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Flying Operations

T-6 PRIMARY FLYING

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This publication contains the basic procedures and techniques that apply to all personnel operating T-6 aircraft under operational control of Air Education and Training Command (AETC). While this manual primarily addresses the student pilot, it provides the general guidelines for all T-6 pilots. It addresses basic flying tasks and planning considerations and is designed to be used in conjunction with AFI 11-2T-6, Volume 1, *T-6 Aircrew Training;* AFI 11-2T-6, Volume 2, *T-6A Aircrew Evaluation Criteria;* AFI 11-2T-6, Volume 3, *T-6 Operations Procedures;* and technical order (TO) 1T-6A-1, *Flight Manual, USAF/USN Series T-6A Aircraft.*

This manual presents a solid foundation on which student training missions can be accomplished and instructor continuation training maintained. It is not designed to be used as a step-by-step checklist of how to employ the T-6. When you encounter situations not specifically covered by this publication, use safety considerations as a guide in determining the best course of action.

The 12 FTW and 80 FTW will forward copies of any supplements to this manual with procedures for their unique mission requirements to 19AF/DO and HQ AETC/DO for post-publication review. Refer recommended changes and conflicts between this and other publications to HQ AETC/DOFV, 1 F Street, Suite 2, Randolph AFB TX 78150-4325, on AF Form 847, **Recommendation for Change of Publication.**

See **Attachment 1** for a glossary of references and supporting information. Maintain and dispose of records created as a result of processes prescribed in this publication in accordance with AFMAN 37-139, *Records Disposition Schedule.*

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Chapter 1

GENERAL INFORMATION

1.1. Introduction:

1.1.1. The objective of this manual is to provide techniques and procedures to aid you in becoming a professional T-6 pilot. To accomplish this goal, you must attain the highest degree of proficiency possible. This requires initiative, good judgment, trained reflexes, and skillful flying, which come only as a result of study, practice, and determination. The information you learn here will form the foundation of your military aviation career. Good study habits are essential. Every detail is important if you expect to be a safe, professional pilot. Some important information from other directives is included in this manual, but this information is not to be considered all-inclusive.

1.1.2. The majority of the skills and techniques you develop in pilot training will come from your assigned instructor, other instructors you fly with, and your own experiences. As you gain experience and confidence as a pilot, you will also be developing your ability to use sound judgment. This manual and other directives are vital to flying operations. But, because of the many different situations you will encounter as a pilot, they can only provide a basis for good judgment; they cannot replace it.

1.1.3. TO 1T-6A-1 (flight manual) contains detailed instructions for inspections, checks, and procedures. Additionally, it provides valuable background information necessary to understand the aircraft systems and why procedures and checks have been established. The flight manual and this publication complement each other.

1.2. Briefings:

1.2.1. **Preflight Briefing.** A preflight briefing precedes each mission throughout the Air Force. The aircraft commander or flight lead is charged with briefing the duties and responsibilities for each mission and ensuring objectives are met. A thorough briefing is absolutely essential to ensure safe and effective mission accomplishment. The aircraft commander or flight lead should start the briefing on time and emphasize overall mission objectives and individual flight member responsibilities. As a minimum, the briefing guides in AFI 11-2T-6, Volume 3, will be used and discussions on special interest items (SII) will be included. Students must be prepared for the briefing and be on time—no excuses.

1.2.2. **Postflight Debriefing.** After each flight, your instructor will review the mission. This review should clear up any mistakes made, but ask questions if you failed to grasp all the steps in any of the maneuvers. Becoming a military pilot demands that you understand each lesson fully. Be sure you understand your mistakes and how to correct them. The time to ask questions is immediately after the flight, when your problems or concerns are fresh in your mind.

1.3. Checklist Discipline. The flight crew checklist is an abbreviated version of TO 1T-6A-1 (flight manual) used by pilots to ensure procedures are followed. You do not have to refer to the checklist to complete each individual item, but you must refer to the checklist to ensure all items are completed. For example, complete a few items and then refer to the checklist to ensure all items are properly completed. (***EXCEPTION:*** It is not necessary to refer to the checklist during critical phases of flight.) Good checklist discipline is an integral part of military flying.

1.4. Visual Inspection:

1.4.1. The preflight check starts before you reach the aircraft. Survey the taxi routes for any obstructions such as repair work on or near the ramp, stray equipment, or personnel who might be harmed by the prop wash. A complete visual inspection of the aircraft is a very important part of each mission. Use particular care while checking the canopy fracture and ejection systems. Appropriate safety pins should be well seated.

1.4.2. The AFTO Forms 781 series is the official log of aircraft operation, servicing, and maintenance. The importance of checking the appropriate form in the series cannot be overemphasized. Report discrepancies such as improper status or failure to sign off the preflight inspection to the line chief. Do not accept the aircraft until you are satisfied it is flyable. Definitions of the status symbols are included in the aircraft forms.

1.4.3. The items in your checklist are listed in an order that begins from behind the left wing and moves toward the front. This system makes it easy to learn and reduces the margin for error. As in the visual inspection, consider each item as important as the next. If you overlook an item, certain systems may become inoperative or damaged. Therefore, refer to the checklist to ensure all items are completed.

1.4.4. Carefully check for fluid leaks in the wheel well, speed brake, and engine bay areas. These leaks are usually apparent from fluid along fairing doors, seams, and line couplings. Check the general condition of trim tabs, hinges, and control surfaces. Binding of the controls and cracked hinges on control surfaces are reasons for rejecting the aircraft. Do not manhandle control surfaces. If you are not sure about the condition, setting, or operation of any single item, check with your instructor or qualified maintenance personnel. The pilot in command has final authority to accept or reject an aircraft.

1.4.5. Accomplish a postflight inspection of the aircraft following each sortie. The purpose of this inspection is to examine the general condition of the aircraft. Look for any abnormalities requiring the attention of maintenance personnel, such as missing panels, damaged tires, or leaking fluids.

1.4.6. Do not stow clothing or personal items in areas that may interfere with normal canopy operation, ejection sequence, or equipment operation.

1.5. Position in the Aircraft. Each time you fly, your seat position should be the same. When sitting comfortably erect, you should just be able to see the upper part of the electronic attitude indicator (EADI) display just below the glare shield. Adjust the rudder pedals to a comfortable distance that allows full travel of the rudder and brakes.

1.6. Interior Check and Starting Procedures:

1.6.1. On all dual flights, verbally confirm all items in the checklist marked “(BOTH)” (on-board oxygen generating system [OBOGS], altimeter settings, etc.). Your instructor will discuss techniques in detail with you.

1.6.2. During engine start, while closely monitoring the engine’s interstage-turbine temperature (ITT), gas generator speed (N^1), and Start Ready light, occasionally glance at the crew chief. He or she may give the first indication of anything unusual in your start.

1.6.3. The canopy may remain open to motor the engine.

1.6.4. Ensure you receive proper acknowledgement from ground personnel before activating any system that could pose a danger to the ground crew. When ground intercom is not used, visual signals will be in accordance with AFI 11-218, *Aircraft Operation and Movement on the Ground,* and this instruction. The crew chief will repeat the given signal when it is safe to operate the system.

1.7. OBOGS Check. The importance of a thorough and proper life support system check cannot be overemphasized. You will perform a check similar to the OBOGS check in every military aircraft you fly. It is important to carefully check your connections to ensure system integrity from the supply to your mask. Good connections and a properly operating oxygen system are key to your survival under normal conditions and in many emergency situations.

1.8. Taxiing. The T-6 is equipped with nosewheel steering to turn the aircraft while taxiing.

1.8.1. After the Before-Taxi Checklist is completed, visually clear to the front and rear and signal the crew chief that you are ready to taxi. Select nosewheel steering, release brakes, and increase power as necessary. Pick up momentum straight ahead and check the brakes. To turn, simultaneously apply rudder in the desired direction and reduce power (normally to idle). If you need a sharper turn than can be made with nosewheel steering, deselect nosewheel steering and use the inside brake to establish the angle of turn desired. When you do this, keep the inside wheel rolling. Any attempt to pivot the aircraft on a locked inside wheel will damage the wheel, tire, and strut. This is particularly dangerous because, although it may not be apparent, the gear may be damaged enough to collapse under the strain of landings. To make sure the inside wheel rolls, release the inside brake intermittently. Apply the brakes smoothly, evenly, and cautiously at all times. When leaving a parking area, be especially alert for aircraft taxiing past your position. Also watch for personnel, ground equipment, etc.

1.8.2. When clear of the parking area, use power as needed to keep the aircraft rolling at a moderate speed. Nosewheel steering will be more sensitive as taxi speed is increased. Use the brakes as necessary to control taxi speed. While taxiing, do not perform checks until the aircraft is in an unobstructed area. Do not concentrate all your attention inside the cockpit.

1.8.3. Do not taxi aircraft with less than 10 feet of clearance from an obstacle. Do not taxi without a wing walker when an obstacle is between 10 and 25 feet from the aircraft. This requirement is waived for locally based aircraft if established taxi lines are marked and obstructions are either permanent or other aircraft parked on established parking spots. Spacing between taxiing aircraft must be a minimum of 75 feet when staggered in trail. If you must taxi directly behind an aircraft, increase the spacing to a minimum of 150 feet to avoid foreign object damage (FOD).

1.9. Radio Procedures. The pilot actually flying the aircraft (PF) is responsible for all radio calls. If the pilot not flying the aircraft (PNF) needs to talk on the radio, he or she must notify the PF before doing so. Physical transfer of aircraft control need not take place. Under normal operations, radio voice communications should be kept to a minimum. A call to ground control for taxi clearance serves as the radio check. Remember, when the microphone button is depressed, the entire channel is blocked for other aircraft. Do not depress the microphone button during another aircraft's transmission. If another aircraft is making a transmission, anticipate an answer to the radio call and do not break in. Make sure the radio is on and the proper channel is selected. A general format for professional radio communications is to broadcast who you are talking to, who you are, where you are, and what you want to do. It is imperative that your message be both clear and concise. Organize your thoughts, depress the microphone button, say what you

intend to say, and get off the air. Do not transmit when another aircraft is in a critical phase of flight (such as in the flare while you are waiting for takeoff).

1.10. Clearing:

1.10.1. Both crewmembers are responsible for clearing. If the PNF sees a hazard, he or she should point it out to the PF, indicating a clock position (left or right) and relationship to the horizon (high, level, or low). If time is critical, the PNF should take control of the aircraft and do whatever is necessary to avoid the hazard. When clearing, ensure your intended flightpath is well clear of other aircraft. The type of clearing will depend on the maneuver, the configuration of the aircraft, and other flight planning factors. Be aware of the restrictions to visibility created by the canopy bows. Focus your eyes on a distant point and use various search patterns (vertical, horizontal). Visual search must become a definite pattern instead of random looking. Constantly practice your search technique.

1.10.2. All aircrews operating in visual meteorological conditions (VMC) must maintain a constant vigilance for other aircraft. The use of radar monitoring or assigned areas does not relieve you of the responsibility to clear. Air traffic control (ATC) provides separation between instrument flight rules (IFR) and participating visual flight rules (VFR) aircraft operating in controlled airspace. Standard IFR separation is provided to all aircraft operating under IFR in controlled airspace. Some maneuvers in the area are good clearing maneuvers; others may require a clearing turn.

1.10.3. You can help yourself remain clear of local traffic by knowing areas of possible conflict. Know your local area procedures. Be aware of local departure and recovery routes, flying areas, and traffic patterns. Emphasize clearing in areas of potential conflict. Ensure the Naval Aircraft Collision Warning System (NACWS) is set on a useful en route range after departing the traffic pattern. Listen for radio transmissions to help you track traffic in your vicinity. (These transmissions are commonly referred to as “clearing on the radios.”) The more you know about your immediate flying environment, the better you will be able to detect and avoid other aircraft.

1.10.4. Area procedures and radio transmissions are only part of the overall effort to avoid other aircraft. The most important ingredient is your ability to visually detect each aircraft. Aircraft unfamiliar with the training areas and routing may fly through your airspace, so be alert.

1.11. Wake Turbulence:

1.11.1. All aircraft generate wake turbulence, and the T-6 is very susceptible to it. When such turbulence is anticipated, proceed with extreme caution. Do not depend solely on the controller to advise you of the possibility of encountering it. Remember, the controller may provide wake turbulence separation that may not be adequate in all situations. In each case, it is your responsibility to ensure proper separation on the approach. Be especially aware of the possibility of wake turbulence during takeoff, approach, and landing, remaining upwind of the preceding aircraft’s flightpath to keep you clear of that aircraft’s wake turbulence.

1.11.2. Flying a nonprecision approach will very likely place your aircraft in the area of wake turbulence generated by an aircraft on a precision glidepath. If you are unable to remain above the aircraft’s flightpath, consider increasing your spacing or going around. However, use caution when going around from below the preceding aircraft’s flightpath because you may fly through that aircraft’s wake turbulence.

1.11.3. Flight through wake turbulence, propwash, or jetwash should be avoided. If this is unavoidable, unload the aircraft to approximately 1G to minimize the possibility of over-G. Use the asymmetric G limits when evaluating a turbulence-induced over-G.

1.12. Takeoff and Landing Data (TOLD). On every flying mission, you will be taking TOLD to the aircraft. Initially, you will find the information at the duty desk or in the flight room. However, before solo, you will be required to compute this information and understand how to apply the numbers. This information will become even more important when you are flying from unfamiliar airfields because temperatures, pressure altitudes, and runway conditions may be significantly different from your home field.

1.13. In-Flight Checks:

1.13.1. The PF is responsible for all checks and avionics functions. The PNF must respond appropriately and/or advise the PF when a required check is missed.

1.13.2. On all dual flights, verbalize each item in the checklist marked "(BOTH)" (OBOGS, altimeter settings, etc.) and expect a response from your instructor. If he or she does not respond within a few moments, verbalize the item again.

1.13.3. Accomplish an Operations Check when reaching your final cruise altitude or established in the military operations area (MOA) and approximately every 15 minutes thereafter. Additionally, if accomplishing multiple VFR patterns or instrument approaches, periodically accomplish an Operations Check.

1.14. Fuel Awareness:

1.14.1. Unlike many operational and training aircraft, the T-6 is not fuel limited on most training sorties. Therefore syllabus directives, not available fuel, will determine the duration of most of your sorties. However, fuel awareness is critical to your success as a military pilot. Regular fuel checks are an important part of each mission, and good habits learned in the T-6 will prove invaluable in your flying career.

1.14.2. Joker, bingo, and normal recovery fuels are defined in AFI 11-2T-6, Volume 3. Bingo fuel and at least one joker fuel are briefed on every mission. Normally, on local sorties recovery is initiated before bingo due to sortie duration requirements. Joker fuel is set at preplanned transition points in the sortie. There may be several joker fuels set on a sortie. Because priorities may change while airborne, it is possible to reset or change a joker fuel during a sortie.

1.15. Area Orientation. Crewmembers will carry a copy of the local in-flight guide and a map of the local flying area on all flights. Use your map and landmarks as primary references for departure, recovery, and area orientation. Additionally, use the aircraft's navigation equipment as a backup in case of restricted visibility or unfamiliar area assignment.

1.16. Transfer of Aircraft and Systems Control:

1.16.1. During flight, it is paramount to know who has control of the aircraft. When you are flying, stay on the controls until told otherwise. During transfer of control, the pilot relinquishing control will say "You have the aircraft." The pilot assuming control will say, "I have the aircraft," and will shake the stick noticeably. It is not important who speaks first; both pilots must verbally acknowledge the

transfer. During critical phases of flight, relinquish the controls (stick, rudder pedals, and power control lever [PCL]) immediately on your instructor's verbal command so you do not obstruct any flight control or PCL movement. In the event of intercom failure, transfer of aircraft control will be accomplished by the pilot assuming control vigorously shaking the stick and the pilot relinquishing control raising both hands in the air for the other pilot to see, unless prebriefed otherwise.

1.16.2. Your instructor will brief you on your responsibilities and how you are to assist in unique situations such as interphone failure or aircraft malfunction. Remember, if you are flying, stay on the controls until you know your instructor has control of the aircraft.

1.16.3. At no time will two people be in control of the aircraft at the same time. This also applies to the brakes during engine runup for takeoff. Only the person in control of the aircraft will apply pressure to the brake pedals; the other person will closely guard them.

1.16.4. The tandem seating and "last use, last in control of a system" setup of the T-6 can be confusing if not managed properly. It is crucial to maintain proper coordination of system use to avoid inadvertent inputs. Examples of systems or actions that require crew coordination include operation of the canopy, radio management unit (RMU), global positioning system (GPS), and EFIS configuration and operation.

1.17. Student Responsibilities:

1.17.1. Primary pilot training is designed to graduate professional military pilots. Organizing and planning are major keys to fulfilling this objective. Your part in this process is to ensure you are properly prepared for the flight line, well nourished, and well rested.

1.17.2. Each day when you report to the flight line, be prepared for any type of mission. This means more than simply reading about the maneuvers in this manual. Know all the procedures for a given maneuver and be able to state the sequence of actions. Many students find that chair-flying is a helpful technique in preparing for a mission. This means you organize a mission profile and then simulate the flight mentally, reviewing each item you must accomplish. Your time in the aircraft is limited. If you prepare properly on the ground, your airborne time will be more profitable.

1.18. Flying Safety. Flying safety is more than merely a set of practices or a particular safety record; it is an attitude. Continually evaluate your performance by asking, "Did I perform that activity in a professional, disciplined, and safe manner?" Perform this evaluation from the time you start planning a flight until you finish debriefing. One of the greatest hazards in today's flying is the potential for a midair collision. Your best defense is to see the other aircraft first. Aggressively clear the airspace around you, using the techniques your instructor will show you.

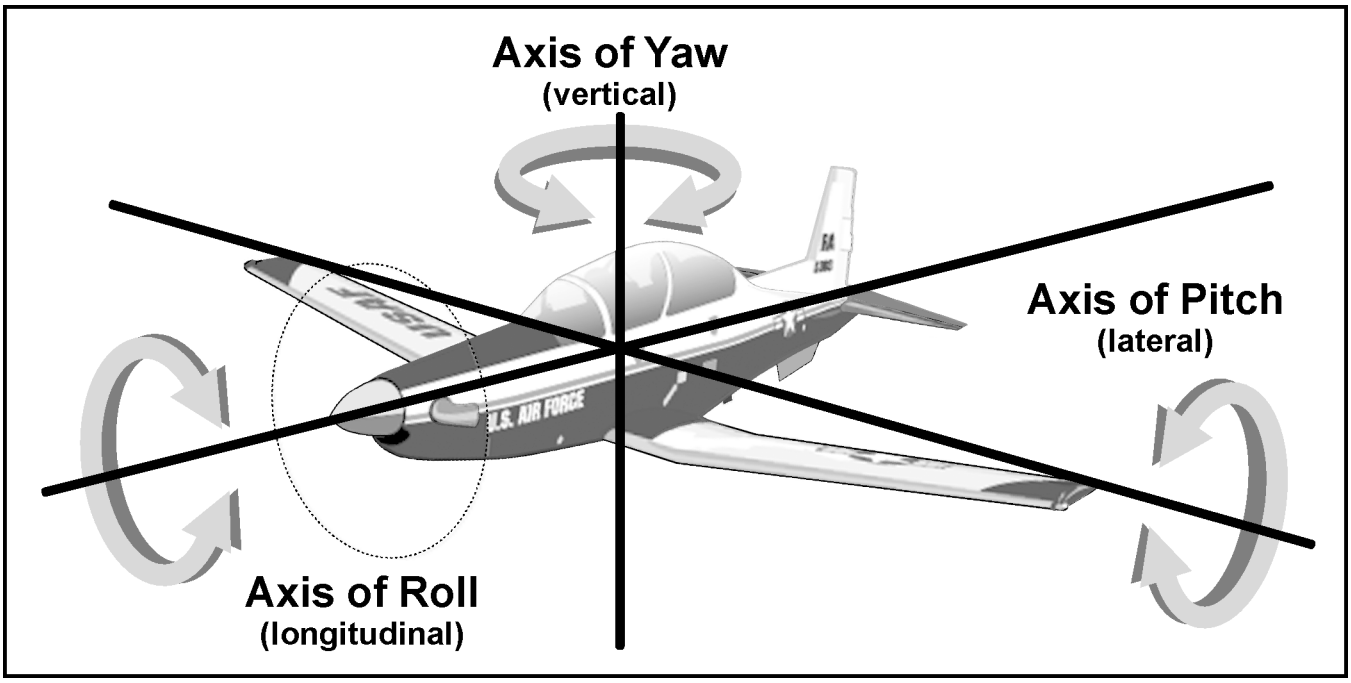
1.19. Ground Safety. The flight line is a hub of activity. Consequently, this calls for extra attention on the part of everyone who is required to be there. When you are on the flight line, you must wear approved devices to protect your hearing against the harmful noise of aircraft engines. Because this protection will block out some of the other sounds that might warn you of danger, you must constantly be alert for hazardous situations. Stay clear of the aircraft danger areas as depicted in Section 2 of TO 1T-6A-1 (flight manual).

Chapter 2

BASIC PRINCIPLES OF FLIGHT

2.1. Effects of the Controls. Each flight control has its effect on the attitude of the aircraft and controls the movement about one of its three axes (**Figure 2.1.**). You should learn these effects in order to control the aircraft and obtain the desired responses. Your instructor will demonstrate the use and effects of the controls, first in straight-and-level flight at cruising airspeed and then in other flight attitudes. The same predictable responses to control movements will result, regardless of the attitude of the aircraft. Think of yourself as the pivot point about which all changes of attitude occur. The axis of pitch, yaw, and roll are defined as follows:

Figure 2.1. Axes of the Aircraft.



2.1.1. **Pitch.** Moving the stick forward and aft (fore/aft) controls the aircraft's pitch (movement about the lateral axis). To achieve level, climbing, or descending flight, hold the nose of the aircraft in a fixed position relative to the horizon. You can use many other outside references to determine pitch attitudes, such as the position of the wingtips or the glare shield in relation to the horizon. You can also check the desired pitch attitude by reference to the flight instruments. Your instructor will show you the outside and instrument references for climbing and descending flight. Continuous cross-check of all pitch references will result in better control of the pitch attitude of the aircraft.

2.1.2. **Yaw.** Yaw is movement about the vertical axis. When yaw exists, the ball in the turn-and-slip indicator is displaced from center. Also, yaw causes your body to lean toward one side of the cockpit like when you round a corner in a car. Coordinated flight should be free of yaw even in a steep bank. When the aircraft is coordinated, your body will retain a comfortable, upright position. The proper use of rudder is essential for coordinated flight about the yaw axis.

2.1.3. **Roll.** Rotation about the longitudinal axis is caused by the lift differential created as aileron surfaces are moved out of the streamlined position of the wing. The wing with the raised aileron goes down because of decreased lift, and the wing with the lowered aileron goes up because of increased lift. The effect of either aileron is augmented by the simultaneous and opposite movement of the aileron on the other wing. In level flight, moving the control stick toward a wing raises that wing's aileron surface, causing the wing to go down and the aircraft to roll in that direction. Simultaneously, the other wing's aileron goes down, causing that wing to go up.

2.2. Adverse Yaw:

2.2.1. The movement of the aileron surfaces out of the streamlined position creates drag. This drag is not distributed equally on each aileron; the down aileron (on the up wing) produces the greater drag. When this condition exists, the aircraft does not turn immediately in the direction of aileron movement, but yaws towards the top wing opposite to the direction of desired turn.

2.2.2. When you use ailerons to bank an aircraft, the aileron that goes down extends into the area of greater static pressure, increasing drag. Due to the shape of the wing, the aileron that goes down also increases the positive camber of that wing, which increases both lift and induced drag. At the same time, the aileron that goes up on the opposite wing decreases the positive camber of that wing, which reduces lift and induced drag. This combination of factors causes the aircraft to tend to yaw in the opposite direction while the banking action is taking place. This adverse yaw tendency continues until the ailerons are neutralized.

2.2.3. Adverse yaw is most apparent at low airspeeds and extreme control surface deflections. At low or near-stalling speeds, adverse yaw is very noticeable. At high speeds, it may not be noticeable at all because the movement required of the aileron surfaces is greater at lower speeds. The ailerons must be moved farther from the streamlined position to cause an appreciable alteration of lift in the slower slipstream. The higher the angle of attack (AOA), the greater the pressure on the bottom side of the wing (until the stalling speed is reached and the airflow disrupted). At high speeds, a small airstream alteration generates more lift than in a slower airstream so less aileron is needed to lift the wing.

2.2.4. Adverse yaw can be overcome by using the rudder. As you apply right or left aileron pressure, simultaneously apply rudder pressure on the same side. 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 used. Keeping the ball centered in the turn-and-slip indicator is a guide to using the correct amount of rudder. Remember to use rudder and aileron pressure simultaneously, although the required amount of pressure will differ depending on the amount of aileron used, airspeed, effect of drag, and design of the particular aircraft you are flying. Also remember that the aileron drag effect is present during recovery from a turn as well as during the entry. The rudder must again be used in the same direction as aileron stick pressure to counteract adverse yaw.

2.3. Use of Controls. When a control surface is moved out of its streamlined position, the air flowing past it will exert pressure against the control surface and try to return it to the streamlined position. It is this pressure you feel on the stick and rudders. The amount of pressure you feel is determined by the airspeed and the degree the control surface is deflected. The higher the airspeed, the greater the pressure.

2.3.1. **How To Use the Rudder.** Position your feet comfortably with all the weight on your heels. Let your heels rest on the cockpit floor with the balls of your feet on the rudder pedals. When you use the rudder, apply pressure smoothly and evenly by pressing with your foot just as if you were using the

brakes of an automobile. Do not let your legs and feet become tense; stay relaxed so you can feel rudder pressure.

2.3.2. **How To Use the Stick.** Generally, you should hold the stick lightly—the same way you would hold the steering wheel of an automobile—relaxed and comfortable. Some maneuvers, such as aerobatics, require more positive pressures. Let your arm and hands relax so you can feel the counterpressure from the stick, but always control the aircraft. Never let it control you.

2.3.3. **Coordination.** The effect of each control has been discussed individually, but you must realize that no single control movement provides all the control for a maneuver. To fly your aircraft efficiently, you must use the controls together. Known as coordination of controls, this is vital to smooth flying. After you know how the aircraft will react when the controls are used, you must learn how to use them properly. Rough, erratic use of any controls will cause the aircraft to react accordingly, so it is important to apply the pressures smoothly and evenly.

2.4. Power Effects:

2.4.1. Power effects on flight characteristics are the result of the high-energy, corkscrew slipstream from the propeller wrapping around the aircraft and impinging on the wing root, fuselage, and tail surfaces. The corkscrew slipstream changes with power and airspeed. The addition of power energizes the air flowing over the tail surfaces, making them more effective at slow speeds. In the T-6, the corkscrew slipstream will induce a slightly higher AOA on the left wing root and tail surfaces and slightly lower AOA on the right wing root and tail surfaces.

2.4.2. Another effect of the propeller, called a P-factor, is that the downward-moving propeller blade has a higher angle of attack than the upward-moving blade. 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 you increase speed or add power.

2.4.3. Torque reaction in a propeller-driven aircraft acts opposite the direction of rotation of the propeller. In the case of the T-6, the aircraft will tend to roll to the left as a result of torque.

2.4.4. Gyroscopic reactions called “gyroscopic precession” 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; that is, in the same direction as the rotation. Typical reactions from a clockwise-turning propeller (as viewed from the pilot’s seat) include:

2.4.4.1. If the nose is yawed to the left, the nose will tend to pitch up.

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

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

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

2.4.5. The effect of gyroscopic precession depends on the rate of movement about the pitch or yaw axis. Increased rates tend to increase the effect. This explains why a pilot who abruptly corrects aircraft deviations (pitch, bank, and yaw) will end up frustrated with the adverse effects of precession. The relatively large propeller on the T-6 and high revolutions per minute (rpm) result in more precession effect than an aircraft with a lighter, smaller propeller turning at slower rpm.

2.5. Composite Flight. Composite flight requires the use of outside references supported by flight instruments to establish and maintain desired flight attitudes. You will use composite flight throughout your flight training, as follows:

2.5.1. Accomplish all maneuvers by establishing attitudes and progressively changing these attitudes throughout various stages of the maneuvers. Establish and maintain an attitude by positioning the nose and wings of the aircraft in relation to the horizon. Very small changes in attitude may not be readily noticed by outside reference to the Earth's horizon, but they will be indicated by the flight instruments. Be careful. Depending solely on your instruments has several disadvantages. The most serious is the inability to observe aircraft and other hazards to flight.

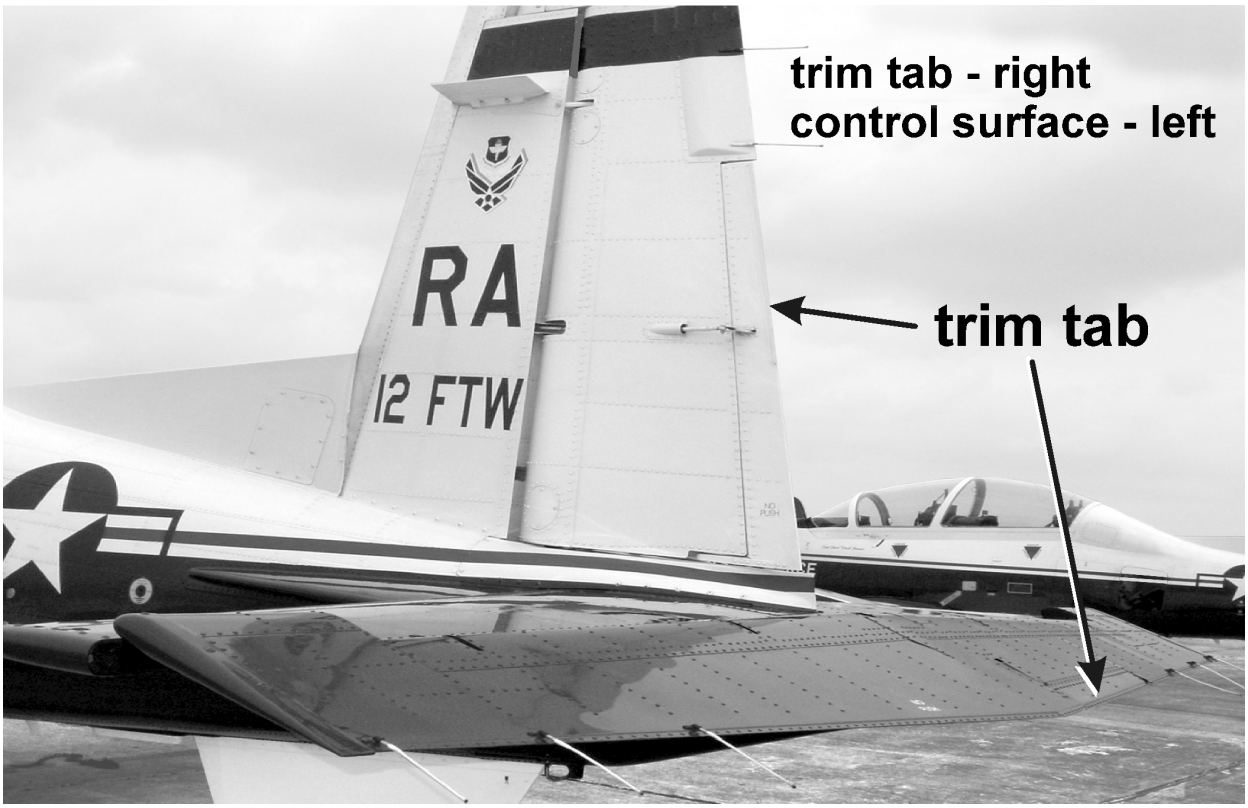
2.5.2. A good composite cross-check is necessary to ensure precise flying. Let the conditions dictate where you direct your attention. As the visibility deteriorates, increase the use of flight instruments. Develop your cross-check so necessary information is obtained at a glance. Always be vigilant to avoid midair collision and remain oriented. Do not concentrate on any one reference. You must maintain a constant vigilance for other aircraft. Check your reference, make a correction, look around, and cross-check other references. Then return to the original reference, using all of the references to confirm the accuracy of your control pressures or the need for a further correction. Continually repeated this process in composite flying.

2.6. Trim:

2.6.1. When you consider all the factors affecting the aircraft in various conditions of flight, the need for trimming becomes apparent. Considerable force is required to hold the correct elevator control pressure for level flight with high airspeed. Flying would be very tiring if some means were not available to relieve these pressures.

2.6.2. Trim tabs act as levers and equalize the pressures exerted on either side of the parent control surface. To equalize pressures, the rudder and elevator tabs are moved in an opposite direction from the parent control (**Figure 2.2.**), repositioning the control surface. If the rudder is not trimmed properly, the aircraft will fly in a skid as indicated by the turn-and-slip indicator. The ball will be deflected while the needle is centered. To correct this condition, first apply rudder to center the ball (while holding the turn needle centered) and relieve the pressure with rudder trim. To correct wing heaviness or rolling tendencies, adjust the aileron trim. When the pressures on the controls have been relieved, the aircraft is correctly trimmed.

Figure 2.2. Trim Tabs—Aids to Smooth Flying.



2.6.3. Because the trim systems on the T-6 are electrically operated, it is possible for any one of the systems to malfunction in flight because of an inadvertent actuation, stuck button, short in the system, or failed relay.

2.6.4. In the T-6, subtle power changes normally do not require large, immediate changes in control pressures. The need for trim, therefore, is evident only gradually as the airspeed changes. Always think of trimming as a recurring process.

2.6.5. Other devices controlled by the pilot that also affect the aircraft attitude are the flaps, landing gear, and speed brake. However, these all have other primary purposes, and their effect on aircraft control is incidental. Trim will compensate for these minor effects.

2.7. Straight-and-Level Flight:

2.7.1. Your objectives in this training exercise are to learn the use of the controls and to combine the use of outside and instrument references for maintaining aircraft attitude. You will also learn to divide your attention by constantly checking all available references without concentrating on any particular one.

2.7.2. Before practicing straight-and-level flight, you must be familiar with the flight instruments. You must understand the effect and use of the controls and be relaxed and properly seated in the aircraft.

2.7.3. Attaining level flight is a matter of consciously fixing reference points on the aircraft in relation to the Earth's horizon and comparing or cross-checking this relationship with the flight instruments.

To control pitch altitude, refer to the attitude indicator, altimeter, vertical speed indicator (VSI), and airspeed indicator.

2.7.4. Your instructor will show you each instrument's indication in conjunction with outside references. Do not concentrate too much on one reference or stare at a particular reference. This will not only hinder your progress, but will create a dangerous situation because you will not be clearing for other aircraft. Check each outside and inside reference in turn and use each for minor control adjustments.

2.7.5. You must have a thorough knowledge of the design, location, and information presented by all the instruments. Familiarity with these instruments and outside references will enable you to determine the control pressures necessary to control the attitude and the direction of the aircraft. Control pressures should be smooth and applied with confidence. Beginning students often overcontrol from lack of experience, but this tendency can be minimized through the practice of smooth application. Good control is a continuous succession of minor, almost imperceptible corrections to keep the aircraft in the desired flightpath.

2.7.6. After you have had a little practice in straight-and-level flight and have learned to check all your references properly, you can establish the correct level flight attitude in a few seconds. You will learn to look around quickly and establish pitch, bank, and direction simultaneously. Power changes and trim technique will become second nature. A trim change is necessary when you are having to hold continuous stick or rudder pressure to maintain the desired flightpath.

2.7.7. The weight of your right arm on the stick may cause the ailerons to be slightly displaced, which will result in flying with the right wing low. In most cases, this will cause a very slight turn to the right. To keep the aircraft from turning, you would have to use a steady left-rudder pressure, but this would set up an undesirable cross-controlled condition. The solution is to place the weight of your right arm on your thigh, which will reduce any tendency to be heavy handed. Remember to check your references frequently to determine any tendency toward heavy handedness.

2.7.8. Let your eyes sweep along the horizon, picking up the wingtips, and make a mental note of required corrections. At the same time, look for other aircraft that might be flying in your area. Make your corrections and return to inside references to confirm them. Then look outside again in a continuous process. Soon the process will become second nature and effortless.

2.7.9. Straight-and-level flight requires almost no pressure on the controls if the aircraft is properly trimmed and the air is smooth. However, when you are flying through turbulence, the flight attitude may change abruptly. Do not fight the controls to stop these changes. Ride them out like a boat on a rough sea, making smooth, but firm, adjustments as needed.

2.8. Turns:

2.8.1. Use a turn to change the direction of the aircraft. This involves the close coordination of all three controls; ailerons, rudder, and elevator. Because turns are incorporated in almost all aircraft maneuvers, you must learn to perform them well. A shallow turn is a turn of approximately 30 degrees of bank or less. A steep turn is a turn of approximately 45 to 60 degrees of bank.

2.8.2. Before beginning any turn, look in the direction of the turn to clear above, below, and at your flight level. Do this to make sure the area is clear of other aircraft. Once you have cleared the area, simultaneously apply pressure to both ailerons and the rudder in the direction of the turn. This pressure will move the control surfaces out of their streamlined position and cause the aircraft to bank and

turn. The rate at which the aircraft rolls is governed by the amount of pressure applied. Hold the pressures constant until you obtain the desired angle of bank. In establishing this bank attitude, use both outside and instrument references.

2.8.3. As bank is introduced, a point on the windscreen directly in front of you will appear to pivot on the horizon. To maintain level flight, this imaginary level flight reference point should remain on or near the horizon throughout the turn. As the bank increases, the pitch attitude will have to increase to compensate for the loss of vertical lift. In shallow turns, the increase in pitch attitude is relatively slight. As bank increases, the required increase in pitch attitude is more pronounced. Also, in steep turns, increased power is required to maintain airspeed.

2.8.4. Just as in straight-and-level flight, outside references can be found in any direction. The best outside reference for the degree of bank is the angle of the Earth's horizon across the windscreen. As you approach the desired angle of bank, return the ailerons and rudder to neutral. This stops the bank from increasing. Do not release the elevator pressure, but hold it constant to maintain a constant pitch attitude. Throughout the turn, hold the angle of bank constant with adjustments of the ailerons, just as you keep the wings level in straight-and-level flight.

2.8.5. To correct a nose-low attitude in a steep turn, reduce the angle of bank with coordinated aileron and rudder pressure. Simultaneously use back pressure to raise the nose to the desired pitch attitude. After doing this, reestablish the desired angle of bank. Do not try to make corrections with any one of the three controls. Instead, use them together.

2.8.6. The rollout from a turn is much the same as the entry except control pressures are used in the opposite direction. Apply aileron and rudder pressure in the direction of the rollout (toward the high wing). As the angle of bank decreases, release the elevator pressure smoothly to maintain altitude. With decreasing angle of bank, the effects of centrifugal force and loss of vertical lift are reduced.

2.8.7. Because the aircraft normally will turn as long as there is any bank, start the rollout before reaching your desired heading. The aircraft will turn some during the time it takes to level the wings. The steeper the bank, the more lead is required to roll out on a desired heading. As the wings become level, release the pressures smoothly until the controls are neutralized.

2.8.8. Your posture in the aircraft is very important to all maneuvers. Do not lean forward, backward, or side to side. Instead, sit erect and move your head around freely. During turns, maintain this position. Do not lean away from the turn or attempt to keep your body vertical with the horizon. Relax and ride with the turn. If you do not maintain a constant position in the cockpit, your outside references will continually change. Relaxed pilots are usually good pilots because they are free to think and can feel the pressures on the controls.

2.8.9. Plan all of your turn exercises so you make precise turns; that is, with a constant angle of bank and a definite amount of turn. To make a precision 90-degree turn, align the aircraft with a road or section line on the ground and turn perpendicular to it. In the absence of any ground reference, pick a point on the horizon directly off a wingtip. Then turn to that point, clearing the area as you do so.

2.8.10. A common misconception among students is that a steep turn is entirely different from a shallow turn. This misconception probably comes from the fact that all of the aerodynamics of a turn are more prominent in a steep turn. The difference between steep turns and other turns is the amount of back-stick pressure and power needed to maintain level flight. A common error is the misuse of controls when entering a steep turn. Some students apply control pressures very rapidly and abruptly, using strong back pressure prematurely. This is sometimes caused by the natural tendency of the arm

to move backwards as it moves to the side. Steep turns are easy to perform if you roll into them like you roll into shallow turns, but you must anticipate the need for additional back pressure and power as the angle of bank increases.

2.9. Uncoordinated Flight:

2.9.1. In a coordinated level turn with constant bank and airspeed, the flightpath of the aircraft is a true circle if the wind is calm. Otherwise, the flightpath is not necessarily a true circle over the ground because of drift. Variation in the circular flightpath is also caused by uncoordinated control, erratic bank, or changes in airspeed.

2.9.2. A skid is caused by an insufficient bank angle in relation to the turn rate of the aircraft. This will occur if you use too much bottom rudder pressure in relation to the aileron pressure or if any bottom rudder is held after a turn is established. A skid will also occur in level flight if the nose of the aircraft rotates sideways about the vertical axis when the wings are held level, resulting in a slow turn. This occurs when rudder pressure is inadvertently held or the aircraft is improperly trimmed.

2.9.3. A slip is caused by too much bank angle in relation to the turn rate of the aircraft. When establishing a turn, if you use insufficient bottom rudder pressure in relation to the aileron pressure, a slip will result. You can also slip the aircraft by holding opposite rudder in a turn.

2.10. Basic Instrument Flight:

2.10.1. Instrument flying is controlling the aircraft by reference to the flight instruments only. Use the same control techniques you use in contact flying. Instrument flying is similar to contact flying in that reference points are used in both to determine the attitude of the aircraft. However, in instrument flight, aircraft instruments, instead of outside references, will show you the attitude of your aircraft in relation to the horizon.

2.10.2. Instrument flying is a series of basic maneuvers. The particular situation determines the sequence in which these maneuvers are performed. For example, both a radar approach and a low-altitude approach contain many of the same maneuvers, but the sequence for making the turns, descents, leveloffs, etc., is not the same. It is easy to understand instrument flying if you consider it a series of basic instrument maneuvers. Vertical-S and confidence maneuvers are practiced to improve your ability to interpret the instruments and increase your proficiency in instrument flying.

2.10.3. You must use all of the flight instruments to precisely determine aircraft attitude. Correct interpretation of their indications and good pitch, bank, and power control are the basic elements of instrument flying. According to their functions, flight instruments are divided into three main groups and this grouping presents the information for the best possible coverage. The three groups are as follows:

2.10.3.1. Control instruments, including attitude and torque indicators.

2.10.3.2. Performance instruments, including altimeter, VSI, airspeed indicator, turn-and-slip indicator, and heading indicator.

2.10.3.3. Navigational instruments, including GPS, very high frequency omnidirectional range station (VOR), distance measuring equipment (DME), and instrument landing system (ILS) equipment.

2.10.4. When flying on instruments, the following two points cannot be overemphasized: (1) initiate corrective action to maintain the desired aircraft performance the moment you confirm a need, and (2) make all corrections smooth, but positive. Performance instruments will indicate the need for a change in aircraft performance. Make these changes by using the attitude indicator and PCL as necessary. Trim to aleviate control pressure and cross-check the performance instruments to determine the adequacy of the correction and make any refinements necessary to attain the desired attitude. The nature of the maneuver flown will determine which performance instruments will receive most of your attention, but constantly cross-check all of them for precision instrument flying. To understand instrument flying, carefully study the techniques and procedures found in the following material: AFMAN 11-217, Volume 1, *Instrument Flight Procedures; Flight Information Publication (FLIP), General Planning;* TO 1T-6A-1; this chapter; and **Chapter 9**.

2.11. Pitch Control:

2.11.1. **General.** An understanding of the similarity between contact and instrument flying is necessary when you cannot determine the attitude of the aircraft by use of outside references. The aircraft can be precisely controlled, using the instruments. The attitude indicator, altimeter, VSI, and airspeed indicator give indications of the pitch attitude of the aircraft. Small, timely pitch corrections on the attitude indicator and an accurate cross-check of the performance instruments are essential to developing good pitch control technique. Proper use of elevator trim is an integral part of pitch control, and good instrument flying is very difficult without it.

2.11.2. **Attitude Indicator:**

2.11.2.1. To fly the aircraft straight and level, adjust the attitude indicator so the wings of the miniature aircraft (shown on the attitude indicator) are superimposed on the horizon bar. While changing pitch, note how the relationship on the instrument corresponds to the actual movement of the nose of the aircraft as it appears on the natural horizon. Cage the standby attitude indicator only when errors have been induced in the instrument and positive relation to level flight can be confirmed. TO 1T-6A-1 (flight manual) has information on the construction and limitations of the attitude indicators.

2.11.2.2. During in-flight practice, change the pitch attitude so the miniature aircraft indicates a climb of 2.5 degrees. Compare this movement with the movement of the aircraft's nose as it appears on the natural horizon. Then reverse this maneuver to show a descent. You can maintain level flight by keeping the wings of the miniature aircraft centered exactly on the horizon bar. Changes in pitch attitude are normally very small, not more than 1 degree.

2.11.2.3. Your instructor will occasionally place the aircraft in a steep climb or dive and have you return it to level flight. This is to give you practice for the special maneuvers that will come later.

2.11.3. **Altimeter:**

2.11.3.1. Fly the aircraft straight and level with a fixed power setting. To maintain a constant altitude and airspeed, the pitch attitude must remain constant. Raise the nose of the aircraft until the miniature aircraft is well above the horizon bar. Observe that the altimeter changes rapidly with any substantial change in pitch attitude on the attitude indicator. Make a small change in pitch attitude and observe the correspondingly slow change in altitude indicated on the altimeter. Make an abrupt change in the pitch attitude and observe the momentary lag in the altimeter. Note that a lag is not as apparent when a gradual change is made in the pitch attitude. Even though there is a

momentary lag in the indication of the altimeter, if the pitch change is smooth and gradual, the altimeter gives an almost immediate indication of a change in pitch attitude.

2.11.3.2. To control the pitch attitude of the aircraft properly throughout a flight, you must use both the attitude indicator and the altimeter. Consequently, a system of cross-checking must be developed. Do not rely solely on the attitude indicator because a change in airspeed will require an attitude change to maintain level flight. With only two instruments at this stage of instruction, the cross-check consists of merely looking from one instrument to the other. During level flight, give the attitude indicator more attention than the altimeter, but cross-check the altimeter to make sure you are keeping the altitude constant.

2.11.3.3. Practice holding the altitude constant, using the attitude indicator and altimeter. Correct for a deviation of 100 feet by changing the pitch attitude not more than 1 degree. Corrections in altitude are made by these small changes in pitch attitude.

2.11.4. **Vertical Speed Indicator (VSI).** While the VSI gives an immediate indication of a change in pitch attitude, there is a short lag before it settles down and indicates the actual rate. This lag is directly proportional to the speed and magnitude of the pitch change. The VSI is a trend instrument so do not chase it. Make small corrections and then wait for the instrument to settle down. Use the VSI as a trend instrument to prevent overcontrolling. Practice maintaining level flight by cross-checking the attitude indicator, VSI, and altimeter. Place emphasis on precision. To learn the function of the VSI and its relationship to other pitch instruments, perform the following exercises:

2.11.4.1. From level flight, place the aircraft in a dive by making a large change in pitch attitude. While the vertical speed is rapidly decreasing in the descent, pull the aircraft up into a climb. Observe that after the lag, the vertical speed reverses its direction of movement and begins to move rapidly upwards, which indicates a change in pitch attitude.

2.11.4.2. During practice, raise the nose of the aircraft so the attitude indicator indicates a climb of 1 degree. A change in pitch of this magnitude indicates a vertical speed of 200 to 400 feet per minute (fpm). This relationship between the attitude indicator and the VSI is for low-speed flight. For altitude corrections, one technique is to change attitude to get a vertical speed in fpm that is about double the error in feet of altitude. For example, if you are 100 feet off your altitude, a 200-fpm correction is generally suitable.

2.11.4.3. In level flight, cross-check the three pitch instruments to detect a deviation in altitude. Add VSI to the sequence of the pitch attitude cross-check previously described. Any deviation of the vertical speed needle from zero indicates the need for a change in pitch attitude.

2.11.4.4. Next, establish a climb or descent of about 100 fpm. Note the VSI shows the change in pitch attitude earlier than the altimeter and the VSI's movement is easier to detect than the attitude indicator's.

2.11.4.5. Descend to 100 feet below the desired altitude and establish a climb to return to the original altitude. To do this, change the pitch a small amount on the attitude indicator and cross-check the VSI to maintain a climb of approximately 200 fpm. Cross-check the altimeter to determine when to start the leveloff. (Normally 10 percent of VSI will be an adequate lead point.)

2.11.5. **Airspeed Indicator.** Airspeed remains constant when in straight-and-level flight with a constant power setting. Small changes in pitch attitude produce very slow changes in airspeed. Extreme changes in the pitch attitude produce faster changes in airspeed. From cruising airspeed in

straight-and-level flight, climb or dive the aircraft. The apparent lag in the airspeed indication is caused by the time required for the aircraft to accelerate or decelerate after the pitch attitude changes. However, there is no appreciable lag in the correct indication of this instrument. Bring the airspeed indicator into the cross-check in the same way as the attitude indicator, altimeter, and VSI. As more instruments are added, a quicker cross-check is needed.

2.11.6. **Elevator Trim.** Your instructor will have you fly the aircraft in level flight with the elevator out of trim. Note that stick pressure is necessary to hold the desired pitch attitude. Adjust the elevator trim to relieve the pressure and note how the aircraft flies hands off. In straight-and-level flight, change the power setting to note how it becomes necessary to hold pressure on the stick to hold your altitude as airspeed changes. Relieve this pressure with elevator trim. The importance of keeping the aircraft trimmed cannot be overemphasized. From level flight, make various power changes and practice the use of elevator trim.

2.11.7. **Summary.** An efficient cross-check is essential for precise instrument flying. The earlier a deviation is noted, the smaller the correction necessary to counteract the deviation. The attitude indicator is the most informative instrument for pitch attitude control in level flight, but you should cross-check the altimeter and VSI with the attitude indicator to ensure the altitude remains constant.

2.12. Bank Control:

2.12.1. **General.** An accurate and timely cross-check between control and performance instruments is necessary to achieve good bank control. The attitude indicator gives direct information about the bank attitude of the aircraft. The heading and turn indicators provide turning information. When you are in straight-and-level flight, maintain your attitude by using the EADI. Use the performance instruments to help you maintain a constant heading and altitude. The cross-check should always be as rapid and accurate as possible, even in simple maneuvers, to allow you more time to direct your attention to other matters in the advanced phases.

2.12.2. **Electronic Attitude Indicator (EADI).** The horizon bar, through gyroscopic properties, stays parallel to the actual horizon. The aircraft's actual attitude is duplicated on the attitude indicator by the miniature aircraft. This is easier to visualize if you imagine yourself in the miniature aircraft. Proper control of the miniature aircraft translates to proper control of the actual aircraft.

2.12.3. **Heading Indicator.** The heading indicator gives an indirect indication of bank. As you roll the aircraft into a very shallow bank, the heading moves slowly in the direction of bank. When you increase the bank, there is a corresponding increase in the rate of turn on the heading pointer. For turns of 30 degrees or less, the bank angle should approximate the number of degrees to be turned. For turns of more than 30 degrees, use a bank angle of 30 degrees. This is a good rule to prevent over controlling the aircraft. After becoming proficient, add the heading indicator to the cross-check with the other instruments used to maintain straight-and-level flight.

2.12.4. **Turn-and-Slip Indicator:**

2.12.4.1. This instrument is composed of two major elements, the turn needle and the ball. The importance of the turn-and-slip indicator has been de-emphasized in recent years because of improved reliability of attitude indicators and improved instrument flight procedures. It is still used when trimming the aircraft and for emergency bank indications if the attitude indicator fails. If such a failure occurs, the turn-and-slip indicator is the only instrument available to help keep the aircraft upright.

2.12.4.2. When the turn needle is exactly centered, the aircraft is in wings-level flight. When the aircraft is banked, the turn needle will deflect from center, indicating the direction of turn. Your instructor will have you occasionally cross-check the turn needle to support the other instrument indications.

2.12.4.3. Use the ball to determine whether the aileron and rudder trim are set correctly. The aircraft is improperly trimmed when the wings are level and the ball is not centered. Hold the wings level with the aileron pressure and center the ball with the rudder. Relieve all pressures by adjusting the appropriate trim. It is very important to keep the aircraft trimmed properly at all times.

2.12.4.4. Instrument flying is not difficult if the aircraft is trimmed and the instruments are cross-checked properly. An accurate and timely cross-check between control and performance instruments is necessary for good instrument flying.

2.13. Power Control. Correct power settings and standard procedures for changing airspeeds are essential to proper power control. **Table 2.1.** lists some of the more common airspeeds and power settings used when flying the T-6. Your instructor will provide techniques that will enable you to quickly set the approximate power setting for the desired performance. The cross-check method used for control and performance is also applicable to power control. Increase the speed of your cross-check when power changes are made. Power changes that result in airspeed changes affect the attitude of the aircraft. These changes require elevator control pressure to prevent any undesired change in the pitch attitude and rudder control pressure to prevent any undesired yaw in the aircraft. These pressures are then relieved by elevator and rudder trim.

Table 2.1. T-6 Airspeeds and Power Settings.

ITEM	A Maneuver	B Airspeed	C Gear	D Flaps	E Pitch (degrees)	F Power	G Other
GENERAL							
1	Level flight	250	up	up	2 NL	93 percent	±1 percent per 1,000 feet
2		200			1 NL	50 percent + altitude (see note)	
3		150			2 NH	35 percent	NA
4	Takeoff	85	down	TO	5 to 6 NH	MAX	
5	Tech climb	180	up	up	9 NH		
6		160			12.5 NH		
7		140			17 NH		
VFR PATTERN							
8	Pattern break	200	up	up	LOL	10 percent	NA
9	Closed	140 min			15 to 25 NH	MAX	
10	At the perch	120	down		3 to 4 NH	25 percent	
11	Final turn/final	110/100		LDG	2/3 ground 1/3 sky	12 to 15 percent	20 to 22 percent
12		115/105		TO			18 to 29 percent
13		120/110		up	1/2 ground 1/2 sky	10 to 12 percent	20 percent
INSTRUMENT MANEUVERS							
14	Vertical-S up	150	up	up	4 NH	55 percent	1,000 fpm
15	Vertical-S down				2 NH	15 percent	
16	45° steep turn				3 NH	45 percent	NA
17	60° steep turn				4 NH	60 percent	
18	Wingover	220			5 NH	80 percent	
19	Aileron roll				25 NH		
20	Slow flight	80 - 85	down	LDG	8 NH	45 percent	
21		85 - 90		TO	9 NH	40 - 45 percent	
22	Slow flight (no flaps)	90 - 95		up	10 NH	40 percent	
PENETRATIONS/EN ROUTE DESCENT							

ITEM	A Maneuver	B Airspeed	C Gear	D Flaps	E Pitch (degrees)	F Power	G Other
23	Penetration	200	up	up	10 NL	25 percent	SB
24						idle	No SB
25	En route descent				5 NL	20 percent	
26					8 NL	10 percent	
APPROACHES							
27	Final approach (level/configured)	120	down	TO	3 NH	35 percent	NA
28	Precision final	110			LOL	22 percent	600 fpm
29	Nonprecision final				1 NL	16 percent	1,000 fpm
30	Holding	150		up	2 NH	35 percent	NA

NOTE: Add MSL altitude. (At 3,000 feet MSL, set 53 percent torque.)

