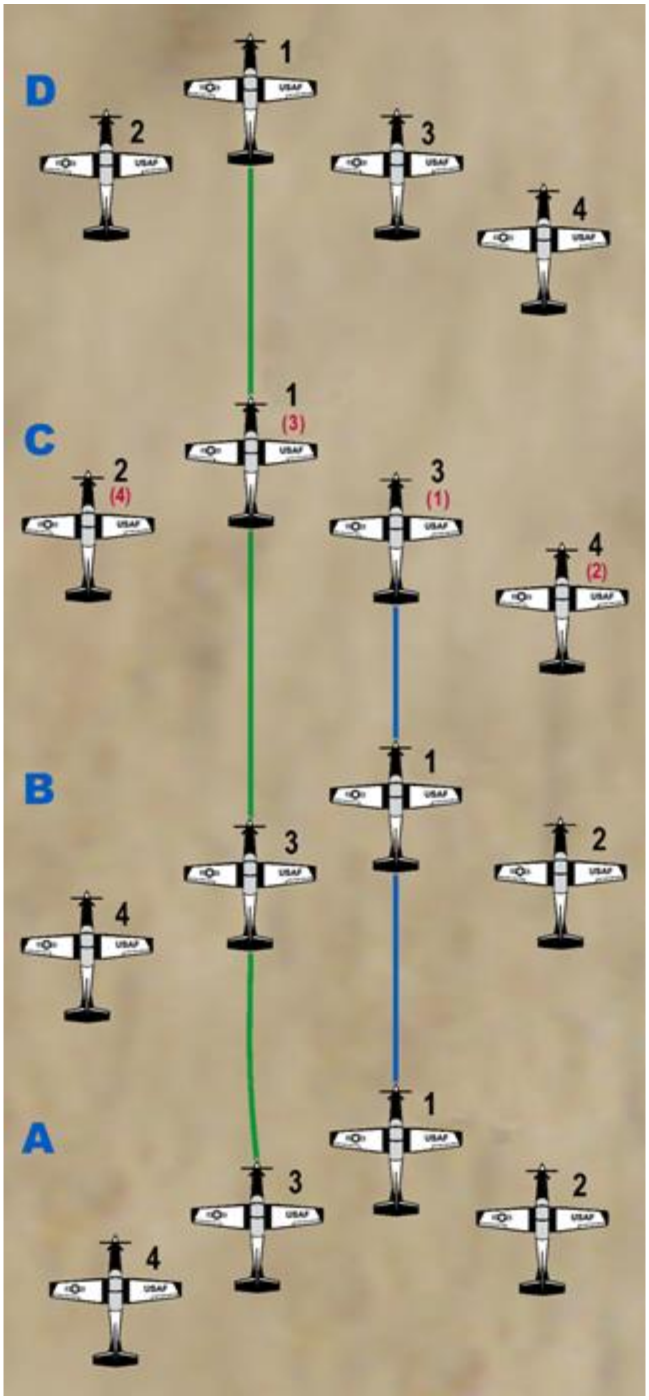
A2.15. In-flight Lead Changes.

A2.15.1. Four-ship lead changes are made from fingertip or echelon. Selected procedures must be thoroughly reviewed in the formation briefing. The most commonly used method is for number 1 to direct the formation to go to route with the radio call, *"Texan, go route."* The wingmen will acknowledge and move to route.

A2.15.2. After the formation is stable in the route position, number 1 will announce the lead change by stating, *"Texan 3 (or 2), you have the lead."* The new lead will acknowledge by stating, *"Texan 3 (or 2) has the lead,"* at which time the lead change is completed. The new lead will pick up the "1" call sign, and confirm the new formation positions with a radio call, *"Texan, check,"* before reforming the formation to fingertip, and beginning other maneuvers.

A2.15.3. During lead changes from fingertip, number 3 always becomes the new number 1; number 4 becomes number 2; number 1 becomes number 3; and number 2 becomes number 4 (**Figure A2.9.**).

Figure A2.9. Route Fingertip Lead Change for a Four-ship Formation.



A2.15.4. During lead changes from echelon, original lead either becomes number 2 or 4 as briefed. When original lead becomes number 2; the original number 2 becomes lead; and numbers 3 and 4 keep their previous positions (**Figure A2.10**). When original lead becomes number 4, number 2 becomes lead, number 3 becomes number 2, and number 4 becomes number 3 (**Figure A2.11.**).

Figure A2.10. Route Echelon Lead Change for a Four-ship Formation (Lead to Number 2).

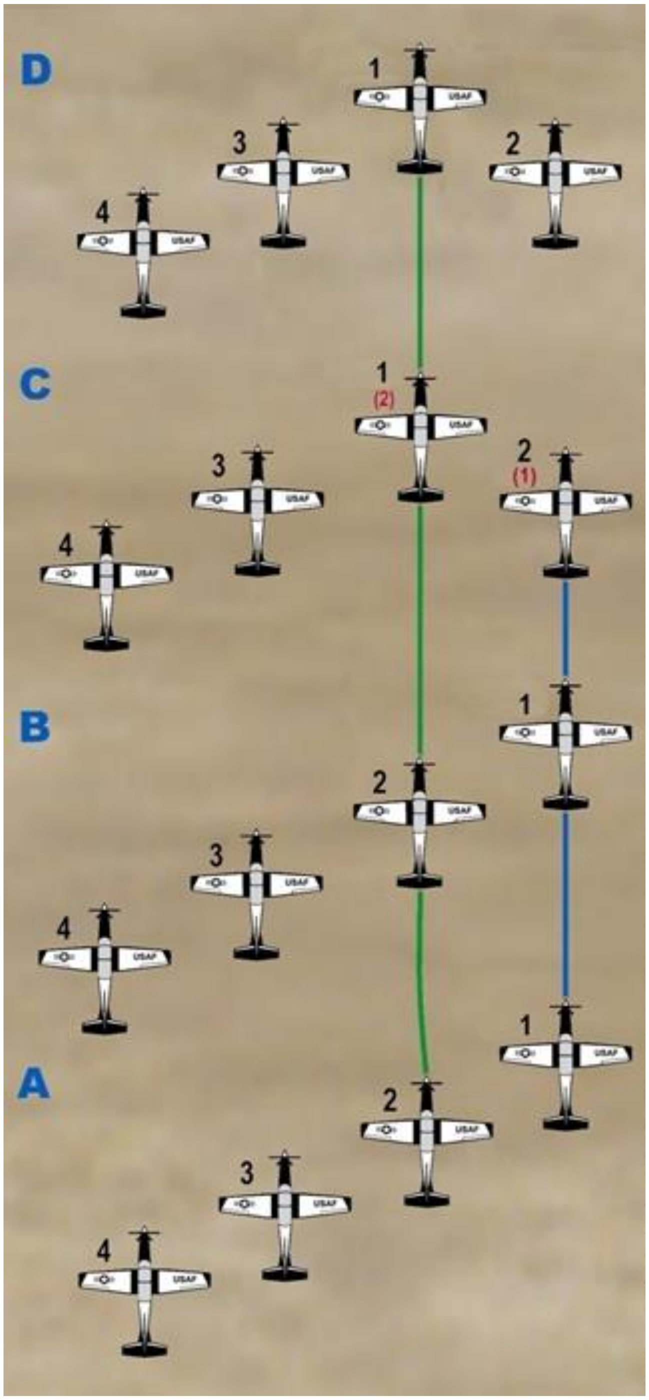
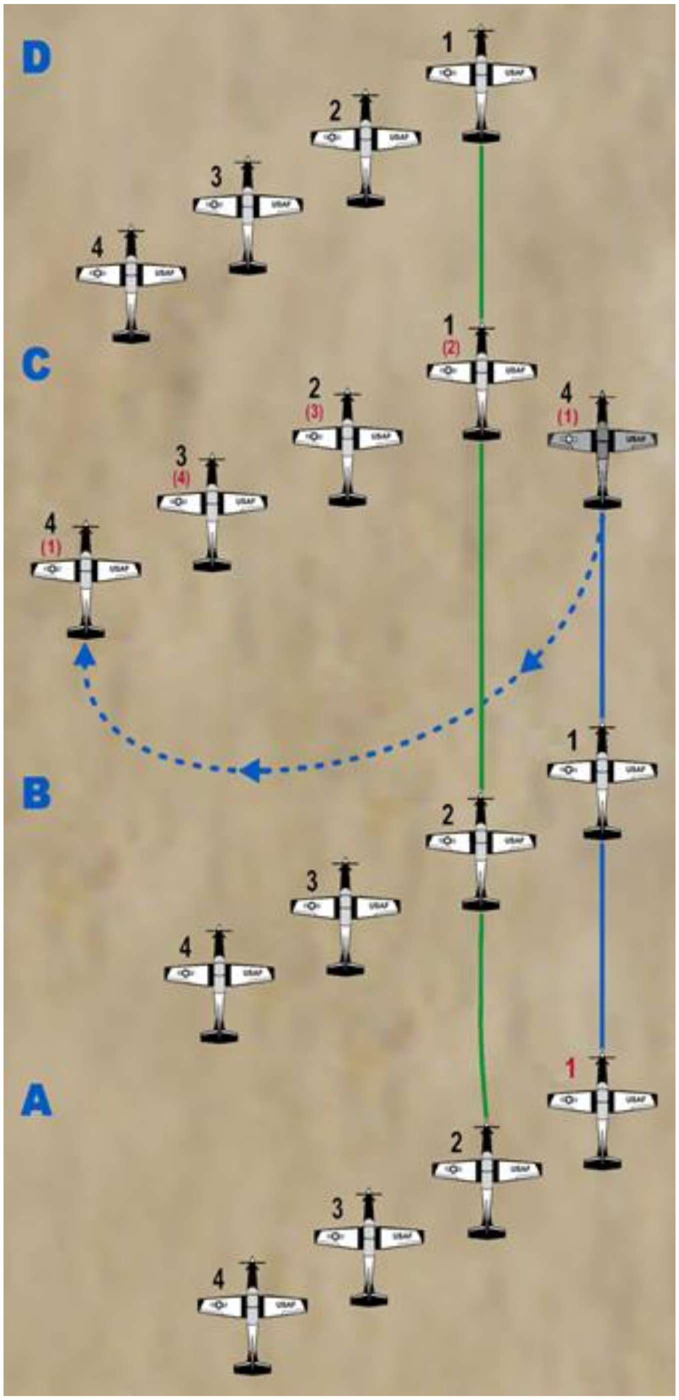


Figure A2.11. Route Echelon Lead Change for a Four-ship Formation (Lead to Number 4).



A2.16. Three-ship Formation.

A2.16.1. **General.** If flying a three-ship formation due to a ground or takeoff abort, lead will be directive and renumber the aircraft in the flight. In a three-ship formation, wingmen may fly the normal positions for number 2 and 3, or may practice phantom 2. Phantom 2 allows the wingmen to practice flying number 3 and 4 positions as if they were in a four-ship formation. If flying phantom 2, numbers 2 and 3 will fly the positions of numbers 3 and 4. During phantom 2, turning rejoins are to the outside of the turn; straight-ahead rejoins are to the same side; and wing work is done with numbers 2 and 3 on the same side.

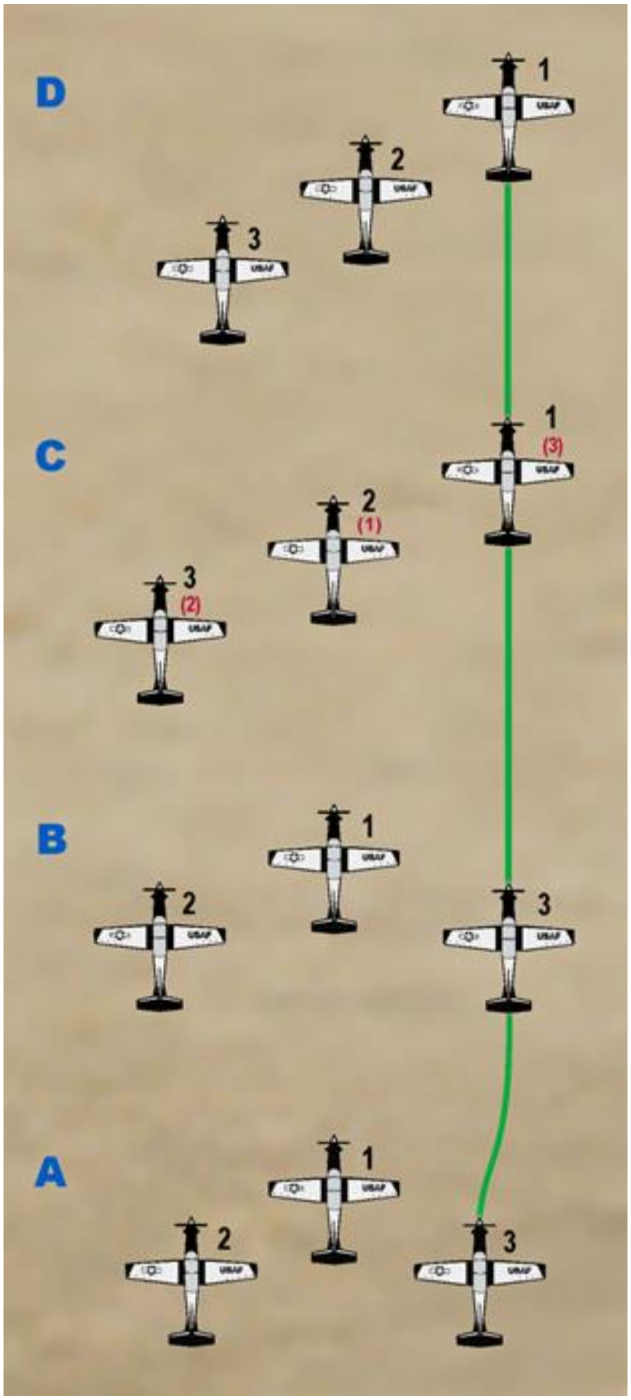
A2.16.2. **Three-ship Rejoins.** When flying phantom 2 for turning rejoins, follow the procedures for the second element for numbers 3 and 4. When flying standard three ship, numbers 2 and 3 positions use normal four-ship procedures.

A2.16.3. **Wing Work or Echelon.** Lead of a three-ship formation will signal for echelon by using the same procedures as in a four-ship formation. If flying phantom 2, direct echelon turns by radio call, "Texan, echelon turn." In phantom 2, if an echelon turn is not directed, numbers 2 and 3 will maintain fingertip references (in numbers 3 and 4 positions). Lead will be directive when reforming the formation to the fingertip position.

A2.16.4. **Three-ship Lead Changes.**

A2.16.4.1. During lead changes from route fingertip, number 3 will move forward (as in a four-ship element lead change) to become number 1; original number 1 will become number 2; and number 2 will become number 3. After the lead change, the formation is in echelon position (**Figure A2.12.**).

Figure A2.12. Route Fingertip Lead Change for a Three-ship Formation.



A2.16.4.2. During lead changes from route echelon, the original number 1 will either drop back to the route fingertip number 2 position (number 2 will become lead, and number 3 will stay number 3), or drop back and cross behind the flight to the number 3 position (number 2 will become lead, and number 3 will become number 2).

A2.16.5. **Three-ship Lead Changes During Phantom 2.** Lead changes during phantom 2 are performed from the route echelon position. Lead drops back and crosses behind the flight to the number 3 position. Number 2 will become lead, and number 3 will become number 2.

A2.17. Lost Wingman (Three-ship).

A2.17.1. **Wings-level Flight (Climb, Descent, or Straight and Level).** The lost wingman will turn away, using 15 degrees of bank for 15 seconds. He or she will inform number 1, resume course, and obtain a separate clearance.

A2.17.2. **Turns (Climb, Descent, or Level).** When outside the turn, the lost wingman will reverse the direction of turn, using 15 degrees of bank for 15 seconds, and inform number 1. He or she will roll out and continue straight ahead to ensure separation before resuming the turn and obtain a separate clearance. When inside the turn, the lost wingman will momentarily reduce power to ensure nose-tail separation and tell number 1 to roll out of the turn. Maintain AOB to ensure lateral separation then obtain a separate clearance. Number 1 may resume turn only when separation is ensured. If in a three-ship flight with both aircraft on the same side of number 1, refer to four-ship lost wingman procedures (paragraph **A2.18.**).

