NAVAL AIR TRAINING COMMAND

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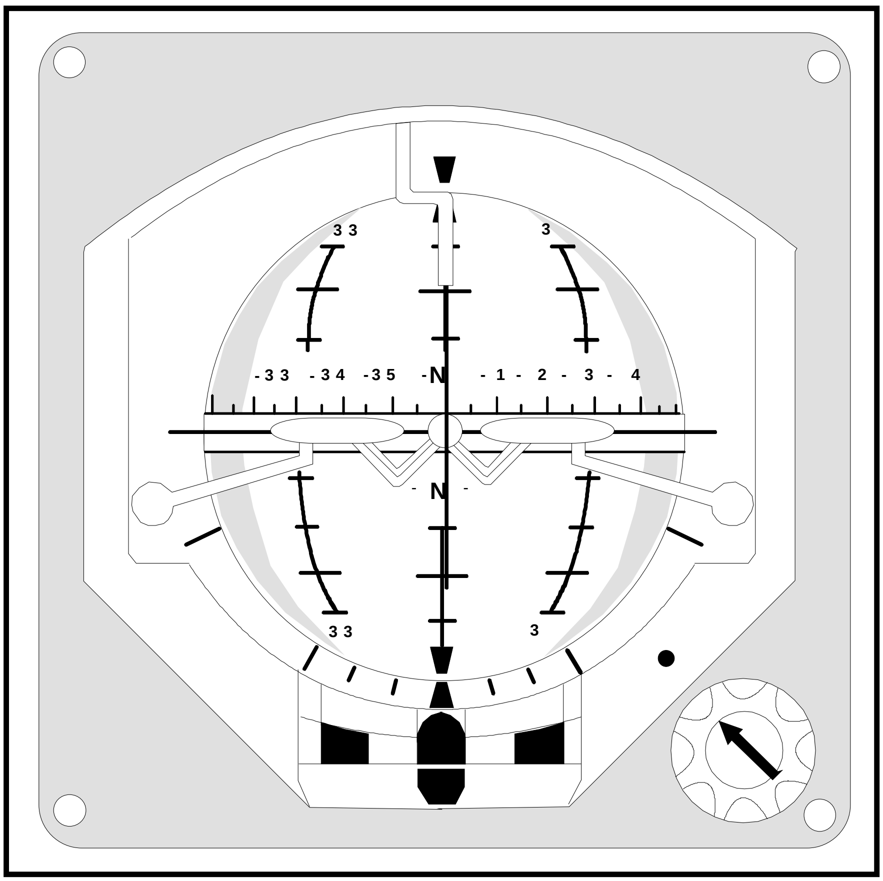

FLIGHT TRAINING INSTRUCTION
T-45TS, ADV, and IUT

2000

T-45A FLIGHT TRAINING INSTRUCTION

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FLIGHT TRAINING INSTRUCTION
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FLIGHT TRAINING INSTRUCTION

FOR

INSTRUMENT FLIGHT

T-45A

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HOW TO USE THIS FTI

This Flight Training Instruction (FTI) is the textbook used for all the instrument flight training conducted for the UJPT, Advanced, E2-C2, and IUT stages. It is the source document for all procedures related to those stages. In addition, it includes suggested techniques for performing each maneuver and making corrections.

Use your FTI to prepare for lessons and hands-on events and afterward to review. Reading requirements for BI, RI, AN, and IR flight procedures are contained in Appendix A, "Lesson Preparation" along with the course learning objectives. The end of stage exam will be based on these objectives. Complete the required reading prior to each lesson. This information will help you effectively prepare for lessons: know all the procedures in the assigned section(s), review the glossary, and be prepared to ask your instructor about anything that remains unclear. Then you can devote your attention to flying the T-45A. After a flight, review the FTI materials to reinforce your understanding and to clarify any difficult maneuvers or procedures.

Note that this FTI also contains information on emergencies related to this stage. This section of the FTI amplifies but does not supplant the emergency procedures information contained in the T-45A NATOPS manual.

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INTRODUCTION

The ultimate goal of instrument training is to enable you to fly your aircraft in an operational environment under all weather conditions.

Basic Instruments (BI) places primary emphasis on aircraft control. Here you will learn the fundamental procedures and patterns that enable you to progress to radio instrument navigation.

In Radio Instruments (RI) you will acquire the complex skills to navigate by reference to radio instruments. In this stage, you will learn the procedures for planning local instrument navigation flights and for identifying your aircraft's position in relation to radio navigational aids on the ground.

In Airways Navigation (AN) you will put all of your instrument training into the real world context of cross-country flight in instrument conditions. During the AN phase, you will refine the techniques acquired in RI to properly plan and complete extended training flights, complying with all enroute and terminal procedures.

As you have probably realized by now, AN will be one of the most demanding stages of your training, and it will require much studying and planning. Here, a thorough working knowledge of procedures is essential to your success on cross-country flights.

As important as the navigation procedures you will learn in RI and AN are, you must always remember your priorities while in flight. Remember the rule: "Aviate, Navigate, Communicate." Perform these functions in that order. Maintaining desired flight parameters and monitoring aircraft systems should be your first priority. Don't become preoccupied with navigation at the expense of basic air-work. Remember, fly the aircraft first.

NOTES

BACKGROUND

While some of the ideas presented in this FTI will be new to you, most will be familiar from your T-34 training. Remember though that you will be performing the same procedures in a much faster aircraft; consequently, events will happen more quickly than you have experienced, so your margins for error will be reduced.

The importance of having the aircraft properly trimmed at all times is paramount. During any maneuver, your trim should be such that the stick has a very light feel. Remember, the idea is for you to fly the aircraft, not for the aircraft to fly you.

TRANSFER OF AIRCRAFT CONTROL

There will always be a two-way communication when transferring control of the aircraft. Since you will be in the rear cockpit and usually under the hood, simply release the controls when the instructor says, “I have the controls.” You will then reply, “You have the controls.”

In the event of a suspected ICS failure, the instructor may remove his mask and say, “I have the controls,” and will shake the stick to take control. Stow the hood so that you can maintain visual communication with the instructor. The instructor may also pump the stick to pass control back to the student.

SENSATIONS OF INSTRUMENT FLIGHT

During flight, you use the sense of sight to determine the aircraft’s attitude in relation to the earth’s surface. In visual flight conditions, you determine attitude by reference to the horizon and flight instruments. During instrument flight conditions, when the horizon is not visible, you can determine attitude only by reference to aircraft instruments.

Under instrument flight conditions, the sense of sight may disagree and conflict with the supporting senses, and equilibrium may be lost. When this happens, you may become susceptible to spatial disorientation (false perception of position, attitude, or motion) and vertigo. The degree to which this occurs will vary with the individual, his or her proficiency, and the conditions which induced it. To recognize and overcome the effects of false sensation that may lead to spatial disorientation, you must understand the senses affecting your ability to remain oriented.

The ability to maintain equilibrium and orientation depends on sensations, or signals, from three sources: motion sensing organs of the inner ear; postural senses of touch, pressure, and tension; and sense of sight. If one of these sensory sources is lost or impaired, you reduce your ability to maintain equilibrium and orientation.

MOTION

The sense of motion originating in the inner ear is very important in a person’s normal ground environment. The inner ear registers linear and rotational acceleration and deceleration; thus it is able to detect turns, slips, and skids during flight. Unfortunately, it is not capable of distinguishing between centrifugal force and gravity.

Linear Acceleration

Centrifugal force and gravity are often fused together in flight, and the resultant force can only be interpreted visually. For example, without visual aid, a decrease in airspeed while turning may cause the inner ear to sense a reverse turn; therefore, you must not rely on these unreliable sensations as a primary cue.

Rotational Acceleration

The other function of the inner ear is to sense rotational acceleration. This is accomplished by the semicircular canals which sense head movement in any of the three dimensions. Normally the semicircular canals work quite well, but their weakness is that the whole system depends on the slight displacement of fluid within the canals. In the first place, the sensitivity of the canals is limited; a slow entry into a turn may not get over the threshold of stimulation, and may not give the sensation of entry into the turn at all. Secondly, when there are sensations, they may be misleading.

False Sensations of Motion

It is easy to see how illusions may arise if you compare the displacement of the fluid in the semicircular canals to the movement of water in a glass. If the glass is turned rapidly, the water will tend to remain in motion. The same type of thing happens in the semicircular canals, only on a smaller scale. The displacement of the fluid in the canals corresponds to the movements of the head only if the rotation is relatively slow and lasts for a short time. In a long turn or a sudden stop, the liquid behaves almost independently of the movement of the head; the inner ear transmits false messages to the brain. Consider how this can produce illusion in flight.

Suppose, during instrument flight, you commence a turn to the right. If your turn is slow, the fluid in the canals catches up with the motion of the body. If the fluid ceases to move, you will sense that the turning has stopped. Acting on this information alone, and still wanting to go to the right, you will turn right again, and get into a much tighter turn which may start a dangerous spiral. If, on the other hand, a relatively sharp turn is stopped, the fluid in the canals, like the water in a glass, will continue to be displaced, even after rotation has ceased. This will give the impression of turning in the opposite direction. Again, depending and acting on the equilibrium senses alone may precipitate entry into a dangerous situation.

WARNING

Extreme care should be taken to limit rapid head movements during descents and turns, particularly at low altitudes. Cockpit duties should be subordinate to maintaining aircraft control.

Another illusion is called “the leans.” The aircraft is banked quickly in rough air and a correct sensation of the attitude results. Then, a slow recovery is performed which does not cross the threshold of angular motion perception; the senses retain the feeling that the aircraft is still in a bank. The impression may be so strong that you may lean to one side in an attempt to assume what you suppose to be the vertical. This sensation is one of the strongest and most frequently experienced in instrument flight. It gives false impressions of both bank and pitch, particularly after entering a cloud in a turn.

POSTURAL SENSE

The postural sense derives its sensations from the expansion and contraction of muscles and tendons, touch and pressure, and the shifting of abdominal muscles. Without visual aid, this sense often interprets centrifugal force as a false climb or descent. The postural sense is also incapable of sensing airspeeds without acceleration or deceleration. Therefore, the postural senses, like those of the inner ear, are unreliable without visual aid. Without visual reference to the horizon or to flight instruments, you could interpret a steep turn as a steep climb, or a shallow descending turn as level flight. You must learn to subordinate these sensations when they conflict with visual reference to the flight instruments.

SIGHT
When blindfolded, you will find that the loss of visual reference to surrounding objects makes it difficult to stand and nearly impossible to walk a straight line. The inner ear and postural senses are relatively reliable when standing still. However, their reliability is different on a moving platform, such as an aircraft in flight. Without the aid of sight, these senses are unable to distinguish gravity, centrifugal force, or small forces of acceleration and deceleration from one another.

FALSE SENSATIONS
The sense of sight, supported by the sense of motion and the postural sense, is present whether orientation is maintained by reference to the horizon, flight instruments, or both.

For the proficient instrument pilot, orientation by reference to the flight instruments rarely produces false sensations of any consequence. In becoming such a pilot, you will learn to overcome any false sensations by relying on the sense of sight to the flight instruments. If these false supporting senses are relied upon during such a conflict, you can easily experience spatial disorientation.

You can minimize spatial disorientation by learning to disregard the false information produced by the supporting senses. Visual reference to the flight instruments is your only reliable solution for coping with spatial disorientation.

OPTICAL ILLUSIONS
Optical illusions result from misleading visual references outside the aircraft. These illusions usually occur at night or during marginal weather conditions when the pilot attempts to remain oriented by outside references, rather than the flight instruments. Although the sense of sight is reliable, visual illusions may cause severe spatial disorientation. You can avoid these illusions only by relying visually on the flight instrument indications.

Some examples of optical illusions are:

* A sloping cloud bank can create the illusion of flying in a banked attitude even though the aircraft is straight and level.

* Light reflected on the canopy or windshield may give the false impression of a steep bank or inverted flight.

* Lights on the ground may be interpreted as stars during a turn at night.

* When you are flying through clouds at night, the anti-collision and strobe lights may produce a false sensation that the aircraft is turning.

MAINTAINING SPATIAL ORIENTATION
The false sensations of instrument flight are experienced by most individuals. You will become less susceptible to those false sensations and their effects as you acquire additional instrument experience. Although these sensations cannot be completely prevented, you can and must suppress them by self-discipline, conscientious instrument practice, and experience. You must learn to control your aircraft by visual reference to the flight instruments. You must also learn to ignore or control the urge to believe any false inputs from the supporting senses. You must focus absolute concentration on the aircraft's performance as depicted on the attitude indicator and confirmed by the supporting instruments.

A few simple precautions to take on entry into instrument flight conditions can help you avoid disorientation:

1. Bring instruments into your scan one at a time (attitude indicator first).

2. Be wings level.

3. Have the aircraft trimmed for level flight.

4. Make all subsequent configuration changes while wings level.

Continuous changes between visual flight and instrument flight during periods of reduced visibility can easily result in disorientation. While in an environment of actual instrument flight conditions, disruption from a scan focused predominantly on instruments to an outside reference, such as the horizon or ground, can induce spatial disorientation.

In instrument flight, factors such as fatigue, boredom, and hypnosis are more likely to occur. To counteract this, you may occasionally move about in the seat, shake your head, or change the intensity of cockpit lighting.

FLIGHT PREPARATION

In preparing for an instrument flight in the simulator or aircraft, you should first look at the Briefing Guide to determine what maneuvers and tasks you'll be responsible for during the flight. Based on the contents of the Briefing Guide, consult the FTI, the T-45A NATOPS manual, and your other study materials to gain a full understanding of the procedures and maneuvers before you climb in the cockpit.

Simulator time and especially flight time are precious resources: always employ this training time as efficiently and effectively as possible. The time to study is before the flight.

NOTES

AIRCRAFT INSTRUMENTATION

Aircraft flight instruments are divided into three categories according to their specific function: control instruments, performance instruments, and position instruments.

CONTROL INSTRUMENTS

The control instruments enable you to provide a proper combination of pitch, roll, yaw (attitude), and power control to achieve the desired aircraft performance. These instruments include: the ADI, RPM gauge, fuel flow gauge, and the slip indicator.

ATTITUDE DIRECTOR INDICATOR (ADI)

This instrument is the primary control instrument. It provides your primary indication for the aircraft's attitude using the horizon bar, bank pointer, pitch reference scale, and the attitude sphere. Whenever a deviation from a desired performance is indicated on one of the performance instruments, the correction should be made referencing the ADI. A standby attitude indicator is provided as an alternate attitude indicator in the event of failure of the primary ADI, and as a cross- check attitude instrument.

FUEL FLOW AND RPM GAUGES

These instruments both provide a reference to the proper control of the aircraft's engine. In many of the different maneuvers a specified rpm or fuel flow can be set to allow for the proper thrust to complete the maneuver. In some cases a range can be used to allow for other possible variables.

PERFORMANCE INSTRUMENTS

The performance instruments indicate how the aircraft is performing as a result of control changes. These instruments include: the airspeed indicator, the various heading indicators (magnetic compass, HSI, and ADI), vertical speed indicator, angle of attack indicator, clock, and turn needle. Although the altimeter is primarily used as a position instrument, in some maneuvers it can be used as a cross-check on aircraft performance.

POSITION INSTRUMENTS

The position instruments convey the aircraft's location in space and will determine what control changes are required to achieve the desired aircraft performance. These instruments include: the altimeter, number 1 and number 2 bearing pointers on the HSI, course deviation indicator (CDI), range indicator (DME) on the HSI, and the ILS azimuth and glideslope indicators in both the ADI and HSI.

INSTRUMENT SCAN

During instrument flight, the pilot must divide his attention between the control, performance, and position instruments. Proper division of attention and the sequence of checking the instruments varies throughout the various phases of flight. There is no one set order for scanning the instruments; it depends on the type of maneuver to be executed as to which instruments are of prime importance. The pilot should become familiar with the factors to be considered when dividing his attention between instruments. The pilot should know the indications which will enable him to identify correct and incorrect scan techniques.

The best way to improve proficiency is through practice. Some common errors in instrument scanning include the following: having no instrument scan pattern plan, omitting an instrument entirely from the scan, fixating on a single instrument, or misusing an instrument and its indication.

SCAN TECHNIQUE

A major factor influencing scan technique is the characteristic manner in which instruments respond to attitude and power changes. The control instruments provide a direct and immediate indication of attitude and power changes, but indications on the performance instruments have an inherent lag. Lag will not appreciably affect the tolerances within which the pilot controls the aircraft; however, at times, a slight unavoidable delay in knowing the results of attitude and/or power changes will occur.

When the attitude and power are smoothly controlled, the lag factor is negligible and the indications on the performance instruments will stabilize or change smoothly. Do not make abrupt control movements in response to the lagging indications on the performance instruments, without first checking the control instruments. Failure to do so leads to erratic aircraft maneuvers which will cause additional fluctuations and lag in the performance instruments. Frequent scanning of the control instruments assists in maintaining smooth aircraft control.

For every maneuver, the ADI is the primary reference instrument that should be scanned most frequently. The majority of the pilot’s time should be spent on the control of the aircraft attitude by referencing the ADI, supported by the control instruments. The remainder of the pilot’s time should be spent confirming the desired performance and position by quickly scanning those instruments.

GROUND PROCEDURES

Prior to taking off on an instrument flight, you must ensure that the instruments, navigation equipment, radios, aircraft lighting, and the hood are in proper operational condition.

INSTRUMENT CHECKLIST

Before each IFR flight, ensure that all the instruments, communications gear, and navigational equipment are in proper operating order by completing instrument checklist in NATOPs Chapter 19, reprinted below. Check the following list of equipment while in the chocks, prior to taxi. Items marked with an asterisk must be checked during taxi.

1. Check all communications and navigation equipment for correct operation.

2. Set navigation equipment to local station.

3. Check cockpit lighting, if necessary, and set as low as possible in order to retain night vision. Adjust the kneeboard light for use in reading approach plates, charts, kneeboard cards, etc.

4. Vertical speed indicator (VSI) - ZERO (Note error if not zero. The aircraft is down for IFR flight if the error exceeds +/- 100 ft.)

5. Mach-Airspeed indicator - ZERO

6. ADI - Adjust to mark on case, ensure pipper on horizon.

7. Altimeter - Set to field barometric pressure. (Note error if not equal to field height. The aircraft is down for IFR flight if the error exceeds +/- 75 ft.)

8. Clock - Set and running.

* 9. Standby compass - Swings freely, fluid full.

*10. HUD, HSI, ADI heading indicators - Check for proper operation while taxiing.

11. Turn needle and slip indicator - Check for proper functioning in a turn.

RADAR ALTIMETER

Procedures for RADALT usage are outlined in the Wing SOP. Those paragraphs concerning instrument flights are summarized below:

1. Takeoff - the front cockpit RADALT bug should be set to the 100 to 200 ft range for low altitude warning during climb out.

2. En route - the front cockpit RADALT bug should be set at 5,000 ft (platform) if above 5,000 ft AGL; and at the desired altitude; less by approximately 10 percent if below 5,000 ft AGL.

3. Penetration - during penetrations, the front cockpit RADALT bug shall be set at 5,000 ft AGL (platform) so the laws tone will serve as a warning to break the rate of descent. The bug should be “stair-stepped” down, through assigned/desired altitudes until down to approach minimums for instrument approaches.

NOTE: Set the bug at Height Above Touchdown for precision approaches.

HOOD USE
You will perform the majority of your instrument flights in the T-45A "under the bag", simulating instrument conditions in a VFR environment (Figure 1). The T-45A NATOPs manual contains specific instructions on installing and stowing the hood. Become familiar enough with the operation of the hood so that it does not impair your performance in other aircraft duties.

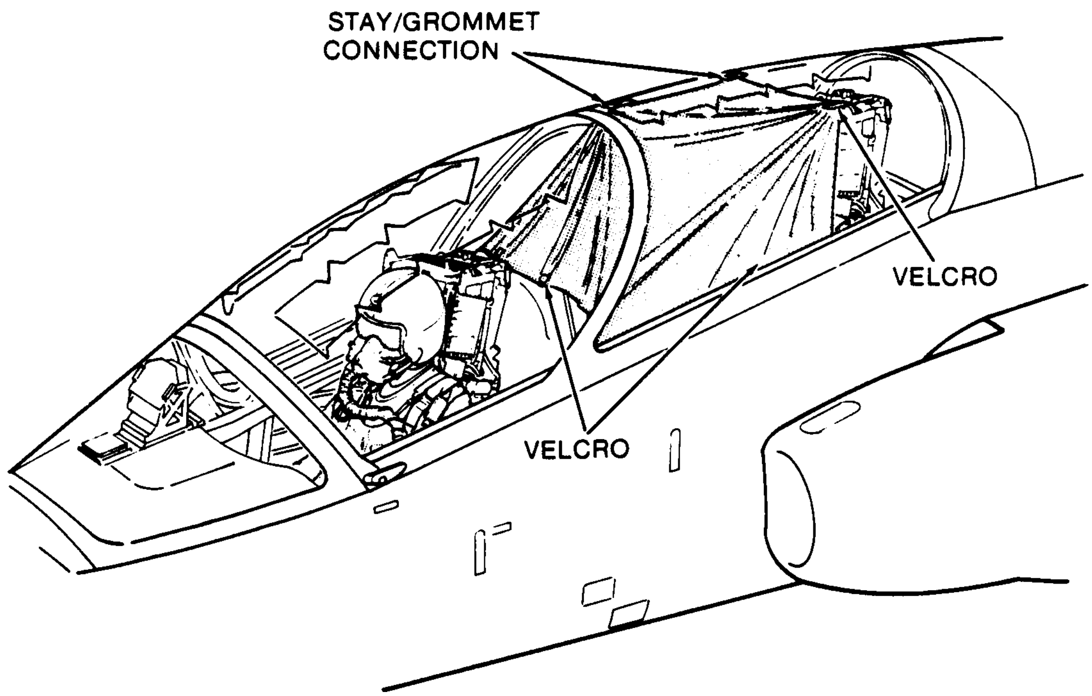


Figure 1: INSTRUMENT TRAINING HOOD

COCKPIT LIGHTING
When preparing for a night flight, set the cockpit lighting as low as possible to safeguard your night vision and reduce glare on the canopy while still enabling you to see your instruments. You should use a white lens in your flashlight for a night preflight (to detect hydraulic fluid leaks). Once in the cockpit, put a diffuser lens over the flashlight to reduce its intensity for use in the cockpit.

BASIC INSTRUMENT MANEUVERS

No matter how accomplished your instrument pilotage--regardless of how well you navigate on the airways or handle any type of approach--your skills originate with basic instruments. Flying the aircraft effectively, accurately, and safely reflects your ability to fly basic instrument maneuvers.

Everything that you do with an airplane in flight is accomplished through the application of a few basic maneuvers, singly or in combination--climbs and descents, turns, speed changes, and the transitions in and out of those maneuvers are the building blocks. For example, a complex TACAN or ILS approach is made up of nothing more than a series of turns, descents, speed changes, and transitions performed in a specific sequence. Your success in the instrument phase, particularly in the advanced stages of Radio Instruments and Airways Navigation, will ultimately depend on your ability to fly the basic instrument flight maneuvers.

Two things that will be repeatedly emphasized during instrument training are scan and trim. The key to executing basic instrument maneuvers successfully is to know the procedures and integrate control and scan efficiently. The ADI is at the center of your scan for most maneuvers and that you will have to trim continuously to maintain smooth and precise control of the aircraft.

NOTE: Students should read and be familiar with the Training Wing In-Flight Guide, but will not normally be responsible for area management while conducting BI events.

INSTRUMENT TAKEOFF (ITO)

The instrument takeoff maneuver is designed to give you confidence in taking off into a low ceiling or in conditions of poor visibility.

When you perform an ITO in the aircraft, your instructor will maintain control of the aircraft until approximately 80 KIAS, at which time he will give the aircraft to you. In the simulator you will, of course, perform the entire ITO. When the instructor initiates the transfer of control, you will acknowledge, “I have the aircraft,” and apply slight forward pressure on the stick. Your instructor will then reply, “You have the aircraft.” If required, your instructor may call, “Check left” or “Check right” to maintain heading control. Respond by using rudder to change heading 2 degrees in the appropriate direction.

Begin the ITO by lining the aircraft up on the centerline of the runway and noting the heading as displayed on the ADI. Runways are numbered to the nearest 10 degrees and you might see as much as 5 degrees difference in your heading system.

Hold the brakes and advance the power to MRT (Maximum-Rated Thrust). Perform your engine instrument checks, release the brakes, and start the takeoff roll. Maintain directional control with nose wheel steering while scanning/checking the engine instruments and monitoring airspeed. Because you are primarily monitoring airspeed as you anticipate the rotation speed of 120 KIAS, your scan should continue to center on heading (ADI) and airspeed.

At 120 KIAS, smoothly rotate to a takeoff attitude of 10 degrees noseup. Maintain directional control with the rudder and expect lift-off to occur at approximately 126-130 KIAS. Once airborne do not exceed optimum AOA. When you have a positive indication of climb on both the VSI and altimeter and are safely airborne, retract the gear with a minimum of 100 ft AGL. Once gear indicated up and locked (less than 200 KIAS), check gear handle for proper operation. If gear handle moves down with light pressure (less than 6 pounds of force), remain below 200 KIAS, abort mission, place gear handle DOWN, and land as soon as practical. Retract the flaps/slats with a minimum of 300 AGL and 140 KIAS wings level. From rotation airspeed until you clean up the aircraft, center your scan on the ADI for pitch, bank, and heading and on the airspeed indicator for speed, with quick checks of the altimeter and VSI prior to configuration changes. Maintain the nose attitude of 10 degrees noseup until climb speed is attained. Five KIAS prior to climb speed, increase nose attitude to intercept and maintain climb speed, approximately 15-20 degrees nose up.

Throttle: MRT

Nose wheel steering: Maintain directional control

Rotation: 5 KIAS prior to lift off, 10-12 degrees noseup (Do not exceed 17 units)

Lift-off: See NATOPS for chart

Gear: Positive climb on VSI and altimeter, and when safely airborne, 100 ft AGL minimum

CAUTION: The gear uplock mechanism can be overridden with 20-50 pounds of force applied to the gear handle.

Flaps/slats: After gear, minimum of 300 ft AGL and 140 KIAS, wings level

CAUTION: Landing gear and flaps/slats should be fully retracted before reaching limit speed of 200 KIAS.

LEVEL OFF CHECK

After level off, compare front & rear cockpit airspeed and altimeter (i.e. "ONE FIVE THOUSAND, MARK; TWO FIFTY, MARK"). If required, perform time hack: "Standby for time hack; THREE, TWO, ONE, HACK." The time hack can also be performed on deck and checked at altitude.

CONSTANT AIRSPEED CLIMBS AND DESCENTS

Constant airspeed climbs and descents will introduce you to the principle that changing the aircraft nose attitude (pitch) is the primary method of controlling airspeed when your aircraft is climbing or descending. Thus, the critical and challenging component of these maneuvers lies in establishing a pitch angle that results in a climb or descent with little or no change in airspeed. You will use constant airspeed climbs during departure and constant airspeed descents for cruise and penetration descents.

Because you are using nose attitude (pitch) to maintain airspeed during these maneuvers, the primary instruments to scan are the ADI for pitch and bank control and the airspeed indicator for performance. You will need to start picking up the altimeter in your scan as the maneuver progresses so that you can identify the point at which you'll transition to level flight. Your scan should center on the ADI and altimeter during the period from lead point to assigned altitude because you will be trying to arrive at a pitch attitude that represents level flight at the same time you reach your altitude. To perform a smooth level off at the correct speed, you will always need to start your transition to level flight by coordinating power and nose attitude.

CONSTANT AIRSPEED CLIMB

When beginning at normal cruise airspeed, maintain heading and advance the throttle to MRT. Simultaneously establish a noseup attitude of 8 to 10 degrees on the ADI to maintain 250 KIAS. During the climb, use small nose attitude changes to maintain airspeed. Trim as necessary during the climb to maintain a very light feel on the stick. Include the ADI (for pitch and bank control) and the airspeed indicator (for airspeed information) in your scan during the entry and to maintain the climb. An occasional glance at the altimeter during the climb will let you know when you are nearing the lead point, at which time you'll incorporate the altimeter fully into your scan. When the aircraft reaches a lead point of 10 percent of VSI (for example, if the climb rate is 3,000 fpm, initiate the level off 300 ft prior to reaching the desired altitude), simultaneously reduce power to cruise and set nose attitude to maintain level flight. You should scan the ADI and altimeter during the period with occasional checks of airspeed from lead point to altitude because you will be trying to arrive at a pitch attitude that represents level flight at the same time you reach the altitude. Once you are established in level flight, retrim the aircraft.

Constant airspeed climb--normal cruise entry and exit:

Throttle: MRT

Pitch: Initially 8-10 degrees noseup to maintain 250 KIAS, then as required to maintain airspeed. Beginning in RI stage, lower the nose to approximately 3 degrees and accelerate to 300 KIAS at 10,000 ft. Adjust nose and trim as necessary to maintain 300 KIAS climb until intercepting .72 indicated mach number (IMN). This occurs at approximately 25,000 ft.

Level off: Lead by 10 percent of VSI or 1,000 ft prior if the VSI is pegged at +6,000 fpm.

Throttle: Cruise (see table of cruise airspeeds and fuel flows in INSTRUMENT FLIGHT PLANNING). For BI stage maintain 250 KIAS in the climb. Plan to level at 250 KIAS at an altitude specified by your instructor. For level flight at 250 KIAS set approximately 1200 pph at 15,000 ft MSL.