LEGEND:

LDG—landing flap position

LOL—line on line

NA—not applicable

NH—nose high

NL—nose low

SB—speed brake

TO—takeoff flaps

2.13.1. **Power Corrections:**

2.13.1.1. When you increase power, the aircraft has a tendency to climb as the airspeed increases and yaw to the left due to the torque increase. Forward pressure on the elevator control is necessary to maintain a constant altitude. Use elevator trim as necessary. An increase of right rudder (or a decrease in the amount of left rudder being used) is necessary to maintain a constant heading.

2.13.1.2. Use rudder trim as necessary. With a decrease in power, the nose has a tendency to drop and yaw to the right. Use back pressure and adjust the rudder input to maintain altitude and heading. Follow these control inputs by appropriate elevator and rudder trim.

2.13.1.3. There is a specific power setting that will hold airspeed at the altitude you choose. If you want 200 knots indicated airspeed (KIAS) at 10,000 feet, level off at 10,000 feet, accelerate, and set the power on the primary engine data display to the torque setting you think will hold 200 KIAS. Keep the aircraft at 10,000 feet with elevator control and watch the airspeed indicator. If the airspeed stabilizes at *more* than 200 KIAS, you must reduce power. If it stabilizes at *less* than 200 KIAS, you must increase power. Again allow the airspeed to stabilize to determine whether a further power correction is needed.

2.13.1.4. Remember, altitude is maintained with pitch control and airspeed is maintained with power control. A quick cross-check between the airspeed indicator and the altimeter will indicate the need for a power or pitch change.

2.13.2. **Combined Corrections:**

2.13.2.1. When the altitude is correct and the airspeed is not, a power change is needed to regain the desired airspeed. When both the altitude and the airspeed are incorrect, use the elevator control to correct the altitude and power to adjust the airspeed.

2.13.2.2. If you are below the desired altitude with a high airspeed, you may be able to deplete the excess airspeed with a pitch correction that will bring you back to the desired altitude. Similarly, if you are above the desired altitude with a low airspeed, you may be able to regain your desired airspeed with a pitch correction that will bring you back down to altitude. This is the reason you generally correct first for pitch and then for power, as required.

2.13.2.3. Obviously, if you are high and fast or low and slow, you will need simultaneous corrections of both pitch and power. You will be required to combine the cross-check of the control and performance instruments with precise power control to maintain straight-and-level flight. During power corrections, the speed of the cross-check must be increased so control corrections can be timely and small.

Chapter 3

EMERGENCY PROCEDURES

3.1. Important Information. The emergency procedures in this section are in *addition to* those in the TO 1T-6A-1 (flight manual). The importance of studying all emergency procedures cannot be overemphasized.

3.2. Takeoff Emergencies. If the PF sees a reason to ABORT, he or she should not hesitate to do so. If the PNF sees something hazardous, he or she should point it out to the PF. If, in the perception of the PNF, a time-critical, dangerous situation requires immediate action and there is no time to relay this to the PF, the PNF should take control of the aircraft to accomplish the appropriate procedures. The aircraft commander will address techniques for engine failure immediately after takeoff based on specific conditions of the runway environment, weather, crew proficiency, etc.

3.3. Complete Electrical Failure, Day or Night:

3.3.1. If you encounter complete electrical failure, fly over the runway supervisory unit (RSU) or tower, as applicable, at an altitude of 500 feet above the ground (AGL) and at an airspeed of 200 KIAS. This will alert the controller to your situation.

3.3.2. At the end of the runway, make a 180-degree climbing turn to the downwind leg. Roll out at normal pattern altitude. Use landing gear emergency extension procedures to lower the landing gear. With complete electrical failure, the speed brake, normal gear extension, flaps, trim, and nosewheel steering are inoperative.

3.3.3. Be alert for a red light or flare from the RSU or tower. This may be a warning of some unseen hazard. If you receive a steady green light or no light from the RSU or tower and it appears a safe landing is possible, continue with the approach and landing.

3.3.4. If a go-around is required, start it as early as possible and do not attempt to raise the gear. With complete electrical failure at night, you can see other aircraft, but they cannot see you, so be especially alert.

3.3.5. In certain situations, you may fly the electrical failure pattern when you do not have radio contact with the RSU or tower and want to declare an emergency. Depending on your problem, you may continue with an emergency landing pattern (ELP) or perform a straight-in approach.

3.4. Radio Failure Pattern, Day or Night:

3.4.1. When the RSU is in control of the runway, fly a normal overhead pattern, rocking the wings on initial. Watch for a green light from the RSU. If no light is received, flash the taxi light and landing lights on final and continue the pattern. Do not sacrifice aircraft control to flash the lights.

3.4.2. When the RSU is not in control of the runway, fly the aircraft alongside the landing runway while rocking the wings. Turn to downwind at the end of the runway and check the tower or RSU for a green light on base leg and final approach.

3.5. Physiological Problems:

3.5.1. There are many physiological factors that may affect a pilot, but they have one common result—degraded pilot performance. The cause may be hypoxia, hyperventilation, bends, chokes, or cramps.

3.5.2. Symptoms are not the same for every pilot. In physiological training, you were allowed to experience and identify some of your symptoms. Learn to recognize your symptoms or the degraded performance. If you, as the PF, start feeling bad, let the PNF know and have him or her fly, if able. If symptom are noted, gang-load your OBOGS, declare an emergency, and descend below 10,000 feet cabin pressure. Even if you begin to feel better, land as soon as practical (preferably where medical treatment facilities are available). The flight surgeon will meet the aircraft and check your personal equipment.

3.6. Low-Level Emergencies:

3.6.1. A low-level en route malfunction or emergency will demand that you climb the aircraft to a safe height above the terrain so you may analyze the situation safely. A safe height above the terrain is considered to be between 1,500 feet AGL and the published route maximum altitude. Performing initial analysis of the malfunction within the low-level route structure allows low-level training to resume if the situation allows. If you abort the route, you may not reenter and resume training. If you must initiate recovery, have positional awareness, and are able, proceed to the nearest suitable airfield while handling the problem.

3.6.2. If you are unable to contact a controlling agency, follow the local lost-communication procedures, specific route lost-communication procedures in the *FLIP AP/1B* or the general lost-communication procedures in the *FLIP Flight Information Handbook*. In the preflight briefing, some emergencies to be discussed are engine failure at low altitude, bird strike, canopy failure, low-level diverts, and unplanned weather.

3.6.3. Compute a route abort altitude for each VFR or low-level navigation route flown and clearly annotate the altitude on the chart for easy reference in flight. Compute this altitude to provide 1,000 feet (2,000 feet in mountainous terrain) clearance from the highest obstacle within 10 nautical miles (nm) either side of course for the entire route.

3.6.4. Instrument meteorological conditions (IMC) encountered while flying VFR or low-level navigation constitute an emergency situation. If you cannot avoid flying into IMC, immediately abort the route and climb to your emergency route abort altitude or higher if appropriate. The climb should be expeditious, using maximum power and a safe airspeed. Several factors, such as the terrain or the nature of the emergency, will influence the airspeed used to abort the route. Normally, a minimum of 160 KIAS is sufficient during the climb.

3.6.5. To abort, immediately establish a climb on course and do not, under any circumstances, attempt to reenter the route once an abort has been initiated. Route aborts are potentially disorienting. Immediately transition to instruments and pay close attention to aircraft control and flight parameters. After reaching the route abort altitude, level off, squawk 7700 if appropriate, and coordinate with the appropriate controlling agency for an IFR clearance to an acceptable destination. A climb to an altitude higher than route abort may be necessary to ensure obstruction clearance during the recovery to the destination airfield.

3.6.6. If at any time you miss consecutive checkpoints or turn points and do not recognize any references from your map, climb to the top of the route structure. Maintain planned headings and airspeed while attempting to identify major references. Use any available navigational aid (NAVAID) to fix your position. Check past actions to trace a possible navigation error. If unable to reorient yourself, abort the route and follow the lost procedures discussed in paragraph **3.9.**

3.7. Airspeed Indicator Malfunction:

3.7.1. An interruption of static or impact pressure will cause an airspeed indicator malfunction. An obstruction at the static ports or pitot tubes will cause erroneous cockpit indications. This may result in a slow decrease toward zero or possibly a stable indication. You should suspect a malfunction if you note any improper response. It is important to ensure the probes anti-ice is turned on when flying in visible moisture to prevent the formation of ice.

3.7.2. The corrective action to be taken for pitot-static system malfunctions will vary, based on the situation. The only cockpit correction for pitot tube blockage is to use probes anti-ice.

3.7.3. Use caution during flight without an airspeed indicator. You must use approximate pitch and power settings and cross-check the results of those settings by referring to the AOA indications. By simply using these AOA indications, you can fly maximum range, maximum endurance, and normal approach speed and avoid a full stall. Avoid rapid pitch and power changes and initiate immediate recovery procedures for any stall indications. If the AOA system is also inoperative, the preferred method of recovery is to use a chase aircraft to lead you down for landing.

3.7.4. If your situation dictates a single-ship recovery and landing, fly a straight-in approach. Plan your approach carefully and use appropriate power settings to provide safe airspeed and AOA control.

3.7.5. The green arc on the AOA gauge (10 to 11 units) indicates the optimum, onspeed AOA for all configurations and bank angles. The central onspeed “donut” is equivalent to the green arc.

3.8. After Landing With an Emergency. If you require assistance from fire protection or maintenance personnel after making an emergency or precautionary landing, set the parking brake and raise both hands to signal that it is clear to inspect the aircraft. Do not actuate switches without visual coordination with the ground crew.

3.9. Lost Procedures:

3.9.1. If you do not pay attention to where you are flying, you may become lost or disoriented. You should have a map of the area to keep yourself oriented in relation to known landmarks at all times. If you become lost, do not hesitate to call for assistance. It is far better to admit you are lost and get help than to wander aimlessly until you are low on fuel and have to eject.

3.9.2. Fuel consumption can be critical. Take immediate steps to conserve your remaining fuel. While calling for assistance and trying to determine your position, climb to the optimum altitude as indicated in the diversion range summary chart and establish maximum endurance airspeed based on the AOA indications (approximately 125 KIAS).

3.9.3. Attempt to contact an ATC radar facility, using either ultra high frequency (UHF) or very high frequency (VHF) radio. If there is no contact, channelize the radio to other frequencies listed in your IFG and squawk 7700 on your transponder. If you cannot contact a radar facility on the listed frequencies, attempt contact on guard frequency (243.0 or 121.5). Preface your calls with “Mayday,” “May-

day," "Mayday," and give your call sign and type of emergency. Several controlling agencies will probably answer your distress call. Select one agency and tell the rest to remain silent. The agency you select will attempt to identify you by requesting that you change your transponder code. Once you are identified, you will be given directional information to the nearest suitable airfield or, if sufficient fuel exists, to your home field.

3.9.4. Remember, radios work on a line-of-sight transmission principle. The higher your altitude, the more likely you are to obtain a good steer from a ground facility. **Figure 3.1.** shows an approximate range for transmission over flat terrain.

Figure 3.1. Approximate Range for Transmission Over Flat Terrain.

Aircraft Altitude	Range
5,000 feet	55 miles
10,000 feet	140 miles
20,000 feet	200 miles

3.9.5. GPS can be of great help in determining your position and locating a suitable landing field. By using the nearest airfield (NRST) function, you can obtain the bearing, range, frequencies, and other airfield information. Your instructor pilot (IP), along with academic training, will cover the use of GPS.

3.9.6. If you cannot establish radio contact with any controlling agency, try to determine your position by radial and DME from a known navigational facility. If the DME is inoperative, try to orient yourself by using two VOR stations. Tune in a nearby VOR and note the radial you are on. Draw this line from the VOR on your map. Tune in another nearby VOR and note the radial you are on. Draw this line from the second VOR on your map. The point where the two radials cross is your position within 2 or 3 miles. Factors such as inaccurate plotting and movement of the aircraft may affect the accuracy of the fix; but, in the absence of other landmarks, this two-bearing fix is very useful.

3.9.7. If you decide to accept radar vectors or attempt to home to a station, ensure your heading system is operating properly. Check it with the standby magnetic compass. If they do not agree, rely on the magnetic compass. To do this, center the course deviation indicator (CDI) with a TO indication on the TO/FROM indicator. Use the CDI to establish a course to the fix while using the magnetic compass for heading information. Once you are oriented, maintain maximum range airspeed as indicated in the diversion range summary chart.

3.9.8. If you are unable to establish your position or navigate by using aircraft instruments, pick out some outstanding landmark on the ground. A significant body of water, a town, or a railroad crossing are all good landmarks. Try to find your selected landmark on the local area map. You should have some idea of your general location so look for your landmark in that general area on your map. Orient your map with the aircraft heading. If you cannot locate the landmark on your map, do not just wander around aimlessly. Fly a definite heading until you can pick up another good landmark. Set up an orbit around it and identify it. If you still cannot locate your position, look for a suitable airstrip and land before you run out of fuel. If you cannot locate an airstrip before running out of fuel, eject.

3.10. Trim Malfunctions:

3.10.1. A trouble-free trim system is essential to minimize fatigue from out-of-trim stick forces. Do not attempt to fly an aircraft that fails the preflight trim check. Once airborne, a trim system failure could result in heavy stick forces, leading to muscular fatigue or even loss of aircraft control due to disorientation from unusual stick pressures.

3.10.2. The most effective way to reduce or eliminate stick forces caused by trim failure is to reduce the airflow over the control surfaces and trim tabs. Flying at faster airspeeds dramatically increases the force required to maintain a desired pitch. If you experience trim failure or runaway trim at low altitude, consider trading airspeed for altitude by climbing.

3.10.3. In addition to trim failure, the trim actuator could "run away" as a result of a malfunction or inadvertent application by a crewmember. This could result in very heavy stick forces. Any time you experience abnormal stick forces, press and hold the trim interrupt button. Use pitch and power to achieve an airspeed that minimizes stick forces and refer to the "Runaway or Stuck/Failed Trim" section of the checklist. When an in-flight trim malfunction occurs, terminate the profile and return to land via a straight-in approach.

3.11. Ejection. If it is necessary to abandon the aircraft, the aircraft commander will use the term "bail out" as the final command. If time and conditions permit, crewmembers should discuss ejection procedures before ejecting from the aircraft. However, in critical situations, they must not delay ejection waiting for the command to bail out. Furthermore, they will not delay ejection once the aircraft commander has given the command.

3.11.1. **Controlled Ejection With Intercom.** The aircraft commander will direct the other crewmember to complete the Controlled Ejection Checklist. When ready to eject, the aircraft commander will call "bail out, bail out, bail out" and both crewmembers will pull their respective ejection handles to initiate the dual-sequenced ejection. Both crewmembers must maintain a good body position and be ready to go.

3.11.2. **Uncontrolled Ejection With Intercom.** The aircraft commander will direct ejection by calling "bail out, bail out, bail out." Both crewmembers will pull their ejection handles without hesitation.

3.11.3. **Controlled Ejection Without Intercom.** The aircraft commander will point to the Controlled Ejection Checklist page and/or yell to the other crewmember. When the other crewmember is ready, he or she will assume a good body position and give the aircraft commander a thumbs-up signal. When the aircraft commander is ready, he or she will give a thumbs-up signal and then three face-curtain signals. Both crewmembers will pull their respective ejection handles to initiate the dual-sequenced ejection. Both crewmembers must maintain a good body position and be ready to go.

3.11.4. **Uncontrolled Ejection Without Intercom.** The aircraft commander will attempt to get the other crewmember's attention, followed by three face-curtain signals. If time is critical, ejection must not be delayed.

3.12. Bird Strikes. If a bird strikes the aircraft on short final and the aircraft is under control, the PF will land. Otherwise, he or she will start a climb away from the ground and keep the aircraft flying. If unable to communicate between cockpits, the PF should gently shake the stick to indicate the aircraft is under control. If the PNF doesn't feel like the airplane is climbing away from the ground, he or she should come on the controls and start the aircraft climbing. If either pilot is partially incapacitated and feels the aircraft

is under control, he or she should lock the harness, sit back, and wait for help. If either pilot is partially incapacitated and feels the aircraft is out of control, he or she must EJECT.

3.13. Engine Failure. If the engine fails and excess airspeed is available, the PF should initiate a zoom (to trade airspeed for altitude) and clean up the aircraft, if required and able. Otherwise, he or she will establish a glide. The PNF should use situational awareness, visual scan, and GPS to find the nearest suitable runway and point it out to the PF.

3.14. Visual Signals With Intercom Failure. If the intercom fails, aircrews can yell back and forth, pass notes, talk on a discrete frequency, or use visual signals as follows:

3.14.1. **Gear Emergency Extension.** If the rear cockpit pilot (RCP) needs the front cockpit pilot (FCP) to emergency extend the gear, the RCP should move the gear handle up and down several times. When the handle stops in the down position, the FCP should emergency extend the gear. (Time permitting, the FCP should accomplish the Emergency Extension Checklist.)

3.14.2. **Transfer of Aircraft Control.** To relinquish control of the aircraft, the PF will pump the rudder pedals. The PNF will assume control by shaking the stick noticeably. After feeling the stick shake, the "new" PNF will complete the transfer of control by showing his or her hands to the "new" PF.

3.14.3. **Ejection.** Follow the instructions in paragraphs **3.11.3.** and **3.11.4.**

Chapter 4

TAKEOFF, CLIMB, AND LEVELOFF

4.1. Before Takeoff. During engine runup for the overspeed governor check, the PNF will guard and be ready to assume control of the brakes in case the rudder pedal rod end fails. The PF will prepare the aircraft for the takeoff, making absolutely certain all applicable procedures and checklist items have been completed. If more than one aircraft is cleared into the takeoff position, use alternate sides of the runway to avoid prop wash. Look around to make sure you are clear of all other aircraft and clear the final approach. Taxi onto the runway, ensuring the nosewheel is aligned straight down the runway and nosewheel steering is disengaged.

4.2. Takeoff Options. Initially, you will practice static takeoffs. Later, you and your instructor will have the option of a rolling takeoff.

4.2.1. **Static Takeoff.** One method of initiating the takeoff is a static engine runup. The PF will pump up the brakes and exert as much pressure as necessary to prevent creeping during engine runup. During engine runup, the PNF will guard and be ready to assume control of the brakes in case the rudder pedal rod end fails. The PF will look down the runway and advance the PCL to 25 to 30 percent torque, glancing into the cockpit only momentarily to ensure the engine instruments are within limitations. The primary concern at this time is to ensure the aircraft is not creeping forward or pulling to one side. Release the brakes to begin the takeoff roll and smoothly advance the PCL to MAX. When stabilized at maximum power, check the engine to ensure proper operation.

4.2.2. **Rolling Takeoff.** Another takeoff method used primarily to aid traffic flow in a busy pattern is a rolling takeoff. It is actually a smooth combination of taxi, application of power, and takeoff roll. Rolling takeoffs have a negligible effect on TOLD, and no recalculation is required.

4.3. Takeoff Procedures:

4.3.1. **Takeoff Roll:**

4.3.1.1. With the aircraft lined up straight down the runway, ensure the nosewheel steering is disengaged and the elevator is approximately neutral. Initial power application may cause the aircraft to yaw slightly to the left. Counteract this yaw by using an appropriate amount of right rudder. Be careful not to “ride” the brakes and transition to the rudder for directional control as it becomes effective. As airspeed increases and the flight controls become more effective, progressively smaller control inputs are required to maintain aircraft control. As airspeed increases, the nose will have a slight tendency to “dig in” and small amounts of elevator are required to keep the aircraft in the desired position.

4.3.1.2. At approximately 85 KIAS, smoothly apply back pressure to the stick to establish the takeoff attitude (approximately 8 to 10 degrees nose high). Your instructor will demonstrate the takeoff attitude. Use whatever back pressure is necessary to hold this attitude. Keep the wings level by applying aileron pressure. At the takeoff point, all flight controls are effective in maneuvering the aircraft. At any time during the takeoff, a situation may arise that requires an abort. The decision to abort depends on the nature of the problem, speed, and runway remaining. You must make decisions accurately and quickly. With certain types of malfunctions, you may find it advisable to continue the takeoff and then land as soon as practical. In any event, use TO 1T-6A-1

(flight manual) procedures to help you make your decision to abort or continue the takeoff. Your instructor will help you develop the judgment to make accurate, timely decisions. There is no substitute for good judgment.

4.3.2. **Leaving the Ground.** On initial takeoff as the airspeed accelerates through approximately 90 KIAS, the aircraft will fly off the ground. Changes in fuel weights and flap settings will vary takeoff airspeeds. As the aircraft leaves the ground, maintain the correct flight attitude and direction. If insufficient back pressure is held, the aircraft may settle back to the runway after the initial liftoff. However, be careful not to force the aircraft into the air by applying too much back pressure before adequate flying speed is gained. If this happens, the nose may rise so high that a stall develops. Forcing the aircraft into the air prematurely is unsafe and must be avoided.

4.3.3. **After Becoming Airborne:**

4.3.3.1. The aircraft will pick up speed rapidly after becoming airborne. When you are safely airborne with a positive climb rate, prepare to raise the landing gear and flaps. To prevent premature gear retractions, make this a conscious act, using the flight condition of the aircraft as the cue. Never allow gear retraction to become a habitual action or rely on a single cue, such as airspeed. When airborne and before moving the gear handle, the PF will make an intercockpit "gear clear" call and pause momentarily. On presolo contact sorties, the IP will acknowledge "clear" before the student pilot moves the gear handle. On all other sorties, "gear clear" is an advisory call only. This is intended to make the pilot consciously aware of the act of raising the gear and to emphasize that the other crewmember has a responsibility to ensure gear retraction is done properly.

4.3.3.2. After gear and flap retraction, adjust the pitch attitude slightly to compensate for the loss of lift. After takeoff, confirm the gear handle is up, warning light in the gear handle is extinguished, flaps are up, and engine instruments are checked. Trim to relieve the pressure on the control stick. If no elevator or trim corrections are made during departure, the increased control effectiveness at higher airspeeds will cause a steeper-than-desired climbout. To counter this, continue to increase forward stick pressure on the elevator to maintain the desired climb angle. Concentrate on maintaining the desired pitch attitude after liftoff and trim to relieve control pressures.

4.3.3.3. When an aircraft has taken off immediately ahead of you, anticipate the possibility of wake turbulence, especially if the wind is calm or straight down the runway. Although sudden deviations in flight attitudes may occur, do not become alarmed. Use firm control pressures to make a very shallow turn in either direction to fly out of the wake turbulence. Then realign the aircraft with the original flightpath. If a crosswind is present, make the turn upwind because the wake turbulence will be blown away from your flightpath.

4.4. Crosswind on Takeoff:

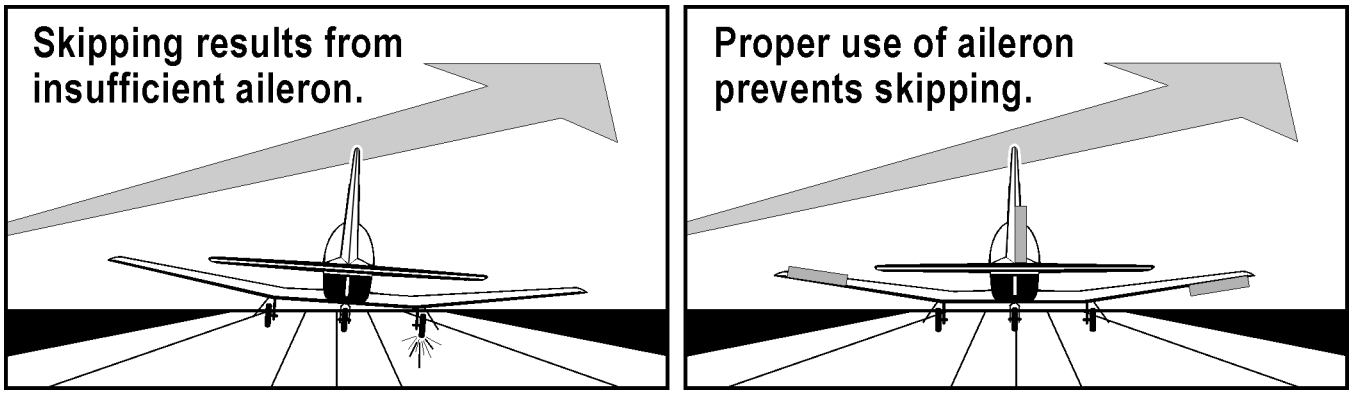
4.4.1. **Takeoff Roll (Crosswind).** As you taxi into takeoff position, check the windsock or other wind indicators or get wind data over the radio so you can anticipate the crosswind.

4.4.1.1. The initial takeoff roll technique for a crosswind is the same as for a normal takeoff except the aileron is held into the wind as the takeoff roll is started. You will also need to adjust rudder input to keep the aircraft from weather-vaning; that is, streamlining itself into the wind. If the crosswind is from the right, all that may be required to ensure proper aircraft alignment is less right rudder.

4.4.1.2. As the aircraft approaches flying speed, the ailerons become more effective. You must reduce aileron deflection to keep the wings level, but you have to maintain some aileron deflection throughout the takeoff roll. Aileron deflection is necessary because the upwind wing develops more lift, causing it to fly (begin rising) before the downwind wing.

4.4.1.3. If the upwind wing rises and exposes more impact surface, a skipping action may result (**Figure 4.1.**). This is a series of very small bounces caused by the aircraft attempting to fly on one wing and then settling back onto the runway. During these bounces, the crosswind will move the aircraft sideways and the bounces will develop into side-skipping. This skipping imposes stress on the landing gear that could result in materiel failure. In addition, the tendency of the aircraft to weather vane is increased.

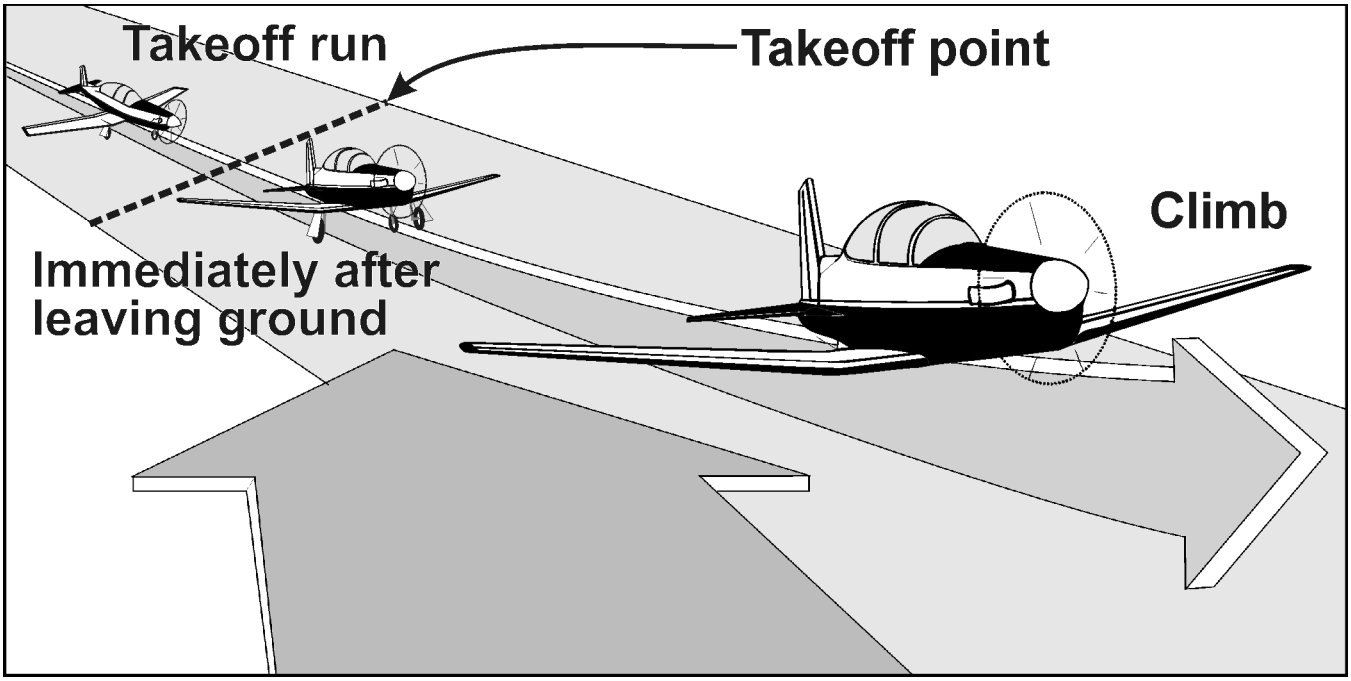
Figure 4.1. Skipping on Takeoff.



4.4.1.4. Use caution during takeoffs in gusty wind conditions or rapidly changing wind direction and velocity. Make timely corrections to maintain directional control.

4.4.2. **Leaving the Ground (Crosswind).** As the wheels leave the runway, the aircraft will start drifting with the wind. Relax the rudder pressure, allow the aircraft to turn into the wind until an adequate crab is established, and then neutralize the crosswind aileron. Continue to climb in the crab to maintain runway alignment on the takeoff leg (**Figure 4.2.**). The remainder of the takeoff climb is the same as previously explained in paragraph **4.3.3.**

Figure 4.2. Crabbing Into Crosswind After Takeoff.



4.5. Climb and Leveloff:

4.5.1. **Turns After Takeoff.** After takeoff, climb straight ahead until you are past the departure end of the runway (or as directed). Attain a minimum of 140 KIAS and 400 feet AGL before the first turn after takeoff. ***NOTE:*** The 400-foot restriction does not apply to the VFR pattern.

4.5.2. **Climbs:**

4.5.2.1. Normal climb speed for the T-6 is 140 to 180 KIAS. Climbout speeds below 160 KIAS are permitted by TO 1T-6A-1 (flight manual), but are not recommended due to high pitch attitudes that limit forward visibility and minimize clearing. You have the option to modify this climb speed range to suit specific mission requirements.

4.5.2.2. If the climb is started from cruising airspeed, increase the pitch to gradually decrease the indicated airspeed to obtain the climb airspeed. This change in airspeed is gradual rather than immediate because of the momentum of the aircraft and the added power for climb.

4.5.2.3. Trim is an important consideration during a climb. When you have established the climbing attitude, trim the aircraft (rudder first) to relieve all pressures from the controls. Trim should be a continuous process throughout the climb and leveloff. When you adjust the flight attitude and/or airspeed, retrim the aircraft.

4.5.3. **Straight-Ahead Climbs:**

4.5.3.1. To establish a straight climb from level flight, advance the PCL and raise the nose to a climbing attitude. Make all pitch changes, using outside references when available. Straight flight can be maintained by using section lines or other outside references supported by the heading indicator. A wings-level attitude should be maintained by outside references. An occasional glance at the electronic attitude indicator will help.

4.5.3.2. Your instructor will show you the climbing attitude at different altitudes and the outside references to maintain it. If the wingtips are equal distant from the horizon, a wings-level attitude should be indicated on the attitude indicator. As the climb is established, use back pressure to increase the pitch attitude. When the airspeed decreases to the desired reading, the amount of back stick pressure required to hold the airspeed will become constant. Use trim to neutralize stick pressures after attaining coordinated flight with rudder trim. Once this is done, you will be able to maintain an attitude without holding pressure on the stick.

4.5.4. **Climbing Turns.** During turns, the loss of vertical lift becomes greater as the angle of bank increases, so use shallow-banked turns to maintain a good rate of climb. During the early part of your training, make each turn a separate maneuver, pausing momentarily before establishing another turn. This will give you practice in entering and recovering from climbing turns. If you trim in the turn, you will experience different pressures during the rollout and you must retrim when the wings become level. Clear the area continuously during climbing turns.

4.5.5. **Leveloff From Climbs.** Stop your climb at a selected altitude and establish level flight. Start the leveloff by using a lead point that will ensure a smooth transition to the desired leveloff altitude. One technique is to use a lead point that is approximately 10 percent of the VSI. For example, if you are climbing at a rate of 2,000 fpm, start the leveloff 200 feet below the desired altitude. At the lead point, smoothly lower the nose of the aircraft to level flight. Adjust the PCL as necessary to obtain the desired airspeed and retrim the aircraft. Trimming is a continuous process from the time you lower the nose until the airspeed stabilizes. After leveling at your desired altitude, perform an operations check. (This check is not required for intermediate leveloffs.)

Chapter 5

CONTACT

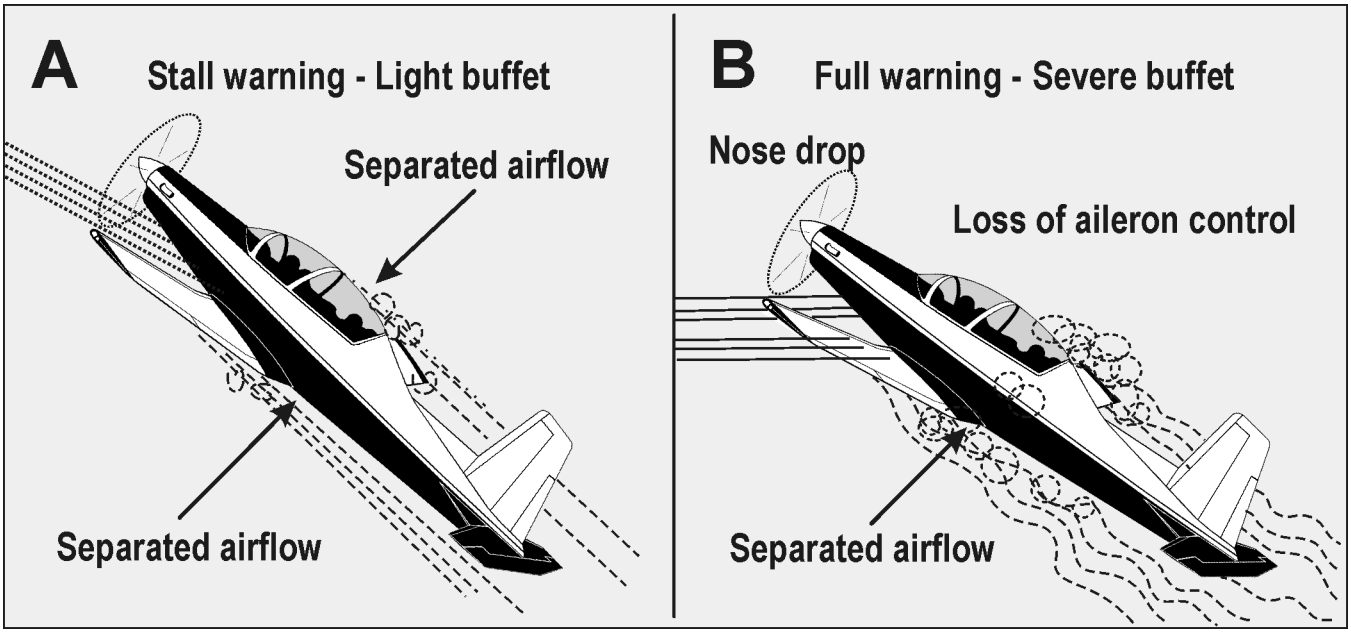
Section 5A—Prior to Maneuvering

5.1. Checklists. Before performing any maneuver, be sure to accomplish the appropriate checklists. If maneuvers are flown in a series, you are not required to run the checklist between individual maneuvers. ***NOTE:*** Avoid aggravated maneuvering (spins, stab demo, aerobatics, etc.) following flight at less than 1 G for an extended time (greater than 5 seconds). If less than 1 G is encountered for more than 5 seconds, but no ops limits are exceeded, recover to 1 G or greater flight for a minimum of 5 seconds prior to the initiation of any subsequent maneuvers.

Section 5B—Stall Training and Slow Flight

5.2. Power-On Stalls. Power-on stalls are designed to teach you to recognize and recover from a nose-high attitude, full stall. You will recover from these stalls when control effectiveness is lost. Control effectiveness is lost when the nose drops or an unplanned rolling motion takes place (**Figure 5.1.**). Full back stick is not needed before initiating recovery, and the exact point where the full stall is reached is not considered a point of emphasis. It is important, however, for you to see how an airplane behaves if recovery from the stall is not made at the first buffet indication. Clear the area. Adjust the PCL to 30 to 60 percent torque prior to the first indication of the stall. Pay particular attention to the area above and in front of your aircraft.

Figure 5.1. Stall Warning.



5.2.1. **Straight-Ahead Stall:**

5.2.1.1. To execute a straight-ahead, power-on stall, raise the nose to a pitch attitude between 15 and 40 degrees. Your IP will point out the outside references to use. Slowly and smoothly increase

back pressure to hold this attitude until control effectiveness is lost. Keep the wings level with aileron pressure.

5.2.1.2. Recover by using stick forces as necessary to decrease the AOA and smoothly advance the PCL to maximum. Apply coordinated rudder and aileron pressure to level the wings. Notice the pitch change necessary to recover. Allow the nose to lower until you feel positive pressure on the controls, indicating the aircraft is regaining flying airspeed. Cross-check the airspeed and recover with a minimum loss of altitude without encountering a secondary stall, which is usually indicated by a loss of nose track. The maneuver is complete when you have established a positive climb.

5.2.1.3. At lower pitch attitudes (between 15 and 30 degrees), the aircraft stalls at a relatively high airspeed. Shortly after you lower the nose, the aircraft will regain flying airspeed. At higher pitch attitudes (between 30 and 40 degrees), the stall speed is slower and a greater pitch change is necessary to regain flying airspeed.

5.2.2. **Turning Stall.** The turning stall is executed in much the same manner as a straight-ahead stall. The pitch and power are the same in the turning stall as they were in the straight-ahead stall. The bank is 20 to 30 degrees in either direction. From straight-and-level flight attitude, set the pitch attitude between 15 and 40 degrees and then establish the desired bank. Hold this established attitude with elevator and aileron pressure until control effectiveness is lost (indicated by a nose drop or unplanned roll). Then recover straight ahead as you did in the straight-ahead stall. A precision entry is not as important as proper recognition and recovery from full-stalled conditions.

5.3. Power-Off or Emergency Landing Pattern (ELP) Stalls. Power-off or ELP stalls are designed to teach you to recognize and recover from an approach to stall with a dead engine or feathered prop. The principle concern in power-off or ELP stall training is maneuver realism and operational applicability. The following distinct scenarios may be considered and/or practiced: a clean glide to high key, a gear-down glide between high and low key, and a gear down and flaps takeoff glide between low key and the runway. ***NOTE:*** The scenarios in paragraphs **5.3.1.** through **5.3.3.** are based on a situation where the pilot somehow becomes distracted or overly fixated on the runway during the glide and allows the nose to come up and airspeed to decay. This sets up a situation where, although the airspeed is lower than it should be, altitude is higher and can be traded off to get back on profile with very little net loss of energy. This is in contrast to the situation where, particularly between low key and the runway, airspeed is low because the aircraft is below the profile and the pilot is trying to "stretch" the glide. In this case, there is no excess altitude to swap to regain airspeed and the only option left—if the runway cannot be reached—is to eject.

5.3.1. **Clean Glide.** *(Simulated en route to high key)* Establish a clean glide at 125 KIAS (4 to 6 percent torque). Raise the pitch attitude slightly (approximately level-flight picture) 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 and reestablish the glide once airspeed reaches 125 KIAS. This should take approximately 300 feet of altitude.

5.3.2. **Glide With Gear Extended, 30 Degrees Angle of Bank.** *(Simulated between high and low key)* Establish a 30-degree bank turn, 120 KIAS glide with gear extended (4 to 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 airspeed is reestablished at 120 KIAS. This should take approximately 800 feet of altitude.

5.3.3. **Glide With Gear and Takeoff Flaps Extended, 30 Degrees Angle of Bank.** *(Simulated between low key and runway)* Establish a 30-degree bank turn, 120 KIAS glide with gear and takeoff flaps extended (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 airspeed is reestablished at 120 KIAS. This should take approximately 900 feet of altitude.

5.4. Traffic Pattern Stalls. You will practice traffic pattern stalls to become proficient in recognizing and recovering from stall conditions that could occur in the traffic pattern when you are rapidly cross-checking all available outside and instrument references. The emphasis is on recognizing an approach-to-stall indication and using appropriate recovery procedures, not on how the stall series is set up or the flow from one stall to the other. Initiate recovery when you recognize an approach-to-stall indication. The stick shaker or natural aircraft buffet is the best indication of an approach to stall. **If a stall indication actually occurs in the traffic pattern, make no attempt to comply with the normal ground track.** Recover the aircraft by using the following procedures to safely regain aircraft control and establish a positive climb:

5.4.1. **Overshooting (Nose Low) Final-Turn Stall.** On the simulated downwind leg, normally configure for a normal overhead pattern with flaps to LDG. At approximately 120 KIAS, initiate a normal final turn. After the turn is established, steadily increase bank and back pressure and retard the PCL to idle until you recognize an approach-to-stall indication. Recover by simultaneously using stick forces as necessary to decrease the AOA, advancing the power to maximum, and leveling the wings with coordinated rudder and ailerons. Do not lose any more altitude than necessary. Occasionally fly the stall with TO and UP flap settings.

5.4.2. **Undershooting (Nose High) Final-Turn Stall.** In level flight at approximately 120 KIAS minimum, reduce the power as you would on a downwind leg. Begin a normal final turn. After establishing the turn, raise the nose slightly, shallow out the bank, and retard the PCL to idle. Continue to turn until you recognize an approach-to-stall indication. Recovery is the same as for the overshooting final-turn stall except airspeed is lower and it will take you longer. Occasionally fly the stall with TO and UP flap settings.

5.4.3. **Landing Attitude Stall.** Establish a 100-knot simulated final approach, reduce the power to idle, and execute a normal roundout for landing. Hold the landing attitude constant until you recognize an approach-to-stall indication. At that point, execute a normal stall recovery. Occasionally fly the stall with TO and UP flap settings.

5.5. Secondary Stall:

5.5.1. A secondary stall is a form of an accelerated stall caused by excessive elevator control. It is called a secondary stall because it occurs after a partial recovery from a preceding stall. A secondary stall is caused by attempting to hasten a stall recovery when the aircraft has not regained sufficient flying speed. This stall demonstration is designed to show you what will happen if you rush the return to level flight after a stall or spin recovery. It also teaches you the value of smooth back pressure at crit-

ical airspeed and the importance of allowing an aircraft to begin flying before completing a stall recovery.

5.5.2. The secondary stall is usually demonstrated after a partial recovery from a power-on stall. Clear the area and perform a normal power-on stall. When the stall occurs, initiate a recovery. Then steadily bring the stick back as if you were trying to rush the return to level flight. Continue to increase back pressure until the aircraft buffets and the nose stops tracking. Note that the PCL is MAX when the secondary stall is actually entered. When this occurs, use stick forces as for a normal stall recovery.

5.6. Slow-Flight Practice:

5.6.1. Slow flight will acquaint you with the characteristics of the aircraft at minimum flying speeds and will demonstrate the importance of smooth control application. Practice slow flight to develop your feel for the aircraft and your ability to use the controls correctly. This will improve your proficiency in performing low airspeed maneuvers.

5.6.2. You may enter slow flight after the traffic pattern stalls or by reducing the airspeed and configuring for the maneuver. When the airspeed is below 150 KIAS, lower the landing gear and LDG flaps and make all geardown checks. Continue to maintain altitude while the airspeed decreases. When the airspeed has decreased to 80 to 85 KIAS, adjust the power to maintain airspeed and altitude. Trim the aircraft as needed throughout these changing flight conditions. You may practice slow flight, using the UP flap configuration and 90 to 95 KIAS or TO flaps at 85 to 90 KIAS.

5.7. Slow-Flight Demonstration:

5.7.1. Your IP will demonstrate the handling characteristics of the T-6 at minimum flying speeds and will have you fly some of these to build your proficiency in the aircraft. These demonstrations will help you recognize attitudes and characteristics leading to unsafe flight conditions.

5.7.2. During slow-flight demonstrations, recover if the aircraft stalls by alleviating the condition that caused the stall (decreasing the AOA, lowering the flaps, or decreasing the bank). However, this is not the primary method of stall recovery and is used only to enhance the effectiveness of the slow-flight demonstration. If a stall or an approach-to-stall indication occurs at any other time or if the stall condition is not immediately alleviated, initiate a normal stall recovery.

5.7.3. Excessively rough control movement at minimum airspeed or a delay in initiating recovery action after a stall or an approach-to-stall indication is recognized may result in an inadvertent spin. Start by accomplishing prestall, spin, and aerobatic checks. Then, at a safe altitude, slow the aircraft below 150 KIAS and configure with landing gear down and LDG flaps. Continue reducing airspeed to approximately 80 KIAS (about 15 units AOA) while setting approximately 45 percent torque. Note that the stick shaker may be on throughout the demonstration.

5.7.4. Demonstrate the following characteristics (**SCAT SAFE**):

5.7.4.1. **S—Straight and Level.** This slow-flight maneuver demonstrates operating the aircraft on the "back side of the power curve." It is critical to understand that increased AOA will result in increased drag and a stall if not carefully flown. Notice the pitch attitude, torque, and rudder deflection required to maintain straight-and-level flight. Also notice that this is the picture a pilot should see at rotation during takeoff or just prior to touchdown during landing.

5.7.4.2. **C—Control Effectiveness.** This maneuver demonstrates how 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.

5.7.4.3. **A—Adverse Yaw:**

5.7.4.3.1. Lack of coordinated rudder during a turn can cause pilots to weave or "S" on final. To demonstrate this, select two points, one directly in front of the nose of the aircraft and one approximately 20 degrees to the right of your present heading. Initiate a rapid right turn, using 20 degrees of bank without applying rudder and notice the initial tendency for the nose to yaw left of your selected point. After approximately 20 degrees of turn, roll out rapidly without using rudder. Notice that the nose continues past the selected roll out point then comes back. Now, initiate a right turn, using coordinated rudder. Notice that the nose immediately tracks in a coordinated manner. After 20 degrees of turn, roll out again; using properly coordinated rudder and notice that the nose stops on the selected rollout point.

5.7.4.3.2. It takes about 2 inches of right rudder to maintain straight-and-level coordinated flight. Turning to the right takes approximately twice the rudder deflection to maintain coordination. Turning to the left requires approximately one-half inch of right rudder to maintain coordination.

5.7.4.4. **T—Torque and Turns.** The T-6 has an initial tendency to pitch up, yaw, and roll left if the pilot does not maintain positive control during full power takeoffs and landings. To demonstrate this, quickly increase power to MAX from straight-and-level coordinated slow flight and let go of the controls. Notice that the nose tracks up, yaws, and rolls left approaching a stall. Recover from the heavy buffet, but prior to the 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. Emphasize that positive control of the aircraft will allow safe takeoffs, touch-and-go landings, or go-arounds.

5.7.4.5. **S—Steep Turns.** High angles of bank at slow airspeeds increase stall speed and cause rapid turn rates. To demonstrate this, slowly increase bank towards 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. Notice how quickly the AOA builds up, progressing into a stall. Roll out of the bank to recover from the impending stall.

5.7.4.6. **A—Abrupt Control Movement.** Fixation on the aimpoint during landing can cause an abrupt flare. Late recognition of the rapidly approaching runway usually leads 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 arrest in sink rate. To demonstrate this, abruptly apply back-stick pressure to 20 degrees nose high to simulate snatching the stick in the flare. Notice the AOA buildup and how quickly the aircraft progresses towards a full stall. Release back pressure to recover. Emphasize viewing the total landing environment and smooth, positive application of controls.

5.7.4.7. **F—Flap Retraction.** Retracting the flaps prior to the recommended airspeeds will cause the aircraft to lose lift and develop a sink rate. Demonstrate this while in straight-and-level coordi-

nated slow flight. Raise the flaps from LDG to UP without pausing at the TO position. While retracting the flaps, increase the pitch attitude to keep the aircraft from losing altitude. Notice initially that airspeed increases (reduced drag as flaps begin to retract). Then, as flaps continue retracting, observe the AOA buildup and how quickly the stall progresses. Recover from the stall by reselecting LDG flaps.

5.7.4.8. **E—Coordination Exercise.** Conduct a series of left and right turns, using 15 to 20 degrees bank. Practice using the coordinate rudder and keep the ball centered.

Section 5C—Recoveries From Abnormal Flight

5.8. Recovery Procedures. Throughout your flying career, but particularly during pilot training, you will find that occasionally maneuvers will not go as planned because of improper flight procedures and/or disorientation. You may arrive at a flight attitude and airspeed where you could lose aircraft control unless you initiate proper recovery procedures. This is especially true when flying aerobatic maneuvers. The key to recovery is early recognition of an improperly flown maneuver. When you recognize a deteriorating situation, apply the appropriate recovery procedures. Do not delay the recovery in an attempt to salvage a poorly flown maneuver.

5.8.1. **Cockpit Checks.** Before practicing these recoveries, clear the area and accomplish prestalling, spinning, and aerobatic checks. You do not have to check these items between individual recoveries if they are flown in a series.

5.8.2. **Recovery Setup Guidelines:**

5.8.2.1. During any abnormal flight recovery setup, IP vigilance is paramount. Do not compromise safe flight during IP demonstration or student performance of recovery training. In all situations where transfer of aircraft control is involved, transfer will be in accordance with paragraph **1.16.** of this manual.

5.8.2.2. Abnormal flight recovery training should be thought of in three phases of proficiency. These phases are not necessarily linked to a particular block of training, but are linked to the student's flying abilities and situational awareness. These phases are:

5.8.2.2.1. Initially, the IP will demonstrate and fly the complete setup and recovery while delivering appropriate verbal instruction. Once the student has seen the recovery demonstrated and has a basic grasp of why the recovery training is performed, the IP will begin setting up recovery situations for the student and talking him or her through the recovery procedures.

5.8.2.2.2. When the student shows proficiency in the recovery procedures, the IP will then begin setting up observable situations requiring an abnormal flight recovery. When the setup is completely developed, the IP will transfer control of the aircraft to the student, using the verbal command, "You have the aircraft—recover." The student will take the aircraft and recover from the abnormal attitude.

5.8.2.2.3. Once the student has seen all the different types of setups and can confidently and proficiently recover from various situations, the IP will setup the abnormal flight recoveries randomly throughout the area profile. Once the setup is complete, the IP will direct the student to take the aircraft with the command, "You have the aircraft." The student will take the aircraft with proper transfer procedures and recover in the appropriate manner.

5.8.2.3. Once a student learns the correct stick and throttle inputs, it becomes paramount to build his or her judgment and ability to recognize abnormal flight and the need to accomplish an abnormal flight recovery. The IP should concentrate on development of the student's situational awareness.

5.9. Inverted Recoveries. The correct procedure to recover from inverted flight is to roll to the level-flight attitude. The technique is the same as in any roll maneuver. Roll in the shortest direction to an upright attitude. When possible, maintain a fairly constant pitch attitude during the recovery. If you have low airspeed, let the nose of the aircraft lower while performing the rollback to the level-flight attitude. This prevents a stall and a potential excessive loss of altitude. Your IP will give you the opportunity to practice this recovery technique. He or she will fly the aircraft into an inverted attitude and then let you make the recovery. This will be practiced at various airspeeds. The correct recovery technique is a coordinated rollback to level flight, not a split-S.

5.10. Nose-Low Recoveries. Many of the maneuvers demonstrated and practiced in flying training will result in intentional or unintentional nose-low attitudes. The following information will provide you with a sound basis for a recovery technique:

5.10.1. Recover from a nose-low attitude with smooth back pressure as you roll to a wings-level attitude. Do not apply back stick pressure unless the wings are less than 90 degrees to the horizon. Start the recovery before the airspeed approaches aircraft limitations. Any time you are in a nose-low recovery situation with airspeed rapidly increasing, adjust the PCL to idle, extend the speed brake, and return the aircraft to level flight. A common technique is to use idle and speed brake any time the airspeed is 200 KIAS or higher. Other situations may occur with low airspeed and shallow pitch attitudes. In these instances, you may modify the recovery procedures to return to level flight with flying airspeed.

5.10.2. Recovery should not involve the use of maximum allowable G-forces unless the altitude available for recovery is critical. (Severe damage to the aircraft may result if design G limits are exceeded.) Airspeed and G-loading may increase during the pullout. Perform a proper anti-G straining maneuver (AGSM) (paragraph **5.13.1.**).

5.10.3. Recover from a nose-low attitude smoothly without excessive airspeed or loss of altitude. When practicing a nose-low maneuver, do not exceed maximum allowable airspeed (316 KIAS). Remember, the airspeed does not stop increasing as you begin raising the nose. It may increase until just before level flight is attained. If you exceed maximum operating airspeed, abort the mission and make an entry in the AFTO Form 781. This writeup will result in an overall inspection of aircraft's structure.

5.10.4. There is a potential for excessive altitude loss in any high speed dive recovery. If the aircraft has progressed to a very high airspeed dive, idle power and speed brake must be used for recovery. If airspeed increases to a point where the aircraft exhibits longitudinal instability, use idle power, speed brake, and back pressure to prevent additional nose-down movements and excessive airspeed. If the critical Mach is exceeded, you must decrease airspeed before a recovery is made.