A2.17.3. **Precision and Non-Precision Final Approach.** The lost wingman will momentarily turn away from lead to ensure separation and start a climb to either the final approach fix or glide slope intercept altitude, as appropriate. While proceeding to the missed approach point, he or she will inform lead and obtain a separate clearance from approach control. Either comply with the new clearance received, or fly the published missed approach, as appropriate.

A2.17.4. **Missed Approach.** The lost wingman will momentarily turn away to ensure clearance, inform number 1, and continue the published missed approach while climbing 500 feet above the missed approach altitude. The wingman will obtain a separate clearance from approach control.

A2.18. Lost Wingman (Four-ship). Numbers 2 and 3 will follow the procedures described in **paragraph A2.17.** However, because it is impossible for number 4 to immediately determine number 3 still has visual contact with lead, number 4's initial action must assume number 3 has also become separated. If number 4 loses sight of number 3, number 4 will proceed as follows:

A2.18.1. **Wings-level Flight.** Simultaneously inform lead and turn away, using 30 degrees of bank for 30 seconds. Then resume course and obtain a separate clearance.

A2.18.2. **Turns (Climb, Descent, or Level).** On the outside of the turn, reverse the direction of the turn, using 30 degrees of bank for 30 seconds to ensure separation from lead and number 3. Obtain a separate clearance. (Using 30 degrees of bank for 30 seconds will develop a significant heading change from lead.) Maintain SA for obstacle clearance when separating from lead. On the inside of the turn, momentarily reduce power to ensure nose-tail separation and increase bank angle by 15 degrees. Tell lead to roll out of the turn. Obtain a separate clearance. Lead will resume the turn only when separation is ensured.

Attachment 3

ENJJPT FORMATION PROCEDURES

A3.1. Two-Ship Tactical Formation.

A3.1.1. **Objective.** Tactical is the primary formation flown when employing fighter aircraft. It is designed to optimize weapons and radar employment while improving visual lookout and increasing maneuverability.

A3.1.2. **Description.** "Tactical" is an umbrella term covering several formations characterized by increased separation between the members of the flight.

A3.1.2.1. A variety of tactical formations may be flown depending on the number of aircraft in the formation and the type of employment desired. For two-ships, tactical formations include line abreast (LAB) and wedge. Both may be referred to on the radio by their separate names; however, if lead refers to "tactical" this is understood to mean LAB. Formations involving three or four aircraft are merely variations of the basic two-ship and include fluid four, wall, and box or offset box.

A3.1.2.2. The basic combat unit employed by fighter aircraft is the two-aircraft element—the element lead and the wingman.

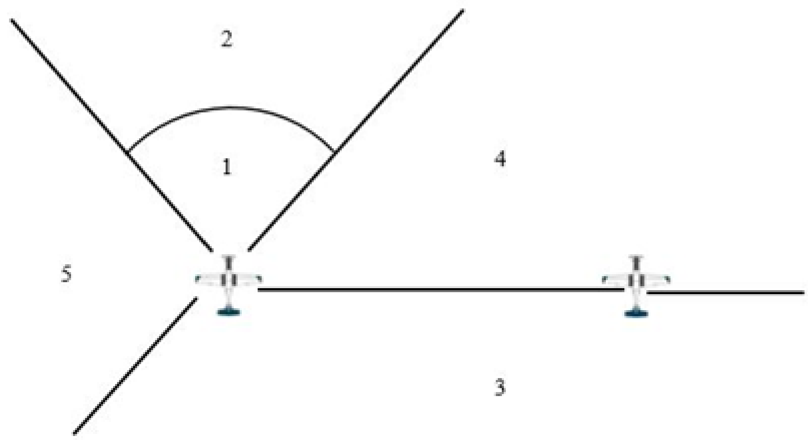
A3.1.3. **Procedure.** Basic formation contracts still apply, but tactical introduces the benefits of increased flexibility, maneuverability, and mutual support. Regardless of the variety of tactical being flown, some basic principles apply:

A3.1.3.1. **Lead.** Lead is responsible for maneuvering the formation and monitoring the wingman, especially during tactical turns that momentarily cause the wingman to lose sight.

A3.1.3.2. **Wingman.** The wingman is primarily responsible for maintaining formation position and deconfliction. ***The wingman's primary reference for heading and airspeed is the lead aircraft.*** As proficiency and task management allow, the wingman may back-up lead by monitoring area orientation, navigation, etc.

A3.1.3.3. **Visual Lookout.** Exercise a disciplined visual lookout to detect threats. **Figure A3.1.** shows the priority of visual lookout for both members of the formation. Often in training, as well as in combat a disciplined visual lookout has saved a formation and allowed them to continue the mission to accomplish their objective. 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 aircraft, but higher and lower as well. As a result, each sector depicted in **Figure A3.1** can be divided up into three vertical sectors. 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. Flight leads may brief, "Check near rocks, check far rocks, check six," in that order of priority. When scanning visually, it is very important to pause in each sector allowing your eyes to focus at range and detect movement.

Figure A3.1. Visual Lookout Priorities in Tactical Formation.



A3.2. Element LAB (Tactical).

A3.2.1. **Objective.** Introduce the benefits of increased flexibility, maneuverability and mutual support.

A3.2.2. **Description.** See **Figure A3.2.** The parameters of T-6 tactical LAB formation are defined as 2,000 to 3,000 feet lateral separation, line abreast to 10 degrees aft, with a vertical stack of up to 500 feet.

A3.2.3. **Procedure.** Tactical formations are normally flown at airspeeds near cornering velocity, but other airspeeds may be flown as required. Normally, T-6 tactical formation is flown at 200 KIAS. Airspeed deviations may be communicated by lead (ex: "*Texan, set two-fifty*").

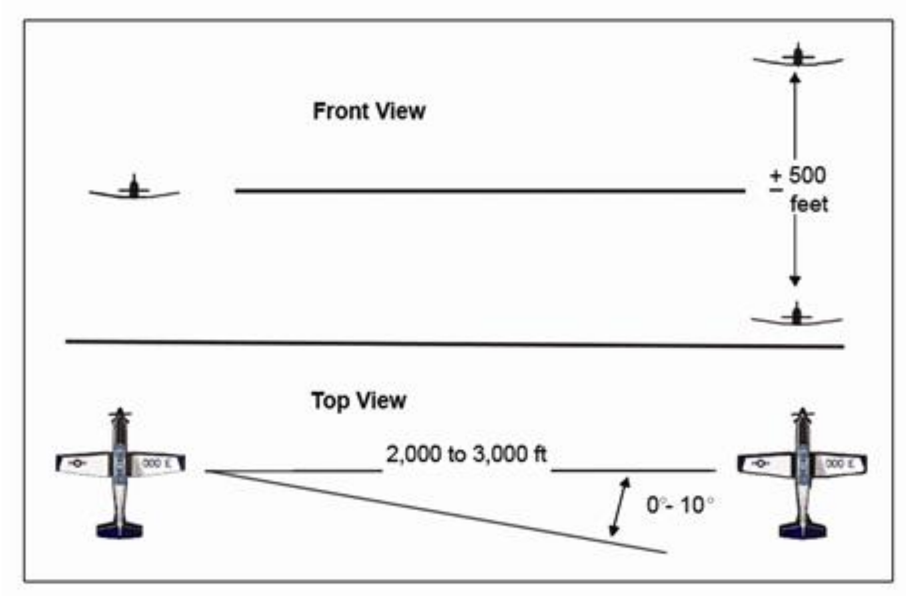
A3.2.3.1. **Visual References.**

A3.2.3.1.1. **Fore/Aft.** The primary reference for LAB in any airframe is for the wingman to put lead directly abeam their shoulder. In the FCP of the T-6 this can also be referenced as in line with the flash guard. The RCP visual reference is to put lead in line with the static wicks.

A3.2.3.1.2. **Lateral.** At 2,000 feet lateral separation, the ejection seats and both pilots' helmets are visible. At 2,500 feet, the ejection seats are still discernable, but individual pilots cannot be distinguished. At 3,000 feet, the canopy begins to blend in with the fuselage, but the prop blade is still visible.

A3.2.3.1.3. **Vertical.** A soda can height above or below the horizon will provide the optimal 200-300 feet of stack. Double this reference for maximum allowable stack (500 feet).

Figure A3.2. LAB Tactical Formation.



A3.2.3.2. **Establishing LAB.** To enter tactical formation, lead may use a radio call (ex: *"Texan 2, tactical left/right side"*) or a visual signal by porpoising the aircraft. The porpoise signal will not be given from fingertip. When sent to tactical, the wingman will clear the flightpath in the direction of turn and smoothly initiate a turn (approximately 10 degrees) to a divergent heading while maintaining/attaining briefed tactical airspeed. Approaching 2,000 to 3,000 feet, wingman will roll back to lead's approximate heading. Assess LOS and adjust power, airspeed and heading as required to zero out LOS and HCA and establish LAB.

A3.2.4. **Technique .** As a technique, when receiving a signal to go to tactical and prior to turning away from lead, the wingman may cross-check their current heading and/or set the heading bug. This is only an initial reference for the wingman to establish and maintain proper lateral spacing. The primary reference is lead's aircraft, not the EHSI.

A3.2.4.1. **Maintaining Position (Station Keeping) and Corrections .** Mutual support depends upon the wingman efficiently maintaining the proper position. Therefore, the wingman should constantly strive for LAB, whereas lateral spacing and vertical stack within the parameters depend on several factors such as training objectives, location of the sun, presence of haze, or other obstructions to visibility. Position corrections, in order of priority, are:

A3.2.4.1.1. **Fore/aft.** Once established LAB, prevent LOS from developing by using small power corrections. If the environment permits, altitude may be traded for airspeed to correct for larger deviations. If aft of LAB, initiate a descent to generate aft LOS and regain LAB. If forward of LAB, initiate a climb in order to generate forward LOS. Initiate an altitude correction in time to regain proper fore/aft position at the proper airspeed and at the desired stack. When using the vertical, it is imperative that wingman modulate power as required to return to the proper tactical position at the briefed airspeed. Lateral s-turns (flying a greater distance than lead) or a combination of climbing and turning can also be used to regain LAB from a forward position. When applying these types of corrections, the wingman must monitor the LOS being created through the correction to anticipate the return to proper LAB position.

A3.2.4.1.2. **Lateral spacing.** Normally a small heading change into or away from lead is all that is required to fix lateral spacing. Once at the proper lateral spacing, wingman will realign fuselages and zero out HCA. Closure toward or separation from lead is more easily discernible if the wingman avoids staring at lead and instead executes the tactical visual scan pattern and a crosscheck of own aircraft parameters. See **Figure A3.1.** Use of headings or ground references such as section lines or lead's LOS across the ground can help in the recognition of closure or separation. Prior to making a heading correction, the wingman may note their current heading, which is causing the vector into or away from lead. Once at the proper lateral spacing, the wingman may then set a new heading that zeroes out HCA. Use of headings should only be used as a building block to develop the ability to maintain lateral separation solely by visual reference to lead's aircraft.

A3.2.4.1.3. **Vertical Stack.** Unless restricted by airspace or environmental conditions, the wingman should strive to be stacked 200-300 feet above lead; however, there are times when level or low stack is appropriate. Having a stack makes it more difficult for the enemy to obtain "tally two." Unless making a correction for fore/aft position, the maximum vertical stack is 500 feet. Ensure both pilots maintain visual.

A3.2.4.2. **Lead Considerations.** Lead must maneuver the formation as required; however, excessive heading or airspeed changes will require wingman to devote more time to element integrity (maintaining position) at the expense of mutual support. Small heading changes should be minimized. Small course corrections may be accomplished through check turns. Turns of more than 30 degrees are usually accomplished by means of a tactical turns as discussed below.

A3.3. Element Tactical Turns.

A3.3.1. **Objective.** Introduce formation maneuvering in LAB tactical formation.

A3.3.2. **Description.** Various tactical turns are employed to maneuver the formation in combat to optimize weapons and radar employment while maintaining or improving visual lookout and maneuverability.

A3.3.3. **Procedures.**

A3.3.3.1. **Initiating the Turn.** All tactical turns except a cross turn, shackle or hook turn into the wingman are normally signaled visually (communication-out or "comm-out"), but radio calls may be utilized for any tactical turn (ex: *"Texan, 90 left/right"*). No radio response is required from the wingman. If given a visual signal, the wingman should always assume a 90-degree turn is desired unless lead's follow on signals indicate a 45-degree turn or a hook turn away. The wingman may hear a "zipper-click" (a rapid double-click of the comm toggle switch) to attract attention toward lead's visual signal. If first to turn, wingman should interpret lead's visual signal as a directive to immediately initiate a contract turn.

A3.3.3.2. **The Contract.** All aircraft should adhere to a "contract" as the turns are executed to ensure turn rate and radii are similar. The contract parameters are normally 200 KIAS, MAX power, G to hold airspeed (approximately 2 to 3 Gs), and level turns. The wingman may use variations in heading, airspeed, stack and Gs to facilitate reacquiring LAB position.

A3.3.3.3. **Turns Away From The Wingman.** For comm-out tactical turns that require the wingman to turn immediately in the direction of lead, lead will show the wingman a large wing flash (approximately 90 degrees of bank) away from the wingman, then roll out to wings level. This large wing flash avoids confusion with minor course corrections (usually 30 degrees of bank or less). More than one signal may be required since the wingman is expected to be executing their visual scan and may miss the initial signal. While it is assumed to be a 90-degree turn after observing a wing flash from lead, the wingman must watch for an additional signal that would indicate a hook turn or delayed 45-degree turn.

A3.3.3.4. **Turns Into The Wingman.** For comm-out turns that require the wingman to delay their turn, lead will initiate a contract turn in the direction of the wingman. When lead is observed turning into the wingman, it is always assumed to be a 90-degree turn; however, the wingman must be prepared for lead to roll out, signaling a 45-degree turn.

A3.3.3.5. **Deconfliction.** The wingman's primary responsibility is to deconflict from lead. If the wingman is stacked high or low, he or she should maintain that stack when commencing the turn, especially if first to turn. If deconfliction is questionable, the wingman should telegraph their intentions to lead by positively maneuvering their aircraft either above or below lead's flight path. If in standard formation (within 1 mile laterally and 100 feet vertically of lead), the wingman should climb or descend only as required for deconfliction. If there is ever doubt, either aircraft may transmit a radio call to make it immediately clear which direction they intend to deconflict (ex: "*Texan 2 is going low*"). During some tactical maneuvering the wingman will momentarily lose sight of lead. This is normal and not a cause for concern if adhering to the established contract and vertical deconfliction. The wingman will continue to fly a contract turn until he or she is in a position to be visual with lead. If the wingman does not re-acquire visual when expected, then he or she must immediately call "blind" with their altitude. Both lead and wing are ultimately responsible for midair collision avoidance, clearing during the turns and taking appropriate evasive action as required.

A3.3.3.6. **Check Turn.** The check turn can be used for small heading corrections (usually no more than 30 degrees) or to realign the formation, and requires a radio call (ex: *"Texan, check 20 left/right"*). The wingman does not acknowledge this call. Both aircraft turn simultaneously using a contract turn and the wingman remains on the same side of the element. For small heading/course corrections that do not require an aggressive contract turn, lead will maintain current airspeed and power setting to make the correction and simply turn. A radio call is not required. Lead will telegraph this type of turn by using a small amount of bank angle. The amount of bank should be enough for the wingman to see and also execute a heading update, but small enough to be clear that the turn is not a delayed turn.

A3.3.3.7. **Delayed 90-degree Turns.** See **Figure A3.3.** These turns may not always be exactly 90 degrees of heading change. For turns greater than approximately 60 degrees, lead will generally direct a delayed 90-degree turn.

A3.3.3.7.1. **Delayed 90-degree Turns into The Wingman.**

A3.3.3.7.1.1. **Lead.** Lead's contract turn into the wingman signals the turn. If the turn is called over the radio, lead begins the contract turn immediately after the call.