Pitch: Adjust for level flight

Trim: Adjust for level flight

To initiate a climb from a cruise airspeed lower than desired climb airspeed, advance power to MRT while trimming the nose down as required to maintain level flight. When the airspeed approaches a 5-KIAS lead point, smoothly raise the nose to maintain climb airspeed (250 KIAS less than 10,000 MSL, 300 KIAS/.72 IMN above). You are actually accomplishing two separate maneuvers in this instance: a level speed change followed by a constant airspeed climb. Your scan needs to change with the maneuver being performed. Be sure that your scan includes the ADI for pitch, bank, and heading control, and the VSI and altimeter for pitch performance during the acceleration to desired airspeed. During the climb be sure that you scan the ADI for pitch and bank control and the airspeed indicator for airspeed performance.

CONSTANT AIRSPEED DESCENT

The constant airspeed descent mirrors the constant airspeed climb, with the power being reduced instead of advanced and pitch decreased as required to maintain cruise airspeed. As with constant airspeed climbs, you will maintain airspeed by adjusting pitch, and you should hold a constant heading throughout the maneuver. Use the same scan as for the climb.

When beginning this maneuver from cruise airspeed, reduce power to idle and smoothly establish a nosedown attitude of 3 to 6 degrees to maintain 250 KIAS. As in a constant airspeed climb, control airspeed by making small pitch changes. Use a lead point of 10 percent of the VSI for exiting the maneuver; when you reach the lead point, increase power to the cruise setting and establish a pitch attitude that results in level flight. Retrim the aircraft at the end of the maneuver.

Constant airspeed descent--normal cruise entry and exit:

Throttle: Reduce to idle

Pitch: 3-6 degrees nosedown to maintain 250 KIAS

Level off: Lead by 10 percent of VSI

Throttle: Increase to cruise power (approximately 1200 pph at 15,000 ft MSL)

Pitch: Level flight attitude

Trim: Adjust for level flight

If you are at an airspeed of less than 250 KIAS, begin the constant airspeed descent by smoothly decreasing the nose attitude 3 to 6 degrees nose-low, allowing the airspeed to approach 250 KIAS (5-KIAS lead) and then reducing the power to idle and continuing the descent in the normal manner.

CONSTANT RATE CLIMBS AND DESCENTS

Serving as the foundation of the more complex “S pattern” maneuvers, constant rate climbs and descents are somewhat more difficult than the constant airspeed climbs and descents because you must maintain a given airspeed, heading, and a specific rate of climb or descent.

In constant rate climbs and descents, control the rate of climb with power while simultaneously maintaining airspeed by adjusting nose attitude. A common mistake in these maneuvers is to attempt to control airspeed with power and climb rate with pitch. Also, pitch and power are interrelated and an adjustment to either one will affect the other, so you will have to coordinate an adjustment to one with an adjustment to the other. For example, if you advance power to increase your climb rate without simultaneously increasing pitch enough, your climb rate will increase and your airspeed will tend to increase.

Your primary scan for these maneuvers must include the ADI for pitch, bank, and heading control, the VSI for rate, and the airspeed indicator for airspeed. Avoid making abrupt adjustments in response to VSI indications because this instrument tends to lag behind the actual values, and you will find yourself chasing it.

The importance of keeping the aircraft correctly trimmed throughout these maneuvers can’t be overemphasized. If you don’t have the aircraft trimmed, it is much more likely that you’ll end up chasing the performance instruments.

CONSTANT RATE CLIMB

Entry speed for this maneuver is 200 KIAS (approximately 1100 pph) at a specified altitude and heading. Initiate a 1,000-fpm climb by advancing power to approximately 1500 pph while establishing a noseup attitude of approximately 2-3 degrees on the ADI to maintain airspeed at 200 KIAS. Monitor your heading on the ADI and ensure that it does not vary during the climb.

During the climb, you will control airspeed with pitch and rate of climb with power. Accomplish the transition to level flight just as you would for constant airspeed climbs. Lead the desired altitude by 10 percent of VSI, simultaneously reducing the throttle to cruise power and lowering the nose to level flight attitude.

NOTE: Plan enroute cruise airspeed with fuel conservation in mind. Unless directed differently by an IP, plan to fly the max range cruise IMN upon level off at altitude.

Constant rate climb entry and exit:

Throttle: 1500 pph

Pitch: Adjust to maintain 200 KIAS (approximately 2-3 degrees noseup)

Trim: Adjust for airspeed

VSI: Maintain 1,000-fpm climb

Level off: Lead by 10 percent of VSI

Throttle: Reduce to approximately 1100 pph

Pitch: Lower to level flight attitude

Trim: Adjust for level flight

CONSTANT RATE DESCENT

The constant rate descent is a mirror image of the constant rate climb. In a constant rate descent you will hold the rate of descent constant at 1,000 fpm and maintain an airspeed of 200 KIAS by simultaneously using power and pitch to control the rate of descent and airspeed.

Entry speed for this maneuver is 200 KIAS. Initiate a 1,000-fpm descent by reducing power to approximately 700 pph while establishing a nosedown pitch of approximately 1-2 degrees on the ADI to maintain airspeed at 200 KIAS. Monitor your heading on the ADI and ensure that it does not vary during the descent.

During the descent you will control airspeed with pitch and rate of descent with power. A common mistake in this maneuver is to attempt to control airspeed with power and descent rate with pitch. Avoid making abrupt adjustments in response to VSI indications because this instrument will tend to lag behind the actual performance of the aircraft, and you will find yourself chasing it.

Accomplish the transition to level flight just as you would for constant airspeed descents. Lead the desired altitude by 10 percent of VSI, simultaneously advancing throttle to cruise power while establishing a pitch reference for level flight.

Constant rate descent entry and exit:

Throttle: Reduce to 700 pph

Pitch: Adjust to maintain 200 KIAS (approximately 1-2 degrees nosedown)

Trim: Adjust for airspeed

VSI: Maintain 1,000-fpm descent

Level off: Lead by 10 percent of VSI

Throttle: Add power to approximately 1100 pph

Pitch: Raise to level flight attitude

Trim: Adjust for level flight

LEVEL TURNS

An essential element of many instrument procedures, level turns establish the foundation on which you will build more complex maneuvers. The key to executing these maneuvers successfully is to know the procedures and to integrate control and scan efficiently.

As you roll into a turn, the vertical component of lift will decrease, requiring a nose attitude correction to maintain a constant altitude--and, of course, the amount of correction required will increase as the turn becomes steeper. As the bank angle and aft stick pressure increase, airspeed will tend to decrease, so you will have to add power to maintain airspeed.

Prior to entering a turn, trim your aircraft on the correct heading, airspeed, and altitude. When you transition into a turn, use the ADI to establish the proper bank and pitch references, cross-check the altimeter/VSI for a level turn. After you are established in the turn, include the airspeed indicator in your scan. Monitor the ADI for roll-out point. During the roll-out, use the ADI to monitor both bank and pitch. As with all other instrument maneuvers, trim throughout the turn to keep pressure off the stick.

NORMAL TURNS

For turns of less than 30 degrees of heading change, use a bank angle that equals that change. For example, if a heading change from 020 degrees to 045 degrees were required (a 25-degree change), you would use a bank angle of 25 degrees. If the heading change is 30 degrees or greater, use a bank angle of 30 degrees.

Prior to entering the turn, you should be in straight and level flight with trim properly set. As you roll into the turn, you will lose some of the vertical component of lift, so you'll have to add power and aft stick (trim) to compensate.

Use a lead point of approximately one-third of the angle of bank for initiating your roll-out. As you roll out of the turn, the vertical component of lift will increase and the aircraft will have a tendency to climb. To counteract this, lower the nose attitude back to level flight reference and reduce power to the pre-turn setting. Any aft stick or trim added during the turn will have to come out when the turn is complete.

Heading change of 30 degrees or more: 30 degrees AOB

Heading change of less than 30 degrees: AOB equal to heading change

Throttle: Increase as needed to maintain airspeed

Pitch: As required to maintain level flight

Lead point for roll-out: 1/3 of the AOB

TURN PATTERN

Consisting of two pairs of left and right turns, the turn pattern gives you practice in smoothly performing a series of linked turns at a constant altitude and airspeed.

To begin the maneuver, make a 30-degree AOB turn for 60 degrees of heading change. Reverse into a 30-degree AOB turn to the original heading. Perform the final pair of reversing turns at 45 degrees AOB for a heading change of 90 degrees each. Execute the turn reversals smoothly, with no straight and level legs. At the end of the maneuver recover wings level on original heading.

Throughout the maneuver, maintain altitude and 250 KIAS, adding more aft stick and more power for each set of turns. When reversing turns, ease the back stick as you apply reverse aileron in order to avoid gaining altitude.

If you get ahead of the turn schedule, reduce AOB so to arrive on the heading on time. Always begin the turn reversal with the descent on the clock.

1/2 STANDARD RATE TURNS

A 1/2 standard rate turn (1/2 SRT) is performed at 1-1/2 degrees per second. Therefore, a heading change of 30 degrees will take 20 seconds to complete. To accomplish this rate at different airspeeds, you will have to vary the bank angle. A good rule of thumb for determining bank angle between 15,000 and 20,000 ft is to use approximately 10 percent of indicated airspeed. At higher altitudes, you will need more bank than 10 percent of indicated airspeed, while at lower altitudes you will need less bank than 10 percent of indicated airspeed to maintain a 1/2 SRT. For example, at 250 KIAS and 18,000 ft, the bank angle would be approximately 25 degrees. Establishing and maintaining a 1/2 standard rate turn at any altitude requires that you monitor the turn needle and adjust the bank angle as necessary to achieve one needle-width of deflection.

TIMED TURNS, 1/2 STANDARD RATE

For practice, you should start your 1/2 SRTs from a cardinal heading using a lead point of 3 seconds prior to the clock's second hand passing the 6 or 12 position. Roll into the turn on the ADI (approximately 25 degrees of bank at an airspeed of 250 KIAS) and adjust the pitch attitude to maintain level flight. Initially, scan the ADI for bank and pitch control, the VSI or altimeter for pitch, and the airspeed indicator for speed.

Once you have made the necessary pitch and power changes, check the turn needle and adjust the bank as necessary to maintain 1 needle-width of deflection. When the ADI shows 30 degrees of heading change, check that 20 seconds have elapsed on the clock. Always check the time when you reach the correct number of degrees of turn (not vice versa) to ensure that you are keeping your scan on the flight instruments rather than on the clock.

Continue to check the clock at least every 30 degrees of turn and adjust (AOB) rate of turn accordingly. If you are ahead of the clock, decrease AOB; if you are behind the clock, increase AOB. When you have the turn back on time, readjust your bank angle to a 1/2 SRT. Use no more than 30 or fewer than 10 degrees of bank when making your corrections.

Lead your roll-out by one-third of the angle of bank, simultaneously reducing power to the level flight setting if it has been advanced.

Bank angle: Approximately 10 percent of IAS (25 degrees at 250 KIAS)

Rate: 1-1/2 degrees per second

Throttle: As required to maintain airspeed

Pitch: As required to maintain level flight

Lead point for roll-out: 1/3 of the AOB

STANDARD RATE TURNS
Standard rate turns are performed at 3 degrees per second. Therefore a heading change of 30 degrees should take 10 seconds to complete. To accomplish standard rate turns at different airspeeds, you will have to vary the bank angle. A good rule of thumb for determining bank angle is to use approximately 20 percent of indicated airspeed. Because your maximum allowed angle of bank for maneuvering the aircraft in instrument flight is 30 degrees, you will not normally perform standard rate turns at cruise altitude and airspeed. You will, however, use SRTs in the slow flight maneuver and the GCA pattern.

TIMED TURNS STANDARD RATE
Use the same procedures and AOB limitations as 1/2 SRT except: establishing and maintaining a standard rate turn requires that you monitor the turn needle and adjust the bank angle as necessary to achieve a 2 needle-width deflection.

Bank angle: Approximately 20 percent of IAS

Rate: 3 degrees per second

Throttle: As required to maintain airspeed

Pitch: As required to maintain altitude

Lead point for roll-out: 1/3 of the AOB

TIMED TURNS (PARTIAL PANEL)
Timed turns are standard or 1/2 standard rate turns performed for a specific duration of time to enable you to turn to a specific heading. Because of the unreliability of the standby compass in turns, you will find it necessary to perform timed turns from a known heading in the event of a heading system failure.

Use the standby compass to determine the total number of degrees of the desired heading change. Compute the time required for the turn by dividing the heading change by the turn rate (1-1/2 or 3).

NOTE: For a half standard rate a simpler method to determine timing is to count the heading change in 30 degree increments, each of which equals 20 seconds. In a 90 degree turn there are 3, 30 degree increments (30, 60, 90). Therefore a 90 degree turn at 1/2 standard rate will take one minute. (3 increments X 20 seconds each = 60 seconds)

As the clock's second hand passes a cardinal point (3, 6, 9, or 12), smoothly roll into the turn, <u>do not lead time</u>. Adjust the bank angle as necessary to establish a 1/2 standard rate turn (approximately 25 degrees at 250 KIAS and 15,000 to 20,000 ft) and adjust pitch and power to maintain altitude and airspeed. Because of its smaller size, the standby AI will appear to move faster and less smoothly and you should be careful not to overcontrol the aircraft when flying partial panel. Correct only as necessary.

Roll out of the turn at the end of the computed time, readjusting pitch and power for level flight. Then check the standby compass to confirm that you are on the desired heading.

It is very important, especially during partial panel work, that you keep the airplane trimmed at all times.

Bank angle: Approximately 10 percent of IAS

Throttle: As required to maintain airspeed

Pitch: As required to maintain altitude

Lead point for roll-out: None--roll out at the end of the computed time

LEVEL SPEED CHANGES

Because pitch attitude must continuously change to maintain constant altitude during the speed change, you will need to pay close attention to pitch and trim. Thus, attitude control will be your primary problem in all level speed changes.

As you adjust the power to begin the maneuver, the change in thrust will tend to cause the nose attitude to rise or fall. As the airspeed and consequently the aerodynamic forces acting on the aircraft change, you will have to adjust and trim the nose attitude to maintain level flight. Your scan, then, needs to include the ADI as the control instrument for pitch and bank and the VSI and altimeter as the performance instruments for pitch. Remember that if you decide to use the VSI as the performance instrument for pitch, you must guard against chasing its movements, because it always lags slightly behind the actual performance of the aircraft. Proper trim technique will help you combat the tendency to chase the performance instruments. Because of the rapid changes in aerodynamic forces during the maneuver, you will need to adjust and trim the nose attitude continuously to maintain level flight.

WINGS LEVEL SPEED INCREASE

The power setting you use for increasing airspeed depends on the magnitude of the desired change. For an airspeed increase of less than 20 KIAS, you should advance the throttle beyond the power setting for the new airspeed, allowing the airspeed to increase, and then reduce the power to the approximate setting to maintain the new airspeed.

For airspeed increases greater than 20 KIAS, advance the power to MRT. Then, at a lead of 5 KIAS from the desired airspeed, reduce the throttle setting to approximately that required for the new speed. Use this method when you practice the speed change from 200 to 250 KIAS in the T-45A.

Throttle: Beyond power setting for desired airspeed or MRT for changes greater than 20 KIAS

Pitch: Decrease as required to maintain level flight

Trim: As required

Lead point for power reduction: 5 KIAS prior to new airspeed

WINGS LEVEL SPEED DECREASE

To perform normal airspeed decreases, reduce the power below the power requirement for the desired airspeed, allowing the airspeed to decrease, and then at a lead point of 5 KIAS, advance power as required for the new airspeed. As airspeed decreases, more noseup trim will be required to maintain level flight.

When making large or rapid airspeed decreases, reduce the throttle to the power setting for the new airspeed and extend and verify that the speed brakes are fully extended. When you extend the speed brakes, expect a pitch-up and anticipate the need to retrim the aircraft to maintain altitude. Because the airspeed will rapidly decrease, you will need to use a 5-KIAS lead point to retract the speed brakes to avoid undershooting your desired airspeed. Use this method when you practice the speed change from 250 to 200 KIAS in the T-45A.

To execute a small change in airspeed:

Throttle: Below power setting for desired airspeed

Pitch: Increase as required to maintain level flight

Trim: As required

Lead point for power advancement: 5 KIAS prior to new airspeed

To execute large or rapid changes in airspeed:

Throttle: To power setting for desired airspeed

Speed brakes: Extend

Pitch: Increase as required to maintain level flight

Trim: As required

Lead point for speed brake retraction: 5 KIAS prior to new airspeed

LEVEL SPEED CHANGES IN 1/2 SRT

The procedures for performing turning speed changes combine the same procedures you used for level speed changes and 1/2 standard rate turns. These maneuvers require a full understanding of the effects of bank, airspeed, pitch, and power on lift. Proper trim is of paramount importance during these turning speed changes because of the constantly changing pitch attitude needed to maintain level flight and the constantly changing AOB needed to maintain a 1/2 SRT.

Accelerating Timed Turn

Using a 3 second lead begin the maneuver by simultaneously advancing the throttle to MRT and rolling the aircraft to a bank angle (approximately 10 percent of the airspeed) for a 1/2 standard rate turn. You can accurately predict that the bank will require an increase in back stick pressure to maintain level flight. On the other hand, as the airspeed increases, the aircraft will tend to pitch up, requiring less aft stick to maintain level flight. To maintain solid aircraft control during the maneuver, you must perform a very efficient scan. Scan the ADI for pitch and bank control, the altimeter and/or VSI for pitch performance information, the airspeed indicator for power performance information, and the clock for turn performance information. Additionally, as airspeed builds, you will have to increase AOB to maintain a turn rate of 1 needle-width deflection. You will normally perform this accelerating airspeed turn from 200 to 250 KIAS.

Throttle: MRT (for 20 KIAS increase or greater)

Bank angle: Approximately 10 percent of IAS (1 needle-width)

Clock: Every 20 seconds for 30 degrees of heading change

Pitch: As required to maintain altitude

Lead point for roll-out: 1/3 of the AOB

Lead point for power reduction: 5 KIAS

Trim: As required

Proper trim is key to maintaining good aircraft control during the maneuver.

Decelerating Timed Turn

Begin the decelerating airspeed turn by using a 3 second lead simultaneously reducing the throttle to the power setting for the new airspeed while extending the speed brakes. Roll the aircraft to a bank angle giving a 1/2 standard rate turn (approximately 10 percent of the airspeed at altitude). When you extend the speed brakes, expect a pitch-up and anticipate the need to retrim the aircraft to maintain altitude. You can accurately predict that the bank will require an increase in back stick to maintain level flight. As the airspeed decreases, the aircraft will tend to pitch down, requiring further back stick to maintain level flight. Include in your scan the ADI for pitch and bank control, the altimeter and/or VSI for pitch performance information, the airspeed indicator for power performance information, and the clock for turn performance information. As airspeed falls, you will have to decrease bank angle to maintain a 1/2 SRT. Normally, this maneuver is performed from 250 to 200 KIAS.

Throttle: Setting for desired airspeed

Bank angle: Approximately 10 percent of IAS (1 needle-width)

Speed brakes: Extend (if 20 KIAS change or greater)

Pitch: As required to maintain altitude

Clock: Every 20 seconds for 30 degrees of heading change

Lead point for speed brake retraction: 5 KIAS

Lead point for roll-out: 1/3 of the AOB

Trim: As required

Again, keeping the pressure trimmed off the stick during the maneuver is an important element in accomplishing the maneuver smoothly.

“S” PATTERNS

The “S” patterns are scan builders that increase your skills in transitioning into and maintaining a rate of descent and climb. Additionally, the S-3 requires you to perform a 1/2 SRT while climbing and descending.

The altimeter and VSI lag, so the 3-second lead point for the initial descent allows you to position the aircraft at the proper attitude with the appropriate power setting. As the second hand keeps moving, the altimeter and VSI initially lag behind. Don’t make any adjustment at this time; let the altimeter and VSI catch up to the clock. The same rule applies for the other transitions: go to the suggested attitude and power setting and let the instruments catch up before you make any corrections.

S-1 PATTERN

The S-1 pattern consists of a 1,000-fpm descent for 1,000 ft followed by a 1,000-fpm climb for 1,000 ft (each maneuver lasting 1 minute in duration). This descent/climb sequence is performed a minimum of two times (Figure 2). Fly the entire maneuver on a constant heading and at a constant airspeed of 200 KIAS.

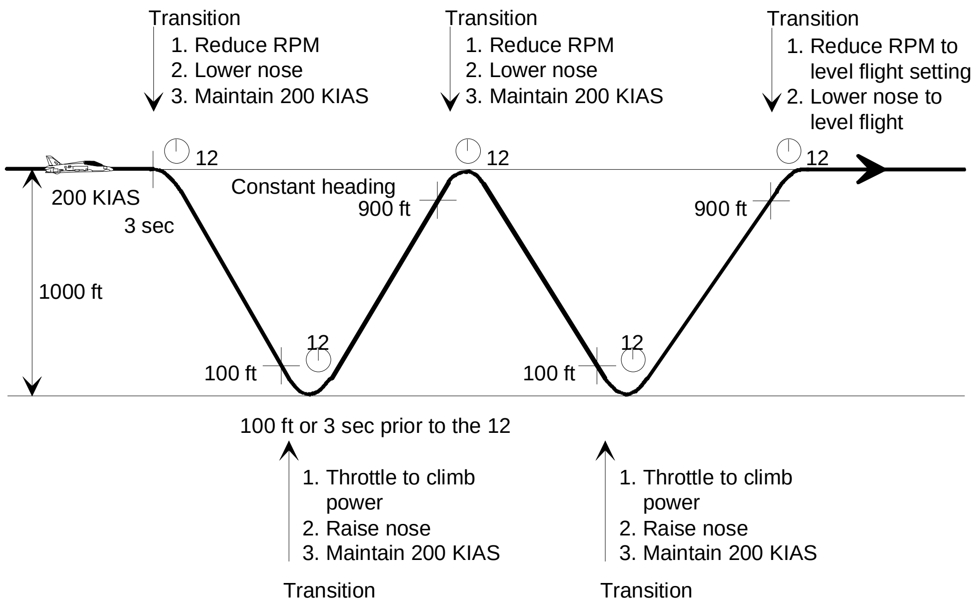


Figure 2: S-1 PATTERN

Initiate the maneuver at an airspeed of 200 KIAS by reducing power to approximately 700 pph and lowering the nose approximately 1-2 degrees, 3 seconds before the second hand reaches the 12 o'clock position on the clock. Descend at 1,000 fpm for 1,000 ft and then climb at 1,000 fpm for 1,000 ft. In order to transition from descent to climb and back to descent at the proper altitudes, start your transition 100 ft or 3 seconds (whichever occurs first) prior to the end of a climb or descent.

To maintain the climb/descent timed rate and airspeed, you will have to vary the pitch and power setting. Avoid making large power and pitch corrections by cross checking the VSI and keeping the vertical speed within +/- 300 fpm of your target rate. You use power to control the rate of climb/descent and pitch to control airspeed. When you reach the lead point for a climb or descent, set the throttle to the appropriate power setting and begin to rotate the nose smoothly to the new pitch angle. During climbs and descents, check the clock against the altimeter to ensure that your altitude has changed by 250 ft every 15 seconds. During climbs the altimeter pointer and second hand should mirror each other.

Near the end of the last climb in the maneuver, prepare for the transition back to level flight: 3 seconds or 100 ft (whichever occurs first) prior to level off, reduce power to the level flight setting and begin lowering the nose to the horizon. Be sure to control the rate of pitch change in order to reach a level flight attitude at the same time you reach level off altitude.

Power setting: Climb approximately 1500 pph; Descent approximately 700 pph

Pitch: Climb = 2-3 degrees noseup; Descent = 1-2 degrees nosedown

Clock: Cross-check with altimeter for 250 ft every 15 seconds

VSI: Steady at 1,000 fpm

Airspeed: 200 KIAS

Heading: Hold constant

S-3 PATTERN

The S-3 pattern combines the climbs and descents of the S-1 pattern with two 180 degree 1/2 standard rate turns. The turn is reversed at the beginning of the second descent. See Figure 3.

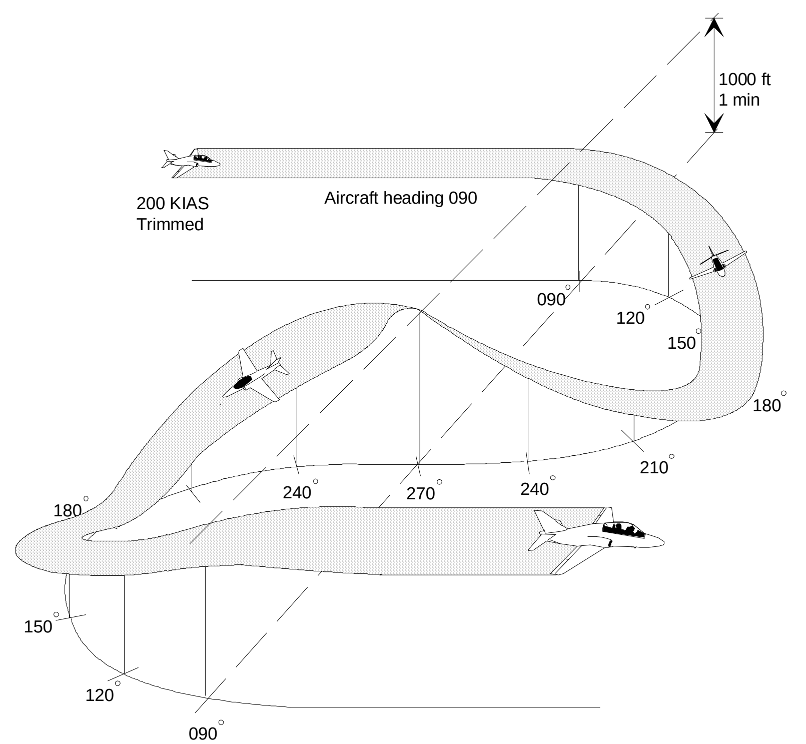


Figure 3: S-3 PATTERN

Once established at 200 KIAS, trimmed, and on assigned heading, begin the maneuver using a 3 second lead on the clock and simultaneously initiating a timed 1/2 SRT and timed 1,000 fpm descent. Adjust the AOB and 200 KIAS descent rate to arrive at the transition point of the descent or climb on time and on heading. (Approximately 3 seconds prior to the twelve o'clock position, 5 degrees short of the 90 degree turn, and 50 ft prior to the end of the 1,000 ft descent.) At the transition point begin 200 KIAS, 1,000 fpm rate climb while continuing the 1/2 SRT in the same direction for another 90 degrees of turn. During the climb adjust AOB to maintain rate of turn and power and pitch to maintain 200 KIAS, 1,000 fpm climb on the clock.

At the appropriate lead point of the climb, simultaneously reverse 1/2 SRT for another 180 degrees of turn and begin the 1,000 fpm descent on the clock. The maneuver is complete at the end of the second climb. Use the same checkpoints on the clock as used for the timed turn 1/2 SRT and S-1 pattern timed climbs and descents. Trim throughout the maneuver to keep pressure off the stick.

Power setting: Climb approximately 1500 pph; Descent approximately 700 pph

Pitch: Climb = 2-3 degrees noseup; Descent = 1-2 degrees nosedown

Bank angle: Adjust to maintain 1/2 SRT and reverse turn at start of each descent

Airspeed: 200 KIAS

Heading: 90 degrees of change for each climb and descent

NOTE: If you get ahead of the turn schedule reduce AOB so to arrive on heading and on time. Always begin reversal turn with descent on the clock.

SLOW FLIGHT MANEUVER

The slow flight maneuver allows you to practice instrument landing procedures, at altitude, prior to your first actual instrument approach. Although this maneuver may appear complex, it is actually just a compilation of individual maneuvers that you have already performed (Figure 4).

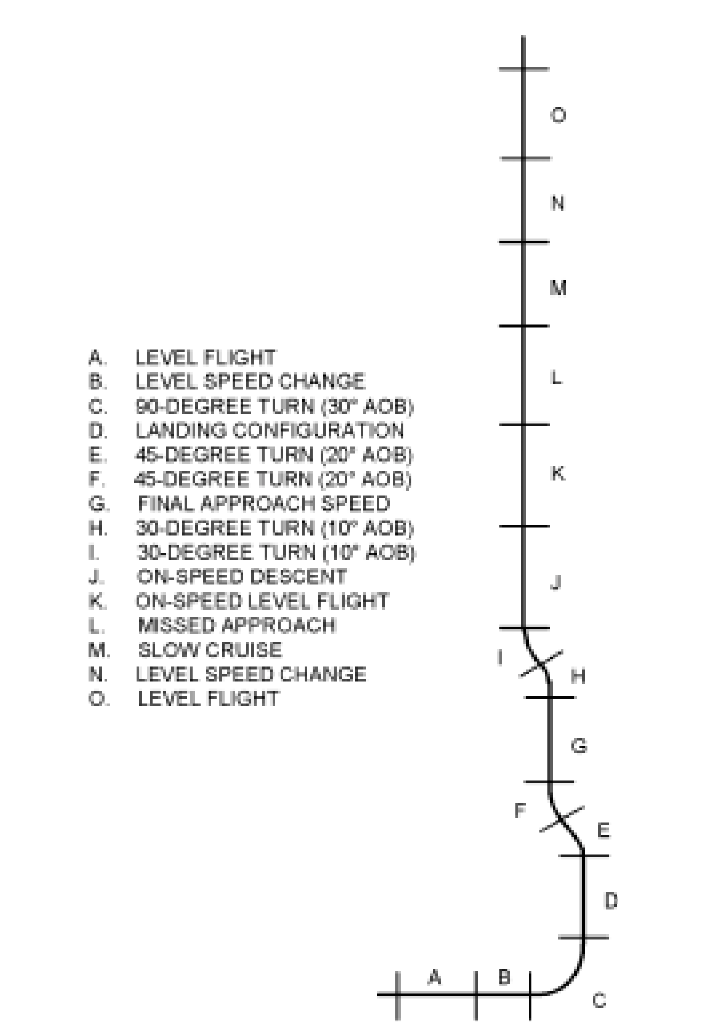


Figure 4: SLOW FLIGHT MANEUVER

Begin the maneuver from level flight at 250 KIAS. Decelerate to 200 KIAS by performing a level speed change using the speed brakes. When you change the power setting and extend the speed brakes, you'll have to trim the nose up to maintain level flight. Retract the speed brakes 5 KIAS before you reach 200 KIAS and retrim the nose to maintain level flight. You should expect a change in pitch when you extend or retract the speed brakes.