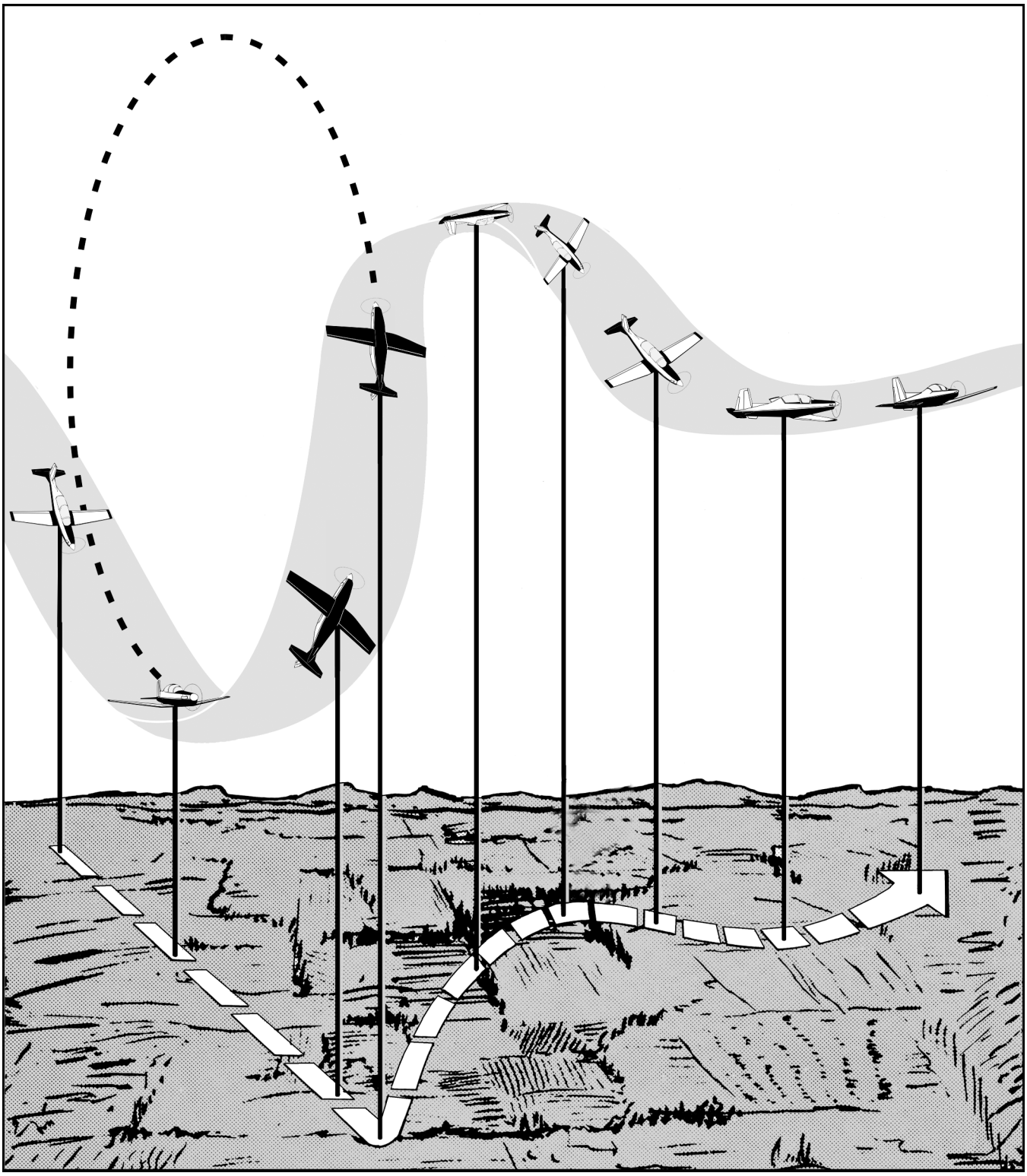
5.11. Nose-High Recoveries:

5.11.1. You will intentionally fly the T-6 through nose-high flight attitudes many times during aerobatic practice. Occasionally, because of improper control, you may find yourself in nose-high attitudes

with less than optimum airspeed to continue the maneuver. Unless immediate and proper recovery procedures are initiated, the aircraft may enter an aggravated stall, which could result in a spin.

5.11.2. The objective of the nose-high recovery is to fly the aircraft to level flight as soon as possible without stalling. To do this, adjust power to maximum and initiate a coordinated roll with back pressure to bring the nose of the aircraft down to the nearest horizon. Depending on the initial airspeed and aircraft attitude, a wings-level, inverted attitude may be reached. As the nose approaches the horizon, roll to an upright attitude (**Figure 5.2.**). Depending on the airspeed, you may need to delay the rollout until the nose is definitely below the horizon.

Figure 5.2. Nose-High Recovery.



5.11.3. During some nose-high situations, when aircraft airspeed is too low or dissipating rapidly, normal recovery control inputs may not be possible. Under these conditions or during disorienting nose-high situations, use an out of control flight (OCF) recovery to return the aircraft to level flight.

This is done by simultaneously reducing the PCL to idle and neutralizing the flight controls. After the controls are neutralized, expect the airspeed to dissipate and the nose to lower as the aircraft seeks to regain flying airspeed. Initially, aircraft control authority will be minimal. However, as airspeed increases during the dive, control inputs will become more effective. Allow the nose to lower until you feel positive pressures on the controls. You may need to lower the nose near vertical during this stage of the recovery. Upon regaining flying airspeed, recover the aircraft to level flight. Keep in mind that an unloaded recovery may result in considerable altitude loss.

5.11.4. Initially, your IP will have you practice both techniques for recovery (paragraphs **5.11.2.** and **5.11.3.**). As you gain proficiency, he or she will allow you to decide on the best technique for a given situation. At times you may attempt a nose-high recovery and have to transition to an OCF recovery due to insufficient airspeed or an approach to stall indication. However, you should learn to evaluate the existing situation and decide on the appropriate recovery technique.

Section 5D—Aerobatics

5.12. Performing Aerobatic Maneuvers:

5.12.1. Aerobatic maneuvers help you develop and perfect your technique for operating an aircraft to obtain maximum flight performance. These maneuvers are smoothly executed and explore the entire performance envelope of the aircraft. You will learn aerobatic maneuvers to help you develop a more sensitive feel for the aircraft and improve your ability to coordinate the flight controls and remain oriented, regardless of attitude. You will also learn to put the aircraft where you want it. Learning to perform aerobatics skillfully will increase your confidence, familiarize you with all attitudes of flight, and increase your ability to fly an aircraft throughout a wide performance range. Aerobatics will also teach you to feel at ease when your body is oriented at any angle. You will realize you can think, plan, observe, and perform as easily inverted as upright.

5.12.2. Training emphasis is on smoothness and proper nose track during the maneuver rather than on meeting exact entry parameters. Do your part to prevent loss of consciousness (LOC) episodes by avoiding unexpected, rapid, or abrupt control inputs when flying the aircraft.

5.12.3. Although each aerobatic maneuver has a range of entry airspeeds and power settings, a target entry airspeed and power setting should be briefed for each aerobatic maneuver planned. You should strive to use the briefed entry parameters for aerobatic maneuvers, but you may make small adjustments to entry airspeeds and power settings when this would enhance energy planning or expedite the profile flow (**Table 5.1.**). ***NOTE:*** Realize that indicated torque will vary relative to altitude and airspeed without changing the PCL position. This is why there is a range for entry airspeeds and power settings for aerobatics.

Table 5.1. Summary of Entry Airspeeds and Power Settings for Aerobatics.

ITEM	A Maneuver (References)	B Airspeed (KIAS)	C Power Setting (Percent Torque)
1	Split-S (paragraph 5.17.)	120 to 140	Idle to 75 percent
2	Aileron Roll (paragraph 5.16.)	180 to 220	80 percent - MAX
3	Barrel Roll (paragraph 5.19.)	200 to 220	
4	Lazy Eight (paragraph 5.21.)		
5	Cloverleaf (paragraph 5.20.)		
6	Chandelle (paragraph 5.18.)	200 to 250	
7	Loop (paragraph 5.15.)	230 to 250	
8	Immelmann (paragraph 5.22.)		
9	Cuban Eight (paragraph 5.23.)		

5.12.4. Continually strive for precision when flying these maneuvers. Normally, your left hand is on the PCL and your right hand is on the control stick. Avoid using a two-handed stick technique to maintain a wings-level attitude. Conscientious practice of these maneuvers will pay big dividends in providing knowledge of control pressures, timing, and planning—all of which are necessary for precision flying. The minimum altitude for entry or recovery from aerobatic maneuvers is 5,000 feet above the terrain.

5.12.5. Before performing these maneuvers, clear the area and perform pre-aerobatic checks. You do not have to check these items between individual maneuvers if they are flown in a series. Ensure the area is clear and attain the entry airspeed for the maneuver.

5.13. Increased G Maneuvering. During aerobatic flying, you will perform maneuvers at different and ever-changing G levels. This is especially true of any maneuver that starts with an extreme nose-down attitude at low airspeed and transitions to increasing airspeeds and higher G loads, such as nose-low recoveries, spin recoveries, and split-S maneuvers. To maintain maximum alertness and avoid grayout, blackout, or LOC during aerobatic flight, an effective anti-G straining maneuver is essential.

5.13.1. **Anti-G Straining Maneuver (AGSM):**

5.13.1.1. It is important to start the AGSM before the onset of the G forces and maintain the strain throughout the period of increased G-loading. The amount of strain required will vary with the amount of applied G force. When encountering high-G situations, all elements of the AGSM are required. During an AGSM, it is vital to anticipate the necessary strain, full muscle contraction, and constant breathing cycles. Lower-G situations will still require all elements of a full AGSM, but at a lower level of strain intensity. Your IP will provide guidance on how to properly accomplish the AGSM and will ensure you can perform it properly.

5.13.1.2. Accomplish the AGSM by firmly contracting muscles of the legs, abdomen, and chest. As the amount of Gs increases, you will need to increase the intensity of the strain and try to exhale through a closed airway. Continue to strain and simultaneously breathe approximately

every 2 to 3 seconds. Think about the AGSM as a continuum. As the amount of Gs increases and you increase the intensity of the strain, pay careful attention to proper breathing techniques. Do not to hold the strain too long without breathing because this will reduce G tolerance. If grayout occurs at the onset of G forces, application of the AGSM may not eliminate the grayout. 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 limits or your personal G limit for the particular day.

5.13.2. **AGSM Demonstration:**

5.13.2.1. Your IP will perform an AGSM demonstration to allow you to practice your anti-G strain technique and familiarize you with increased G flight. The demonstration will consist of a series of turns, each at a constant G level, with a break between turns for critique and rest. The maneuver will be flown at gradually increasing G levels, starting at 2 Gs and increasing to 4 Gs depending on your proficiency.

5.13.2.2. Your IP will advise you before maneuvering to ensure you are prepared. If at any time you approach your G tolerance, tell your IP. It is important that the demonstration be of sufficient duration to ensure you can perform the AGSM properly. The AGSM cycle should last a minimum of 10 seconds (at least 4 to 5 breathing cycles).

5.13.3. **G-Awareness Exercise.** If an AGSM demonstration has not been done, perform a G-awareness exercise on sorties that include maneuvers that require or may result in 3 or more Gs. 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. The G onset rate should be slow and smooth, allowing sufficient time to evaluate the effectiveness of your AGSM and determine your G tolerance. Increase Gs to approximately 4 Gs and maintain for approximately 10 seconds (4 to 5 breathing cycles) in order to allow full cardiovascular response. If you begin to gray out during the maneuver, return to 1 G flight, reevaluate your strain, and then slowly and smoothly reenter the G-awareness exercise. After entering the advanced aerobatic and advanced formation stages of training, the G-awareness exercise should be flown to G-loads of 4 to 5 Gs.

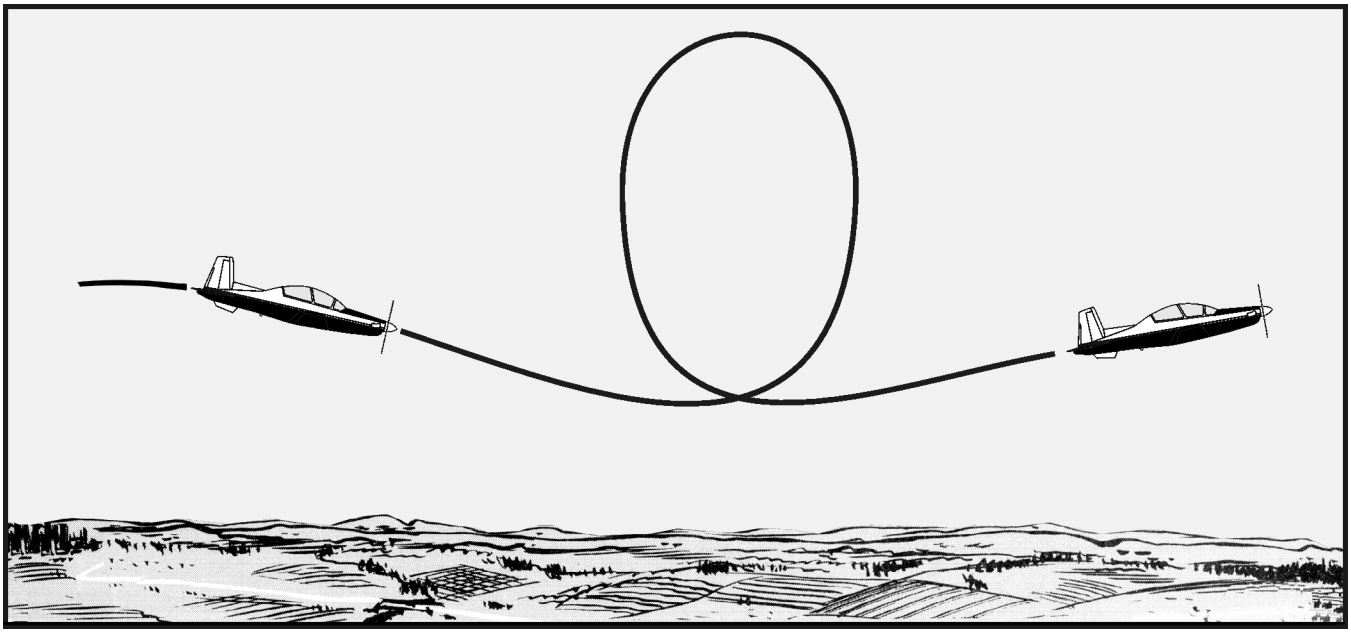
5.14. Energy Maneuvering. A good knowledge of energy planning will enhance your ability to use time, fuel, and an assigned altitude block. Total energy is a combination of altitude and airspeed, and one can be traded for the other. To trade altitude for airspeed, lower the nose and set maximum power. A commonly used reference is the canopy bow on the horizon. Using this reference and maximum power, you will gain approximately 50 knots for every 1,000 feet of altitude. One effective way to trade airspeed for altitude is to use maximum power and approximately 20 degrees nose high with wings level. The ideal energy level occurs near the middle of the altitude block at 150 to 200 KIAS. You can perform any aerobatic maneuver from this energy level. Plan your maneuvers to flow from one to another. Spins, traffic pattern stalls, cloverleafs, split-Ss, nose-low recoveries, excessive Gs, and steep-banked turns are energy-losing maneuvers. Power-on stalls, nose-high recoveries, stability demonstrations, and chandelles are energy-gaining maneuvers.

5.15. Loop:

5.15.1. The loop is a 360-degree turn in the vertical plane (**Figure 5.3.**). Because it is executed in a single plane, the elevator is the principle control surface used. The ailerons and rudder are used for

coordination and directional control. The objective of the maneuver is to maintain a constant nose track.

Figure 5.3. Loop.



5.15.2. To remain oriented, select a road or section line for a ground reference. Align the aircraft with the reference and keep them aligned throughout the loop. Adjust the PCL and attain the briefed entry airspeed.

5.15.3. Increase back pressure to pull the nose up at a constant rate—normally 3 to 4 Gs, depending on entry parameters. If you pull up too fast, you may exceed the critical AOA and stall. If you pull up too slowly, your airspeed will be slow over the top and you may stall. Centrifugal force will cause you to feel a definite seat pressure. Use this seat pressure to determine the correct rate of movement of the nose; for example, if there is very little seat pressure, your pullup is too slow.

5.15.4. Maintain the initial rate of nose movement throughout the maneuver by adjusting back pressure. As airspeed is depleted in the pullup, more back pressure is required to maintain a constant rate of nose movement. Increased right rudder is required as airspeed decreases to keep the nose tracking in a straight line. Use aileron and rudder pressure to keep the wings level throughout the maneuver.

5.15.5. When you can no longer see the horizon ahead, look at the wingtips and keep them equidistant from the horizon. After passing the vertical flight position, tilt your head back and watch for the horizon to appear. Use the horizon to maintain a wings-level attitude. Locate the reference on the ground that you used to begin the maneuver.

5.15.6. As the inverted position is attained, adjust back pressure in order to maintain a constant rate of nose movement. Use aileron pressure as needed to keep the wings level. As the nose passes through the horizon and the aircraft reenters a dive, increase back pressure to return to the level-flight attitude. Throughout the last half of the maneuver, use the ground reference to maintain the desired vertical plane.

5.16. Aileron Roll. The aileron roll is a coordinated 360-degree roll done in either direction with a constant roll rate. Adjust the PCL and attain the briefed entry airspeed. Smoothly raise the nose to 20 to 30 degrees pitch attitude, relax back pressure, and initiate the roll by applying aileron and coordinated rudder pressure. After the aircraft begins the roll, continue coordinated control pressure to maintain the desired rate of roll. Make no attempt to keep the nose on a point. As you approach the wings-level attitude, gradually release aileron and rudder pressure to ensure a smooth coordinated return to wings level.

5.17. Split-S:

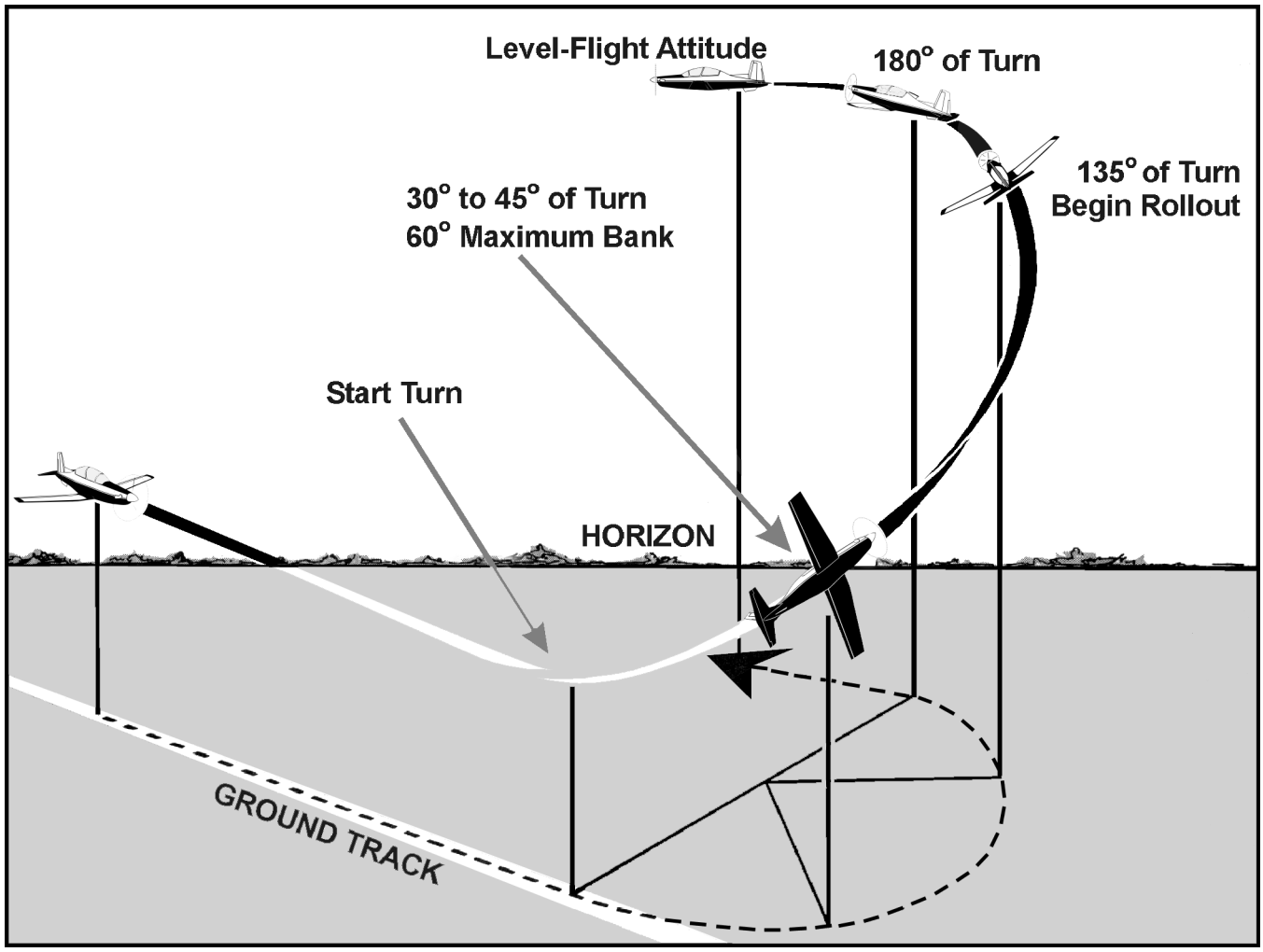
5.17.1. The split-S combines the first half of an aileron roll with the last half of a loop. The basic difference is that you are max performing the aircraft. It demonstrates how much altitude is lost if recovery from inverted flight is attempted by pulling through the horizon. Clear the area and keep in mind that the aircraft climbs during entry and descends during recovery.

5.17.2. From straight-and-level flight, adjust the PCL and simultaneously raise the nose to an approximately 20-degree pitch attitude. When the airspeed approaches approximately 20 knots above the briefed entry airspeed, roll the aircraft to the wings-level, inverted attitude. From this attitude, apply back pressure to bring the nose through the horizon. Attempt to achieve maximum nose track without stalling the aircraft by applying back pressure between the stick shaker and approximately 17 units AOA. Airspeed and G-loading (approximately 3 to 4 Gs) will increase during the pullout. Remember to perform a proper anti-G strain. The maneuver is complete when the aircraft returns to level flight.

5.18. Chandelle:

5.18.1. The chandelle is a precision 180-degree steep climbing turn with a maximum gain of altitude (**Figure 5.4.**) for a given power setting.

Figure 5.4. Chandelle.



5.18.2. Look in the direction of the turn and clear while performing the maneuver. Enter the maneuver with the nose approximately 15 degrees below the horizon and the PCL set. When the airspeed reaches briefed entry airspeed, blend rudder, aileron, and elevator pressure simultaneously to begin a climbing turn, using approximately 3 Gs. Allow the bank to keep increasing and the nose track to keep rising at a uniform rate. The nose should describe a straight line diagonal to the horizon.

5.18.3. The nose of the aircraft should pass through the horizon between 30 to 45 degrees of turn; and, at this point, you should reach a maximum bank angle of 60 degrees.

5.18.4. Check the amount of turn by using outside references. Time the bank-and-pitch increase so that when the aircraft passes through the horizon, your bank is approximately 60 degrees. (Cross-check the attitude indicator and outside references.) At this point, the vertical component of lift will decrease, which requires considerably more back pressure to keep the nose rising at a uniform rate. Continue to observe the amount of turn by checking outside references. At the 135-degree point in the turn, start the rollout.

5.18.5. Allow the nose to continue to rise at a uniform rate. Some lift is gained by decreasing the angle of bank, and some lift is lost by decreasing the airspeed. These variables require constant changes in control pressures to keep the nose rising at a constant rate.

5.18.6. Monitor the amount of turn remaining before reaching the 180-degree point by checking outside references. Time the rollout so the wings become level and the nose reaches the highest pitch attitude (approximately 40 to 45 degrees) at the 180-degree point. After the maneuver is complete (180 degrees of turn), lower the nose to the horizon or perform a nose-high recovery.

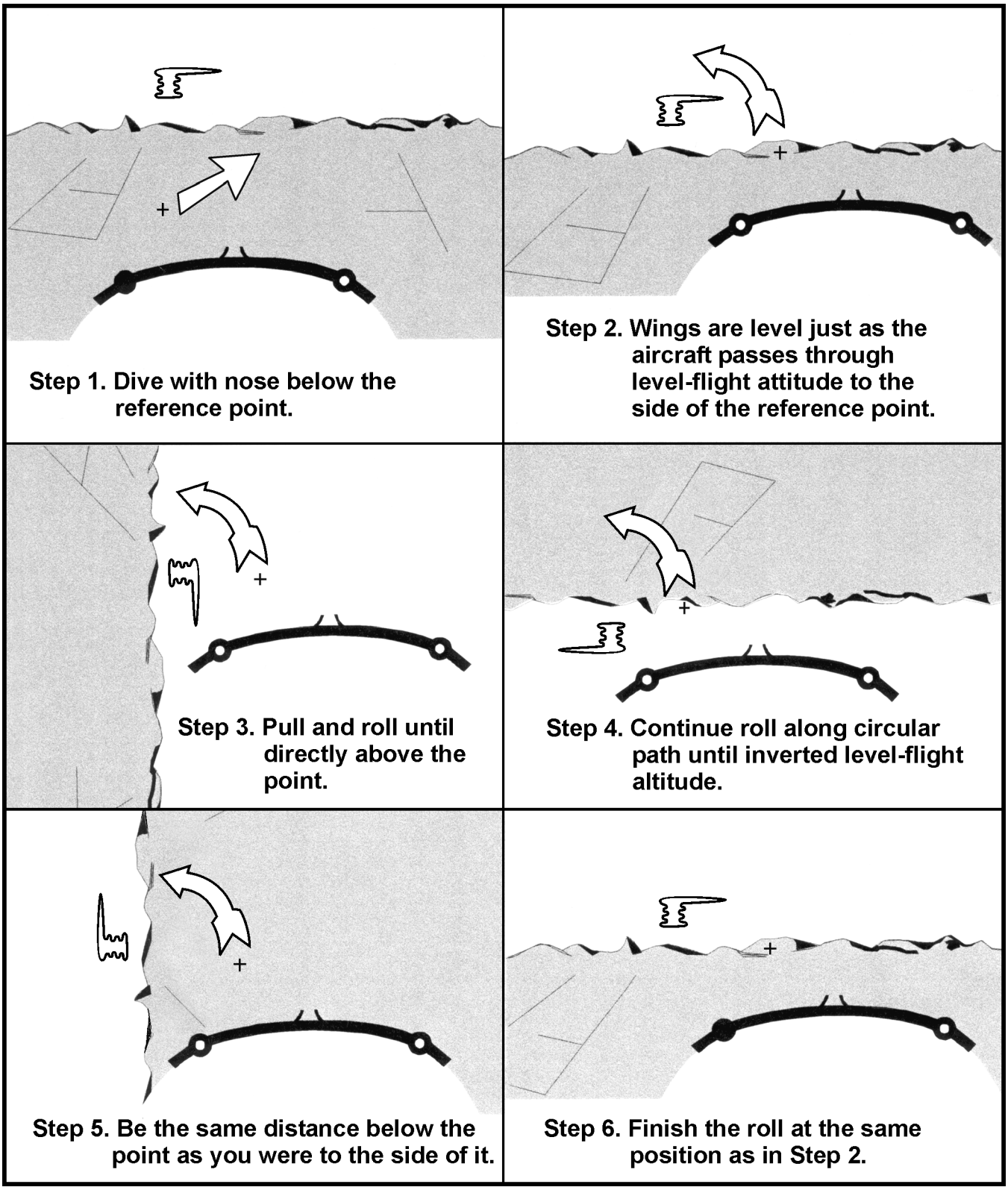
5.18.7. If the rate of climb is too fast, the aircraft will approach a stall before turning 180 degrees and the maneuver must be discontinued. If the rate of pitch change is too slow, the 180-degree point may be reached before the maximum pitch attitude is attained. If you plan to pull fast, roll in fast. If you plan to pull up more slowly, roll in slowly.

5.18.8. One point must be emphasized. When starting the maneuver, the rate of roll-in is faster than the rate of pullup. The result is a greater change in bank than in pitch from the beginning to the completion of the maneuver. The bank will increase to 60 degrees and then back to level. The total pitch change may only be 55 or 60 degrees The nose should describe a straight diagonal line to the horizon from the lowest point at the beginning of the maneuver to the highest point at the 180-degree position.

5.19. Barrel Roll:

5.19.1. A barrel roll (**Figure 5.5.**) is a coordinated roll in which the nose of the aircraft describes a circle around a point on the horizon. Maintain definite seat pressure throughout the roll. Practice the barrel roll in both directions. There is little or no net loss or gain of altitude from the maneuver.

Figure 5.5. View of Barrel Roll Around a Cloud.



5.19.2. Select a reference point—a cloud or landmark—on or near the horizon. Adjust the PCL and attain the briefed entry airspeed by diving the aircraft while clearing. Attain this airspeed with the nose of the aircraft below the reference point.

5.19.3. Begin a coordinated turn in the opposite direction of the desired roll. Keep the aircraft nose below level flight until it has turned up to 45 degrees to the side of the reference point. Then begin rolling out of the initial turn and allow the nose to rise so the wings are level just as the aircraft passes through a level-flight attitude. At this point, the distance to the side of the reference point depends on the speed of the rollout. This distance from the reference point should remain the same throughout the barrel roll.

5.19.4. From level flight, continue with coordinated stick and rudder pressure, causing the climb and bank to increase. As the wings reach the vertical attitude, the aircraft should be at its highest pitch directly above the reference point. After you pass this position, relax some of the back pressure, but continue the roll by blending in more aileron pressure. If you hold the same amount of back pressure as you did in the first quarter of the roll, you will put the nose down too fast in relation to the horizon because gravity is now assisting lift (downward). Plan the roll so the wings become level just as the aircraft reaches the inverted level-flight attitude.

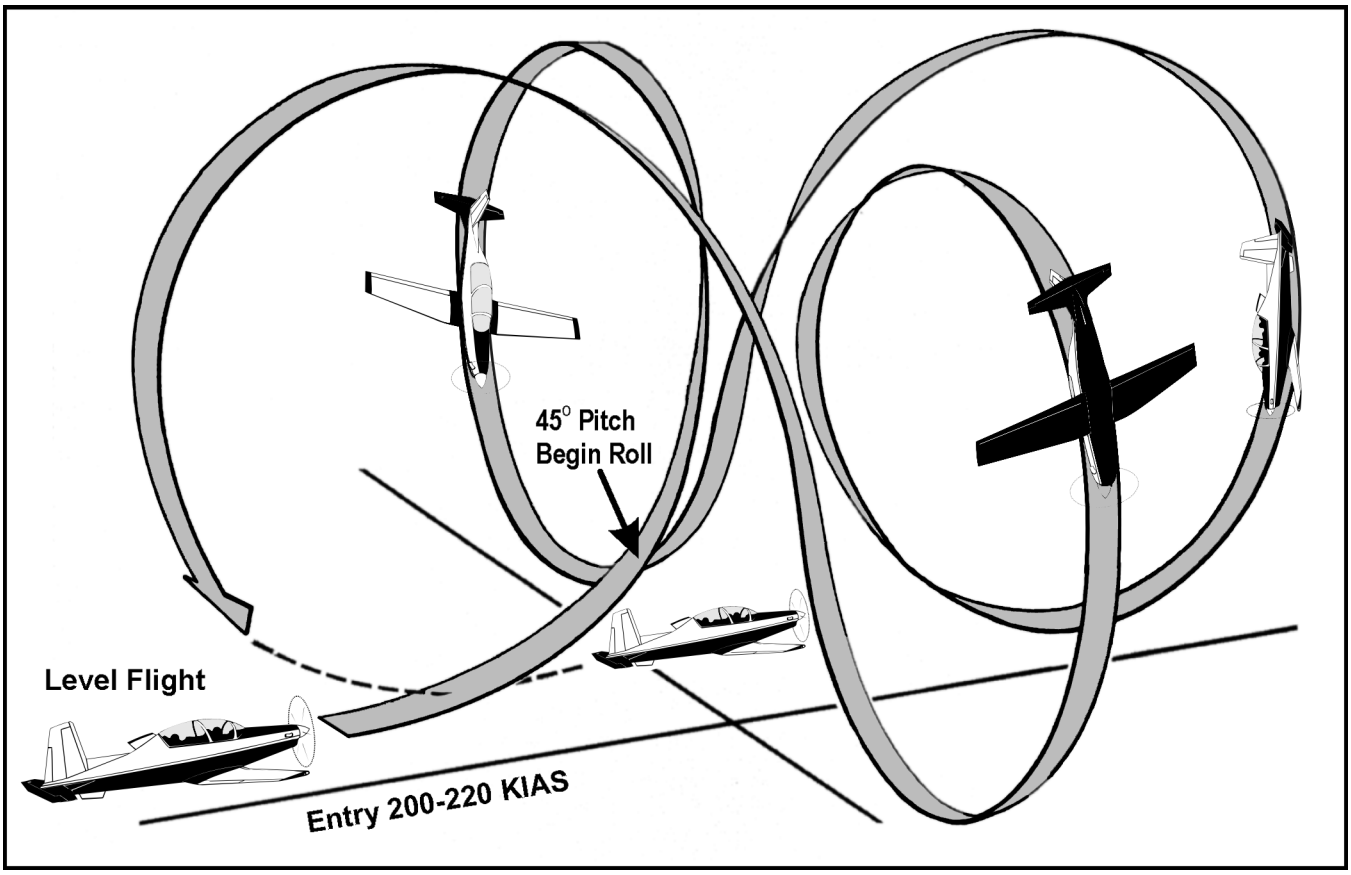
5.19.5. The aircraft nose track should now be the same distance on the opposite side of the reference point as it was at the beginning of the maneuver. The aircraft nose should have described a semicircle about the reference point. As the aircraft passes this position, continue the roll and begin applying increased elevator pressure.

5.19.6. As the wings again reach the vertical attitude at the bottom of the maneuver, the nose track should continue to be an arc of a circle with the reference point at its center. In this last quarter of the roll, begin to blend in more elevator and maintain coordinated control pressures to continue the roll so the nose track completes the circle around the reference point while positive seat pressures are held throughout the roll. The reason for this is to maintain a constant rate of roll. Because the nose is rising continuously up to this point and the airspeed is decreasing, the aileron deflection is less effective than it was at the beginning of the maneuver. This means the rate of roll will slow down unless more aileron surface is presented to the relative wind. Hold the rate of roll constant by the added aileron pressure.

5.20. Cloverleaf:

5.20.1. The cloverleaf is composed of four identical maneuvers, each begun 90 degrees from the preceding one (**Figure 5.6.**). The top part of this maneuver is similar to the recovery from vertical flight. The lower part resembles a split-S. This maneuver will help develop your timing, planning, and coordination, using outside references.

Figure 5.6. Cloverleaf.



5.20.2. Perform the cloverleaf smoothly without rapid rates of roll or excessive G-forces. If possible, choose an area with section lines for easy reference. To begin the cloverleaf, adjust the PCL and attain the briefed entry airspeed as the aircraft reaches level flight. The initial part of the maneuver is a straight pullup similar to a loop except for a slightly lower G-loading (2.5 to 3Gs).

5.20.3. Pick your reference point 90 degrees from the nose. Start a climb and keep checking this point as you progress through the climb. As the aircraft reaches 45 degrees of pitch, 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. Your first objective is to climb and roll so the nose passes through the reference point with the aircraft at wings level, inverted, and at a relatively low airspeed (approximately 120 KIAS). ***NOTE:*** Do not stare at the airspeed indicator, but check it as you pass through your selected point.

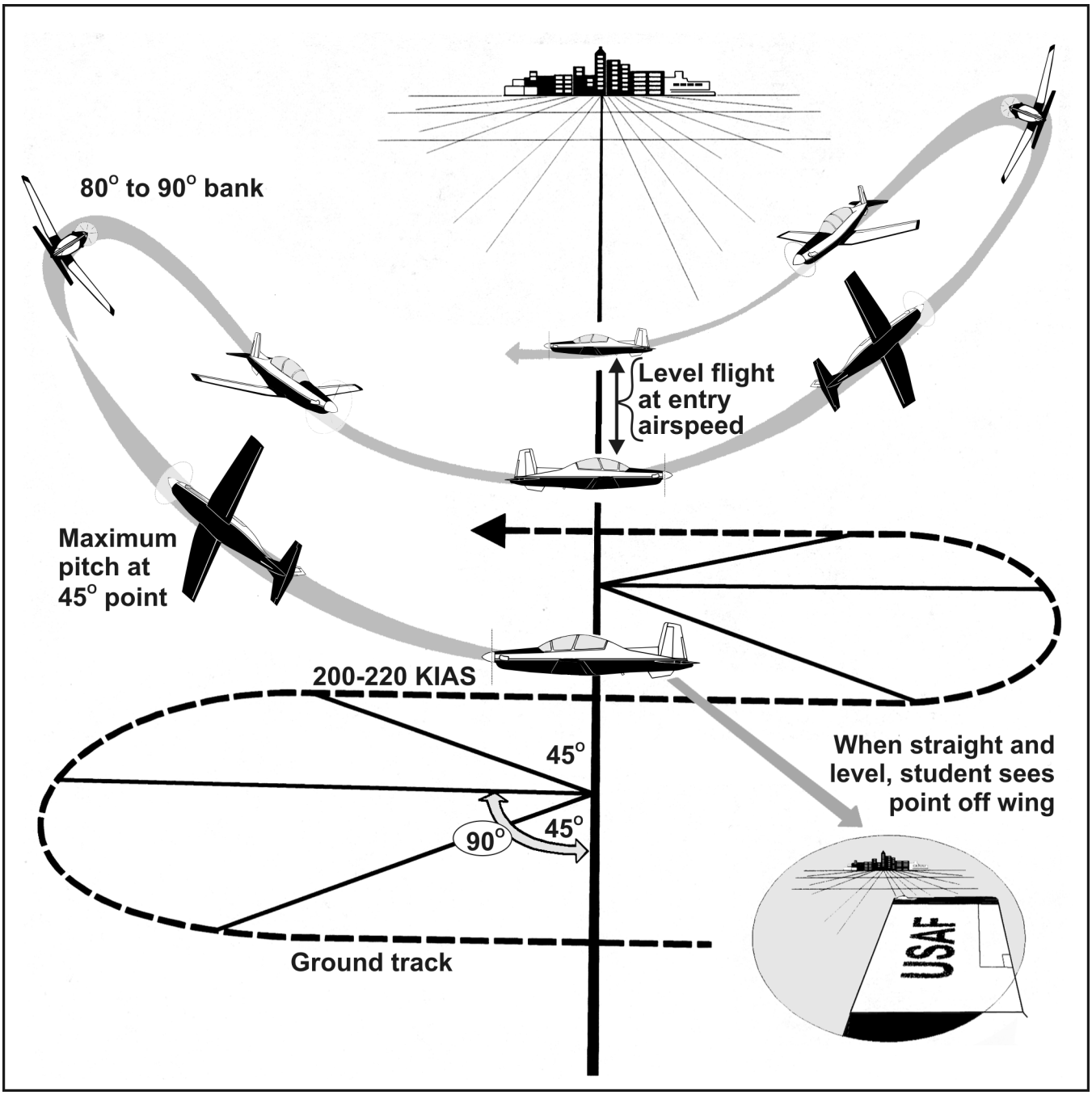
5.20.4. As the aircraft is brought through the 90-degree point, keep the wings level and pull through the bottom of the maneuver. Plan the pull to reach level flight with the briefed entry airspeed. To avoid excessive Gs at the bottom of the pull, apply more back pressure as soon as the nose track descends below the horizon and hold sufficient back pressure to keep the airspeed from building up too quickly during the initial part of the pullout. You may have to release some back pressure in order to reach entry airspeed. If you let the airspeed build up too fast, you will probably exceed 220 KIAS and find yourself pulling high G-forces in the pullout.

5.20.5. Having completed one quarter of the maneuver, again select a point 90 degrees from the nose and repeat the maneuver just described. Four complete loops in the same direction make the clover-leaf.

5.21. Lazy Eight:

5.21.1. A lazy eight (**Figure 5.7.**) is basically a coordination exercise. It is a slow, lazy maneuver where the nose track of the aircraft describes a figure eight lying on its side at the horizon. The horizon line bisects this figure eight lengthwise. The maneuver includes a 180-degree change of direction and reversal and requires a continuous change of pitch and bank.

Figure 5.7. Lazy Eight.



5.21.2. To execute the lazy eight, you must use constantly changing control pressure. This is due to the changing bank, pitch attitudes, and airspeeds. As an aid to making symmetrical "leaves," select a prominent point on the horizon or a ground reference, such as a section line or road, from which you can mentally project an imaginary intersection at the horizon. The more references you use, the easier it is to perform good lazy eights and remain oriented in the area.

5.21.3. Look in the direction of the turn and clear while performing the maneuver. In straight-and-level flight, with the PCL set and at briefed entry airspeed, select the desired reference

point on the horizon. 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.

5.21.4. The initial bank should be very shallow to prevent turning too fast. As the nose is raised, the airspeed decreases, causing the rate of turn to increase. Also, as the bank is increased, the rate of turn will increase. Time the turn and pullup 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.

5.21.5. Do not hold the nose in this attitude, but lower it slowly to the horizon and toward the reference point. Continue to increase your bank to attain 80 to 90 degrees as the nose reaches the horizon. Cross-check outside references and the attitude indicator for bank. The level-flight pitch reference point should reach the horizon at the 90-degree point. Keep a check on the progress of the turn by checking outside references.

5.21.6. The lowest airspeed will be encountered just as the nose reaches the horizon (approximately 100 knots below entry airspeed). Do not stop the nose at the horizon, but fly the aircraft into a descending turn so the nose track describes the same size loop below the horizon as it did above the horizon. When the nose track passes through the horizon, gradually begin to decrease the bank. When the aircraft has turned 135 degrees, the nose should have reached its lowest attitude. The bank should diminish during the descending turn at about the same rate as it increased in the climbing turn.

5.21.7. At the 135-degree point, there are 45 degrees of turn remaining before the aircraft reaches a level-flight attitude. Continue blending sufficient stick and rudder pressure to simultaneously raise the nose and level the wings. Monitor the progress of the turn by checking your outside reference point. Plan to arrive at the 180-degree point in level flight with entry airspeed. The wings should become level as the aircraft reaches the level-flight attitude at the 180-degree point.

5.21.8. Having completed half the eight, the opposite wing is now toward the reference point and the nose is at the 180-degree point, with entry airspeed. Do not hesitate in straight-and-level flight, but begin another climbing turn in the direction of the reference point. This turn is opposite to the one used at the start of the maneuver. Fly the second 180-degree turn like the first to complete the maneuver.

5.22. Immelmann:

5.22.1. The Immelmann is a half loop followed by a half roll, all flown in the same vertical plane.

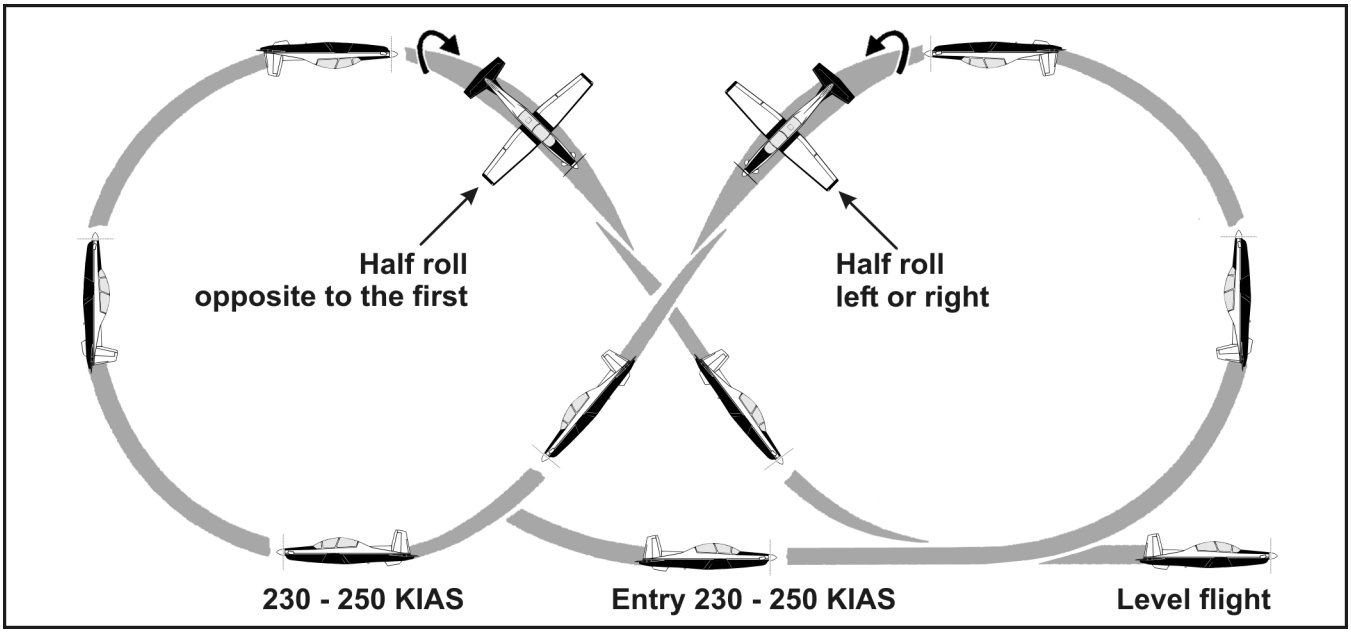
5.22.2. Adjust the PCL and begin the maneuver by making a normal loop entry at the briefed entry airspeed. Continue the movement of the nose by increasing back pressure (normally 3 to 4 Gs, depending on entry parameters). Maintain a constant rate of movement of the nose throughout the pullup. Maintain wings level with coordinated flight controls.

5.22.3. As the aircraft reaches a point approximately 10 degrees above the horizon inverted, relax back stick pressure and apply aileron with coordinated rudder in either direction to initiate a roll to level flight. The maneuver is complete after a momentary pause in level flight following the rollout.

5.23. Cuban Eight:

5.23.1. Each half of this maneuver is a slightly modified combination of the loop and Immelmann. It is approximately the first five-eighths of a loop followed by a half roll. It is then repeated in the opposite direction (**Figure 5.8.**).

Figure 5.8. Cuban Eight.



5.23.2. Adjust the PCL and begin the maneuver by making a normal loop entry at briefed entry airspeed. Proceed over the top. After passing through inverted-level flight, relax back pressure approaching 45 degrees below the horizon and execute a half roll in either direction. Use rudder pressure as in the Immelmann to hold the aircraft on the desired heading. Release the elevator pressure to keep the nose track in the same vertical plane.

5.23.3. After completing the half roll, plan your pullup to attain briefed entry airspeed when passing through level flight. This will require initiating the pullup approximately 25 to 30 knots below briefed entry airspeed. Continue the pullup into another loop entry. The second half of the Cuban eight is identical to the first except the roll is in the opposite direction. The maneuver is complete when you attain level flight at entry airspeed.

Section 5E—Out-of-Control Flight (OCF) and Spin Training

5.24. Stability Demonstration:

5.24.1. This maneuver demonstrates that the aircraft will not depart controlled flight except from an aggravated stall. The first requirement for an aircraft to spin is a stall. As long as the aircraft is not allowed to stall, it will not enter a spin.

5.24.2. Perform the prestall checks, accelerate to 160 KIAS, adjust PCL to 60 percent torque, and clear the area. Raise the nose to a 45-degree pitch attitude. Your IP will point out the references used to maintain this attitude. Maintain coordinated wings-level flight with the rudder and ailerons. Hold

this attitude constant until flying airspeed is depleted to approximately 80 KIAS (or at first stick shaker).

5.24.3. Initiate the recovery by selecting idle power and neutralizing all controls. Allow the nose to lower until you feel positive pressures on the controls. This indicates the aircraft is regaining flying airspeed. Recover to level flight without stalling the aircraft. The maneuver is complete when you have returned to level flight. Remember to avoid zero-G flight for greater than 5 seconds due to engine operating limitations in TO 1T-6A-1 (flight manual).

5.25. OCF Training. OCF training will increase your confidence in the aircraft and improve your ability to orient yourself in any attitude. Refer to TO 1T-6A-1 (flight manual) and your academic courseware for detailed discussion on T-6 aerodynamic flight characteristics. Any time the aircraft departs controlled flight, immediately apply boldface OCF procedures.

5.26. Normal OCF Recovery Practice:

5.26.1. Practice OCF from power-on stalls, aerobatic maneuvers, nose-high recoveries, and intentional spin entries.

5.26.2. If entered from an intentional spin, initiate OCF recovery procedures any time before the end of the incipient spin phase. Do not wait for the spin to reach steady state because this will result in excessive loss of altitude.

5.26.3. Cross-check your altitude and determine if the aircraft is in a spin. If not, recover from the ensuing dive.

5.26.4. Physically recheck the PCL to ensure it is in idle.

5.26.5. Position all flight controls to their neutral position.

5.27. Intentional Spin Entry:

5.27.1. 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.

5.27.2. Accomplish the pre-spin checks and adhere to spin restrictions in AFI 11-2T-6, Volume 3. Use power as required to establish a minimum of 120 KIAS prior to decelerating for spin entry. Then reduce the power to idle and gradually increase pitch to maintain level-to-slightly-climbing 1 G flight. At spin entry airspeed (approximately 80 KIAS), the pitch attitude should be 15 to 20 degrees nose high. Apply full rudder in the direction of the spin. Make sure you use full travel of the stick and rudder and hold the controls firmly against the stops with the ailerons neutral.

Chapter 6

TRAFFIC PATTERN AND LANDING

6.1. General Guidelines. You will do most of your flying in the T-6 at the home base and auxiliary field. Due to the number of aircraft operating at these locations, every pilot must conform to established procedures and a standardized traffic pattern. The runway is the primary reference in the traffic pattern. Your IP will provide ground references at these fields to fly the patterns for existing conditions. You will learn how to adjust for winds and how to determine universal references that will work at any field. Use these references as aids in developing the judgment required to accurately estimate distances and glidepath. The radio calls in this chapter are standard calls in the joint primary pilot training environment. When not flying in this environment, use local procedures or standard service terminology, as appropriate.

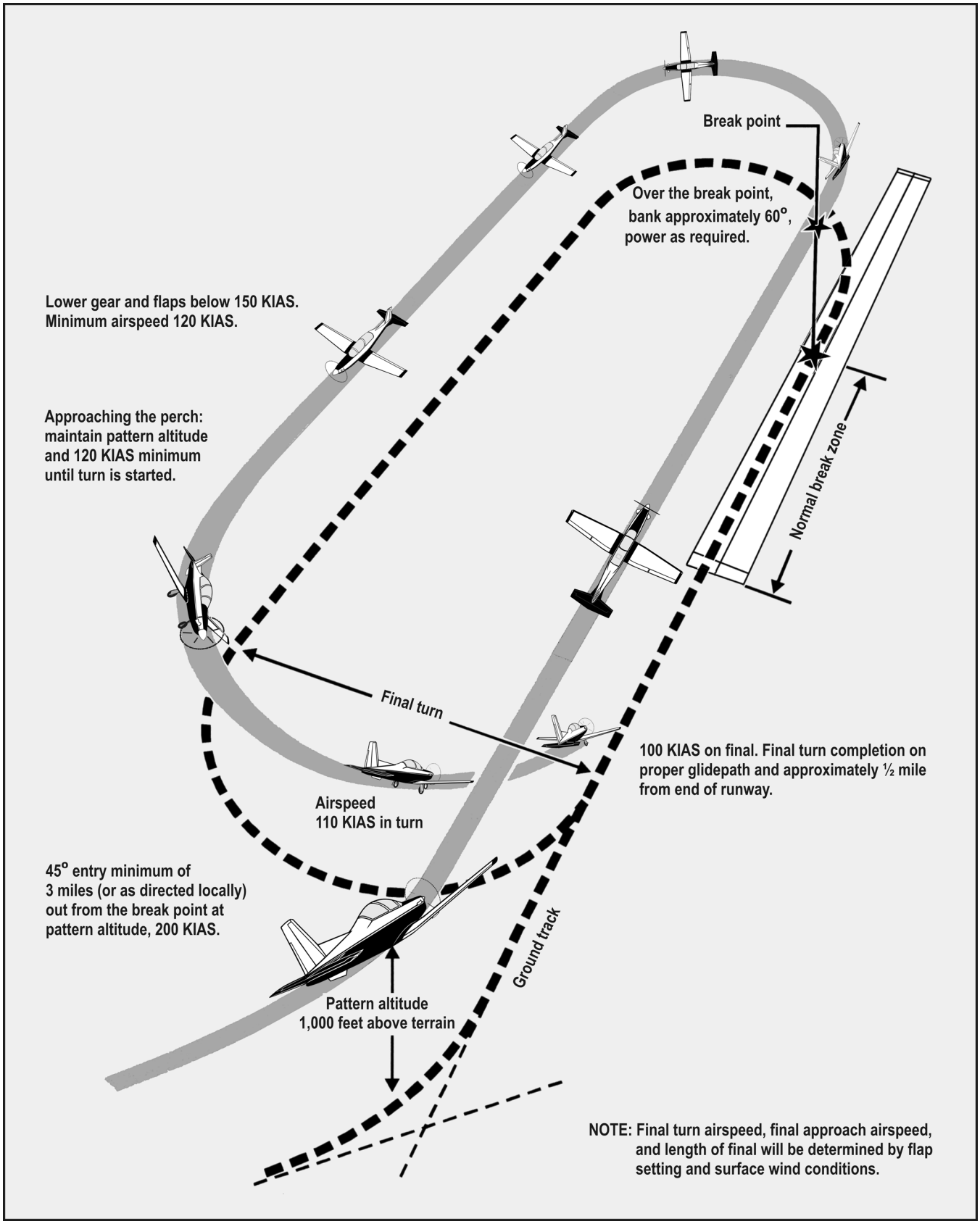
6.2. Letdown:

6.2.1. The letdown is used to descend to traffic pattern altitude. Plan the letdown to enter the traffic pattern or to comply with approach directives. To begin a letdown, simultaneously lower the nose and adjust the power as necessary. Using the speed brake is optional. The airspeed in the letdown is normally 200 to 250 KIAS or as directed by approach control (within safe limits). This allows you to concentrate on the outside references and clearing during the descent.

6.2.2. An excellent technique to aid clearing during a VMC letdown is to use clearing turns. This also helps control descent rates. Your IP will demonstrate the proper letdown techniques. A good lead point will allow you to accomplish a smooth leveloff at the desired altitude. One technique for determining a lead point is to use approximately 10 percent of the VSI. As you approach the leveloff altitude, gradually bring the nose of the aircraft to the level-flight attitude, trim the aircraft, and adjust the power and speed brake as necessary.

6.3. Overhead Pattern. The 360-degree overhead pattern is used to safely and properly handle a maximum number of aircraft with minimum congestion (**Figure 6.1.**). The pattern spacing should be adjusted for existing wind conditions.

Figure 6.1. Normal Traffic Pattern (LDG Flaps).



6.3.1. **Before Traffic Entry.** Before entering the traffic pattern, determine the landing direction by monitoring the appropriate radio frequency and watching other aircraft. If you are not sure of the direction of traffic, obtain landing instructions from the RSU, tower, or other controlling agency. When the RSU or tower broadcasts runway winds, keep this information in mind because it directly affects how you fly the traffic pattern. Local directives define the traffic pattern entry procedures. You must adequately clear while descending to enter traffic.

6.3.2. **Initial Approach.** When turning onto initial, plan the rollout so your ground track is aligned with the runway center line or as directed. Altitude is normally 1,000 feet above the terrain, and airspeed is 200 KIAS. Call initial to the controlling agency as directed and state your fuel remaining (in pounds) if you plan a full stop.

6.3.3. **Break.** The break—a 180-degree decelerating, level turn to downwind—is normally performed between the approach end and 3,000 feet down the runway. The exact point of the break is affected by existing wind conditions and traffic saturation. To accomplish the break, smoothly roll into approximately 60 degrees of bank. The angle of bank and amount of back pressure will vary according to wind conditions. Adjust the PCL as required (approximately 10 percent torque) to slow the aircraft to between 120 to 150 KIAS. Continue the level turn and roll out on inside downwind with proper spacing and the necessary drift correction to maintain a flightpath parallel to the runway. In calm winds, proper spacing for a 30-degree bank final turn is approximately when the landing runway is placed halfway between the fuel filler cap and the wingtip.