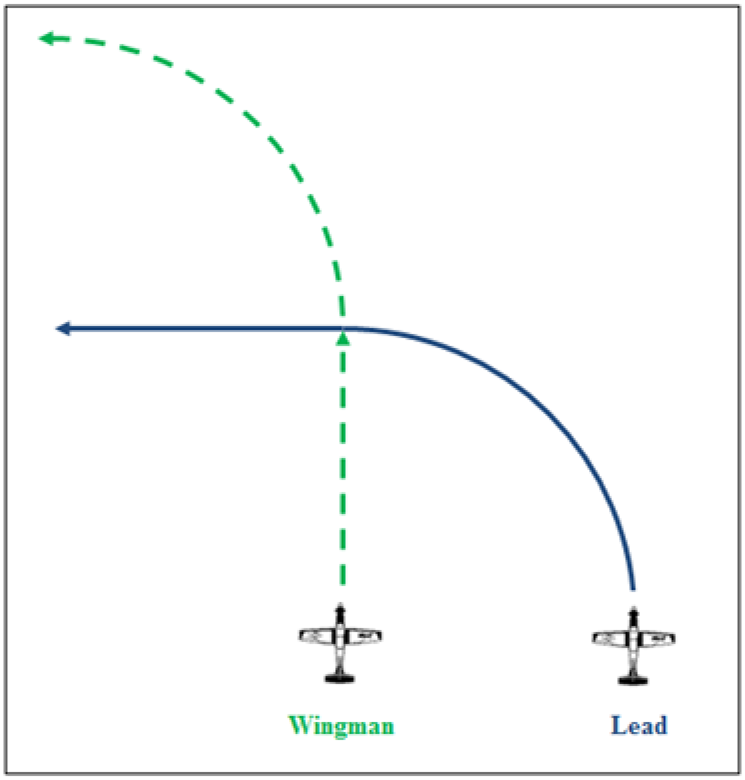
A3.3.3.7.1.2. **Wingman.** As lead begins the turn, continue straight ahead. Initiate a 90-degree contract turn at the increase in LOS (this occurs approximately when lead's aircraft is approaching nose on). If out of position, the wingman should vary the timing and G loading of the turn (based on lead's LOS) to finish the turn in position. Generally, when starting a turn tight or aft, begin the turn earlier. When wide or forward, begin the turn later.

A3.3.3.7.2. **Delayed 90-degree Turns Away from The Wingman.**

A3.3.3.7.2.1. **Lead.** Signal the turn, then execute IAW paragraph **A3.3.3.7.1.2**.

A3.3.3.7.2.2. **Wingman.** Begin a contract turn as soon as lead signals for the turn (radio call or wing flash). Roll out after approximately 90 degrees of turn. The wingman is responsible for being in position and must make necessary adjustments as required. Start maneuvering to the correct position as soon as it becomes apparent that a deviation will occur. As a technique, the wingman may visually acquire a reference point (section line, cloud, lake, etc.) on the opposite side of lead's aircraft and use this as their initial rollout point for a 90-degree turn.

Figure A3.3. Delayed 90-degree Left Turn into the Wingman.



A3.3.3.8. **Delayed 45-degree Turns.** See **Figure A3.4.** These turns may not always be exactly 45 degrees of heading change. For turns between approximately 30 to 60 degrees, lead will generally direct a delayed 45-degree turn.

A3.3.3.8.1. **Delayed 45-degree Turns into The Wingman.**

A3.3.3.8.1.1. **Lead.** Lead's contract turn into the wingman signals the turn. If the turn is called over the radio, lead begins the contract turn immediately after the call. Lead indicates a 45-degree turn by rolling out on the desired heading. If the wingman initiates a 90-degree turn (goes belly-up to lead) prior to lead's roll-out for the 45-degree turn, lead should use a radio call to indicate the turn (ex: "*Texan 2, roll out, forty-five*"). This situation may develop when the wingman is flying closer to the 2,000' range of lateral separation.

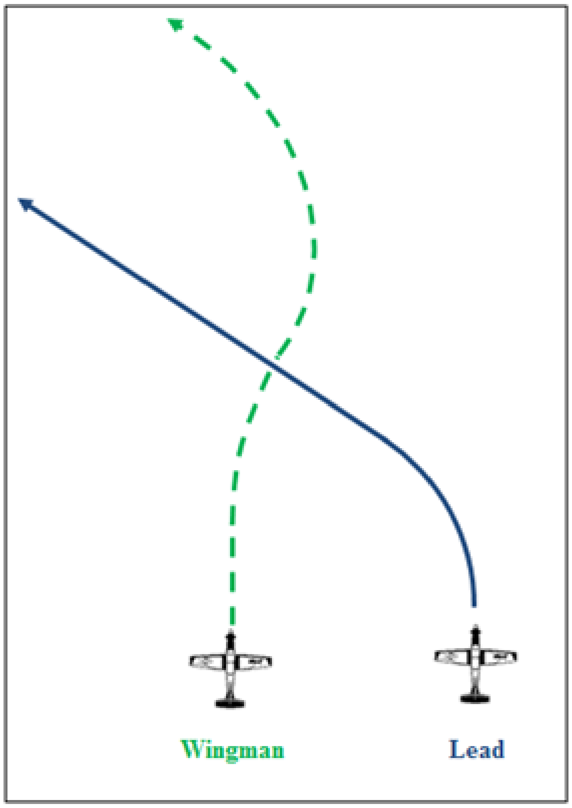
A3.3.3.8.1.2. **Wingman.** As lead rolls out, execute a turn towards lead to generate aft LOS. A turn of 20-30 degrees is usually sufficient. As aft LOS increases, the wingman reverses the turn to regain visual with lead and maneuvers as required to attain tactical on the opposite side of lead's aircraft.

A3.3.3.8.2. **Delayed 45-degree Turns Away from The Wingman.**

A3.3.3.8.2.1. **Lead.** Signal the turn, then when the wingman's nose is approximately on the desired roll-out heading, signal the roll-out by initiating a turn into the wingman.

A3.3.3.8.2.2. **Wingman.** When directed, begin a contract turn into lead. Roll out when observing lead banking into you or when directed. Obtain correct spacing and position as lead rolls out.

Figure A3.4. Delayed 45-degree Left Turn into the Wingman.



A3.3.3.9. **In-Place Turns.** Use an in-place turn to maneuver the formation any number of degrees of turn in one direction at the same time. To initiate, lead transmits *"Texan, in-place 90 left/right."* The wingman does not acknowledge this call. Both aircraft turn at the same time—in the same direction—using contract turns. If executed from LAB, a 90-degree turn will put the formation in trail at whatever lateral spacing existed prior to the turn.

A3.3.3.10. **Hook Turns.** See **Figure A3.5.** During a hook turn, the formation turns 180 degrees with both aircraft performing a contract turn at the same time in the same direction.

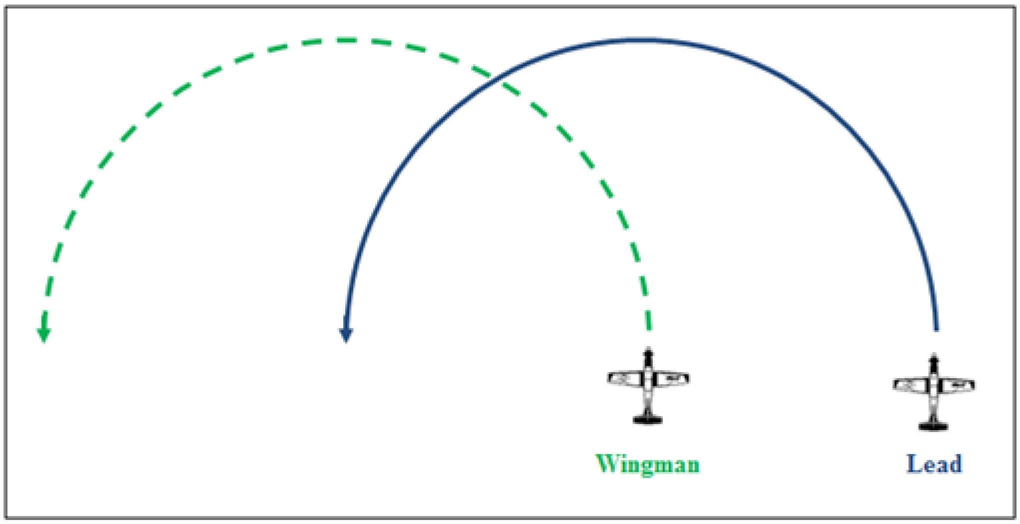
A3.3.3.10.1. **Hook Turns into the Wingman.** A hook turn into the wingman must be called over the radio and does not require an acknowledgment (ex: *"Texan, hook right/left"*).

A3.3.3.10.1.1. **Lead.** During the first half of the turn, lead is visual and should match the wingman's fuselage through 90 degrees of turn. Approximately halfway through the turn, lead will lose sight of the wingman. Continue a contract turn to the desired rollout heading.

A3.3.3.10.1.2. **Wingman.** Initiate a contract turn upon receiving lead's radio call. After passing through 90 degrees of turn, begin looking out the top of the canopy for lead while continuing the contract turn. Once visual is attained, vary airspeed and Gs to roll out in LAB position after approximately 180 degrees of turn.

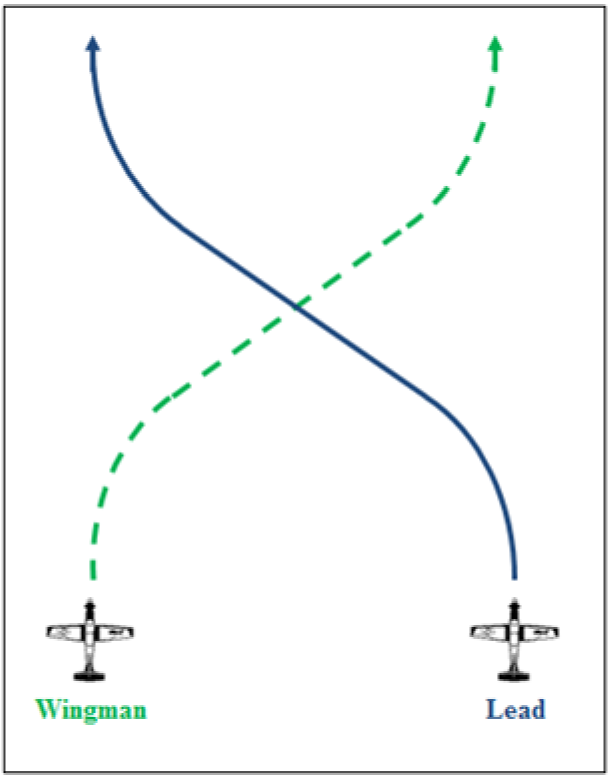
A3.3.3.10.2. **Hook Turns Away from the Wingman.** Hook turns away from the wingman may be signaled visually by a wing flash or called over the radio. If initiated with a wing flash, lead will begin turning when the wingman begins the turn. Lead's immediate turn indicates a hook turn. For the first half of the turn, the wingman should match lead and align fuselages through 90 degrees of turn, then transition to a contract turn. Shortly after halfway through the turn, lead should reacquire sight of the wingman.

Figure A3.5. Hook Turn, Left, into the Wingman.



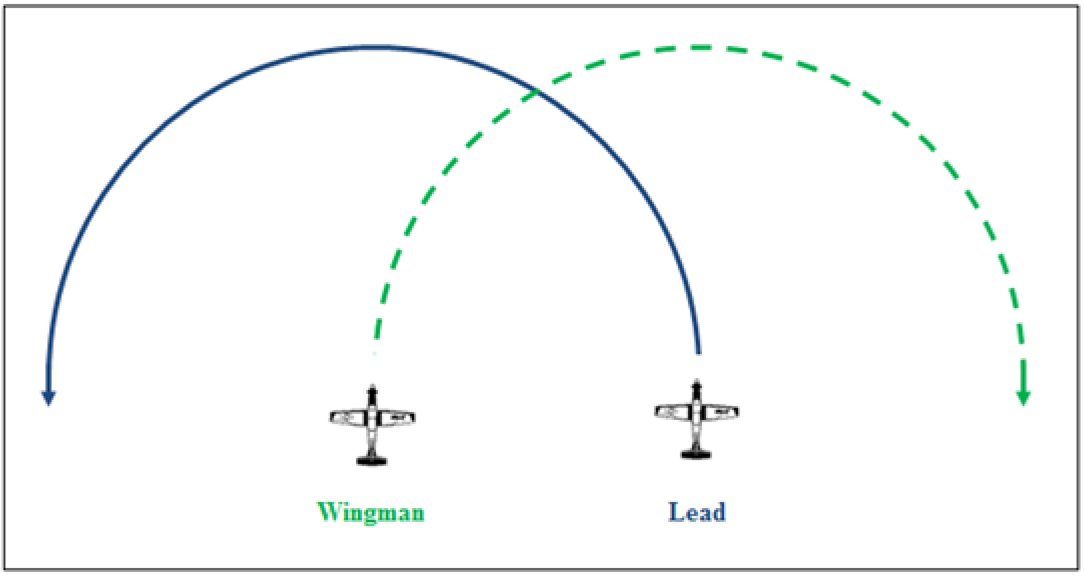
A3.3.3.11. **Shackle.** See **Figure A3.6**. A shackle is used to place the wingman on the opposite side. Lead initiates the turn by transmitting, *"Texan, shackle."* The wingman does not acknowledge this call. Normally both aircraft simultaneously turn approximately 45 degrees into one another. The wingman rolls out as required to zero out LOS and cross directly over or under lead (the wingman should clearly deconflict using the vertical). Both aircraft reverse the turn after crossing flight paths. Lead may maneuver as required and may not turn at all if the shackle is being utilized to fix wingman's excessive forward position or simply place the wingman on the opposite side. It is the wingman's responsibility to cross directly over or under lead and maneuver to LAB on the opposite side.

Figure A3.6. Shackle.



A3.3.3.12. **Cross Turn.** See **Figure A3.7**. Cross turns are another 180-degree reversal option. Lead initiates the cross turn by transmitting *"Texan, cross turn."* The wingman does not acknowledge this call. Both aircraft execute a contract turn into each other. The wingman is responsible for ensuring flight path deconfliction in the vertical. Aircraft should cross after 60-90 degrees of turn and continue through 180 degrees of turn. The flight is now on a reciprocal heading. Lateral separation may be wide even though the original spacing was correct. To correct this, it is a common technique to perform an auto-shackle after the cross turn.

Figure A3.7. Cross Turn.



A3.3.3.12.1. **Auto-Shackle Blind Procedures.** If either aircraft has not reacquired visual by 180 degrees of turn, simultaneously roll out and call "blind" IAW AFI 11-2T-6V3. If the other aircraft is visual, they may call "continue." After "continue" the blind aircraft will initiate a shackle by resuming the turn for 45 degrees. The visual aircraft will continue the turn as required to zero out LOS, establish and maintain altitude deconfliction, and call "*Texan 1/2, crossing high/low*." The blind aircraft will call "*Texan 1/2, visual*" when reacquiring the other aircraft and complete the shackle. It is possible for neither aircraft to regain sight after the cross turn. In this case, both aircraft will maintain the reciprocal of the cross turn entry heading. Lead will be directive to ensure deconfliction and regain mutual support.

A3.3.3.13. **Fluid Turns.** These turns are used to maneuver a formation when there is very little G or excess thrust available (heavy weight and/or higher altitudes). If a 180-degree turn is required, combine the techniques for two 90-degree turns. The radio call for a fluid turn is "*Texan, fluid left/right.*" No acknowledgement is required. Immediately following the radio call, lead will begin turning using approximately 45 degrees of bank while maintaining airspeed..