Next, roll into a 30-degree AOB turn and hold it for 90 degrees of heading change, adjusting pitch and power as needed to maintain altitude and airspeed. Lead the roll-out by about one-third of your bank angle, readjusting pitch and power to maintain level flight.

After completing the turn, lower the gear, and set full flaps/slats. Adjust pitch to maintain level flight throughout the transition. At 155 KIAS, advance power to maintain 150 KIAS and retrim the nose. Complete the landing checklist at this time.

Once you are stabilized at 150 KIAS, initiate a 20-degree AOB turn for 45 degrees of heading change, first in one direction and then back to the original heading. When rolling into the turns, adjust pitch and power as necessary to maintain airspeed and altitude.

At the finish of these turns, adjust nose attitude and power to maintain level flight at optimum AOA.

Perform a 10-degree AOB turn for 30 degrees of heading change and then make a 10-degree AOB turn back to the original heading.

Extend the speed brakes and establish and maintain a 500-fpm descent for 1,000 ft. Using 10 percent of your VSI as a lead point, adjust pitch and power for level flight at optimum AOA.

When you have the aircraft stabilized at optimum AOA in level flight, initiate a climb (missed approach) back to your original altitude by advancing the throttle to MRT, retracting the speed brakes, and raising the nose 10 degrees to establish a positive rate of climb. Once you can confirm a positive rate of climb on the VSI and altimeter, raise the landing gear. At or above 140 KIAS, raise the flaps/slats. When your airspeed reaches 200 KIAS, raise the nose to maintain this airspeed. Using 10 percent of VSI as a lead point, reduce power to the slow cruise setting and adjust pitch for level flight at 200 KIAS at the original altitude.

Finally, perform a level speed change to return to normal cruise airspeed (250 KIAS).

The slow flight maneuver is nothing more than a series of basic maneuvers, linked into a continuous sequence. Pay particular attention to executing smooth transitions from one element of the maneuver to the next.

The following lists the elements comprising the slow flight maneuver, in the sequence of performance:

1. **Perform level speed change from 250 to 200 KIAS**
2. **Execute level 30-degree AOB turn for 90 degrees of heading change**
3. **Configure aircraft for landing and stabilize airspeed at 150 KIAS**
4. **Perform level 20-degree AOB turn for 45 degrees heading change and reverse to original heading**
5. **Slow to optimum AOA**
6. **Perform level 10-degree AOB turn for 30 degrees and reverse to original heading**
7. **Extend speed brakes and descend at 500 fpm for 1,000 ft with aircraft at optimum AOA**
8. **Establish level flight at optimum AOA**
9. **Advance throttle to MRT, retract speed brakes, initiate a climb, raise gear and flaps/slats, and climb at 200 KIAS to original altitude**
10. **Establish level flight at slow cruise (200 KIAS)**
11. **Perform a level speed change from 200 to 250 KIAS**

STALLS AND UNUSUAL ATTITUDE RECOVERIES

Practicing stalls and unusual attitude recoveries will give you confidence and experience in recognizing abnormal situations and in promptly taking the appropriate corrective action. You will perform these maneuvers entirely on instruments.

STALLS

The stalls consist of recoveries initiated from two types of entries: clean and dirty. Prior to executing these stalls, complete the stall and aerobatic checklist. You must begin all stalls at a minimum altitude of 10,000 ft AGL.

<u>Clean</u>

Clean stalls are performed with gear up, flaps/slats retracted, and speed brakes in, and they are initiated at an airspeed of 200 KIAS. To commence the maneuver, reduce throttle to idle rpm to idle, extend the speed brakes to assist in slowing down, retract the speed brakes at 150 KIAS, keep the wings level, and maintain altitude. As the airspeed bleeds off, you will have to increase back stick pressure to hold altitude constant, do not trim past 150 KIAS. Maintain altitude until you feel the rudder shaker, heavy buffet, and obtain wing drop off at stall. To recover, advance the throttle to MRT, retract the speed brakes, lower the nose to attain 20-21 units AOA, and level wings. Hold 20-21 units AOA until you see a positive rate of climb on the VSI and altimeter.

Stall and Aerobatic Checklist:

Secure cockpit of foreign objects

Secure map case

Check fuel state

Clear area

Entry:

Stall and aerobatic checklist: Complete

Configuration: Clean, speed brakes out

Altitude: 10,000 ft AGL minimum

Airspeed: 200 KIAS

Throttle: Idle rpm

Speed Brakes: Extended until 150 KIAS then retracted

Nose attitude: Adjust to maintain altitude

Trim: Do not trim into stall past 150 KIAS

Wing attitude: Wings level

Recovery:

Throttle: MRT

Speed brakes: In

Nose attitude: Lower until 20-21 units AOA achieved, level wings

AOA: Maintain 20-21 units

Altitude: Maneuver complete when positive rate of climb confirmed on VSI and altimeter

Dirty

To set up for a dirty stall, configure the aircraft for level flight with gear and flaps/slats down, speed brakes out, trimmed up, on-speed; then perform the landing checklist and review the stall and aerobatic checklist. Set the throttle to idle rpm, as the aircraft decelerates, maintain altitude and hold the wings level. As with the other stall entry, you will have to increase back stick pressure as your airspeed bleeds off to maintain altitude (do not trim into the stall). Continue to maintain altitude through rudder shaker into the onset of buffet, and until a wing drop off is achieved at stall. To recover, simultaneously advance the throttle to MRT, retract the speed brakes, lower the nose to attain 23-24 units AOA and level wings. Hold AOA at 23-24 units until you see a positive rate of climb on the VSI and altimeter.

Entry:

Altitude: 10,000 ft AGL minimum

Configuration: Dirty, speed brakes extended, trimmed for level flight

AOA: Optimum

Landing checklist: Complete

Stall and aerobatic checklist: Review

Throttle: Idle rpm

Nose attitude: Adjust to maintain altitude

Wing attitude: Wings level

Recovery:

Throttle: MRT

Speed brakes: Retract

Nose attitude: Lower until 23-24 units AOA achieved, level wings

AOA: Maintain at 23-24 units

Altitude: Maneuver complete when positive rate of climb confirmed on VSI and altimeter

UNUSUAL ATTITUDES

An unusual attitude is any aircraft attitude you encounter inadvertently. It may result from inattention to scan, instrument failure, vertigo, turbulence, or a combination of factors. Although the severity of the unusual attitudes you'll encounter during instrument flight will probably not be as extreme as those that occur during tactical maneuvering, the recovery techniques are basically the same.

There are several general rules that apply to all unusual attitude recoveries. First, neutralize the flight controls (center the stick and rudder peddles). Second, analyze and evaluate the situation before initiating a recovery. Third, if your aircraft is in a dive, reduce power and, if required, extend the speed brakes to aid in airspeed control, then roll the aircraft in the shortest direction to wings level. Fourth, when nose-high, hold your wing position while adding MRT and retracting the speed brakes until the nose is below the horizon and airspeed reaches 150 KIAS.

General procedures:

Controls: Neutralize

Attitude: Analyze and evaluate to determine best recovery

Airspeed: Limit in dives

Bank: Eliminate when nose-low; Hold constant when nose-high

Nose-High Recovery

Your primary concern when recovering from a nose-high unusual attitude is to maintain the AOA between 5 and 10 units. At slow speeds, very slight back stick pressure will cause a rapid increase in the AOA. Additionally, uncoordinated aileron and rudder inputs at slow speeds can introduce enough adverse yaw and increased AOA on the rising wing to cause a departure from controlled flight.

When given control of the aircraft, simultaneously neutralize the flight controls and analyze the situation by scanning the appropriate instruments (i.e., ADI, AOA, airspeed, and altimeter). To recover from a nose-high condition, advance power to MRT and retract the speed brakes to minimize loss of airspeed.

If upright, maintain neutral aileron and rudder and smoothly push the nose over to maintain AOA between 5 and 10 units (you will be between 0 and 1 g). Hold this AOA until the nose falls through the horizon and the aircraft accelerates to 150 KIAS. Then roll wings level and return to level flight.

If inverted, maintain neutral aileron and rudder and pull the nose through the horizon maintaining optimum AOA. When the aircraft accelerates to 150 KIAS, level the wings in the shortest direction, pull the nose to the horizon, and adjust power for straight and level flight. Do not exceed optimum AOA. During recovery at low speeds, you must be careful not to stall the aircraft.

Nose-high upright recovery:

Controls: Neutralize

Attitude: Analyze and evaluate

Throttle: MRT

Speed brakes: Retract

AOA: Apply stick pressure to obtain 5-10 units

Nose: Lower to slightly below horizon

Airspeed: Minimum of 150 KIAS

Wings: Level in shortest direction

Nose: Pull to horizon - optimum AOA

Throttle: Adjust for level flight

Nose-high inverted recovery:

Controls: Neutralize

Attitude: Analyze and evaluate

Throttle: MRT

Speed brakes: Retract

AOA: Apply back stick to obtain optimum AOA

Nose: Pull through horizon

Airspeed: Minimum of 150 KIAS

Wings: Level in shortest direction

Nose: Pull to horizon - optimum AOA

Throttle: Adjust for level flight

Nose-Low Recovery

Recognize a nose-low unusual attitude by a nose-low indication on the ADI and/or standby AI accompanied by increasing airspeed and decreasing altitude.

Once again, first neutralize the controls and then analyze the performance and attitude instruments to determine the best recovery.

With your airspeed above 150 KIAS, retard the throttle to idle to control airspeed and to minimize the loss of altitude. If airspeed is rapidly increasing, extend the speed brakes as necessary. Either or both of these procedures are used to control airspeed and altitude loss. Roll the aircraft to wings level in the shortest direction and smoothly pull the nose up to the horizon. Do not attempt to raise the nose and roll wings level at the same time (a "rolling pullout") because this can overstress the aircraft. Complete the recovery by readjusting the throttle for level flight.

Nose-low recovery:

Controls: Neutralize

Attitude: Analyze and evaluate

Throttle: Retard to idle with airspeed above 150 KIAS

Speed brakes: Extend (as required) if airspeed is rapidly increasing

Wings: Roll level in shortest direction to horizon

Nose: Pull to horizon

Throttle: Adjust for level flight

AEROBATICS CONFIDENCE MANEUVERS

Confidence maneuvers are basic aerobatics designed to gain confidence in the use of the ADI in extreme pitch and bank attitudes. Practicing these maneuvers will also be helpful when recovering from unusual attitudes. All maneuvers should be planned to recover at a minimum of 10,000 ft AGL.

Review the Stall and Aerobatics checklist prior to commencing these maneuvers.

AILERON ROLL

The aileron roll is a maneuver in which the aircraft is rolled 360 degrees about its longitudinal axis. Aileron rolls can be performed at any pitch attitude and maneuverable flying airspeed. For practice the maneuver will begin from straight and level flight at approximately 89 percent power and 300 KIAS. Smoothly pull the nose to 10 degrees above the horizon, relax back-stick pressure, and start a roll in either direction. Adjust the roll rate so the nose is passing through the horizon when inverted. A constant roll should be continued to recover in a nose low, wings level upright attitude. You should complete the maneuver at the same time altitude you started.

WARNING

Roll yaw divergence may occur if the roll exceeds 360 degrees. NATOPS prohibits any roll in excess of 360 degrees.

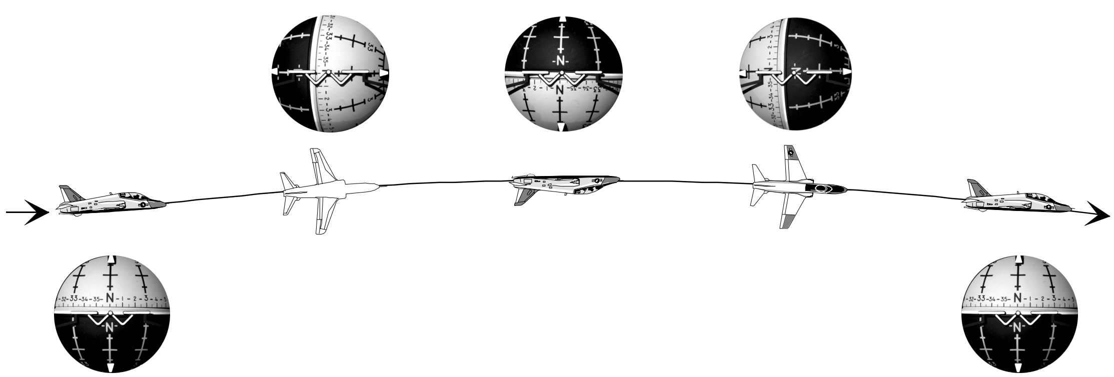


Figure 5: AILERON ROLL

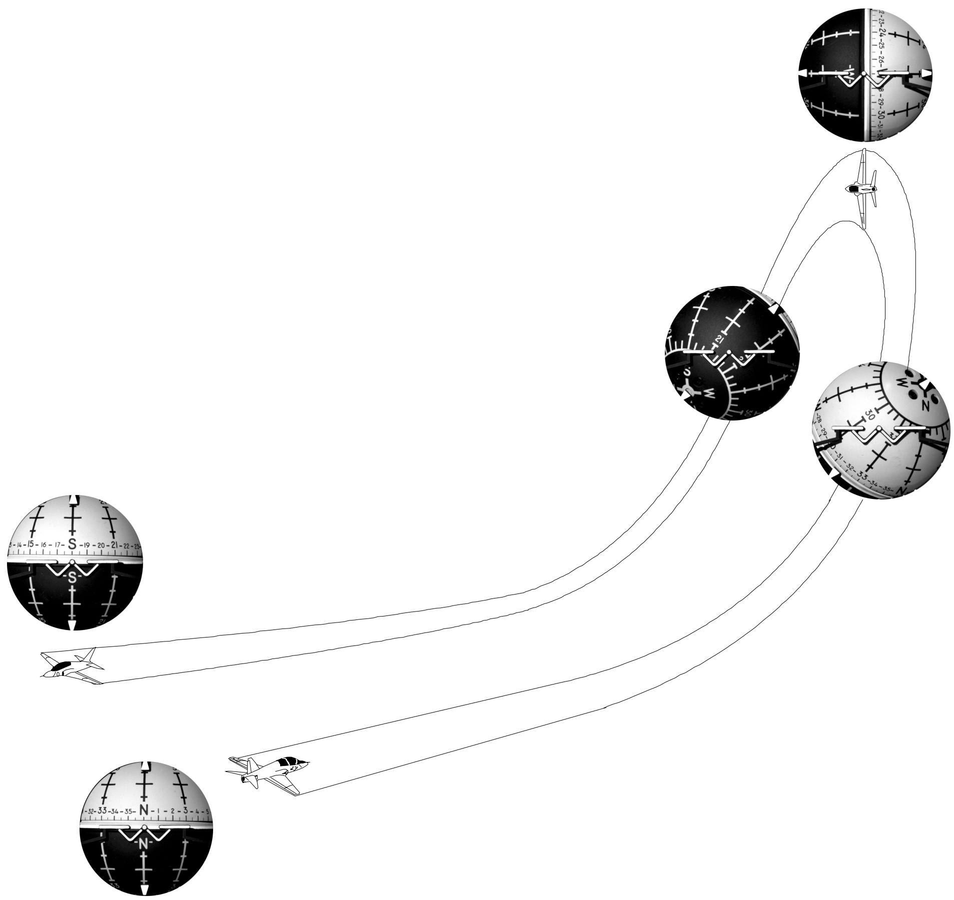


Figure 6: WINGOVER

WINGOVER

The wingover is a combination of a climbing and diving turn with 180 degrees of direction change. The maneuver is commenced from straight and level flight at 89 percent power and 300 KIAS. Start a steep climbing turn in either direction so the nose describes an arc above the horizon reaching a maximum pitch of 45 degrees after 45 degrees of heading change. Continue the increasing bank angle so that your heading will have changed 90 degrees as 90 degrees of bank angle is reached. As the nose passes through the horizon start a gradual rollout to be at the maximum nose-down pitch of 45 degrees at 135 degrees of heading change. The roll rate during the recovery should be the same as the rate used during the entry. Airspeed passing the horizon should be 150-170 KIAS.

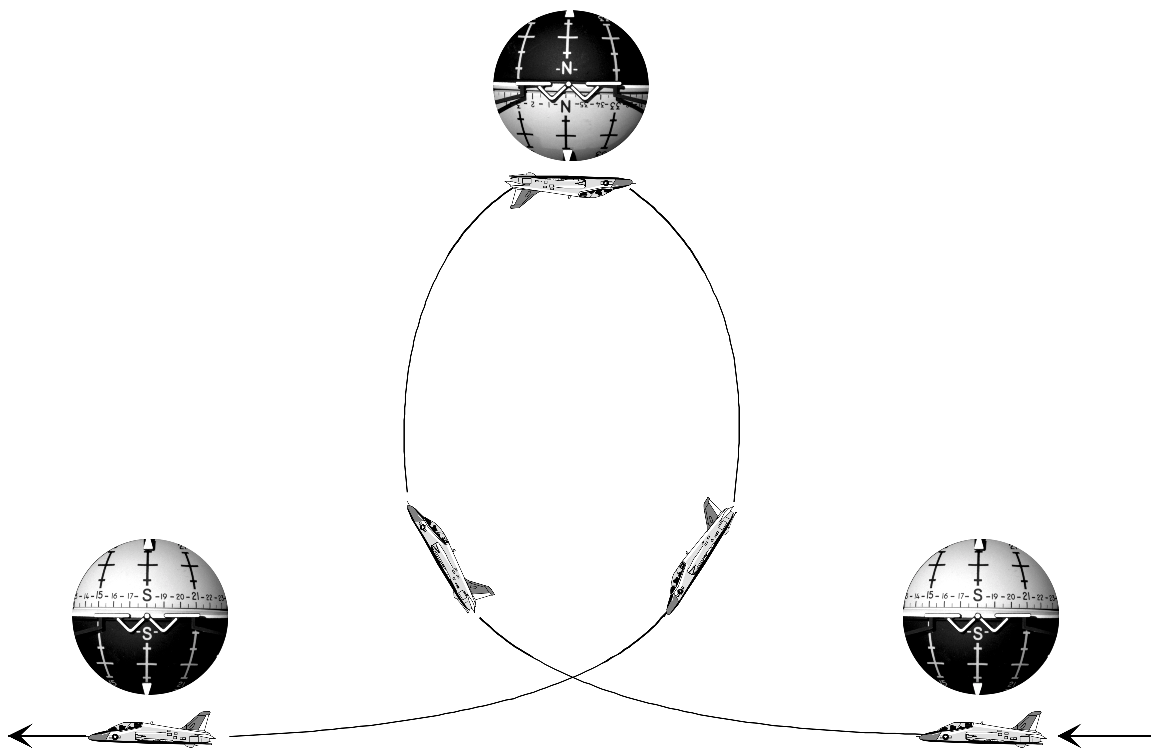


Figure 7: LOOP

LOOP

The loop is a 360 degree turn in the vertical plane. Start the loop from a straight and level flight, 96 percent power, and 380 KIAS. Initiate a 4g pullup keeping the wings level. Continue the pull until reaching optimum AOA (17 units), then maintain optimum AOA over the top. Verify that the wings are level and that the airspeed is about 150 KIAS over the top. Bring the nose through horizon, keeping the wings level, maintaining optimum AOA and staying aligned on start heading. Maintain optimum AOA until reaching 4 g's. Complete the loop at 380 KIAS, at initial altitude, and heading. Aircraft heading or reciprocal should be maintained throughout the maneuver.

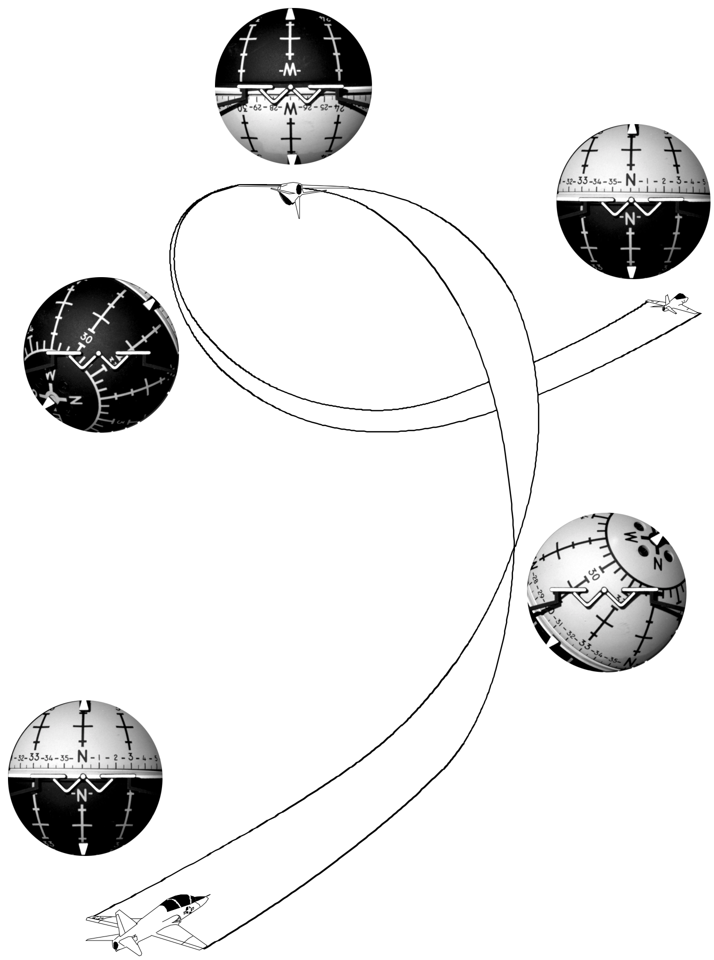


Figure 8: BARREL ROLL

BARREL ROLL

The barrel roll is a combination climbing and diving maneuver which is accomplished by rolling the aircraft about a point 45 degrees off the aircraft heading on the horizon. Begin in straight level flight, 350 KIAS, and 92 percent power. Commence a climbing roll with initial acceleration of 2-3 g's to achieve a 90-degree heading change as the aircraft passes through the horizon inverted. Airspeed passing through the horizon will be 170-190 KIAS. The nose should reach 45 degrees above the horizon as 90 degrees of roll are completed. Continue the roll so the nose passes 45 degrees below the horizon when the wings are 90 degrees to the horizon. Coordinate the rate of roll and backpressure as necessary to place the aircraft straight and level on the entry altitude and heading.

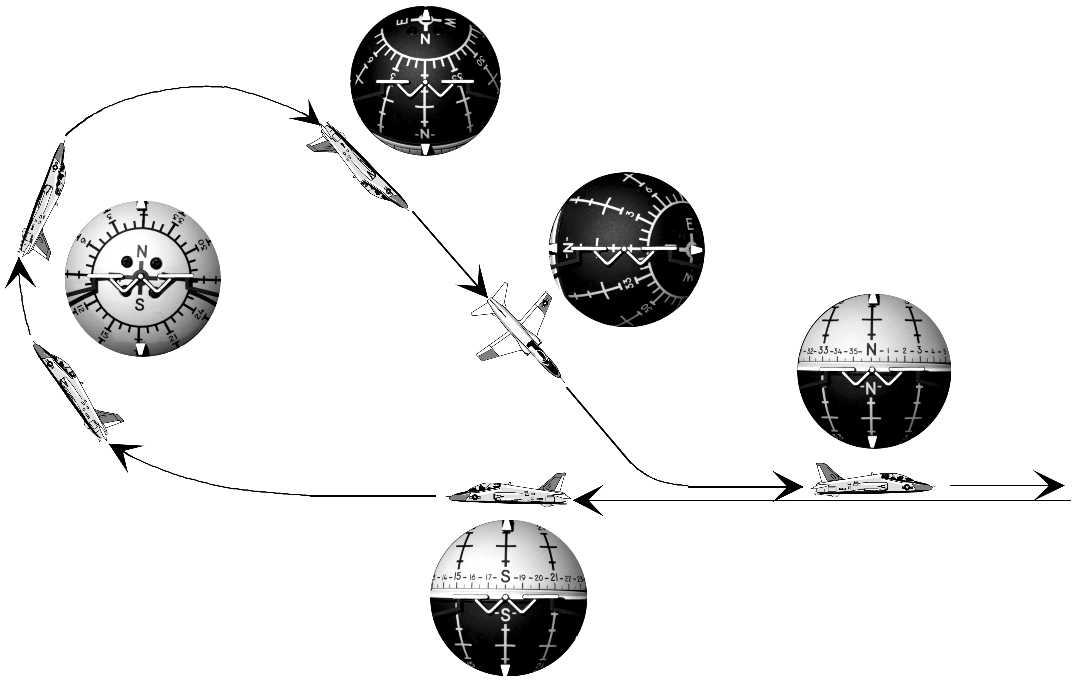


Figure 9: HALF-CUBAN EIGHT

HALF-CUBAN EIGHT

The half-cuban eight is commenced in the same manner as the loop. After the nose passes through the horizon inverted it is flown to just prior to the 45 degrees nose low at which time the backpressure is released and a coordinated roll is initiated to a wings level 45 degree dive. For recovery the nose is brought to the horizon wings level on entry altitude.

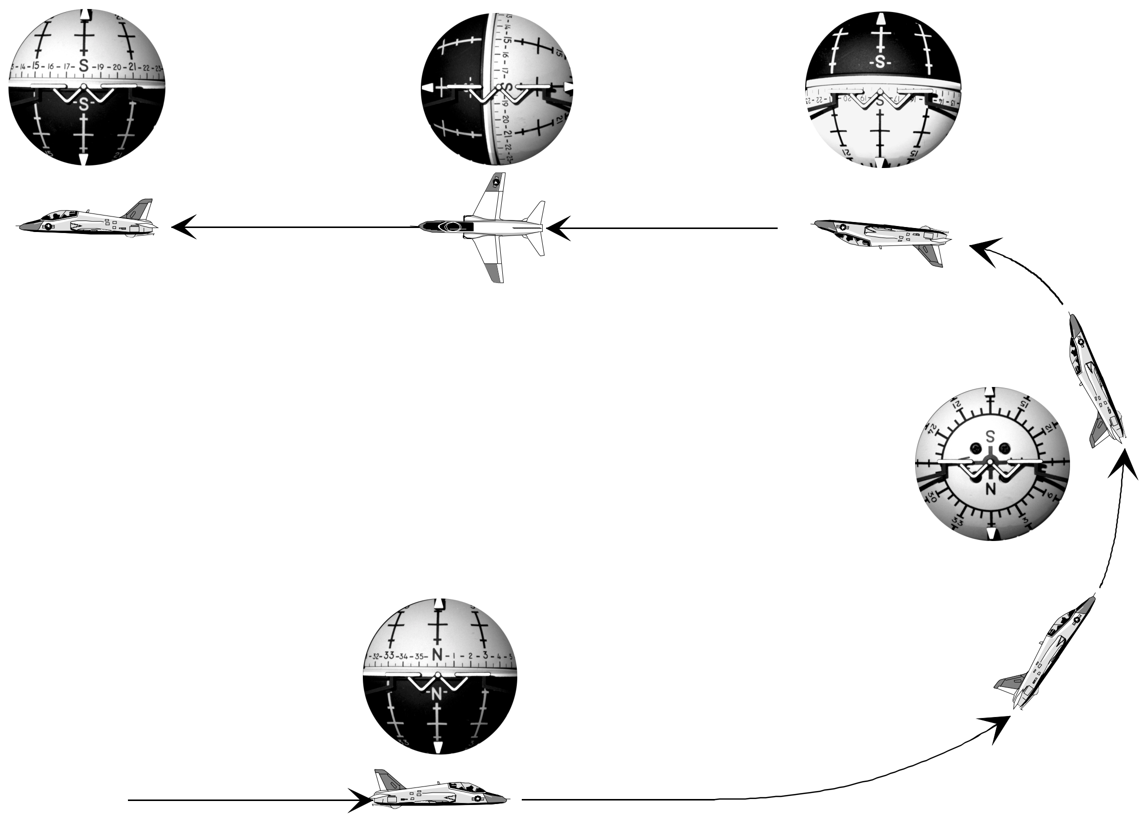


Figure 10: IMMELMANN

IMMELMANN

Utilize the same entry parameters as for the loop except that a 180 degree roll is executed from inverted flight by stopping the nose 5-10 degrees above the horizon at about 150-170 KIAS. Heading will be 180 degrees from the entry heading and airspeed about 180-220 KIAS. Coordinated aileron and rudder is required to maintain heading.