6.3.4. **Inside Downwind Leg:**

6.3.4.1. As you roll out on the downwind with the airspeed below 150 KIAS, lower the landing gear and flaps. Before moving the gear handle, the PF will make an intercockpit “gear clear” call and pause momentarily before moving the gear handle. On presolo contact sorties, the IP will acknowledge “clear” before the student pilot moves the gear handle. On all other sorties, “gear clear” is an advisory call only. This procedure applies to any situation where the gear will be lowered in flight. Use power as necessary to maintain airspeed and altitude. The minimum airspeed on the downwind leg is 120 KIAS. As airspeed decreases to 120 KIAS, you will have to retrim the aircraft and increase the pitch attitude to maintain level flight (horizon line approximately 1/4 up the windscreen). With the gear and flaps extended, approximately 35 percent torque will maintain 120 KIAS.

6.3.4.2. Begin the final turn at a point that will allow approximately a 1/2 mile final. Do not start the final turn in the following cases: (1) if there is another aircraft in the final turn and not in sight, (2) if there is a straight-in inside of 2 miles and not in sight, (3) if there is an ELP inside low key and normal spacing cannot be maintained, or (4) if you cannot maintain normal pattern size and safe spacing. For any of these cases, break out from the downwind leg, using local procedures.

6.3.5. **Final Turn:**

6.3.5.1. The final turn begins as you initiate the turn from the downwind leg. The turn is complete when the wings are level on final approach. Plan the final turn to roll out on final approach with a 3- to 4-degree glidepath, depending on flap setting. This equates to approximately 150 to 200 feet above the terrain at 1/2 mile from the approach end of the runway. The rollout on final should be approximately 1/2 mile from the runway. Adjust the altitude lost during the final turn to establish a good glidepath.

6.3.5.2. Adjust the turn point for the existing wind condition. Remember, if a strong tailwind exists on downwind, this will blow the aircraft from the approach end and a long final will result if the turn is started at the normal position. Before beginning the final turn, it is helpful to pick a specific rollout point on the ground. Begin your turn to final to arrive wings level on final over this point.

6.3.5.3. Starting the final turn, simultaneously lower the nose of the aircraft and roll into approximately 30 degrees of bank. When the bank and pitch are set, the horizon should be in the upper one-third of the windscreen.

6.3.5.4. After starting the final turn, slow to 110 KIAS for LDG flaps, 115 KIAS for TO flaps, or 120 KIAS for flaps UP and trim the aircraft. Make a geardown call to the controlling agency as soon as safely possible after confirming your configuration.

6.3.5.5. In the final turn, divide your attention between the airspeed indicator, rollout point, and runway. Visualize and project your descent angle around the final turn, over the rollout point, and down the final approach. The descent angle, projected to the ground, will be to a point just short of the intended touchdown point. Because of crosswinds, it may be necessary to vary the bank angle in the final turn. You may increase the bank up to a maximum of 45 degrees, but keep in mind that the stall speed of the aircraft will increase. The final turn bank angle is normally planned to be 30 degrees. If 30 degrees cannot be maintained, adjust downwind spacing on subsequent patterns to fly 30 degrees bank angle. If you have any doubt about the safety of continuing the approach, go around. Do not hesitate to use traffic pattern stall recovery procedures if required.

6.3.6. **Final Approach:**

6.3.6.1. The final approach begins when the wings are level after the final turn. On final approach, slow to and maintain 100 KIAS for LDG flaps, 105 KIAS for TO flaps, and 110 KIAS for flaps UP and trim the aircraft. Check your spacing with the aircraft ahead of you on final approach. If it appears you will not be able to land with proper spacing, anticipate the need to go around and make a timely decision.

6.3.6.2. After rolling out on final and aligned with the runway, you have two objectives. The first is to maintain runway alignment; the other is to maintain a smooth, constant glidepath to round out and touch down.

6.3.6.3. The pitch attitude on final approach is slightly higher than the pitch attitude in the final turn. Consequently, you must raise the nose of the aircraft and add power (approximately 18 to 20 percent torque) to establish the correct glidepath. Your “aimpoint” is the point on the runway that intersects your glidepath. Normally, a good final approach pitch reference is when your aimpoint, typically the runway threshold, is halfway up the windscreen. Reduce or “crack” the PCL back approximately 1,000 feet from the threshold (approximately 10 percent torque). This will require a slight increase in back stick pressure and nose-up trim. Plan to cross the threshold approximately 10 knots below final approach speed.

6.3.6.4. On final approach (as in the final turn), the aircraft is affected by wind, but the flightpath must coincide with the desired ground track. Because there is almost always a crosswind condition, you will need to use techniques to maintain runway alignment. There are two ways to do this, the wing-low method and the crab method. In the T-6, you must transition from the crab method to the wing-low method as you roll out on final and determine the crosswind control requirement. The T-6 landing gear struts are not designed to continually withstand the side loads imposed by

landing in a crab. The amount of crab into the wind required on final is a good indicator of how much control deflection is needed for transition to the wing-low method.

6.3.6.5. The proper method for applying crosswind controls is to apply sufficient rudder deflection to align the longitudinal axis of the aircraft with the runway. Use aileron as necessary to keep the flightpath aligned with the runway. Maintain airspeed by increasing the power to compensate for the increased drag caused by crosswind controls. An easy way to remember this technique is by the acronym **RAP** (rudder to align the nose, aileron into the wind to prevent drifting, and power to counteract the increased drag from flying uncoordinated).

6.3.6.6. The second and most difficult objective is visualizing a constant glidepath to the roundout and touchdown position. In the normal landing configuration, the T-6 flight attitude is such that the aimpoint is short of the intended touchdown point. Aim short of the intended touchdown point (normally the runway threshold) because of the delay during the roundout. Plan to touch down 500 to 1,000 feet past the threshold for LDG or TO flap settings and 1,000 to 1,500 feet for flap UP setting. This does not mean that routinely landing in the first few feet or 1,000 feet down the runway is acceptable. Your main objective is to strive for a touchdown with the proper landing attitude at a point on the runway that provides an adequate safety margin against landing short, yet allows the aircraft to easily stop within the available runway. In determining your aimpoint, consider all factors (wind, runway length, aircraft weight, flap setting, etc.).

6.3.6.7. If you land in a gusty wind condition, increase final approach airspeed by 1/2 the gust factor up to a 10-knot increase. In crosswinds greater than 10 knots, plan to use TO flaps and touch down at approach speed minus 10 knots. The aircraft may float farther than normal before touchdown because of the configuration and extra airspeed.

6.3.6.8. There are several differences between heavyweight and lightweight aircraft during final approach. Although minimum airspeeds remain the same, lift requirements change with differences in aircraft gross weights (fuel on board). A heavy aircraft has a higher lift requirement and will develop a sink rate quicker than a lighter aircraft. This sink rate can only be stopped with combined corrections of pitch and power. At heavier weights, the added lift requirement increases the amount of time between power application and the effect of this power application in stopping the sink rate. In addition, the higher stall speed will decrease the time lapse between a pitch increase and the actual stall. Adhere to minimum airspeeds, plan the pattern to avoid high sink rates, and remember that extra time is required to stop a sink rate as it develops on final.

6.4. Normal Landings. So you can better understand the factors affecting your judgment and pilot technique, landings are divided into three phases—roundout, touchdown, and landing roll—as follows:

6.4.1. **Roundout:**

6.4.1.1. During the roundout, decrease the rate of descent as you approach touchdown. Smoothly continue back pressure to increase the pitch attitude until the proper landing attitude is reached. When making a roundout, you are decreasing the airspeed so the aircraft will settle gently onto the runway. Target touchdown speeds are 80 KIAS (± 5 KIAS) for LDG flaps, 85 KIAS (±5 KIAS) for TO flaps, and 90 KIAS (± 5 KIAS) for flaps UP. Factors such as aircraft weight, crosswind, and outside air temperature may raise these speeds slightly. Retard the PCL with a smooth reduction in power to the idle position at or before touchdown.

6.4.1.2. Different rates of descent will cause the height of the roundout to vary. To allow for greater loss of altitude, execute a high roundout more slowly than a lower roundout. Make the roundout proportionate to the apparent rate of descent. Your IP will show you the height at which to start a roundout with different rates of descent.

6.4.1.3. Throughout the roundout, be aware of the effects of crosswinds. If crosswinds exist, you must use crosswind controls throughout the roundout. As the airspeed decreases to just above the stall, you may need additional aileron and rudder deflection. If the control surfaces are deflected out of their normal streamlined position, they will add drag, airspeed will dissipate much faster, and stall speed will increase. Use caution during gusty wind conditions because of rapidly changing wind direction and velocity. Timely control inputs are needed to maintain directional control.

6.4.1.4. Power can be used effectively during the roundout to compensate for errors in judgment. Any time the controls feel mushy or you feel approach-to-stall indications you learned from traffic pattern stall training, apply power and execute a go-around. This will cushion any ensuing touchdown. If it appears you are going to land excessively long, do not hesitate to go around.

6.4.2. **Touchdown.** A touchdown is the gentle settling of the aircraft onto the runway in the landing attitude. On touchdown, lower the nose to the runway and slightly relax the back stick pressure. Continue to hold any crosswind control deflection used during the roundout. If you do not, the aircraft will crab into the wind and you will touch down in a crab. When using crosswind controls, expect one main gear to touch down before the other. Avoid lowering the nosewheel abruptly. If power was used during the roundout to decrease the rate of descent or prevent a stall, retard the throttle to idle on touchdown so the aircraft will stay on the ground.

6.4.3. **Landing Roll:**

6.4.3.1. With the nose gear on the runway, smoothly apply brakes (below 80 KIAS) and increase the back stick pressure. This decreases the weight on the nose gear, increases the weight on the main gear, and counteracts the wheelbarrow effect of braking with the stick forward. Do not allow the nose gear to lift off the runway. Continue to increase back stick pressure and brake pressure as the aircraft decelerates. Confirm that N^1 reduces to 60 percent approximately 4 seconds after weight is applied on the wheels. Always apply braking in a straight line; do not attempt to turn and brake. Initially, maintain directional control with rudder and/or brakes. Remember to keep in any crosswind controls throughout the landing roll. As the airspeed decreases, crosswind control deflection will need to increase to achieve the same effects.

6.4.3.2. Avoid using nosewheel steering until the aircraft has slowed to normal taxi speed. When engaging the nosewheel steering, first ensure the rudder pedals are centered. At higher speeds, nosewheel steering is extremely sensitive and easily overcontrolled. Before reaching taxi speed, you should use nosewheel steering only if you are unable to maintain directional control with the rudder and brakes on the landing roll. If you encounter nosewheel shimmy during the landing roll, continue to apply forward stick pressure to place more weight on the nose gear.

6.4.3.3. Familiarize yourself with the factors that influence the controllability of the aircraft after the landing. Some of these factors are the center of gravity, strong crosswinds, a low strut, and a slippery runway. As you slow down, your flight controls lose their effectiveness, thus increasing the effect of the crosswind. The T-6 has more surface area behind the main landing gear than in front. After the aircraft is on the ground, the main landing gear is the fulcrum point, and the impact of the crosswind on the side area will cause the airplane to act as a weather vane and turn into the

wind. You can see how important it is to use rudder and/or brakes to maintain directional control during the landing roll.

6.4.3.4. You must also use aileron to prevent the crosswind from lifting the upwind wing; but, if you use too much aileron, the other wing will start to rise. However, when rudder effectiveness is lost, full aileron deflection may be necessary.

6.4.3.5. During any ground roll, you can change direction by applying pressure on a single brake or uneven pressure on both brakes. You must use caution when applying the brakes to avoid over-controlling. To use the brakes, slide your feet up on the rudder pedals so toe pressure can be applied to the top of the pedals. If rudder pressure is being held at the time the brakes are needed, try to hold the rudder pedals in position as you slide your feet up. The brakes work independently of the rudder pedal position. For example, it is quite possible to hold the right rudder and left brake, although such a requirement is not likely.

6.4.3.6. The physical limitations of the tire and brake system make it extremely difficult to consistently achieve optimum braking action, particularly at high speeds where the weight component is reduced due to lift. A single, smooth application, increasing as airspeed decreases, offers the best braking opportunity. Great caution should be used when braking at speeds above 80 KIAS. Locked brakes should be discontinued at the first indication of directional problems and then cautiously reapplied. Once a wheel is locked, it may be necessary to completely release brake pressure to allow wheel rotation. At speeds below 80 KIAS, the chances of approaching optimum braking action are greatly increased. Apply smooth and continuous pressure until the aircraft slows to taxi speed.

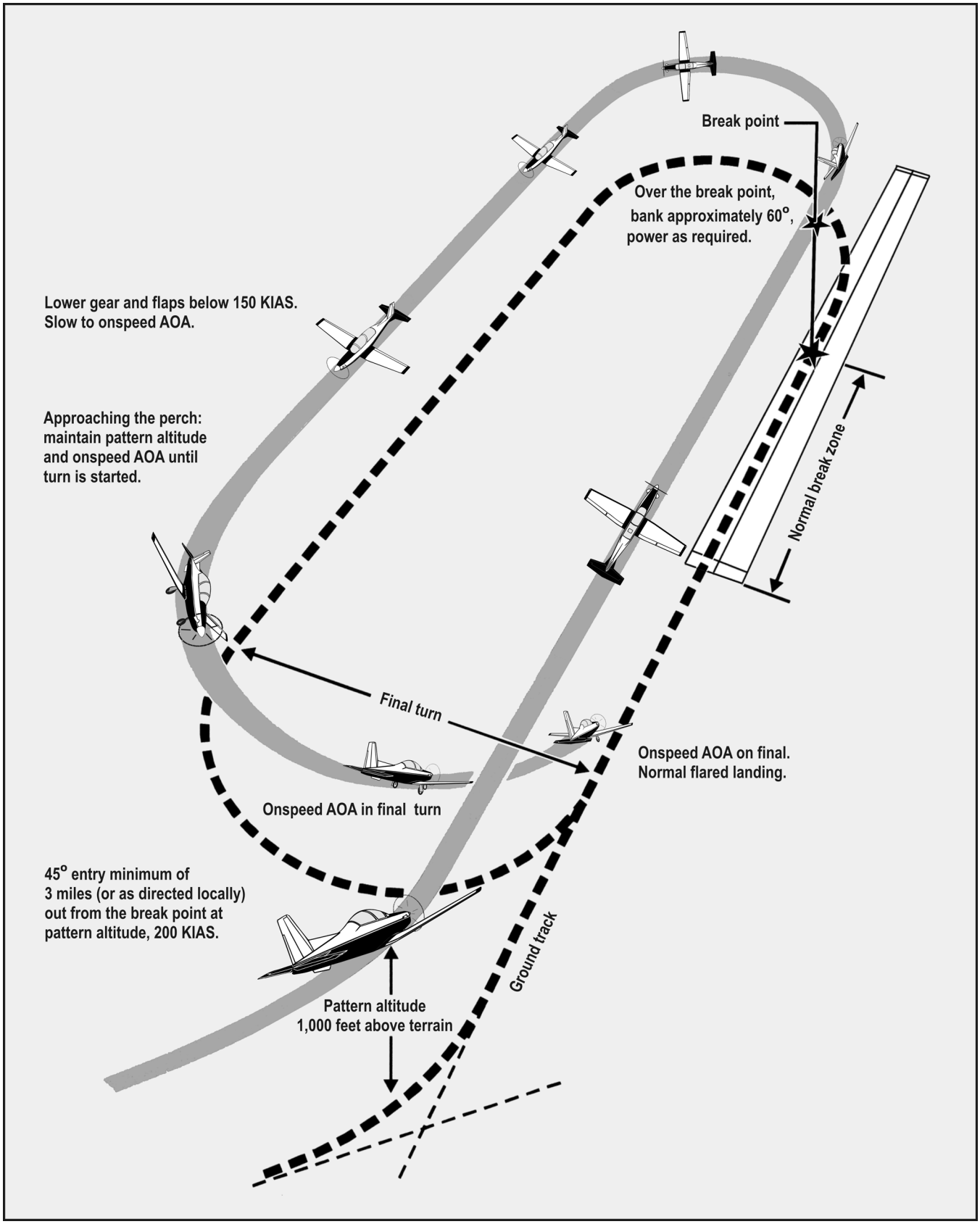
6.4.3.7. At the end of the landing roll, ensure the aircraft is at taxi speed. (Cross-check the groundspeed readout on the GPS.) Release the brakes, bring the stick forward, and engage the nosewheel steering prior to initiating the turn off the runway. **Do not attempt to brake while turning off the runway.** Do not complete any after-landing checklist items until you are clear of the runway. Concentrate on maintaining directional control and slowing the aircraft to a safe taxi speed.

6.5. Angle of Attack (AOA) Patterns:

6.5.1. AOA Approaches (General):

6.5.1.1. During most of your flight training, the runway aimpoint and computed airspeed are primary references while flying in the Air Force traffic pattern (**Figure 6.2.**). The AOA pattern is different because it allows the pilot to fly a slower airspeed with constant AOA through the final turn and final until the landing phase. The ability to fly AOA patterns is crucial to the success of short field operations with high performance aircraft. AOA patterns are common in Air Force fighter aircraft and virtually mandatory for Navy carrier aviation.

Figure 6.2. AOA Traffic Pattern at Air Force Bases.



6.5.1.2. The main purpose of the AOA approach for T-6 operations is to familiarize Navy primary students with the AOA system and pattern operations. The AOA pattern and approach will be flown like the normal traffic pattern until slowing to configure on the inside downwind. Once the aircraft is slowed and configured, the optimum AOA is maintained by adjusting aircraft pitch and the rate of descent is controlled by adjusting power. For the purposes of flying AOA patterns, it is critical to remember that the AOA indexer information is only useful if you are maintaining the proper glidepath to the runway. Flying onspeed AOA with an improper glidepath may cause you to land short of the runway.

6.5.2. **AOA Indexer Color Scheme.** The T-6 AOA indexer utilizes a Navy color scheme that matches the Navy fresnel lense optical landing system's color scheme. This color scheme differs with that of follow-on Air Force aircraft. For this reason, the following discussion will use the symbol position of the indexer (upper chevron, center donut, lower chevron) rather than the color to describe the use of the AOA indexer:

6.5.2.1. The symbols indicate distinct AOA conditions. The center donut illuminates when the aircraft is in the optimum AOA range. The upper and lower chevrons indicate, by the direction of the chevron angle, which direction to change pitch attitude to achieve the correct AOA for the pattern.

6.5.2.2. For a normal approach with gear down, flaps LDG, and PCL set for a 3-degree approach, the optimum approach speed (center donut) is approximately 100 KIAS at maximum landing weight. As landing weight decreases, the approach AOA (center donut) will continue to provide the optimum approach speed regardless of bank angle. Optimum approach airspeed will decrease approximately 1 knot for every 100 pounds of fuel burned.

6.5.3. **AOA Indexer Pattern and Landing (*Air Force overhead pattern, Navy primary students only*):**

6.5.3.1. The initial leg, break, and closed pullup during an AOA pattern will be flown identical to the normal pattern. Roll out on the inside downwind, slow below 150 KIAS, extend the landing gear, and lower the flaps to the desired setting. (Students will configure, using takeoff flaps.)

6.5.3.2. Configure early enough to ensure the aircraft is at optimum AOA (onspeed center donut on the AOA indexer, 10 to 11 units on the AOA gauge) with a stabilized power setting by the perch. This will result in an airspeed of less than the normal 120 knots minimum on downwind. Adjust power as necessary to maintain level flight and onspeed AOA indications.

6.5.3.3. Initiate the final turn, using 30 degrees of bank. (If necessary, bank angles of up to 45 degrees may be used to prevent overshooting final.) Use pitch changes to adjust AOA and power changes to adjust descent rate or glidepath. The illuminated AOA indexer chevron points in the direction the nose needs to be moved. If the upper (slow) chevron is illuminated, your AOA is higher than optimum and your airspeed is too slow to maintain the current glidepath. To correct to optimum AOA, lower the nose slightly. Then add power to maintain the desired glidepath. Use caution to avoid being slow because excessive sink rates can develop quickly.

6.5.3.4. If the pitch attitude is too low, the lower (fast) chevron will illuminate, indicating less than optimum AOA and excessive airspeed for the current glidepath. To correct to optimum AOA, raise the nose slightly. Then reduce power as necessary to maintain the desired glidepath.

6.5.3.5. During the final turn and final, scan the AOA indexer, AOA gauge, and intended point of landing. The rollout on final should be approximately 1/2 mile from the runway. Use the runway threshold as an aimpoint. Anticipate that the landing will be assured later than normal due to a slower-than-normal approach speed. Maintain final approach power setting through the roundout until the sink rate has been arrested. Then smoothly reduce power to idle and accomplish a normal touchdown. If the pattern was flown to a touch and go, complete after-takeoff checks normally. ***NOTE***: The intent of this training is to perform an AOA approach to a *normal* flared landing, not an AOA approach to an *AOA* landing.

6.6. Touch-and-Go Landings:

6.6.1. Smoothly apply power as soon as the main gear touches down. Maintain directional control with the rudder pedals. Lower the nose slightly from the landing attitude to the takeoff attitude as the PCL is advanced. Coordinate pitch and power so the aircraft will not become airborne prematurely with too low an airspeed. After becoming safely airborne, perform the after-takeoff checklist.

6.6.2. If it appears you are going to land long, advance the power and go around. The aircraft may continue to settle and touch down. In this event, do not try to hold the aircraft off the runway in a nose-high attitude. Maintain a landing attitude and allow a normal touchdown.

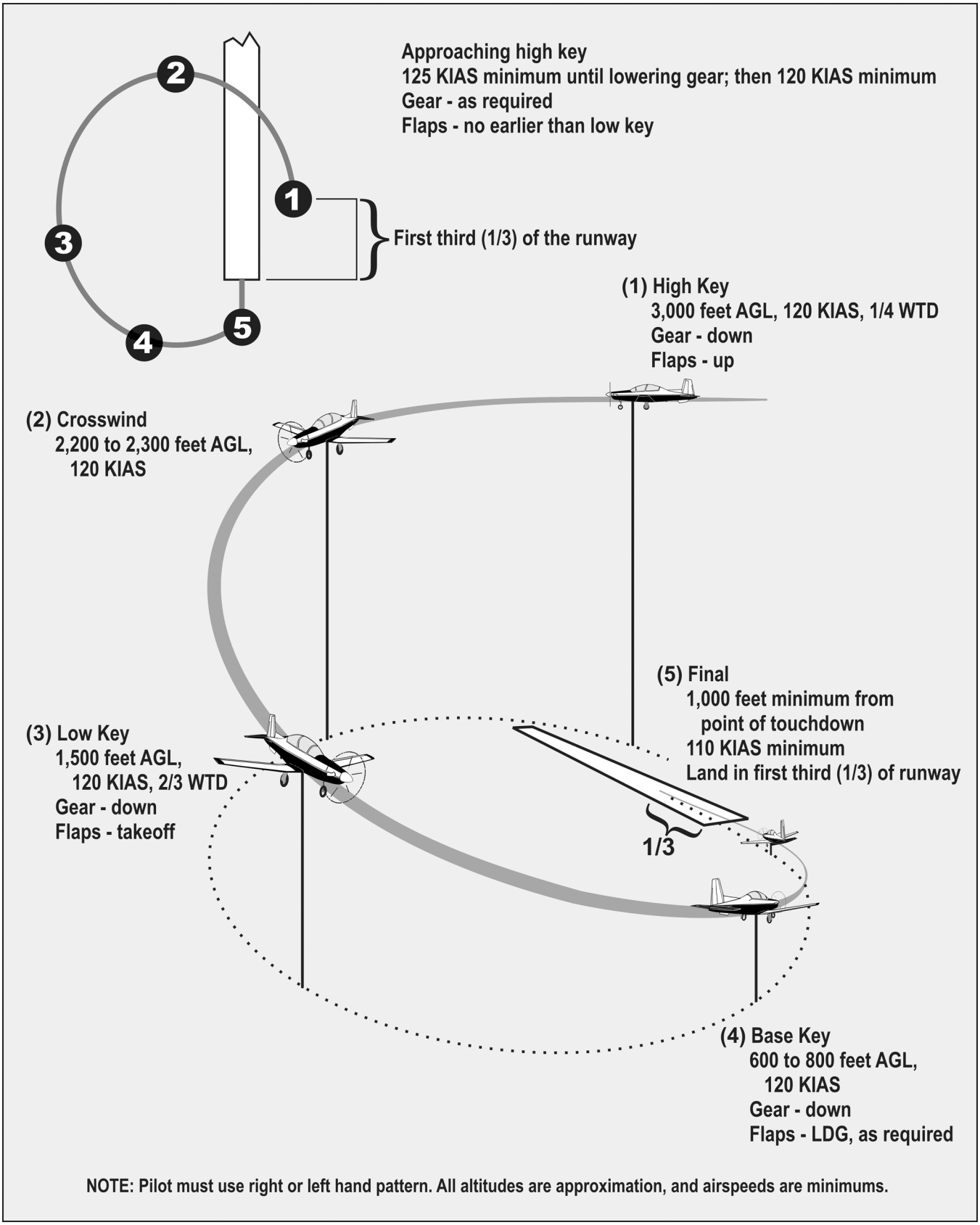
6.6.3. If you have trimmed the elevator properly on final approach, the back stick trim will tend to fly the aircraft off as flying speed is attained. You may have to use forward stick pressure to compensate for the tendency of the nose to pitch up. This forward pressure may be significant if you elect to trim in the flare, in which case you should use caution and be prepared to apply substantial nose down trim during and/or after the touch-and-go.

6.7. Emergency Landing Pattern (ELP):

6.7.1. Overview:

6.7.1.1. The ELP (**Figure 6.3.**) is a 360-degree pattern designed to position the aircraft for landing when power is not available (forced landing [FL]) or the possibility of a power loss exists (precautionary emergency landing [PEL]). The pattern will only be flown to a suitable landing area (hard surface runway, taxiway, or underun, or overrun). Landing on an unprepared surface will only be done if ejection is not possible or the ejection system malfunctions.

Figure 6.3. Emergency Landing Pattern (ELP).



6.7.1.2. Flying an ELP can be very challenging. One of the most important factors is to achieve the desired checkpoints (altitude, airspeed, and position over the ground). This is accomplished through a good cross-check. Check *outside* to reference the aircraft's position. Position deviations can occur as a result of poor planning, imprecise aircraft control, or improper wind analysis. Check *inside* for airspeed, altitude, and heading. Make all corrections smooth and expeditious.

6.7.1.3. Both FL (paragraph **6.7.4.**) and PEL (paragraph **6.7.5.**) are flown by using the ELP profile. The difference between the FL and PEL is the type of engine malfunction that has occurred. The FL is flown with the engine inoperative; the PEL is flown with impending engine failure, but with the engine still running. If flown correctly, the ELP will look the same whether flown as an FL or PEL. However, the methods used to correct for low energy states will differ between the two situations. For an 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 the pattern or ground track. For a PEL, use power to correct for low energy as soon as recognized.

6.7.1.4. See **Table 6.1.** for a summary of checkpoints to assist in maintaining the optimum ELP profile.

Table 6.1. Checkpoints for Emergency Landing Patterns (ELP).

ITEM	A	B	C	D	E
	Checkpoint	**Target Altitude**	**Airspeed**	**Target Configuration**	**Position Description**
1	High Key	3,000 feet AGL	120 knots	Gear - down Flaps - up	One-quarter (1/4) wingtip distance (WTD) abeam intended point of landing (notes 1 and 2), runway heading or aligned with landing direction, and wings level.
2	Crosswind	2,200 to 2,300 feet AGL			Halfway from high key to low key.
3	Low Key	1,500 feet AGL		Gear - down Flaps - TO	Two-thirds (2/3) WTD abeam intended point of landing.
4	Base Key	600 to 800 feet AGL		Gear - down Flaps - LDG as required	Halfway between low key and final.
5	Final	NA	110 knots (minimum)		Plan for a 1,000 foot (minimum) final prior to the intended point of touchdown.

NOTES:

1. If below target altitude on an FL, delay configuration changes only until you are on profile. If below target altitude on a PEL, immediately add power to get back on profile prior to extending gear or flaps. The goal is to correct deviations early to arrive at checkpoints on target altitude.

2. The intended point of landing is within the first one-third (1/3) of runway on the centerline with LDG flaps extended and touching down at LDG flap landing speed (80 to 90 knots).

6.7.2. **Choosing a Suitable Landing Surface:**

6.7.2.1. Some factors to consider are distance to airfield; airfield fire rescue support; terrain around the airfield; runway length, width, direction, and condition; threat to the public if aircraft must be abandoned; and weather. Weather can be a very complicating factor and will make the ELP much more challenging. Techniques for accomplishing ELPs in weather are discussed in paragraph **6.7.6.**

6.7.2.2. Once an airfield is selected, an important consideration for choosing the appropriate runway is wind condition. While landing into the wind is an important goal, a larger or longer runway should not be sacrificed just to be perfectly aligned with the wind. If the engine has failed, expect the aircraft to float in ground effect while the excess energy is dissipated. Attempt to set up the ELP to take advantage of the headwind and maximize available runway length.

6.7.2.3. To help determine if a suitable airfield is within gliding distance, use the NRST function on the GPS. Also, GPS airfield, user, and/or terminal way points can be very helpful when judging distance to intercept the ELP. There are various ways to calculate glide distance and altitude required, as follows:

6.7.2.3.1. For no-wind planning, the aircraft should glide 2 miles for every 1,000 feet of altitude (AGL) at 125 knots clean. Be sure to account for winds and any turns that must be made. When beginning a glide, the aircraft will gain approximately 100 feet of altitude for every 10 knots of excess airspeed above 125 knots. If unable to climb or zoom, the aircraft will travel approximately 1,000 feet of horizontal distance for every 10 knots of excess airspeed above 125 knots in a level deceleration.

6.7.2.3.2. Gliding at 125 knots provides best glide range. Time permitting, use DME or GPS to confirm the actual glide ratio is 2 miles/1,000 feet. If the actual glide distance is different, plan accordingly.

6.7.2.3.3. One technique to calculate glide distance is to double your altitude (AGL) and subtract 6 for high key and 3 for low key.

6.7.2.3.4. Carefully manage your energy to arrive at high key on altitude. If expecting to arrive at high key with excess altitude, slip, S-turn, or lower the gear early to increase rate of descent. Attempt to dissipate excess energy prior to arriving at high key to minimize disorientation and allow the remainder of the profile to be flown as normal as possible. If excess altitude is too great to dissipate with a slip, S-turn, or by lowering the gear early, one technique to lose the excess altitude is to make 360-degree turns prior to high key. Expected altitude lost will be approximately 2,000 feet for a 30-degree bank turn, 1,500 feet for a 45-degree bank turn, and 1,000 feet for 60-degree bank turn.

6.7.3. **Flying the ELP:**

6.7.3.1. Plan to arrive at high key aligned with the landing runway, energy permitting. Maintain 125 knots minimum until extending landing gear. Then maintain a minimum of 120 knots until intercepting final.

6.7.3.2. High key is approximately one-third of the way down the planned runway at 3,000 feet AGL, offset approximately one-quarter WTD away from the intended ELP direction. Placing the runway just above the canopy rail is a good approximation for one quarter WTD. The exact amount of displacement is not critical, but the intention is to be able to see the runway to determine the high key position without excessively banking the aircraft.

6.7.3.3. If on profile at or prior to high key, lower the landing gear. At high key, turn and use angle of bank as necessary (approximately 20 degrees initially - no wind) toward low key. Halfway from high key to low key (crosswind) check for 2,200 to 2,300 feet AGL. If this altitude is excessively high or low, check for proper power setting and/or configuration. Otherwise, evaluate airspeed, bank angle, and/or winds to determine cause of altitude deviation.

6.7.3.4. Low key is two-thirds WTD (fuel cap on runway) abeam the intended point of landing and altitude is approximately 1,500 feet AGL and 120 knots. As you glide into low key, keep cross-checking the runway to make sure the wind is not pushing the aircraft into or away from the runway. Wind will change with altitude, and a good cross-check will help minimize excessive pattern deviations.

6.7.3.5. At low key, level the wings momentarily and check for proper spacing and altitude. If energy is suitable, lower TO flaps. Avoid maintaining wings level too long and allowing the aircraft to fly past the last usable landing surface without turning. This is especially important when there is a strong tailwind at low key, which could cause the aircraft to go too deep at base key and not be able to make the runway.

6.7.3.6. Fly toward base key, maintaining 120 knots. Visualize base key by imagining the interception of two 45-degree lines, one from low key and the other from the intended point of landing. Fly the aircraft to be perpendicular to the landing runway at that point at 600 to 800 feet AGL. When landing is assured, lower flaps to LDG.

6.7.3.7. Intercept final a minimum of 1,000 feet from the intended point of touchdown. This will allow time to stabilize the descent rate and evaluate the landing runway. Aircraft may be slowed to 110 knots minimum during the rollout on final. Maintain 110 knots minimum on final until beginning the transition to landing. The transition to landing may begin as early as 2,000 feet prior to the intended point of touchdown. In no case should airspeed be allowed to slow below 95 knots until it is over a suitable landing area.

6.7.3.8. The following are some common errors that can lead to an improperly flown ELP: (***NOTE:*** Keep this list in mind and be proactive to fly a smooth and effective procedure.)

6.7.3.8.1. Failing to properly position for high key.

6.7.3.8.2. Not maintaining airspeed in the ELP.

6.7.3.8.3. Not flying checkpoints.

6.7.3.8.4. Making improper corrections (or none at all).

6.7.3.8.5. Not trimming the aircraft throughout the pattern.

6.7.3.8.6. Not taking wind affects into account.

6.7.4. **Forced Landing (FL):**

6.7.4.1. Use the ELP profile to ensure a safe landing can be made. If expecting to arrive at high key below desired altitude, regain profile by using one of the following options: delay landing gear or flap extension, intercept the ELP at some point other than high key, and/or adjust the pattern or ground track. Also, if you have excess energy, do not rush losing altitude because this time can be very valuable when preparing for the FL.

6.7.4.2. 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 end of the runway, execute the Aircraft Departs Prepared Surface Checklist or eject.

6.7.4.3. To fly a *simulated* FL, set 4- to 6-percent torque to simulate a dead engine with a feathered prop. Do not adjust power throughout the profile unless safety of flight is jeopardized. Anticipate a longer flare and touchdown because the PCL will not be reduced to idle when landing is assured.

6.7.5. **Precautionary Emergency Landing (PEL):**

6.7.5.1. Use the ELP profile to ensure a safe landing can be made if directed by the checklist or any time continued engine operation is questionable. Even though the PEL procedure is accomplished in case the engine fails, power is available and should be used to intercept and maintain the ELP profile. Use the highest power setting commensurate with the associated emergency, but realize that the engine may fail at any moment. To ensure proper energy exists to make the runway, correct low energy as soon as it is recognized.

6.7.5.2. A good memory aid for remembering the PEL steps from TO 1T-6A-1 (flight manual) is **Turn, Climb, Clean, Check, and BIP** (**B**oost, **I**gnition, and **P**lan), as follows:

6.7.5.2.1. **Turn** to nearest suitable field. Initiate this by turning toward the nearest suitable field consistent with the associated emergency, weather, airfield conditions, altitude, and gliding distance. In most situations requiring a PEL (chip light, low oil pressure, etc.), time is the critical element. The longer the engine is required to run, the greater the chance it will fail completely. In situations where engine indicate indications of impending failure, it may be advantageous to select an airfield that is NOT necessarily the nearest. For example, even though a usable airfield with a 3,000-foot runway may only be a few minutes away, the situation may warrant using the engine longer to reach the engine-out glide range for a field that is familiar and has a significantly longer runway, crash crew support, medical assistance. In no case should the engine-out glide range for the *nearer* field be exceeded until the engine-out glide range for the *desired* field is achieved.

6.7.5.2.2. **Climb** or accelerate to intercept ELP:

6.7.5.2.2.1. If not within dead-engine gliding distance of high key, use the highest suitable power setting and 140 knots to climb (best rate). Once sufficient altitude is achieved to make high key, reduce power to 4- to 6-percent torque (minimum) and retrim for the 125-knot (minimum) descent. When climbing to an altitude that will allow gliding to reach high key (that is, reaching dead-engine gliding distance), do not lose situational awareness or visual contact with the intended landing runway. When determining how high to climb, be sure to account for winds and any turns that must be made approaching high key.

6.7.5.2.2.2. The preferred method of gaining energy is climbing. However, if weather conditions prevent a climb to reach dead-engine gliding position, leave the power set and accelerate, remaining clear of clouds until you are at a position from which you can descend and/or decelerate to enter the ELP.

6.7.5.2.2.3. Ten (10) knots of extra airspeed is approximately 100 feet of altitude. For example, 175 knots and 6,000 feet is approximately the same energy level as 125 knots and 6,500 feet. Once high key is "made," reduce power to 4- to 6-percent torque and maintain altitude as the airspeed bleeds off to 125 knots.

6.7.5.2.2.4. Check the descent rate after setting 4- to 6-percent torque (clean configuration). If greater than 1,500 feet per minute, increase torque to achieve a 1,350 feet per minute rate of descent. If power is insufficient to achieve a descent rate less than 1,500 feet per minute, consider shutting down the engine to improve glide performance.

6.7.5.2.3. **Clean** up the aircraft by raising landing gear, flaps, and speed brake (as appropriate to the emergency) as soon as possible because retraction may not be possible if the engine fails. Remember that any excess drag will delay reaching the desired energy state and greatly reduce gliding range.

6.7.5.2.4. Conduct a systematic **Check** of the aircraft. To determine the nature of the problem, look at all indications. Try to determine the nature of the emergency and respond with the appropriate checklists.

6.7.5.2.5. Use **B**oost pump and **I**gnition switches as required. Turn boost pump and ignition switches ON unless a restart or relight would not be warranted should the engine fail.

6.7.5.2.6. **P**lan to intercept the ELP at high key. If the situation warrants intercepting the ELP at a point other than high key, intercept that point in the appropriate configuration and airspeed.

6.7.5.3. Use experience and judgment to position the aircraft for the 125-knot (minimum) descent into high key. If expected to arrive at high key below planned altitude and/or airspeed, add power to highest suitable setting and climb at 125 knots to regain profile before lowering the gear and slowing to 120 knots. Check the energy at crosswind, analyze the energy state, and make adjustments as needed.

6.7.5.4. At low key, if energy is suitable, lower TO flaps. If energy is not suitable, correct with power and then lower TO flaps. Make every effort to arrive at low key on altitude. Be proactive and make corrections early.

6.7.5.5. Maintain 120 knots or decelerate to 110 knots from base key to final. Maintain a minimum of 110 knots on final until commencing the landing transition. The descent to final will generally be at a greater rate than for a normal pattern. Reduce power to idle when landing is assured to touch down at the intended point of landing. Adjust the nose attitude in the flare to transition to a normal landing. Touch down on the main gear and then gently lower the nosewheel as in a normal landing. Apply braking commensurate with the runway remaining. If the insufficient runway remaining prevents a full stop before going off the runway, execute a go-around if you believe the engine will continue to develop sufficient power to obtain a low key position for another attempt. If you feel the engine is not reliable for another attempt, consider ejection.

6.7.5.6. The following are some common errors that can lead to an improper PEL: (***NOTE:*** Keep this list in mind while flying a PEL and be proactive to fly a smooth and effective procedure.)

6.7.5.6.1. Not turning toward the nearest paved field before starting a climb. Remember, the first step is to turn.

6.7.5.6.2. Poor judgment and planning to arrive at high key. This includes climbing excessively, thereby delaying entry into the ELP.

6.7.5.6.3. Late or insufficient power additions to keep the aircraft in the ELP profile. Whenever low in a PEL, use power immediately and judiciously. Remember, the engine may give only 1 or 2 seconds of a power burst. Therefore, use power whenever you are low in a PEL so you will always be able to maintain the proper profile.

6.7.5.6.4. Delaying configuration instead of adding power when the aircraft is below the ELP profile.

6.7.5.6.5. Excessive angle of bank off high key which results in a high and tight low key.

6.7.5.6.6. Setting other than 4- to 6-percent torque once the ELP profile is intercepted.

6.7.6. **ELPs Through Weather:**

6.7.6.1. 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.

6.7.6.2. The recommended minimum weather for an FL is a 2,000-foot ceiling and 3 miles visibility. This weather allows VMC at a low-key position and sufficient visibility for a straight-in ELP. The recommended minimum weather for a PEL is a 2,000-foot ceiling and 3 miles visibility. However, if the weather is below 2,000 feet and 3 miles, a normal overhead or instrument approach should be flown as dictated by the weather.

6.7.6.3. If the weather will not allow for VMC at high key, accomplish (1) the standard ELP from high key or (2) a high speed ELP, as follows:

6.7.6.3.1. When flying the standard ELP from high key, use the GPS to navigate to high key, using the standard 125-knot glide and turns as necessary to achieve the appropriate altitude upon reaching high key:

6.7.6.3.1.1. The concept behind this technique is to fly the ELP as normally as possible, using the GPS rather than visual references for ground track control. If there is a published GPS approach for the runway selected, it may be possible to load that approach and omni-bearing selector (OBS) off the missed approach data point to estimate high key, using runway bearing as the OBS course. If no approach is available, it may be necessary to estimate high key, using the data point for the field itself.

6.7.6.3.1.2. Assuming there is weather all the way down to low key altitude, attempt to maintain the standard ELP ground track by turning to achieve a displacement of .7 to 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.

6.7.6.3.1.3. In any event, once VMC is encountered, attempt to intercept and maintain the proper ground track visually. If not clear of clouds by low key altitude, give serious consideration to abandoning the aircraft.

6.7.6.3.2. The high speed ELP requires at least enough altitude to make high key, and it should provide maneuvering capability to achieve the proper ELP ground track:

6.7.6.3.2.1. The concept behind this technique 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 on a 1:1 glide ratio (that is, 1,000 feet above low key altitude for every mile from high key). For example, if low key altitude is 1,500 feet, look for 11,500 feet at 10 miles, 8,500 feet at 7 miles, and so on. Upon reaching the 1:1 ratio, lower the nose to approximately 10 degrees nose low and accelerate, adjusting the pitch to maintain the 1:1 ratio until breaking out of the weather. The resulting airspeed could be as high as 230 knots.

6.7.6.3.2.2. 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, give serious consideration to abandoning the aircraft.

6.7.7. **Zero-Torque ELPs:**

6.7.7.1. Zero-torque ELPs result from one of the following conditions; (1) a mechanical malfunction resulting in an unfeathered prop or (2) an inadvertent setting of the PCL to less than 4- to 6-percent torque during a PEL or simulated FL training. An actual unfeathered prop situation due to a mechanical malfunction is unlikely due to the fail-safe design of the propeller. TO 1T-6A-1 (flight manual) provides guidance for this situation, which will only be practiced in the simulator.

6.7.7.2. Because an improper power setting is a more likely occurrence, with zero-torque having the worst consequences, the following procedure will be used to demonstrate the effects on a normal ELP with an improper power setting and stress the importance of cross-checking power setting during ELP training:

6.7.7.2.1. Fly to normal high key altitude, set the PCL to idle, and configure with gear. Notice the pitch attitude required to maintain 120 knots. The halfway point between high key and low key altitude loss should be approximately 750 feet. Note the actual loss. If allowed to continue, the altitude loss at low key would be excessive.

6.7.7.2.2. Add power to arrive at low key on altitude and set power to idle. Notice the pitch required to maintain airspeed 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 greater than normal pitch attitudes (more nose down) and descent rates throughout the maneuver, initiate a go-around a minimum of 200 feet AGL. This demonstration may also be conducted by starting from low key.

6.8. Go-Around:

6.8.1. **General Guidelines.** At times during traffic pattern and landing practice, you will find yourself poorly positioned. If this happens, discontinue your approach for reasons of safety and execute a go-around. Although you can abort an approach at any point, a go-around is usually executed from the final approach or roundout. The sooner a poor landing condition is recognized and a go-around is started, the safer you will be. Do not wait until the last second to make the decision and do not try to salvage a bad approach. Ideally, there should be little need for a runway supervisor to direct a go-around. The pilot of the aircraft should execute the go-around when a dangerous condition is encountered. Examples of dangerous conditions are low final turns, overshot final turns, wake turbulence, and inadequate spacing with other aircraft.

6.8.2. **Final Approach or Landing Go-Around:**

6.8.2.1. The correct method for executing a go-around from the final approach or landing phase is to advance the PCL to maximum power. When you are sure you will remain airborne with a positive climb indication, retract the landing gear and flaps. After ballooning or bouncing, a second touchdown may occur. Under these conditions, you might consider delaying gear retraction. Remember to call "gear clear" on dual sorties.

6.8.2.2. As the flaps retract, raise the nose slightly to offset any tendency of the aircraft to sink. Clear the runway, if necessary, to avoid overtaking an aircraft ahead of you. To clear the runway, smoothly roll into a shallow banked, coordinated turn (after attaining a safe altitude and airspeed) and turn approximately 20 degrees. When you are well clear of the runway, execute another turn to realign yourself with the runway. This is called the "offset" position. The direction of these clearing turns will depend on local procedures. Allow the aircraft to accelerate to between 140 and 200 KIAS. Then climb or descend to 500 feet above the terrain during the go-around until you are beyond the departure end of the runway or as directed locally. ***EXCEPTION:*** It is not necessary to clear the runway during a go-around if the runway is clear of other aircraft.

6.8.3. **Final Turn Go-Around.** Normally, the procedures for a go-around from the final turn are performed after rolling out on final approach. In the final turn, use power as necessary to maintain a safe airspeed. Monitor your airspeed closely to avoid overspeeding the gear and flaps. If a go-around to the inside of the normal pattern is required, use extreme caution. **Attempting to tighten a turn without proper consideration for power and airspeed could lead to a stall.** Your IP will cover techniques for this type of go-around.

6.8.4. **Straight Through on Initial.** If it is necessary to discontinue a pattern before the break, continue (or carry) straight through on initial at 1,000 feet above the ground and 200 KIAS or as directed locally. At the departure end of the runway or as directed locally, turn crosswind. Make sure you clear below your aircraft for aircraft on takeoff leg or pulling up into closed traffic. You must also clear for aircraft already established on closed downwind.

6.8.5. **Breakout from an Overhead Pattern.** If it is necessary to discontinue an overhead pattern, follow the local procedures for leaving the traffic pattern. Do not wait to be directed to break out if you see a dangerous situation developing. Use your initiative and judgment and exit the traffic pattern immediately. If you are directed to leave the traffic pattern, follow instructions without hesitation. Use caution when breaking out from the downwind leg because you will have slow airspeed and may have the gear and/or flaps extended. Never break out from the final turn.

6.9. Straight-In Approach. Use the straight-in approach when conditions require a landing with minimum maneuvering or gradual airspeed changes. Examples of these conditions are flight control malfunctions, electrical or pitot-static problems, structural damage, an open nose-access door, an unlocked canopy, or other nonengine-related emergency recovery. Your IP will demonstrate the straight-in approach and have you practice it with and without flaps, as follows:

6.9.1. Notify the runway supervisor or tower as directed locally and obtain permission for the approach.

6.9.2. Arrive at the designated entry point at 500 feet above the terrain, if not otherwise specified.

6.9.3. Before you are 2 miles from the runway, lower the gear, lower the flaps as required, and establish an approach airspeed.

6.9.4. During a normal straight-in approach, start the descent to establish a normal glidepath. Continue as you would on a normal final approach.

6.9.5. During a no-flap straight-in approach, reduce power as necessary and start the descent to establish a no-flap glidepath. Continue as you would on a no-flap final approach.

6.10. Closed Traffic:

6.10.1. The closed traffic pattern was devised to get the aircraft on the ground, using a minimum amount of fuel. You may accomplish a closed traffic pattern from an initial takeoff, touch-and-go landing, or go-around.

6.10.2. At a minimum of 140 KIAS and no sooner than the locally designated point, request clearance for a closed traffic pattern.

6.10.3. When you have received clearance, clear the area, advance the PCL smoothly, and start a climbing turn to the downwind leg. Plan your pullup, using approximately 60 degrees of bank, so the downwind leg is displaced at approximately the same distance from the runway it would be after a break. As you approach pattern altitude, reduce power so as to arrive on downwind at between 150 and 140 KIAS. Minimum airspeed during the pullup is 140 KIAS; maximum bank in the pullup is 90 degrees.

6.10.4. When you roll out on the downwind leg, report “closed downwind” if local procedures dictate. If you plan a full-stop landing, state your fuel remaining. Add “departing” if you plan to depart the pattern. Clear and continue with normal approach and landing procedures. (Lower gear and flaps at the same points as after the break.) If the controller instructs you to break out, follow the local procedures for leaving traffic from inside downwind.

6.11. Final Turn Radio Call. This call is an important part of the traffic pattern procedure. It tells the controller, as well as other aircraft in the pattern, where you are. Transmit the “gear down” call as soon as safely possible after starting the final turn. Add no-flap, departure, and/or full stop, if applicable. No response from the controller means you are cleared to continue with the requested approach, but be alert for other instructions from the RSU or tower. Regardless of the type of approach flown (overhead, straight-in, precision, or nonprecision), **do <u>not</u> make a gear down call until the gear indicates DOWN AND LOCKED and is confirmed with the IP**.

6.12. Landing Irregularities. Up to this point, explanations of landings have been devoted mainly to ideal situations in which landings were executed correctly. However, there are several errors student pilots can make while developing landing proficiency so you must be thoroughly familiar with the following causes, effects, and proper recoveries from these situations:

6.12.1. **Low Final Approach.** There are different ways to get below the desired flightpath. You can start the final turn too late, place the final turn too far from the runway while maintaining normal pitch and descent rates, or dive the aircraft through the final turn. The result is excessive altitude loss and a final approach below the desired approach path. Such a situation requires additional power to fly the aircraft to the runway. This is called a dragged-in final approach and should be avoided.

6.12.1.1. A dragged-in final approach is dangerous because you might misjudge the extra power needed to fly in this attitude. Once you have become accustomed to the amount of power normally required on final, habit may cause you to use only this amount. With inadequate power in this nose-high, level-flight condition, the aircraft may stall. Dragging the aircraft in with a dangerously nose-high attitude is not the proper solution for the error in judgment that was made in the final turn.

6.12.1.2. Adjust pitch and power as soon as you start getting low on the final approach. Then readjust pitch and power when you are back on the proper glide slope. If you have any doubt about the approach (if it looks wrong or feels wrong), go around.

6.12.2. **Steep Final Approach.** This approach is caused by placing the final turn too close to the runway, starting the final turn too early, or keeping the nose too high in the final turn. If the final approach is continued, a high descent rate with a low power setting will result. This low power setting, coupled with the pitch change required to intercept the normal glidepath, will result in a rapid decrease in airspeed and a high sink rate. If you do not correct early or go around, this power deficient situation could result in a very firm touchdown or a stall.

6.12.3. **Too Slow on Approach:**

6.12.3.1. If your airspeed is too low on the final approach, your perception of the proper glidepath may be inaccurate. Slower airspeed on final approach also requires delaying the roundout, which reduces the margin for error. In addition, the higher AOA increases the likelihood of stalling the aircraft, especially if the wind is gusty. When you recognize a slow approach, make the same recovery as for a low final approach. Apply power at an altitude high enough to reestablish the correct airspeed and attitude or go around.

6.12.3.2. A slow approach may also be caused by improper glidepath control. If your pitch increases and your aimpoint shifts down the runway, your airspeed will decrease. Correcting your aimpoint and glidepath may be the only action necessary to reestablish proper airspeed and glidepath.

6.12.4. **Rounding Out Too High:**

6.12.4.1. If you begin the roundout too early or round out too aggressively, you will be too high above the runway in a high flare. This may result in a stall or a dropped-in landing with a firm touchdown. To compensate, release a small amount of back pressure; and, as the airspeed diminishes, the aircraft will settle down to the runway.

6.12.4.2. Use this technique only when you have adequate airspeed and runway remaining. If you have reached a landing attitude and are still well above the ground, do not wait for the aircraft to

start descending again. Go around and plan another approach. Remember, when the landing attitude is attained, the aircraft is rapidly approaching a stall. As the airspeed decreases, you are approaching the critical AOA.

6.12.4.3. You have learned that, as the nose is lowered to a descending attitude, the pitch change causes lift to decrease momentarily. This is also true during a roundout. Do not lower the nose to increase the rate of descent when you are fairly close to the runway. The momentary decrease in lift may cause the aircraft to land on the nosewheel, which could collapse. You should go around any time you feel the need to lower the nose excessively to avoid a stall during the roundout. The need for substantial lowering of the nose is an indication you are too high above the ground and approaching a stall.

6.12.4.4. Any time you approach a stalling condition after ballooning or bouncing, apply full power, adjust your pitch attitude, and go around. It is unsafe to continue the landing. However, if you have applied power to go around and the aircraft continues to settle, do not try to hold it off by raising the nose above the landing attitude. Hold the landing attitude and let the aircraft touch down. The contact will be moderate if you have added power, and you will be safely airborne again shortly.

6.12.5. **Rounding Out Too Late or Too Rapidly.** If you are late starting the roundout and pull the stick back too rapidly in an effort to prevent a touchdown, you can cause an accelerated stall. This is a dangerous situation, which may cause an extremely hard landing on the main gear. This may or may not be a controllable situation, depending on the airspeed. If it occurs, immediate use of power will increase thrust, lift, and controllability and will enable you to recover and go around. The important things to remember in this situation are: (1) do not panic, (2) recognize the problem, and (3) do something immediately--that is, add power and control the aircraft. In your recovery, hold the landing attitude. Your main gear will probably contact the ground a second time; but, if you have initiated recovery properly, your second contact will usually be moderate.

6.12.6. **Porpoising:**

6.12.6.1. This is a condition encountered during landing, where the aircraft bounces back and forth between the nosewheel and main gear. It is caused by a landing attitude at touchdown that brings the nosewheel in contact with the runway before the main gear touchdown. It most likely will occur when landing is attempted with an incorrect landing attitude and at an excessive airspeed. If immediate corrective action is not initiated, the porpoise will progress to a violent, unstable pitch oscillation. Because repeated heavy impacts of the aircraft on the runway will ultimately result in structural damage to the landing gear and airframe, a proper landing attitude immediately before touchdown is imperative to prevent the occurrence of a porpoise.

6.12.6.2. If you begin to porpoise, immediately position the controls to establish a nose-high attitude sufficient to prevent the nosewheel from contacting the runway. Maintain this attitude and simultaneously advance the PCL to maximum. Do not attempt to counteract each bounce with opposite-stick movement. The combined reaction time of pilot and aircraft is such that this control movement will aggravate the porpoising action. Repositioning and holding the controls (restricting movement) will dampen out the oscillation. The addition of power will increase control effectiveness by increasing airspeed. It will also allow the aircraft to become safely airborne.

6.12.6.3. If you initiate a go-around after porpoising, do not raise the landing gear. Structural damage can occur during porpoising, which may prevent the landing gear from being lowered on the next landing attempt.