A3.3.3.13.1. **Fluid Turns into the Wingman.** Immediately start a turn in the same direction as lead. One technique is to use less bank angle (approximately 30 degrees) than lead and maintain it until you cross in front of lead. Another way is to initially match lead's bank and momentarily roll out of the turn or bank in the opposite direction to check leads relative position. Depending on leads position at the start of the turn, you should normally have 20 to 30 degrees of the turn completed as lead passes the 6 o'clock position. Once lead has passed the 6 o'clock position, increase bank angle and lower the nose to pick up airspeed, if necessary. Play the turn to establish the proper spacing on the opposite side. Use altitude to gain or reduce airspeed to arrive in the proper position as lead rolls out of the turn.

A3.3.3.13.2. **Fluid Turns Away from the Wingman.** The wingman will immediately be behind at the onset of the turn. Therefore, roll into more bank (approximately 60 degrees) than lead and lower the nose slightly to gain airspeed in order to move to the inside of the turn behind lead. As the turn progresses, the wingman should reduce the bank angle to attain proper lateral spacing and trade excess airspeed for altitude approaching the LAB position. Airspeed corrections should be made through the use of vertical while maintaining a fairly constant power setting.

A3.4. Tactical G-Awareness Exercise.

A3.4.1. **Objective.** During tactical flying, especially during fluid maneuvering, G loading changes constantly. The G-awareness exercise allows practice of the anti-G strain technique and familiarization with increased G loading in a controlled setting.

A3.4.2. **Description.** The tactical GX is flown as two slightly descending 180 degree (hook) turns from LAB formation, allowing AGSM practice of 10-15 seconds (4 or 5 breathing cycles) per turn.

A3.4.3. **Procedure.** Accomplish the turns in MAX power and 200-220 knots. The first turn is the “G-warm-up” turn and is flown with approximately 4.0 Gs. The second turn is the “G-awareness” turn flown with approximately 5.0 Gs. The wingman should strive for 3,000 feet LAB prior to starting the GX. The GX is not an instrument maneuver and will require looking outside the cockpit to deconflict with the other aircraft. With both aircraft maintaining proper Gs and airspeed, the formation will complete the exercise in LAB.

A3.4.3.1. The tactical GX must be initiated using the radio:

A3.4.3.1.1. “*Texan, push it up, standby GX*”; “*2*”

A3.4.3.1.2. “*Texan 1 ready*”; “*Texan 2 ready*” or “*Texan 2 standby airspeed/spacing*” etc.

A3.4.3.1.3. “*Texan, G warm-up, hook left/right*” after 2’s ready call.

A3.4.3.1.4. “*Texan 1 ready*”; “*Texan 2 ready*” or “*Texan 2 standby airspeed/spacing*” etc.

A3.4.3.1.5. “*Texan, G awareness, hook left/right*”

A3.4.3.2. It may be required (due to WX, airspace, etc.) to execute a tactical turn following the “push it up” call but prior to the GX. In these cases lead will signal the non-GX turn using comm-out signals, or use the radio and omit any reference to G-awareness.

A3.4.3.3. Following the GX, lead will initiate an ops check and decelerate to 200 knots.

A3.5. Wedge.

A3.5.1. **Objective.** Wedge formation can be used when terrain, tactics, etc., require an increased degree of flight maneuverability.

A3.5.2. **Description.** The wedge position is primarily used in the low altitude environment. The wedge position is defined as 30-45 degrees off lead’s 6 o’clock (30-45 AA) with a lateral spacing of 2,000-3,000 feet. Wingman should stack up to 500 feet high (200 to 300 feet high is optimal) but will not fly lower than lead in the low altitude environment.

A3.5.3. **Procedure.** Lead normally directs the wedge position with a radio call (ex: "*Texan 2, go wedge*"). The wingman maneuvers using power and/or geometry to attain proper position. After lead directs wedge formation, turns do not need to be called. The wingman will maneuver as required to maintain position.

A3.6. Tactical Rejoins.

A3.6.1. **Objective.** Safely and efficiently transition the formation from LAB to close formation for mission accomplishment or external factors.

A3.6.2. **Description.** Straight-ahead and turning tactical rejoins are the two primary methods or rejoining the wingman from LAB.

A3.6.3. **Procedure.** Rejoins will be initiated with a wing rock or radio call. The wingman must acknowledge all radio calls to rejoin. The standard platform for lead is 200 KIAS, 45 degrees of bank (turning), and level flight. The wingman should strive to maintain closure throughout the rejoin.

A3.6.3.1. **Straight-ahead Tactical Rejoin.** The wingman will rejoin to the side occupied when the rejoin was directed. Unlike a normal straight-ahead rejoin from a trail position, a tactical straight-ahead rejoin begins from LAB. The mechanics of flying this maneuver will vary based on the wingman's position when initiating the rejoin. Make a bid toward lead's 6 o'clock position to generate forward LOS while simultaneously working toward a slightly low stack. If forward LOS is not established by this initial heading change, it may be necessary to make another bid to lead's 6 o'clock. As a technique, visualize an aimpoint toward the close trail position. Maintain sufficient power to achieve approximately 10-20 knots of overtake and begin to eliminate HCA to freeze lead's forward LOS. Once established 100-200 feet on an extended fingertip line, stabilize (but don't stop) in this position and continue to move into fingertip. Accomplish the rejoin without crossing lead's 6 o'clock position. If excessive closure exists, do not rejoin closer than route and make sure to parallel lead's flight path to avoid a conflict. If closure still exists when approaching the 3/9 line, turn away from lead's aircraft to establish a diverging heading. Once closure is under control, complete the rejoin.

A3.6.3.2. **Turning Tactical Rejoins.**

A3.6.3.2.1. **Turns into the Wingman.** Even before lead turns, excessive AA exists. Both lag pursuit and vertical turning room are required to decrease this aspect. The wingman should use no more than 10-15 knots of overtake once crossing back inside lead's turn. If stacked above lead, use vertical turning room above; if stacked below, use vertical turning room below lead, but always use caution for excessive airspeed and a high asymmetric over-G potential.

A3.6.3.2.1.1. **Vertical Stack above Lead or Stacked Level.** In this case, increase power to MAX, roll to set the lift vector to lead's high 6 o'clock and pull to attain forward LOS. Once forward LOS is observed (use caution not to exceed 90 degrees of HCA), reverse the turn to reacquire lead, low on the inside of the turn. Use caution not to apply back stick pressure during the turn reversal in order to continue a flight path toward lead's turn circle. Once visual, pull to align fuselages at or near lead's turn circle and assess LOS. Avoid descending prior to ensuring aft of lead's 3/9 line and observing forward LOS. With forward LOS established, begin a controlled descent toward the normal rejoin line on the inside of lead's turn circle. Crosscheck airspeed and modulate power to arrive on the rejoin line with desired stack and closure. Once established on the rejoin line, follow normal turning rejoin procedures.

A3.6.3.2.1.2. **Vertical Stack below Lead.** Make a turn into lead while maintaining airspeed and adjusting stack towards the rejoin line. As a technique, reverse the turn to align fuselages as lead crosses the nose. This type of rejoin can result in a flight path overshoot, which should be flown IAW paragraph **9.26.3.2.**

A3.6.3.2.2. **Turns Away From the Wingman.** As soon as lead turns, the wingman is outside the turn and needs to maneuver to the inside of the turn with lead pursuit. Immediately apply MAX power and turn towards lead, maneuver inside lead's turn circle, and establish the desired rejoin line. Cross lead's 6 o'clock while remaining clear of their prop wash and assess overtake (10-15 knots is normally sufficient). Once inside the turn circle, follow normal turning rejoin procedures.

A3.7. ET Entry from Tactical.

A3.7.1. **Objective.** Transition from tactical maneuvering to the ET Exercise.

A3.7.2. **Description.** ET is flown from the fighting wing position. ET entry from Tactical requires analyzing and solving angular, range, closure, and LOS problems to move the number 2 aircraft from a Tactical position to fighting wing position

A3.7.3. **Procedure.** Lead initiates entry into ET from tactical with a radio call: *"Texan, next set ET level 1/2/3."* After responding with *"2,"* the wingman maneuvers to attain 3,000 feet lateral separation. Once lead assesses both aircraft have achieved the correct starting parameters and completed a CLEF check, he or she will call*, "Texan 1 ready"*, followed by the wingman responding, *"Texan 2 ready."* Lead then directs a check turn: *"Texan, check 45 left/right,"* and turns away from the wingman using a contract turn. The wingman does not roll out after the check turn but maneuvers as necessary to establish pure pursuit. As the wingman achieves pure pursuit, lead reverses turn direction and sets the wingman on a 4 aspect. The wingman maneuvers as required until reaching fighting wing parameters and then calls, *"Texan 2 in."* Both aircraft then set the briefed power setting and commence ET maneuvering.

A3.8. Tactical Initial.

A3.8.1. **Objective.** Align the formation with the landing runway while maintaining the maneuverability and mutual support of LAB formation.

A3.8.2. **Description.** Flown similar to single-ship initial. However, prior to initial, lead should position the wingman on the side opposite the direction of the break.

A3.8.3. **Procedure.**

A3.8.3.1. **Lead.** At the break point, lead will signal the break with a wing flash and initiates the break to a normal downwind upon observing the wingman's turn.

A3.8.3.2. **Wingman.** The wingman breaks upon lead's signal and rolls out after approximately 90-degrees of turn (perpendicular to runway). The wingman then executes a second turn (approximately 90 degrees) to roll-out on a normal downwind. The wingman should use power modulation and lag pursuit as required, and may have to fly slightly wider than lead's ground track in order to maintain proper spacing.

A3.9. Fluid Maneuvering.

A3.9.1. **Objectives.**

A3.9.1.1. Introduce and practice the administrative set-ups, terminations, and resets for advanced maneuvering.

A3.9.1.2. Introduce and practice the application of air-to-air training rules.

A3.9.1.3. Introduce and practice recognizing and solving problems of range, closure, AA, HCA, and turning room using pursuit curves and out of plane maneuvering against a cooperative aircraft flying a scripted training platform.

A3.9.1.4. For the training aircraft, practice setting and controlling the briefed training parameters.

A3.9.1.5. For the maneuvering aircraft, introduce and practice recognition and alignment of turn circles.

A3.9.1.6. Practice maneuvering to, recognizing, and stabilizing (fuselages aligned and zero LOS) in the ET cone from a position well outside that cone.

A3.9.1.7. Practice recognizing and resolving high closure and/or high aspect situations in FM Levels 3 and 4 and stabilize in the goal position (500 feet from training aircraft, approximately 4 AA, fuselages aligned).

A3.9.1.8. **Training Aircraft.** Although the primary training objectives are for the maneuvering aircraft pilot, there are significant training opportunities for the training aircraft pilot. These include over-the-shoulder SA, POM assessment, lift vector control, floor awareness, G awareness, and energy management. The responsibilities of the pilot in the training aircraft include adjusting bank or backstick pressure to "set" the aspect, monitoring the maneuvering aircraft (normally the wingman), and most importantly, flying the pre-briefed parameters ("the contract"). Because the parameters are so vital to achieving the DLOs, it is imperative that IPs monitor SP performance.

A3.9.1.9. **Maneuvering Aircraft.** FM's primary objectives are for the pilot in the maneuvering aircraft. The responsibilities of the pilot in the maneuvering aircraft include being in level, pure pursuit to start, helping the training aircraft pilot adjust the starting aspect, and remaining vigilant for maintaining proper airspeed.

A3.9.2. **Description.** FM in the T-6 is the first of several building blocks that will introduce the concepts and skills required in future tactical training. FM builds on the short-range maneuvering practiced in ET by requiring an understanding of turn circle geometry along with the creative use of pursuit curves and energy management in order to close from medium-range to short-range.

A3.9.3. **Fluid Maneuvering Responsibilities.**

A3.9.3.1. **General.**

A3.9.3.1.1. **Collision Avoidance.** Flight members must be vigilant with regard to clearing their flight path to recognize and avoid the pre-briefed minimum range limitation ("the bubble").

A3.9.3.1.2. **Fuel Awareness.** Because FM generally involves higher power settings for longer periods of time, pilots must continually monitor their fuel state to prevent overflying joker or bingo. Leads will call for an ops check with fuel and Gs after each setup.

A3.9.3.1.3. **Setup Standardization.** During FM training, the need for setup standardization is critical to the reconstruction, debriefing, and assessment of the desired learning objectives (DLOs). Therefore it is imperative that the training aircraft (normally lead) not deviate from the pre-briefed profile. Leads are responsible for aggressively controlling the appropriate setup and training platform parameters. Pilots must strive to be in the correct position and must not call "ready" until the pre-briefed starting parameters have been achieved.

A3.9.3.2. **Special Instructions (SPINS), Training Rules (TRs), and Rules of Engagement (ROE).** These three terms intertwine in their application to training scenarios. Violation of TRs has serious implications for flight safety. Adherence to TRs is essential to becoming a disciplined combat aviator. Outside the UPT and PIT environment, AFI 11-214, *Air Operations Rules and Procedures* mandates numerous TRs, which have been developed over years of combat aviation training and are designed to provide a safe, effective training environment. Although AFI 11-214 does not apply in UPT or PIT, the concept of TRs remains the same. The following TRs apply to FM:

A3.9.3.2.1. **Floor.** The floor is 500 feet above the bottom of the assigned airspace. Call "terminate" when a violation occurs or becomes imminent. Flight leads are responsible for setting a new maneuvering floor if weather or other conditions dictate.

A3.9.3.2.2. **Bubble.** Under no circumstances will the maneuvering aircraft close inside of 300 feet from the training aircraft. Call "knock-it-off" if a bubble violation occurs or is imminent. When the maneuvering aircraft approaches a stabilized position in the ET cone, the training aircraft will limit maneuvering to a slightly descending turn maintaining constant G and airspeed until the exercise is terminated or a transition to ET occurs.

A3.9.3.2.3. **3/9 Line.** Maximum AA is 9 AA (3/9 Line). Call "knock-it-off" if the maneuvering aircraft exceeds this aspect. The training aircraft shares responsibility for this restriction and should control bank angle/turn rate to ensure the maneuvering aircraft remains aft of the 3/9 line.

A3.9.3.2.4. **Reversing Direction of Turn (FM Levels 3 and 4 only).** A reversal by the training aircraft is scripted to generate range/closure/aspect problems. The training aircraft must have SA on the maneuvering aircraft's position or may reverse at the request of the maneuvering aircraft. These directional changes should be commensurate with the maneuvering aircraft's proficiency and are not intended to force a bubble or 3/9 violation.

A3.9.3.3. **Starting Parameters.**

A3.9.3.3.1. **Altitude block.** 11,000 to 12,000 feet MSL or center of the airspace as defined locally (Flight leads may adjust for weather or airspace restrictions).

A3.9.3.3.2. **Airspeed.** 200 (±10) KIAS.

A3.9.3.3.3. **Position.** 3,000 feet LAB for FM 1/2 or 3,000-4,000 feet LAB for FM 3/4 (if entry is from tactical).

A3.9.3.3.4. **Stack.** Level (±100 feet).

A3.9.3.3.5. **Maneuvering aircraft.** Pure pursuit (after check turn).

A3.9.3.3.6. **Aspect angle.** Approximately 40 degrees. The maneuvering aircraft is centered between the training aircraft's wingtip and vertical stab.