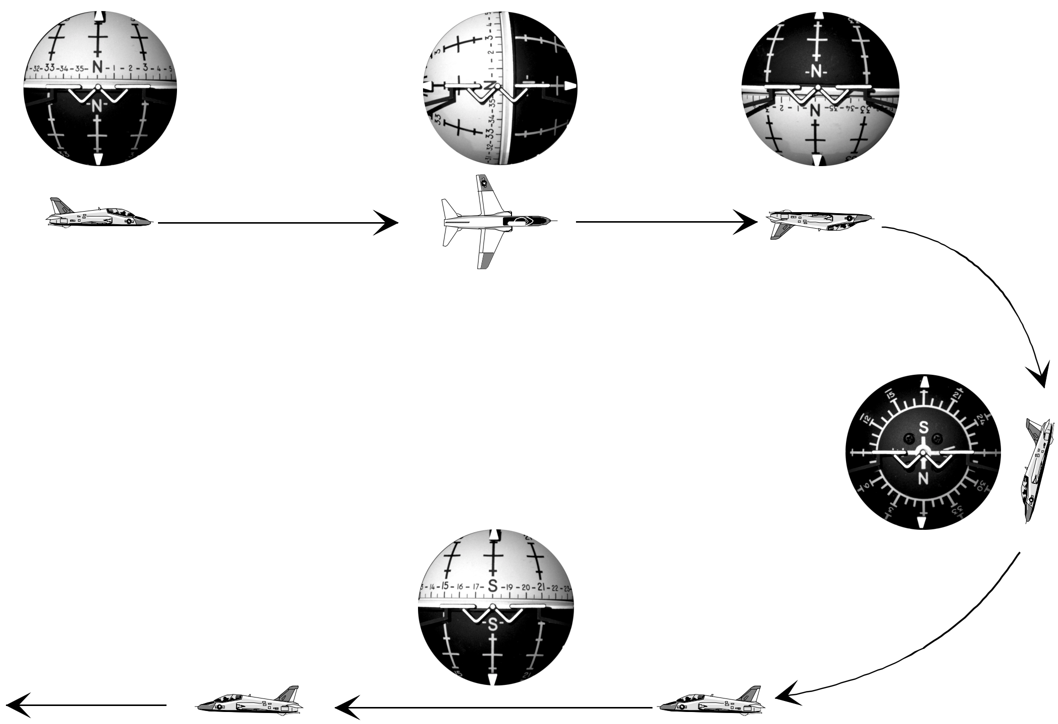


Figure 11: SPLIT-S

SPLIT-S

Begin the maneuver at 180 KIAS, wing level, on heading. Pull the nose up to 10-15 degrees above the horizon, reduce the power to idle and roll inverted using aileron and rudder. Gently but expeditiously pull to optimum AOA. Maintain optimum AOA as your airspeed increases and maintain wings level and on heading. Maintain optimum AOA until intercepting 4 g's and hold 4 g's for the remainder of the maneuver. The maneuver is complete when you are in level flight going in the opposite direction.

PARTIAL PANEL

While flying under instrument conditions utilizing all the instruments available, you can readily see that all corrections for a desired performance and attitude must be positive, well founded, and smoothly executed. You have seen while practicing "full panel" instrument flying that you must have and use the following: (1) a rapid scan of the instrument panel, (2) positive corrections with the controls, and (3) confidence in you ability to fly under instrument conditions. Even when the aircraft's instruments are functioning properly, you have learned to monitor angle of bank, nose attitude, power setting, and general cockpit procedures more closely while flying instruments than while flying contact.

You should realize that while operating under instrument conditions when any of the instruments are inoperative, the task of maintaining any attitude and performance becomes difficult. The situation in which an instrument or a group of instruments becomes inoperative is referred to as a "partial panel" condition. Practice under partial panel conditions is not only desired but mandatory if you are to become an accomplished instrument pilot.

For the purpose of this course of instruction, you will consider partial panel flying as flight under instrument conditions wherein you control the aircraft utilizing all the attitude, performance, and power instruments except the AI (and HSI in case of SAHRS failure).

On instrument flight, failure of the A.C. power supply for the ADI or the HSI could occur at any time, therefore, you must be ready to continue controlled flight while handicapped by the loss of these instruments. In the event that you allow the aircraft to enter an "unusual attitude", positive recovery methods must be applied to return the aircraft to the desired altitude and heading. These recovery methods are discussed. You must apply yourself at this time to the fundamental procedures of basic attitude instrument flight under partial panel conditions.

A review of Sensations of Flight under instrument conditions is suggested. A thorough understanding of why you must correctly interpret and believe the instrument panel is mandatory. You should realize that to discard completely those body sensations, indications of attitude through control pressure, etc., is not completely warranted. However, because these sensations of flight can give you erroneous indications of aircraft attitude, especially while flying partial panel, you should rely completely on the instrument indication.

Necessary control pressures will be recognized through experience. Perfect trim technique is mandatory when flying partial panel. You must remember that all partial panel instruments have a tendency to lag. Therefore, over-controlling is an ever present hazard. To avoid over-controlling, you must avoid large or rapid control movements. After a correction has been initiated, time must be allowed for instrument indications to catch up to the aircraft's new performance; <u>do not apply an ever increasing correction</u>. In other words, smoothly set and hold a specific attitude on the STBY AI, allow time for VSI and AOA to stabilize. Fine tune attitude as necessary with small changes.

The amount of stick movement which should be applied will depend on the attitude of the aircraft. With too large a stick movement, there will be a rapid change of attitude; conversely, with a small stick movement, only a small attitude change will result. There are no set rules which can be given as to the amount of movement required, however, with experience, the amount of movement will become an educated guess. At no time should an additional correction be initiated before the original correction has had sufficient time to indicate the magnitude of progress.

Compared to full panel attitudes, partial panel attitude will be approximately 3-7 degrees higher. However, calibrate you standby ADI by noting the attitude for level flight as a baseline to work from.

UNUSUAL ATTITUDE RECOVERY (PARTIAL PANEL)

Partial panel unusual attitude recoveries employ the same procedures as described above, except that you will derive attitude information from the standby AI instead of the ADI.

Because of the standby AI's smaller size and different location, you will have to adjust your scan pattern. Resist any tendency to refer to the ADI. You may tend to overcontrol the aircraft during a recovery when using the standby AI because the relative amount of displacement appears to be less than you would see when using the ADI. Additionally, you will have to look carefully at the standby AI when determining your attitude because it is somewhat harder to read than the ADI.

TRANSITIONS (CLEAN TO DIRTY)

Reduce power to idle and extend the speed brakes if necessary. Slow to 200 KIAS and note level flight attitude on the ADI. Select gear down and flaps to half (if required, flaps may be lowered, but not raised, in a turn). The increased lift and drag combination causes a "ballooning" effect that must be countered with firm forward stick force to maintain attitude and prevent climbing. Wait for stick pressure to dampen out before selecting full flaps, if desired. Again, use forward stick pressure to counter the nose pitch up and maintain altitude.

As stick forces settling, trim nose up as aircraft decelerates. As airspeed approaches 160 KIAS, increase power for 150 KIAS (see table "Approximate Fuel Flow To Maintain Level Flight"). Decelerate to optimum AOA/airspeed (no sooner than 10 nm, 30 degrees of FAC) by reducing power, adding nose up trim to maintain level flight and add power according to the table for "Approximate Fuel Flow To Maintain Level Flight" found later in this chapter. Do not decelerate below 150 KIAS airspeed until the landing checklist is complete (except for the AOA check). The deceleration should be gradual to prevent settling (meaning the aircraft is slowing and or descending). Significant power-on corrections will be required to stop settling. The large power addition must be followed immediately by a large counter correction. Subsequent corrections should dampen out (become smaller), bringing the power back to the appropriate setting.

OPTIMUM AOA DESCENT

Once established in level flight with desired configuration at optimum AOA, extend speed brakes to begin descent. Apply forward stick pressure and/or trim to counter nose pitch and influence the nose down toward desired VSI. Initially, this will cause a fast indication. As stick pressure subsides, retrim nose up for optimum AOA and readjust power to maintain desired VSI. Coordinated power and attitude adjustments will be required throughout the descent. Use a technique of anticipating power corrections to "bracket" the AOA to optimum.

When the AOA and VSI needles are moving in opposing directions, more abrupt and larger power corrections are necessary. For example, descent rate increasing (VSI needle moving down) and AOA increasing (AOA needle moving up) requires a significant power addition. Lead the counter correction by reducing the power when the AOA is breaking before it passes through optimum to fast. All pitot static instruments have a certain lag time. You must anticipate the re-correction before the "slow" becomes a "fast". Add power back on to maintain optimum and fine tune as necessary. The goal here is to lead power and coordinated attitude adjustments so that the corrections are on before the AOA reaches its "peak" or "valley". This technique should continually decrease the amplitude of VSI and AOA fluctuation.

When descent rate is decreasing (VSI needle moving up) and AOA decreasing (needle moving down), make a large power reduction along with forward stick pressure to influence the nose and descent rate back down. Add power before AOA "peaks" at optimum. Reduce power and apply coordinated back stick to stabilize at optimum AOA.

When AOA and VSI needles are moving in the same direction, energy can be traded with nose movement and a coordinated power adjustment as necessary. For example, trade increasing descent rate (VSI needle moving down) and decreasing AOA (needle moving down) by adjusting the nose up. As descent rate decreases and AOA slows to optimum, adjust power as necessary to maintain desired VSI. Make this trade off in a timely, controlled manner and avoid abrupt nose movements that rapidly change VSI.

MISSED APPROACH CLIMB OUT AND LEVEL OFF

Simultaneously advance throttle to MRT, retract speed brakes and rotate at optimum AOA, to approximately 10-12 degrees nose up. Maintain this ADI attitude through the transition. Rate of climb should increase toward 2,000 fpm. With positive rates on the altimeter and VSI, call for the gear (minimum of 100 ft AGL). Backstick force will be required to maintain attitude and climb as the gear comes up. At a minimum of 300 ft AGL, with 125 KIAS minimum indicated, the flaps may be called for and moved from FULL to 1/2. With 140 KIAS minimum, the flaps may be called for and raised from FULL or 1/2 to UP (do not raise flaps in a turn). Again, backstick will be required to maintain attitude and prevent rapid acceleration through 200 KIAS. Report aircraft clean before 200 KIAS. As aircraft accelerates toward climb airspeed (200 KIAS GCA box, 250 KIAS otherwise), increase backstick to maintain this airspeed.

Once established in a clean MRT climb out (a 200 KIAS MRT clean climb out will stabilize at approximately 4,000 fpm and 20 degrees nose up; a 250 KIAS MRT clean climb out will stabilize at approximately 6,000 plus fpm and 18 degrees nose up), lead level off by 1,000 ft, smoothly reducing power for desired airspeed and allowing the nose to drop.

APPROXIMATE FUEL FLOW TO MAINTAIN LEVEL FLIGHT

KIAS	CONFIGURATION	FUEL FLOW (PPH)
200	CLEAN	1100
150	GEAR DOWN, FLAPS HALF	2400
150	GEAR DOWN, FLAPS FULL	2600
OPTIMUM AOA	GEAR DOWN, FLAPS HALF	1800
OPTIMUM AOA	GEAR DOWN, FLAPS FULL	2100
OPTIMUM AOA	GEAR DOWN, FLAPS HALF, BOARDS OUT	2600
OPTIMUM AOA	GEAR DOWN, FLAPS FULL, BOARDS OUT	2900

NOTE: Extending boards without adding power will give approximately 500 fpm descent at optimum AOA.

LANDING APPROACH SPEED

17 UNITS AOA

GROSS WEIGHT	FULL FLAPS	HALF FLAPS	ZERO FLAPS
11,000	114	132	151
12,000	119	138	157
13,000	124	143	164
14,000	128	149	170
15,000	133	154	176

The most important element in performing a missed approach is to arrest your rate of descent and initiate a climb as soon as possible. The procedure for executing a missed approach is as follows:

Throttle: MRT if required

Speed brakes: Retract

Pitch: Maintain optimum AOA and rotate to approximately 10 to 12 degrees nose-up (do not exceed optimum AOA)

Climb: Confirm on altimeter and VSI

Gear: Raise with positive rate of climb

Flaps/slats: Up at 140 KIAS minimum (half at 125 KIAS minimum)

Missed approach call: Make (may be made simultaneously with power addition)

Airspeed (if remaining in pattern): 200 KIAS

Airspeed (if leaving pattern): 250 KIAS

Remember that you must comply with the controller's and/or published missed approach instructions.

PARTIAL PANEL MISSED APPROACH
Partial panel missed approach procedures are the same as full panel. As you rotate to on speed note the attitude will be approximately five degrees higher on the STBY AI. Due to instrument lag, reference the Baro Altimeter for level off and hold attitude as VSI stabilizes.

FLIGHT WITH PARTIAL PANEL
In the T-45A, partial panel flight consists of flying without the ADI. All flight maneuvers remain the same whether you are flying under full or partial panel conditions. In the event that the ADI fails, you will have to substitute the standby AI for the ADI and use the HSI for your heading reference.

The standby AI is smaller than the ADI and will not appear to move as smoothly, which may give rise to the perception that the standby AI is more sensitive to control inputs than the ADI.

COMMON ERROR: As a result of the difference in size between the ADI and standby AI, your control of the aircraft may be erratic. This will occur because the standby AI doesn't appear to respond to control inputs in the same way the ADI does.

Substituting the standby for the ADI will require you to change your scan pattern.

Be careful not to fixate on the standby AI because of its unfamiliar location and the resulting change in you scan pattern.

You will find it more difficult to exercise fine aircraft control because of the standby AI's smaller size. It will move a smaller distance for a given control input even though the actual attitude indications are the same.

Unlike the ADI, the standby AI provides only nose and wing attitude information. If you lose the ADI, you can get ILS and heading information from the HSI, but turn rate indications may no longer be available. The loss of the turn needle means that you will have to fly a specific bank angle at a given airspeed to maintain 1/2 standard rate and standard rate turns (refer to the section on turn and slip indictor failure above). Because all heading information will be provided by the HSI, you will have to give it greater emphasis in your scan. The CDI and glideslope pointer on the HSI will become your primary course and glideslope references for an ILS approach.

COMMON ERROR: Be careful not to overcontrol the aircraft. The small size and different location of the AI may cause you to rely more on the performance instruments than you would under full panel conditions, so you may tend to "chase" your remaining performance instruments.

GENERAL COMMUNICATION PROCEDURES

You may have heard the old adage covering flight priorities--"Aviate, navigate, communicate." The message is, of course, that first you take care of flying the aircraft, then you attend to keeping the airplane at the correct point in three-dimensional space, and, finally, you worry about talking to others. There certainly is good sense in that set of priorities, but simply because communication is last on the list does not relegate it to insignificance.

When flying on an IFR flight plan, you will be in constant contact with various air traffic control (ATC) facilities from before takeoff until after landing, and to operate successfully within the traffic control system, you must be thoroughly familiar with the responsibilities and capabilities of these control facilities. Although you must comply with controller instructions, it is your responsibility to follow them intelligently, not blindly. Always be sure that you understand the controller's intentions and that he or she understands your needs.

General ATC procedures will be discussed later in this FTI, each addressed as it normally occurs in each phase of flight.

NAVIGATION & COMMUNICATION COCKPIT MANAGEMENT

TWO NAVAID MANAGEMENT

Use both TACAN and VOR/ILS to navigate airways and maintain orientation at airfields. En route, navigate primarily off the applicable TACAN and set the VOR to the next station ahead. During ILS vectors at the field, one option is to maintain orientation off the TACAN until base leg then select ILS and, if required, change from TACAN to ILS DME frequency. During the approach phase, consider tuning NAVAIDs so one back up another in case of failure. For example, if on HI TACAN penetration approach and TACAN bearing fails, have ILS in VOR to fly ILS or localizer as back up.

TWO RADIO MANAGEMENT

Managed effectively, two radios can add convenience. However, avoid the confusion of listening to two radios at once. In addition, inform the other crew member of any changes in audio selection.

Start by briefing the communication plan before the hop. When audio selection is changed, inform the other crew member "selecting COMM 2" who should normally follow along. Also, selecting COMM 2 implies deselecting COMM 1 unless otherwise briefed. Here is one sample scenario for calling METRO in flight:

"Center KATO Two Two One, request switch, monitor guard two mikes"
"KATO Two Two One, approved as requested, report back up Center frequency"
"KATO Two Two One, WILCO"

Select METRO frequency in radio #2, T/R&G and deselect radio #1 or turn volume low after informing crew on ICS. After completing transmission to METRO, inform crew, deselect radio #2, and reselect radio #1 (or turn up volume). "Center, KATO Two Two One back-up (frequency #)".

During approaches, consider putting tower frequency in #2 (deselect) until approach directs switch and crew is informed "selecting #2". After reporting missed approach to tower, deselect #2, inform crew and select #1.

IFR VOICE PROCEDURES

REPORTS THAT ARE MADE AT ALL TIMES (RADAR & NON-RADAR)

1. When vacating any previously assigned altitude or flight level for a newly assigned altitude or flight level.

2. When an altitude change will be made if operating on a clearance specifying "VFR ON TOP." (Below 18,000 MSL or above FL600)

3. When unable to descend or climb at a rate of at least 500 ft per minute.

4. When an approach has been missed. (Include a request for specific action; i.e., to alternate airport, another approach, etc.)

5. Change in the average true airspeed (at cruising altitude) when it varies by 5 percent or 10 KIAS (whichever is greater) from that filed in the flight plan.

6. Time and altitude arriving at a holding fix or point which cleared.

7. When leaving any holding fix or point.

NOTE: The reports in subparagraphs (6) and (7) above may be omitted by pilots of aircraft involved in instrument training at military terminal area facilities when radar service is provided.

8. Any loss of navigation capability such as VOR, TACAN, ADF, complete or partial loss of ILS capability or impairment of air/ground communications capability. Reports should include aircraft (identification), (equipment affected), (degree to which the capability to operate under IFR in the ATC system is impaired), and the (nature and extent of assistance desired from ATC).

NOTE: Other equipment installed in an aircraft that may effectively impair safety and/or the ability to operate under IFR. If such equipment (e.g. airborne weather radar) malfunctions and in the pilots judgement either safety or IFR capabilities are affected, reports should be made.

9. Any information relating to safety of flight.

10. Encountering weather conditions which have not been forecast or hazardous conditions which have been forecast are expected to forward a report of such weather to ATC, and time permitting, FSS or METRO.

NOTE: The ATC controlling agency should be informed anytime weather conditions on an IFR approach differ from the latest observation or anytime a wind shear or (microburst) is encountered on departure or approach.

11. Beginning and end of a direct route (off airway) between two navigational points or fixes regardless of altitude or flight level including when operating on an ATC clearance specifying VFR ON TOP. Additionally, if a pilot is handed off while in transit on a direct leg, state present position to new controller on initial contact.

12. When unable to comply with an ATC clearance as given.

REPORTS SPECIFIC TO RADAR ENVIRONMENT

When operating in a radar environment and no position is required: On initial contact, pilots should advise controllers of their altitudes preceded by the word "level," "climbing," or "descending" and provide the present vacating altitude, if applicable, and the final altitude. Also, when on other than published routes, pilots should include the present navigational position on initial contact with each air traffic controller.

NOTE: Pilots will comply with all specific ATC requested reports during a given flight regardless of environment, (radar or non-radar).

REPORTS SPECIFIC TO NON-RADAR ENVIRONMENT

When radar contact has not been established by initial handoff

1. Initial contact **not at a fix**; report will include "ATC (name), aircraft (identification), estimating (to the next identifiable published fix or reporting point and time), (descending, climbing, or maintaining altitude or flight level)."

2. Initial contact **at a fix**; report will consist of a courtesy call only "ATC (name), aircraft (identification), and (position).

NOTE: If ATC states "Roger" and does not state "Go ahead" then no additional information is required at this time. Another courtesy call shall be made once the aircraft has reached the next designated reporting point "solid triangles" (low altitude structure). ***(There are no compulsory reporting points in the high altitude structure.)***

If ATC states "Go ahead" then a full position report is required.

3. Position report includes, "(position), (time), (altitude), (next compulsory reporting point), (planned time to that point), (next compulsory reporting point)." (P.T.A.P.T.P.)

NOTE: If radar contact is established or has been reestablished once lost along the route, pilots should discontinue position reports over designated reporting points in the low altitude structure. Pilots should resume normal non-radar position reporting when ATC advises "Radar Contact Lost" or "Radar Service Terminated."

4. When leaving a final approach fix inbound on final approach (non-precision approach) or when leaving the outer marker or fix used in lieu of the outer marker inbound on final approach (precision approach).

NOTE: OPNAVINST 3710.7 requires gear down report be made to the controlling agency by the final approach fix.

5. A corrected ETA at anytime it becomes apparent that an estimate as previously submitted is in error in excess of three minutes.

CHANGE OF FLIGHT PLAN

There are three voice procedures that are used when changing your flight plan. Each procedure addresses a different change to your flight plan and contains different content to be delivered to ATC in a specific sequence. The categories are:

1. Change of route or destination - 13 items

2. Change from VFR to IFR only - 7 items

3. Change of ETA by more than 30 minutes - 4 items

The specific items and sequence are found on the inside back cover of the IFR Supplement which should be used when delivering an in-flight change of flight plan.

NOTE: Pilots should request a frequency change for a change in flight plan from the ATC controlling agency. Normally the change is given to an FSS facility. However, if the ATC controller handling you is not too busy he will often copy the change.

INSTRUMENT FLIGHT PLANNING

Flight planning requires you to understand the planning process along with the associated documents needed to manage a cross-country flight. Before you can prepare a flight plan, you must gather accurate and complete weather and route information for your intended flight.

FACILITY REQUIREMENTS

When planning a flight, be sure to take into account the facilities and equipment available at your destination and alternates. Those airports must have an adequate runway and the equipment required for aircraft servicing. Especially, you need to determine before departing for an unfamiliar field that (1) the runway is of adequate length and is properly surfaced, (2) there is fuel available of the proper grade IAW NATOPS and (3) that if you are going to a civilian field that they have contract fuel and will accept a government fuel card. Additionally, you should always determine if your destination is PPR (prior permission required).

ROUTE AND ALTITUDE

You must give primary consideration to enroute weather and winds when planning a flight. You will normally want to use the most direct route at the most favorable altitude for your fuel requirements.

ALTERNATE

You are required to plan for an alternate anytime your destination is forecast to be below a 3,000-foot ceiling and 3 miles visibility during the period from 1 hour prior to and 1 hour after your ETA. If your destination is forecast to be below published minimums, then your alternate must be above 3,000-3. If your destination is between published minimums and 3,000-3, your alternate must be forecast to be 300-1 above published minimums for a non-precision approach or 200-1/2 above published minimums for a precision approach. Check alternate weather for the time you would arrive there and not for the ETA at your destination. Refer to Figure 12 for single pilot restrictions.

NOTE: CNATRA regulations require that you always plan an alternate.

FILING MINIMUMS

When filing an IFR flight plan, base your weather requirement on the existing weather at your point of departure and the forecast weather at your destination and alternate from 1 hour before to 1 hour after your ETA. Figure 12 outlines the weather criteria to follow when selecting an alternate for an IFR flight.

The following are filing criteria for your destination:

1. Single piloted aircraft (T-45A) absolute minimums are 200-1/2.
2. Use minimums for instrument approach to probable runway based on forecast surface winds.
3. Use the lowest minimums for any approach you and your aircraft are equipped to fly.

For single-piloted aircraft you may not commence an instrument approach if the weather is below the minimums published for your planned approach unless you do not intend to land. However, if you have commenced the approach prior to the weather being reported below minimums, you have the option of continuing down to the published minimums for that approach.

DESTINATION WEATHER ETA plus and minus one (1) hour	ALTERNATE WEATHER ETA plus and minus one (1) hour		
0-0 up to but not including published minimums	3000-3 or better		
Published minimums up to but not including 3000-3 (single-piloted absolute minimums 200-1/2)	NON-PRECISION	PRECISION	
		ILS	PAR
	*Published minimums plus 300-1	Published minimums plus 200-1/2	*Published minimums plus 200-1/2
3000-3 or better	No alternate required		
*In the case of single-piloted or other aircraft with only one operable UHF/VHF transceiver, radar approach minimums may not be used as the basis for selection of an alternate airfield.			

Figure 12: IFR FILING CRITERIA

FUEL REQUIREMENTS

Fuel requirements are a chief concern in planning for a flight. In addition to having enough fuel for the route, you must also account for all the fuel you will use from engine start to the approach at your destination. On top of this you will have to include the required amount of reserve fuel and the fuel you'll need from destination to alternate (if required) under various circumstances, including a divert at enroute altitude, at the destination IAF altitude, or from a missed approach at the destination. Additionally, you must be prepared for unusual occurrences such as unforecasted weather en route.

TAKE OFF MINIMUMS

Special Instrument Rating

1. No takeoff ceiling or visibility limits apply.
2. Takeoff dependent upon judgment of pilot and urgency of flight.

Standard Instrument Rating

1. Lowest non-precision minimums for runway in use but not lower than 300-1.
2. If runway has a precision approach, takeoff is permitted to precision minimums or 200-1/2, whichever is higher.

Use the STANDARD T-45A FUEL PLANNING DATA chart (Figure 13) to determine your fuel requirements for a flight.

OPNAVINST 3710.7 and CNATRA cross-country instructions set policy for minimum fuel requirements. Local directives may impose further fuel requirements for your cross-country flights, and the situation may dictate that you need to plan for more reserve fuel than the minimum required in the event of higher winds, worse weather, increased distance to a suitable alternate, or other unusual circumstances.

NOTAMS

Notices to Airmen (NOTAMS) are your primary source of up-to-date information concerning the establishment, condition, or change in any component (facility, service, procedure, or hazard) in the National Airspace System. NOTAMS are available in several forms and are divided into various coverage categories, depending on the location, nature, or duration of the notice. Prior to filing a flight plan, you must check all applicable NOTAMS for your intended route, destination, and alternate.

FLIGHT PLANNING FORMS

You will use three forms to prepare for a cross-country flight: the weather briefing form (DD-175-1), the Single-Engine Jet Log, and the Military Flight Plan (DD-175).

WEATHER BRIEFING (DD-175-1)

You are required to get a completed DD-175-1 for all IFR flights. For cross-country flights you should attend the weather brief in person prior to filing your flight plan. The forecaster shall complete the form for briefings conducted in person and for autographic briefings. It is the pilots responsibility to complete the briefing form for telephonic or weathervision briefings. It is important that you become familiar with all the available charts and data available in the weather office so that you can have a complete picture of the expected weather during the flight.

SINGLE-ENGINE JET LOG

The Single-Engine Jet Log is designed primarily to facilitate your fuel management. The front of the jet log, when properly filled out, is a ready reference for your entire flight. Included on the jet log are departure and destination information, clearance instructions, NAVAID, course, distance, time enroute, fuel required for each leg, and data for a divert from the destination to your alternate.

MILITARY FLIGHT PLAN (DD-175)

After planning your flight, complete a DD-175 and file it with Base Operations at least 30 minutes prior to your planned takeoff time (or as local directives require). The procedures and guidelines for completing and filing a DD-175 can be found in FLIP General Planning and OPNAVINST 3710.7.

STANDARD T-45A FUEL PLANNING DATA

Based on T-45A NATOPS flight manual, 15 JANUARY 1997.
Actual performance will vary with prevailing temperature, winds, drag index, and varying gross weight.

For initial planning only.

Total usable fuel (JP-8/JET A+) . . . . 2,861 LB
Start/Taxi/Takeoff 200
Penetration 200
GCA 250
Reserve (20 min @ 10,000 ft MSL) 300
Low level (360 KGS, 12K GW = 6.6 LB/NM and 2,375 PPH/300 KGS = 5.0 LB/NM = 1,500 PPH)

JP-4 = 6.5 LB/GAL **JP-5 = 6.8 LB/GAL** **JP-8 = 6.7 LB/GAL ALSO JET A+**

Climb Out (13K GW, 250 KIAS to 10K, 300 KIAS to .75 IMN)

Altitude	KIAS	NM	Time	Fuel Used
5,000	250	04	0+01	60 lb
10,000	250	08	0+02	110
15,000	300	14	0+03	180
20,000	300	22	0+04	240
25,000	300	32	0+05	320
30,000	283/.75	44	0+07	380
35,000	253/.75	60	0+09	460
40,000	225/.75	91	0+13	570

En route (Optimum Cruise @ 12K GW)

Altitude	#/NM	IMN	CAS	#/HR	TAS
5,000	4.76	.38	230	1,195	250
10,000	4.35	.42	230	1,138	262
15,000	3.88	.46	230	1,102	282
20,000	3.42	.51	230	1,073	310
25,000	3.09	.56	230	1,055	340
30,000	2.82	.61	230	1,047	370
35,000	2.58	.68	230	997	380

Normal descent (12K GW IDLE W/SPD BRAKES IN)

Altitude	IAS	NM	Time	Fuel Used
5,000	250	10	2+30	19 lb
10,000	250	20	4+30	36
15,000	250	31	6+30	57
20,000	250	41	8+30	66
25,000	250	52	10+30	79
30,000	250	64	12+15	90
35,000	235	74	14+00	100
40,000	209	84	15+30	108

Figure 13: T-45A FUEL CARD

Stop-Over Flight Plan

When you are planning to land at one or more points prior to reaching your final destination, you may file a stop-over flight plan. You are responsible for updating your weather briefing (DD-175-1) and NOTAMS at each stop.

Enroute Delay Flight Plan

If your planned flight includes an enroute delay, you must file an enroute delay flight plan. You would commonly use this type of flight plan when performing instrument approaches at airports along the route of flight or if you were to delay in a MOA.