6.12.7. **Floating.** When you misjudge the final approach (for example, reduce the power too late, use too much power on final, or fail to use the flaps properly), your tendency is to dive toward the end of the runway in an attempt to land. When you dive, the airspeed increases. This causes you to float and possibly balloon or bounce, and you will be well down the runway before landing. To correct a slight problem of floating, gradually adjust (increase) the pitch attitude as airspeed drops and landing speed is approached. Your recovery from floating will depend on the amount of floating and runway remaining. Avoid prolonged floating, especially in strong crosswinds. If you have any doubt about the recovery, execute a go-around.

6.12.8. **Ballooning:**

6.12.8.1. There are several factors that cause an aircraft to balloon. Rounding out too rapidly or raising the nose to the landing attitude before lift has decreased sufficiently are only two of the factors that will cause you to balloon. The altitude gained will depend on the airspeed or the rate at which the pitch attitude is increased.

6.12.8.2. When ballooning is slight, you may complete the landing. Maintain direction, hold a constant landing attitude, and let the aircraft settle onto the runway. Use rudder pressure to keep the aircraft straight as it settles onto the runway. When ballooning is pronounced, go around. Do not attempt to salvage the landing.

6.12.8.3. Be extremely cautious of ballooning in crosswinds. If you do not maintain the wing-low crosswind correction until touchdown, the aircraft will probably balloon more because of the added lift as you level the wings. This puts you in double jeopardy because you will start drifting once you level the wings. Be sure to keep the appropriate wing down in a crosswind and maintain direction with opposite rudder. If you balloon slightly, you may need to lower the wing even further to compensate for the relative increase of drift component at the lower airspeed. Again, if you have any doubt, go around.

6.12.9. **Bouncing:**

6.12.9.1. Bouncing is very similar to ballooning, but the cause is different. If the aircraft strikes the runway hard, it will bounce into the air. The height it reaches depends on the force with which it strikes the runway and the amount of back pressure held. This height also depends on the speed at the point of touchdown. The aircraft may bounce if it makes contact with the ground before the landing attitude is attained. A common student error is to apply excessive back pressure when the student realizes too late that the aircraft is settling too fast, but he or she is not yet in the landing attitude. In attempting to correct the first mistake, the student increases pitch attitude too late—just as the bounce occurs. Both factors tend to force the aircraft aloft again.

6.12.9.2. The corrective action for a bounce is the same as ballooning, and it depends on the severity of the bounce. When the bounce is slight and there is no great change in pitch attitude, continue with the landing. Maintain direction and smoothly adjust the pitch to the landing attitude just before touchdown. When a bounce is severe (that is, you feel the aircraft rising rapidly), go around immediately. Simultaneously apply power, maintain direction, and lower the nose to a safe pitch attitude. Follow through with the go-around even if another bounce occurs. Do not attempt a landing from a bad bounce. Leave the landing gear extended if a hard landing is encountered.

6.12.9.3. Because airspeed diminishes very rapidly as the aircraft rises, a stall may occur before a landing is made. Expect to contact the ground or bounce a second time during a proper recovery. The second bounce will not be as severe.

6.12.9.4. Use extreme caution any time you bounce in a crosswind. When one wheel strikes the runway, the other wheel will touch down immediately afterwards. The crosswind correction will be lost, and the aircraft will drift. You should reestablish crosswind controls to stop the drift and either continue the landing or go-around, depending on you situation.

6.12.10. **Landing in a Drift or Crab:**

6.12.10.1. At times you may find yourself correcting for drift by crabbing on the final approach. If you round out and touch down while the aircraft is drifting or in a crab, it will contact the runway moving sideways. This will impose extreme side loads on the landing gear and may cause material failure.

6.12.10.2. After crabbing into the wind, the proper method of correcting for drift on the final approach is the wing-low method. This allows you to keep the longitudinal axis aligned with the runway throughout the final approach and landing.

6.12.10.3. During final approach, roundout, and touchdown in a crosswind, the path or track of the aircraft over the ground is a straight line in the same direction as the runway and the fuselage of the aircraft should remain lined up with the runway throughout. In other words, do not angle toward the runway or cock the nose. Failure to apply sufficient wing-low crosswind corrections will result in landing with a drift, in a crab, or a combination of both.

6.12.11. **Wing Rising After Touchdown:**

6.12.11.1. During crosswind landings, a wing may rise during the landing roll. Depending on the amount of crosswind and degree of corrective action, you could lose directional control.

6.12.11.2. When an aircraft is rolling along the ground in a crosswind, the upwind wing is receiving more impact of air pressure than the downwind wing because the fuselage blocks the wind over the downwind wing. This causes a lift differential. The wind also strikes the fuselage on the upwind side. This causes a rolling moment about the downwind main landing gear, which may further assist the raising of the upwind wing. When the effects of these two factors are great enough, one wing may rise even though directional control is maintained. If no correction is applied, one wing will rise enough to cause the other one to strike the ground. Use rudder, brakes, and/or nosewheel steering to maintain directional control; use ailerons to keep the wings level.

6.12.11.3. If a wing starts to rise during the landing roll, immediately apply more aileron toward the high wing and continue to maintain direction. The sooner aileron is applied, the more effective it is. The farther you allow a wing to rise before taking any corrective action, the more aircraft surface is exposed to the impact pressure of the crosswind.

6.12.11.4. There is a situation where a wing comes up and there is also a loss of directional control. Not only are the same factors attempting to raise the wing, but the crosswind is also acting on the fuselage surface behind the main wheels, swerving the aircraft into the wind. Again, you should apply aileron to lower the high wing and stop the swerve with the most effective control. When the wings are approximately level, maintain directional control until the aircraft has slowed to taxi speed or has stopped.

6.13. Landing on Alternate Sides of the Runway. When landing on alternate sides of the runway, plan to land near the center of the runway. The side of the runway closest to your turn off the runway is known as the "cold" side; the side away from the turnoff is the "hot" side. If traffic permits and the approach and landing for a touch-and-go or full stop will not affect spacing criteria, you may land in the center of the runway.

Chapter 7

NIGHT FLYING

7.1. Introduction:

7.1.1. Night flying is a very important phase of pilot training. Do you remember how surprisingly easy it was to learn to drive an automobile at night? The transition from day to night flying is just as easy. You will find that most of the same techniques and procedures used in day flying will apply to night flying. Generally speaking, any apprehension you might have about night flying will result from restrictions placed on your visibility. Once you overcome the feeling of discomfort because of visual limitations, you should have very little difficulty flying at night.

7.1.2. Before night flying, ensure you are familiar with the location and positions of all switches and controls. The ability to locate switches and controls should become second nature to you through practice in either a synthetic trainer, simulator, or parked aircraft. Determine which switches might be mistakenly or accidentally actuated and whether or not such a mistake could create a problem. If so, spend extra time learning the correct switches in this area.

7.1.3. The traffic pattern during night flying is the same as the day pattern, but some of the visual checks and procedures used in the daytime are more difficult at night. Orientation with the ground and other aircraft is harder to maintain. Tension is quite normal because flying an aircraft at night is a new and different sensation. For example, you may notice lights reflecting on your canopy due to a glare from your instrument or cockpit lights. Do not confuse these with lights of other aircraft. Once you realize the things that appear strange at night are really quite normal, you will have overcome your biggest obstacle to successful night flying.

7.1.4. Night flying will demand more of you than day flying. You must be constantly alert for other aircraft in the area. You may have to rely on your instruments to determine the attitude of the aircraft. Know your cockpit procedures for taxiing as well as for flying. This will eliminate confusion and the need for turning up the cockpit lights unnecessarily.

7.1.5. Cockpit organization is especially important at night. The instruments may not generate enough light to see items in your G-suit holddown straps or on your kneeboard. Although the utility light may be held in your hand to see items in the cockpit, flying with this light in your hand is impractical at best. The utility light may be placed on the right canopy rail for increased lighting on the right side, and it may also prove useful for lighting items on the left side of the cockpit. However, keep the intensity of the utility light as low as practical to prevent degrading your night vision and to minimize the possibility of spatial disorientation.

7.2. Spatial Disorientation:

7.2.1. A pilot is much more susceptible to spatial disorientation at night than during the day. Also, depth perception at night is not completely reliable.

7.2.2. Before takeoff, always study a map of the field. Get a good mental picture of the takeoff runway and taxiways leading to it. Too often, pilots on a strange field at night take wrong turns, thus losing time and creating confusion.

7.2.3. Always carry an operable flashlight. If there is electrical failure, a flashlight is your only means of checking the standby instruments or maps.

7.2.4. The T-6 lighting system consists of red and white lights for the cockpit and instrument panel. These lights are used on the instrument panel separately or in combination, and they can be adjusted for intensity. To avoid eye strain and keep canopy reflections to a minimum, adjust instrument lights to the minimum necessary to read the instruments. Remember, once your eyes are adapted to the dark, even a momentary glance at bright lights destroys this adaptation. With bright instrument lights, you will be unable to distinguish objects outside the cockpit until your eyes readjust.

7.2.5. In the weather at night, strobes may be disorientating. If they are, turn them off.

7.3. Inspections and Checks. In addition to the normal daytime exterior check, perform the following:

7.3.1. Ensure all required exterior and interior lights are operational (AFI 11-202, Volume 3).

7.3.2. Ensure all transparencies are clean. Because scratches and dirt cause reflection, ask the ground crew to wipe off any spots on the windshield and instrument panel.

7.3.3. Keep the cockpit lights, including those controlled by the warning light's dimming switch, turned down to a comfortable level. This is especially important during traffic pattern operation because canopy glare and bright lights can seriously restrict visibility when clearing is most important.

7.3.4. Know the location of all important switches by touch to avoid operating the wrong one in a dim or dark cockpit. The same applies to all control levers. The flap lever and landing lights are items required at a critical time in the landing pattern. Know their locations by touch. Also know the location of the flap indication without searching for it.

7.3.5. Store your flashlight in a readily accessible place.

7.4. Taxiing. Taxi at night with a minimum of 300 feet spacing and on the taxiway center line. The taxi light should be used during all night taxi operations and landing lights should be used when necessary. When taxiing toward a landing runway, be careful that your lights do not interfere with the vision of pilots landing or taking off. The taxiing aircraft will come to a complete stop if the area cannot be visually cleared without the lights. Judgment of speed and depth perception is poor at night. Allow for this and follow procedures with extra care. Always taxi more slowly at night to compensate for the reduced visibility and taxi on established taxi lines. (Do not taxi "staggered.")

7.5. Takeoff. Line up on the center line of the runway and perform a static takeoff. Before brake release, turn on taxi and landing lights and complete the Lineup Checklist. After brake release, look down the runway—not to one side—at the runway lights. On night takeoffs, there is a tendency to fly the aircraft back onto the runway so do not retract the gear in a hurry. Be sure to confirm "gear clear." If you become disoriented, immediately resort to instrument flight. Use instrument takeoff procedures. If you resume outside visual reference, use extreme caution. You need not be alarmed by loss of references on takeoff if you go confidently on instruments, maintaining a positive pitch attitude on the attitude indicator and a positive rate of climb on the VSI.

7.6. Area Orientation:

7.6.1. Your IP will show you the local flying area, prominent landmarks, familiar cities or towns, and any points of interest that may help to keep you oriented. He or she will also point out local hazards at night and minimum safe altitudes for local night operations.

7.6.2. There are several methods to compensate for the lack of visual references at night. Two of these methods are using a reduced descent rate and reading out altitudes over the intercom when descending for a level off close to the ground.

7.6.3. Take extra care in reading the altimeter at night because your actual height above the ground is difficult to visually confirm. Many accidents have resulted from pilots who have misinterpreted altimeter readings, so constantly guard against this error. Careful interpretation of altimeter indications is an absolute necessity for safe night flying.

7.6.4. After you are comfortably adjusted to night flying, your IP will place the aircraft in an unusual attitude. You will then recover from the unusual attitude and return the aircraft to level flight, using instruments only. If you become disoriented, trust your instruments. Causes and hazards of spatial disorientation are listed in AFMAN 11-217, Volume 1, and must be clearly understood by all aircrews before night flying.

7.7. Night VFR:

7.7.1. Night VFR flight is a combination of instrument and contact procedures. The degree of darkness and horizon clarity determines how you should divide your attention between the flight instruments and outside references. On bright moonlit nights, you can do most of your flying visually with occasional glances at the instruments to confirm your visual references. On dark nights, when there is little or no horizon, concentrate on the instruments and occasionally glance outside to confirm the aircraft's position in relation to known points on the ground. However, whether the night is light or dark, the transition from instruments back to outside references should be gradual and should not normally be started until the aircraft is 500 feet AGL after takeoff.

7.7.2. Visibility at altitude often exceeds 100 miles at night, which makes judging distances difficult. A bright light on the ground at a distance can sometimes be confused with a star. Conversely, bright stars can often be mistaken for lights on the ground, especially in sparsely populated areas. Both these cases can lead to disorientation. Lights displayed by other aircraft are usually easy to detect, but their direction of flight, distance, and closure rate are difficult to determine. Their navigation and strobe lights can help to determine their direction of flight.

7.7.3. The reduced ability to see at night creates other hazards for VFR flight. Clouds are sometimes difficult or even impossible to see. Flying into an unexpected cloud at night can be very disorienting. Aircrews who inadvertently fly into clouds at night must quickly transition to their flight instruments to minimize disorientation.

7.7.4. In addition, aircrews must use caution when selecting landmarks for checkpoints. During darkness, an unlit landmark may be difficult or impossible to see. Lighted landmarks, such as cities and towns, stand out more clearly at night; but lights can be confusing because they appear closer than they really are. Large cities can often be recognized by their shapes, but many small towns are darkened at night and not visible. Busy highways are usually discernable at night due to automobile headlights, and airfield rotating beacons make good checkpoints.

7.8. Landings. The importance of using the before-landing checklist on night landings and of making sure the gear is down and locked before turning onto final cannot be overemphasized. After rolling wings level on final, concentrate on the descent and plan to touch down within the first 1,000 feet of the runway. Keep your eyes moving; don't stare at any bright lights on the ground. It is easy to confuse a moving light

with a stationary one. Plan to touch down on the center line of the runway. Turn on the landing lights after rolling out on final. When flying in the traffic pattern or other congested areas, be especially vigilant for other aircraft. Constantly look around for aircraft lights.

Chapter 8

FORMATION

Section 8A—General

8.1. Introduction:

8.1.1. The purpose of flying formation is to provide the mutual support required to accomplish a given mission. The effectiveness of a formation mission is highly dependent on solid flight discipline. This originates in mission preparation and is displayed in the formation briefing by flight lead or another designated flight member. During the briefing, the flight lead formally describes the mission and establishes the rules of conduct for all flight members during ground operations and in-flight maneuvers.

8.1.2. Flight discipline is displayed when each flight member adheres to these rules of conduct throughout the mission until debriefing. Uncompromising flight discipline is absolutely essential for successful mission execution. More than any other type of flying, formation provides the best environment for building confidence and for teaching self-reliance, self-discipline, and the proper application of aggressiveness in military flying.

8.1.3. Aggressiveness is a state of mind, an attitude not to be confused with speed of flight control movement or reckless abandon. Aggressiveness is knowing the rules and parameters, recognizing deviations, and making expeditious, controlled corrections. T-6 formation training teaches you the basic techniques and procedures. You must be disciplined and aggressive, and you must trust lead. Throughout this manual, you as the wingman are directed to “stabilize” in a particular position before continuing the maneuver. However, “stabilized” does not mean “stopped”; it means in control and able to complete the maneuver safely within your capabilities. The ability to fly good formation does not come easily.

8.2. Responsibilities:

8.2.1. **Collision Avoidance:**

8.2.1.1. Flightpath deconfliction is the most fundamental and important tenet of formation flying. It requires the full and constant attention of flight leads and wingmen, whether cruising in route formation or maneuvering tactically. When there is a potential for conflict or loss of sight, immediate action with precise communications is required to prevent a midair collision.

8.2.1.2. When referring to aircraft within the formation, use the terminology “blind” or “visual” as appropriate. When referring to aircraft from outside the formation, use the terminology “no joy” (when you do not have visual contact) or “tally ho” (when you do have visual contact).

8.2.1.3. Wingmen are expected to maintain visual contact with their lead and are responsible for element deconfliction until they call “blind” or “padlocked.” (A “padlocked” call indicates the pilot cannot take his or her eyes off an aircraft or ground target without losing sight.) Additionally, wingmen must call “blind” if they lose sight or cannot maintain visual contact.

8.2.1.4. Likewise, leads are expected to monitor their wingmen and talk the wingman’s eyes back onto lead if the wingman is blind. Most importantly, if lead is also blind, he or she must effect

immediate altitude deconfliction and, if necessary, call "knock-it-off" if safety is becoming an issue.

8.2.1.5. The following factors contribute significantly to the potential for a midair collision:

8.2.1.5.1. Failure of lead to properly clear or visually monitor the wingman during a critical phase of flight, such as during a rejoin or trail. As lead, you must monitor your wingman, looking at him or her directly or using the mirror. Be directive or take evasive action if your wingman loses sight of you. If you lose sight of your wingman and are uncertain of his or her position, query him or her.

8.2.1.5.2. Failure to execute lost wingman procedures promptly and correctly if visual contact is lost in IMC. While flying in IMC, if the wingman cannot maintain the normal fingertip position (using normal visual references) or loses sight of lead, he or she will immediately follow the appropriate lost wingman procedures (paragraph **8.6.6.**).

8.2.1.5.3. Failure to recognize excessive overtake. Learn to judge closure and detect overshoots. The airspeed indicator can be a vital aid. During rejoins, compare your airspeed with the prebriefed or announced airspeed. If you are directly in trail, move laterally to gain greater perspective of closure rate and provide a safe margin for breakout or overshoot. Use power and/or speed brake as necessary.

8.2.1.5.4. Failure to maintain lateral or vertical separation. This generally applies to turning or straight-ahead rejoins. Always maintain lateral or vertical separation until closure rates are under control and you reach the route position.

8.2.1.5.5. Failure to call "blind" and maneuver in the safest direction when visual contact is lost. As the wingman, if you lose sight of lead for any reason (other than in IMC), call "blind." If deconfliction is questionable or there is no timely acknowledgement of the "blind" call from lead, break out of formation. Do not delay your breakout by attempting to regain visual contact. Break in a safe direction (away from the last known position or flightpath of lead) to gain immediate separation. Call your breakout over the radio and do not attempt to rejoin until directed by lead.

8.2.1.5.6. Failure to consider the effects of wingtip vortices. Wingman fly into vortices when they get too close during fingertip maneuvers or crossunders. The resulting control difficulties are very dangerous. If wingmen encounter vortices, they must control the aircraft and move back out or break out as necessary.

8.2.2. **Lead:**

8.2.2.1. Clearing and planning are the most important aspects of leading a formation. You must monitor the wingman, clear the area, and plan each maneuver. Execute each maneuver with skill and precision, allowing the wingman to maintain position without difficulty. Never become so overly conscious of smoothness that precision or safety is compromised. It is far more important to fly your aircraft safely with minor excursions from perfect performance than to fly super smooth and be a liability to the flight.

8.2.2.2. Plan all maneuvers to keep the flight well within the assigned working area. Select a power setting to manage your energy state in a similar manner to contact flying. High performance and high G maneuvers require smooth and deliberate control inputs to keep your wingman from exceeding G limitations while attempting to maintain formation position. You must also monitor

the wingman to ensure he or she is in position before the next maneuver. Before directing a maneuver, always consider the wingman's position and ability to safely perform such a maneuver.

8.2.3. **Wingman.** The three basic aspects of being a wingman are maintaining position, mutual support, and formation integrity. Initially, you will spend most of your time learning to maintain position, but you should develop the other skills that are an integral part of being a formation wingman. In a mutual support role, you can also help clear for the formation by scanning the area you can see beyond lead. Do this by using all of lead's aircraft as a reference; do not focus on just one spot. If you need to tell lead about a conflict, give your call sign, traffic's clock position (prefaced with side), elevation (low, level, or high), and an approximate distance. For example, transmit, "Texan 21, traffic right 2 o'clock, slightly high, 3 miles." Although procedural differences exist between operational units and from aircraft to aircraft, basic wingman responsibilities include:

8.2.3.1. Keeping lead in sight at all times.

8.2.3.2. Being aware of the departure, recovery, and en route altitudes and routing so he or she can assume the lead at any time.

8.2.3.3. Monitoring lead for system malfunctions and proper configurations and assisting, as possible, during emergencies.

8.2.3.4. Monitoring the radios and assisting lead if necessary.

8.2.3.5. Maintaining a constant awareness of the potential for a midair collision.

8.2.3.6. Trusting lead and following directions.

8.3. Radio Procedures:

8.3.1. Communications are a good indicator of flight discipline. All radio calls, to the flight as a whole or to an outside agency, should begin with the full call sign. Aircrews should attempt to minimize and combine radio calls on common-use frequencies to reduce radio congestion. Lead will add the suffix "victor" for the VHF radio calls (for example, "Texan, go channel 2 victor"). When using a discrete interplane frequency, using the radio may simplify and expedite safe and effective mission accomplishment. Lead must ensure calls are clear and concise, combining calls when practical.

8.3.2. Unless briefed otherwise, the wingman should change radio channels only when directed by lead and only after all flight members have acknowledged. When directing a radio channel change, lead may elect to use the "go" or "push" command. If using the "go" command (for example, "Texan, go channel 5"), the wingman will respond "2" before switching frequencies. If using the "push" command (for example, "Texan, push channel 5"), the wingman will switch frequencies without making a response until being checked in on the new frequency. Normally, when in fingertip formation, wingmen will automatically move to the route position when lead directs a channel change, and they will return to the fingertip position after being checked in on the new frequency. If in any position wider than fingertip, wingmen will remain in that position unless directed otherwise by lead. If in IMC, wingmen will maintain fingertip spacing and use the crew concept to accomplish channel changes. (The crewmember flying talks on the radio, and the crewmember not flying accomplishes the channel change.)

8.3.3. Aircrews of each aircraft in the formation will be assigned a call sign. For example, Captain X and his student sign out as Texan 01, and Captain Y and her student sign out as Texan 02. No two airborne formations will have the same word call sign (for example "Rough," "JAPAT," "Narly," etc.).

Regardless of flight lead's position during takeoff, he or she will always use the call sign with the lowest numeric designator. In this case, flight lead would be Texan 01. Flight lead may also use 11, 21, 31, etc., depending on the local wingman's call sign procedures. In a four-ship formation, the deputy lead will always use the numeric call sign ending with the number 3.

8.3.4. The flight lead may be in any position on takeoff, landings, and area work to optimize training; but he or she will always be responsible for the safe and effective accomplishment of the mission. The call signs received when the formation signed out will be used any time the formation breaks up. In the above example, when in formation, Captain Y will acknowledge radio calls with her position number, but will use Texan 02 if the formation breaks up with no intention of getting back together. For radio calls within the formation, only the word call sign will be used as follows: for lead, "Texan, ops check," for wingman, "2."

8.3.5. When a member of the formation has total radio failure, the aircraft with the inoperative radio (no radio [NORDO]) will normally be given or retain the wing position. The flight member with the operative radio will lead the NORDO aircraft into the overhead pattern, notify the RSU or tower, and make a low approach to the landing runway. The NORDO aircraft will fly the pattern and land. If weather prevents an overhead pattern, lead will prebrief a straight-in or instrument approach as appropriate for the weather. When the lead aircraft clears the wingman off with a visual signal, the wingman will assume landing clearance, transition visually to the runway, and land normally.

8.3.6. Flight members who experience total radio failure while in close formation should maneuver within route parameters, attract the attention of another flight member, and give the appropriate visual signals. The mission should be terminated as soon as practical and the NORDO aircraft led to the base of intended landing.

8.3.7. If flying other than close formation when radio failure occurs and a planned rejoin will not shortly follow, the NORDO aircraft should cautiously attempt to rejoin no closer than route position. It should rock its wings (attention in the air), but not complete the rejoin until receiving a rejoin signal. Once joined, the NORDO aircraft will give the appropriate visual signals. The mission should be terminated as soon as practical and the NORDO aircraft led to the base of intended landing.

8.4. Visual Signals. Visual signals are used during formation flying when radio transmissions are inappropriate or difficult to make. Visual signals are described in AFI 11-205, *Aircraft Cockpit and Formation Flight Signals,* or this manual. Any nonstandard visual signals will be briefed before they are used. As the wingman, when lead gives a signal, acknowledge it by nodding your head. If you do not understand or are unsure of a signal, do not acknowledge. Lead will repeat the signal until an acknowledgment is received from you. Use the radios, if necessary, to avoid confusion or when more practical.

8.5. In-Flight Checks:

8.5.1. **General.** The "fuel check" visual signal will be used to initiate all checks except the climb check. Lead and the wingman will check fuel and perform any checklist appropriate for the phase of flight (ops, descent, pre-aero). The "oxygen check" signal will be used for the climb check. If forced to turn during a check, lead should call the turn and ensure the wingman is attentive before turning. The wingman resumes the check after the turn is complete. In-flight checks are normally accomplished in the following manner:

8.5.1.1. **Lead.** As lead, initiate the check with either a radio call or visual signal. After directing the wingman to accomplish the appropriate checklist, perform your own checklist items. Allow enough time for the wingman to do the same. If forced to turn during a check, call the turn and ensure your wingman is attentive before turning. Check the wingman in with a visual signal (according to AFI 11-205) or a radio call. If using the radio, check in by transmitting a call sign and OBOGS status for the climb check and total fuel for ops checks and descent check ("Texan 1, OBOGS good" or "Texan 1 is 800").

8.5.1.2. **Wingman.** As wingman, acknowledge lead's visual signal or radio call, move to route if check was initiated in fingertip, and perform the appropriate checklist items. Accomplish the check one item at a time, checking your position on lead between each item. Prioritize your tasks. If necessary during turns, fly the aircraft and resume the check after the turn is complete. Return to the fingertip position only after flight lead's check-in radio call or visual signal. During IMC, use the crew concept for completing in-flight checks. (The crewmember flying will fly the fingertip position, and the crewmember not flying will perform the check.) Check in with OBOGS status ("2's OBOGS good") for the climb check or total fuel ("2's 600") for ops and descent checks. If your OBOGS is good or you are within 50 pounds of lead's stated fuel, respond with "2's same."

8.5.2. **Climb and Ops Check.** This is a check of the fuel quantity and aircraft systems, which will be performed periodically during every mission. Lead will initiate the check with the appropriate visual signal or transmit, "Texan, ops/climb check." The wingman will acknowledge the visual signal or radio call, as appropriate. Lead should monitor any abnormal fuel state reported by the wingman.

8.5.3. **Fuel and G Awareness:**

8.5.3.1. It is lead's responsibility to monitor the G-loading and fuel state of all members of the formation. He or she must also take appropriate action when any aircraft exceeds G limitations, reaches joker or bingo fuel, or reports an abnormal fuel condition. To fulfill this responsibility, lead must initiate a fuel and G check several times throughout the mission ("Texan one is 900, 4.2 Gs"). These checks are normally accomplished after the G awareness exercise and the extended trail exercise. It is the wingman's responsibility to monitor his or her own G-loading and fuel state and report joker or bingo fuel, as well as any abnormalities, to lead. The maximum G on the meter will be reported on each G check.

8.5.3.2. It is important to remember that any time a wingman is maneuvering behind lead (extended trail exercise, close trail, fighting wing, etc.), he or she must use caution to avoid areas of propwash or wake turbulence. This is especially important in lead's high or direct six o'clock. The more G lead pulls, the higher the probable turbulence area. Any time wake turbulence or propwash is encountered, the wingman 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 structural damage or controllability check, as required. In the case of an over-G, the G meter will not be reset until the aircraft can be looked at by a certified maintenance technician.

8.5.4. **FENCE Check.** "FENCE-in" is normally directed by lead when entering the MOA or military training route (MTR). "FENCE-out" will normally be accomplished when exiting the MOA or MTR. Items to accomplish will vary with the mission type. During your training in the T-6, "FENCE-in" will ensure you are prepared for area work. In this case, **FENCE** means **F** - Fuel, **E** - Engine, **N** -

NAVAIDs or NACWS, **C** - Comm or Checks (ops, pre-aerobatic, or descent, as appropriate), and **E** - Equipment (G-suit test). When exiting the MOA, "FENCE-out" prepares you for recovery.

8.5.5. **Battle Damage (BD) Check:**

8.5.5.1. When accomplished, lead initiates the BD check using a radio call or the "check mark" visual signal. Number 2 will look over one side of lead (high and low) and cross under to look at the other side. He or she must not sacrifice nose-tail separation in examining the other aircraft. Upon completion of the check, the wingman will return to the formation position from which the check was initiated (normally fingertip or route), but on the new side of lead. While inspecting lead, the wingman will look for any damage, leaks, missing panels, or any irregularities. ***NOTE:*** Peacetime maneuvering can cause these problems as well as combat maneuvering.

8.5.5.2. If lead is clean, the wingman passes a thumbs-up to lead. If lead is not clean, the wingman will use the radios to describe discrepancies. Lead then initiates a lead change, using visual signals or radios, and the wingman assumes the navigation lead only while clearing for the flight. Flight lead then inspects Number 2. When lead is finished, Number 2 passes the navigation lead back to lead.

8.5.5.3. When the lead aircraft contains two pilots, the option exists to conduct the BD check without changing leads. In this case, one pilot in the lead aircraft will inspect the wingman as the wingman maneuvers to inspect the leader, and the other pilot in the lead aircraft will clear the flightpath for the formation.

8.5.5.4. During the BD check, the aircraft fulfilling lead responsibilities must clear for the formation while the wingman maintains deconfliction within the formation. On a four-ship formation, lead directs either Number 2 or 4 to check the rest of the flight with a radio call. Numbers 3 and 4 or 2 and 3 maintain position while Number 4 checks each side of the formation and returns to the original position. When Number 4 is back in position, lead directs Number 2 to check Number 4.

8.6. Training Rules. AFI 11-214, *Air Operations Rules and Procedures,* defines training rules. This paragraph provides training rules applicable to T-6 formation flight.

8.6.1. **G-Awareness Exercise.** Aircrew will perform a G-awareness exercise as described in paragraph **5.13.3.** before flying any maneuver that may result in greater than 3 Gs. The exercise will be briefed and will emphasize wingman and flight lead deconfliction procedures while maintaining spatial and situational awareness throughout the maneuver. Aircrews must have sufficient visual cues to perform this maneuver. Flight leads should consider sun angle prior to the maneuver and anticipate possible loss of sight due to the sun. If poor weather conditions prevent safe accomplishment of the G-awareness exercise, flight lead will modify the flight mission profile and limit maneuvering accordingly.

8.6.2. **"Knock-It-Off" and "Terminate" Procedures:**

8.6.2.1. AFI 11-214 defines the use of "knock-it-off" and "terminate" calls to direct aircraft to cease tactical maneuvering. In the T-6, these calls will be used throughout formation maneuvering, and any formation member can make these calls. "Knock-it-off" will be used when safety of flight is a factor or when doubt or confusion exists. If danger is imminent, be directive when making the "knock-it-off" call.

8.6.2.2. Aircraft with radio failure will signal "knock-it-off" with a continuous wing rock. Another aircraft observing a continuous wing rock will transmit "knock-it-off" and provide required assistance. This radio call applies to all phases of flight and all types of formation maneuvers, and all formation members must acknowledge this call in turn; for example, "Texan, knock-it-off." Regardless of who made the "knock-it-off" call, lead will acknowledge with the call, "Texan 1, knock-it-off," followed by the wingman's call, "Texan 2, knock-it-off." The wingman should then await directions from lead.

8.6.2.3. When hearing a "knock-it-off" call, lead will continue the current maneuver with the current power setting until directing a rejoin. This will ensure he or she remains predictable and will aid in flightpath deconfliction, especially if any aircraft in the formation loses sight of the other aircraft. Ensuring flightpath deconfliction should be the primary concern for all aircraft. If any aircraft loses sight, the aircraft losing sight should make the appropriate "blind" radio call and all aircraft should follow lost sight procedures (paragraph **8.6.5.**). Upon hearing a "knock-it-off" call or observing a continuous wing rock, all participating aircraft will:

8.6.2.3.1. Clear the flightpath.

8.6.2.3.2. Cease maneuvering.

8.6.2.3.3. Acknowledge with a call sign or wing rock.

8.6.2.3.4. Obtain verbal clearance before resuming maneuvers.

8.6.2.4. "Knock-it-off" will be transmitted when any of the following situations occur:

8.6.2.4.1. The maneuver or exercise, if continued, would cause the formation to go out of the authorized area.

8.6.2.4.2. An unbriefed or unscheduled flight enters the working area and is detrimental to the safe conduct of the mission.

8.6.2.4.3. The minimum altitude or cloud clearance is approached (unless in a nonmaneuvering fingertip formation).

8.6.2.4.4. Situational awareness is lost.

8.6.2.4.5. A radio failure is recognized.

8.6.2.4.6. An aircraft is observed continually rocking its wings.

8.6.2.4.7. A member calls "knock-it-off."

8.6.2.4.8. A dangerous situation is developing.

8.6.2.4.9. Bingo fuel is inadvertently overflown and the state of the fuel requires traffic priority or direct routing to primary or alternate recovery base.

8.6.2.4.10. An over-G occurs.

8.6.2.5. "Terminate" actions are as follows:

8.6.2.5.1. The "terminate" call will be used to direct a specific aircraft or flight to cease maneuvering and proceed as briefed or directed. The term "terminate" will be used when safety of flight is not a factor. When the wingman has met the desired learning objectives, is outside the desired formation parameters (desired learning objectives are not achievable), is

visual with lead, and desires to resume maneuvering when attaining proper position, he or she will request "(*call sign*), terminate." Lead will acknowledge and, if desiring to continue the maneuver, smoothly transition to a shallow turn or level flight until the wingman has attained the desired formation parameters and transmitted, "(*call sign*), 2's in." At this point, lead may continue the present maneuver or direct the formation, as desired.

8.6.2.5.2. When hearing a "terminate" call, participating aircraft will cease maneuvering, clear the flightpath, acknowledge with their call sign, and proceed as briefed or directed. Termination calls will be acknowledged in the same manner as a "knock-it-off" call; for example, "Texan terminate," "Texan 1 terminate," or "Texan 2 terminate."

8.6.3. **The "Bubble."** Aircraft flying the extended trail exercise inside 500 feet will call "terminate" and maneuver aft of 500 feet. Aircraft flying inside the 300-foot "bubble" or forward of the 3/9 line during the extended trail exercise will call "knock-it-off" as described in paragraph **8.6.2.**

8.6.4. **Formation Breakout:**

8.6.4.1. The purpose of a breakout is to ensure immediate separation and avoid a midair collision. The wingman must break out of formation when (1) directed, (2) visual contact with lead is lost, causing a loss of situational awareness, (3) unable to rejoin to or remain in formation without crossing under or in front of lead, or (4) any time his or her presence constitutes a hazard to the formation. During a breakout, it is possible for crewmembers to lose sight. Both lead and the wingman must remain vigilant to ensure deconfliction and maintenance of situational awareness. ***NOTE:*** A breakout **does not** always require an abrupt, high-G turn away from lead. Some breakout situations may require minimal or no change to the flightpath to ensure safe separation.

8.6.4.2. If the wingman has initiated the breakout, it is his or her responsibility to maintain safe separation until the breakout is acknowledged by lead, who will confirm visual contact on the wingman or establish altitude separation. If lead directs the breakout, he or she is responsible for safe separation and deconfliction until the wingman acknowledges or regains visual contact or achieves altitude separation.

8.6.4.3. It is the wingman's responsibility to call "blind" if, during the formation breakout, he or she loses visual contact and/or situational awareness on lead. It is lead's responsibility to talk the wingman's eyes back onto lead after hearing the wingman's "blind" call. The following radio calls will be made, as appropriate:

8.6.4.3.1. When the wingman initiates breakout, he or she will call "Texan 2 is breaking out."

8.6.4.3.2. When the wingman loses visual contact and/or situational awareness on lead, he or she will call "Texan 2 is blind, 17,000 feet."

8.6.4.3.3. If lead has the wingman in sight, he or she will call "Texan 2, roll out . . . visual is at your right four o'clock for 3,000 feet, slightly high."

8.6.4.3.4. The wingman will answer "Texan 2 visual."

8.6.4.3.5. Lead will then call " Texan 2, cleared to rejoin left/right side."

8.6.4.4. If lead is <u>also</u> blind, he or she will take immediate action to ensure altitude deconfliction, as follows:

8.6.4.4.1. When the wingman loses visual contact and/or situational awareness on lead, he or she will call "Texan 2 is blind, 17,000 feet."

8.6.4.4.2. Lead will then call "Texan 1 is blind, 15,000 feet."

8.6.4.4.3. From this point, lead will be directive with the wingman while attempting to reform the element:

8.6.4.5. When breaking out, the wingman will clear in the direction of the break. He or she will maneuver away from lead's last known position (or in the direction that ensures immediate separation), using power as required to maintain safe maneuvering airspeed and/or speed brakes to expedite separation. When able, the wingman will inform lead that he or she has broken out ("Texan 2 is breaking out"). Lead will continue to fly predictably and, if the wingman is in sight, maneuver to maintain sight and deconflict flightpaths. Once safe separation is assured, the wingman may roll out to attempt to regain visual contact. ***NOTE:*** To prevent disorientation, the wingman must use caution when passing under lead or viewing lead through the top of the canopy.

8.6.4.6. If a wingman must break out of formation on final approach, he or she must remember that a rapid increase in back stick pressure can quickly result in a stall. Also, abrupt application of excessive rudder 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.

8.6.4.7. The wingman may encounter a hazardous situation in which an aggressive breakout is inappropriate. For example, if the aircraft drifts into a position dangerously close to lead, an aggressive breakout may possibly result in a collision. In this situation, the wingman should move away from lead, using smooth and positive control inputs as required.

8.6.4.8. Leaving formation is the same in a three- and four-ship formation as in a two-ship formation, with the following exceptions:

8.6.4.8.1. If Number 2 or 4 breaks out of fingertip formation, the remaining aircraft will maintain their original position on lead. If Number 3 leaves the formation, Number 4 will follow Number 3 at a safe distance to maintain element integrity.

8.6.4.8.2. When it is confirmed that an aircraft has left the formation, lead will direct the rejoin to the desired formation. An aircraft that has left formation will not rejoin until directed by lead.

8.6.4.9. Practice breakout procedures in VMC to prepare for actual situations you may encounter. The IP in either the lead or wing aircraft will initiate all practice breakouts. With the wingman in sight, lead will direct the practice breakout with the radio call, "Texan 2 break out." The wingman will execute the appropriate breakout maneuver and, after separation is established, make the radio call, "Texan 2 is breaking out." At this point, all maneuvering and radio calls are identical to an actual breakout. The maneuver priorities must be establishing and maintaining safe separation, followed by establishing appropriate communications, and lastly reforming the flight.

8.6.5. **Lost Sight Procedures:**

8.6.5.1. In some cases, losing sight of the other aircraft does not require a breakout or lost wingman procedure because sufficient spacing already exists; for example, following a pitchout. However, if the other aircraft is not in sight when anticipated, the wingman will notify the other aircraft of the situation and state the current altitude; for example, "Texan 2 is blind, 17,000 feet." If there

is no timely acknowledgement of the "blind" call, the wingman will maneuver away from the last known position of the other flight member or element and alter his or her altitude. In some cases, heading or turn information may also be appropriate for this call.

8.6.5.2. If lead maneuvers into the sun, the wingman may lose sight. Although visual contact is usually regained within a few seconds, a momentarily "blind" condition could pose a great hazard for midair collision. A "sun-blind" condition is an actual lost-sight case, and the proper procedures must be applied immediately to ensure proper separation is maintained.

8.6.5.3. When the wingman is flying the extended trail exercise and loses sight of lead, he or she will break out of the formation as described in paragraph **8.6.4.** and call "blind."

8.6.5.4. If the other aircrew has not lost sight, they will transmit that fact with a relative position to the "blind" aircraft; for example, "Texan 1, visual, right, 2 o'clock, high." If lead is the "blind" aircraft, but the wingman has lead in sight, lead has the option to direct a rejoin. In this case, the wingman will not rejoin closer than a route position until lead has called "visual." If the wingman is "blind," lead has him or her in sight, and the situation requires immediate aircraft separation, lead will maneuver to ensure separation between the two aircraft.

8.6.5.5. Lead will direct a rejoin only after the wingman has reached a position from which a safe rejoin is possible. The wingman should maintain a minimum of 1,000 feet of separation until directed to rejoin. As the wingman, if an excessive closure rate is apparent, break out or overshoot as appropriate to stay away from lead's flightpath.

8.6.5.6. If both aircraft have lost sight of each other, lead will immediately ensure a minimum of 1,000 feet of altitude separation. If visual contact is still not regained, lead will take positive action to ensure flightpath deconfliction within the flight to include a "terminate" or "knock-it-off" radio call if necessary. Both aircrews will maintain this separation until making visual contact and initiating a rejoin or receiving clearance to recover separately.

8.6.6. **Lost Wingman Procedures.** Lost wingman procedures may not guarantee obstacle clearance. It is the responsibility of all the pilots in the formation to be aware of terrain and obstacles along their flightpath. Good judgment must be used when executing lost wingman procedures.

8.6.6.1. **Lost Wingman Actions:**

8.6.6.1.1. During actual weather conditions, the wingman may lose sight of the lead aircraft. The action taken depends on the phase of flight. The wingman should review pertinent procedures at each briefing where weather or other restrictions to visibility are known or anticipated for the flight.

8.6.6.1.2. In any lost wingman situation, immediate separation of aircraft is essential. On losing sight of lead or if unable to maintain position due to disorientation, the wingman will simultaneously execute the applicable lost wingman procedure while transitioning to instruments. Smooth application of control inputs is imperative to minimize the effects of spatial disorientation.

8.6.6.1.3. Additionally, the wingman will notify lead, who will coordinate with the controlling agency and request a separate clearance for the wingman. If required, the controlling agency can aid in ensuring positive separation.

8.6.6.1.4. Lead should immediately perform the appropriate procedure, acknowledge the lost wingman's radio call, and transmit lead's aircraft attitude, which will be acknowledged by the wingman. Lead should transmit other parameters such as heading, altitude, and airspeed as necessary to aid in maintaining safe separation.

8.6.6.2. **Lost Wingman (Two- or Three-Ship):**

8.6.6.2.1. **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 lead, resume course, and obtain a separate clearance.

8.6.6.2.2. **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 lead. 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 lead to roll out of the turn. Maintain angle of bank to ensure lateral separation; then obtain a separate clearance. Lead may resume turn only when separation is ensured. If in a three-ship flight with both aircraft on the same side of lead, refer to four-ship lost wingman procedures (paragraph **8.6.6.3.**).

8.6.6.2.3. **Precision and Nonprecision 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.

8.6.6.2.4. **Missed Approach.** The lost wingman will momentarily turn away to ensure clearance, inform lead, 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.

8.6.6.3. **Lost Wingman (Four-Ship).** Numbers 2 and 3 will follow the procedures described in paragraph **8.6.6.2.** However, because it is impossible for Number 4 to immediately determine that Number 3 still has visual contact with lead, Number 4's initial action must be based on the assumption that Number 3 has also become separated. If Number 4 loses sight of Number 3, Number 4 will proceed as follows:

8.6.6.3.1. **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.

8.6.6.3.2. **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 situational awareness 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.

8.7. Practice Lost Wingman Procedures. Lost wingman procedures will be practiced in VMC to prepare for actual situations encountered. Lead will direct practice of lost wingman procedures with the radio call, "Texan, go practice lost wingman." At this time, the wingman will execute the appropriate lost wing-

man procedures and acknowledge, "Texan 2 is practice lost wingman." The IP will monitor the lead aircraft to ensure adequate separation is maintained. After appropriate lost wingman procedures have been executed, the wingman has confirmed "visual" on lead, and permission for rejoin has been granted, lead will specify the type and direction of rejoin.

8.8. Formation IMC Procedures:

8.8.1. **Spatial Disorientation in Formation.** As lead of a formation, if you suspect your wingman is becoming spatially disoriented, transmit your current flight parameters. This may reduce or eliminate the sensations of spatial disorientation. As the wingman, you must remain aware of flight conditions to the maximum extent practical. If you become spatially disoriented, inform lead and request flight parameters if necessary. Lead will minimize maneuvering, transmit flight information and, if in IMC, attempt to acquire VMC. If disorientation persists, lead should attain straight-and-level flight, if possible, and consider passing the lead to the wingman if conditions will allow lead to maintain orientation and situational awareness while on the wing. If conditions do not allow this, the wingman should make every effort to maintain formation position. If unable to maintain formation position, the wingman will immediately transition to instruments while executing lost wingman procedures and notifying lead.

8.8.2. **Aircraft Strobe Lights.** At times, lead's strobe lights may become distracting, which could lead to spatial disorientation. The wingman will advise lead when this happens, and lead will turn the strobe lights off.

8.8.3. **Icing.** If the wingman is experiencing icing, he or she will notify lead. Lead will climb or descend to avoid cruising in icing conditions.

8.9. Airborne Formation Aborts. The primary reason for formation flying is mutual support. This also applies to noncombat hazards. If either member of the formation must return to the airfield prematurely, the other aircraft should normally return also and provide any assistance required. (The IP may make exceptions to this if the difficulty is routine and the field is in sight or if the weather conditions would complicate a safe formation return.)

8.10. Emergency Procedures:

8.10.1. Mutual support can be a great advantage in emergency situations. Emergency aircraft should use other aircraft in the formation to aide in a safe recovery. Safe separation of aircraft in formation is critical to safety. Caution should be used so application of appropriate checklists or recovery is not unnecessarily delayed in an attempt to maintain formation position.

8.10.2. In general, the lead should be offered to the aircraft with a malfunction. This will allow the affected aircraft to handle the emergency without the requirement to maintain position. The lead 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.

8.10.3. After a midair collision, lead will coordinate separate clearances and chase ships.

8.10.4. If diversion is necessary with a NORDO aircraft on the wing, lead will show the pink pages in the IFG followed by the number of the diversion base. The wingman will repeat the number to acknowledge.

8.10.5. In VMC, without engine problems, the emergency aircraft will generally lead back to a straight in. In IMC, the emergency aircraft will generally lead back to an instrument approach unless it is unable to navigate. With engine problems, the emergency aircraft will lead back to an ELP. If weather or field conditions at the intended recovery runway are unknown, the "good" aircraft may be sent ahead as a "scout" to observe the airfield and report to the emergency aircraft.

8.10.6. During a physiological incident, the "bad" aircraft will typically lead back. The unaffected wingman will use caution and good judgment, especially if penetration of IMC is required.

8.10.7. If ejection is required, the wingman will act as the onsite commander (rescue combat air patrol [RESCAP] commander) until relieved. As a guide, the wingman will:

8.10.7.1. Monitor the ejection from a high offset position and set and check his or her bingo fuel.

8.10.7.2. Not descend below the last observed altitude of the parachutes if not visual.

8.10.7.3. Notify the controlling agency and inform them that he or she is the onsite commander.

8.10.7.4. Make contact with the downed pilots on 243.0 and then switch to 282.8.

8.10.7.5. Start coordination for search and rescue (SAR) support with other wing aircraft (especially T-6 and T-1 due to long loiter times).

8.10.7.6. Mark aircrew position with radial or DME, ground reference, GPS coordinates, or ident. Notify the supervisor of flying (SOF) about ejection location, number of parachutes, and loiter time.

8.10.7.7. Use SOF and ATC to restrict air traffic in the area.

8.10.7.8. Direct rescue crews onto the scene.

8.10.7.9. Return to base when relieved or when bingo fuel. Pass applicable information to the new RESCAP commander.

8.10.8. If either aircraft in the formation encounters a bird strike, aircrews must maintain separation between aircraft. If both aircraft are affected, lead will arrange for separate chase ships.

Section 8B—Two-Ship Formation

8.11. Engine Start, Taxi, and Takeoff:

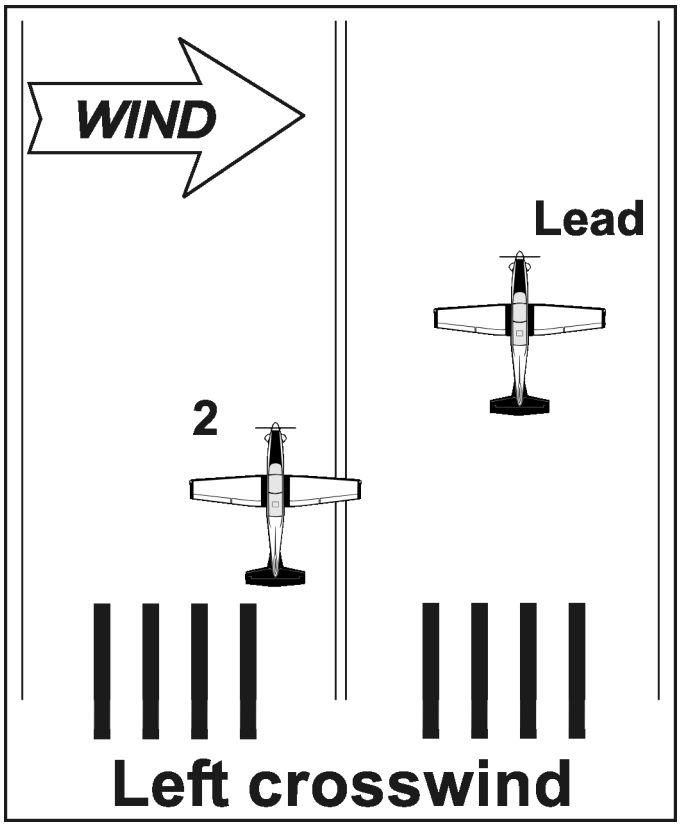
8.11.1. If aircraft are parked together, the formation will start engines on a visual signal. If aircraft are parked separately, a prebriefed starting time will be used. Lead will be informed of any difficulties that may delay departure.

8.11.2. After engine start, lead will check the flight in on UHF and VHF radios. Wingmen will acknowledge with their formation position. After all flight members "sweep" the automated terminal information service (ATIS) and the flight checks in, lead will call for taxi clearance. The wingman will respond with "2" to signify he or she understands the clearance. If another aircrew attempts to taxi between members of the formation, lead will ask that aircrew to hold. The formation should have the right of way. The wingman should turn NACWS off prior to takeoff.

8.11.3. Lead will take the center of his or her half of the runway and taxi a sufficient distance down to allow the wingman room to maneuver into position. The wingman will line up on the fingertip line with a minimum of 20 feet of lateral wingtip clearance (**Figure 8.1.**). Lead will consider such factors

as wind, weather, and direction of the turn out of traffic when determining the proper side to place the wingman. Lead will place the wingman on the upwind side for takeoff when the crosswind component exceeds 5 knots to keep the wingman from entering lead's wake turbulence in the event the wingman falls behind.

Figure 8.1. Runway Lineup.



8.11.4. For takeoff in the wing position, lead will look at the wingman and give the runup signal. The wingman will acknowledge with a head nod, smoothly increase the PCL to approximately 30 percent torque, check the engine, and nod to lead when ready for takeoff.

8.11.5. Lead will signal for brake release with a downward motion of the head. Both aircraft will then smoothly add power, with lead targeting 85 to 95 percent torque as briefed (unless MAX torque is a factor) to give the wingman a power advantage. Power will be used, as necessary, to maintain position on the takeoff roll. If unable to maintain fore or aft position with normal power settings, the wingman will select MAX power and perform an individual takeoff. Lead will be directive to reform the formation. The wingman will use peripheral vision to help detect any lateral movement on the runway. He or she will match lead's pitch attitude and stack level until the gear and flaps are raised.

8.11.6. When the formation is safely airborne with a minimum of 110 KIAS, lead will retract both the gear and flaps. The wingman will raise the gear and flaps when seeing lead's gear begin to retract and the wingman is sure he or she will remain airborne. If overrunning lead, the wingman may delay retracting the gear. The wingman will never raise his or her gear before lead. The wingman will perform the after takeoff check and assume the fingertip position (paragraph **8.14.1.**)

8.11.7. Lead will set a maximum of 95 percent power and maintain the takeoff attitude, allowing airspeed to increase. The first turn out of traffic will not be initiated until at least 140 KIAS and 400 feet AGL have been attained.

8.11.8. If lead aborts the takeoff after the brake release, he or she will make the call, "Texan, lead's aborting." The wingman will normally continue the takeoff. For this reason, the wingman must maintain proper wingtip clearance when lining up on the runway and throughout the takeoff. If lead determines it is necessary for both aircraft to abort the takeoff, he or she will make the call, "Texan, abort, abort, abort." During an aborted takeoff, aircrews must maintain lateral control of their aircraft; follow proper abort procedures; and, if time permits, call on the radio with intentions.

8.11.9. It may become difficult for the wingman to determine that lead is experiencing a problem (loss of power, etc.) that would require an abort or emergency landing. If the wingman overruns lead, the wingman will select MAX power and make a separate takeoff, maintaining his or her side of the runway and following lead's direction.

8.11.10. If the wingman drops behind on takeoff, he or she may not have sufficient airspeed to rotate with lead. In this case, the wingman will cross-check engine instruments and airspeed indicator and make his or her own abort decision or a separate takeoff. He or she will rejoin on lead after becoming safely airborne.

8.12. Interval Takeoff. If aircraft take off separately, they will use MAX power, 6-second spacing, and follow local procedures for this type of rejoin. They will use a turning rejoin, a straight-ahead rejoin, or, in some cases, a combination of both. After lead is airborne with a minimum of 140 KIAS, he or she will reduce power to accelerate to and maintain 160 KIAS. Initially, the wingman will use MAX power. The wingman must be alert for transitions from one type of rejoin to another as lead follows the departure route. If lead aborts an interval takeoff, the wingman should normally abort.

8.13. Instrument Trail Departure:

8.13.1. During trail departures in IMC, basic instrument flying is the first priority and it must not be sacrificed while performing secondary trail tasks. All aircraft will strictly adhere to the briefed climb speeds, power settings, altitudes, headings, and turn points. If task saturation occurs, the wingman will cease attempts to maintain trail, immediately concentrate on flying the instrument departure, and notify lead.

8.13.2. Takeoff spacing will be no less than 20 seconds.

8.13.3. Each aircraft or element will climb at MAX power at 160 KIAS and use 30 degrees of bank for all turns.

8.13.4. Until join-up or leveloff, each aircraft or element will call when passing even thousands of feet (2000, 4000, etc.) and when initiating heading changes. Acknowledgments are not required, but monitoring radio transmissions and the progress of the succeeding aircraft or elements is imperative. Aircrews will immediately correct any deviations from the departure route.

8.13.5. During the climb and through leveloff, each aircraft or element will maintain positional awareness using NAVAIDs and all available aircraft systems, including the clock, NACWS, and GPS.

8.13.6. Each aircraft or element will maintain at least 1,000 feet of vertical separation from the preceding aircraft or element except where departure instructions specifically prevent compliance. If the

wingman cannot comply with the minimum safe altitude, lead may reduce the vertical separation to 500 feet.