A3.9.4. **Procedures.**

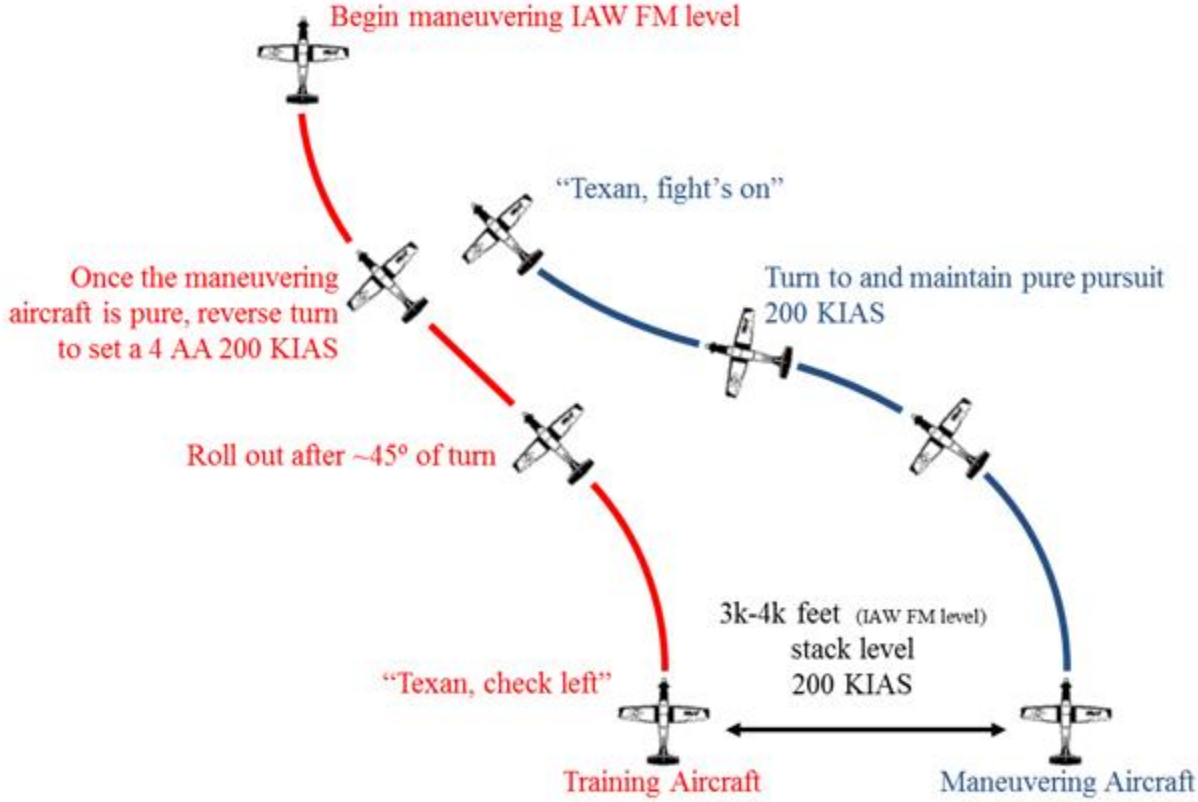
A3.9.4.1. **Setup Comm and Execution.** Each setup should be preceded by a descriptive preparatory call (ex: "*Texan, next set FM level 2 for 2*"; "*2*"). The maneuvering aircraft will use this time to refine formation position and complete any required in-flight checks. Once the preparatory calls and admin have been accomplished, the entry to FM may be flown from one of three methods:

A3.9.4.1.1. **Entry from Tactical.** See **Figure A3.8**.

A3.9.4.1.1.1. After maneuvering into the block, completing setup admin, and acknowledging the descriptive call for the next exercise, the maneuvering aircraft slides out to approximately 3,000 feet LAB. If transitioning from a climb (160 KIAS), an acceleration maneuver may be directed by lead (ex: "*Texan, push it up, reference 180*", "*2*".) If transitioning from 200 KIAS tactical, no acceleration maneuver is required. The wingman should strive to be ready before the flight lead. Once the flight lead calls "*Texan 1 ready*", the wingman will respond immediately with his/her status ("*Texan 2 ready*" or "*Texan 2, standby airspeed/stack/spacing/etc*."). If the wingman makes a "standby" call, he/she will call ready as soon as they are in starting parameters for" the exercise.

A3.9.4.1.1.2. After the "ready" calls, lead directs a check turn, normally away from the wingman ("*Texan, check left/right*."). The training aircraft normally turns 45 degrees away from the maneuvering aircraft, but may adjust as necessary. The maneuvering aircraft continues the turn as needed to go to pure pursuit (training aircraft in the middle of the windscreen). The training aircraft acquires visual, remains on the roll-out heading until the maneuvering aircraft has achieved pure pursuit, and then reverses the turn using bank as required to maintain the maneuvering aircraft at a 4 aspect. Power, bank and back stick pressure may be adjusted as required to maintain the desired aspect and parameters. The maneuvering aircraft will verify the correct aspect angle and call "*Texan, ease off*" or "*Texan, tighten up*" if required. When range decreases to 1,500 feet, the maneuvering aircraft will call "*Texan, fight's on*".

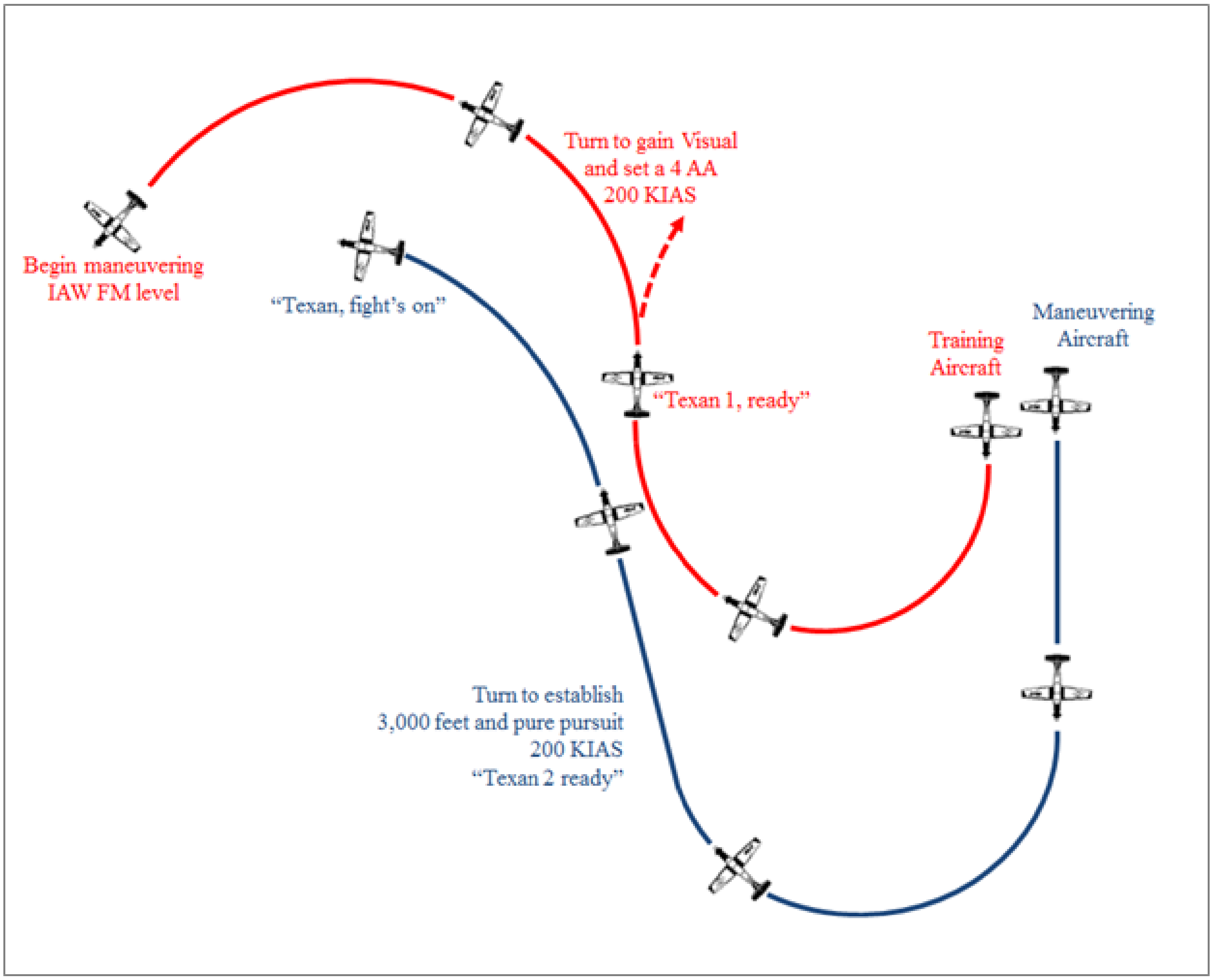
Figure A3.8. Fluid Maneuvering Entry from Tactical.



A3.9.4.1.2. **Entry from a Pitchout.** See **Figure A3.9.**

A3.9.4.1.2.1. After the preparatory comm, lead will direct a pitchout and roll out at approximately 180 degrees of heading change (or as required for airspace management). The maneuvering aircraft will delay the turn as required to create proper spacing (approximately 7 seconds). Adjust the turn to roll out approximately 3,000 feet at the training aircraft's 6 o'clock. Once both aircraft have rolled out and "ready" calls have been exchanged, the training aircraft will turn in either direction to acquire visual and set the desired aspect. The maneuvering aircraft will maintain pure pursuit, stacked level and 200 KIAS until range decreases to 1,500 feet then call "*Texan, fight's on*". Contingencies such as "standby" or "ease off/tighten up" may be used IAW A3.10.4.1.1.2.

Figure A3.9. Fluid Maneuvering Entry from a Pitchout.



A3.9.4.1.3. **Entry from Directed Positions.** This option is slightly more comm-intensive, but is especially efficient for dealing with weather-restricted airspace. Lead maneuvers or directs the flight as necessary back into the block for the next setup. For example, lead can direct the maneuvering aircraft to maintain 3,000 feet in trail and when the formation is clear of weather exchange "ready" calls and begin a turn in either direction similar to the pitchout entry.

A3.9.4.2. **Initial Moves.** Once the maneuvering aircraft calls "fight's on" the training aircraft will begin maneuvering IAW **Table A3.1**. The maneuvering aircraft should maneuver as described in the following paragraphs to arrive in a stabilized position within the ET cone.

A3.9.4.2.1. **Aligning Turn Circles.** See **Figure A3.10**. If the call to begin maneuvering comes right at 1,500 feet, the initial move is normally to drive to the training aircraft's turn circle. From 1,500 feet only a small delay is required before arriving at the turn circle. This can be accomplished by easing off the pull required for pure pursuit, allowing the training aircraft to drift toward the canopy bow (lag) or by momentarily rolling out. Initially, the training aircraft's aspect will increase with slow LOS rate across the canopy. During this drive toward the turn circle power modulation may be used to control airspeed. While greater than 200 KIAS is acceptable for the break turn, use caution allowing the airspeed to accelerate past 227 KIAS as there will be an increase in over-G potential. A slight climb may also be used to control airspeed and generate vertical turning room.

Figure A3.10. Initial Move.

A3.9.4.2.2. **Turn Circle Entry Cues.** When the training aircraft's aspect appears to be stabilized and the LOS rate increases, the maneuvering aircraft has entered the turn circle. This is the point the break turn should be executed (see below). If a roll out was used during the drive to align turn circles it is imperative to anticipate these cues in order to set the lift vector prior to the LOS increase.

A3.9.4.2.3. **Break Turn.** The goals of the break turn are to realign fuselages as much as possible and decrease range while preserving enough energy and turning room to solve subsequent geometry problems. Heightened G awareness and careful reference to current G are required to prevent exceeding aircraft limits.

A3.9.4.2.3.1. **Timing.** A break turn too early results in cutting across the training aircraft's turn circle, which quickly decreases range but creates high AA and can lead to HCA problems. A break turn too late causes a turn circle overshoot and results in excessive lag and range. Depending on the FM level and aggressiveness of the training aircraft, a properly timed break turn should allow for closely aligned turn circles with decreased HCA and AA, while preserving the most energy for follow-on maneuvering.

A3.9.4.2.3.2. **Execution.** To execute the break turn, select MAX power and simultaneously roll to place the lift vector such that your POM will be on or slightly below the training aircraft and smoothly apply backstick pressure in a symmetrical pull to stop the training aircraft's LOS up the canopy.

A3.9.5. **FM Exercise Levels.**

A3.9.5.1. **Objective.** Levels provide a measure of difficulty of the exercise. They provide a building-block approach to develop fingertip flying skills and proficiency. Levels also provide a way to set training objectives.

A3.9.5.2. **Description.** See **Table A3.1.** The building-block approach is used in FM training by decreasing the maneuvering limitations of the training aircraft as the maneuvering aircraft's proficiency increases. FM level 1 and 2 are primarily used for student sorties. FM levels 3 and 4 are only flown on IP continuation training (CT) sorties under the supervision of properly certified IPs. FM levels 3 and 4 provide instructors with more tools and experience to handle abnormal situations.

Table A3.1. Fluid Maneuvering Exercise Levels (Training Aircraft).

FM Level	Maneuver	Gs	Airspeed	Power
1	Level to slightly descending (±10º)	1 to 2	180 to 220	70-85% Torque
2	Slight climb/descent (MAX 120º bank and ±30º pitch	2 to 4	150 to 250	85%-MAX Torque
3	Level to slightly descending (±10º) (note 1)	Approx 2	180 to 220	70 to 85% Torque
4	Slight climb/descent (MAX 120º bank and ±30º pitch (note 1)	2 to 4	150 to 250	85%-MAX Torque
NOTES: 1. Training aircraft may reverse turn IAW with 9.54.12 and 9.54.13.				

A3.9.5.3. **Procedures.**

A3.9.5.3.1. **FM Level 1.** FM Level 1 is used to introduce the initial concepts required to recognize and maneuver to the turn circle of the training aircraft. The building block approach is used to limit the training aircraft and allow time for the maneuvering aircraft to drive to the turn circle, recognize the entry cues and react appropriately to stabilize the aircraft in the ET cone. With a properly timed and executed break turn, the maneuvering aircraft should arrive in the ET cone on the initial move. The setup and execution will be as previously discussed.

A3.9.5.3.2. **FM Level 2.** FM Level 2 builds on the skills introduced in FM Level 1 by allowing the training aircraft to maneuver more aggressively, thus requiring the maneuvering aircraft to recognize and react in a more timely manner under more dynamic conditions. Due to the higher G available and tighter turn circle of the training aircraft, it is imperative that the maneuvering aircraft effectively use pursuit curves and power modulation to arrive in the ET cone with sufficient energy for follow-on maneuvering. This may require two or more iterations of the initial moves discussed in 9.54.8. to further align turn circles and HCA. The setup and execution will be as previously discussed.

A3.9.5.3.3. **FM Level 3 (Not Used During Undergraduate Training).** FM Level 3 utilizes three passes (Alpha, Bravo, Charlie) to illustrate several student errors IPs may face and provides the tools necessary to safely intervene and maintain formation deconfliction. Although the setup is executed the same as FM Levels 1 and 2, the maneuvering aircraft will include a deliberate error to drive a specific DLO. Between each pass, the maneuvering aircraft may call "*Texan 2, resetting for A/B/C pass*" and lag to the outside of the training aircraft's turn circle to establish approximately 2,500 feet. The training aircraft may facilitate the setup by easing off the turn to open up the turn circle. Once the maneuvering aircraft is established at 2,500 feet, a "fight's on" call will be made to signal the start of the next pass.

A3.9.5.3.3.1. **Alpha Pass.** The first pass shows how out-of-plane maneuvering towards the training aircraft's high 6 o'clock can be used to solve high AA and closure. This situation represents a common student rejoin error due to an aggressive rejoin line combined with late recognition of excess closure.

A3.9.5.3.3.1.1. **Execution.** At the "fight's on" call, use power as required and execute a low yo-yo to create lead pursuit and maneuver towards a 9 AA. As closure develops with lead pursuit, the AA will increase and range will decrease. Maneuver as necessary to maintain a 9 AA while avoiding a 3/9 line violation. Approaching 500 feet, maneuver out of plane from the training aircraft towards the high 6 o'clock position. This may result in briefly losing sight of the training aircraft as the flight path crosses high and to the outside of the training aircraft's turn circle. Crossing the turn circle, continue above the training aircraft's POM and bank back toward the direction of turn to regain sight and realign fuselages. A lag roll may be used to maintain sight throughout the reposition. Remain slightly outside of the training aircraft's turn circle to reestablish 2,500 feet of separation for the Bravo pass, or ensure forward LOS is observed before maneuvering back to the rejoin line.

A3.9.5.3.3.2. **Bravo Pass.** The second pass demonstrates the use of lag pursuit to control AA and closure similar to a rejoin overshoot except in a more dynamic phase of flight, such as ET. This replicates a situation during ET where lead reverses the turn with no SA that the wingman overshot to save the bubble or 3-9 line.