NOTES

FLIGHT PROCEDURES

This section of the FTI discusses instrument flight procedures in sequence by phase of flight.

DEPARTURE PHASE

The departure phase of instrument flight includes that portion of your flight occurring from takeoff to level off at your enroute altitude and requires specific communication and standard instrument departure procedures.

DEPARTURE COMMUNICATION PROCEDURES

In your initial communication with clearance delivery, you should state your aircraft identification, location on the airport, type of operation planned (VFR or IFR), point of first intended landing, and request (i.e. clearance on request). If no delay is expected, you should receive your clearance within 30 minutes of filing your flight plan.

Your IFR clearance should contain the following information in order:

* Aircraft identification
* Clearance limit
* Departure instructions or SID
* Route of flight
* Altitude
* Special information, including departure frequency and IFF code

You should not accept a clearance if it has a clearance limit short of your destination, an altitude not in the filed route structure, or an altitude at which sufficient fuel reserves would not be available, unless you receive an expected further clearance time (EFC) or expected higher (suitable) altitude, as appropriate.

STANDARD INSTRUMENT DEPARTURE (SID)

The standard instrument departure (SID) is designed to expedite traffic from airfields and provide a set transition from takeoff to the enroute structure while ensuring adequate vertical and horizontal aircraft separation. The two types of SIDs are pilot nav (Figure 14) and vector (Figure 15).

Procedures - SID Preflight and pre-takeoff preparation

* Identify frequencies used by ATC and ensure compatibility with communication equipment
* Determine if your aircraft’s performance is adequate to adhere to all restrictions
* Identify routes, altitude, and specific restrictions

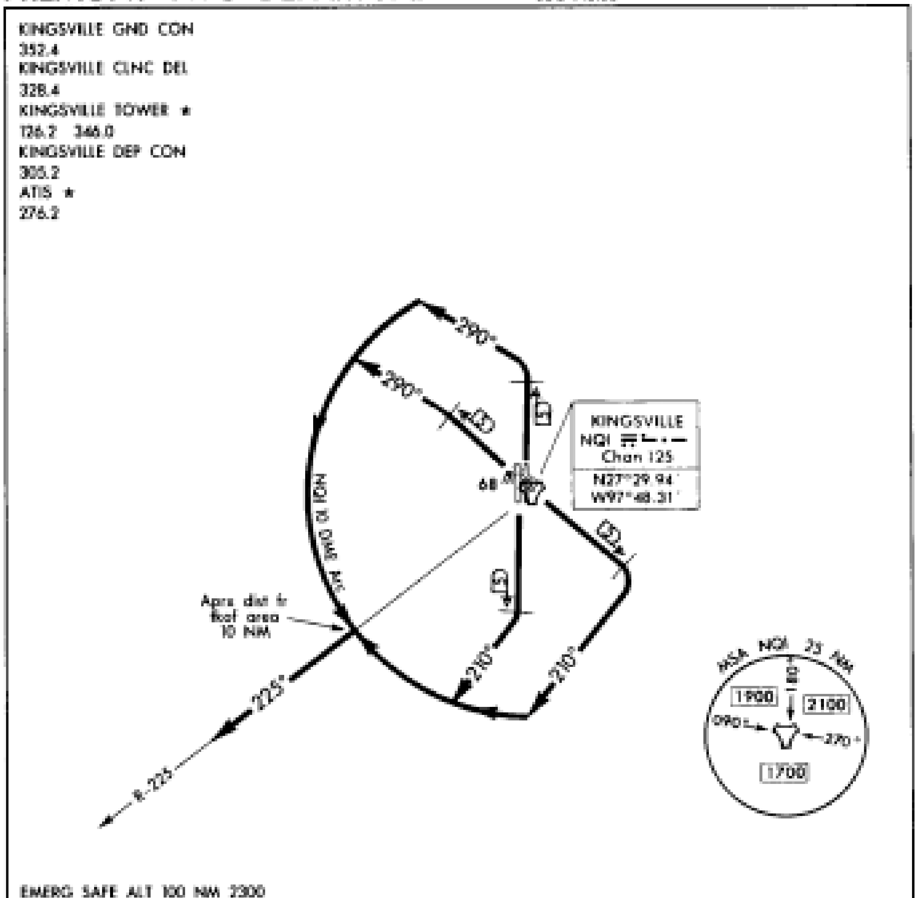
NOTE: When accepting a SID, you must comply with all requirements and restrictions unless ATC amends it.

Pilot Nav

For a pilot nav SID, you will use a prepublished route that supplies headings, altitudes, and reporting points for the transition from takeoff to the enroute structure. ATC can issue amendments to initial clearance anytime action is necessary to avoid conflict between aircraft. When a SID is changed, confirm what part of the SID is still in effect. If ATC desires to reinstate a cancelled SID, departure control must state portion of routing that applies and restate altitude restrictions. The card is divided into two sections, with a pictorial representation on top and a textual description of the departure procedures on the bottom (Figure 14).

When performing a pilot nav SID, you must comply with the instructions published on the SID plate. Normally, you will be assigned the SID as part of your clearance and receive no further departure instructions. The pilot nav SID has distinct advantages: it requires a minimum of controller time and sorts departing aircraft by initial route. On the other hand, the prepublished format of the pilot nav SID cannot adapt to changing weather or traffic conditions.

PREMONT TWO DEPARTURE IUO 918.06 KINGSVILLE NAS
KINGSVILLE, TEXAS



DEPARTURE ROUTE DESCRIPTION

TAKE-OFF RWY 13L/R and 17L/R: Fly runway heading to NQI 5 DME, turn right heading 210° to intercept 10 DME arc. Arc Southwest to R-225, then......................

TAKE-OFF RWY 31L/R and 35L/R: Fly runway heading to NQI 5 DME, turn left heading 290° to intercept 10 DME arc. Arc Southwest to R-225, then...........

Fly R-225. Upon reaching FL180 proceed direct to the assigned SOA.

PREMONT TWO DEPARTURE KINGSVILLE, TEXAS
KINGSVILLE NAS

5

Figure 14: PILOT NAV SID

<u>Vector</u>

A vector SID is more flexible than a pilot nav SID, but at the cost of being more labor-intensive for the controller. In this type of SID, you will be given radar vectors and altitudes by the controller, who will constantly monitor your position (Figure 15).

Because the vector SID requires the active participation of the controller, the amount of radio traffic between you and the controller will be significant. You must acknowledge all radio calls; repeat all headings, altitudes, and altimeter settings; and promptly comply with any instructions.

While a vector SID makes more demands on the controller than does a pilot nav SID, it also provides the controller more flexibility in dealing with changing weather or traffic conditions or with temporary restrictions. Consider the SID canceled if the aircraft is vectored or cleared off the SID (a specified heading), unless ATC adds “expect to resume the SID” or otherwise indicates the deviation is temporary.

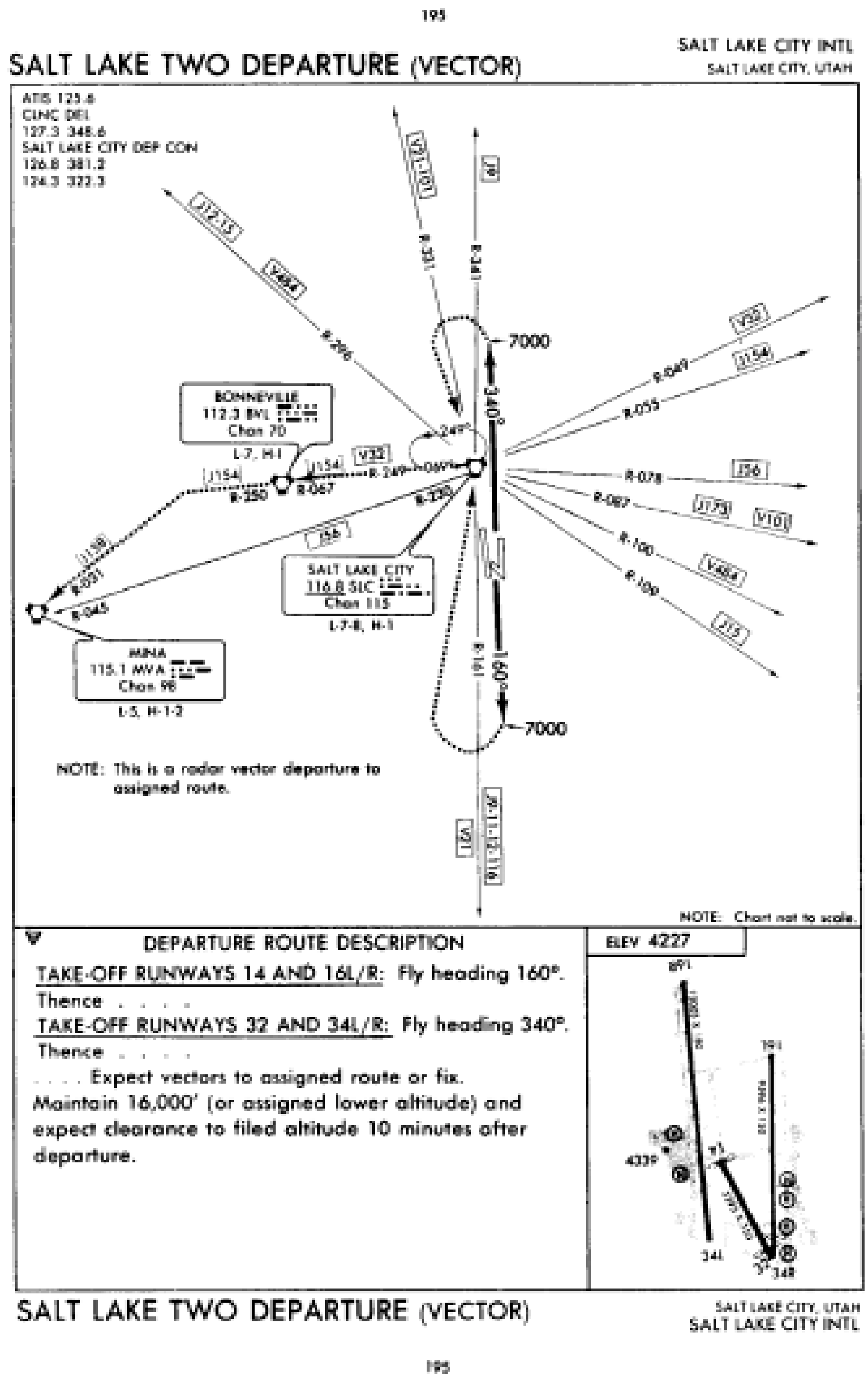


Figure 15: VECTOR SID

ENROUTE PHASE

The enroute phase of flight includes all your flight activities from the time you level off at enroute altitude until you initiate an approach at your destination.

ENROUTE CRUISE

Level off at enroute altitude at "optimum cruise", IMN for cruise altitude. Use the fuel chart found in TRAWING II In-flight Guide for cruise settings.

ENROUTE COMMUNICATION PROCEDURES

Enroute communications will begin when you switch from departure control to ARTCC (hereafter referred to as "center"). The phrasing of your initial contact with center should be in one of the following three formats:

* When operating in a radar environment and no position reporting is required: "[name] Center, [aircraft identification] at/climbing to/descending to/passing [altitude] for [altitude]."

* When a position report is required: "[name] Center, [aircraft identification], [position], [altitude]."

* When no position report is required, but you're not in radar contact: "[name] Center, [aircraft identification], estimating [reporting point] at [time] [altitude]."

When operating in a non-radar environment, you will give position reports to center at designated compulsory reporting points along your route of flight. The report is always preceded by a courtesy call which includes "[name] Center, [aircraft identification], [position]". If center's reply is "[Roger]" then no further information is required or wanted from the pilot. If center states "[Go Ahead]" then the full position report is given. The report includes the following information:

* Identification
* Position
* Time
* Altitude/FL
* Position - (Next reporting point)
* Time
* Position - (Name only of next succeeding reporting point)

When you are operating under an IFR clearance, you may not deviate from it unless you obtain an amended clearance or unless safety of flight considerations prohibit compliance.

When you are cleared to climb or descend at pilot's discretion, you may do so, leveling off at intermediate altitudes if so desired, but you may not return to an altitude once you have vacated it.

Don't forget to report leaving altitude.

When cleared to a point short of your destination, you should ask for an expected further clearance (EFC) time, if it is not given or offered. When cleared to a point not on your route of flight, you must receive expected further routing (EFR). You should normally receive further clearance at least 5 minutes prior to reaching your clearance limit.

Request an amendment to your clearance as early as possible to avoid delays. Refer to the format for filing a flight plan while airborne and requesting a change of routing on the back of the FLIP IFR Enroute Supplement or in the Flight Information Handbook.

To file a change to your flight plan en route, the pilot communicates five required items to the ARTCC. You can remember these items by using the acronym D-R-A-F-T: (D)estination, (R)oute, (A)ltitude, (F)uel, and (T)ime. This acronym may not be understood by ATC; it is only a memory aid for you to recall the items necessary in the request.

LOST COMMUNICATIONS

When dealing with a communications failure, you are expected to use good judgment in whatever action you take. Don't be reluctant to take emergency action to maintain safety of flight.

If your aircraft has a usable transponder when two-way radio communications are lost, squawk mode 3, code 7600. Using this code will bring immediate controller attention to your problem. Continue to squawk this code while you still have radio problems or until directed by ATC to change your squawk. In addition to the squawk, also make "in the blind" calls in case your transmitter is still operating.

If you lose communications en route, first try to contact center on the last assigned frequency, then on an appropriate frequency listed in the FLIP Enroute IFR Supplement. If you are unable to reestablish contact with center, attempt to call the nearest FSS on 255.4 or 122.5, monitor the appropriate VOR frequency (as center may issue instructions over this frequency), or as a last resort, transmit on guard.

If you have lost your transmitter but are still receiving, you can expect ATC to attempt to determine if you are receiving by requesting that you do one or more of the following: squawk ident on your IFF, change your IFF squawk, switch IFF squawk to standby, or by requesting that you execute turns.

If you are in visual meteorological conditions (VMC) when communications are lost, do not enter IFR conditions if it is possible to descend and land VFR at a suitable field.

If you are in instrument meteorological conditions (IMC) or must reenter IMC when communications are lost, continue along your route and altitude in accordance with the following procedures in the order presented:

Route:

1. **Route assigned in the last ATC clearance**
2. **If on a vector, direct to the point specified in the vector clearance**
3. **In absence of assigned route, by the route given in an expected further routing (EFR)**
4. **In absence of EFR or assigned route, by route filed in flight plan**

Altitude (at the highest of the following):

1. **Altitude or flight level last assigned**

2. **Minimum enroute altitude/flight level for the segment being flown**

3. **Altitude ATC says you may expect in a further clearance**

As previously mentioned, if a climb is required, commence it as necessary to comply with the minimum altitude as required in one through three above.

If you lose communications while on a vector off your planned route with no expected further routing, return to your filed route. If at all possible, do not accept a clearance off your filed route without an expected further routing.

PROCEEDING DIRECT TO A STATION

There are two ways to fly to a NAVAID--by homing and by proceeding direct. The difference between the two is that in the presence of a crosswind, a homing aircraft will fly an arcing route (therefore not maintaining a given course) to the station instead of flying in a straight line (Figure 16).

To proceed direct to a station, first tune and identify the station and then turn the aircraft in the shortest direction to place the head of the No. 1 (VOR) or No. 2 (TACAN) bearing pointers under the heading index at the top of the HSI. (If you were to stop at this point and fly to the station, keeping the bearing pointer at the top of the HSI, you would be homing.) Once the bearing pointer is centered at the top of the HSI, rotate the course set knob until the CDI is centered with a TO indication. Note the course and maintain a wind corrected heading that will track the selected course to the station by crabbing as necessary to keep the CDI centered.

<u>Indications Of Station Passage</u>

When flying VOR or VOR/DME note when the FROM indication appears in the TO/FROM indicator on the HSI.

NOTE: To obtain a FROM indication after station passage, you must set the course deviation indicator to a course that results in a TO indication prior to station passage.

TACAN station passage, due to increased size of the cone of confusion associated with TACAN stations, is noted when minimum DME is reached.

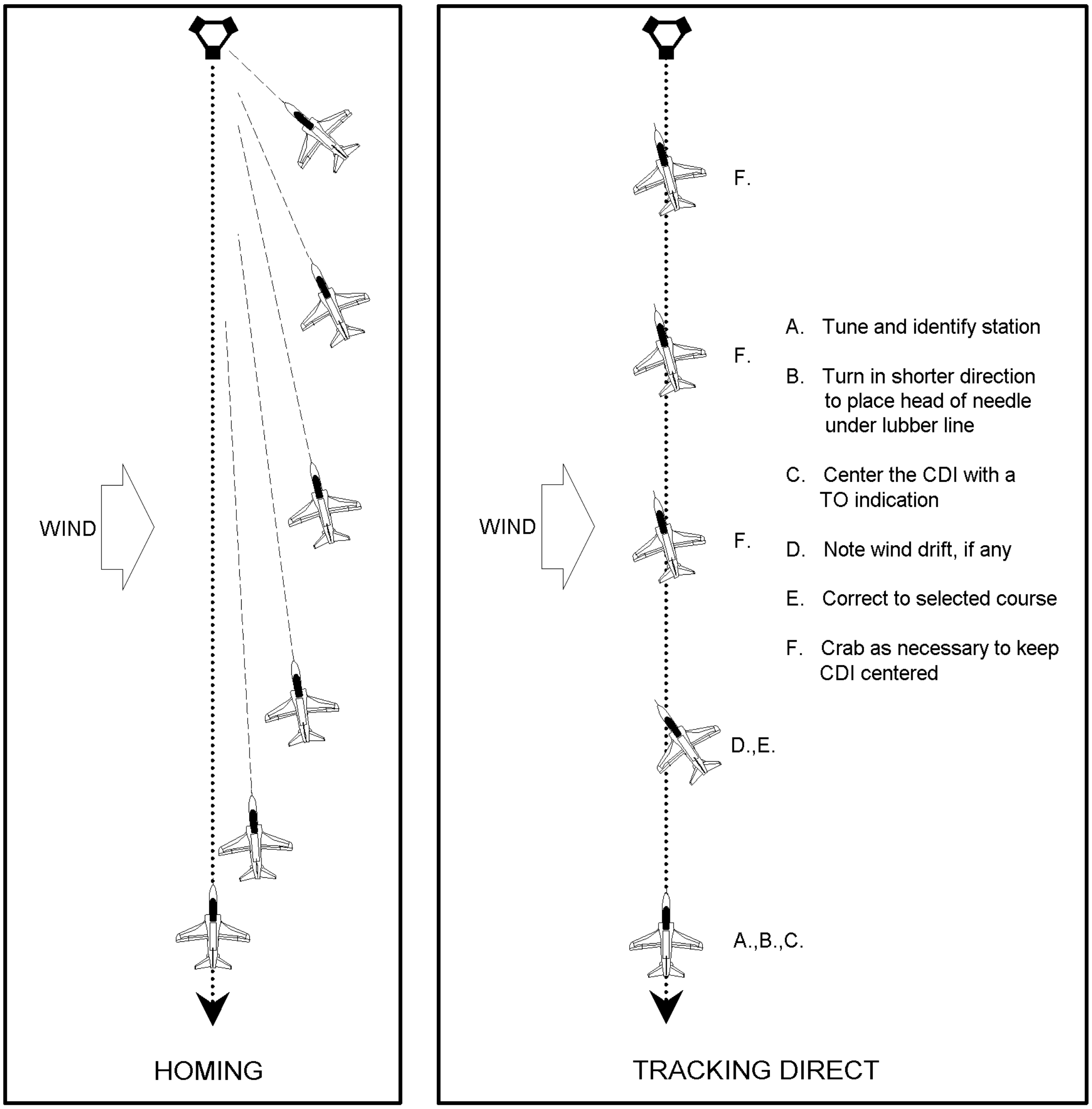
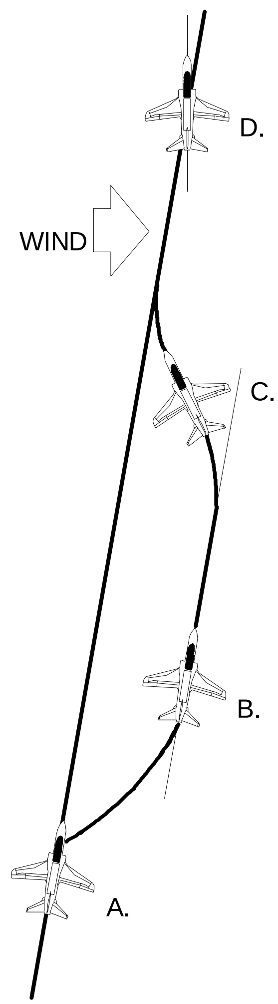


Figure 16: PROCEEDING DIRECT

WIND DRIFT CORRECTION

Determining wind corrected heading (WCH), is the technique you will use to compensate for crosswinds when maintaining a course on a radial. To compensate for wind, use a WCH that stops drift from your course. The difference between WCH and desired course is called "crab angle." (Figure 17).

To determine a WCH, first establish the aircraft on a radial tracking on course, CDI centered, inbound or outbound from a station. While maintaining a constant heading, check for an indication of drift on your CDI. If a drift from course is observed, turn the aircraft sufficiently to correct for the effect of the wind and reintercept the course, (CDI centered). Once established on course, reduce the intercept heading used to correct back to course while leaving a crab angle into the wind to maintain your course. Continuously monitor the CDI to ensure that you are maintaining the desired course. The amount of crab angle required will vary with wind strength and direction, so you'll have to experiment until you find the best WCH for the course being tracked.



A. Aircraft on course and on heading

B. Aircraft drifts off course while remaining on heading

C. Heading changed to reintercept course

D. Heading adjusted into wind to keep CDI centered

Figure 17: WIND DRIFT CORRECTION

COURSE INTERCEPTS

It is sometimes necessary to change positions or radials inbound to or outbound from a facility. Both inbound and outbound course intercepts are basically the same in that you must determine the angle of intercept to achieve the most expeditious intercept of the desired radial.

The angle of intercept is the angle between the heading of your aircraft and the desired course; it is normally greater than the number of degrees you are from your desired course, but it must not exceed 90 degrees. At 90 degrees, the rate of interception is the maximum possible. Within these two limits, you can adjust your intercept angle to achieve the most desirable rate of interception.

Lead point for course intercepts is calculated as 1 percent of your estimated ground speed for an intercept angle of 90 degrees. For intercept angles of less than 90 degrees, use an applicable ratio of this formula (e.g., a 45-degree intercept would require one third as much lead as a 90-degree intercept). See Figures #22 and #24. You will calculate lead point either in radials or DME, depending on the maneuver you're performing.

The HSI provides two indications that will assist you in determining lead point. First, the bearing pointer will give you the relative speed at which you are approaching the desired course. By observing the rate at which the bearing pointer approaches the desired course, you can determine when to initiate your turn. Second, the CDI also shows the relative speed at which you are approaching the desired course by starting to move once you are within 10 degrees of that course. When you are 60 nm from the station, the radials are 1 nm apart and at 30 nm they are 1/2 nm apart. Therefore, the CDI will move rapidly when you are close to a station and more slowly when the station is distant.

<u>Inbound Intercepts</u>

To perform a course intercept inbound to a station, first tune and identify the station (if you haven't already done so) and then dial in the desired inbound course in the course select window. The two most used procedures for accomplishing an inbound intercept are the 30-degree and the double angle off the bow methods. When determining which intercept is most appropriate, consideration should be given to the aircraft distance to the NAVAID (if known). A double angle off the bow intercept could be as little as 1 or 2 degrees or as much as 45 degrees. The 30 degree method is always 30 degrees. Consideration for radial spread and closure rate determined by the distance from the NAVAID and wind should always be a factor in the selection and application of an inbound intercept.

30-Degree Method
Once you have tuned the station and selected the desired course in the HSI course select window, look from the desired course on the compass card to the head of the bearing pointer used and 30 degrees beyond. The heading located 30 degrees beyond the bearing pointer is the heading you will fly to the intercept. Turn the aircraft to this heading and maintain it until you reach the lead point and then complete the intercept (Figure 18). You look from the desired course to the bearing pointer.

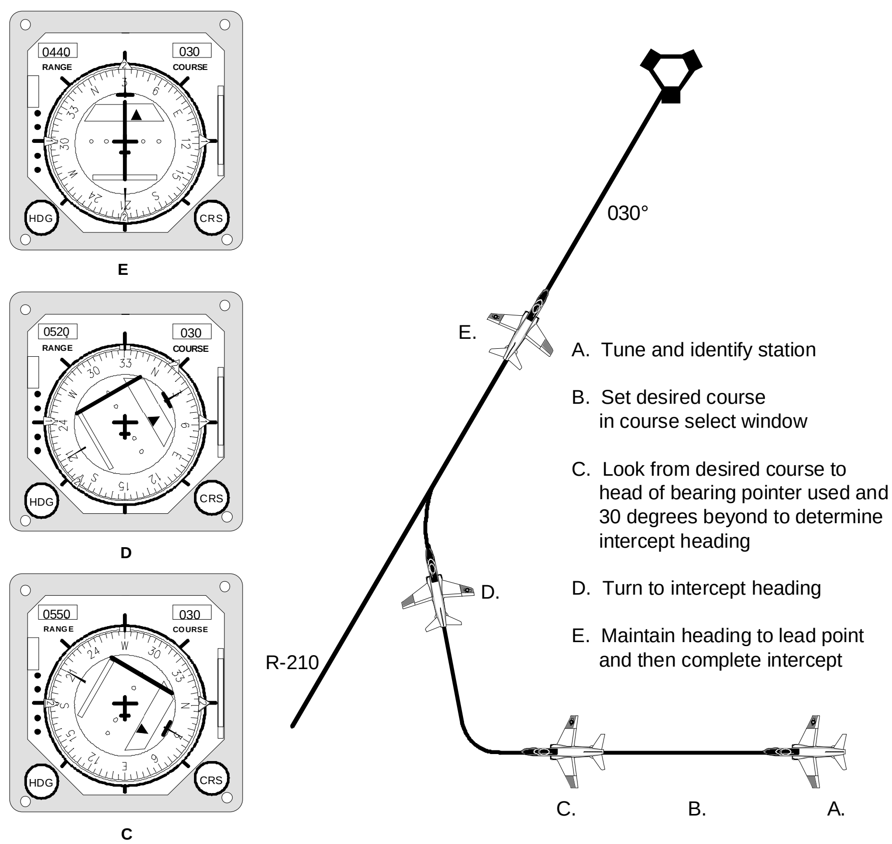


Figure 18: 30-DEGREE METHOD

Double Angle Off The Bow Method

As with the 30-degree method, begin this intercept by tuning the station and setting the desired inbound course in the course select window. Now look from the desired course on the compass card to the head of the bearing pointer used and an equal number of degrees beyond . The heading located an equal number of degrees beyond the head of the bearing pointer is the heading you will fly to the intercept (max 45 degrees). Turn the aircraft to this heading and maintain it until you reach the lead point and then complete the intercept (Figure 19). You look from the desired course to the head of the bearing pointer.