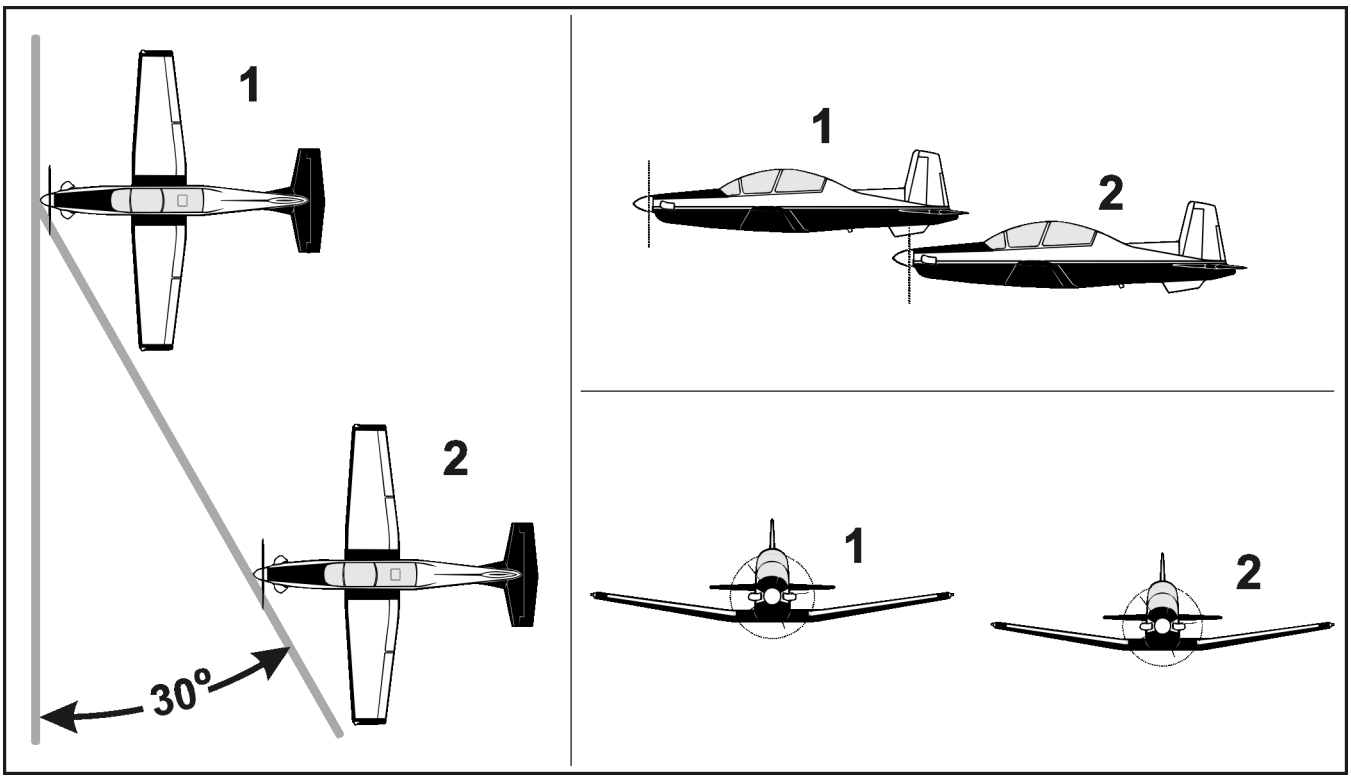
8.13.7. If a visual join-up cannot be accomplished by leveloff, lead will request 1,000 feet of altitude separation for each succeeding aircraft or element, if all aircraft can comply with the minimum safe altitude.

8.13.8. Wingmen will rejoin only after visually acquiring lead and receiving permission to rejoin.

8.14. Fingertip Formation. This type of formation flying will form a basis for all formation flying.

8.14.1. **Position.** The primary reference from the front cockpit to maintain proper longitudinal and vertical position is to center lead's aft wingtip light on the front edge of the engine exhaust stack opening and position lead's pitot tube aligned with the aft edge of the engine exhaust stack opening which is visible above the wing (**Figure 8.2.**). Wingmen have approximately 10 feet of wingtip spacing when the front seat pilot is looking down the forward edge of the horizontal stabilizer. Wingman should not stare at one reference, but look at the whole aircraft and clear through lead. Scanning from reference to reference will help detect small changes in position.

Figure 8.2. Fingertip References.



8.14.2. **Technique:**

8.14.2.1. Good formation is the result of recognition, anticipation, and application of small corrections. Make continuous, small, and controlled corrections to stay in position. Always keep the aircraft trimmed and coordinated. In turns, the wingman maintains the same relative position as in level flight with respect to lead (**Figure 8.3.** and **Figure 8.4.**). The wingman must increase back

pressure and climb to maintain vertical position when lead turns away. This requires an increase in power to maintain airspeed and position.

Figure 8.3. Turn-Into Position.

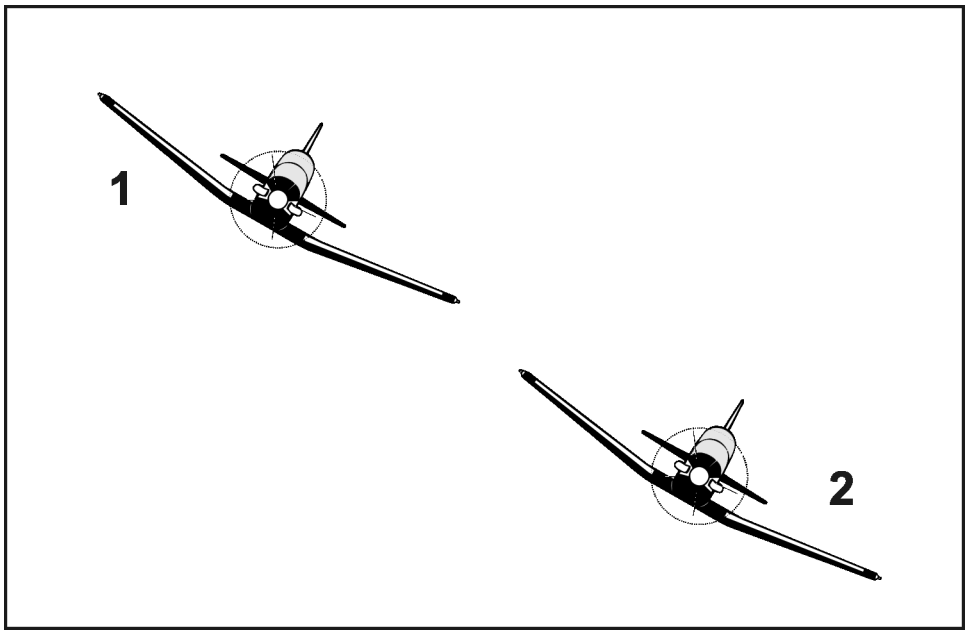
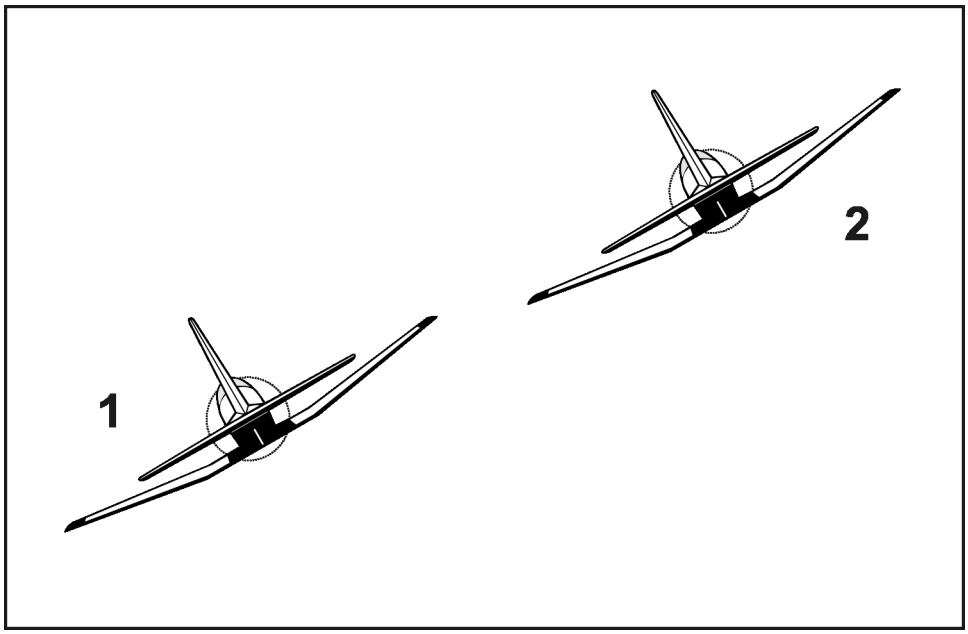


Figure 8.4. Turn-Away Position.

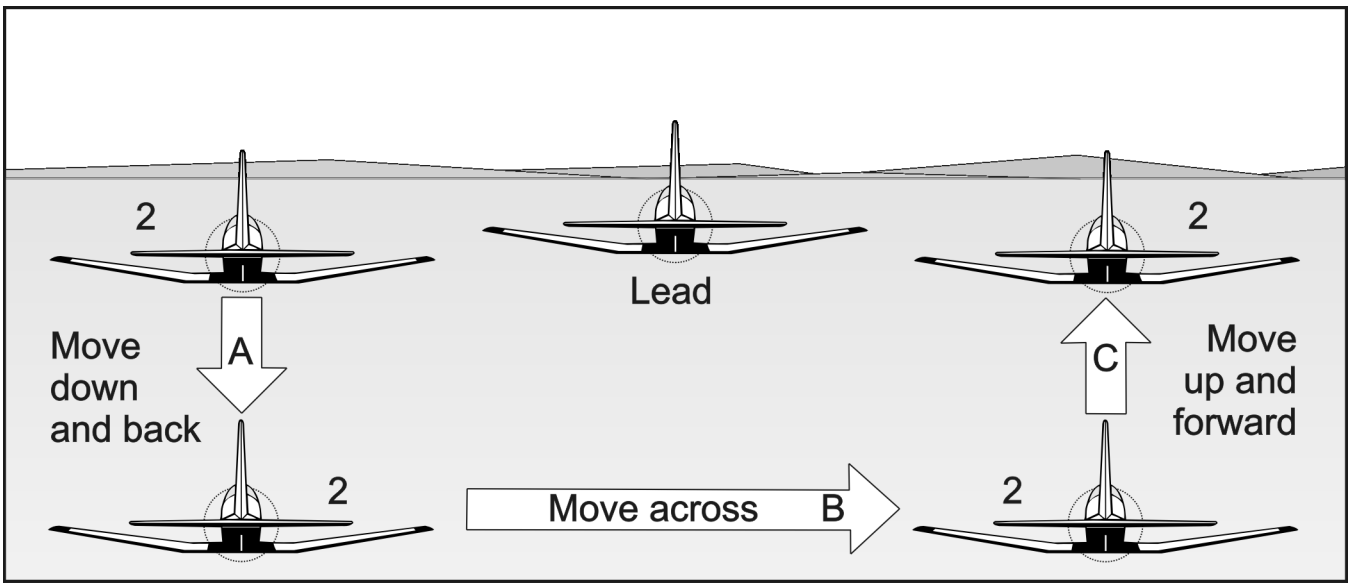


8.14.2.2. When lead stops the roll-in, as wingman, you have to take off some of the power you added because you are no longer climbing. When lead turns toward you, add slight forward pressure to maintain vertical position and reduce power. Be aware of collision potential at all times. The collision potential increases in turbulence or while flying maximum performance maneuvers or maneuvers that are not frequently flown (for example, pushovers at less than 1 G).

8.14.2.3. During pushover maneuvers, as wingman, your ability to counteract movement toward lead will be limited with near zero or negative Gs. For example, bank alone in 0 G conditions will not produce a heading change. Under these conditions, avoid wingtip vortices because a rapid roll into lead may develop. Should a breakout become necessary, use flight controls, power, and speed brake as the situation dictates. Break out in the direction that will most quickly ensure separation.

8.15. Crossunder. The purpose of performing a crossunder is to efficiently and safely move from one side to the other. A crossunder may be accomplished from either fingertip or route formation positions. The wingman will not pass under lead. Lead will signal for a crossunder with a rapid, shallow wing dip in the desired direction of change (**Figure 8.5.**). When accomplishing the crossunder from fingertip, the wingman will:

Figure 8.5. Crossunder.



8.15.1. Reduce power slightly and, as airspeed is reduced, move a few feet lower than normal position.

8.15.2. Move aft to obtain nose-tail clearance. Then increase power slightly to maintain this spacing.

8.15.3. Bank slightly toward the new position to change the aircraft heading a few degrees. Roll wings level and fly to the opposite side. A heading change of only 1 or 2 degrees will cause the aircraft to fly smoothly from one side of lead to the other. Keep proper nose-tail clearance with power; a power increase is necessary to maintain this clearance. With proper clearance from lead, the wingman's canopy bow should appear superimposed on the trailing edge of lead's elevator.

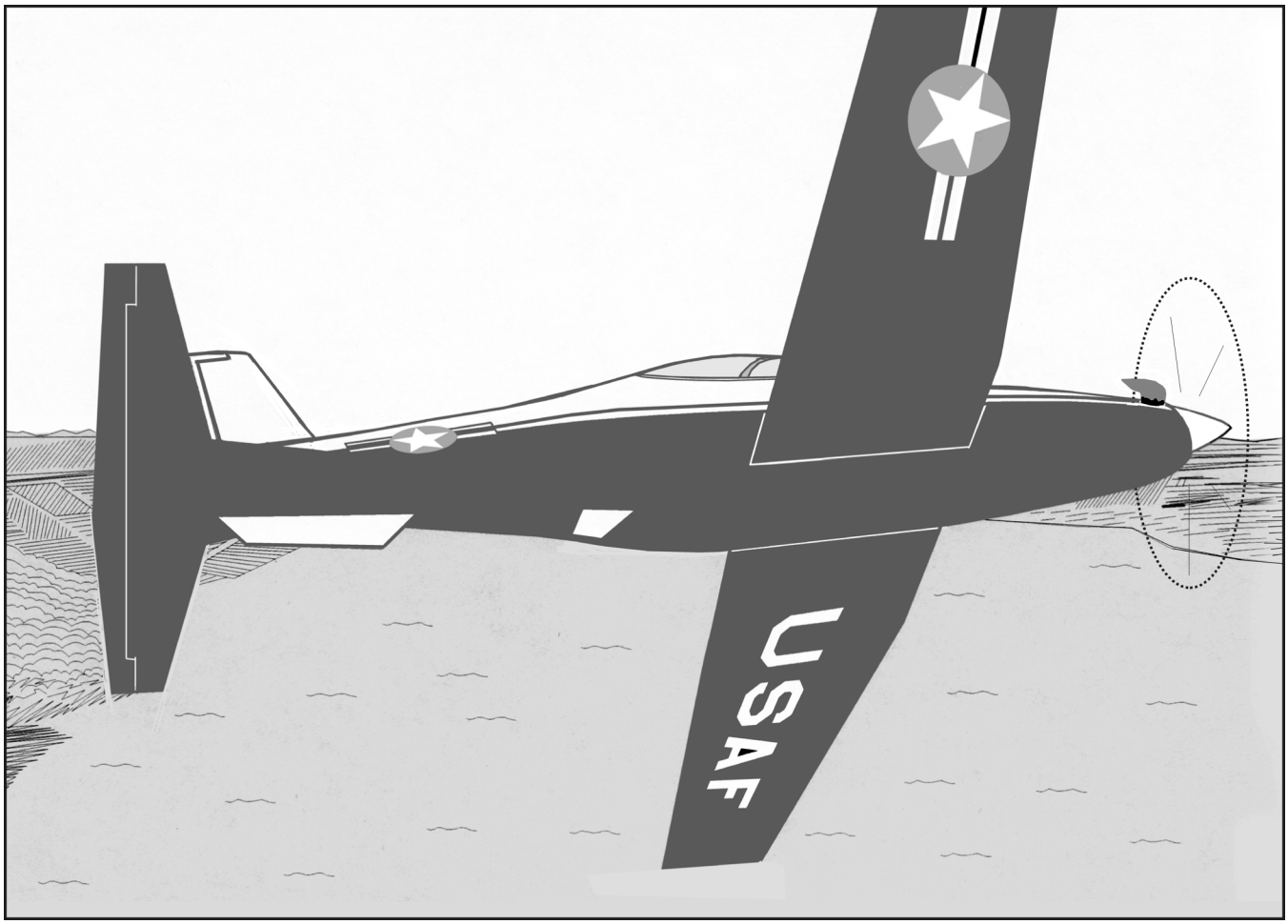
8.15.4. Return to lead's heading when the wingman has wingtip clearance. Add power and move forward and up to regain the fingertip position, reducing power to stabilize in position.

8.15.5. To fly good crossunders, anticipate each power change and make the smallest possible changes in pitch and bank. As the wingman's proficiency increases, crossunders may also be completed during turns.

8.16. Echelon:

8.16.1. Echelon (**Figure 8.6.**) is a variation of fingertip. Lead will direct the formation to enter echelon turns by radio call or visual signal. Echelon turns are always made away from the wingman. Lead should roll in smoothly and maintain back pressure commensurate with bank angle. Slight variations in bank angle to control undesired climbs and descents are smoother and easier for the wingman than variations in G-loading.

Figure 8.6. Echelon.



8.16.2. As the wingman, you should match lead's roll rate. For a level turn, position yourself so the horizon bisects lead's fuselage. Additionally, you should see most of lead's center canopy rail over the aft edge of the wing. Distance between aircraft (measured fuselage to fuselage) should be the same as before turn entry. If you are out of position, use power to make corrections fore and aft, back pressure to maintain horizontal spacing, and bank to make corrections up or down.

8.16.3. During rollout, lead should use a slow, smooth roll rate and gradually reduce back pressure. The wingman should match lead's roll rate and maintain relative position. The maximum angle of bank in echelon is approximately 60 degrees.

8.17. Route Formation:

8.17.1. Route formation provides flexibility to allow the wingman to check aircraft systems and personal equipment, clear, or simply relax. With the formation in route, lead should restrict maneuvering to moderate turns and pitch changes. Maximum bank angle in route is 60 degrees.

8.17.2. Route is an extension of fingertip flown with the lateral spacing of two ship widths to 500 feet. Aircrews should fly no farther aft than the normal fingertip line, no farther forward than line abreast, and vertically the same as fingertip. A good reference for a 30-degree line at 500 feet is to put lead's wingtip on his or her spinner. The wingman will go to route when lead directs or gives the loosen formation signal. Due to the effectiveness of the T-6 rudder, lead may brief, using an open hand with the palm outward and making an outward pushing motion as an alternate visual signal.

8.17.3. On the inside of the turn, the wingman will descend only as necessary to keep lead in sight and stay below lead's plane of motion. When on the outside of the turn, maintain the same vertical references used in echelon. During turns, you may need to maneuver behind the fingertip line to maintain spacing and keep sight of lead. Do not cross to the opposite side unless directed by lead. Route crossunders may be directed with a radio call or wing dip.

8.17.4. When lead directs a move to route formation from fingertip for radio channel changes, in-flight checks, or lead changes, wingmen will fly two to four ship width spacing unless briefed otherwise. During rejoins, wingmen will stabilize in a route position with two to four ship width spacing before closing to fingertip.

8.18. Pitchout. The purpose of the pitchout is to provide spacing for rejoin practice, as follows:

8.18.1. **Lead.** The pitchout signal is the same as the signal for engine runup. Clear in the direction of the desired turn and begin a turn away from the wingman, using approximately 60 degrees of bank. Continue the turn for approximately 180 degrees. Although a level pitchout is desired, you may make modifications to your energy level. Do not sacrifice clearing in order to maintain precise altitude control or an exact 180-degree turn.

8.18.2. **Wingman.** Begin a turn to duplicate lead's rate of roll, bank, and general flightpath. Typically, a 2- to 3-second delay will result in 1,000- to 1,500-foot spacing, and a 5-second delay will result in 3,000-foot spacing. After turning approximately 90 degrees, play the turn by varying bank and back pressure to roll out behind and slightly below lead. Lead may choose an alternate method for obtaining spacing for rejoins by directing the flight to take spacing. Acknowledge and drop back to obtain the appropriate spacing.

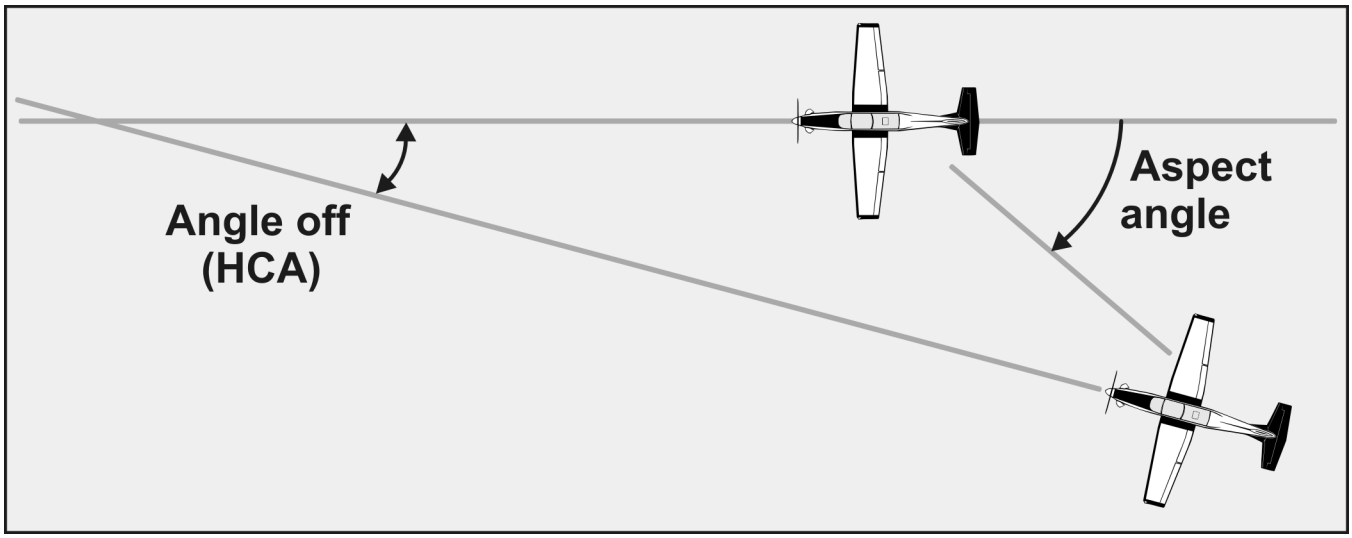
8.19. Maneuvering Fundamentals. Although not always apparent, two basic parameters apply to every situation where two or more aircraft maneuver three-dimensionally in relation to each other. These parameters are aspect angle and angle off (**Figure 8.7.**). As you read the remaining parts of this chapter and progress in the formation category of training, you will begin to see all the applications of these principles.

8.19.1. **Angle Off.** Angle off is the angular difference between the longitudinal axis of the wingman and the longitudinal axis of lead (also called the heading crossing angle [HCA]).

8.19.2. **Aspect Angle.** Aspect angle is the angle measured from the tail of lead to the position of the wingman. Aspect is expressed in degrees off lead in multiples of 10. For example, in lead's 6 o'clock,

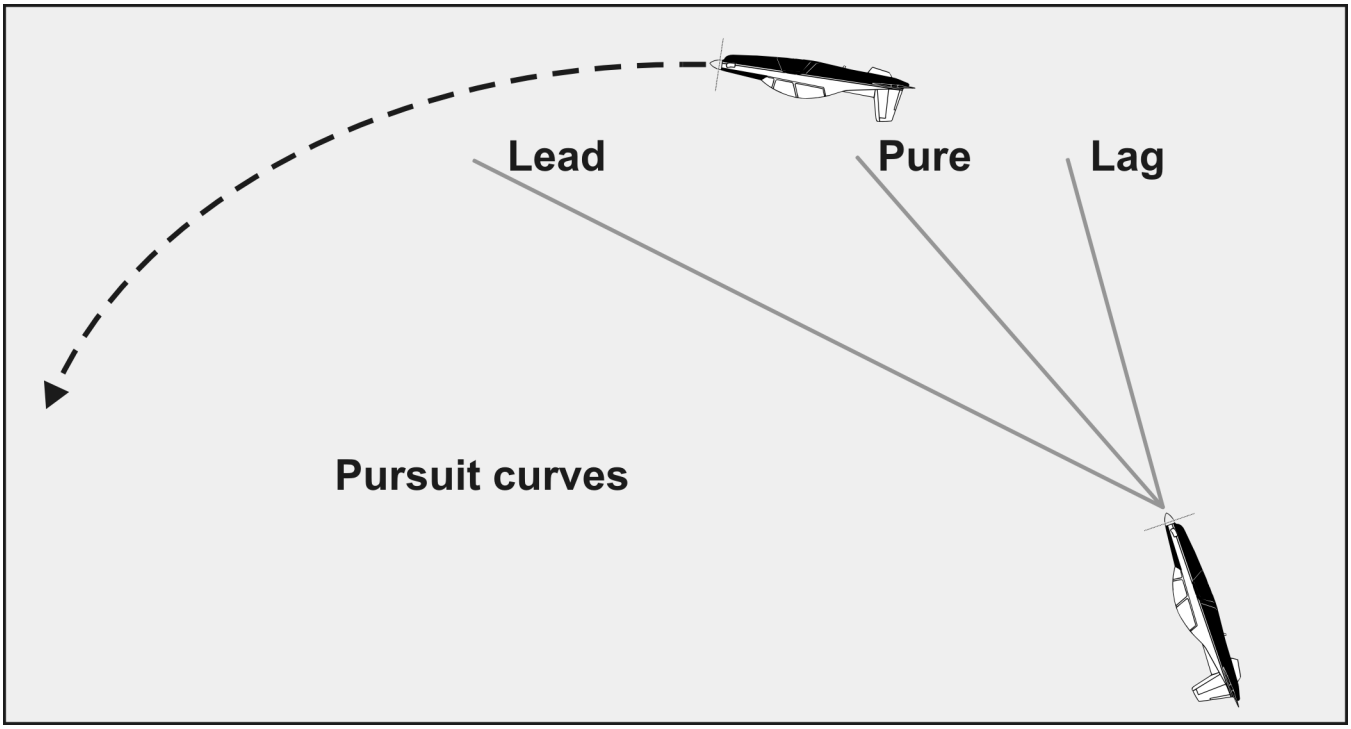
the aspect is zero, and at 40 degrees on either side, the aspect is 4. Aspect angle is not a clock position off of lead (**Figure 8.7.**).

Figure 8.7. Maneuvering Fundamentals (Aspect Angle Versus Angle Off).



8.19.3. **Pursuit Curves.** Lead, lag, and pure pursuit curves control aspect angle and angle off (**Figure 8.8.**). Although these air-to-air principles are complex in the ever-changing combat arena where very few absolute rules exist, these basic relationships apply in the controlled training environment as follows:

Figure 8.8. Pursuit Curves Relationship Chart.



8.19.3.1. **Lag Pursuit.** This is the path a wingman's aircraft will follow if it flies to an imaginary point behind lead (**Figure 8.8.**). Although there may still be some closure, angle off will increase and aspect angle will decrease. Lag pursuit results in a forward line of sight (LOS).

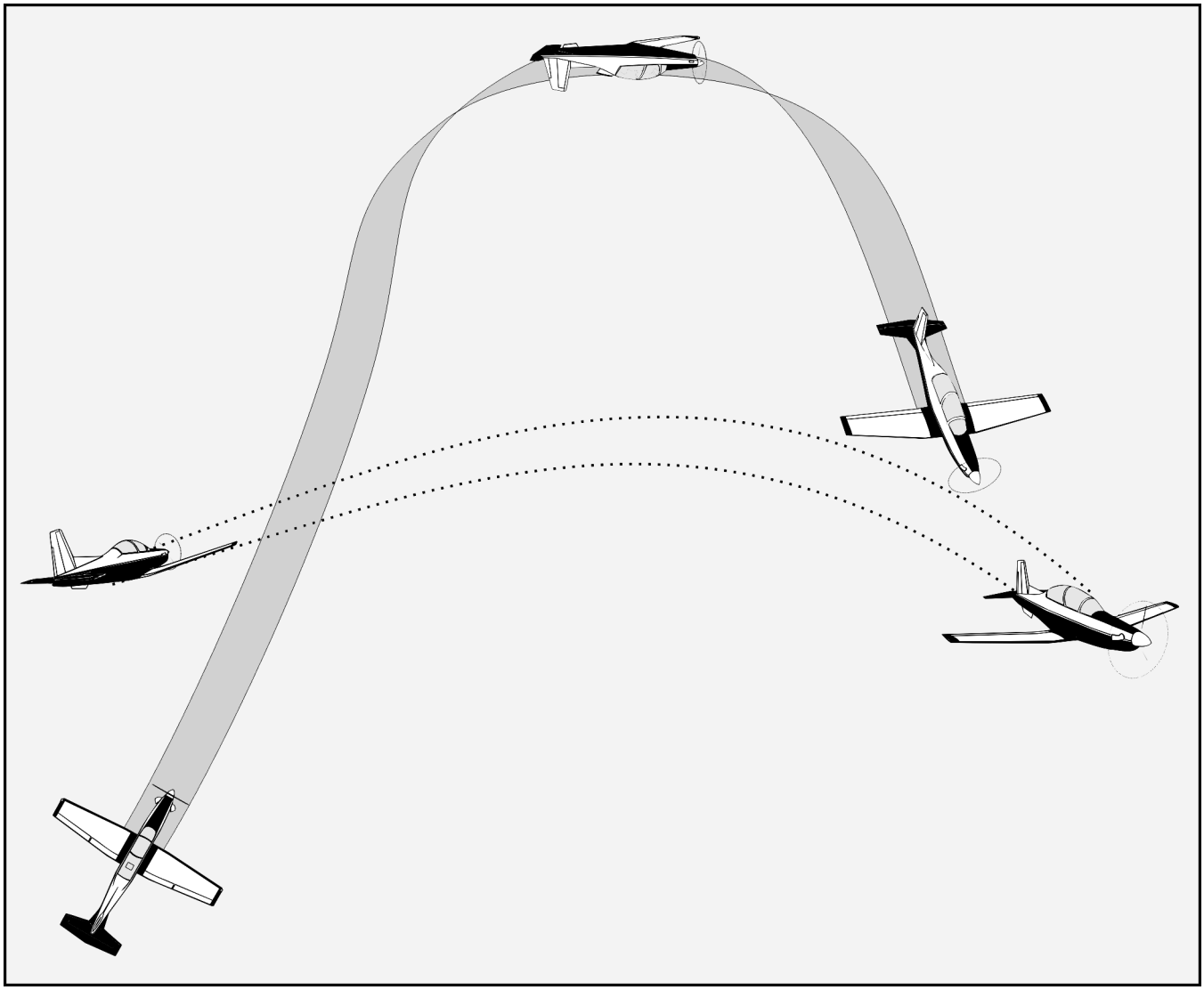
8.19.3.2. **Lead Pursuit.** This is the path a wingman's aircraft will follow if it flies to an imaginary point in front of lead (**Figure 8.8.**). Aspect angle and closure will increase; angle off will decrease. Lead pursuit results in aft LOS.

8.19.3.3. **Pure Pursuit.** This is the path a wingman's aircraft will follow if it flies to an imaginary point that will result in a collision with lead (**Figure 8.8.**). Pure pursuit creates less closure than lead pursuit. The geometry is stagnant with little or no change in aspect angle or angle off. Pure pursuit results in no LOS; lead will remain stationary in the canopy. In a turn, the wingman's aircraft will be pointed in front of lead. (Pointing the aircraft at lead is lag pursuit if turning.)

8.19.4. **Three/Nine (3/9) Line.** This is a hypothetical line extending out of the aircraft's lateral axis. The wingman must remain aft of lead aircraft's 3/9 line during maneuvering. This line equates to a 90-degree aspect angle (9 aspect) for a trailing aircraft.

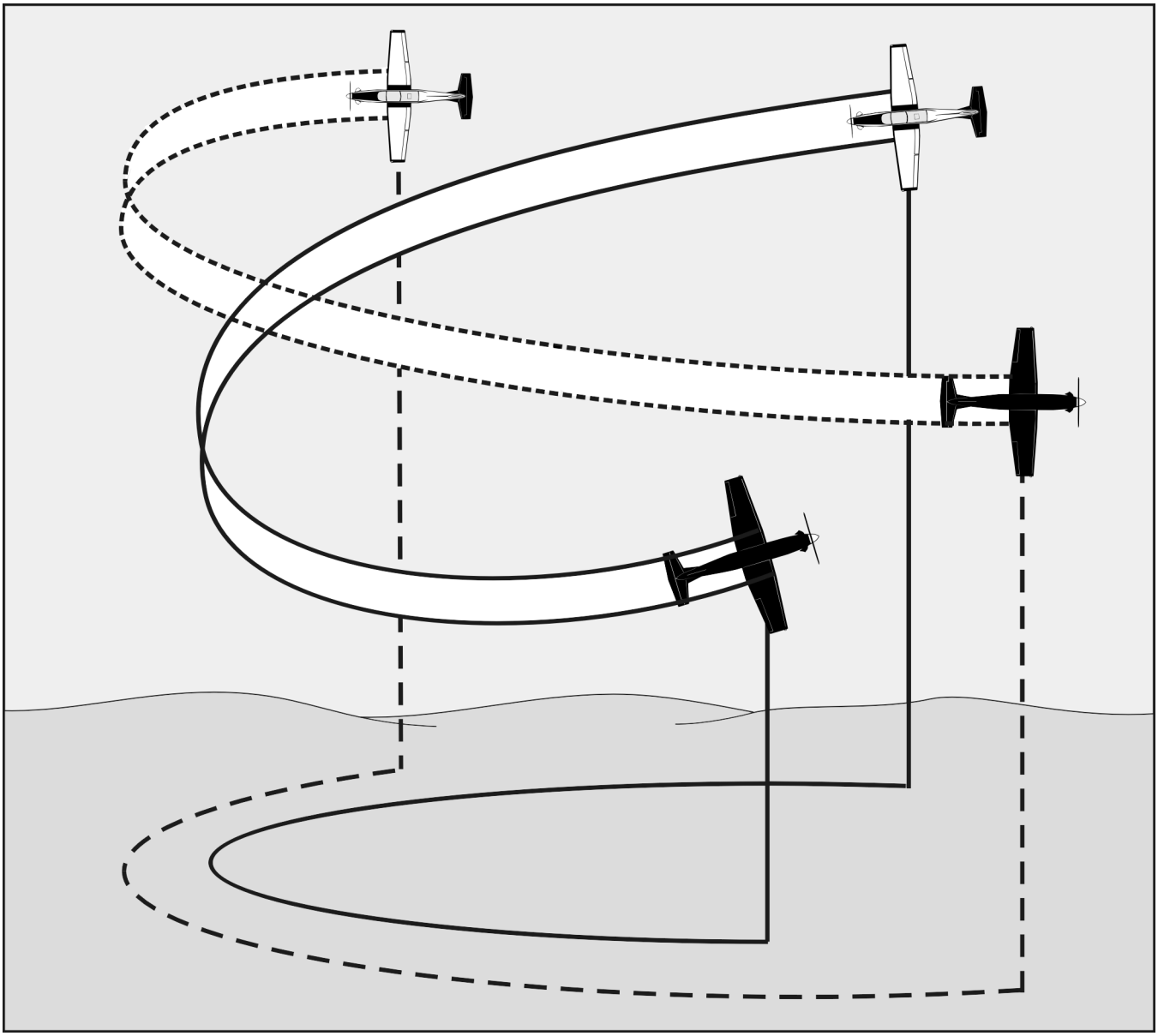
8.19.5. **High Yo-Yo.** This is a reposition of the wingman's aircraft, using a combination of pure or lag pursuit and a movement above lead's plane of motion to decrease closure, decrease aspect, and prevent a potential 3/9 line overshoot. It also allows for turning room in a vertical plane of motion above lead's plane of motion (**Figure 8.9.**).

Figure 8.9. High Yo-Yo.



8.19.6. **Low Yo-Yo.** This is a reposition of the wingman's aircraft, using a combination of lead pursuit and a movement below lead aircraft's plane of motion to increase closure. It will also increase the wingman's aspect angle (**Figure 8.10.**).

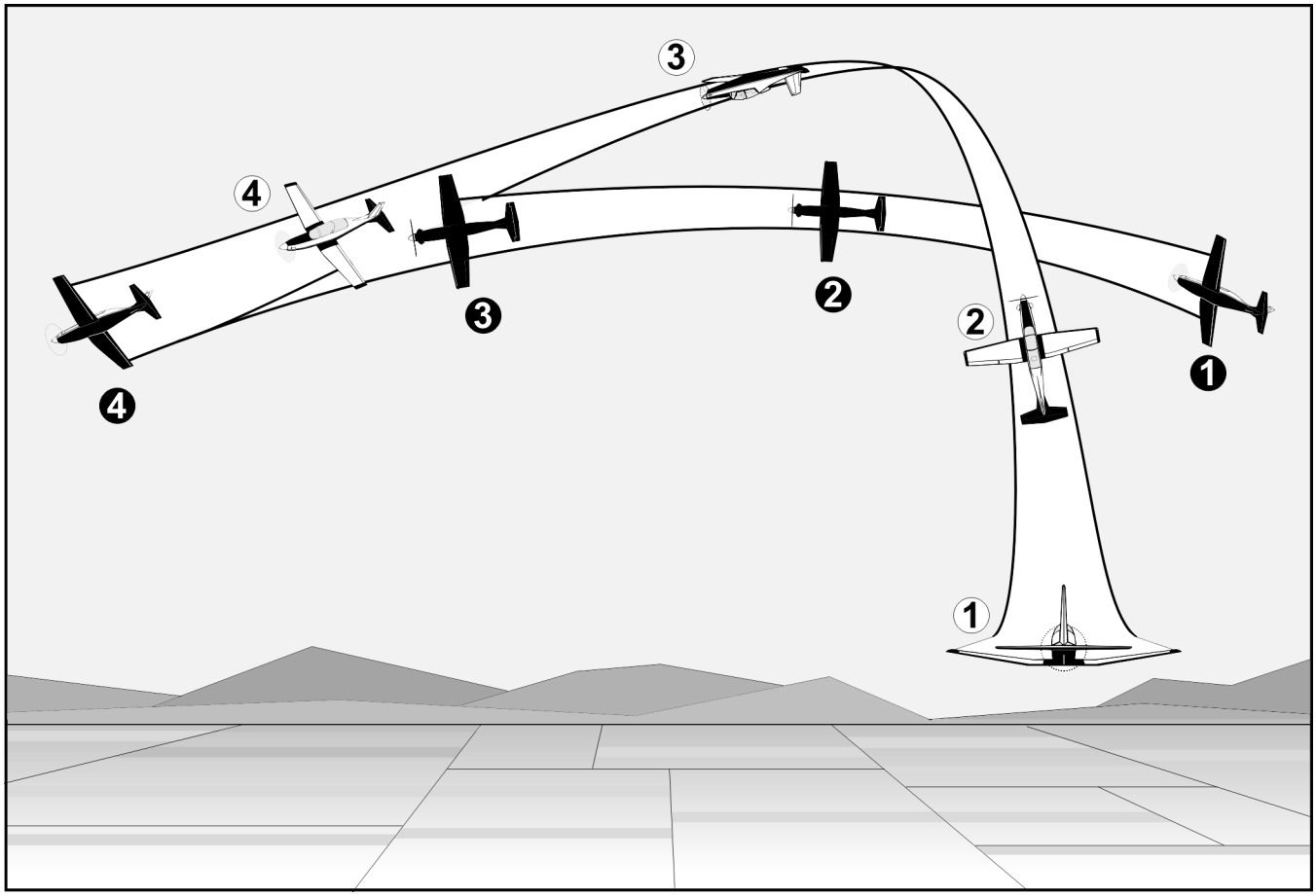
Figure 8.10. Low Yo-Yo.



8.19.7. **Plane of Motion.** This is the geometric plane described by the flightpath of an aircraft. At high G loading (above 4 Gs), the plane of motion is approximated by the lift vector.

8.19.8. **Quarter Plane.** This is an out-of-plane lag maneuver used to preserve the 3/9 line. This situation may be caused by a late decision (or no decision) to execute a high yo-yo or a failure to control closure. Indicators that a quarter plane is needed are similar to those of a high yo-yo. However, aspect, angle off, and closure are more severe and the range is usually much closer (**Figure 8.11.**).

Figure 8.11. Quarter Plane.



8.19.9. **Rate of Turn.** This is the rate of change of heading, normally measured in degrees per second.

8.19.10. **Turning Room.** This is the volume of airspace in the vertical, horizontal, or both which can be used to execute a maneuver for solving aspect, angle off, and closure when maneuvering in relation to another aircraft.

8.20. Turning Rejoins. Rejoins are used to get the aircraft safely into fingertip as expeditiously as possible. Rejoin airspeed is 180 KIAS unless otherwise briefed. The descriptions below describe a basic rejoin—a good starting point for working with and understanding pursuit options. Aspect and airspeed may be varied to account for different levels of proficiency and to adapt to different situations.

8.20.1. **Lead.** After rolling out of the pitchout, wait long enough for your wingman to roll out in trail. Signal for a rejoin by making a radio call or rocking your wings. Establish a turn, using approximately 30 degrees of bank, and adjust power and pitch as necessary to maintain rejoin airspeed. Announce the airspeed if is differs more than 10 knots from that briefed. Hold bank and pitch stable to assist the wingman. During rejoin, monitor the wingman and clear the area.

8.20.2. **Wingman:**

8.20.2.1. When lead gives the rejoin signal and enters a turn, start a turn in the same direction. Use approximately the same angle of bank as lead and generate angular closure with lead pursuit until

you approach the desired aspect angle. An airspeed increase will also generate closure to expedite the rejoin. Stay slightly beneath lead's altitude at all times, keeping lead in sight.

8.20.2.2. For a good starting point, generate approximately 20 knots airspeed advantage as you use lead pursuit to increase aspect. As you move inside lead's turn, you will notice his or her vertical stabilizer appears to move toward the outside wingtip as the aspect angle increases. When the vertical stabilizer approximately bisects the outside wing, reduce your angle of bank to establish pure pursuit and maintain this reference (no LOS).

8.20.2.3. If the vertical stabilizer appears to move toward the wingtip, your aspect angle is increasing. To correct this, shallow your bank to establish lag pursuit. If the vertical stabilizer appears to move toward the wing root, your aspect angle is decreasing. To correct this, increase your bank (lead pursuit). This reference will provide a reasonable aspect during the initial phase of the rejoin. As you get closer to lead, the tail on the wing reference will change and the vertical stabilizer will appear to move toward the outside wingtip.

8.20.2.4. The critical stage of the rejoin will begin when you are approximately 500 feet from lead and slightly behind the 30-degree line. From this position, you will begin to see the normal fingertip references. To move toward lead, move forward (increase aspect with lead pursuit) slightly onto an extension of the fingertip line. Begin decreasing the overtake airspeed with a power reduction and speed brake, as necessary. Monitor bank and overtake closely during the last few hundred feet before join-up to ensure your movement is controllable. Plan to arrive in the route position with airspeed nearly the same as lead. Stabilize in this position and then move into fingertip at a controlled rate.

8.20.2.5. To rejoin on the outside of the turn (Number 3 position), plan to pass behind (at least two ship lengths) and below lead. Stabilize in route position and then move into fingertip at a controlled rate.

8.21. Straight-Ahead Rejoins. Straight ahead rejoins are used to get the aircraft safely into fingertip when it is not possible for lead to maintain a turn. Rejoin airspeed is 180 KIAS unless otherwise briefed. The descriptions below describe a basic rejoin—a good starting point for balancing the desire for an expeditious rejoin with pilot abilities. Airspeed may be varied to account for different amounts of spacing and proficiency.

8.21.1. **Lead.** Direct the wingman to "take spacing" with a radio call or visual signal in lieu of a pitchout. The radio call is, "call sign, take spacing," and the visual signal is a horizontal, rearward motion with a closed fist with thumb extended (and pointing rearward). After spacing is achieved (approximately 500 to 1,000 feet), call or signal for a straight-ahead rejoin. Announce the airspeed if it differs more than 10 knots from that briefed. If a turn is required during the rejoin, inform the wingman and clear. Do not turn into the wingman if it would exceed his or her capabilities or prevent a safe rejoin.

8.21.2. **Wingman.** Increase airspeed to generate closure (initially use 20 to 30 knots). Establish yourself behind and slightly below lead. Your flightpath should angle away from lead to the route position. Rejoin to the left side unless directed otherwise. Continue to close until you are approximately 500 feet to the rear of lead. From this point, begin decreasing the overtake speed with a power reduction and plan to arrive in the route position with the same airspeed as lead. After stabilizing in the route position, move into the fingertip position. If lead must turn during a straight-ahead rejoin, transition to

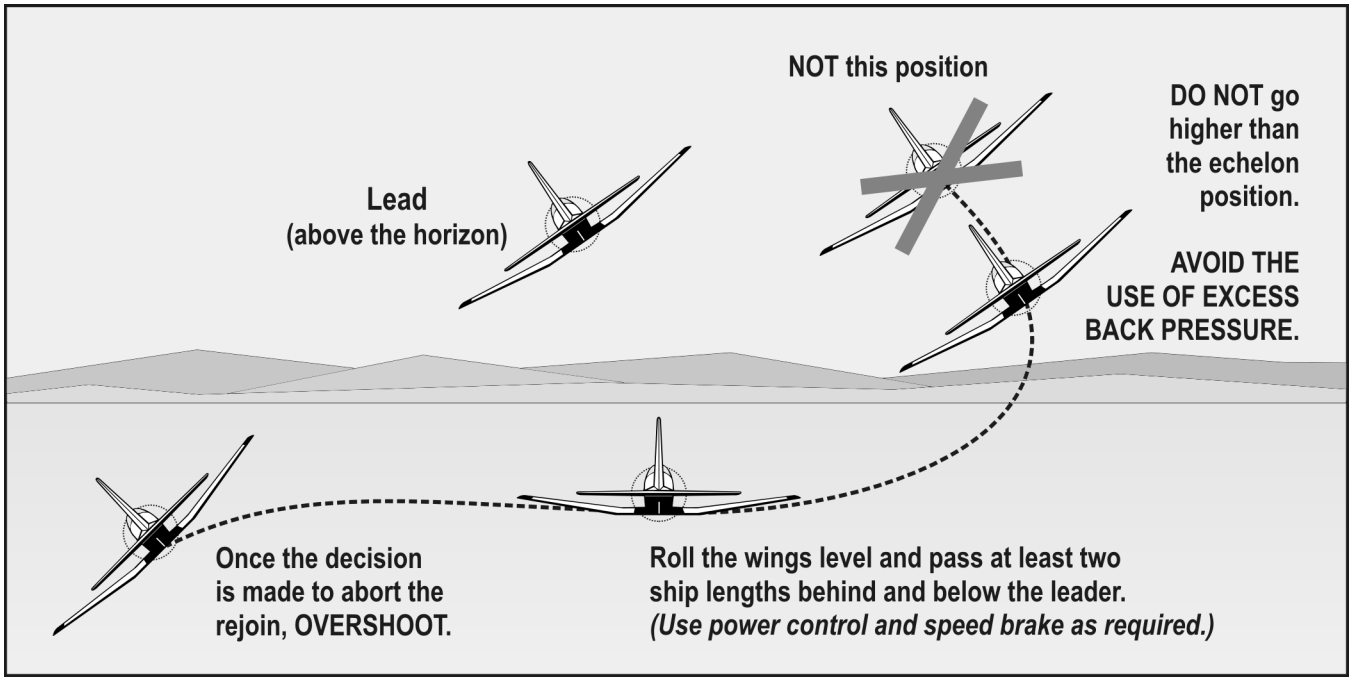
a turning rejoin and be alert for overshoot situations because you may have greater-than-desired airspeed and aspect.

8.22. Overshoot. An overshoot is required when excess closure makes it impossible for the wingman to stabilize in route and safely complete the rejoin.

8.22.1. **Turning Rejoin:**

8.22.1.1. If, despite reduced power and use of the speed brake, an overshoot is required, the wingman will stay low enough to keep lead in sight and use lag pursuit to move outside of the turn with at least two ship lengths of nose-tail clearance (**Figure 8.12.**). The greater the closure rate, the wider the wingman must go to prevent moving forward of lead's position.

Figure 8.12. Overshoot.



8.22.1.2. As the wingman, once outside the turn, do not move forward of lead's position. Avoid excessive back pressure because this will cause you to close on lead. Go no higher than lead. After momentarily stabilizing, return to the inside of the turn with a minimum of two ship lengths of nose-tail clearance on the lead aircraft and complete a normal join-up.

8.22.1.3. During an overshoot, lead should keep the wingman in sight if practical and must provide a stable platform for Number 2. However, if a collision appears imminent, lead must take positive action to prevent a midair collision.

8.22.2. **Straight-Ahead Rejoin:**

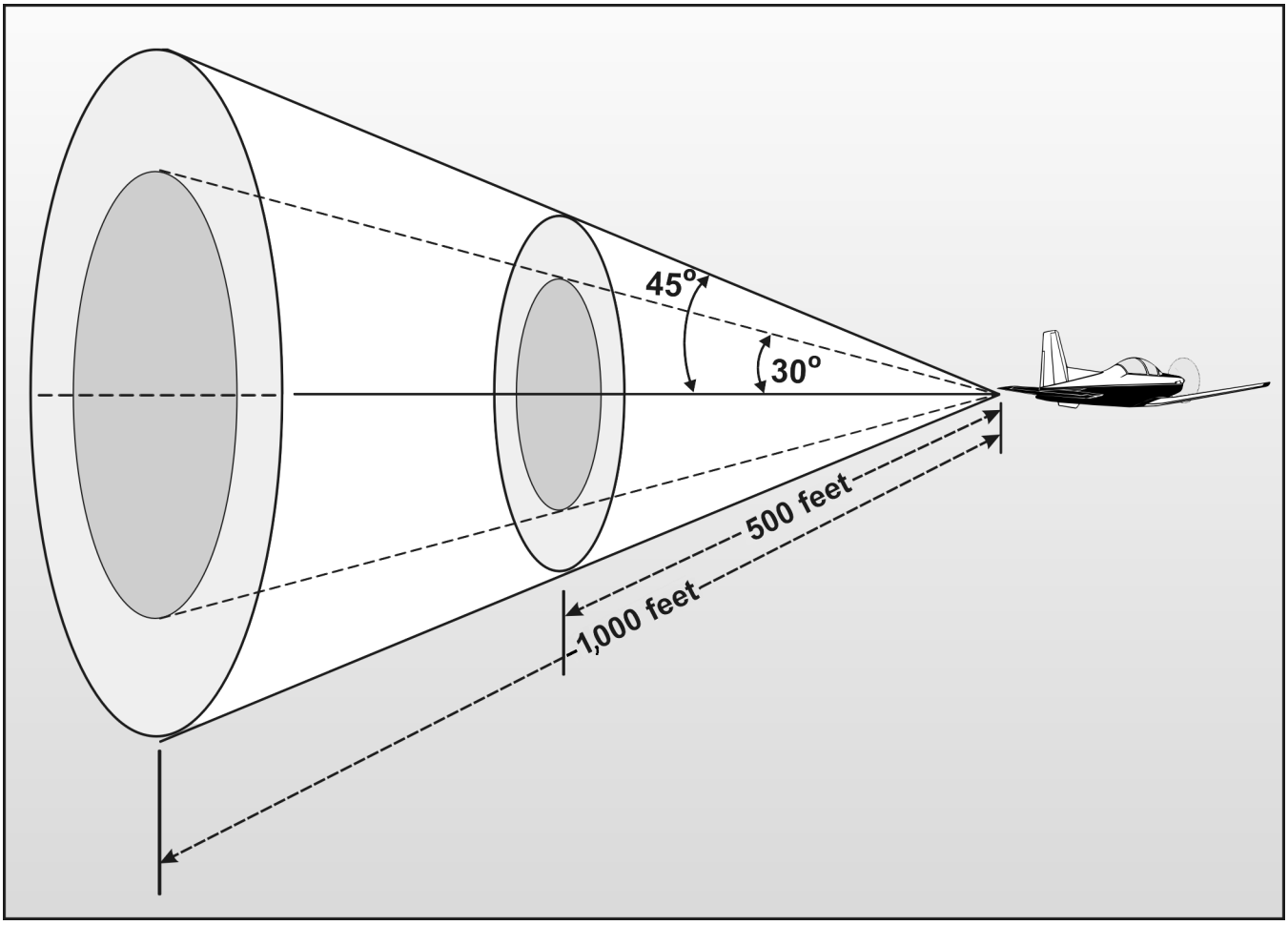
8.22.2.1. As the wingman, if your closure rate is excessive during the straight-ahead rejoin, reduce power and use the speed brake as required to establish a safe closure rate. If you are going to overshoot, maintain lateral separation by turning away slightly from lead. **Keep lead in sight.** Resume the rejoin when lead begins to move ahead.

8.22.2.2. When overshooting straight ahead, there is a tendency to move the control stick in the direction you are looking; that is, toward lead. If uncorrected, this action may cause your aircraft to pass in front of or below lead, resulting in one of the mandatory breakout situations (paragraph **8.6.4.**). A position ahead of lead's 3/9 line is not necessarily "in front" of lead and may not require a breakout. If you overshoot to a point where it becomes difficult to keep lead in sight, break out of formation.

8.23. Fighting Wing:

8.23.1. Fighting wing is a fluid position, using a 30- to 45-degree cone 500 to 1,000 feet aft of lead. The cone is defined as 30 to 45 degrees out from the extended longitudinal axis of the lead aircraft, with 30 degrees as the inner limit and 45 degrees the outer limit (**Figure 8.13.**).

Figure 8.13. Fighting Wing and Extended Trail Exercise Cone.



8.23.2. The wingman may maneuver within the cone to enhance formation flexibility, maximize clearing, or simply to give an alternate departure, cruise, or recovery position. Staying within the cone requires constant analysis of aspect angle and closure in order to apply the proper amounts of lead and lag pursuit.

8.23.3. To send the wingman to the fighting wing position, lead will use a radio call, "Texan, go fighting wing" or use a pointing motion with an index finger across the chest as a visual signal. The wingman will acknowledge the call or signal and maneuver into the cone.

8.23.4. Even though the fighting wing position is defined by the cone described in paragraph **8.23.1.**, the wingman should typically remain on or near the plane described by lead's wings (the plane defined by lead's lateral and longitudinal axis). This "in-plane" position affords good visibility and maneuverability.

8.23.5. During turns, climbs, and descents, the wingman may use different parts of the cone to enhance clearing. To "clear through lead," the wingman can fly on the side opposite lead's direction of flight. For example, if lead is in a descending right turn, the wingman would be on the left side and near "in-plane." This position places the wingman higher than lead on the outside of the turn and allows the wingman to more easily monitor lead and lead's flightpath. The wingman should not stagnate in lead's high or low 6-o'clock position while maneuvering within the cone.