A3.9.5.3.3.2.1. **Execution.** Use the low yo-yo to increase aspect towards a 9 AA. At approximately 1,000 feet from the training aircraft, use lag to decrease AA. Plan the maneuver to attain a 6 AA at a range of approximately 500 feet.

The 6 AA is achieved when the leading edge of the tail is approximately aligned with the aft end of the opposite wingtip. The maneuvering aircraft must then establish a POM that is slightly above or below lead approaching the 6 o'clock. When crossing the training aircraft's 6 o'clock (0 AA) position (inside of 500 feet, but in no case violating the 300 foot bubble), exaggerate the flight path overshoot with increased angle off. With SA or as directed by the maneuvering aircraft, the training aircraft will reverse the direction of turn, increasing closure and aspect. To control closure and complete the reposition, maneuver to the training aircraft's new high 6 o'clock position. Reestablish 2,500 feet of separation or ensure forward LOS is observed before maneuvering back to the rejoin line.

A3.9.5.3.3.3. **Charlie Pass.** The third pass will illustrate how earlier intervention and appropriate use of power, G, and pursuit curves can solve most problems students may present.

A3.9.5.3.3.3.1. **Execution.** Pull lead and allow the AA to increase towards a 9 AA. At approximately 1,000 feet, begin using lead and lag pursuit to control AA and HCA. Plan to fly to a stabilized goal position (500 feet from the training aircraft with approximately a 4 AA and fuselages aligned). A 4 AA reference is the vertical tail on the wingtip. Approaching the stabilized position, modulate power to help control closure. Varying Gs during maneuvering will also help to control energy.

A3.9.5.3.4. **FM Level 4 (Not Used During Undergraduate Training).** The objective of FM Level 4 is to demonstrate an understanding of the aforementioned principles while the training aircraft maneuvers through a greater range of pitch and airspeed variations. This provides the opportunity to recognize and react to unexpected student errors like those that are common during poorly flown rejoins, ET and FM.

A3.9.5.3.4.1. **Execution.** The maneuvering aircraft will attempt to maneuver to and stabilize in the ET cone by using the skills learned in previous FM levels. Errors may be introduced to achieve specific DLOs if desired. The training aircraft, with SA or as directed by the maneuvering aircraft, should reverse the direction of turn several times to create closure and angle problems.

A3.9.5.3.5. **Transition to ET.** If briefed, FM may culminate with a transition to the maneuvering phase of the ET exercise. Once established in the ET cone the maneuvering aircraft will call "*Texan 2's in*", after which both pilots will adhere to ET parameters and restrictions.

A3.9.5.3.6. **Post-Terminate Flow.** Under normal circumstances the maneuvering aircraft will terminate the exercise when the DLOs have been met. If lead does not direct a new formation, fighting wing should be maintained until directed otherwise. The normal post-terminate maneuver is a reset to tactical with a climb back to the starting altitude block. The reset to tactical is dynamic due to the likely differences in energy between lead and wing.

A3.9.5.3.6.1. As soon as practical lead should direct the formation back to tactical in the most expeditious manner depending on the geometry, airspace, and environmental conditions. A common technique to establish LAB is for lead to direct the maneuvering aircraft to lag the training aircraft and for the training aircraft to reverse their turn to put the formation line abreast. Both aircraft should then begin a climb with MAX power and the briefed airspeed (normally 160 KIAS) to the starting block.

A3.9.5.3.6.2. Once established in the climb, the wingman's primary responsibility is to maintain the appropriate climb airspeed and, secondarily, to establish tactical spacing. Depending on energy states at the "terminate" call, a significant altitude difference between the two aircraft may develop in order to maintain LAB and proper airspeed. This is acceptable as long as visual is maintained.

A3.9.5.3.6.3. During the climb it is imperative that both aircraft maintain the briefed climb speed without bleeding off airspeed in the turns. Lead may elect to turn at less G than a level tactical turn, therefore the wingman must evaluate lead's turn rate and adjust turn timing and geometry to stay in position. Typically these turns are referred to as "easy" turns (ex: "*Texan, easy hook right/left*").

A3.9.5.3.6.4. While climbing back to the starting block, it is a good time to accomplish an ops check and preparatory call for the next set (ex: "*Texan, next set FM level 2 for 2*", "*2*"). If required, lead may direct a check turn left or right to force the wingman to LAB and facilitate the next setup.

A3.9.5.3.6.5. Once the formation is re-established in the block the wingman will stack level.

A3.10. Two-Ship Low-Level Navigation.

A3.10.1. **Objective.** Maneuver a formation safely through a selected ground track while avoiding threats to arrive at a designated time over target (TOT).

A3.10.2. **Description.** A successful two-ship low-level navigation mission will require a combination of solid low-level navigation practices, formation skills, and discipline.

A3.10.3. **Procedures.**

A3.10.3.1. **Mission Analysis.** Mission analysis for a two-ship low-level mission is generally more involved than a single-ship low-level or a standard formation mission. The major addition in the planning process is that the turn points and ground track may need to be altered to ensure the formation stays in the corridor, avoids threats, and can adjust for significant terrain changes. Extra time should be spent during the route study and briefing phases to ensure all formation members are aware of where the wingman should fly to comply with the considerations above.

A3.10.3.2. **Formation Types.**

A3.10.3.2.1. **Tactical Line Abreast.** When flying low over relatively level terrain, LAB formation works well. LAB provides an excellent formation for clearing in a high-threat section environment. However, it is less flexible and requires a greater degree of planning. The LAB parameters described in **paragraph A3.2**. should be used, but the wingman should not stack lower than lead.

A3.10.3.2.2. **Wedge.** Utilize wedge when substantial maneuvering is required, such as over terrain with significant vertical development. Wedge gives the wingman the flexibility to alter sides as necessary and may lessen lead's saturation in ensuring the wingman is on the proper side. The wedge parameters in **paragraph A3.6.** should be used, but the wingman should stack no lower than lead. Turns do not need to be called over the radio.

A3.10.3.2.3. **Fighting Wing.** When aggressive maneuvering is required, fighting wing may be flown. Fighting wing offers a great deal of flexibility, but drastically reduces the wingman's ability to clear for the formation. The fighting wing parameters described in Section 9D should be used, but the wingman should stack no lower than lead.

A3.10.3.3. **Departure.** To enhance clearing and preparation for route entry, send the wingman to tactical formation as soon as possible after takeoff. Unless weather or other conditions dictate, maintain LAB to the route entry.

A3.10.3.4. **Route Entry.** In a relatively short span of time, lead must locate the entry point, maneuver the formation as necessary for course alignment, call entering the route, accelerate to the planned airspeed, and call the time hack over the radio. Before commencing navigation in the low level environment, flight lead should ensure the formation has set the appropriate altimeter setting for the SR route being flown. Prior planning and solid SA are imperative for a smooth entry into the low-level structure.

A3.10.3.5. **Low-Level "Contract" and Priorities as Lead.**

A3.10.3.5.1. **Navigate and Clear.** Use single-ship low-level route and timing corrections to fly the route, identify all turn points and threats, and be in a position to arrive at the target on time. In addition to single-ship techniques, formation check turns, tactical turns, and shackles may be incorporated. Roll out of each turn on the heading for the next leg. Find, call out, and avoid any threats (traffic, birds, obstacles, etc.) that could be a factor to the formation. If able, position the wingman on the side opposite the threats. Climb the formation in sufficient time to avoid all factor obstacles along the planned ground track unless able to visually acquire and ensure lateral separation IAW AFI 11-202V3 and 11-2T-6V3. If obstacle clearance for the wingman is questionable, lead may direct the wingman to climb without climbing the formation. TAS may help to focus the visual lookout and provide additional SA on traffic outside the formation.

A3.10.3.5.2. **Maintain SA on the wingman.** Direct formation adjustments as necessary and stay aware of the wingman's fuel state. Initiate ops checks at appropriate intervals.

A3.10.3.5.3. **Communications.** Use standard brevity code IAW AFTTP 3-2.5 *Multi-Service Brevity Codes* when referring to threats (towers, traffic, etc.). Unless local standards dictate or lead briefs otherwise, formations should use the following verbiage to communicate threats:

A3.10.3.5.3.1. The first flight member to see the obstacle transmits his or her call sign and the clock position (relative to their own nose) and approximate range of the obstacle (ex: "*Texan 2, tower, 1 o'clock, 4 miles*"). The other flight member acknowledges (ex: "*Texan 1, contact*" or "*Texan 1, negative contact*"). If immediate action is required to ensure safety of flight, use directive, and then descriptive comm (ex: “*Texan 1, climb, tower, 1 o’clock, 1 mile*”).

A3.10.3.6. **Low-Level “Contract” and Priorities as the Wingman.**

A3.10.3.6.1. **Maintain vigorous visual lookout.** In addition to deconfliction, do not hit the ground or anything attached to it. Although lead is responsible to clear for the formation, do not hesitate to climb for own-aircraft obstacle clearance.

A3.10.3.6.2. **Be in Position or Correcting.** Always strive for the directed or briefed formation position unless safety dictates otherwise. In LAB and wedge, stack no lower than lead. Lead should be on or slightly below the horizon. Whenever a flight path conflict with lead exists, cross high in relation to lead.

A3.10.3.6.3. **Navigate.** Only after accomplishing previous priorities, strive to maintain sufficient positional awareness on navigation, route, and timing to know when to expect key events such as threats, turns, and target acquisition. Strive to maintain enough SA to confidently assume the lead if necessary.

A3.10.3.7. **Two-Ship Low-Level Maneuvering.**

A3.10.3.7.1. **Contract Turn.** Plan and fly turns at low altitude by continually looking outside and in the direction of turn using MAX power and G (2-3 Gs) to hold planned airspeed. It is critical that each pilot ensures the aircraft is not descending in the turn as any over-bank or incipient sink could result in impact with the terrain.

A3.10.3.7.2. **Low-Level Turns as lead.**

A3.10.3.7.2.1. **Wingman on the Inside of the Turn.** Begin the contract turn over the planned turn point to keep the aircraft on the planned ground track. The wingman should climb to deconflict flight paths, if necessary.

A3.10.3.7.2.2. **Wingman on the Outside of the Turn.** Direct the wingman to turn early enough to allow for lead to delay the turn until over the planned turn point. Since most turns are not exactly 90 or 45 degrees, turn timing may vary from the references described in paragraph **A3.3.** For example, a turn of greater than 90 degrees will require the second aircraft to turn sooner than the normal 90-degree turn reference.

A3.10.3.7.2.3. **Turns of 30 Degrees or Less.** Normally, turn to the new heading using a check turn; a delayed turn is not necessary.

A3.10.3.7.3. **Low-Level Turns as the Wingman.** Anticipate the turn and be vigilant for lead’s signal. Have the roll out heading in mind, execute a contract turn, and climb to deconflict if necessary. Since degrees of turn will vary, it may be necessary to vary power and/or G loading to compensate and roll out in proper tactical position. Once lead is established on the next leg of the route, expeditiously correct back to the briefed or directed formation position as required.

A3.10.3.8. **IP to Target Flow.**

A3.10.3.8.1. **Target Run.** Lead will normally direct the wingman to wedge prior to the IP to target run. From LAB, the wingman may use a check turn into or away from lead, along with power modulation, to establish the wedge position. The wingman will maintain the directed position until necessary to overfly the target in level flight.

A3.10.3.8.2. **Target Egress.** The flight lead will plan and brief a method for achieving the desired tactical formation (normally LAB) off-target. A common technique is for lead to execute an immediate in-place turn followed by a reversal to put the wingman LAB. The wingman should typically establish the next leg heading upon target egress.

A3.10.3.9. **Low-Level Lead Change.** Accomplish the lead change IAW AFI 11-2T-6V3. Normally, initiate the lead change over the radio from tactical formation.

A3.10.3.10. **Contingencies.** During any abnormal circumstances, it is critical to ensure terrain clearance and remain aware of the formation's fuel state, other aircraft scheduled on the low-level, other threats, and degraded situational awareness. As a general rule, initiate a climb to at least 1,000 feet AGL prior to analyzing any abnormal situation.

A3.10.3.10.1. **Lost Sight Situations.**

A3.10.3.10.1.1. **Wingman's Actions.** During low-level tactical turns, a momentary blind situation is acceptable as long as sight of lead is regained at an appropriate time. If not regained or if sight of lead is unexpectedly lost at any other time, transmit your callsign along with "blind" IAW AFI 11-2T-6V3. Maintain current heading and climb to 1,000 feet AGL or as briefed to help ensure deconfliction and terrain clearance while searching for lead. Once visual with lead, call "visual" and continue the mission. If unable to regain sight of lead after the climb, continue to ensure terrain clearance and follow lead's instructions.

A3.10.3.10.1.2. **Lead's Actions.** If visual, climb to 1,000 feet AGL and talk the wingman's eyes on (ex: "*Texan 1, visual, left, 9 o'clock, 1 mile*"). Consider a shallow wing rock, reference to prominent ground features, or have the wingman turn on TAS/squawk to aid the wingman in reacquiring visual. Once the wingman is visual, descend and continue the route.

A3.10.3.10.2. **"Double-Blind" Situation.**

A3.10.3.10.2.1. **Wingman's Actions.** See "Lost Sight Situations" above.

A3.10.3.10.2.2. **Lead's Actions.** Once both aircraft have called blind IAW AFI 11-2T-6V3, direct the wingman to climb to an MSL altitude that equates to 1,500 feet AGL and reference the current planned heading (ex: "*Texan 2, climb 2,700, reference 007*"). Maintain current heading and altitude until the wingman is established. Once altitude deconfliction is assured, lead should climb to 1,000 feet AGL. Lead should be directive and use the techniques from "Lost Sight Situations" above to regain visual.

A3.10.3.10.2.3. If visual is regained, descend and continue the route.

A3.10.3.10.2.4. If unable to regain visual, both aircraft may continue to the next turn point while maintaining altitude deconfliction, using landmarks along the route to try to find each other. When arriving at the next turn point, if visual mutual support has not been regained, lead will be directive. Do not continue the route as a formation. As a technique, lead may direct the wingman to climb out of the MTR to a VFR hemispheric altitude and orchestrate a single-ship recovery. Lead may then continue to the next turnpoint before executing a separate single-ship recovery. This will ensure lateral separation for the formation.

A3.10.3.10.3. **Radio Failure.** If either aircraft experiences radio failure, climb to a minimum of 1,000 feet AGL, give the appropriate AFI 11-205 visual signals and recover VFR IAW local guidance. It may be necessary to collapse range to exchange visual signals, but do not proceed closer than 500 feet until directed.

A3.10.3.10.4. **IMC Route Abort.** If the route cannot be continued due to weather, lead should make every attempt while aborting the route to keep the formation in VMC. If unable to maintain VMC, in-place turns, hook turns, and fighting wing may be utilized as required until able to rejoin the wingman and obtain an IFR clearance.

A3.10.3.10.4.1. **Wingman rejoined prior to IMC.** Comply with single-ship IMC route abort procedures in paragraph **8.25.3.**

A3.10.3.10.4.2. **Wingman unable to rejoin prior to IMC.** In addition to complying with single-ship IMC route abort procedures, lead must ensure formation deconfliction. Simultaneously direct the formation to execute an immediate climb to the Emergency Route Abort Altitude (ERAA) and ensure heading and altitude deconfliction between aircraft (ex: "*Texan 2, climb 5,500, reference 180*", "*2*"). Lead should ensure a minimum of 1,000 feet separation above the ERAA. It may be necessary to establish diverging headings for deconfliction during the climb. Having the wingman turn on TAS and squawk may also aid in establishing deconfliction. Although single-ship route abort procedures must be complied with, formation and obstacle deconfliction is the number one priority.

Attachment 4

AHC PROGRAM

A4.1. Overview of the AHC Program. The AHC program provides IPs an in-depth look at the handling characteristics of the T-6A when operated at the very edges of the envelope. The program focuses on the effects of torque on spins, stalls, and slow flight; alternative weather penetration ELP profiles; and aircraft ELP capabilities from within the standard pattern.