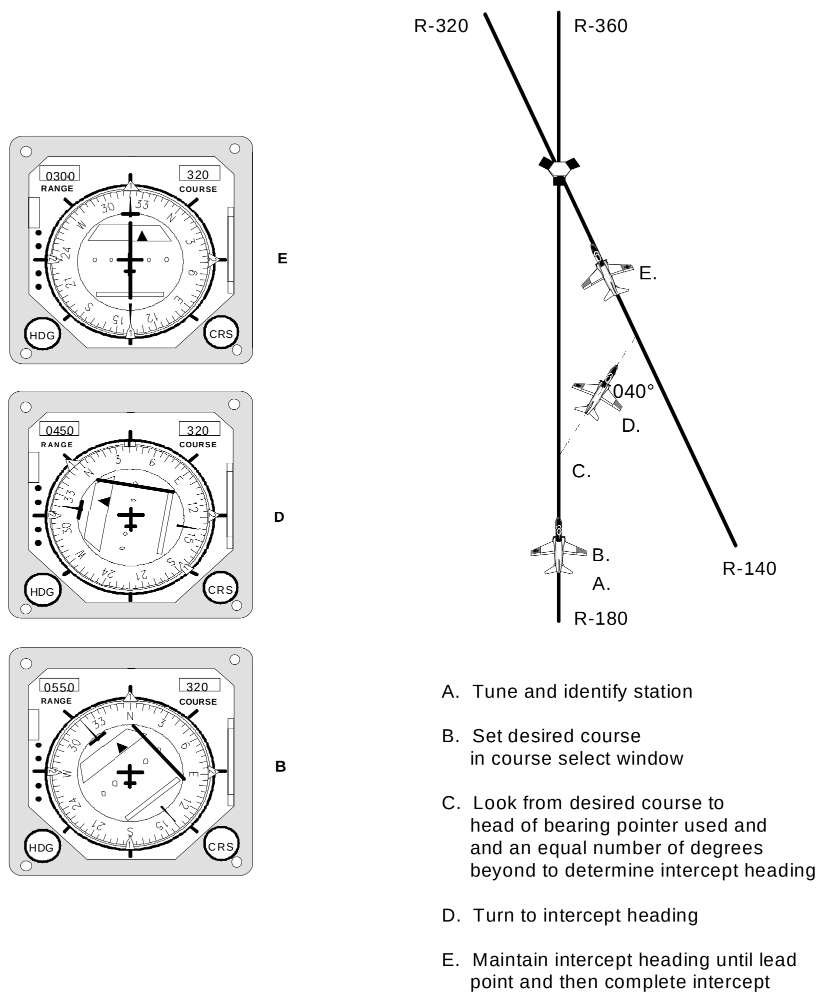


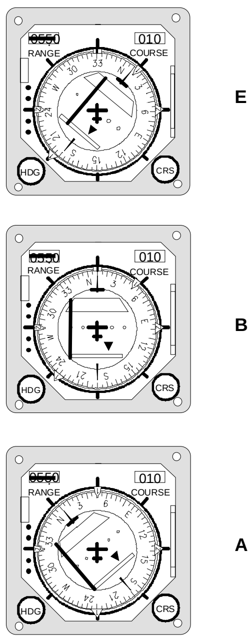
Figure 19: DOUBLE ANGLE OFF THE BOW METHOD

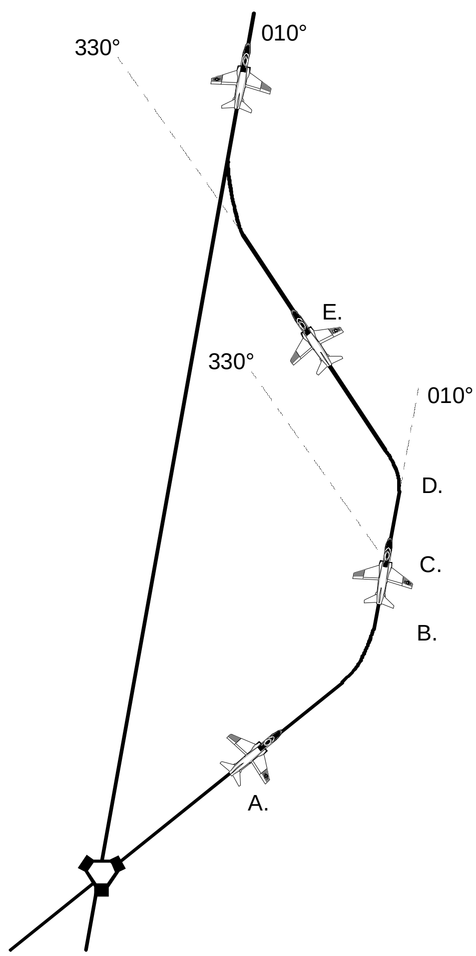
Outbound Intercepts

You can intercept a radial outbound from a station either when you fly directly to a station and then pick up an outbound radial immediately after passing the station or when you intercept an outbound radial at some distance from the station. The two outbound intercept procedures discussed here will address each of these situations.

Course Intercept Immediately After Station Passage

First, tune and identify the station if you have not already done so. When station passage occurs, turn parallel to your desired course and then dial it in on the course select window. Now look from the tail of the bearing pointer used to the desired course and an equal number of degrees beyond, but not more than 45 degrees, to determine the intercept heading. Turn to and maintain the intercept heading until you reach the lead point and then turn to intercept the desired course (Figure 20). You look from the tail of the bearing pointer to the desired course.





A. Turn parallel to desired course after station passage

B. Set desired course in course select window

C. Look from tail of bearing pointer used to desired course and an equal number of degrees beyond, but not more than 45 degrees, to determine intercept heading

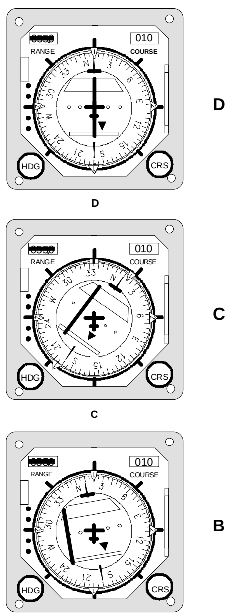
D. Turn to intercept heading

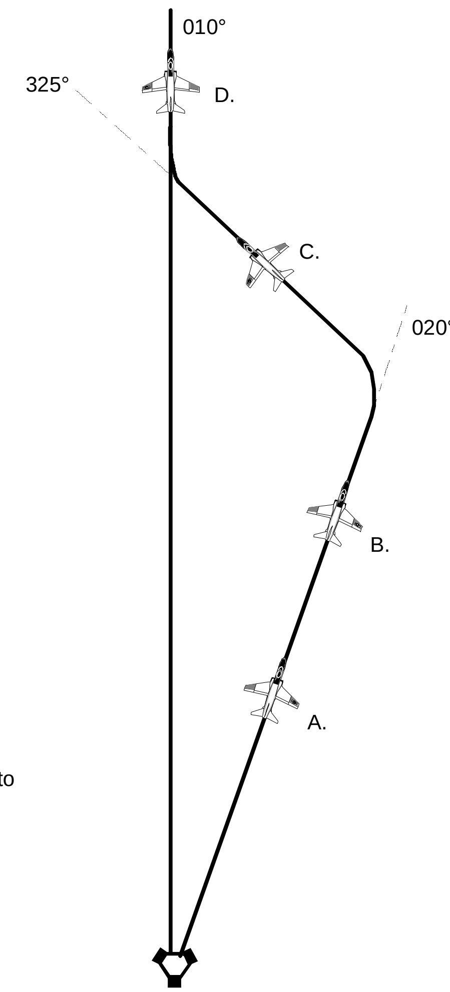
E. Maintain heading to lead point and then complete intercept

Figure 20: COURSE INTERCEPT IMMEDIATELY AFTER STATION PASSAGE

45-Degree Method

You will find this procedure useful when intercepting an outbound radial of a VOR or TACAN station that is some distance away. As with the other intercept procedures, you must first ensure that the station is properly tuned and identified and then dial in the desired course (radial) in the HSI course select window. To determine the intercept heading, look from the tail of the bearing pointer used to the desired course and 45 degrees beyond. Now turn to and maintain the intercept heading until you reach the lead point (Figure 21).





A. Set desired course in course select window

B. Look from tail of bearing pointer used to desired course and 45 degrees beyond to determine intercept heading

C. Turn to intercept heading

D. Maintain heading to lead point and then complete intercept

Figure 21: 45-DEGREE METHOD

TACAN AND VOR/DME PROCEDURES

Adding range information to instrument navigation enables you to perform several other navigational procedures, including flying an arc around a station, proceeding point-to-point, and determining ground speed.

Ground Speed Checks

You need to remember two facts to perform a TACAN ground speed check: first, your DME from the station must be greater than or equal to your altitude in thousands of ft (in order to limit the impact of slant range on your calculation); second, you must be flying either directly to or directly from a station to get an accurate ground speed check. If you are arcing or cutting across radials, your check will be inaccurate.

Start your timing when the DME displays a whole number. After a predetermined time (in minutes), record the DME that has elapsed.

To calculate your ground speed, divide the distance (in nautical miles) by the elapse time (usually 1 or 2 minutes) and then multiply the quotient by 60. The product of this calculation will be your ground speed in knots.

For example: 12 nm/2 min = 6 X 60 = 360 knots

You can also time for a longer period of time to find the average miles per minute and then multiply by 60. This will increase the accuracy of your ground speed calculation.

For example: 12 nm in 3 minutes = 4 nm/min = 240 knots

NOTE: ATC can also provide you with ground speed from radar.

Intercepting an Arc from a Radial

The key to intercepting an arc precisely at the desired DME lies in performing an accurate lead point calculation (LPC) to determine the correct lead point DME to initiate the interception turn. For radial to arc intercepts, you will determine the lead point in miles (DME) instead of radials, which are used in arc to radial intercept calculations discussed later in this chapter.

The turn to intercept an arc from a radial will normally be at approximately 90 degrees. When intercepting an arc, you have to calculate the lead point at which you initiate the turn in order to intercept it at the correct distance. To determine the lead point, use 1 percent of your ground speed. For example, whether flying inbound or outbound at a ground speed of 250 knots, your lead point will be 2.5 DME prior to the desired arc. When inbound to the arc, add the 1 percent to the arc DME and when outbound, subtract 1 percent from the arc DME when calculating the lead point.

When you reach the lead point, initiate a 1/2 SRT turn in the proper direction and maintain it until the bearing pointer nears the wingtip position. You may have to modify your turn rate/AOB somewhat in order to arrive on the arc at the proper DME.

When intercepting an arc from a radial that is significantly more or less than a 90 degree turn, adjust the lead point by applying the following:

* For turns of approximately 45 degrees use 1/3 of the distance calculated for a 90 degree turn.

* For turns of approximately 60 degrees use 2/3 of the distance calculated for a 90 degree turn.

* Turns of 30 degrees or less, require very little lead.

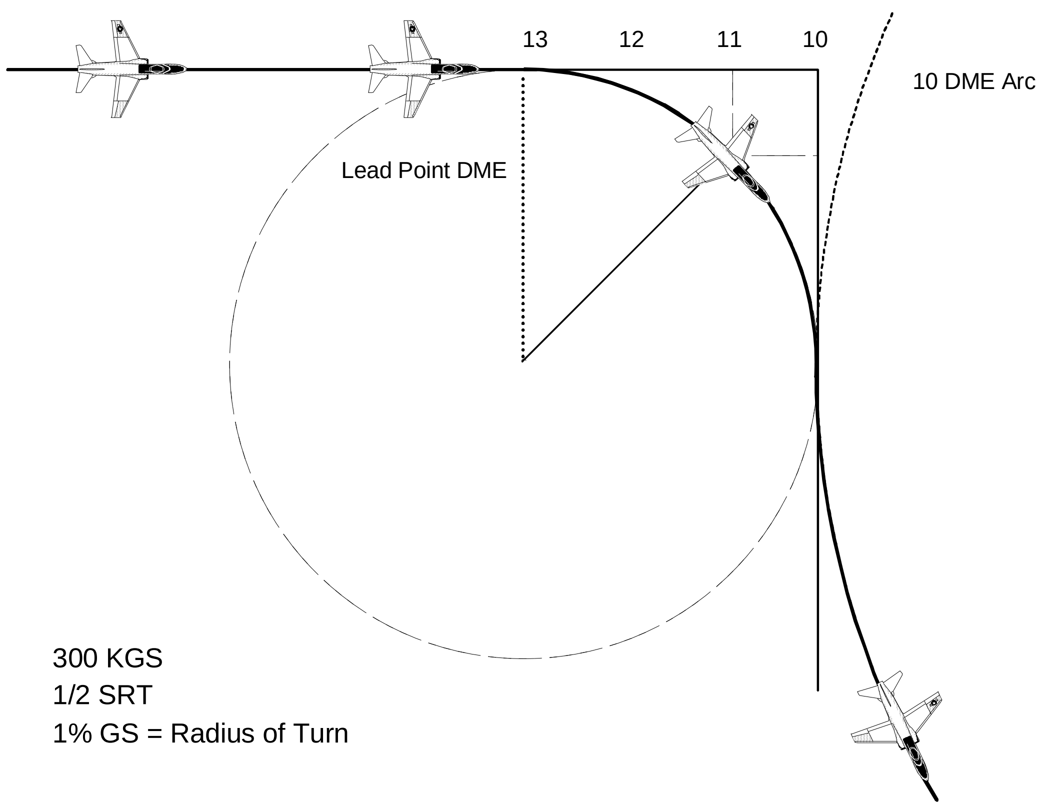


Figure 22: RADIAL TO ARC INTERCEPT PROCEDURE

Maintaining an Arc Around a Station

Two ways of maintaining an arc around a station are the chord method and the angle of bank method. Either procedure (or a combination of the two) will work at any distance from a station. However, the chord method is generally more practical when you're flying a distant arc (usually more than 12 DME from a station) while the angle of bank method usually works better when you're flying an arc close in (12 DME or less). The chord method consists of a series of short straight legs, connected by turns. The angle of bank method is flown as a shallow turn with variable AOB to maintain a constant arc.

Chord Method
(Normally used for arcs of greater than 12 DME) To maintain an arc using the chord method, fly a series of short, straight legs connected by small turns that take you slightly inside and outside the actual arc (Figure 23). To use the chord method; first, ensure that the station is tuned and identified. Then determine direction of turn and calculate lead point. Initiate the turn at the lead point (when DME equals radius of arc, plus or minus the LPC) using a 1/2 SRT. Roll out from your interception turn when the bearing pointer is 5 to 10 degrees ahead of the wingtip position at the correct DME. Maintain your heading until the bearing pointer has moved to 5 to 10 degrees behind the wingtip and then turn until the bearing pointer is once again positioned 5 to 10 degrees ahead of the wingtip. Repeat this procedure as long as you are flying on the arc. The length of the legs will decrease as you fly arcs closer to a station until you reach a point where this method loses its advantage over the angle of bank method described below.

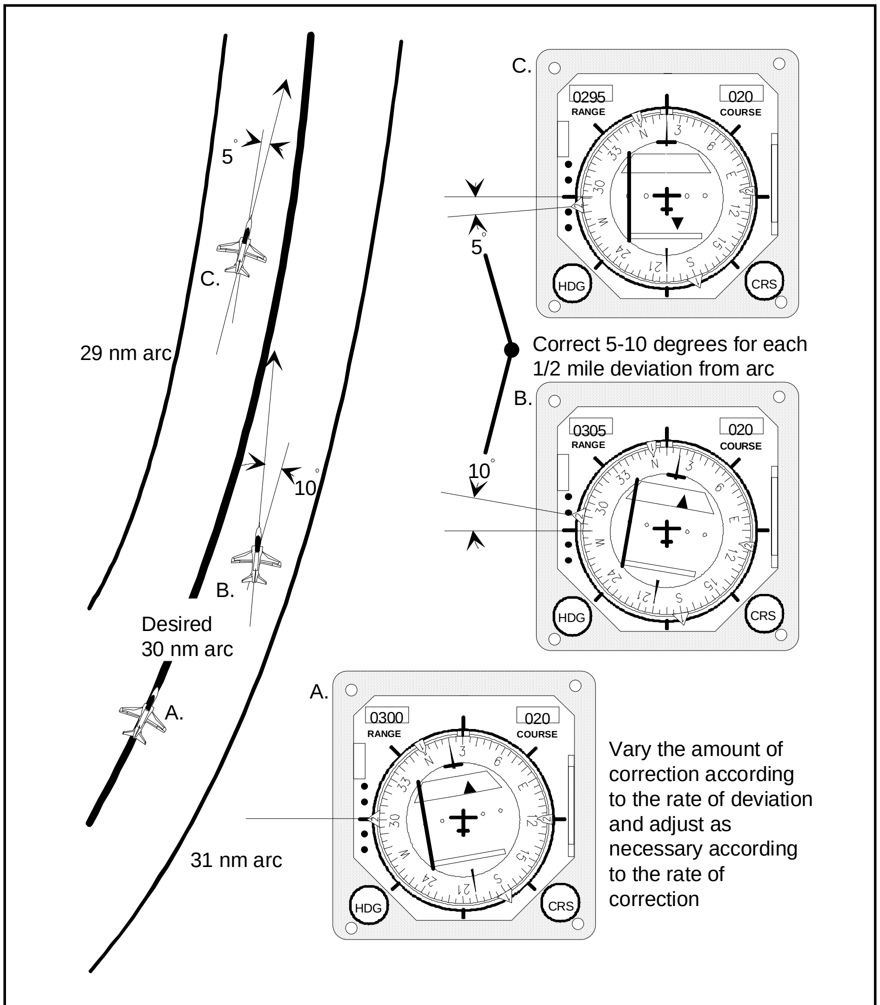


Figure 23: MAINTAINING AN ARC (CHORD METHOD)

If a crosswind makes holding your DME difficult, you may need to increase or decrease the number of degrees you place the bearing pointer ahead of the wingtip or the number of degrees that you allow it to move behind the wingtip position to avoid having to make heading changes too frequently to maintain the arc.

Angle of Bank Method
To maintain an arc using the angle of bank method, first ensure the station is tuned and identified. Next, determine direction to turn and lead point. At the lead point, turn and position the bearing pointer on the wingtip and keep it there by holding the aircraft in a shallow turn. The closer you are to a station, the greater your bank angle will be. The angle of bank method is normally used inside of 12 DME. Outside of 12 DME, the bank angle required to maintain an arc will probably be too small to hold accurately.

Adjustments to the position of the head of the bearing pointer relative to the 90 degree benchmark will have to be made to compensate for the position of the wind relative to the aircraft on the aircraft as it moves around the arc.

Intercepting a Radial from an Arc

When intercepting a radial from an arc, you must determine which way you have to turn to intercept and fly the radial in the correct direction (Figure 24). Since you will most often be performing an arc as part of an approach or departure procedure, you can obtain this information from the appropriate approach plate or SID. To turn from an arc to a radial, your main consideration is to determine the proper lead in radials. Radials diverge as you get further from a station and are 1 nm apart at 60 DME. Take this divergence into account when calculating your lead point for the turn. To calculate the lead point for intercepting a radial from an arc, first you must calculate or estimate the ground speed. Then apply the following formula:

Divide the arc DME into 60 then multiply the quotient by 1 percent of the ground speed.

For example, if you are on a 15 DME arc at 250 knots ground speed, your lead point will be 10 radials (60 divided by 15 equals 4, 1 percent of 250 is 2.5, and 2.5 multiplied by 4 equals 10).

When making your intercept turn, you can also use the movement of the bearing pointer and CDI as a guide to determine when to initiate the turn. When you are flying close to the station, the CDI will move too quickly to follow at 30 degrees AOB. Therefore, the turn must be initiated at the calculated lead point.

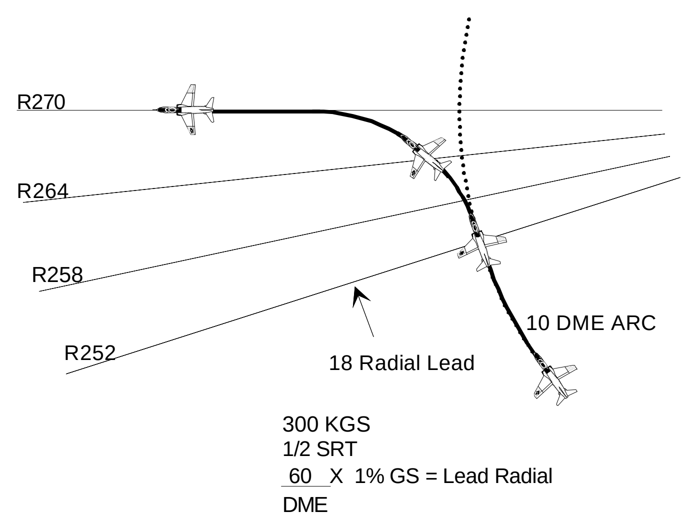


Figure 24: RADIAL TO ARC INTERCEPT PROCEDURE

To intercept a radial from an arc, first set the desired course in the course select window. Next, determine your lead and then turn using a 1/2 SRT when you reach the lead point. Finally, vary your AOB in the turn with the movement of the CDI so that it is centered when the turn is complete. Do not exceed 30 degrees AOB.

The above formula assumes a 90 degree turn. However, inbound radial intercepts will require a greater lead than outbound because the aircraft turns through more than 90 degrees.

For radial intercepts from arcs less than approximately 10 DME , an adjustment must be applied to the arc-to-radial formula to compensate for turns outbound (less than 90 degrees) and turns inbound (greater than 90 degrees) according to the formula:

$$\left(\frac{90 \pm \textit{LEAD (radials)}}{90}\right) \textit{x (TURN RADIUS)}$$

Approximate Lead in Radials for Arcing Around a NAVAID at 10 DME or Less:

ARC DME	90 DEGREE LEAD	INBOUND LEAD (>90 DEGREE LEAD)	OUTBOUND LEAD (<90 DEGREE LEAD)
20	7.5	N/A	N/A
15	10	N/A	N/A
10	15	≈18 (7/6)	≈13 (5/6)
7	21	≈27 (6/5)	≈16 (3/4)
5	30	≈40 (4/3)	≈20 (2/3)

NOTE: Correction factor in parenthesis is calculated from the formula:

[90 +/- ***LEAD*** (radials)]/90 X (***TURN RADIUS***)

Point-to-Point Navigation

As you approach a terminal area, the controller may clear you either to a holding fix or to the IAF. When cleared direct to a fix, you will have to use radar vectors or point-to-point navigation. Point-to-point navigation allows you to fly directly from any fix (radial and DME) to any other fix within reception range of a given station (Figure 25).

The following steps are used to accomplish the point-to-point procedure: First, tune and identify the appropriate TACAN or VOR/DME equipped station. The aircraft HSI will function as a plotting board. Visualize the HSI compass card as a compass rose with the station at the center. Picture the fix with the greater distance on its radial at the outside edge of the HSI compass card. Visualize the fix with the lesser distance (determined by the previous step) is placed at a proportional distance from the center of the HSI on its radial. The aircraft is placed on the tail side of the radial the aircraft is on. Where on the radial is determined by which fix is greater. If the aircraft is further away from the station than the Pt-to-Pt target fix then the aircraft fix will be located where the tail of the bearing pointer crosses the compass card. If closer, then the aircraft is located at a proportional point along the tail of the bearing pointer. Once the fixes are determined, connect them with an imaginary line or with the aid of a straight instrument such as a pencil. Move the line to the center of the HSI, paralleling the original imaginary line, and read the course to the target fix where the line intersects the outside edge of the compass card. Turn the aircraft to the new course and apply a WCH if known. Repeat the point-to-point procedure periodically en route and make corrections to the target fix as needed.

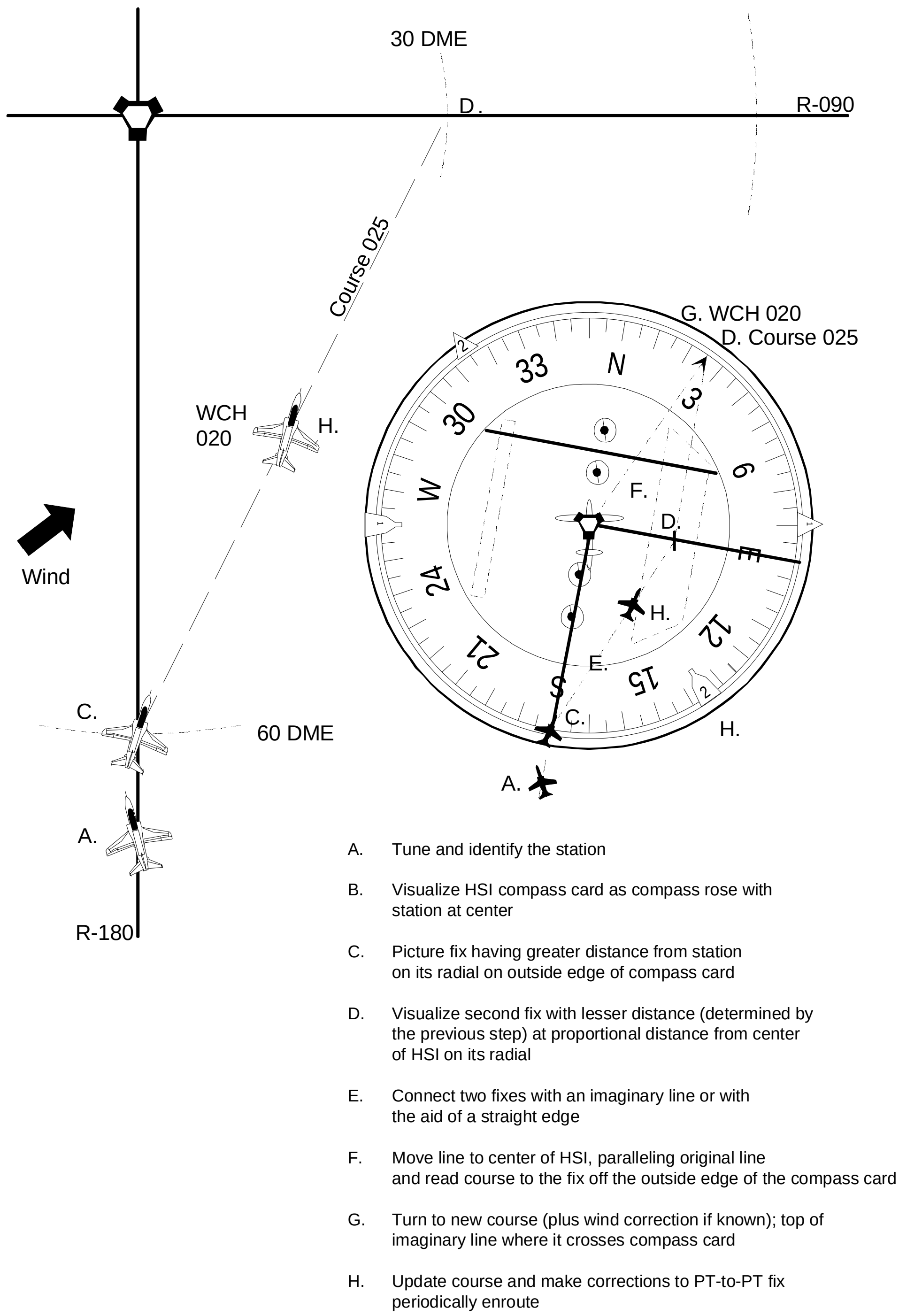


Figure 25: POINT-TO-POINT NAVIGATION

ARRIVAL PHASE

This phase consists of those activities occurring in the transition from enroute flight to approach and includes procedures for holding and performing enroute descents.

HOLDING

"Holding" refers to the maneuvering of an aircraft in relation to a navigational fix. Holding patterns are defined areas of airspace where aircraft could be required to hold en route, when awaiting clearance to commence an approach, or after executing a missed approach. All aircraft given the same holding instructions must fly the same pattern separated only by altitude. Holding is often required when weather conditions are poor in a terminal area and traffic congestion occurs.

There are two basic categories of holding flown in the T-45A, VOR only and TACAN/VOR DME. The difference between the two is predicated on the use or availability of DME to identify the fixes and the limits of the holding pattern. There are also two different types of holding patterns, standard and nonstandard. Standard holding uses right turns in the pattern and nonstandard holding is flown using left turns in the pattern. Determination of which category and type of holding to be flown is dictated either by a depiction on a chart, the clearance the pilot receives from the controller, or equipment availability. The next several pages will discuss the clearances, holding communication, entries, pattern, and pattern corrections in detail.

TACAN/VOR DME Holding

When you are instructed to hold in relation to a TACAN or VOR DME station, the radial, DME of the holding fix, and DME limits of the pattern will be published (as on an approach plate) or will be assigned to you by the controller (Figure 26).

A TACAN/VOR DME holding clearance will consist of the following instructions (if published holding instructions are not available):

1. **Direction of holding from the fix (e.g., W, NE, East)**
2. **Radial and DME of the holding fix**
3. **Outbound leg length or the outer limit of the pattern in nm (applicable DME)**
4. **Altitude**
5. **Direction of turns (if nonstandard, pilot request, or controller considers information necessary)**
6. **Expected further clearance (EFC) time**

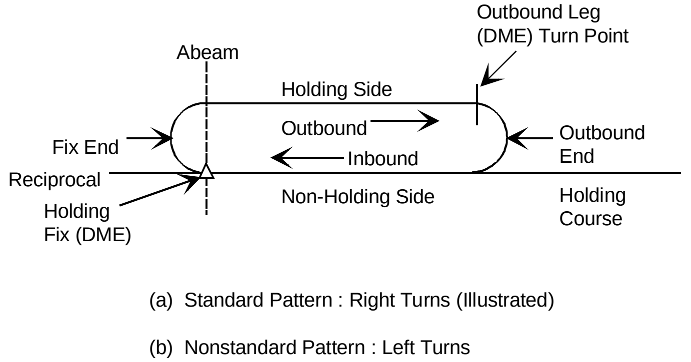


Figure 26: STANDARD HOLDING PATTERN (TACAN)

VOR Holding

The VOR holding clearance is essentially the same as that for TACAN/VOR DME except that VOR holding will not include leg lengths. Unlike DME-based patterns, VOR patterns are located over the station because there is no distance reference available to establish the holding fix (Figure 27).

The difference between VOR holding and TACAN/VOR DME holding is that instead of measuring leg lengths with DME, you'll have to time the legs. Leg times are 1-1/2 minutes above 14,000 ft MSL and 1 minute at 14,000 ft MSL and below. These times apply only to the initial outbound leg and all subsequent inbound legs. You may have to adjust your outbound time (due to head or tail wind components) to achieve the necessary inbound time. Outbound leg timing begins when you are abeam the fix or when you roll wings level out of the turn, whichever occurs last.

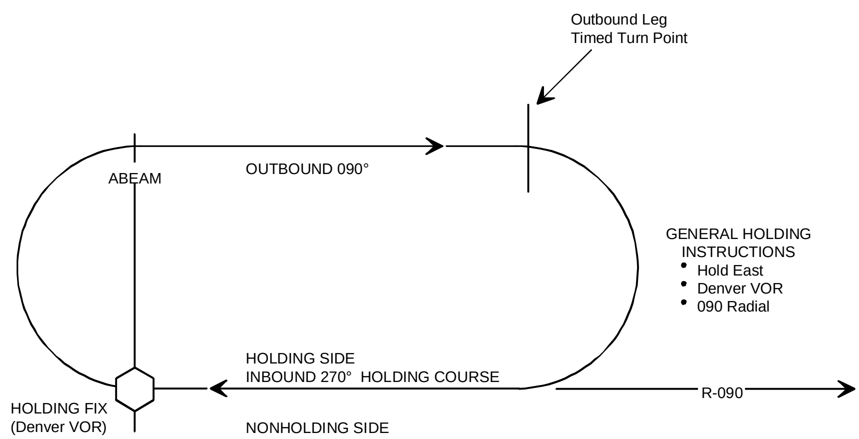


Figure 27: NON-DME HOLDING PATTERN

General Holding Procedures

The basic procedures for flying a holding pattern are as follows: First, begin slowing to holding airspeed no sooner than 3 minutes from the holding fix. Next, from your holding clearance, or published holding procedure, determine the type of holding to be used. From your heading determine the appropriate entry procedure. Upon arrival at the holding fix, note the time and initiate the entry procedure. If timing is used for the pattern vice DME, note the time wings level or abeam the holding fix whichever occurs last on the entry procedure heading outbound and on subsequent outbound orbits. Set inbound holding course in the HSI course select window. Turn inbound when the appropriate time outbound has elapsed for the holding altitude and begin timing inbound wings level. All turns in holding are made at 3 degrees per second (standard rate) but do not exceed 30 degrees AOB. Communicate entering holding, if required, once established in the pattern. On subsequent orbits adjust heading and or timing as required for winds to maintain a holding pattern track and time.