8.24. Extended Trail Exercise. The primary purpose for flying the extended trail exercise is to develop the ability to use lead, lag, and pure pursuit to explore and practice three-dimensional maneuvering in relation to another aircraft. The ultimate goal is to demonstrate an understanding of pursuit curves, aspect angles, and closure control in order to establish and maintain an aircraft within specific parameters. The process of analyzing and solving these problems requires an understanding of the consequences of flying each pursuit curve.

8.24.1. **Position.** The extended trail exercise is flown from the fighting wing position, using a 30- to 45-degree cone approximately 500 to 1,000 feet aft of lead. The cone is defined as 30 to 45 degrees out from the extended longitudinal axis of the lead aircraft, with 30 degrees as the inner limit and 45 degrees the outer limit (**Figure 8.13.**). Staying within the cone requires a constant analysis of aspect angle and closure in order to apply the proper amounts of lead and lag pursuit.

8.24.2. **Philosophy:**

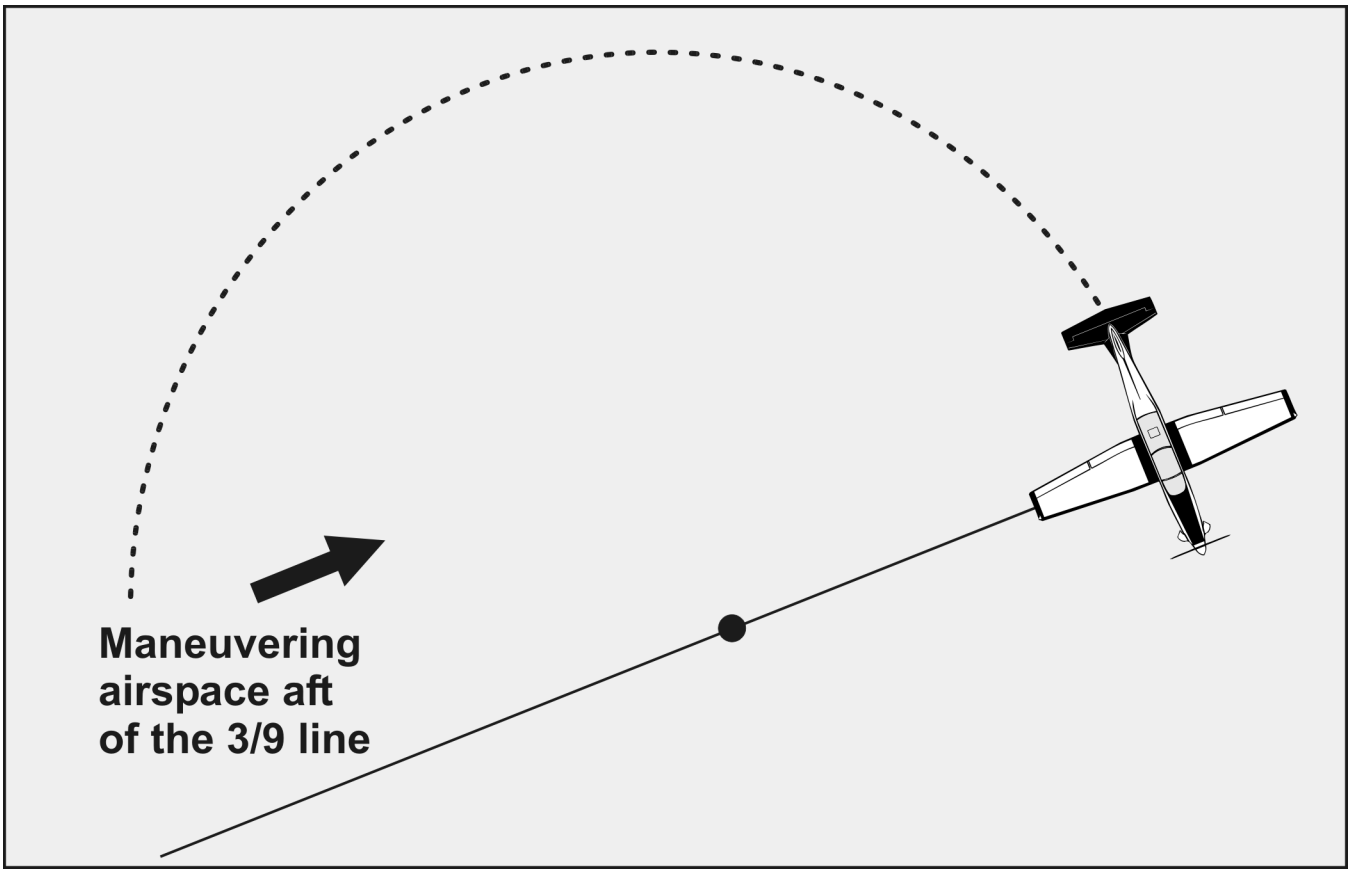
8.24.2.1. The extended trail exercise is a "blue-on-blue" exercise and the culmination of maneuvering fundamentals training. Lead should emphasize clearing, smoothness, and providing a stable training platform for the wingman with consistent, predictable roll rates and no sudden changes in back pressure.

8.24.2.2. As the wingman, the basic principles of pursuit curves and closure control you learned during rejoins are expanded into a more fluid environment. The extended trail exercise allows your IP to show the relationship between lead, lag, and pure pursuit curves as they relate to aspect, range, and closure. Essentially, you will learn how to properly fly the appropriate pursuit curve to solve problems of range, aspect, and closure that lead will create.

8.24.2.3. As the wingman, learning how and when to transition from one pursuit curve to another to solve these problems requires that you understand basic concepts involving turn circle geometry, aspect awareness, and energy management. You must also remain aware of and be ready to use other methods to maintain position. For example, you can reduce power and extend speed brake to increase separation or make a "terminate" call over the radio if too much spacing develops. Be sure to perform a G-awareness exercise as described in paragraph **5.13.3.** of this manual before flying the extended trail exercise.

8.24.3. **Turn Circle Geometry.** During the extended trail exercise, you (as the wingman) will analyze the geometry of lead's turn; for example, turn rate and turn radius (based on lead's airspeed), bank angle, and G-loading. Lead's turn geometry and how you fly the various pursuit curves will determine the aspect, range, and closure problems you must solve. In a level turn—using 2 Gs, 60 degrees of bank, and approximately 230 knots true airspeed (KTAS)—lead's approximate turn rate and turn radius will be 8 degrees per second and 2,500 feet, respectively. As lead turns, his or her 3/9 line will point to the center of the turn circle. The line will continue through the center of the circle, creating the diameter of that circle and defining the airspace in which you (as the wingman) must maneuver. Always remain in the airspace aft of the 3/9 line (**Figure 8.14.**).

Figure 8.14. Aircraft 3/9 Line.



8.24.4. **Aspect Awareness:**

8.24.4.1. As the wingman, aspect recognition and turn circle geometry are equally important in determining how and when to fly the proper pursuit curve. During the extended trail exercise, you will analyze your aspect angle continually during the entry and maneuvering phases. During the entry, because the maneuvering area is limited up to but not forward of the 3/9 line, your aspect angle will range from 0 degrees to 90 degrees when closing on lead.

8.24.4.2. For simplicity, aspect range is described from 0 to 9, left or right. (Remember, aspect is not a clock position.) The straight wing of the T-6 makes recognition of the 9 aspect line easy even at large distances. You are already familiar with the 6 aspect line because this is the extended fin-

gertip line. A 4 aspect reference is the vertical tail on or inside the wingtip. A 3 aspect reference is the vertical tail bisecting the wing.

8.24.4.3. When assessing your position in relation to lead, you must determine how aspect will change as you maneuver. Because of the T-6's small turn radius and fast turn rate, you must anticipate where your aircraft is going and maneuver to control aspect. Anticipation will help you avoid exceeding extended trail exercise parameters. This is especially true when lead turns into you or when you initiate a low yo-yo to decrease range. You must also be aware that your aspect angle and angle off are constantly changing due to lead's continuous turning movement.

8.24.5. **Energy Management:**

8.24.5.1. While maneuvering with a fixed, prebriefed power setting, lead should plan to use vertical movement to preserve energy and provide various angle problems for the wingman to solve. As in wing work, vertical movement will allow lead to maintain sufficient energy to maneuver.

8.24.5.2. G-loading is also important while maneuvering because the T-6 is easily susceptible to energy loss under high G-loading. Consequently, both aircraft should avoid the buffet, and the wingman should consider unloading to 1 G or less when applicable to preserve and/or gain energy. This is particularly effective when the wingman is in lag pursuit and both aircraft are in a descent. The wingman has the option to change the power setting to preserve position and prevent training loss or because a difference in aircraft performance dictates.

8.24.6. **Specific Training Rules for the Extended Trail Exercise:**

8.24.6.1. Aircraft flying inside the 300-foot slant range "bubble" or forward of the 3/9 line will call "knock-it-off" as described in paragraph **8.6.2.**

8.24.6.2. Aircrews will limit the extended trail exercise to turns and modified lazy eights (bank angles not to exceed 120 degrees).

8.24.6.3. Abrupt turn reversals will not be performed; that is, turns in one direction followed by a rapid, unanticipated roll in the opposite direction.

8.24.6.4. The extended trail exercise is limited to two-ship formations.

8.24.6.5. When the wingman is performing the extended trail exercise and loses sight of lead, he or she will break out of the formation as described in paragraph **8.6.4.** and call "blind" as described in paragraph **8.6.5.**

8.24.7. **Flying the Extended Trail Exercise—Entry:**

8.24.7.1. **Lead.** When reaching 180 to 200 KIAS and approximately the middle of the altitude block, direct the formation to begin the extended trail exercise with the radio call, "Texan, go extended trail exercise" or a prebriefed visual signal. After the wingman acknowledges the call or signal, initiate a steep bank turn (approximately 2 to 3 Gs) away from the wingman at MAX power. When the wingman calls, "Texan 2's in," set briefed power and commence maneuvering. 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. Likewise, a lower power setting may be appropriate in some cases.

8.24.7.2. **Wingman.** To obtain the separation required to enter the extended trail exercise, delay 2 to 3 seconds after lead turns away and then turn in the same direction. When within extended trail

exercise parameters, call in and set briefed power. Ensure you are never less than 300 feet from lead or forward of lead's 3/9 line.

8.24.8. **Flying the Extended Trail Exercise—Maneuver:**

8.24.8.1. **Lead:**

8.24.8.1.1. After the wingman calls in position, set prebriefed power and begin maneuvering. Consider the skill level of your wingman when performing all maneuvers. Tight, high-G maneuvers are of little value if the wingman is unable to maintain proper position. Constantly monitor your G-loading and take into account that your wingman is often exceeding your G-loading to maintain position. Look for the wingman behind the wing, not at your 6-o'clock position. Monitor the wingman's aspect and closure for inadvertent 3/9 line passage. Be prepared to "knock-it-off" if there is no attempt to correct the deviation.

8.24.8.1.2. Never maneuver in an unpredictable or abrupt manner that may force the wingman forward of your 3/9 line. Vertical movement to manage energy also presents difficult angle and closure problems for the wingman. Always observe the wingman's aspect angle and angle off before maneuvering aggressively because he or she may, in turn, be aggressively repositioning to counteract your current flightpath.

8.24.8.1.3. Because you are a training platform for your wingman, it is incumbent upon you to provide reasonable problems to solve. If you maneuver too aggressively, your wingman may not be able to achieve the desired training objectives. Once the learning objectives have been met, you may terminate the maneuver by directing a rejoin. Remain predictable as you transition to a level turn for the rejoin. When directing a rejoin, attempt to be in level flight at approximately 180 KIAS.

8.24.8.1.4. After each extended trail exercise, initiate a fuel and G check, using the radio. For example, you will begin "Texan 1, 800, 4.0 G," and the wingman will respond, "2's, 800, 4.5 G." Do not reset the G meter; report the maximum G reading on all G checks.

8.24.8.2. **Wingman:**

8.24.8.2.1. Once inside 1,000 feet and in the 30- to 45-degree cone, make the radio call, "Texan 2's in." Your range should never be less than 300 feet from lead or forward of lead's 3/9 line. Once you make the radio call indicating you are in position, lead will fly turns and vertical maneuvering with modified lazy eight-type maneuvers at various G-loads to familiarize you with the fundamental concepts of maintaining position using pursuit curves.

8.24.8.2.2. As your proficiency increases, you will explore the performance envelope of the aircraft, thus building the confidence and ability required for high-performance formation maneuvering under varying flight conditions. During these maneuvers, you must predict lead's flightpath and maneuver in relation to lead. This will require you to analyze lead's plane of motion and turn rate before deciding which pursuit curve to fly. As you anticipate lead's nose movement, you will move continuously from lag to lead pursuit curves while lead is maneuvering. Aspect changes can occur rapidly, and you must be prepared to maneuver accordingly. For example, if lead turns into you as you are aggressively pulling lead pursuit, you may easily exceed the forward 45-degree limit. Pause momentarily to see how rapidly lead is moving, predict lead's flightpath, and then maneuver. When in lag pursuit, do not allow your angle off to build excessively. Normally, you will not spend much time in a lag pursuit curve.

8.24.8.2.3. Conservation of airspeed is critical during the extended trail exercise; and it requires awareness of the maneuver being performed, amount of back pressure applied, and buffet encountered.

8.24.8.2.4. You may have to exaggerate your pursuit curves and adjust your power to remain in position. Normally, you will stay in an exaggerated pursuit curve for only a short period of time and remain below lead's flightpath to enhance your visibility in case lead turns into you. From that position, a move to a lag pursuit curve is the best solution.

8.24.8.2.5. Flying intentional lag rolls is not a desired training objective. Transitory periods in lead's high or low 6-o'clock position while maneuvering is acceptable. However, you should avoid stagnating in the 6-o'clock position, concentrating instead on maintaining the 30- to 45-degree cone and approximately "in-plane" (the plane described by lead's wings).

8.24.8.2.6. Even when using the various pursuit curves to maintain position, most of the time you will be in an arc that is ± 45 degrees from "in-plane" when viewing the extended trail exercise cone from the rear. This position will challenge your knowledge of pursuit curves as well as aspect and closure awareness. If you desire to cease maneuvering or are unable to maintain position, use the "terminate" procedures described in paragraph **8.6.2.**

8.24.8.3. **General.** As with other formation maneuvering, each pilot has the responsibility to take whatever action is necessary to avoid a collision. Because of the dynamic nature of the extended trail exercise, the problems of collision avoidance are compounded and require uncompromising flight discipline. Either aircraft should use the "knock-it-off" radio call as described in paragraph **8.6.2.** to cease maneuvering when a training rule has been violated or a safety of flight conflict arises.

8.25. Close Trail. Close trail is flown to demonstrate flying in close proximity directly behind another aircraft. Lead may initiate the maneuver from fingertip, echelon, or route.

8.25.1. **Lead.** Direct the wingman to the close trail position with a visual signal (placing an open hand on the back of the helmet) or with the radio call, "Texan, go close trail." Wait for the wingman to call in before maneuvering. Maneuver in a smooth, predictable manner and maintain positive G forces at all times. Avoid sudden releases of back pressure and rapid turn reversals. Power and maneuvering requirements are identical to fingertip formation.

8.25.2. **Wingman.** Acknowledge and maneuver into the close trail position and use the radio call, "Texan 2's in" when you are in position. The proper close trail spacing is one to two aircraft lengths (nose to tail) behind lead and just below lead's propwash. Maintain this position primarily through the use of power. However, when lead is turning at higher G-loads, you may need to use a small amount of lead pursuit to maintain position.

8.25.2.1. **Close Trail Position.** Use the relationship between the tips of lead's horizontal tail and the underside of lead's wing as an aid in estimating nose and tail separation. At approximately two ship lengths, the tips of lead's elevator will line up about one-third of the way out the wings after the bend. As a vertical reference, you should see the engine exhaust stacks on top of the wing. Another technique is to make a "T" out of the aft edge of the speed brake and the UHF/VHF antenna. To prevent encountering propwash, never fly higher than a position where you can see more top wing than bottom wing. As lead maneuvers, anticipate power changes to prevent too little or too much spacing.

8.25.2.2. **Closure.** Closure rates are difficult to determine when directly behind lead. Therefore, if excessive spacing exists, do not attempt to move forward with power alone. Add power and establish a small amount of lead pursuit while in a turn. If you are in a wings-level attitude, move off to one side to obtain a better perspective of lead. The two most important points to remember are to (1) remain below lead's propwash and (2) always keep lead in sight.

8.25.3. **Termination.** Lead will direct the formation to reform to fingertip with a shallow wing rock or radio call. The wingman should return to the left side (if straight and level) or inside of the turn, unless directed otherwise. Lead should maneuver in a smooth, predictable manner and avoid any significant power changes until the wingman has reached the fingertip position.

8.26. In-Flight Lead Changes:

8.26.1. Lead changes will be made with the formation in wings-level flight. Lead will direct the wingman to route and call or signal for the lead change. A radio call is mandatory when directing a position change in limited visibility conditions. The wingman will assume the line abreast route position. If lead uses a radio call, the wingman will acknowledge the call and become the new lead at that time. If lead uses a visual signal, the wingman will acknowledge with a head nod and become the new lead at that time. The lead change is not complete until the wingman has acknowledged it. The new lead should maintain the current power setting to provide a stable reform platform, turn on his or her NACWS, and turn the identification, friend or foe (IFF) to "alt."

8.26.2. The new wingman will turn off the NACWS, turn the IFF to standby, and stay in route until rocked back into fingertip by the new lead. (***EXCEPTION:*** During BD checks [paragraph **8.5.5.**], lead will maintain the squawk and NACWS throughout the entire procedure.) It is not necessary for the wingman to be on or forward of the 3/9 line to take the lead. The wingman need only be in a position from which he or she can safely lead the flight. Lead changes accomplished with visual signals should be expeditious to minimize the time without a leader actively clearing for the formation.

8.27. Descent and Landing:

8.27.1. If the formation needs to recover as single ships, lead will coordinate a new squawk for the other aircraft and clear them off at the appropriate time. If weather is a factor, lead will consider breaking up in the MOA to minimize traffic congestion in the radar pattern. During letdowns, the speed brake may be used at lead's discretion. Once established at pattern altitude for entry to the VFR pattern, all turns away from the wingman will be echelon unless briefed otherwise. Before initial approach, lead will position the wingman on the opposite wing from the direction of the break. Initial should be long enough to allow the wingman to settle down in fingertip before the break.

8.27.2. At the break point, lead should smoothly turn to the downwind and delay retarding the PCL until the turn is initiated. After lead's break, the wingman will wait a minimum of 5 seconds before following. He or she will attain spacing in the break and on downwind. (On downwind, the wingman should be slightly outside lead's flightpath.)

8.27.3. As the wingman, fly a normal contact pattern. Each aircraft should be able to initiate the final turn at the same point. However, do not follow a poorly flown pattern by the aircraft ahead. Go around if you cannot complete a proper pattern. Each crewmember will use his or her individually assigned call sign for the gear check. In crosswinds, lead will normally land on the downwind side of the run-

way. If splitting the formation in the pattern, the aircraft on the inside of the pattern will pull closed or turn crosswind first; if Number 2 is on the inside, that aircraft must be cleared off by lead.

8.28. Instrument Penetration. Formation penetration procedures are the same as for a single ship. Before starting the penetration, lead will position the wingman away from the direction of the penetration turn. Lead should not use less than 10 percent torque to allow the wingman to stay in position.

8.29. Formation Approach. Lead will position the wingman on the upwind side of the landing runway, using a visual signal or radio call to lower the gear and flaps. (Minimize visual signals when in IMC.) The gear and flaps are normally lowered with one signal unless briefed otherwise. Formation approaches are flown with TO flaps. After configuring and internally confirming, the wingman will check lead's configuration and give a "thumbs up" to lead to indicate good internal configuration and that lead's configuration is good. Lead will transmit a geardown call for both aircraft after the configuration has been confirmed. After configuring, lead will maintain 110 KIAS on the approach unless winds dictate otherwise.

8.30. Wing Landing:

8.30.1. When the formation breaks out of the weather and visual contact with the runway can definitely be maintained, lead will line up with the center of one side of the runway and plan the touchdown approximately 1,000 feet down the runway. No later than 1/2 mile from the runway, the wingman will stack level with lead. Formation takeoff references will be used for lateral spacing. Lateral spacing will increase the wingman's margin of safety if any problems occur during touchdown and landing roll.

8.30.2. As the flight approaches the overrun, the wingman should begin to cross-check the runway. He or she continue to fly off lead during the flare and landing, but monitor the runway and flight parameters to ensure a safe landing. Lead will gradually reduce power for the roundout. The wingman must reduce power gradually with lead to avoid falling out of position during the roundout and touchdown.

8.30.3. As the wingman, once on the runway, maintain your side of the runway and use normal braking technique regardless of lead's deceleration rate. If passing lead on a landing roll, do not attempt to maintain position by overbraking. Brake normally and clear and maintain your side of the runway. Trailing aircraft on the cold side will clear the preceding aircraft to the cold side when separation is established and at a safe taxi speed, "Texan cleared cold." If the trailing aircraft is not on the cold side, the aircrew will clear themselves to cross.

8.30.4. A formation go-around, when required, should be initiated as early as possible. Lead should smoothly add power to approximately 75 percent torque and follow normal formation takeoff and go-around procedures. If clearing the runway is required, lead should confirm Number 2's position and ensure the wingman has safe altitude and airspeed during maneuvering.

Section 8C—Three- and Four-Ship Formations

8.31. 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

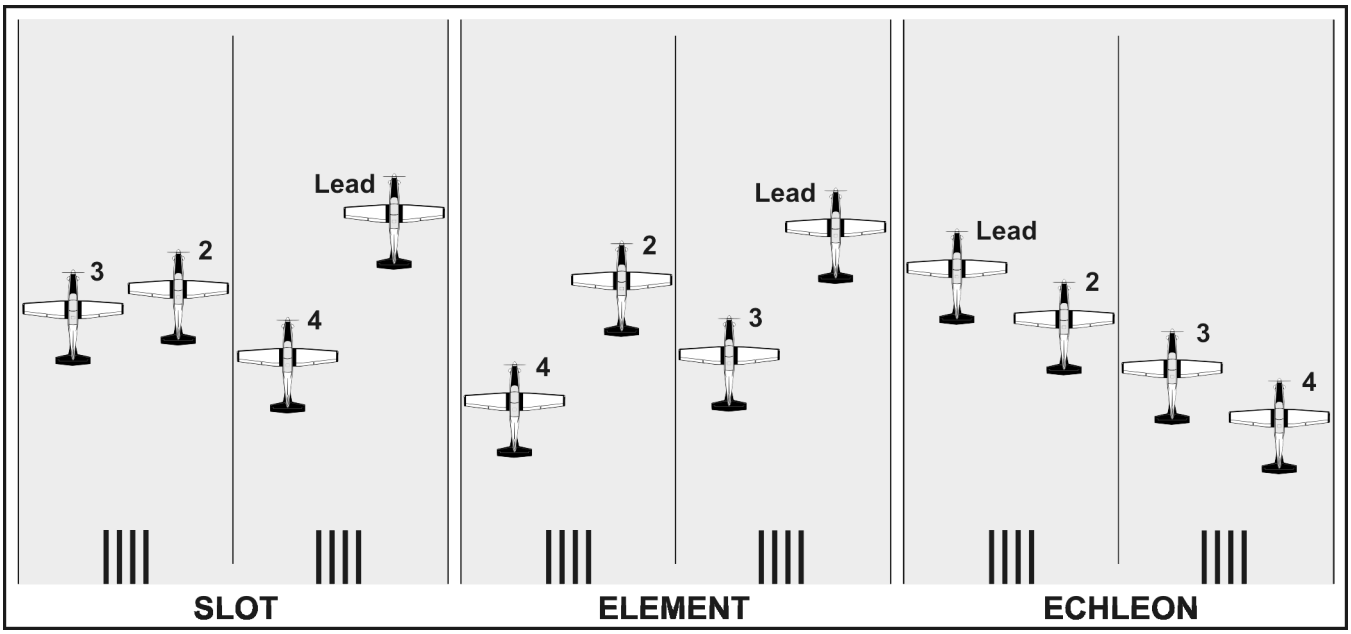
described for a two-ship formation also apply to three- and four-ship formations. Airspeed for rejoins will normally be 180 KIAS or as briefed.

8.32. 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. A three-ship plan will be briefed for all four ships. See paragraph **8.46.** for three-ship specifics.

8.33. Runway Lineup:

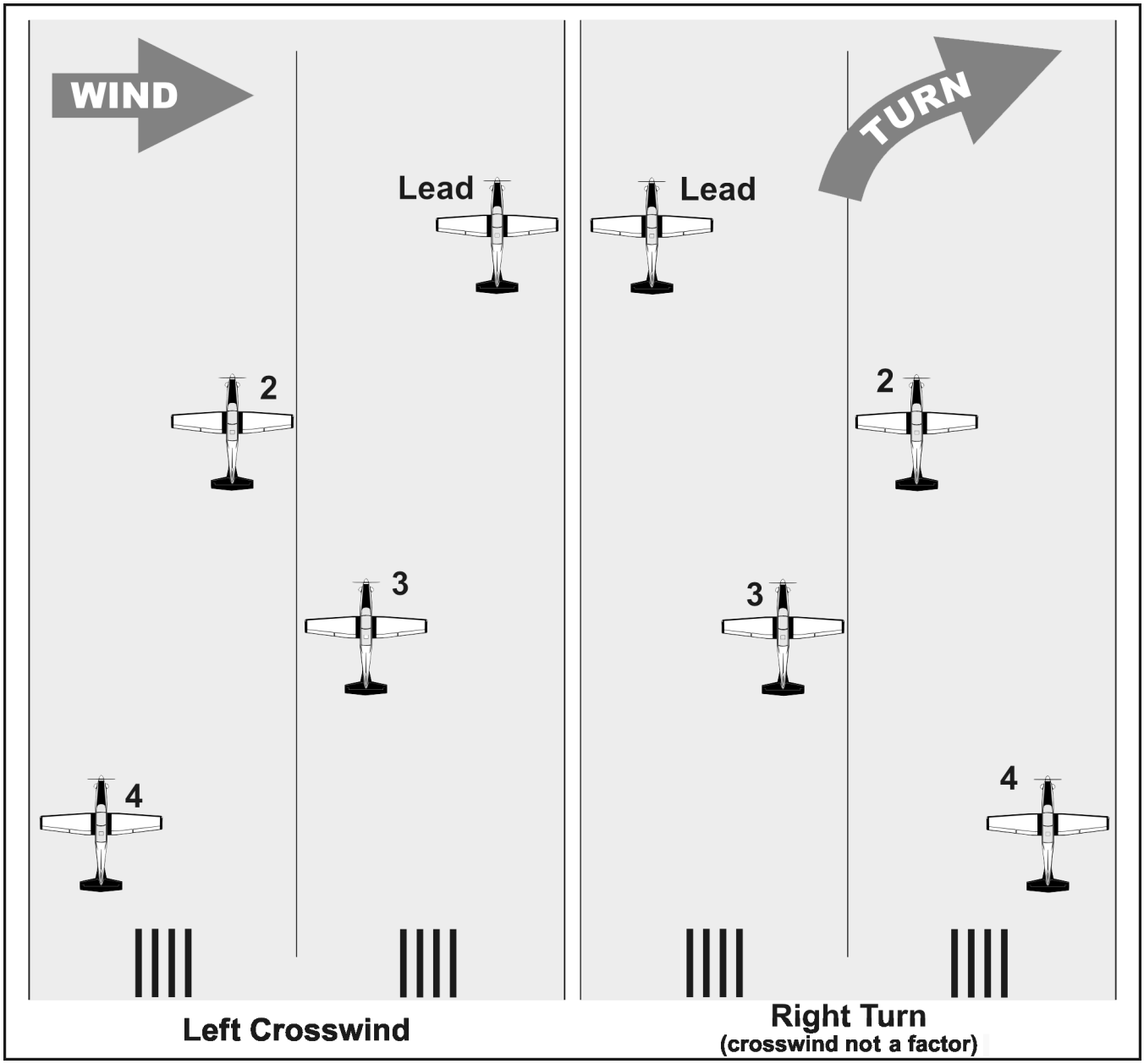
8.33.1. **Figure 8.15.** depicts the runway lineups for a four-ship takeoff. See AFI 11-2T-6, Volume 3, for runway width restrictions for each lineup.

Figure 8.15. Four-Ship Runway Lineup.



8.33.2. Normally, a formation will use the element lineup depiction. Wingmen should be placed on the upwind side of the runway just like a two-ship formation. If crosswinds are not a factor, lead will place the wingmen on the inside of the first turn out of traffic (**Figure 8.16.**). If runway length is not a factor, 500 feet of space between elements can also be used as an option.

Figure 8.16. Four-Ship Element Lineup.



8.33.3. 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 center line, 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.

8.34. Runup and Takeoffs:

8.34.1. When all aircraft are in position, lead will direct the engine runup, using the same runup procedures as in a two-ship formation. During individual takeoffs, Numbers 2, 3, and 4 may delay their runup a few seconds.

8.34.2. A three- and four-ship formation takeoff may be accomplished by single-ship takeoffs with individual rejoins out of traffic or by element takeoffs. Six-second (minimum) spacing will be used between individual aircraft departures. Ten-second (minimum) spacing will be used between elements. However, if element instrument trail departures are used due to weather, spacing criteria specified in paragraph **8.13.** will be used in combination with local directives. Fingertip will be maintained until reaching VMC.

8.35. 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.

8.36. 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.

8.37. Turns (From Takeoff). Lead 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, lead will ensure Number 2 is positioned on the inside of the turn, allowing Numbers 3 and 4 to join to the outside. If required, lead may roll out and call for a straight-ahead rejoin.

8.38. Straight Ahead (From Takeoff). Lead will maintain briefed power and airspeed until the formation is joined. Following element takeoffs, lead will ensure Number 2 is positioned on the left, allowing Numbers 3 and 4 to join to the right side.

8.39. Formation Positions. The following positions are approached primarily from the wingman's point of view:

8.39.1. **Fingertip.** Number 4's position should be determined, using the normal fingertip references relative to the Number 3 aircraft. If Number 3 is rough, Number 4 should fly a stable position on lead and constantly monitor Number 3's position (**Figure 8.17.** and **Figure 8.18.**).

Figure 8.17. Four-Ship Fingertip Formation.

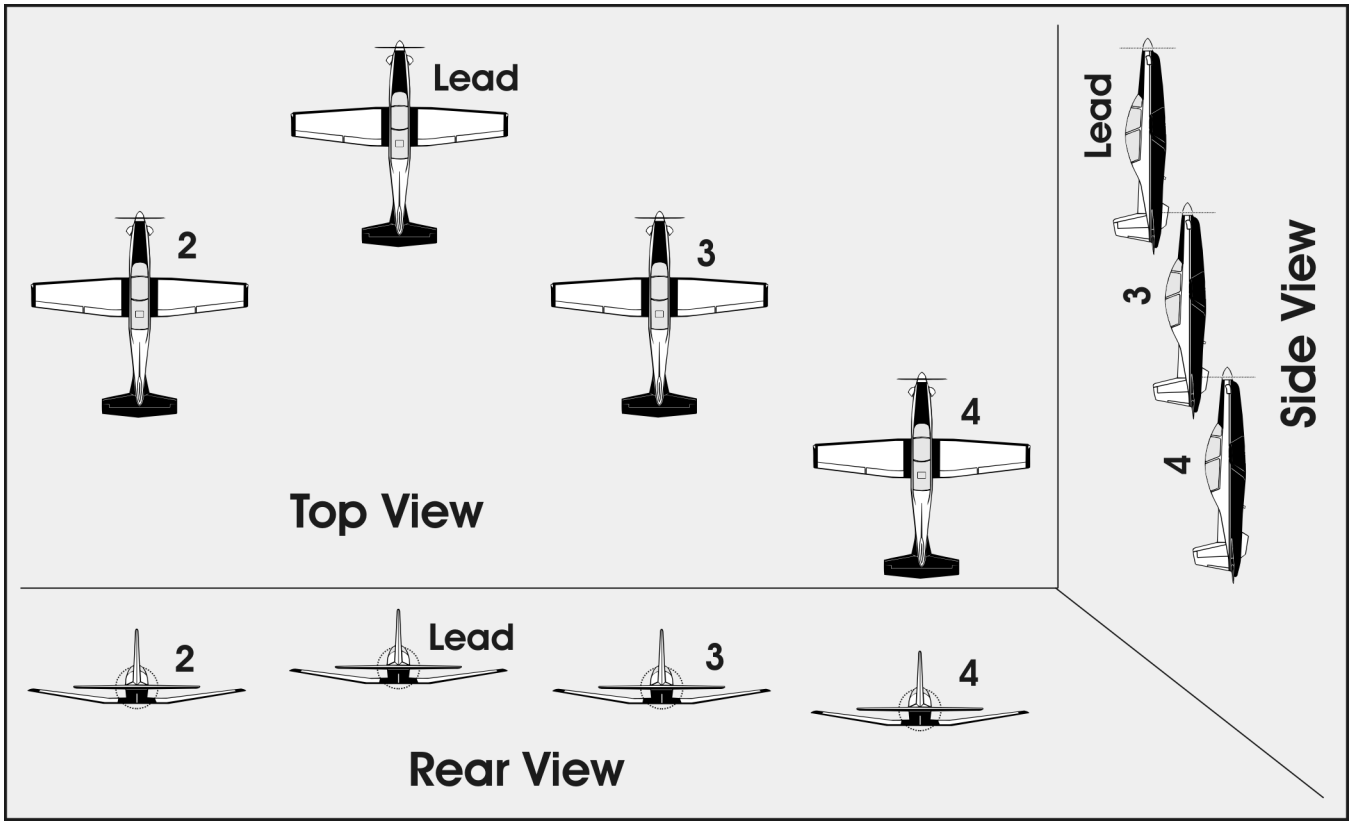
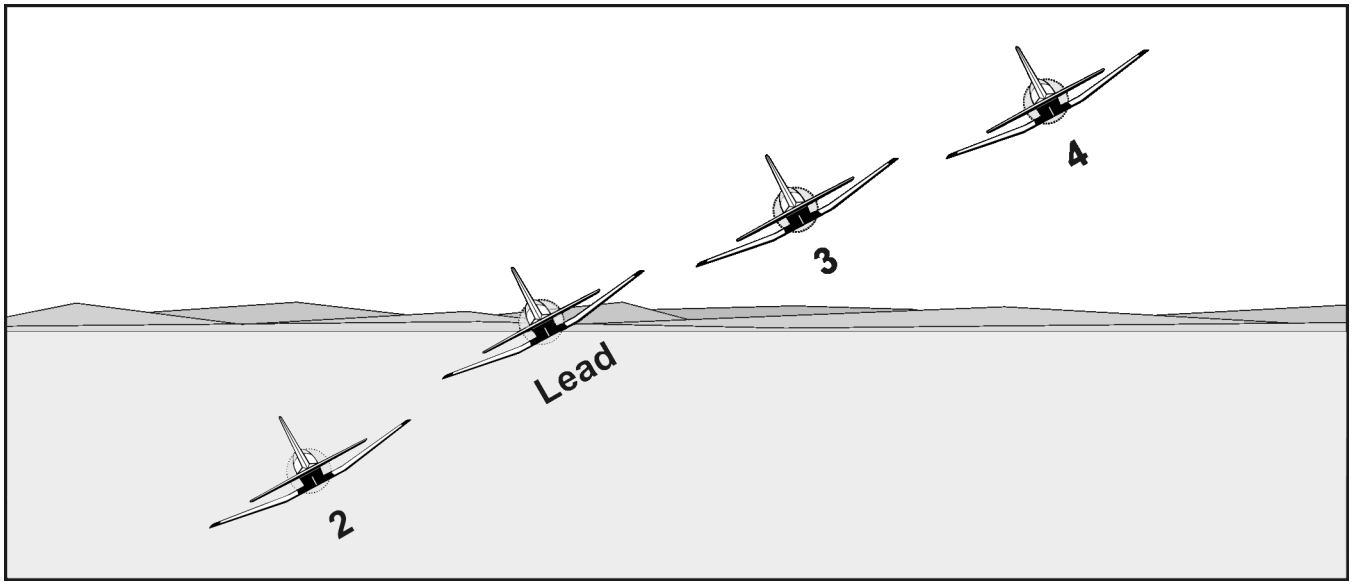


Figure 8.18. Four-Ship Fingertip Formation in a Turn.



8.39.2. **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 8.19.** and **Figure 8.20.**).

Figure 8.19. Four-Ship Echelon.

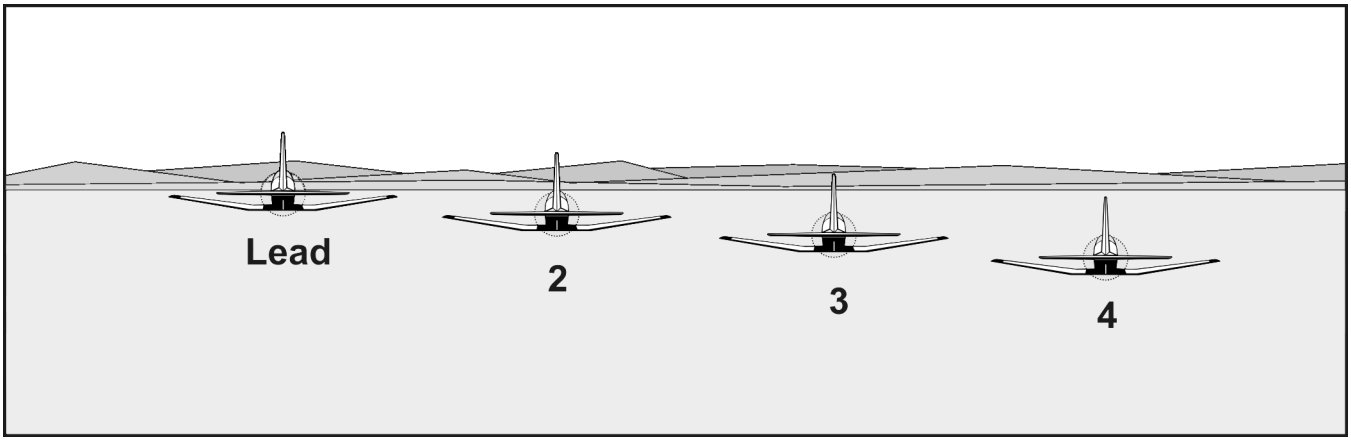
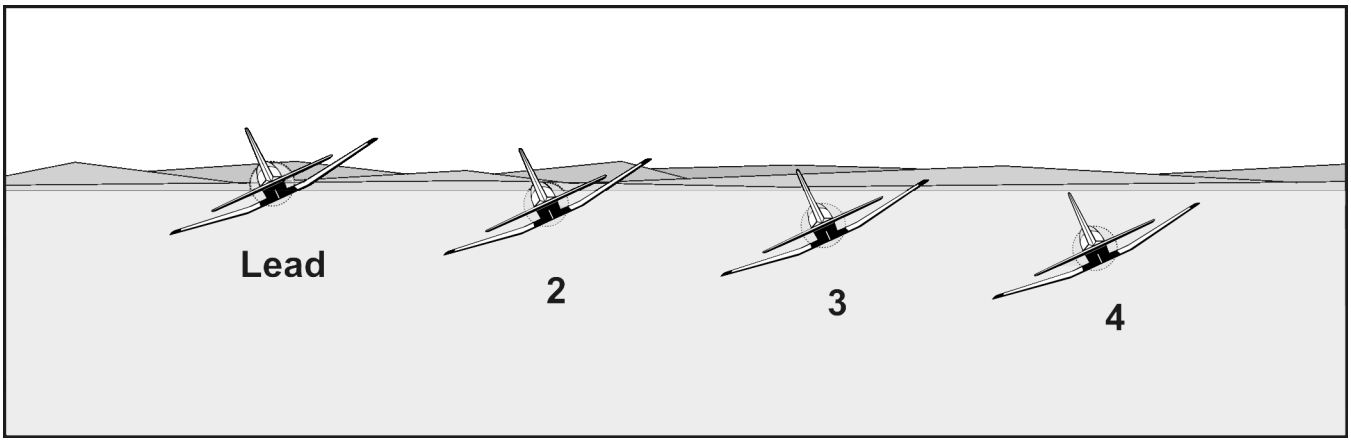
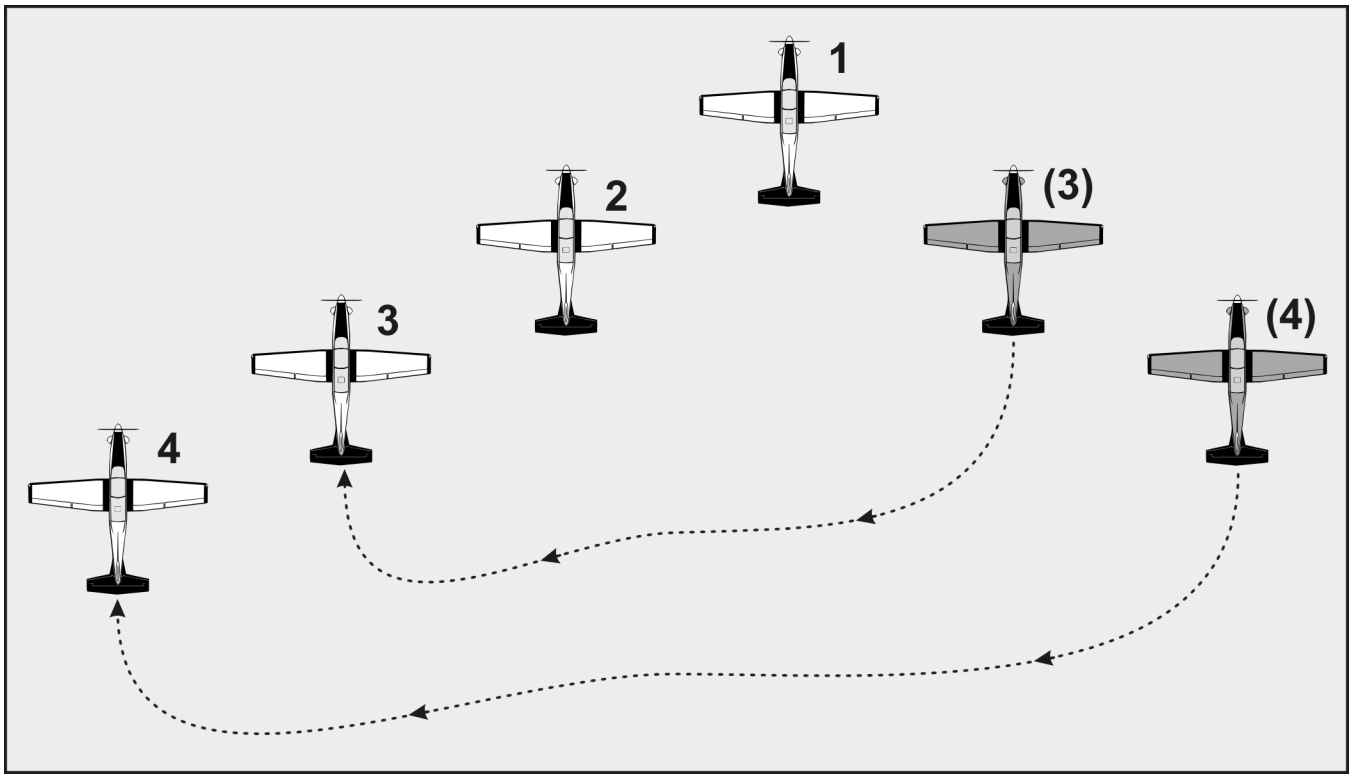


Figure 8.20. Four-Ship Echelon Turn.



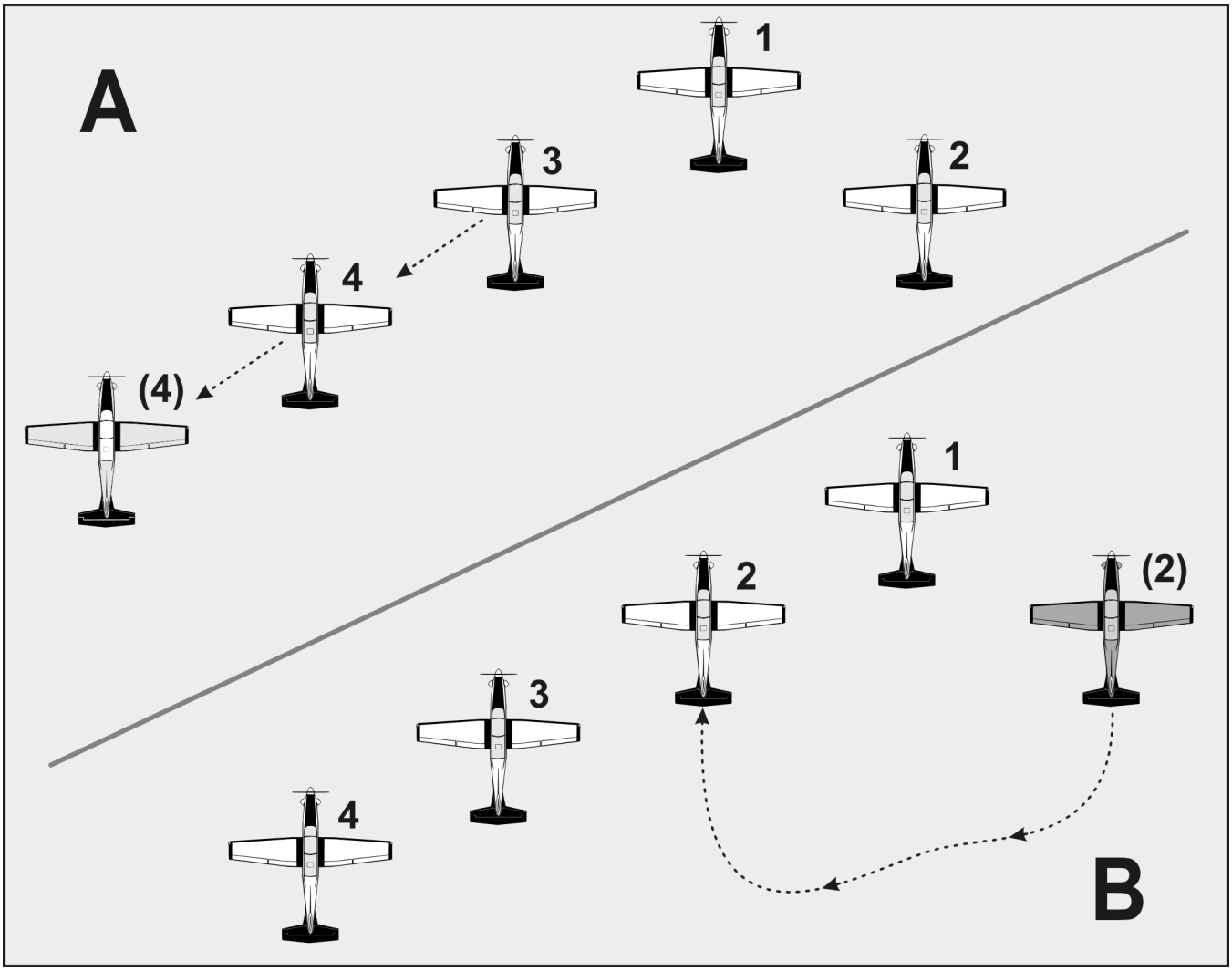
8.39.2.1. Lead will signal for echelon by dipping a wing in the desired direction. If lead's wing dips toward Number 2, that aircraft will hold position. Numbers 3 and 4 will move back and down to provide adequate clearance from the lead element. Number 3 (with Number 4 on the wing) will then begin to cross to an echelon position on the wing of Number 2, keeping safe clearances. As Number 3 crosses behind lead, Number 4 will cross under to the new position on the other wing of Number 3 (**Figure 8.21.**).

Figure 8.21. Echelon Crossunder for Numbers 3 and 4.



8.39.2.2. 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 lead. Numbers 3 and 4 will align themselves with Number 2 and lead. Smooth technique by Numbers 2 and 3 will prevent a crack-the-whip on Number 4 (**Figure 8.22.**).

Figure 8.22. Echelon Crossunder for Number 2.



8.39.2.3. Except for very gentle turns into the echelon, turns are always made away from the echelon. Number 3 will fly off Number 2 and Number 4 will fly off Number 3, using normal echelon references.

8.40. 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.

8.41. Rejoins:

8.41.1. **Turning Rejoins:**

8.41.1.1. 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 lead's turn. Rejoin procedures for Number 2 are identical to the procedures described in paragraph **8.20.** 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.

8.41.1.2. Number 3 will always join to the outside of lead'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.

8.41.1.3. Number 3 should establish an aspect angle no greater than that used by Number 2. Number 3 should accelerate to gain an airspeed advantage on lead and maintain a 100-foot clearance (minimum) on the lead element until Number 2 is stabilized in route.

8.41.1.4. Number 3 should plan the rejoin to pass at least two ship lengths 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 lead. Number 3 will avoid abrupt control pressure and rapid throttle movements if Number 4 has closed to minimum distance (approximately 100 feet).

8.41.1.5. Number 4 will also always join to the outside of lead'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 aspect angle no greater than Number 3 or 2, while accelerating to gain an airspeed advantage. As Number 4, maintain this aspect angle on the lead element and Number 3 and plan your rejoin to pass at least two ship lengths 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.

8.41.2. **Straight-Ahead Rejoins.** After completing the pitchout, lead 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 Number 2 and maintain a minimum of 100-foot clearance on Number 3 until Number 3 is stabilized in route.

8.42. 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:

8.42.1. As Number 2, announce your overshoot to alert Number 3 that you are encroaching on his or her side of lead, "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.

8.42.2. 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 lead's turn. If you extend the speed brake or remain in zero torque to rapidly bleed your airspeed, notify Number 4, "Texan 3, idle/speed brake."

8.42.3. 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.

8.42.4. 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.

8.43. Leaving Formation (Breaking Out). Leaving formation is the same in three- and four-ship formations as in two-ship formations, with the following exceptions:

8.43.1. If Number 2 or 4 breaks out of fingertip formation, the remaining aircraft will maintain their original positions on lead. If Number 3 leaves formation, Number 4 will follow Number 3 at a safe distance to maintain element integrity.

8.43.2. Lead will direct the rejoin to the desired formation. An aircraft that has left formation will not rejoin until directed by lead.

8.44. Speed Brakes. Speed brakes are lowered or raised on verbal signal by lead 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.

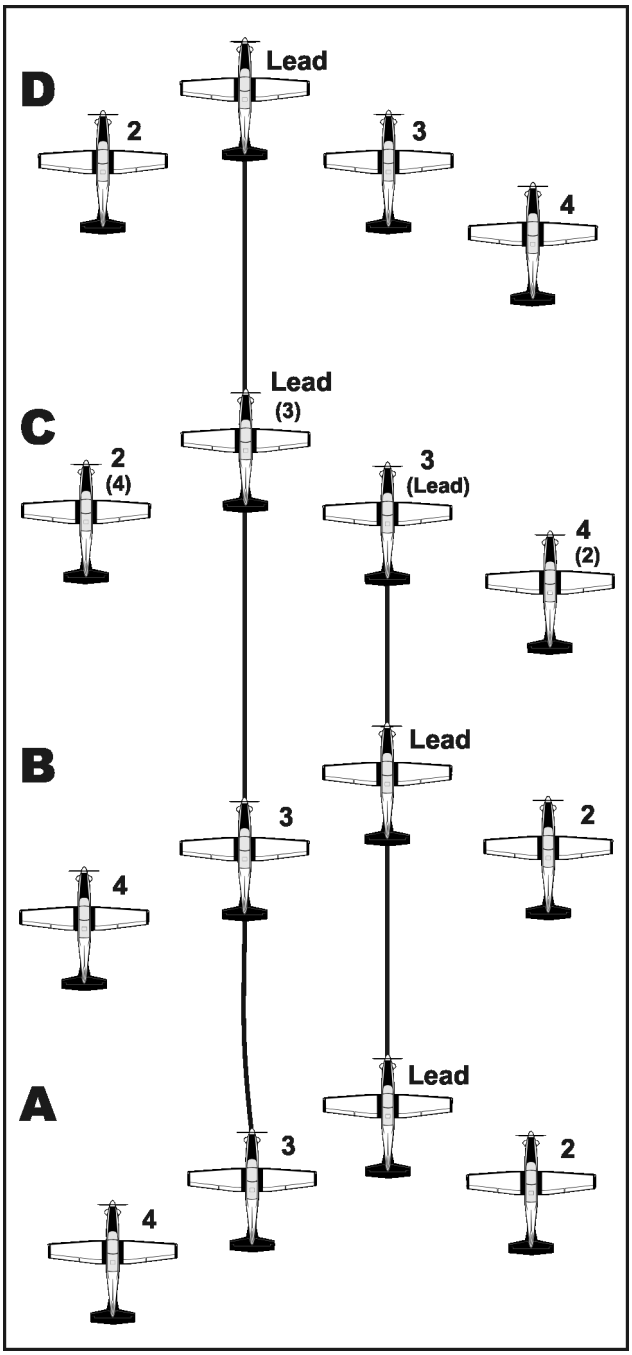
8.45. In-Flight Lead Changes:

8.45.1. Four-ship lead changes are made from route fingertip or route echelon. Procedures to be used must be thoroughly reviewed in the formation briefing. The most commonly used method is for lead to direct the formation to go to route with the radio call, "Texan, go route." The wingmen will acknowledge and move to route.

8.45.2. After the formation is stable in the route position, lead 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.

8.45.3. During lead changes from route fingertip, Number 3 always becomes new lead, Number 4 becomes Number 2, lead becomes Number 3, and Number 2 becomes Number 4 (**Figure 8.23.**).

Figure 8.23. Route Fingertip Lead Change for a Four-Ship Formation.



8.45.4. During lead changes from route 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 8.24.**). When original lead becomes Number 4, Number 2 becomes lead, Number 3 becomes Number 2, and Number 4 becomes Number 3 (**Figure 8.25.**).

Figure 8.24. Route Echelon Lead Change for a Four-Ship Formation (Lead to Number 2).