A4.2. AHC IP Certification. Only AHC IPs certified according to AFI 11-2T-6, Volume 1, *T-6 Aircrew Training,* will conduct AHC training. Operations group commanders will determine the minimum number of AHC IPs necessary to accomplish the mission.

A4.3. AHC IP Currency. See AFI 11-2T-6 Volume 1, *T-6A Aircrew Training*

A4.4. AHC Sortie Overview. AHC sorties are designed to allow the IP or PIT student to observe and practice AHC maneuvers to ensure an understanding of the aircraft's capabilities and characteristics during each maneuver performed.

A4.5. Preflight Review. Prior to the sortie, the pilot will review Section III and VI of the T-6A flight manual; this manual; and AFI 11-2T-6, Volume 3; to include:

A4.5.1. OCF entry procedures and restrictions.

A4.5.2. OCF recovery procedures.

A4.5.3. Stability demonstration procedures, characteristics, and engine limitations.

A4.5.4. Stall characteristics and restrictions.

A4.5.5. Weather conditions and restrictions for stalls, spins, and ELPs.

A4.5.6. AHC ELP profiles.

A4.6. Preflight Briefing. The preflight briefing should include objectives of the flight, details and sequence of each maneuver to be accomplished, and an explanation of the expected results in each of the maneuvers.

A4.7. Sortie Profile.

A4.7.1. **Restrictions and Requirements.**

A4.7.1.1. No more than two aircraft total (one in the tower controlled pattern at Randolph AFB PIT and 479FTG, NAS Pensacola) are allowed in the pattern during AHC operations.

A4.7.1.2. Only AHC sorties will be in the pattern when an aircraft is conducting AHC maneuvers.

A4.7.1.3. Only AHC maneuvers will be conducted during AHC pattern times.

A4.7.1.4. ELPs must be flown in a runway supervisory unit (RSU)-controlled pattern. Additionally, an AHC controller must be the active controller.

A4.7.1.4.1. Randolph AFB PIT may conduct AHC pattern operations in the tower controlled pattern. The 12 OG will ensure that AHC ELPs flown in the Randolph AFB tower controlled pattern will be flown under the supervision of a tower controller and SOF who have received an orientation on T-6 AHC ELP operations. This orientation will be given by the runway supervisory unit training and standardization officer, runway supervisory unit training officer, or the SOF program manager and will cover basic AHC ELP operations as well as the SOF/tower controller's role in making safety-of-flight radio calls (i.e., "go around," "discontinue").

A4.7.1.4.1.1. Randolph AFB PIT may conduct AHC maneuvers in the tower controlled pattern as long as the supervisor of flying [SOF] monitors pattern operations, and any one of the following conditions are met:

A4.7.1.4.1.1.1. No other aircraft monitored by the SOF are airborne in the local area.

A4.7.1.4.1.1.2. The only other airborne aircraft in the local area is a single FCF sortie or an additional AHC sortie accomplishing the area profile. Only one aircraft may be in the pattern during the AHC sterile period.

A4.7.1.4.1.1.3. An additional SOF is in the tower with the sole responsibility of monitoring the AHC sortie. If an additional SOF is in the tower, there is no limit to the number of local aircraft airborne during the AHC, however, only one aircraft may be in the pattern during the AHC sterile period.

A4.7.1.4.2. 479FTG will conduct AHC pattern operations in the Pensacola NAS tower-controlled pattern. 479FTG/CC will ensure USN tower controllers receive an orientation briefing on T-6 AHC pattern operations. This orientation will cover AHC ELP pattern operations, with specific guidance on the tower controller's role in making safety-of-flight radio calls ("go around/wave-off", "discontinue", etc.)

A4.7.1.5. Opposite-direction and crossing or parallel runway landings will not be attempted. In zone B, assess the energy level of both approach end and departure base keys, then intercept a normal inside downwind ground track. In addition, crews will not practice takeoff emergencies below 500 feet AGL.

A4.7.1.6. Crews will use **O**n profile, **R**unway in sight, and safely **M**aneuver to land 3-2-1 (**ORM 3-2-1**) gate heights as minimum altitudes. At 300 feet AGL (**3**), the crew should determine whether to continue or not. No later than 200 feet AGL (**2**), the crew will confirm the gear down. At no less than 100 feet AGL (**1**), the aircraft will be on center line (or alternate sides for reduced runway separation) for landing.

A4.7.1.7. Following an initial torque reduction, the pilot flying (PF) will set the PCL to 4 to 6-percent torque or direct the pilot not flying (PNF) to set 4- to 6-percent torque. Torque will be fine tuned to 4 to 6 percent by the PNF only after the ELP has been approved and the PF directs, "set torque." Once 4- to 6-percent torque is set, the PNF will respond with "torque is set," informing the PF that no further adjustment will be made by the PNF.

A4.7.1.8. Crews will lower the gear normally and then announce on the intercom, "simulate emergency gear handle pull." The emergency gear handle will not be activated unless it is required in an actual emergency.

A4.7.1.9. ELPs will not be attempted from zones A or G or from other areas not defined. 479FTG-assigned pilots are not required to perform AHC ELP training from Zones C & D at NAS Pensacola.

A4.7.1.10. Crews will refer to MAJCOM and local guidance for pattern deconfliction rules and radio calls.

A4.7.1.11. To avoid entering IMC during an AHC sortie where OCF recoveries are required, a minimum of 10,000 feet of airspace clear of clouds must exist below OCF entry altitude. In addition, minimum weather must allow line of sight to a suitable airfield within engine-out glide range or the minimum obscuration (few, scattered [sct], broken [bkn]) to be 4,000 feet AGL with a minimum of 5 miles visibility.

A4.7.2. **Best Rate-of-Climb Takeoff (Optional).** This maneuver demonstrates the T-6A best rate of climb. Perform this maneuver according to Section II of the T-6A flight manual. Rotate to 15 degrees nose high after liftoff and accelerate to the best rate-of-climb speed of 140 knots indicated airspeed (KIAS), using normal procedures until reaching 5,000 feet mean sea level or as directed locally.

A4.7.3. **Slow Flight (Torque Demonstration).** The purpose of the slow flight profile is to demonstrate the effects of torque on the aircraft while operating in the *very slow* flight regime. Start by accomplishing pre-stall, spin, and aerobatic checks. Then, at a safe altitude, slow the aircraft below 150 KIAS and configure with landing gear down and landing flaps. Continue reducing airspeed to approximately 80 KIAS (about 15 units of AOA), while setting approximately 45-percent torque. Note that the stick shaker may be on throughout the demonstration. Accomplish the following procedures:

A4.7.3.1. **Straight and Level.** This slow flight maneuver demonstrates operating the aircraft on the *back side of the power curve*. Pilots must understand that increased AOA will result in increased drag and a stall if not carefully flown. Note the pitch attitude, torque, and rudder deflection required to maintain straight-and-level flight. This is the picture a pilot should see at rotation during takeoff or just prior to touchdown during landing.

A4.7.3.2. **Control Effectiveness.** Rapid control inputs, especially in the flare, often do not give the aircraft sufficient time to respond to the inputs. While moving the ailerons with small, rapid movements, notice that even though the ailerons are moving, the controls have little effect on changing the heading or bank of the aircraft during slow flight. In slow flight, less airflow over the control surfaces requires smooth, positive inputs to effectively control the aircraft.

A4.7.3.3. **Torque.** The T-6A has an initial tendency to pitch up, yaw, and roll left if the pilot does not maintain positive control during full power takeoffs, go-arounds, missed approaches, and the go portion of touch-and-gos. To demonstrate this, quickly increase power to MAX from straight-and-level coordinated slow flight and let go of the controls. Note that the nose tracks up, yaws, and rolls left approaching a stall. Recover from the buffet prior to the stall. Reestablish slow flight and increase power to MAX again. This time, hold the proper takeoff pitch and apply a coordinated rudder to maintain a proper nose track. Emphasize that positive control of the aircraft will allow a safe takeoff, touch-and-go landing, or go-around.

A4.7.4. **Stability Demonstration.** The purpose of the stability demonstration is to show that the aircraft will not spin if it is not stalled (even though there is yaw induced by torque). It also shows the effect of different torque settings on the aircraft in this flight regime. Accomplish the following procedures:

A4.7.4.1. **Idle.** Accelerate to 160 KIAS and set 60 percent torque. Increase the pitch smoothly to 45 degrees nose high. Allow the airspeed to decay, using back stick pressure to maintain 45 degrees pitch and ailerons to maintain wings level. Apply enough rudder inputs for coordinated flight. Passing 80 KIAS (or at first stick shaker), select idle power and position the stick and rudder to neutral. Note that there is some nose track to the left as the nose smoothly falls through the horizon. The aircraft will not stall as long as neutral stick is maintained. When the nose is well below the horizon, recover from the dive. Use power as required when the engine parameters (for example, oil pressure) are confirmed within limits and stable.

A4.7.4.2. **Sixty Percent Torque.** Accelerate to 160 KIAS and set 60 percent torque. Increase the pitch smoothly to 45 degrees nose high while using coordinated rudder. Allow the airspeed to decay, using back stick pressure to maintain 45 degrees pitch and ailerons to maintain wings level. Apply enough rudder inputs for coordinated flight. Passing 80 KIAS (or at first stick shaker), position the stick and rudder to neutral. Note that the nose falls and the aircraft smoothly rolls significantly to the left. When the nose is well below the horizon, recover from the dive. Use power as required when the engine parameters (oil pressure) are confirmed within limits and stable.

A4.7.5. **Stall Series.** The stall portion of the AHC sortie demonstrates T-6A handling characteristics while stalled with different configurations and power settings. Perform AHC stalls above 6,000 feet AGL, complete the pre-stalling, spinning, and aerobatic checklists, and clear the working area prior to starting. Accomplish the following procedures:

A4.7.5.1. **Power-On Stalls.** In a wings level stall with idle power, typically the right wing will drop first at the point of stall. With higher power settings (greater than or equal to 60 percent) in the same situation, the effect of torque will typically cause the aircraft to roll left as it stalls. Gear position has little effect on stall characteristics, but extending the flaps (which lowers stall speeds) aggravates the roll off tendency (slightly right with power off, left with high power settings) at stall. Enter the stall setup near 140 KIAS and raise the nose approximately 30 degrees. Increase back stick pressure as required to maintain this attitude until past the stick shaker and into the stall (loss of control effectiveness). Emphasis during the AHC sortie is on recognizing torque effect vs. stall recognition and recovery. Recover the aircraft by relaxing back stick pressure and using power, ailerons, and rudder as required. Power-on stalls require only relaxing back stick pressure to allow the nose to decrease to approximately 2 degrees nose high. Looking straight ahead and feeling the aircraft response is the most effective technique to determine pitch attitude and rudder requirements. Perform power-on stalls with the configuration, torque, and bank angle shown in **Table A4.1**.

Table A4.1. Power-On Stalls.

Configuration	Torque	Bank Angle	Expected Result
Clean	Idle	Zero degrees	Roll right

	60 percent		Roll left
Gear/LDG flaps	Idle		Roll right
	60 percent	30 degrees left	Aggravated roll left
		30 degrees right	Aggravated roll to wings level

A4.7.5.2. **Full Aft Stick Stall.**

A4.7.5.2.1. The aft stick stall demonstrates that the aircraft can be fully stalled without a nose drop, and requires a composite cross-check to determine a stalled condition. Accelerate to 140 KIAS and raise the nose to approximately 30 degrees nose high. Then set approximately 30-percent torque. Use back stick pressure, ailerons, and coordinated rudder to maintain level flight until reaching full aft stick. Note that the stick shaker is activated, AOA is at maximum (beyond 18 units), airspeed is 80 to 110 KIAS, and vertical speed indicator (VSI) indicates a 1,500 to 4,000 feet per minute descent. Note how much effort it takes, using rudder and ailerons, to maintain wings level and that the pitch attitude remains at or near the horizon with no nose drop. Be aware that aggressive control inputs while in a deep stall may result in a pilot-induced oscillation and post-stall gyrations.

A4.7.5.2.2. Recover the aircraft by relaxing back stick pressure and using power as required. Use right rudder pressure as required to center the ball through the acceleration and recovery. Recovery is immediate with very little decrease in pitch. To confirm recovery, check that the AOA is below 18 units; the altimeter has stopped decreasing; and VSI has reversed.

A4.7.6. **Spin Series.** The spin portion of the AHC sortie demonstrates the characteristics of a spin and the effect of recovery controls. Because an unplanned departure from controlled flight can be quite abrupt and unnerving for most pilots, IPs must be familiar with aircraft departure characteristics and recovery procedures in order to properly teach them to students. Recovery from an inadvertent loss of control (including post-stall gyrations, incipient spins, steady-state spins, inverted spins, and spirals) can be accomplished by promptly reducing power to idle and positively neutralizing the flight controls in all axes. Patience and the maintenance of controls (including visual verification of control positions) are vital because the dynamics of any aircraft departure may prevent an immediate response of the aircraft to control inputs. Pilots will enter AHC spins with power at idle and pitch approximately 15 to 40 degrees nose high. The following spins will be accomplished during this portion of the sortie: (**Warning:** During AHC spin training, do not exceed four 360-degree turns from the application of rudder at spin entry until recovery controls are applied.)

A4.7.6.1. **Neutral Controls (OCF) Recovery.** This maneuver demonstrates spin parameters and the standard recovery technique used when the aircraft departs controlled flight. The IP will point out the AOA (full deflection 18+ units), airspeed (120 to 135 KIAS), and turn rate. Normally, an OCF recovery is initiated immediately when an out-of-control condition is recognized, typically within a turn or two. For purposes of this demonstration, however, the recovery will be delayed for at least two turns in order to look at the spin characteristics and show that the procedure remains effective.

A4.7.6.2. **Controls-Free Recovery.** This maneuver demonstrates the inherently stable characteristics of the aircraft. Trim the aircraft pitch into the green band before entering this spin. Once the aircraft has entered a normal erect spin, ensure the PCL is in idle and release all controls (including the rudder). The nose-down pitch angle and spin rate will increase, and the control stick will move slowly forward and in the direction of the spin. The stick will be forward of the pilot's knee and leaning in the direction of the spin with an accelerated turn rate when it *pops out* of the spin in a nose-low attitude. Take the controls immediately and recover from the ensuing dive.

A4.7.6.3. **Erect Spin Recovery (Simulator Only).** This maneuver demonstrates fully-developed spin characteristics and the ability to rapidly recover from a spin by applying anti-spin control inputs. The IP will point out the AOA (full deflection 18+ units), airspeed (120 to 135 KIAS), and turn rate. The turn needle will be deflected in the direction of spin. For purposes of this demonstration, the recovery will be delayed for at least six turns in order to observe spin characteristics and demonstrate spin recovery using anti-spin control inputs. Erect spin recovery is prompt after recovery controls are applied. In all cases, as the control stick is moved forward and rudder is applied opposite to the direction of turn needle deflection, the pitch attitude will steepen and spin rate will initially increase. Approximately 50 pounds of push force will be required to move the control stick well forward of the neutral position. Avoid excessive forward stick input, as it will result in a steeper nose-low attitude and possibly negative G. Spin rotation will abruptly cease with the aircraft in a steep nose-down attitude within one and one-half turns after applying controls. Controls should be neutralized and a smooth pullout initiated to stop the loss of altitude and prevent airspeed from building excessively. Apply the following erect spin recovery steps after six turns:

Table A4.2. Erect Spin Recovery Steps.

1. Gear, flaps, and speed brake - Retracted
2. PCL - IDLE
3. Rudder - Full opposite to turn needle deflection
4. Control stick - Forward of neutral with ailerons neutral
5. Smoothly recover to level flight after spin rotation stops
NOTE: This maneuver will only be flown in the OFT, and will be included in the pre-AHC simulator profile (normally in conjunction with TI (or during ENJJPT PIT) as directed in AFI 11-2T-6, Volume 1.). If follow-on (10-18month) AHC sorties are flown in the OFT, the erect spin recovery demonstration will be included in the simulator profile.