Communication Procedures For Holding

For a normal holding pattern with a charted destination, the controller will not necessarily provide instructions unless they are requested by the pilot or the controller deems it necessary. If the destination is not charted the controller will provide fix, direction from fix, radial or bearing, leg length if DME, altitude if different than present assigned, and an EFC time or expected further routing (EFR). The controller will only indicate turn direction if holding is nonstandard by stating "Left Turns" in the clearance, at the pilots request, or if the controller considers it necessary.

The pilot is required to report the time and altitude or flight level upon reaching a holding fix to which cleared and to report leaving the holding fix. However, these reports may be omitted by pilots involved in instrument training at military facilities when radar service is being provided. If the holding fix is the clearance limit (EFC assigned, and not cleared for approach), then the fix is a compulsory reporting point.

EXAMPLE: “KATO TWO ZERO ONE, BIGFOOT, FLIGHT LEVEL TWO ONE ZERO, TIME ONE THREE FIVE ZERO ZULU”

Once cleared for the approach, penetrate upon arrival at the IAF (you need not make a complete turn in holding). See “Penetration from Holding.”

Holding Airspeeds

If you have been cleared to a holding fix or have not received further clearance while en route, begin slowing to holding airspeed no sooner than three minutes prior to a holding fix.

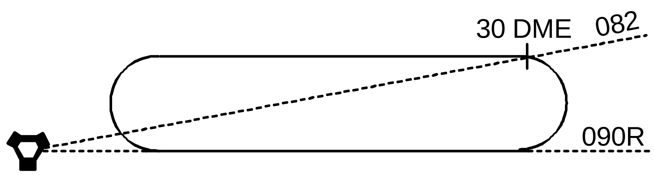
Since holding is a delaying or loitering maneuver until further clearance is received, it is flown at an airspeed approximating maximum endurance. Maximum holding airspeed for this aircraft as published by the FAA is 230 KIAS. Maximum endurance airspeed in the T-45A is 14 units, for simplicity, procedural holding airspeed for the T-45A is 200 KIAS regardless of altitude, not to exceed 14 units AOA. If turbulence is encountered hold at 250 KIAS per NATOPS and notify ATC. The T-45A NATOPS recommended turbulence penetration airspeed is 250 KIAS. When higher speeds are no longer necessary, return to normal holding airspeed and notify ATC.

Entry Procedures

To enter holding, use one of three possible procedures, depending on your heading relative to the holding pattern when you arrive over the fix. (The discussions of entry procedures, on the following pages, assume a standard [right-hand] pattern; reverse the turns for a nonstandard [left-hand] pattern.) In each procedure, you cross the fix and turn outbound on the appropriate heading. At holding fixes that are not over NAVAIDs, an outbound offset should be determined prior to the entry (Figure 28). Turn inbound to intercept the holding course at the appropriate DME or time (Figures 29 and 30).

No-Wind VOR/TACAN DME Entry Offset

Prior to reaching the holding fix on a teardrop or direct entry, based on the T-45A turn radius for 180 degrees at holding airspeed, the pilot should calculate the approximate offset required so at the inbound turn point, a SRT or 30 degree AOB turn for 180 degrees, will place the aircraft on the holding course inbound. The actual offset required will vary with wind, true airspeed, altitude and Turn radius. For 200 KIAS at 15,000 ft, the T-45A turn radius is approximately 2 nm, or 4 nm for 180 degrees of turn. See Figure 28.



NO WIND

Offset 8 radials according to table:

DME (At turn inbound)	RADIAL OFFSET (Approximate)
10	24
20	12
30	8
40	6

Figure 28: NO WIND HOLDING OFF-SET

The quickest and most accurate method of determining which type of entry to perform, is to use the HSI compass card as a plotting board (Figure 29). For a standard holding pattern, locate the holding radial on the compass card. If the holding radial is located within an area of 70 degrees to the right of aircraft heading at the holding fix, perform a teardrop entry. If the holding radial is located within an area of 110 degrees to the left of aircraft heading, perform a parallel entry. If the holding radial is located outside an area of 110 degrees to the left and 70 degrees to the right of aircraft heading, perform a direct entry. For a nonstandard pattern (left turns), reverse the 70- and 110-degree lines. Additionally, most approach plates include a holding entry diagram, to aid you in determining which type of entry to perform.

NOTE: If the holding radial is within +/- 5 degrees of the entry plot quadrant division points, either entry procedure associated with the point may be used. The most appropriate entry is determined by consideration of known wind, holding airspace, etc.

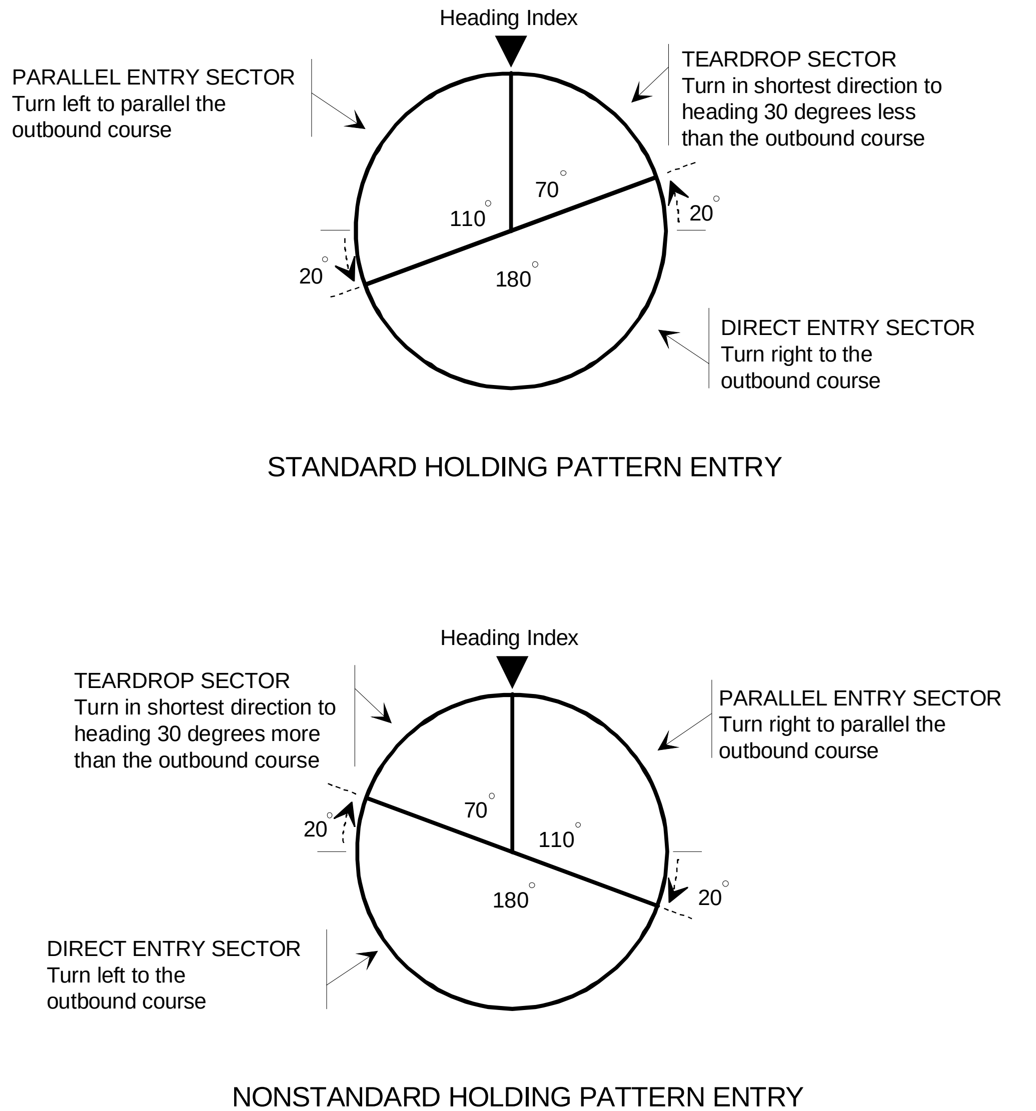


Figure 29: DETERMINING HOLDING ENTRY

1. Parallel Procedure: When approaching the holding fix from anywhere in sector (a), the parallel entry procedure would be to turn to a heading to parallel the holding course/radial outbound on the nonholding side. Wings level (VOR only) time for one or one and one half minutes (depending on the altitude), at end of timing (VOR) or outbound DME (TACAN) turn in the direction of the holding pattern through more than 180 degrees, and return to the holding fix or intercept the holding course inbound.

2. Teardrop Procedure: When approaching the holding fix from anywhere in sector (b), the teardrop entry procedure would be to fly to the fix, turn outbound with a heading change of 30 degrees more than the outbound holding course/radial for a non-standard holding pattern or 30 degrees less than the outbound holding course/radial for standard holding pattern to initiate the teardrop entry within the pattern (on the holding side). Wings level outbound (VOR only), time for a period of one or one and one half minutes (depending on the altitude). Turn to parallel holding radial at desired offset. At end of timing (VOR) or pattern outbound DME (TACAN), turn in the direction of the holding pattern to intercept the inbound holding course or proceed directly back to the fix.

3. Direct Entry Procedure: When approaching the holding fix from anywhere in sector (c), the direct entry procedure would be to fly directly to the fix and turn outbound to follow the holding pattern. Initial timing (VOR only) would begin wings level or abeam whichever occurs last. Time for a period of one or one and one half minutes (depending on the altitude). At end of timing (VOR) or pattern outbound DME (TACAN), turn in the direction of the holding pattern to intercept the inbound holding course or proceed directly back to the fix.

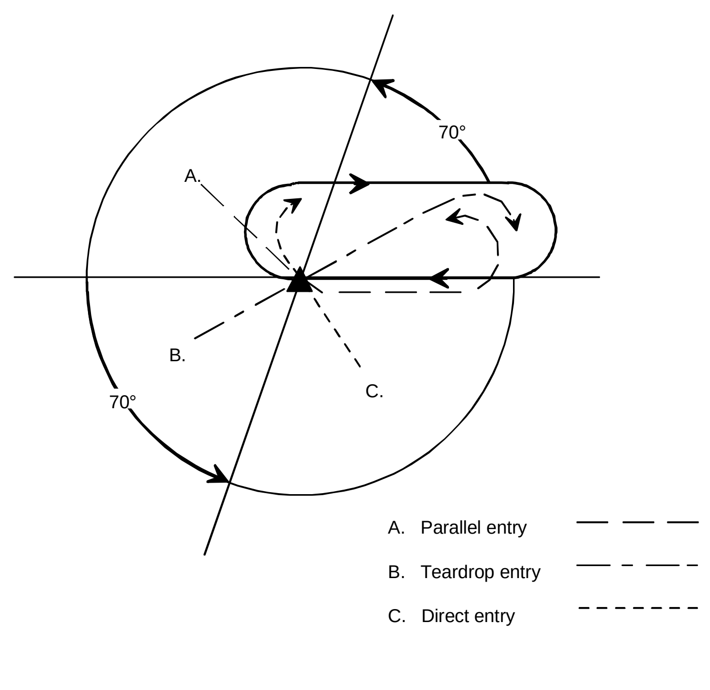


Figure 30: HOLDING ENTRY

Wind Drift Correction Techniques

You may have to compensate for two different wind effects while flying a correct holding pattern--head/tail winds and crosswinds. Head/tail winds will only be a factor on non-DME patterns, for which you will have to adjust the outbound leg for a correct inbound time. Compensate for crosswinds in order to arrive at an outbound position from which a turn inbound will place the aircraft on the holding course. This is normally accomplished by utilizing a larger (approximately two to three times) drift correction on the outbound leg.

See Figure 31.

Lost Communication

If communication is lost, and the pilot has received EFC time and the holding fix and initial approach fix (IAF) are the same, then leave the fix at EFC time. If, however, the holding fix and IAF are not the same, leave the holding fix at EFC time and proceed to initial approach fix. When EFC has not been received, continue on assigned route and do not hold.

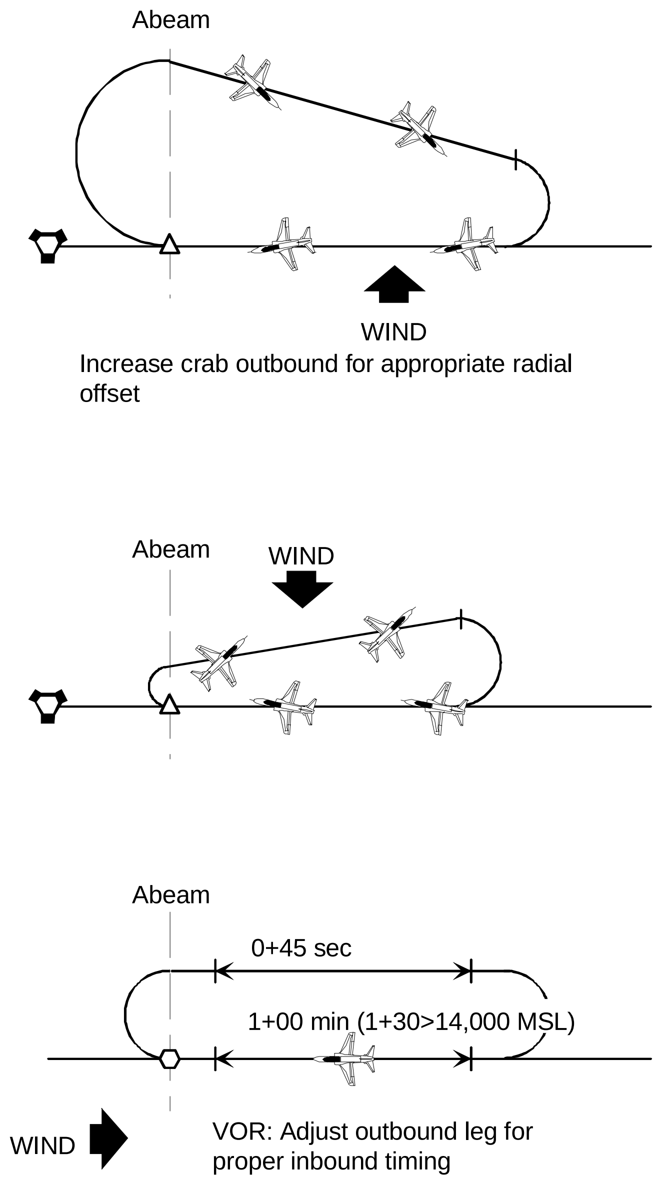


Figure 31: WIND CORRECTION FOR HOLDING

Penetration From Holding
Depending on the goal, choose an appropriate method to accelerate from holding airspeed to 250 KIAS (TACAN penetration airspeed).

1. For fuel conservation, plan to intercept 250 KIAS as you descend out of altitude. At the fix, lower the nose and begin descent while accelerating to 250 KIAS. As airspeed approaches 250 KIAS, reduce power to IDLE and extend the speed brakes if necessary.

2. For timing considerations (for example, CV approaches), accelerate to arrive at the IAF at 250 KIAS. Once cleared, inbound and on course, perform a level speed change from 200 KIAS to 250 KIAS.

At the IAF, simultaneously lower the nose and accelerate to 250 KIAS. At 250 KIAS, reduce power to IDLE and adjust nose attitude and trim to maintain speed, countering the resulting nose pitch up with forward stick. Retrim for 250 KIAS. Remember, descending at idle, 250 KIAS with speed brakes extended yields approximately 6,000 fpm or 1,000 ft of altitude loss for each nautical mile (no wind). Idle, 250 KIAS clean descent yields approximately 2,000 fpm or 1,000 ft of altitude loss for every two nautical miles.

NOTE: To begin penetration, the aircraft must be established on the initial approach course.

During approaches to airfields, retract boards when the profile allows and maintain 250 KIAS. Unlike airfield approaches, CV penetrations are closely sequenced and require all aircraft to maintain 250 KIAS and 4,000 fpm until 5,000 ft AGL, also known as “platform”. At platform, CV aircraft reduce the rate of descent from 4,000 to 2,000 fpm by retracting speed brakes and maintaining 250 KIAS. The T-45A NATOPS Chapter 8 provides more details concerning carrier approaches.

During field approaches call “Platform” and retract the speed brakes if practical. Regardless, honor the minute to live rule.

ENROUTE DESCENT
Enroute descents are used to transition from an enroute altitude to the final portion of an instrument approach or visual approach in lieu of published penetrations. An enroute descent can also be flown to a GCA pickup. The routing on this descent may be via radar vectors or the NAVAIDS depicted on the high altitude charts.

You may request or a controller may initiate an enroute descent; however, the controller must advise you of his or her intention to provide this service, and you may refuse it in favor of a published instrument approach. Prior to issuing descent clearance below the highest published IAF for an airport, the controller must advise you of the type of approach to expect, current altimeter, and the current weather if the ceiling is below 1,000 ft AGL or the highest published circling minimums (whichever is greater) or if visibility is less than 3 miles.

ENROUTE DESCENT PLANNING

Cruise Descent

Goal: Reduce time to destination by descending at an IAS that is higher than the max range airspeed. This type of descent is used when saving fuel is less important than time to destination.

Procedure: To calculate VSI, divide altitude to lose by nm to go times groundspeed. For example, cruising at FL 300 and center clears you to "descend and maintain 15,000 ft" in the next 50 miles. Substituting these numbers into our equation: (-15,000 ft/50 nm) (5 nm/min) equals -1,500 ft per min. Of course, the specific VSI depends on groundspeed, but the following table provides a rough approximation.

From cruise power and IAS at altitude, lower the nose to accelerate (if necessary) to desired descent airspeed (usually 250 KIAS), then reduce power (if necessary) to maintain desired VSI. At altitude, you will need to reduce fuel flow by approximately 50 pph for every -100 ft of VSI. Remember you must request permission to perform directed descents at rates less than 500 fpm.

Max Range Descent

Goal: Use less fuel while maximizing distance traveled. NATOPS lists the max range descent airspeed and descent point in the BINGO tables for various airspeeds and configurations. Max range descent AOA will be higher than the max range cruise AOA (triangle at 12-13 units). Center normally plans to descend you at your altitude plus ten, so you may need to ask for an earlier descent. For example, the let down point for max range descent from FL 350 is approximately 123 nm but Center would not normally descend you until 45 nm. A rough approximation is to let down three and half times altitude plus desired DME from field level off.

Delayed Descent

Goal: Minimize downrange travel if your descent is delayed by ATC or weather. Use this strategy when you are forced to stay higher than desired. At altitude, maintain max endurance AOA ("box" at 14 units) until cleared lower, then lower the nose and accelerate to 250 KIAS, reduce power to idle and use boards as necessary. The idle-with-boards configuration gives the maximum altitude loss for distance over the ground.

All Descents

When descending through 5,000 ft AGL, call "platform" and comply with the "minute to live" rule. When practical, retract the speed brakes.

Descent Comparison, no wind, 2,000 # FUEL: T-45A (all figures are approximate)

FUEL FLOW (pph)	AIRSPEED (KIAS)	VSI (fpm)	DME TO LOSE 1 K
500 (idle)	250	-2,500	2
500 (idle), BDS	250	-6,000	1
500 (idle)	Max Range	-1,500	3-4
700 (75%)	250	-2,500	2.5

STAR

A STAR is a pre-planned instrument flight rule (IFR) air traffic control arrival procedure published for pilot use in graphical and/or textual form. STARs provide transition from the enroute structure to an outer fix or an instrument approach fix/arrival waypoint in the terminal area. Its purpose is to simplify clearance delivery procedures.

Until the military fully distributes STAR publications, STARs will be issued to military pilots only when requested in the flight plan or verbally by the pilot. Still, some of the "preferred" routes in the A/P-1A contain STARs. Use of STARs requires pilot possession of at least the APPROVED textual description. As with any ATC clearance or portion thereof, it is the responsibility of each pilot to accept or refuse an issued STAR. Pilots should notify ATC if they do not wish to use a STAR by placing "NO STAR" in the remarks section of the flight plan or by the less desirable method of orally stating the same to ATC. Remember, this option may result in terminal delays and holding.

APPROACH PHASE

Instrument approaches enable you to transition from IMC to a visual landing while providing terrain clearance and separation from air traffic. Part of the FLIP series, instrument approach procedure charts are divided into two categories, high altitude (Figure 32) and low altitude.

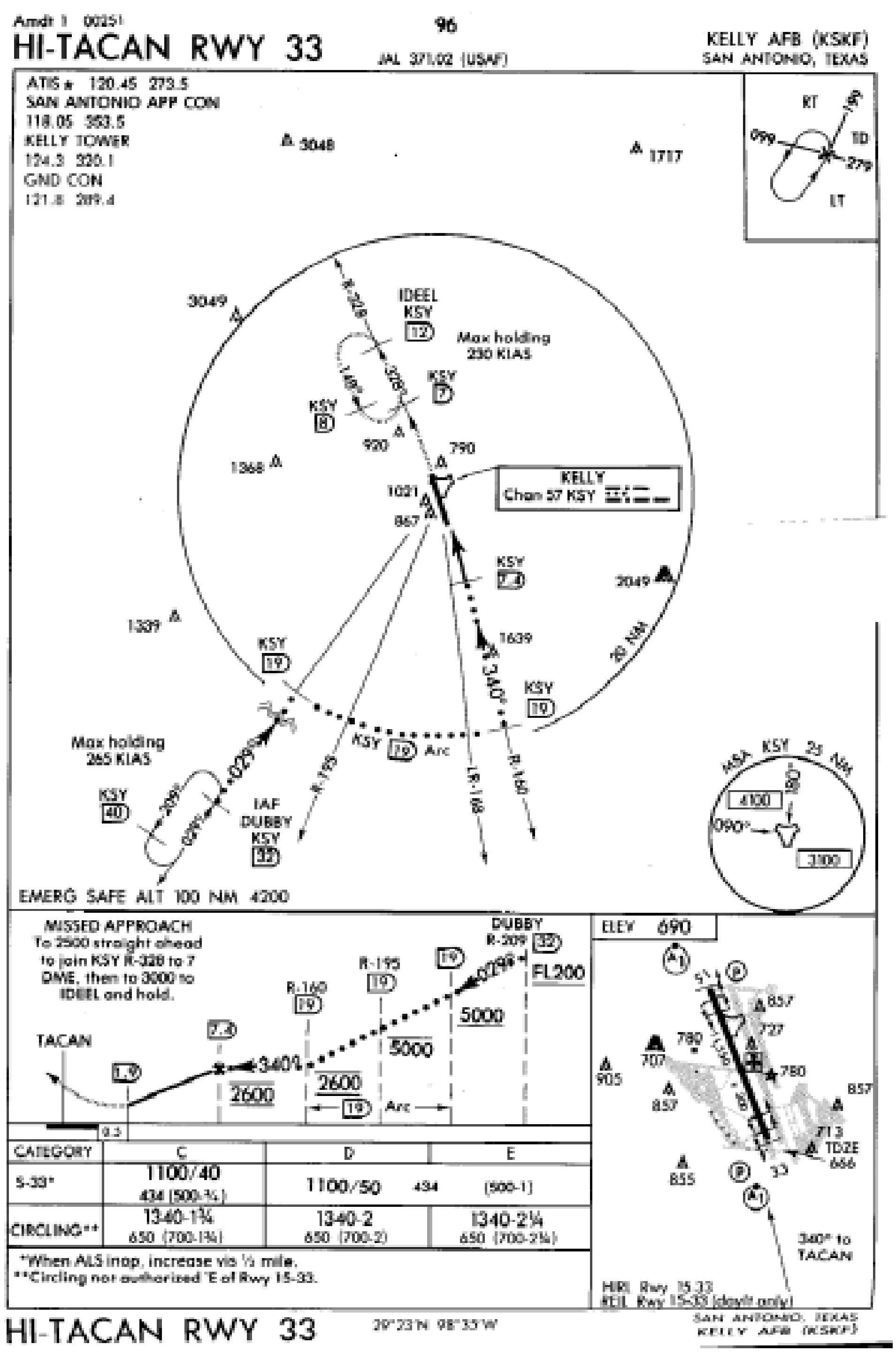


Figure 32: INSTRUMENT APPROACH CHART

Consider the following factors as you select an instrument approach:

1. Altitude structure flown (high or low)
2. Navigational equipment aboard aircraft
3. Types of approaches available at your destination
4. Published approach, pilot, and aircraft minimums
5. Weather

In preparing to execute an instrument approach, you should thoroughly familiarize yourself with the following information:

1. Minimum and emergency safe altitudes
2. Initial approach altitude
3. Penetration and final inbound course
4. Altitude restrictions
5. Approach weather minimums
6. Approach minimums (minimum descent altitude (MDA) and/or decision height (DH)
7. Field elevation plus any special notes on terrain or obstacles
8. Missed approach procedures
9. Communications procedures

In addition to approach procedures, instrument approach charts also provide a diagram of the airport (Figure 33) showing runway lengths, taxi ways, obstructions, arresting gear and barrier locations, approach lighting configuration, buildings and structures ground tract from FAF to runway.

Before commencing an instrument approach you must know the approach procedure in use and complete the "WARP" checklist; confirm the Weather, Altimeter setting, Runway in use, and perform Penetration checks.

After determining which approach you desire to fly, request clearance to commence the approach. Clearance for an approach does <u>not</u> constitute clearance to land or give you priority over VFR traffic in the landing pattern: only the control tower may grant you clearance to land. However, landing clearance can be relayed to you by the approach control facility (i.e., a radar controller).

NOTE: Selection of an approach other than the one identified by approach control as the approach in use, may cause a delay in clearance. If not equipped for approach in use, relay that information to the controller on initial contact with approach control.

NOTE: Because the instrument hood is used to simulate IMC conditions, acquiring the runway environment is not possible and, therefore, you will always execute a missed approach at the decision height (DH) or missed approach point (MAP) when under the bag.