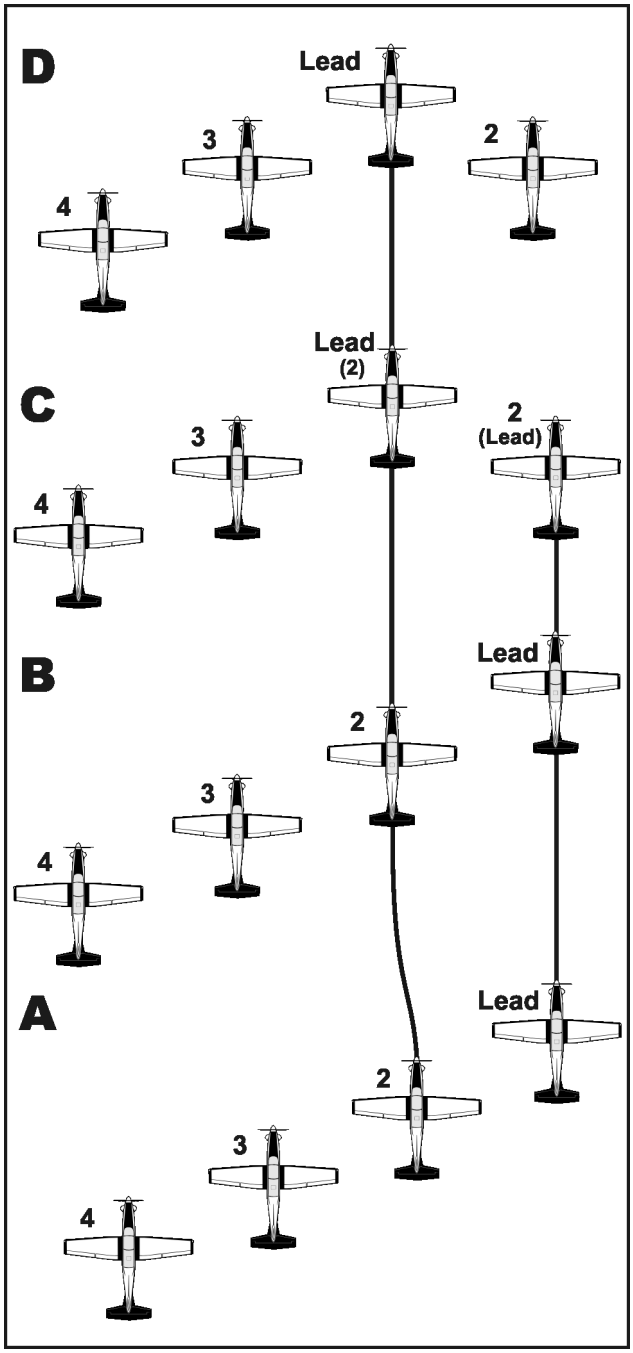
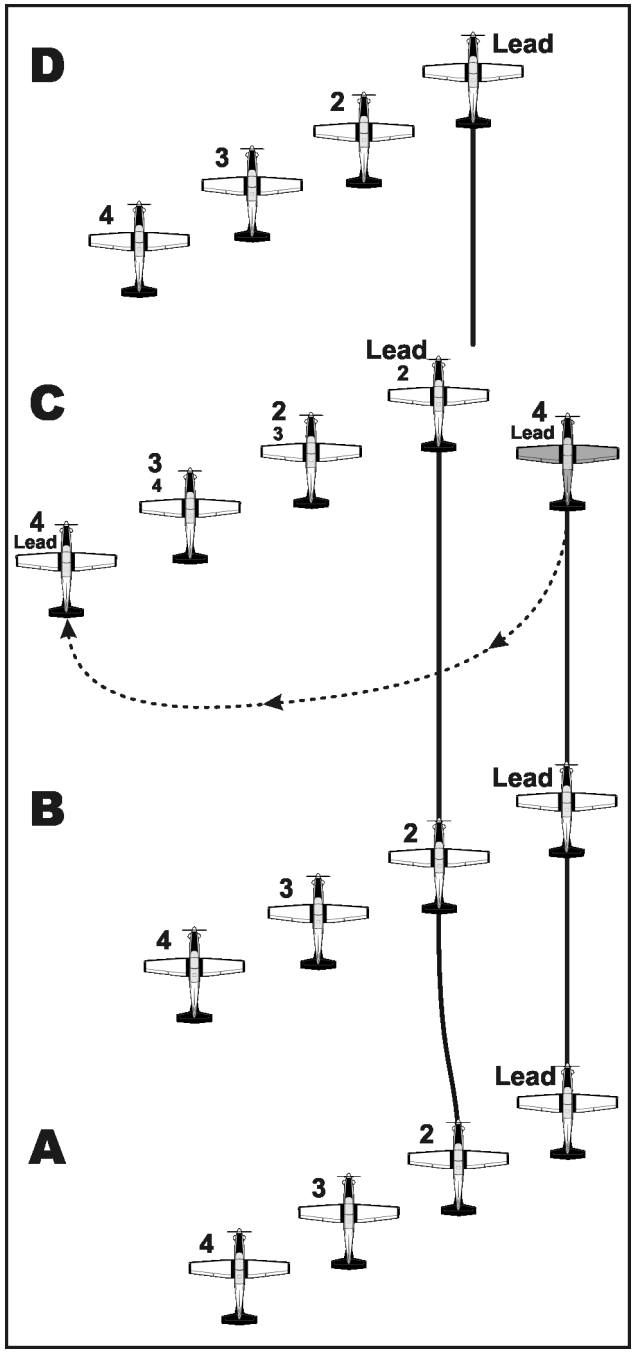


Figure 8.25. Route Echelon Lead Change for a Four-Ship Formation (Lead to Number 4).



8.46. Three-Ship Formation:

8.46.1. **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.

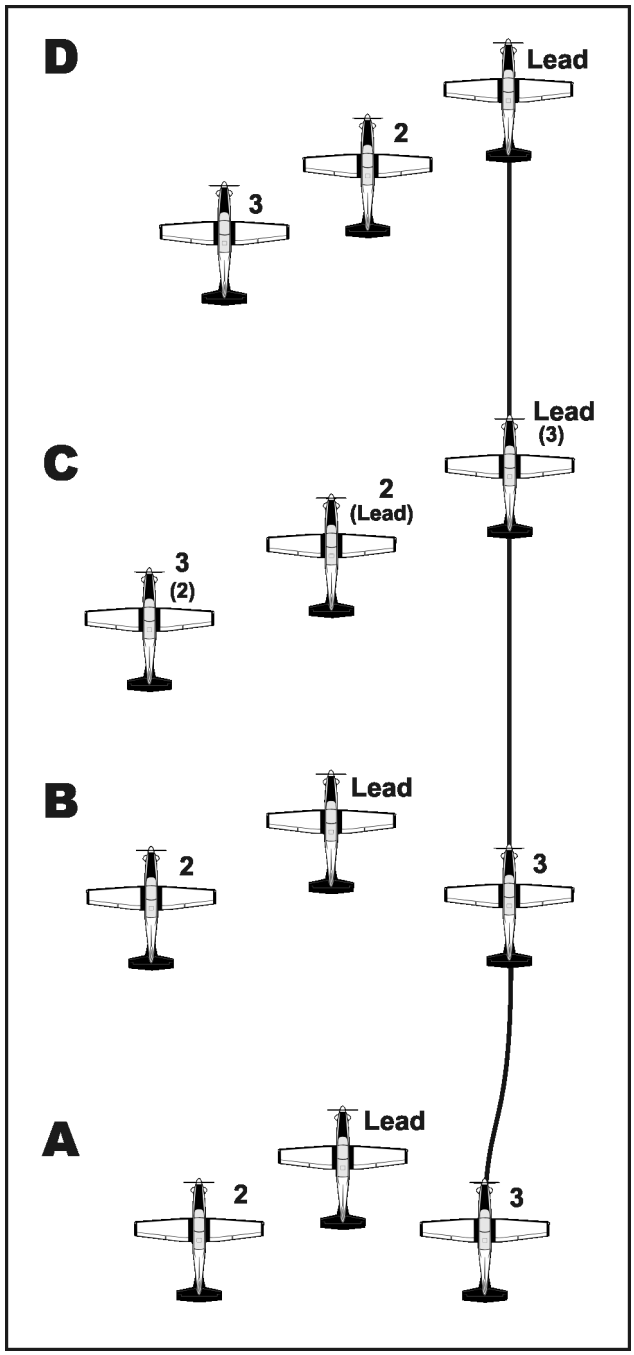
8.46.2. **Three-Ship Rejoins.** When flying "Phantom 2" for turning rejoins, follow the procedures in paragraph **8.41.** for Numbers 3 and 4 straight-ahead rejoins and rejoin to the right side unless lead directs otherwise. When flying normal Numbers 2 and 3 positions, use normal four-ship procedures.

8.46.3. **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; that is, by dipping a wing in the desired direction of echelon. If flying "Phantom 2," echelon turns must be directed 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 Number 3 and 4 positions). Lead will be directive when reforming the formation to the fingertip position.

8.46.4. **Three-Ship Lead Changes:**

8.46.4.1. During lead changes from route fingertip, Number 3 will move forward (as in a four-ship element lead change) to become lead, lead will become Number 2, and Number 2 will become Number 3. After the lead change, the formation is in echelon position (**Figure 8.26.**).

Figure 8.26. Route Fingertip Lead Change for a Three-Ship Formation.



8.46.4.2. During lead changes from route echelon, the original lead 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).

8.46.5. **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.

Chapter 9

INSTRUMENT FLYING

9.1. Instrument Takeoff (ITO) and Climb:

9.1.1. The ITO is taught so you will attain proficiency in takeoff without total reliance on references outside the cockpit. With practice, you will be able to transition smoothly and safely from outside visual references to instruments if you encounter restricted visibility during or shortly after takeoff. It is rarely necessary to perform a takeoff using instruments only. Even during low visibility conditions, visual references such as runway lights, center line, or runway edges are usually visible. During an actual ITO, visual references used will become a part of the instrument cross-check.

9.1.2. Perform an ITO in a definite sequence. Learning the procedures well before flight will allow you to devote more attention to the cross-check and aircraft control. As you rotate, maintain runway alignment with rudder and ailerons. Establish a takeoff attitude, using outside and instrument indications. Raise the pitch attitude on the attitude indicator approximately 7 degrees and continue to maintain a constant heading.

9.1.3. When the aircraft leaves the ground, control the pitch-and-bank attitude, using outside references and the attitude indicator. When the altimeter and VSI indicate a positive climb indication, call "gear clear" and retract the gear and flaps.

9.1.4. Maintain wings level and a 7-degree, nose-high indication to establish a definite rate of climb. Trim to relieve stick pressures and cross-check the altimeter and VSI for climbing indications. Maintain this attitude until you reach a climb speed of 160 to 180 KIAS. Nonstandard climb gradients on published departures may require you to adjust these procedures.

9.1.5. The rate at which you transition entirely to instruments will depend on the rate at which you lose outside references. Unless otherwise directed, make the first turn on an instrument departure procedure at a safe airspeed and a minimum of 400 feet above the aerodrome elevation. Normally, use a bank angle of 30 degrees. Additional information on performing the ITO is in Chapter 9 of AFMAN 11-217, Volume 1.

9.2. Level Off:

9.2.1. If an IFR departure necessitates leveling off at an intermediate altitude before continuing the climb to final altitude, maintain your climb airspeed for that altitude. Level off at cruising altitude at the airspeed specified by your instructor. To level off at an airspeed below the tech order climb speed, lower the nose to level flight and retard the PCL sufficiently to reduce the airspeed. The magnitude of the airspeed change will determine your power setting. As you approach the desired airspeed, adjust power as necessary to maintain it.

9.2.2. To level off at an airspeed higher than climb speed, leave power at maximum until approaching the desired airspeed and then reduce the PCL to the power setting that will maintain it. The magnitude of any power change will determine the lead point for advancing or retarding the PCL.

9.3. Turns and Turns to Headings. In high performance aircraft, it is possible but impractical to maintain a constant rate of turn, using the turn needle. This is especially true at higher altitudes and under

instrument conditions in turbulence. Use the turn needle only in an emergency; use the attitude indicator for bank control in all turns.

9.3.1. **Normal Turns:**

9.3.1.1. For a normal turn, use 30 degrees of bank.

9.3.1.2. Enter a turn by applying steady coordinated pressure on the aileron and rudder in the direction of the turn. Refer to the attitude indicator to control bank. In level turns, maintain a constant altitude and airspeed by cross-checking the attitude indicator and performance instruments.

9.3.1.3. Increase the pitch attitude, as necessary, to counteract the loss of lift when the aircraft is banked. Apply corrective pressures only when the flight instruments indicate deviations. The cross-check is basically the same as that used for straight-and-level flight.

9.3.1.4. When the desired level of bank is reached, it may be necessary to exert slight aileron pressure in the opposite direction. This prevents the bank from increasing beyond the desired amount. Maintain an exact angle of bank.

9.3.1.5. Adjust the power to hold a constant airspeed. As the bank is established, a small increase in power is usually required.

9.3.1.6. Reverse these procedures to return to straight-and-level flight. As the miniature aircraft on the attitude indicator approaches wings level, resume a normal flight cross-check and return the power to the level flight rpm.

9.3.2. **Turns to Headings:**

9.3.2.1. Enter a normal turn with smooth and coordinated control pressures. Start the rollout before reaching the desired heading because the aircraft will continue to turn as long as the wings are banked.

9.3.2.2. Pilot technique determines the lead point on the heading indicator. As a starting point and guide, use one-third the angle of bank as the number of degrees to lead the desired rollout heading. Develop a consistent roll-in and rollout rate. Make no attempt to play the rollout. If you miss your heading after rollout, change the lead point until you determine the proper amount needed. If the number of degrees to be turned is less than 30 degrees, the angle of bank should not exceed the number of degrees to be turned. If the number of degrees to be turned is more than 30 degrees, normally use a 30-degree bank.

9.3.2.3. Precise turns to headings are required in actual instrument flight. The success of an actual instrument approach depends on turning to and maintaining specified headings.

9.4. Steep Turns:

9.4.1. A turn with greater than a 30-degree angle of bank is seldom advisable when flying on instruments. Practice steep turns at 45 or 60 degrees of bank at both normal and high cruise airspeed.

9.4.2. Enter a steep turn by applying steady, coordinated control pressures in the direction of the turn. The attitude indicator is the pitch and bank control instrument. Set a power setting to control airspeed. The performance instruments will indicate the need for corrections.

9.4.3. It is more difficult to control the pitch attitude in steep turns because of the greater loss in vertical lift with the increased bank angle. Because there is a tendency to lose altitude in steep turns, take

corrective action as soon as you detect the need. Remember, the fuselage of the miniature aircraft must be kept slightly above the straight-and-level position. After making the attitude change, check the altimeter and VSI to determine whether the correction was adequate.

9.4.4. You can minimize G forces if you don't allow the vertical velocity to go below zero. However, anticipate the need for changes in pitch because the VSI will lag behind actual aircraft performance. Because any back stick pressure involves an increase in the AOA, the drag will increase and the airspeed will decrease. The tendency is noticeable in normal turns, but will increase markedly as the bank increases. Therefore, as you enter the steep turn, anticipate the addition of power to maintain a constant airspeed.

9.4.5. Use a constant angle of bank during steep turns and correct the altitude by adjusting the pitch attitude. However, if you are losing or gaining excessive altitude, make a corresponding decrease or increase in bank to help correct the pitch attitude. With practice, you will learn to do steep turns without varying the bank.

9.4.6. Power control is much more critical in a steep turn than a normal turn. Because of the back pressure required to counteract the loss of vertical lift, the airspeed will dissipate more rapidly than normal as you enter the steep turn. It will also build more rapidly as you roll out. Return to straight-and- level flight smoothly, using a normal rate of rollout. The vertical lift will increase during the rollout, and the aircraft will tend to climb. Make pitch corrections as soon as they are needed and readjust the power to maintain airspeed. A reduction of power is necessary as soon as you initiate rollout.

9.5. Airspeed Changes:

9.5.1. Establishing and Maintaining Airspeed:

9.5.1.1. To establish and maintain an airspeed, refer to the airspeed indicator and adjust the power or aircraft attitude. A knowledge of the approximate power required to establish a desired airspeed will aid in making power adjustments. After you establish the approximate power setting, cross-check the airspeed indicator to see if you need additional power adjustments. Make it a point to learn the approximate power settings for various airspeeds and configurations throughout a normal mission.

9.5.1.2. Airspeed changes require a rapid cross-check and good pitch control. Referring to the attitude indicator, altimeter, and VSI and using trim during these changes will help control the aircraft attitude.

9.5.1.3. When you observe an airspeed deviation, correct as necessary with power and pitch. For example, if you are below the desired altitude and fast, a pitch adjustment may correct both airspeed and altitude. Conversely, a pitch adjustment made at a desired airspeed will induce the need for a power adjustment. This is more noticeable at slow airspeeds.

9.5.1.4. To change airspeed in straight-and-level flight, adjust the power and/or speed brake. To increase airspeed, advance the power beyond the setting required to maintain the new airspeed. As airspeed increases, the aircraft will gain lift and have a tendency to climb. Adjust the pitch attitude to maintain altitude. When the airspeed approaches the desired indication, reduce the power to an estimated setting that will maintain the new airspeed.

9.5.1.5. To reduce airspeed, retard the power below the setting for the new airspeed. As the airspeed decreases, the aircraft will lose lift and have a tendency to descend. Adjust the pitch attitude to maintain altitude. When the airspeed approaches the desired indication, advance the power to an estimated setting that will maintain the new airspeed. You may use the speed brake for large or rapid airspeed reductions. It is best to reduce the power to the estimated setting and then extend the speed brake. Approaching the new airspeed, retract the speed brake and adjust the power, if required.

9.5.2. **Change of Airspeed in Turns.** The procedures for making a change of airspeed in turns are the same as for airspeed changes in straight-and-level flight. Airspeed changes in turns are taught to speed up your cross-check and improve your aircraft control. Your instructor may vary the amount of turn to give you practice in rolling out before, after, and as you reach your target airspeed. The use of trim is very important during airspeed changes. Along with your cross-check, trim will help maintain altitude while you adjust airspeed.

9.6. Constant Airspeed Climbs and Descents:

9.6.1. **General.** Many instrument flight procedures require constant airspeed climbs and descents. Perform climbs and descents at low, normal, or high cruise. If a change in airspeed is necessary, you should normally make the change before starting the maneuver.

9.6.2. **Constant Airspeed Climbs:**

9.6.2.1. To enter the climb, simultaneously increase the power and adjust the pitch on the attitude indicator to maintain the desired airspeed. Only a slight amount of back pressure is necessary to change from level flight to a climbing attitude.

9.6.2.2. Once you establish the climb, your instructor may have you change the pitch attitude so the airspeed is 2 to 5 knots low. You will note a definite change on the VSI. Use this knowledge as an aid to maintaining a constant airspeed. To regain 2 knots, adjust the pitch to change the vertical speed by approximately 100 fpm (or by 200 fpm to regain 5 knots). In climbs, as in level flight, use the VSI as an aid in pitch control.

9.6.2.3. To make a leveloff at a predetermined altitude, refer to the altimeter for a lead point. A technique for determining the amount of lead to use on leveloffs (climbs and descents) is 10 percent of VSI. As you start the leveloff, reduce the pitch attitude by reference to the attitude indicator and adjust power to maintain airspeed.

9.6.2.4. To attain level-flight attitude, cross-check the altimeter and VSI to determine if the pitch attitude is approximately correct for level flight. Use power as necessary to maintain airspeed and adjust the pitch to maintain altitude. It may be necessary to trim slightly during and after the leveloff.

9.6.3. **Constant Airspeed Descents:**

9.6.3.1. To enter the descent, reduce the power and adjust the pitch attitude on the attitude indicator. The amount of pitch change will vary with airspeed and power setting. Maintain the desired airspeed during entry. Use VSI to help maintain constant airspeed climbs (as stated in paragraph **9.6.2.**). Use the speed brake to expedite a constant airspeed descent. This will require larger pitch changes.

9.6.3.2. To level off, retract the speed brake (if extended), adjust the pitch attitude for level flight, and simultaneously adjust the power to maintain the desired airspeed. Do this when you reach the lead point for the leveloff. Reset the power and pitch for level flight, using the altimeter and VSI. Then resume a normal cross-check for straight-and-level flight.

9.6.4. **Constant Airspeed Climbing and Descending Turns.** Simultaneously, use the techniques to establish the bank for a level turn and the pitch for a straight climb or descent during the entry to a constant airspeed climbing or descending turn. Level off as in straight climbs and descents.

9.7. Constant Rate Climbs and Descents:

9.7.1. **General.** Initially enter constant rate climbs and descents from level flight, maintaining an airspeed of 150 KIAS and a vertical speed of 1,000 fpm. If a change of airspeed is necessary, make the change before starting the maneuver. As proficiency increases, perform rate climbs and descents at different airspeeds, vertical velocities, and configurations.

9.7.2. **Constant Rate Climbs:**

9.7.2.1. To enter the climb, simultaneously advance power to the approximate climb power setting. Adjust pitch to the proper attitude to maintain airspeed. After the vertical speed stabilizes, readjust pitch and rpm as necessary to maintain the desired vertical speed and airspeed. Maintain heading with the heading indicator.

9.7.2.2. Any deviation from the desired rate of climb on the VSI indicates a need for a change in the pitch attitude. Coordinate pitch and power corrections closely. For example, if the vertical velocity is correct but the airspeed is high, reduce the power. As power is decreased, increase pitch slightly to avoid a decrease of vertical velocity. A leveloff from a rate climb is the same as a leveloff from a constant airspeed climb.

9.7.3. **Rate Descents.** The technique and cross-check are exactly the same as those used for climbs. The only differences are the pitch attitude and power setting. A leveloff from a rate descent is the same as a leveloff from constant airspeed descents. Rate descents have many practical applications in instrument flight procedures. Radar and ILS approaches require rate descents during the final approach. The precision with which you perform a rate descent could mean the difference between breaking out of a low ceiling and landing or executing a missed approach.

9.8. Instrument Slow Flight. Before performing an instrument approach, you should practice instrument slow flight to become familiar with aircraft handling characteristics. Practice instrument slow flight at airspeeds and configurations specified for an instrument final approach. This exercise may also be used to become familiar with the aircraft handling characteristics during visual straight-ins.

9.9. Vertical-S (A, B, C, and D):

9.9.1. Accomplish vertical-S maneuvers as described in AFMAN 11-217, Volume 1.

9.9.2. These maneuvers are designed to improve your instrument cross-check, including pitch, bank, and power control. Procedures for maintaining the descent or climb are exactly the same as those for constant rate climbs and descents. Pitch and power coordination are essential.

9.9.3. Establish a climb or descent at a rate of 1,000 fpm. After each 1,000-foot change of altitude, use the lead point for a leveloff as a starting point for the reversal in vertical direction. The use of trim

increases the ease of aircraft control. A rapid crosscheck is necessary during the changes in vertical direction. You must anticipate the need for a power change before reaching the 1,000-foot point because you cannot stop the vertical velocity in an instant. Use power as necessary to maintain 150 KIAS throughout the maneuver.

9.10. Confidence Maneuvers. The aileron roll and wingover are taught to show that an aircraft can be flown safely through extreme attitudes by reference to instruments. The attitude indicator is the most useful instrument in extreme pitch and bank attitudes. Before performing any maneuver, be sure to accomplish the appropriate checklists. If maneuvers are flown in a series, you are not required to run the checklist between individual maneuvers. Start both maneuvers with power set at 80 percent and lower the nose to attain an entry airspeed of 220 KIAS. Accomplish the maneuvers as described in AFMAN 11-217, Volume 1.

9.11. Unusual Attitudes:

9.11.1. An unusual attitude is any unexpected or inadvertent attitude that is encountered but not required for normal instrument flight. Some possible causes of unusual attitudes are slow cross-check, spatial disorientation, turbulence, transition from VFR to IFR, and extreme attitudes resulting from combat tactics.

9.11.2. Use the attitude indicator as the main recovery instrument after verifying it is operating properly and an unusual attitude exists. Do this by comparing control and performance instruments.

9.11.3. Bank interpretation and control response are most important in recovering from unusual attitudes. In high performance aircraft, an inverted diving attitude is the most critical situation. Proper bank correction to return to right side up is mandatory; you <u>must</u> initiate it before pitch correction. From inverted (beyond 90 degrees of bank) diving attitudes, the aircraft must first be rolled to less than 90 degrees of bank to avoid excessive loss of altitude or exceeding aircraft design limits.

9.11.4. From steep climbing attitudes, the aircraft must be rolled toward a 90-degree banked attitude to allow the nose to slice smoothly to the horizon to avoid stalling or negative Gs. By rolling toward the 90-degree bank attitude, the nose will fall naturally to the horizon and enough back pressure can be held to keep you comfortably in your seat.

9.11.5. The initial recovery is made by referring to the attitude indicator. As long as the horizon bar is visible on the EADI or standby attitude indicator, similar indications of attitude can be observed. However, in extreme pitch attitudes, the horizon reference goes out of sight. If the miniature aircraft has a black background, you are diving; if it has a blue background, you are climbing. In other than extreme pitch attitudes, the background coloring and lettering (climb or dive) may be used to determine if you are upright or inverted.

9.11.6. If the aircraft is diving, roll (or continue the roll) toward wings level, adjust power and extend the speed brake as appropriate, and return to level flight. If you are inverted, back pressure will only increase the loss of altitude. Therefore, hold only enough back pressure to keep well seated until the bank is less than 90 degrees.

9.11.7. If the aircraft is climbing, use power as required and roll (or continue to roll) to bring the bank pointer toward the nearest 90-degree bank index mark. Maintain the bank and back pressure to remain well seated. As the fuselage dot of the miniature aircraft approaches the horizon bar, adjust bank to establish a wings-level attitude. Depending on airspeed, adjust pitch as necessary to regain

straight-and-level flight. Then complete the recovery with minimum altitude loss. In some cases, recovery can be made before reaching 90 degrees of bank. This recovery is similar to the wingover maneuver.

9.11.8. Recovery from unusual attitudes on partial panel (without the attitude indicator) is an emergency procedure. Refer to AFMAN 11-217, Volume 1, for this procedure.

9.12. VOR Orientation:

9.12.1. Previously, most of your instrument flying has been basic instrument maneuvers. They have been performed with no specific relation to a fixed ground reference. The VOR provides a fixed reference from which these basic maneuvers can be performed in a planned sequence.

9.12.2. The maneuvers and procedures explained in the remainder of this chapter are used to arrive at a definite fix and, if necessary, to hold at a fix until the controlling agency can clear you for an instrument approach and landing.

9.12.3. Information for operation of the equipment is in Section 1 of TO 1T-6A-1 (flight manual). Procedures for time-and-distance check, homing, course interception, maintaining course, and station passage are in AFMAN 11-217, Volume 1.

9.13. DME Orientation:

9.13.1. DME extends the instrument capabilities of the T-6 by providing continuous slant-range distance information. It also permits position orientation, groundspeed checks, arcing, proceeding direct to a radial or DME fix (fix-to-fix), and improved instrument guidance when flying VOR/DME approaches. Detailed procedures for using the DME are in AFMAN 11-217, Volume 1.

9.13.2. Remember, the distance displayed on the DME indicator is the slant-range distance between the aircraft and a tactical air navigation (TACAN) or DME station, not a VOR station. You are receiving course guidance from one station and DME information from another, but these two stations may or may not be collocated. Instrument approaches using VORTAC, but designated TACAN should not be flown because the VOR portion has not been flight checked.

9.14. Instrument Departures. Although you are normally provided radar vectors during instrument departures, published departure procedures are usually provided to expedite traffic flow if departure control radar malfunctions. These departure procedures afford a safe and fast method for aircraft to transition from the takeoff leg to IFR altitudes and routes. Your IP will have you practice instrument departures during advanced instruments. Normally, you will use tech order climb speed during departures, and any intermediate leveloffs will be flown at the tech order climb speed for that altitude.

9.15. Holding. Procedures for entering, holding, and leaving the holding pattern are described in *FLIP General Planning;* AFMAN 11-217, Volume 1; and TO 1T-6A-1 (flight manual). Normal holding airspeed is 150 KIAS, but DO NOT use less than 120 KIAS or the maximum endurance AOA mark for holding at all altitudes. To descend in the holding pattern, adjust the power as required (speed brake is optional) and maintain holding airspeed.

9.16. Penetrations and Descents. In instrument flying, two methods are used to depart the en route structure and prepare for the final approach and landing. One is the penetration, which uses a published

descent specifying altitudes and courses. The other is the en route descent, which is not published, but is requested from the controlling agency. The decision to use one or the other is based on many factors, as follows:

9.16.1. **Penetration:**

9.16.1.1. Entry airspeed for penetration will depend on whether penetration is started on station passage from an en route cruise or a holding pattern. If holding is not required, reduce to penetration airspeed or below before crossing the initial approach fix (IAF). If holding is required, entry airspeed is holding pattern airspeed.

9.16.1.2. Complete the descent check before departing the IAF. Also, ensure you are familiar with the minimum and emergency safe altitudes, field elevation, and other recovery information (weather, altimeter setting, type of approach, etc.).

9.16.1.3. There are numerous techniques for accomplishing an instrument penetration. One option is to simultaneously reduce power to 25 percent and lower the nose of the aircraft to approximately 10 degrees nose low on the attitude indicator until the airspeed approaches 200 KIAS. Upon reaching 200 KIAS, reduce power to a setting below 10 percent torque. During this procedure, trim to relieve stick pressure and maintain 200 KIAS. For a 5-degree descent, use approximately 20 percent torque. Use the speed brake to prevent exceeding 250 KIAS below 10,000 feet mean sea level (MSL). If a penetration turn is required, use 30 degrees of bank. However, you may decrease bank to keep from undershooting the inbound course.

9.16.1.4. Monitor the altitude carefully during penetration. Because of the high rates of descent associated with this phase of flight, you can easily misjudge the altitude and misread the altimeter. Carefully cross-check all needles and counter drums on the altimeter to prevent misreading the instrument by 1,000 or 10,000 feet—the two most common errors.

9.16.1.5. You may want to decrease the rate of descent as you approach leveloff altitude. To do so, decrease the pitch attitude and allow the airspeed to decrease. When you reach a normal lead point for leveloff, smoothly adjust the pitch to level flight and adjust power and speed brake. If you need to slow to gear-lowering airspeed immediately after leveloff, leave the speed brake extended, if desired.

9.16.1.6. Use the procedures in paragraphs **9.16.1.** - **9.16.1.5.** during normal teardrop VOR penetrations. They are designed to comply with descent gradients and altitude restrictions. They will also ensure you remain within the specified distance from the facility. During penetrations that use DME, you may alter these procedures as necessary to comply with altitude restrictions. Refer to AFMAN 11-217, Volume 1, for procedures for intercepting inbound courses. **Do not** transmit the geardown call until the gear is DOWN AND LOCKED.

9.16.2. **En Route Descent:**

9.16.2.1. You will frequently use an en route descent instead of a published penetration from an en route altitude to a final approach fix (FAF). This is a simple procedure that expedites air traffic movement. Airspeed, power settings, and speed brake are optional during an en route descent. Vary their use to comply with controller instructions.

9.16.2.2. Fuel consumption is an important planning consideration. Refer to AFMAN 11-217, Volume 1, for specific instructions regarding this type of instrument descent.

9.16.2.3. Before performing an en route descent, make sure you are familiar with the minimum and emergency safe altitudes, field elevation, lost communication procedures, and other associated recovery information.

9.17. Final Approach:

9.17.1. The penetration from en route altitude or the en route descent will lead you to an instrument approach procedure. These approaches are found in *FLIP* or your local in-flight guide. AFMAN 11-217, Volume 1, has basic procedures for all types of approaches. Reference the TO 1T-6A-1 (flight manual) for emergency procedures.

9.17.2. The airspeed for all instrument final approaches (other than crosswind or emergency conditions) is 110 KIAS. Configuration is landing gear, landing lights, and takeoff flaps down. Before glidepath interception on precision and visual approaches and before the FAF on nonprecision approaches, configure, slow to 110 KIAS, and complete the Before-Landing Checklist. With crosswind or gusty wind conditions, configure using flap settings and airspeeds used on final during contact conditions. For configuration purposes, the FAF on an airport surveillance radar (ASR) approach is the point at which the controller directs descent to the minimum descent altitude (MDA).

9.17.3. The transition-to-landing phase begins when visual contact is made with the runway environment. You may maintain the instrument glidepath to landing or transition to a visual glidepath such as the VFR overhead pattern. In either case, you may lower full flaps when the situation warrants. When lowering flaps to LND, slow to 100 KIAS. If you elect to maintain TO flaps, slow to 105 KIAS. For no flaps, maintain 110 KIAS.

9.17.4. In lower ceiling and visibility situations, be sure to establish adequate visual references with the runway environment before transitioning to a visual glidepath. Do not duck under or set up a high sink rate, which will result in a short or hard landing. See AFMAN 11-217, Volume 1, for further information on “duck-unders” and illusions during instrument transitions to landing.

9.18. Circling Approach:

9.18.1. A circling approach is a visual flight maneuver flown at the completion of an instrument approach to align the aircraft with the landing runway. Use it when conditions such as wind, runway closure, etc., rule out a straight-in approach. Many variables exist in executing a circling approach. Consider airfield obstructions, weather, aircraft turning performance, and cockpit visibility in your preflight planning.

9.18.2. At circling MDA, the visual cues for runway displacement will be considerably different than those commonly used in the overhead pattern. Because the circling approach is generally flown at a lower altitude than the overhead pattern, proper displacement will appear to be much wider than normal. A technique that works well when circling at approximately 500 feet AGL is to put the wingtip on the landing runway. Remember to compensate for the existing winds and avoid excessive bank and back pressure. If any unfavorable situation develops during the approach, do not compromise safety. Instead, initiate an immediate go-around or missed approach.

9.18.3. While maneuvering at circling MDA, fly 120 KIAS with takeoff flaps and gear. Extend additional flaps on base leg or final, if desired. Maintain 120 KIAS until established on final. If visibility permits, attempt to establish a normal final approximately 1/2 mile from the runway, using 30 degrees

of bank. Additional procedures for executing a circling approach are in AFMAN 11-217, Volume 1, and TO 1T-6A-1 (flight manual).

9.18.4. A low closed traffic pattern was devised to allow practice circling approaches in the local traffic pattern. The prerequisites for requesting a low closed traffic pattern are the same as for a normal closed traffic pattern. Radio procedures are the same except you add the word "low" to your request and downwind call.

9.18.5. Plan the pullup to attain the desired lateral downwind position at approximately 500 feet AGL. Use normal closed traffic procedures during the pullup and on downwind. Because the downwind altitude is lower, the power and pitch requirements are different.

9.18.6. Lower gear and TO flaps on downwind and maintain 120 KIAS minimum while circling to land. Extend additional flaps on base or final, as desired, using normal circling procedures. With gusty wind conditions, configure by using flap settings and airspeeds used on final during contact conditions.

9.19. Landing. The primary purpose in performing any instrument approach is to land. The transition from instrument to visual references to complete the landing is critical. Therefore, you must completely understand AFMAN 11-217, Volume 1, information about landing from instrument approaches. You may elect to increase the flap setting when transitioning to a visual glidepath for the landing.

9.20. Missed Approach:

9.20.1. Execute a missed approach any time you cannot complete a safe landing from an instrument approach. Advance the PCL to maximum and establish a climbing attitude on the attitude indicator that is 10 degrees above your existing level-flight reference. Cross-check the VSI and altimeter for climbing indications. When definitely climbing, raise the gear and flaps. If an immediate turn is necessary, ensure you have a safe airspeed.

9.20.2. Ensure a positive climbing attitude is maintained. When the airspeed reaches 160 KIAS, adjust the power and pitch as required. Maintain a constant airspeed climb until reaching missed approach altitude. Cross-check all instruments to ensure the proper heading and climb are maintained. Level off and maintain a minimum of 160 KIAS if successive approaches are desired or accelerate to appropriate airspeed if diversion is necessary. Follow the missed approach procedure until you have coordinated for another clearance. Then follow the instructions given by approach control or ATC.

9.21. Voice Procedures. Air-to-ground communication is almost wholly dependent on use of the voice. That is, control of air traffic locally and along the airways is predicated entirely on voice communication. With the ever-increasing amount of air traffic, there is a corresponding increase in the number of voice transmissions required to control the traffic. Therefore, good voice procedures are not merely desirable, but mandatory. Refer to *FLIP General Planning* for voice procedures, position reporting, and phraseology.

9.22. Spatial Disorientation Maneuvers. The spatial disorientation maneuvers listed in paragraphs **9.22.1.** through **9.22.5.2.** have been selected because of their relation to normal instrument or turbulent flight. These maneuvers should be simulated and practiced only under direct supervision. More violent and prolonged maneuvers may have a disorienting effect, but they are not the type of maneuver or situa-

tion likely to be inadvertently encountered. For further information on spatial disorientation, carefully study Chapter 22 of AFMAN 11-217, Volume 1.

9.22.1. **Sensation of Climbing While Turning:**

9.22.1.1. **Demonstration.** Having the pilot's eyes closed while the aircraft is in a straight-and-level attitude can induce this sensation. With a relatively slow entry, the IP should execute a well coordinated 90-degree turn, using about 1 positive G. While the aircraft is turning under the effect of positive G and with the pilot's eyes still closed, the IP should ask the pilot's impression of the aircraft attitude. The usual sensation is that of a climb.

9.22.1.2. **Correlation Under Actual Instrument Conditions.** If the aircraft enters a slight, coordinated turn in either direction while the pilot's eyes are diverted away from the instruments, the sensation of a nose-up attitude may occur. If the angular acceleration in the turn is too little to stimulate the inner ear, the change in G force caused by the turn is the only sensation perceived. Positive G is usually associated with a climb; negative G is usually associated with a dive or noseover.

9.22.2. **Sensation of Diving During Recovery From a Turn:**

9.22.2.1. **Demonstration.** This sensation can be created by repeating the turning procedure described in paragraph **9.22.1.** except the pilot keeps his or her eyes closed until the recovery from the turn is approximately one-half completed. While the recovery is being executed and with the pilot's eyes still closed, the IP should observe the pilot's impression of the aircraft attitude. The usual response is that of the aircraft descending.

9.22.2.2. **Correlation Under Actual Instrument Conditions.** If the pilot's eyes are diverted from the instruments during a turn under instrument conditions, a slow recovery will cause the body to perceive only the decrease in positive G force. This sensation causes the pilot to believe the aircraft has entered a descent.

9.22.3. **False Sensation of Tilting to Right or Left:**

9.22.3.1. **Demonstration.** This sensation may be induced from a straight-and-level attitude with the pilot's eyes closed. The IP should maintain wings level and use the right rudder to produce a slight skid to the left. The usual sensation is that of being tilted to the right.

9.22.3.2. **Correlation Under Actual Instrument Conditions.** If the pilot's eyes are momentarily diverted from the instruments as a skid to one side occurs, a false sensation of tilting the body to the opposite side may occur.

9.22.4. **False Sensation of Motion Reversal:**

9.22.4.1. **Demonstration.** This false sensation can be induced from a straight-and-level attitude with the pilot's eyes closed. The IP should roll the aircraft at a constant rate of 1 to 2 degrees per second to a 30- to 45-degree bank angle. The roll should be stopped abruptly and the bank attitude held. The usual reaction is a sense of rapid rotation in the opposite direction.

9.22.4.2. **Correlation Under Actual Instrument Conditions.** If the aircraft rolls or yaws with an abrupt stop while the pilot's eyes are diverted from the instruments, a sensation of rolling or yawing to the opposite direction may occur. Therefore, the natural response to this false sensation would result in a reentry or an increase of the original roll or yaw. This response is a common error

in rolls or spins when the visual references are poor. The sense of sight is the only sense that should be relied upon for correct recovery techniques.

9.22.5. **Sensation of Climbing:**

9.22.5.1. **Demonstration.** This maneuver may be demonstrated by starting from a straight-and-level flight attitude at the aircraft's normal final approach airspeed and then adding power and accelerating straight ahead. The supervisory pilot should ask the pilot (whose eyes are still closed) what his or her sensation is of the aircraft's attitude. The usual sensation perceived without visual reference is that of the aircraft climbing.

9.22.5.2. **Correlation Under Actual Instrument Conditions.** This sensation may be very strong during an instrument missed approach. The false sensation of an excessive climb is produced by the change in aircraft attitude and acceleration. This sensation may occur before the climb and after leveloff.

9.23. Conclusion:

9.23.1. This chapter ties together the reasons for all of the previous basic instrument maneuvers. Actual instrument flying is nothing but a series of basic instrument maneuvers flown in a sequence depending on the route flown, weather, air-traffic congestion, etc. You should be able to make an ITO and a tech order climb speed to altitude and navigate from one fix to another, using VOR and DME equipment. On arriving at your destination, you should be able to hold or, when cleared, penetrate, make an approach, and land at the airport.

9.23.2. The power settings in **Table 2.1.** are approximate; use them as a guide. They will vary with fuel load, temperature changes, and different aircraft.

Chapter 10

NAVIGATION

10.1. Introduction. This chapter is a short review of navigation techniques, but it is not intended to replace a through knowledge of AETC TRSS HO 11-1, *Navigation for Pilot Training.* (See Web site **http://trss3.randolph.af.mil/bookstore//general.htm** under Nav4Pilots.)

10.2. Preparation for Flight. Navigation is an integral part of flying and a culmination of knowledge and skills you have learned in academics and other phases of training. Thorough preflight planning is the key to a successful navigation flight. Preparations for the flight may actually begin days before departure. You can select the base and route early, leaving wind computations, fuel requirements, and weather conditions until just before filing the required flight plan. Remember, the publications normally carried on the aircraft are for the local flying area. Therefore, because your planned route or a possible weather divert may take you to an area not covered by these local publications, you should obtain other publications before departing the home field.

10.3. Preflight Planning:

10.3.1. Plan your flight at optimum altitudes and airspeeds consistent with mission requirements, safety, and sound flight planning. Include a review of airfields en route for possible emergency or diversion use. A good technique is to circle these fields on your map for ready reference in flight. These emergency airfields should be compatible with T-6 landing requirements.

10.3.2. Carefully examine the aircraft-servicing capabilities of your destination and alternate airfields. Some aircraft transient maintenance personnel, particularly at nonservice installations, may not be totally familiar with T-6 servicing procedures. Refer to the strange-field procedures section of your flight crew checklist for proper fuel, oil, hydraulic fluid, oxygen, and tire-pressure requirements. If you have any doubts about the ability of transient maintenance to properly service your aircraft, check with your IP before filing your flight plan.

10.3.3. When completing takeoff data, variables such as pressure altitude, temperature, and runway data can cause major deviations from the computations associated with home-field operations.

10.4. Ground Operations. Ensure transient alert personnel are familiar with starting and poststarting procedures. After receiving your ATC clearance, check it against your original plan to ensure you can comply with changes.

10.5. Departure. Before takeoff, plan for departure by reviewing departure routing and altitude restrictions. Ensure all NAVAIDs and GPS are set up appropriately. ATC may change your clearance by giving you radar vectors, changes in altitude, or changes in route of flight. The better your preflight plan, the easier you can handle these changes. At leveloff, make a comparison of aircraft position and fuel remaining against the preplanned position and fuel. Any significant deviations may require a change of flight plan.

10.6. En Route:

10.6.1. Outside the local training environment, it is very easy to forget the required in-flight checks. The same checks are required; only the location has changed.

10.6.2. Once you have reached cruise altitude and set the power to maintain your preplanned airspeed, check your groundspeed. Compare your actual groundspeed with your preplanned computations to determine the effects of actual wind. When crossing the checkpoints, compare your fuel and time to the preplanned computations. A significant deviation may require a change in the flight plan.

10.6.3. A good technique is to write down assigned radio frequencies. This will aid you if contact is not made on the next assigned frequency. Return to the previous frequency and confirm the new frequency when necessary.

10.6.4. Maintain a constant awareness of position through the use of NAVAIDs or GPS, map-reading, and dead reckoning (DR). A radio or NAVAID failure can occur at any time.

10.7. Arrival and Landing. Refer to **Chapter 9** in this manual and AFMAN 11-217, Volume 1, for the descent and instrument approach. Determine what type of approach to expect at the destination before you commit yourself. Some approaches require extensive cruise at lower altitudes, which may not be desirable because of excessive fuel consumption. From this planning, you should be familiar with airfield layout, approach lighting, type of glidepath guidance, field elevation, runway data, tower and ground control frequencies, etc. Wide runways (more than 150 feet) may contribute to high flares and dropped-in landings; narrow runways may cause late or incomplete flares and hard landings.

10.8. After Landing:

10.8.1. 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. Be sure the aircraft will be properly secured.

10.8.2. Tell transient maintenance how to contact you should any questions arise or unusual situations be encountered after you leave the aircraft. Remember, the aircrew is ultimately responsible for the aircraft until it is returned to the home 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 your aircraft, contact your SOF before any servicing is begun.

10.9. Low-Level Navigation on Military Training Routes (MTR). The purpose of low-level navigation is to fly a selected ground track and arrive at a designated time over target (TOT). Low-level flying requires extensive preflight planning to ensure flight safety and maximum training from each sortie.

10.9.1. **Preflight Coordination.** The first step in preparing for low-level missions is to become completely familiar with the route requirements and applicable publications; that is, *FLIP AP/1B,* AETC TRSS Handout 11-1, and *Chart Update Manual (CHUM)*.

10.9.2. **Mission Planning:**

10.9.2.1. Select a groundspeed that is easily converted to miles per minute, but allows for required airspeed corrections (180, 210, or 240 knots). Reference the charts in TO 1T-6A-1 (flight manual) for the required fuel flow for the planned true airspeed. For normal planning purposes, use 210 knots groundspeed.

10.9.2.2. During premission planning, check the forecast weather for the route. Use the forecast temperature, pressure altitude, and winds to compute the indicated airspeeds required for the planned groundspeed.

10.9.3. **Route Development:**

10.9.3.1. Use a 1:500,000 scale map—tactical pilotage chart (TPC)—when flying low levels or VFR legs below 5,000 feet AGL. You may also use a 1:250,000 scale map—joint operations graphic (JOG)—on low-level routes.

10.9.3.2. After drawing the route corridor, update the chart with the latest information from the *CHUM*. This step is imperative for flight safety. Next, study the route corridor to identify all significant obstacles and high terrain.

10.9.3.3. Select a target and easily recognizable turn points for navigation. The best features for turn points are usually natural (as opposed to manmade) because natural features seldom change. Choose these turn points for uniqueness, vertical development, funneling features, and surrounding terrain. Avoid using a feature that may be hidden by high terrain or trees.

10.9.3.4. Choose an initial point (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. At the IP, continue running elapsed time to the target. Begin timing at your start route point.

10.9.3.5. The start point must be within the route corridor, but it does not necessarily have to be at the published entry point. When picking turn points, consider the turning room required to remain within the route corridor. Remain clear of any *FLIP*-directed, noise-sensitive areas or airfields. Wherever possible, choose easily identifiable points along the route to update and fine-tune course navigation. Where no such points exist, rely solely on DR.

10.9.3.6. A thorough and detailed map study is essential after developing the route. Reading the shape of the land from the map is also important. A JOG may initially help you interpret data if you are using a TPC. Try to visualize all the key points on the route, and the general features around them, so you can minimize reference to the map while airborne. Funneling features such as converging ridgelines, rivers, and roads are especially helpful in locating selected points.

10.9.4. **Map-Marking.** In addition to the information required in AETC TRSS Handout 11-1, you should make the following marks (or computations) on your map:

10.9.4.1. Draw in the MTR corridor from entry to the planned exit point. Circle turn points to prevent masking critical details.

10.9.4.2. Draw and label timing lines along the planned ground track. A 1- or 2-minute interval is sufficient.

10.9.4.3. Draw information boxes aligned with each leg, to include heading, leg time, and any other relevant information.

10.9.4.4. Highlight any obstacles or high-terrain features that may be a factor along the route.

10.9.4.5. Compute a 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 AFI 11-202, Volume 3, fuel reserves.

10.9.4.6. Compute a bingo fuel that includes the required minimum AFI 11-202, Volume 3, fuel reserves for return to base by the most practical means from the most distant point on the route. Consider factors such as cloud ceilings, winds, freezing level, and forecast icing when calculating the bingo fuel.

10.9.4.7. Compute and clearly annotate a route abort altitude for the low-level route. This altitude will provide 1,000 feet of clearance (2,000 feet in mountainous terrain) from the highest obstacle within 10 nm of the planned course.

10.9.4.8. Annotate the map with emergency and alternate airfield locations and information necessary to expedite an unplanned divert.

10.9.4.9. Plan the routing to and from the low-level route. Look for points that may help identify the start point. Ensure each map has identical turn points, IPs, targets, headings, and times.

10.9.5. **Flying the Route:**

10.9.5.1. If the mission is planned properly, flying accurate headings and airspeeds on each leg will get you close to your turn points, IP, and target. Rely on DR.

10.9.5.2. If the MTR is close to your base and departure procedures allow DR to the entry point, fly your planned headings, airspeeds, and times from takeoff to the entry point. On routes that are a long distance away or at bases that require extensive IFR vectoring prior to route entry, find a point en route at which you can begin DR. In either case, a VOR radial/DME or GPS way point is an excellent way to confirm an entry point.

10.9.5.3. Before arriving at the entry point, compare the electronic horizontal situation indicator heading with the magnetic compass to ensure accuracy. Identify the point as early as possible and maneuver the aircraft to overfly the entry point on the correct heading. Once inside the route structure, accelerate to the preplanned airspeed. Start your stop watch as you pass the start point.

10.9.5.4. Do not continuously map-read because this will jeopardize safety and may lead to mis-identifying points. Instead, use selective map-reading by only looking for prominent points along the route. Look for points that are 30 seconds to 1 minute ahead of the aircraft; avoid looking at points behind the aircraft. Trimming the aircraft and setting the proper fuel flow or power setting for the planned groundspeed can greatly aid low-level navigation by providing a stable platform.

10.9.5.5. As much as possible, keep your head out of the cockpit. Clearing is essential at low level. When looking at the map, do not look into the cockpit. Raise the map so some forward clearing still exists. but never totally block forward vision with the map. Make corrections as necessary to get back on track and time, but avoid excessive changes if possible.

10.9.5.6. As much as possible, visually assess the height above the ground. Occasionally, cross-check the altimeter against the known elevation of towers, lakes, airfields, and peak elevations.

10.9.5.7. Develop a work cycle for performing cockpit duties, assessing altitude, and updating aircraft position. Identify a turn point as early as possible and review the next heading and airspeed. If you are unable to acquire the turn point, do not panic. Turn on time and then try to analyze the reason for not seeing the turn point. Attempt to confirm position with other features.

Remember that throughout the route, 500 feet AGL is a minimum altitude. An unfamiliar route, poor visibility, a mountainous terrain, or a number of other factors may require a higher altitude.

10.9.5.8. Turns at low altitude require extra emphasis in clearing and aircraft control. Clear in the direction of the turn. Then roll to the planned bank angle and use back pressure and power as required to maintain altitude and airspeed. Cross-check pitch and bank closely, using outside references to prevent a descent and ensure proper clearing.

10.9.5.9. Arrive over the IP as close to possible to your planned time. Make small corrections as early as possible to prevent large airspeed changes later.

10.9.5.10. Avoid becoming complacent during the return to base. Give the return leg the same emphasis you gave the route entry leg.

10.9.6. **Mountainous Terrain:**

10.9.6.1. Flying low level in an environment with rapidly changing terrain is demanding and requires constant positional and situational awareness. Realize that low-lying check or turn points can easily be hidden when off the planned track. Be alert for areas of turbulence on the downwind side of large features and fly upwind of ridges whenever possible.

10.9.6.2. To fly safely over high terrain features, begin the climb early enough to arrive at the desired AGL altitude at least 2,000 feet prior to the high terrain. Very large altitude increases may warrant calculation of a start climb point to ensure minimum clearance is maintained. When descending, use an appropriate power reduction to control airspeed.

10.9.7. **Route Abort:**

10.9.7.1. You may need to abort a low-level route for various reasons, to include insufficient fuel to complete the route, aircraft malfunction, bird hazards, and weather. Low-altitude flight increases the danger of distraction and complicates the recovery or ejection decision. To successfully abort a route and deal with complicating factors, thoroughly prepare before you fly and prioritize tasks correctly.

10.9.7.2. If 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.

10.9.7.3. If IMC, immediately climb to the computed route abort altitude or higher, maintain preplanned ground track, and attempt contact with the appropriate ATC agency. If you are required to fly IMC before contact with ATC, fly the proper VFR altitude.

10.9.8. **Conclusion.** Flying high performance aircraft on low-level missions is a deadly serious business. You are flying at high speeds close to the ground in a high-threat environment. The threat is not enemy aircraft or air defense weaponry, but it is just as real and more deadly. (The ground has a 100 percent probability of a kill.) Remember, your margin for error and time to react are greatly reduced due to the close proximity of the ground. Thorough preflight planning and preflight briefings are imperative for safe and effective low-level training. As a minimum, use the low-level navigational briefing guide in AFI 11-2T-6, Volume 3.

10.10. Forms Adopted. AF Form 847 and AFTO Form 781.

RONALD E. KEYS, Lt General, USAF
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Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

AFI 11-2T-6, Volume 1, *T-6 Aircrew Training*

AFI 11-2T-6, Volume 2, *T-6A Aircrew Evaluation Criteria*

AFI 11-2T-6, Volume 3, *T-6 Operations Procedures*

AFI 11-202, Volume 3, *General Flight Rules*

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

AFI 11-214, *Air Operations Rules and Procedures*

AFMAN 11-217, Volume 1, *Instrument Flight Procedures*

AFI 11-218, *Aircraft Operation and Movement on the Ground*

TO IT-6A-1, *Flight Manual, USAF/USN Series T-6A Aircraft*

AETC TRSS Handout 11-1, *Navigation for Pilot Training* (See the following Web site: http://trss3.randolph.af.mil/bookstore//general.htm.)

Flight Information Publication (FLIP)

General Planning

AP/1 and AP/1B

Chart Update Manual (CHUM)

Flight Information Handbook

Abbreviations and Acronyms

AETC—Air Education and Training Command

AGL—above ground level

AGSM—anti-G straining maneuver

AOA—angle of attack

ATC—air traffic control

CDI—course deviation indicator

DME—distance measuring equipment

DR—dead reckoning

EADI—electronic attitude indicator

ELP—emergency landing pattern

FAF—final approach fix

FCP—front cockpit pilot

fpm—feet per minute

GPS—global positioning system

IAF—initial approach fix

IFF—identification, friend or foe

IFR—instrument flight rules

ILS—instrument landing system

IMC—instrument meteorological conditions

IP—instructor pilot

ITO—instrument takeoff

JOG—joint operations graphic

KIAS—knots indicated airspeed

LOC—loss of consciousness

LOS—line of sight

MAX—maximum thrust position

MDA—minimum descent altitude

MOA—military operations area

MTR—military training route

NACWS—Naval Aircraft Collision Warning System

NAVAID—navigational aid

nm—nautical mile

NORDO—no radio

NRST—nearest airfield

OBOGS—onboard oxygen-generating system

OBS—omni-bearing selector

OCF—out of control flight

PCL—power control lever

PEL—precautionary emergency landing

PF—pilot flying

PNF—pilot not flying

RCP—rear cockpit pilot

RESCAP—rescue combat air patrol

rpm—revolutions per minute

RSU—runway supervisory unit

SOF—supervisor of flying

TACAN—tactical air navigation

TOLD—takeoff and landing data

TPC—tactical pilotage chart

UHF—ultra high frequency

VFR—visual flight rules

VHF—very high frequency

VMC—visual meteorological conditions

VORTAC—very high frequency omnidirectional range station and tactical air navigation

VOR—very high frequency omnidirectional range station

VSI—vertical speed indicator