A4.7.6.4. **Spiral Recognition and Recovery (Simulator Only).** The high-speed spiral is characterized by a nose low attitude, high roll rates and rapidly increasing airspeed. A spiral is a rolling and/or yawing motion of the aircraft that is often mistaken for a spin, but is not steady-state in that airspeed is increasing through 160 KIAS and motions are oscillatory. A spiral can result from misapplication of pro-spin controls (insufficient rudder or aft stick), typically seen during an improper set-up for a planned OCF maneuver. A spiral may easily be confused with a spin if the pilot relies solely on the interpretation of outside references and fails to accomplish a proper analysis of the cockpit flight instruments. Should the pilot misinterpret a high-speed spiral as a spin, it is highly unlikely that anti-spin inputs will affect a successful recovery, and will likely aggravate the condition. The cockpit indications differ significantly from those of a steady state, erect spin. The aircraft is not stalled; therefore, AOA will not be pegged as in an erect spin. Airspeed will most likely be rapidly building through 140 KIAS. The rate of descent will exceed that of a steady state spin because of the high airspeeds ultimately attained through this flight regime. The turn needle will, however, be fully deflected in the direction of the roll. The key to a safe recovery lies in the expeditious recognition of the aircraft's actual flight condition. For this demonstration, set up a typical OCF entry using IDLE power, 15-40 degrees nose high. At 80 knots, apply full aft stick and ½ rudder input (not full) in the direction of desired spiral. Maintain these control inputs and observe both outside and cockpit indications (AOA, turn needle, airspeed). Slowly relax the stick forward following two turns and observe roll rate and airspeed increase. As airspeed passes 160 KIAS, neutralize the controls using OCF recovery procedures and recover to level flight. **Note: This maneuver will only be flown in the OFT, and will be included in the pre-AHC simulator profile (normally in conjunction with TI (or during ENJJPT PIT) as directed in AFI 11-2T-6, Volume 1). If follow-on (10-18month) AHC sorties are flown in the OFT, the spiral recognition and recovery demonstration will be included in the simulator profile.**

A4.7.7. **ELP Series - General.** Pilots flying a single-engine airplane must be aware of the aircraft's engine-out capabilities. While ELPs are practiced in VMC, situations may arise where a pilot must be aware of different methods for recovering an engine-out T-6A through a cloud deck. In addition, a T-6A pilot instructing primary students may expect to spend a significant amount of time in the traffic pattern. An engine failure in the pattern requires quick thinking and instinctive reactions to optimize chances of a successful recovery. Both of these situations require a familiarity with ELPs. (For purposes of the AHC sortie, an ELP is defined as one that does not pass through high key.) This series is designed to demonstrate the engine-out profiles for weather penetration and techniques for engine failure in the standard pilot training pattern. The AHC sortie will consist of a high-speed ELP, straight-in ELP, and pattern ELPs from zones B, C, D, E, and F (**Figure A4.1**). Additional ELPs may be attempted, fuel and pattern saturation permitting. **Note:** If weather prevents accomplishment of the high-speed ELP and/or straight-in ELP during an AHC sortie, these maneuvers will be accomplished in the simulator.

A4.7.8. **Weather Penetration ELP Series.** Generally, there are three methods for recovering an engine-out T-6A through the weather. In all cases, the pilot must set a minimum acceptable weather to attempt the ELP. Whether a pilot will actually attempt an engine-out weather penetration will depend on the reported weather, his or her proficiency, familiarity with the airfield, obstructions, and minimum altitudes. For the following weather penetration ELPs, the pilot will simulate ceiling and visibility at 2,000 feet and 3 miles.

A4.7.8.1. **Classic ELP.** The first method is to fly a *classic* ELP from high key using the global positioning system (GPS) for situational awareness as described in **paragraph 5.18.6.** This method is just like a normal ELP practiced every day and will not be flown on the AHC sortie.

A4.7.8.2. **High-Speed ELP.** The high-speed ELP assumes there is sufficient energy to reach a high-key position. More energy is better. Excess energy will be converted into airspeed, which can be used to maneuver the aircraft to a low-key position when breaking out of the weather. For the AHC sortie, obtain approval to depart the military operating area, contact the RSU, and set up a 125-KIAS clean glide toward the intended field. For high-speed ELP training, the start point should be a locally developed point approximately 5 to 15 miles from the over-field point. Using either a navigational aid on the field or a GPS point as the overfield point, plan to intercept a one-to-one profile (1,000 feet of altitude loss for every mile traveled) and be over that point at 1,500 feet AGL. The aircraft will accelerate as the nose is pushed over to maintain profile. If intercepting the profile far enough away, the aircraft speed will stabilize at approximately 230 KIAS. Once below 2,000 feet AGL, maneuver to intercept the ELP profile at a modified low key. Perform a touch-and-go or low approach as appropriate.

A4.7.8.3. **Straight-In ELP.** A straight-in ELP is flown if energy is not sufficient to fly a classic or high-speed ELP. This is typically a last resort because (1) there is little room for error, and (2) wind effects weigh heavily on the planned profile. From outside downwind, continue out to 5 miles from the runway threshold and climb to 3,000 feet AGL. (**Exception:** When flown in the Randolph AFB tower controlled pattern, straight-in ELPs will be *modified* to remain within Randolph AFB class D airspace.) After receiving clearance from the RSU (or tower at Randolph), establish a 125-KIAS clean glide at 5 miles and 3,000 feet AGL, and monitor the profile. The target is to cross 1 mile at 600 to 800 feet AGL configured with gear and flaps as required. If the aircraft is maintaining a 2-to-1 profile, it would reach 1 mile at 1,000 feet AGL in a clean configuration. Therefore, if you are still on or near profile at 1.5 miles (approximately 1,250 feet AGL), configure with gear and flaps as appropriate to reach the target 600 to 800 feet AGL at 1 mile. Perform a touch-and-go or low approach as appropriate.

A4.7.9. **Pattern ELP Series (Figure A4.1). (Note: Figure A4.1** depicts the pattern ELP zones used in a nominal pattern. Pilots may alter the profile and ground track as mission needs dictate.)

A4.7.9.1. **Overview.** The typical US Air Force pilot training pattern can be divided into zones that define how the pilot should react to an imminent engine failure and where the pilot should attempt to intercept the ELP profile. The ELP series allows the pilot to see the worst case energy limitations of different pattern positions. Because pattern sizes vary from field to field, each IP must be aware that results may vary. Most, but not all, areas of the standard pattern are defined in paragraphs **A4.7.9.2.** through **A4.7.9.8.** (Areas not covered, but worthy of discussion, are the straight-in ground track, breakout and VFR entry, and go-around.) The defined zones assume a single runway and no wind. Crossing or parallel runways on an airfield provide numerous other possibilities for recovery. In most pattern ELP scenarios, pilots should:

A4.7.9.1.1. Simultaneously zoom the aircraft and turn toward the intended landing surface.

A4.7.9.1.2. Establish 125-KIAS clean glide and intercept the ELP at the appropriate point.

A4.7.9.1.3. Configure with gear and flaps as appropriate when landing is assured.

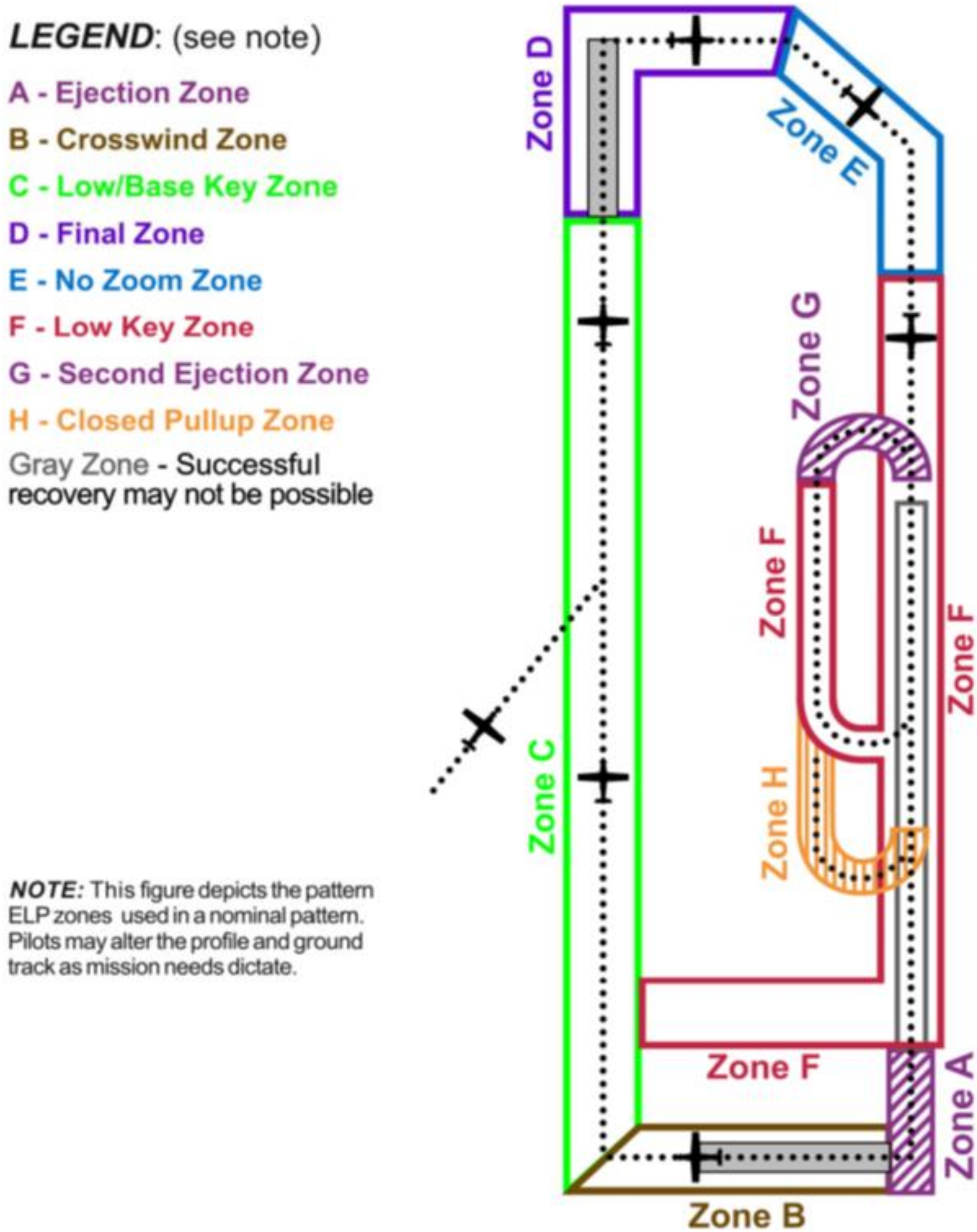
A4.7.9.2. **Zone A, Ejection Zone.** This zone is defined as the departure leg, past the point where an airplane can be landed straight ahead, until reaching approximately 1,000 feet AGL and 160 KIAS or until turning crosswind. If an immediate engine failure is experienced in this zone, the only option may be ejection. No simulated engine failures will be practiced in the aircraft in this zone.

A4.7.9.3. **Zone B, Crosswind Zone.** This zone is defined as departure leg at approximately 1,000 feet AGL and 160 KIAS or anywhere on crosswind until completing the turn onto outside downwind. On the AHC sortie, simulate an engine failure on crosswind. The reaction should be to simultaneously zoom and turn back to assess the energy level for a glide to a low-key (landing runway) or an opposite-direction landing. After making the energy assessment, discontinue the maneuver by adding power and proceed to inside downwind for a normal pattern, or high downwind or high key for an ELP. For any pattern where the crosswind turn is initiated at departure end, there may be sufficient energy to reach a modified low-key position for the normal landing direction.

A4.7.9.4. **Zone C, Low Key or Base Key Zone.** This zone is defined as most of outside downwind. On the AHC sortie, simulate an engine failure on outside downwind and attempt to intercept a low key or base key. The reaction should be to simultaneously zoom and turn toward low or base key. An engine failure just after turning onto outside downwind will be slightly low on energy, which may necessitate using less than the full runway. The energy state improves along outside downwind until passing abeam the approach end of the runway. Passing this point, the energy level starts to decrease until reaching zone D. Headwinds or gusts exceeding 15 knots may significantly reduce the ability to intercept Low Key or Base Key.

A4.7.9.5. **Zone D, Final Zone.** This zone is defined as the latter part of outside downwind and the 90-to-initial ground track. On the AHC sortie, simulate an engine failure in this zone. In this zone, because of the distance from the runway, the turn back to the runway is vitally important. The reaction should be to simultaneously zoom and start an aggressive turn back to the runway. If you are already on a 90-to-initial, most of the turn is out of the way. Therefore, the turn to the runway need not be as aggressive. In all cases, the attempted result is to intercept final. Depending on pattern size and winds, it may not be possible to get back to the runway from this far corner of the pattern.

Figure A4.1. An Example of Pattern ELP Zones.



A4.7.9.6. **Zone E, No Zoom Zone.** This zone is defined as a 45-to-initial through a 1-mile initial point. On the AHC sortie, simulate an engine failure in this zone. This zone is distinctly different than the rest of the pattern because the energy level is too low to intercept a low-key position but too high to intercept base key or final. The best technique in this zone is not to zoom but to maneuver the aircraft in level flight to dissipate excess energy and intercept base key or final. From 45-to-initial, either delay the turn or overshoot final or turn toward a low-key position as necessary, then back to the runway. From an initial, an immediate 45-to-90-degree level turn from the runway is required, then turn back to intercept base or final. From approximately a 1-mile initial, a 2G- to 3G-level 360-degree turn will dissipate enough energy to position the aircraft on final.

A4.7.9.7. **Zone F, Low Key Zone.** This zone is defined as 1-mile out on initial through the break until reaching the approach end of the runway on inside downwind configured. If carrying straight through the break point, this zone continues until intercepting zone C on the turn to outside downwind. On the AHC sortie, simulate an engine failure in this zone. The reaction should be to zoom (airspeed permitting) and turn toward a low-key position. The energy level is sufficient through most of this zone for a near normal low key. After turning crosswind on a break point straight through, the energy level will start to decrease. This might necessitate using less than the full runway.

A4.7.9.8. **Zone G, Second Ejection Zone.** This zone is defined as inside downwind past the approach end of the runway through most of the final turn. If an engine failure occurs once slowed down and configured in this zone, there will probably not be sufficient energy to make the runway, which will necessitate an ejection. No simulated engine failures will be practiced in the aircraft in this zone.

A4.7.9.9. **Zone H, Closed Pullup Zone.** This zone is defined as the closed pullup for an overhead pattern or low-key ELP, until reaching inside downwind or high downwind. An engine failure in zone H at a low-energy state (e.g., closed pullup initiated at lower airspeed and/or lower altitude) will be similar to zone A, where the only option may be ejection. At increased energy levels past departure end of the runway, a turn back to land opposite direction may be possible but a 360-degree pattern to land will usually not be an option unless engine failure occurs at a very high energy level. If the closed pullup was initiated prior to the departure end of the runway and an engine failure occurs at higher energy levels in zone H, energy may be sufficient to execute a 360-degree turn back to a touchdown near or abeam where the closed pullup was initiated, which may necessitate using less than the full runway. The higher the energy is in zone H prior to engine failure, the greater the opportunity will be to maneuver toward the approach end of the runway before initiating a low-key turn. The highest energy levels in zone H near or at closed downwind or high downwind eventually result in intercepting zone F. No simulated engine failures will be practiced in the aircraft in this zone.

A4.7.9.10. **ELP Summary.** Being able to land an engine-out, single-engine aircraft requires exceptional flying skills and airmanship. An engine failure while flying at low altitudes or in or above IMC further complicates an already difficult situation. Any combination of factors (weather, low altitude, strong winds, etc.) that task-saturate the situation, exceed the pilot's flying capabilities, or cause the pilot to feel he or she is unable to safely land an engine-out aircraft should lead to an aircrew ejection decision. However, planning for and practicing these challenging ELP conditions and situations (in the aircraft and OFT) will invariably increase the pilot's chances for a safe engine-out landing. The ELP series of the AHC sortie demonstrates some of the pilot techniques, aircraft capabilities, situational awareness, and judgment required for these challenging engine-out situations.