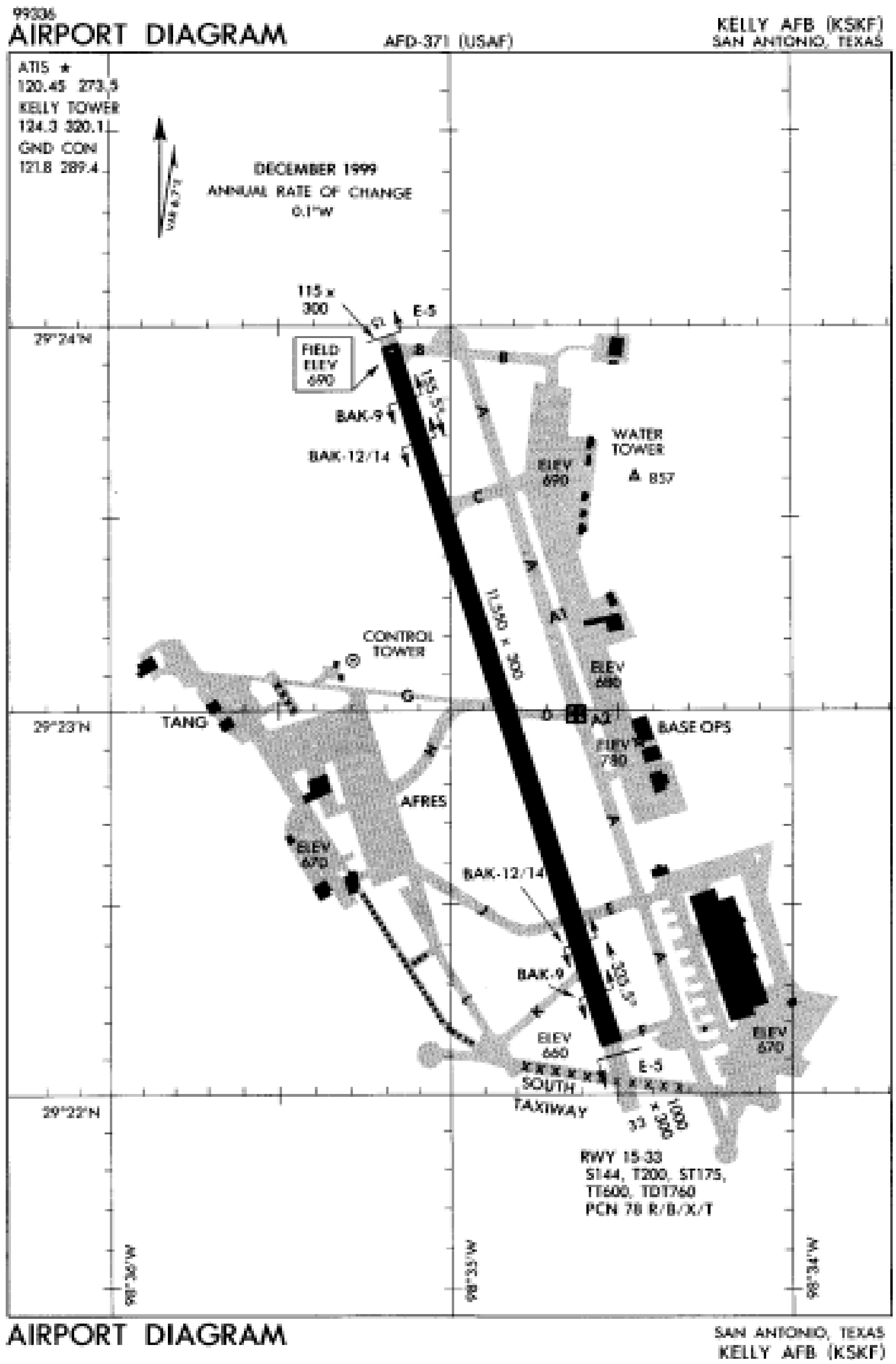


Figure 33: AIRPORT DIAGRAM

You may not commence an instrument approach if weather is below minimums unless: 1) you are dual-piloted, or 2) you are performing a practice approach and do not intend to land. However, if the approach was above minimums when commenced you may continue to the published minimums regardless of changes in the weather. An approach is considered to commence from an enroute descent when leaving the highest published IAF altitude. For penetration approaches, leaving the IAF is commencing. Before commencing an instrument approach, complete the penetration checklist, as follows:

Armament panel: Checked OFF and SAFE

CONTROL AUG switch - ALL

Canopy defog and cockpit temperature: AS REQUIRED

Weather/field conditions: CHECKED

NAVAIDS: TUNED AND IDENTIFIED

Wet Compass, ADI, HSI: ALIGNED

SAHRS: CHECKED/ALIGNED

Altimeter: SET AS REQUIRED

Standby attitude indicator - ERECT

Radar altimeter: SET

Fuel: CHECKED

Approach clearance time: NOTE & PLAN HOLDING

APPROACH COMMUNICATION PROCEDURES

In your initial communication with approach control, known as P-A-R format, give your Position (if required) and your Altitude and ATIS letter (information Alpha) and Request an approach. Most often you will be requesting a specific approach (e.g., High TACAN runway 13). In addition, you may also request current weather information, the altimeter setting, and the duty runway (WAR), if ATIS is not available. A prudent pilot would have already tuned and copied ATIS and based his approach request on that information. If it is not included, then the controller is required to give you the weather. If the letter identifier is no longer current the controller will automatically provide you with updated weather information. In response to your request, approach control will provide clearance, duty runway, surface wind, ceiling and visibility, current altimeter setting, and missed approach instructions. Whenever the controller gives you instructions containing headings, altitudes, or an altimeter setting, you are required to read that information back.

GROUND CONTROLLED APPROACH (GCA)

There are two basic types of ground-controlled approaches--the precision radar approach (PAR) and the surveillance radar approach (ASR). A PAR provides you with precise course, glidepath, and range information and is classified as a precision approach. An ASR (commonly referred to as a surveillance approach) provides lower resolution course and range information only (no glideslope) and is classified as a non-precision approach.

NOTE: Glideslope is defined as the descent angle assigned to an approach to a given runway for obstacle clearance and/or signal reception. Glidepath is defined as the portion of a precision approach that intercepts the azimuth of an ILS approach or the FAC of a PAR approach.

Both the PAR and ASR approaches are divided into two segments: initial pattern and final approach. Refer to (Figure 34) for an illustration of the GCA pattern.

During the initial pattern of an ASR or PAR approach, you will be guided by surveillance radar. This segment includes all maneuvering up to the point at which your aircraft is inbound on the final approach course and at approximately 8 nm from touchdown. During the transition to final, the GCA controller will direct your headings and altitudes. All controller instructions to initiate turns and descents should be complied with immediately. In the pattern, maintain standard rate turns not to exceed 30 degrees AOB. On final, your AOB should approximate the number of degrees to be turned not to exceed half standard rate (approximately 10 degrees AOB). A good technique is 30 degrees AOB in pattern, 20 degrees AOB turning base to final. Once on final, do not exceed 10 degrees AOB for heading corrections to course.

Radar approach minimums can be found in the FLIP instrument approach procedure publications, both on the approach plates and in the radar approach minimums section (Figure 35). Although some published approach minimums are lower than 200-1/2, you are limited to absolute minimums of 200-1/2 when single-piloted.

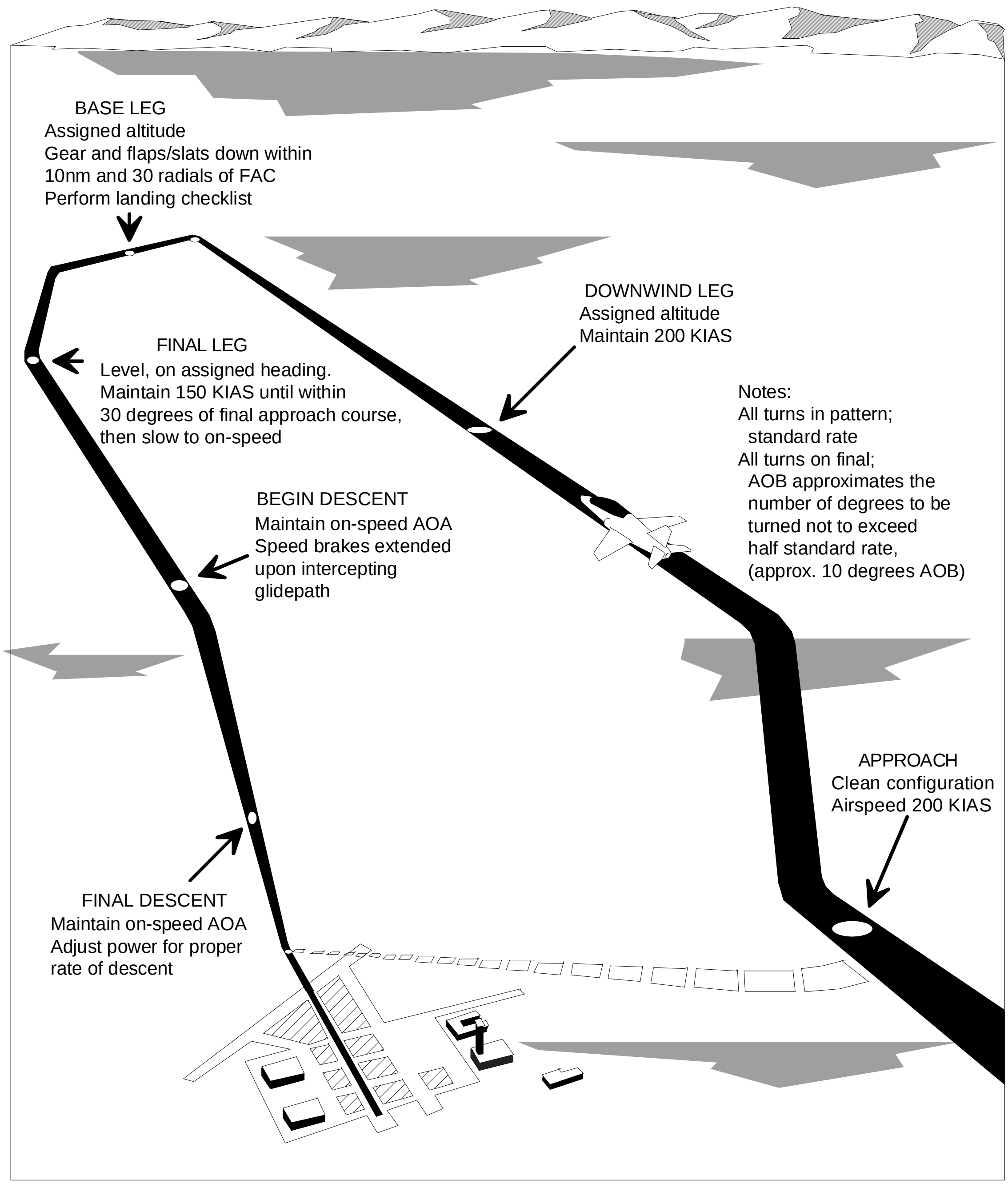


Figure 34: GCA PATTERN

RADAR INSTRUMENT APPROACH MINIMUMS

KINGSVILLE NAS, TX (9 OCT 97 USN) **ELEV 50**

RADAR (E) 128.45x 300.4x 305.2x 310.8x 322.0x 325.2x 358.0x 363.6x 384.4x

	RWY	GS/TCH/RPI	CAT	DH/ MDA-VIS	HAT/ HAA	CEIL-VIS
PAR (d)	35R (a)	3.0°/33/630	CDE	**148**-¼	100	(100-¼)
	31R	3.0°/37/681	CDE	**144**-½	100	(100-½)
	31L	3.0°/32/589	CDE	**148**-½	100	(100-½)
	17L	3.0°/33/622	CDE	**149**-½	100	(100-½)
	35L	3.0°/33/634	CDE	**149**-½	100	(100-½)
	13R	3.0°/33/634	CDE	**150**-½	100	(100-½)
	13L	3.0°/36/671	CDE	**150**-½	100	(100-½)
	17R	3.0°/35/662	CDE	**150**-½	100	(100-½)
W/O GS (d)	35R (b)		CDE	**400**-¾	352	(400-¾)
	35L		C	**400**-1	351	(400-1)
			DE	**400**-1¼	351	(400-1¼)
	31R		CDE	**320**-1	276	(300-1)
	31L		CDE	**320**-1	272	(300-1)
	13L/R		C	**420**-1	370	(400-1)
			DE	**420**-1¼	370	(400-1¼)
	17R		CDE	**340**-1	290	(300-1)
	17L		CDE	**340**-1	291	(300-1)
ASR (d)	17R		CDE	**340**-1	290	(300-1)
	17L		CDE	**340**-1	291	(300-1)
	35R (b)		CDE	**400**-¾	352	(400-¾)
	31L		CD	**380**-1	332	(400-1)
			E	**380**-1¼	332	(400-1¼)
	31R		CD	**380**-1	336	(400-1)
			E	**380**-1¼	336	(400-1¼)
	35L		C	**400**-1	351	(400-1)
			DE	**400**-1¼	351	(400-1¼)
	13L/R		C	**420**-1	370	(400-1)
			DE	**420**-1¼	370	(400-1¼)
CIR (c)(d)(e)	All Rwys		C	**500**-1½	450	(500-1½)
			D	**600**-2	550	(600-2)
			E	**620**-2	570	(600-2)

(a) When ALS inop, increase vis ¼ mile. (b) When ALS inop, increase vis CAT ABDE ½ mile, CAT C ¼ mile. (c) CAT E circling not authorized SW of Rwy 13-31. (d) Use landing/taxi lights when conducting apch during VMC. (e) Circling authorized only from PAR W/O GS and ASR.

RADAR INSTRUMENT APPROACH MINIMUMS

XXIX

Figure 35: RADAR INSTRUMENT APPROACH MINIMUMS

GCA Communication Procedures

During a GCA, your position in the pattern and on final will be directed by a controller who will continuously feed you course and heading information and, in the case of a PAR approach, glidepath information on final.

In the pattern, you are required to acknowledge all radio calls and read back all headings, altitudes, and altimeter settings. According to FAR 7110.65 the controller is required to give missed approach instructions, weather conditions (if less than VFR), altimeter, and lost comm instructions (if likely to encounter IMC).

In the pattern, the controller must communicate with you at least once a minute and you are required to acknowledge the controller's calls. If you hear no transmissions for more than 60 seconds, attempt to contact the controller. If you are unable to reestablish contact, then comply with the lost communication instructions. While you are flying the pattern, the controller will furnish the following information:

* Type of approach to expect (precision or surveillance)
* Duty runway
* Location of the missed approach point (MAP) (surveillance only)
* Advisory to perform landing check (USN/USMC controllers only)
* Missed approach and lost communication instructions

Additionally, the controller will give you position information and heading changes as necessary to keep you on course.

As you commence your final approach, the final controller will perform a radio check; "This is Kingsville final controller. How do you hear?"; you should respond with "loud and clear, three down and locked" (or position of gear). The controller may also tell you that you need not acknowledge further transmissions. On final approach, the controller is required to make contact with you at least every 5 seconds on a PAR or 15 seconds on an ASR. If you lose contact with the controller for the respective amount of time for the approach being flown, attempt to re-contact and if not successful, execute the lost communication instructions.

GCA Pattern

The entry configuration for the GCA pattern is as follows:

Airspeed: 200 KIAS

Gear: Up

Speed brakes: In

Flaps/slats: Up

Available NAVAIDS: Tuned

Normally, you fly the first leg of the pattern (the downwind leg) straight and level at 200 KIAS and pattern altitude. At the end of the downwind leg the controller will direct a turn to base leg. At the end of the base leg, the controller will direct a turn to either a dogleg or the final approach course. On the downwind leg, unless directed by ATC, stay clean and at 200 KIAS. Once established on base leg, or on a dogleg to FAC, if within 5-7 nm of glideslope, transition to landing configuration speed brakes retracted, slow to 150 KIAS, and complete the landing checklist (speed brakes retracted). You will have to retrim the nose to maintain level flight. When within 02 nm of either descent point or glideslope intercept, slow to on-speed.

NOTE: USN/USMC controllers will state "perform landing checks" on the base leg; this is only a reminder and does not direct the pilot to dirty up. If the controller says "slow to approach speed," the controller is directing this for sequencing and the aircrew must comply or state that they are unable.

NOTE: GCAs can be flown at full, one-half, and no-flap configurations.

Because the remainder of the PAR and ASR final approach procedures differ considerably, they will be discussed separately below.

PAR Final Approach

At the beginning of a PAR final approach, you will be straight and level, on-speed, and normally at approximately 1,500 ft AGL. Restrict AOB to the approximate number of degrees to be turned, not to exceed 1/2 SRT (approximately 10 degrees). Verify gear down, flaps full. Trim aircraft for hands off level flight. When the controller informs you that you are "on glidepath," extend the speed brakes and adjust power as required to establish a descent. Report "speed brakes full, landing checklist complete" on the ICS.

The rate of descent will vary for different glideslope angles and ground speeds. The inside back cover of the approach plates contains a chart that will provide you rate of descent for a given glideslope and ground speed. Adjust power to maintain your rate of descent and keep the aircraft on-speed. When making heading corrections, try to keep the amount of bank angle small (5 to 10 degrees) so that you don't end up chasing the heading. If you get off heading, don't try to correct to course. Use smooth control inputs and return to your last assigned heading.

As you near the decision height, begin an "inside/outside" scan to visually acquire the runway environment. If you do not have the runway environment in sight when you reach the DH, execute a missed approach (remember to make the mandatory missed approach call).

ASR Final Approach

On the ASR final approach, the controller cannot furnish glideslope information. It will be up to you to establish and maintain the correct rate of descent. The controller will identify the Missed Approach Point (MAP) in nautical miles from the end of the runway, and will direct the descent by stating "begin descent." On pilot request, the controller will provide recommended altitudes each mile on final. Recommended altitudes decrease 300 ft per mile (approximates a 3 degree glideslope). In order to smoothly level at MDA prior to the MAP, your altitudes should be slightly lower than those recommended. Depending on winds, a descent rate of 500 to 700 fpm will allow you to descend to the MDA prior to reaching the MAP. Upon reaching the MAP, if you do not have the runway in sight or are otherwise unable to perform a safe landing, execute the missed approach as instructed.

RADIO INSTRUMENT APPROACHES

Radio instrument approaches, unlike GCAs, employ on-board navigational equipment as a guide and can be flown, if necessary, without communication with the ground. In the T-45A, you will fly these approaches--VOR, TACAN, Localizer, and ILS--in accordance with the published instructions found on high or low altitude approach plates.

Plan ahead by reviewing the procedures for the chosen approach before arriving at the IAF and stay ahead of the aircraft during the approach. Use all available NAVAIDs during the approach as backups in the event of equipment malfunction. If, for example, you are flying an ILS approach at a field that also has a TACAN facility, you should have the TACAN tuned and set as a backup.

VOR Penetration Approach

VOR navigational aids supply you with bearing information to the VOR station you have tuned. Instrument approaches flown to these facilities usually rely on direct overflight of the station during the approach (Figure36).

The VOR penetration approach is generally a procedure turn (i.e., 90/270, teardrop). Before beginning the approach, set the final approach heading in the course window of the HSI. Begin the approach when you pass over the station on the altitude and heading prescribed by the approach plate. Penetrate by lowering the nose and accelerating to 250 KIAS. At 250 KIAS reduce power to flight IDLE, lower the nose and extend the speed brakes. Adjust nose attitude as required to maintain 250 KIAS and 4,000-6,000 fpm descent (approximately 15 degrees nose down). At one-half your initial altitude or at reaching the published penetration turn altitude, initiate the penetration turn (do not exceed 30 degrees AOB) to intercept the final approach course.

NOTE: Do not exceed the “minute to live” rule in the penetration descent.

At this point, the approach procedure can vary depending on whether the NAVAID is located at the field or not.

* If the approach has a FAF (station located away from the field), station passage is normally the FAF and timing will determine the MAP. After completing the penetration turn, transition to the landing configuration, and check speed brakes up or retracted if used, prior to reaching the FAF. At station passage, start timing to the MAP, basing your timing on ground speed and the FAF to MAP table on the approach plate under the sketch. Extend speed brakes, reduce power if necessary, transition to descend on-speed to MDA. (Do not exceed 1,000 fpm.) Report FAF with gear to ATC and landing checklist complete on the ICS. Continue to a landing if you visually acquire the runway up to the MAP and you are in a position to land or maneuver to land safely. If you do not have the runway environment in sight when at the MAP (i.e., time expires), execute a missed approach.

* If the approach does not have a FAF (station located at the field), transition to the landing configuration, on-speed, speed brakes down, as soon as you are wings level inbound to the station. Descend to the published MDA using the procedures in the paragraph above and start looking for the runway. Station passage is usually the missed approach point (MAP) for this type of approach.

* If executing a low altitude TACAN and VOR approach that require the aircraft stay within 10 nm of the IAF/field, maintain 200 KIAS during the procedure turn and penetration.

NOTE: Generally you should not exceed the 1,000 fpm rate of descent during the final portion of the approach. If the approach requires a higher rate of descent, request clearance from the instructor prior to exceeding 1,000 fpm.

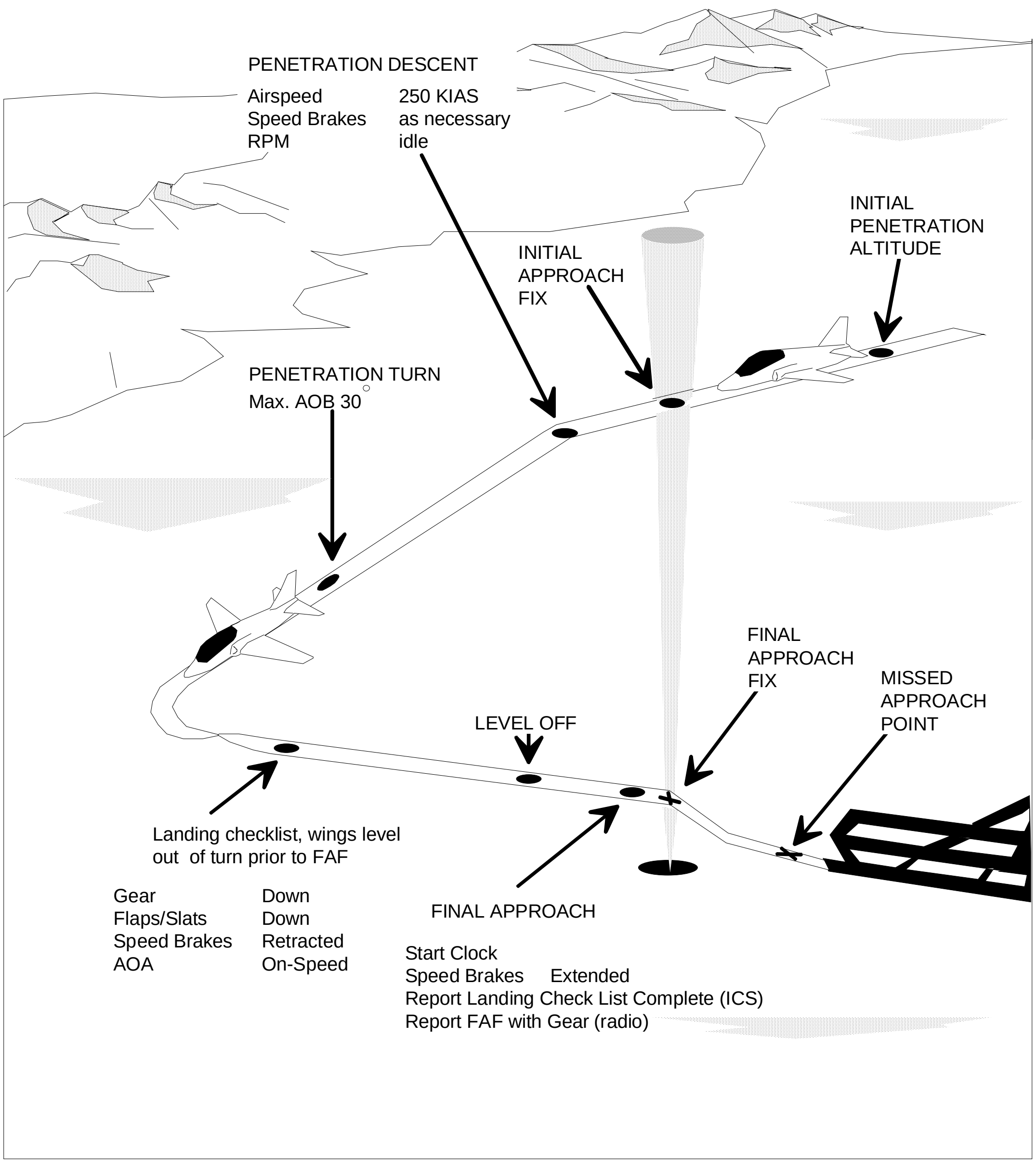


Figure 36: NON-DME PENETRATION AND APPROACH

TACAN Approach

TACAN (and VOR/DME) navigation equipment supplies both range and distance information, making arcing approaches possible. Because range information is available, you can determine the fixes (IAF, FAF, and MAP) defined by DME (Figure 37).

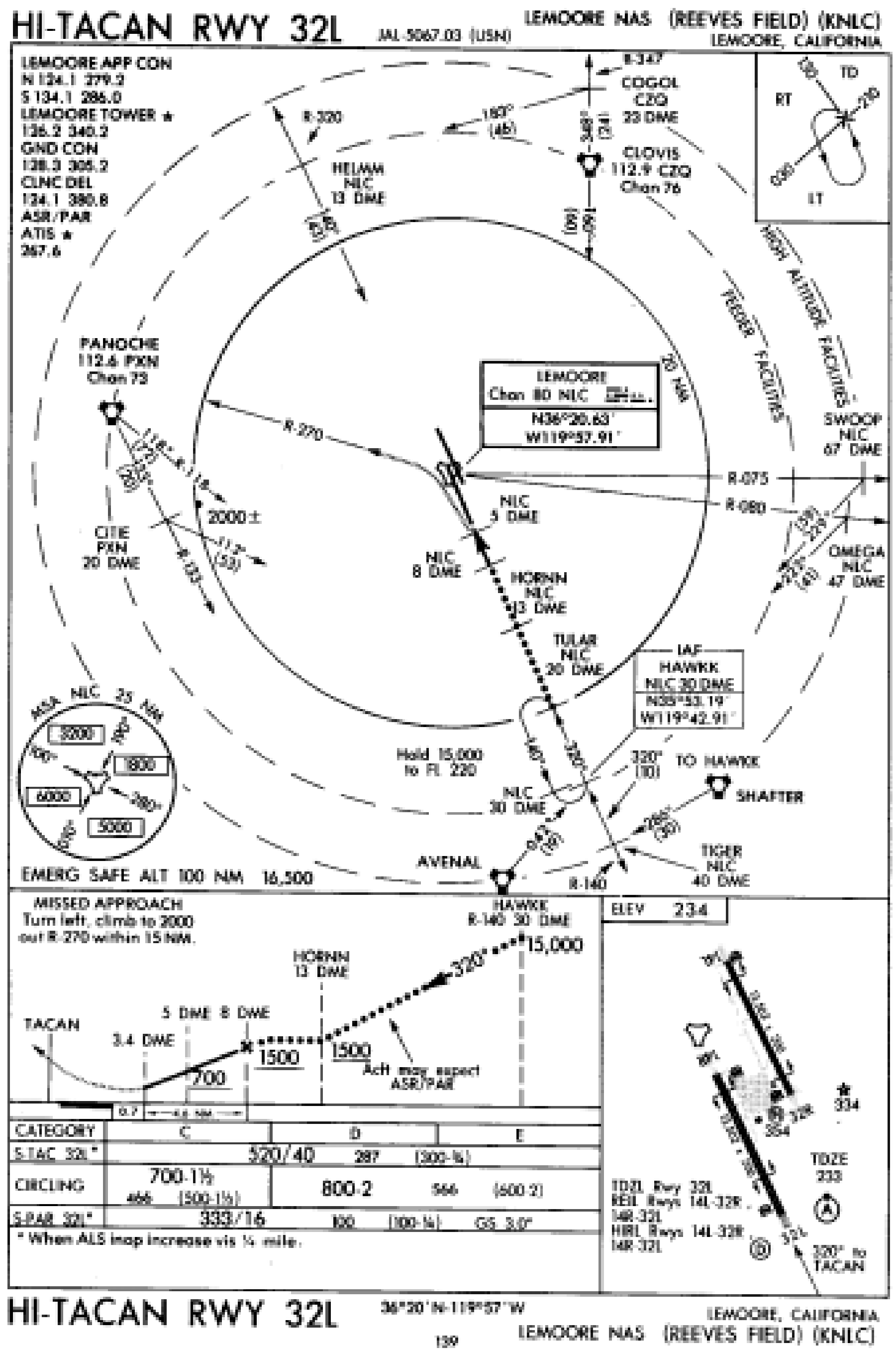


Figure 37: TACAN APPROACH

The CDI may be used for tracking all radials on the approach (e.g., initial inbound radial, final approach course).

When executing a TACAN/VOR DME approach and before reaching the IAF, set the final approach course into the course select window of the HSI. At the IAF, intercept and maintain the approach course as published. Lower the nose and accelerate to 250 KIAS. At 250 KIAS, reduce power to flight idle. Adjust nose attitude as required to maintain 250 KIAS and 4,000 to 6,000 fpm (approximately 10 degrees). Extend speed brakes as necessary for increased rate of descent. Report departing the IAF if requested. Start penetration turn 2.5 nm DME from the arc. At 5 to 7 nm prior to the FAF slow to 200 KIAS. Configure the aircraft for landing 3 to 5 nm prior to the FAF and perform landing checklist (speed brakes retracted). Conform to all course, altitude, and DME instructions on the approach plate. Lead level off from penetration by 1,000 ft if VSI pegged at 6,000 fpm.

At the FAF, start the clock, extend speed brakes, report landing checklist complete on the ICS and make gear down call to ATC. Descend to the MDA and start looking for the runway while monitoring your DME for the MAP. Plan your descent to be in level flight at the MDA prior to reaching the MAP. From the FAF maintain precise course, speed, and rate of descent control. Do not exceed 1,000 fpm. Keep heading changes small so you don't chase the final approach course on the CDI.

When you reach the MAP, if you don't have the runway environment in sight or determine that a safe landing is not possible, execute a missed approach.

ILS Approach

The ILS approach is a precision approach in which you are provided precise glideslope, azimuth (course), and range information. The ILS (Figure 38) is composed of three elements; the localizer transmitter, the glideslope transmitter, and marker beacons. As with any approach, you should back up the ILS approach with any other available NAVAIDs.

The localizer transmitter provides azimuth information to the CDI in the HSI and azimuth deviation bar (ADB) in the ADI for maintaining alignment with the approach course. The localizer signal has a maximum range of 18 nm from the station, if you are within 10 degrees either side of the course centerline.

The glideslope transmitter provides glideslope information to the GS pointer in the HSI and glideslope deviation bar in the ADI. Glideslope transmitters have a normal range of approximately 10 nm, if you are on or near the localizer course. However, at some locations the glideslope has been certified for an extended service volume which exceeds 10 nm.

NOTE: Glideslope is defined as the descent angle assigned to an approach to a given runway for obstacle clearance and/or signal reception. Glidepath is defined as the portion of a precision approach that intercepts the azimuth of an ILS approach or the FAC of a PAR approach.

When overflown, the three marker beacons (outer, middle, and inner) provide a distance (range) reference by sounding an aural tone and illuminating one of three marker beacon lights on the instrument panel. Although there are a maximum of three marker beacons, most ILS approaches do not have all three, and some do not use them at all. If beacons are not present, cross-radial fixes, DME or radar is required. The outer beacon usually marks the FAF and will often indicate the point of glidepath intercept. The middle marker denotes the vicinity of the DH for category I approaches (the T-45A is equipped for Category I) and progress points for categories II and III. You will cross the middle marker approximately half a mile from the runway, at 200 ft AGL (this may vary depending on local terrain and minimums). The inner marker denotes the DH for category II approaches and is a progress point for category III approaches. You will usually cross the inner marker at 100 ft AGL.

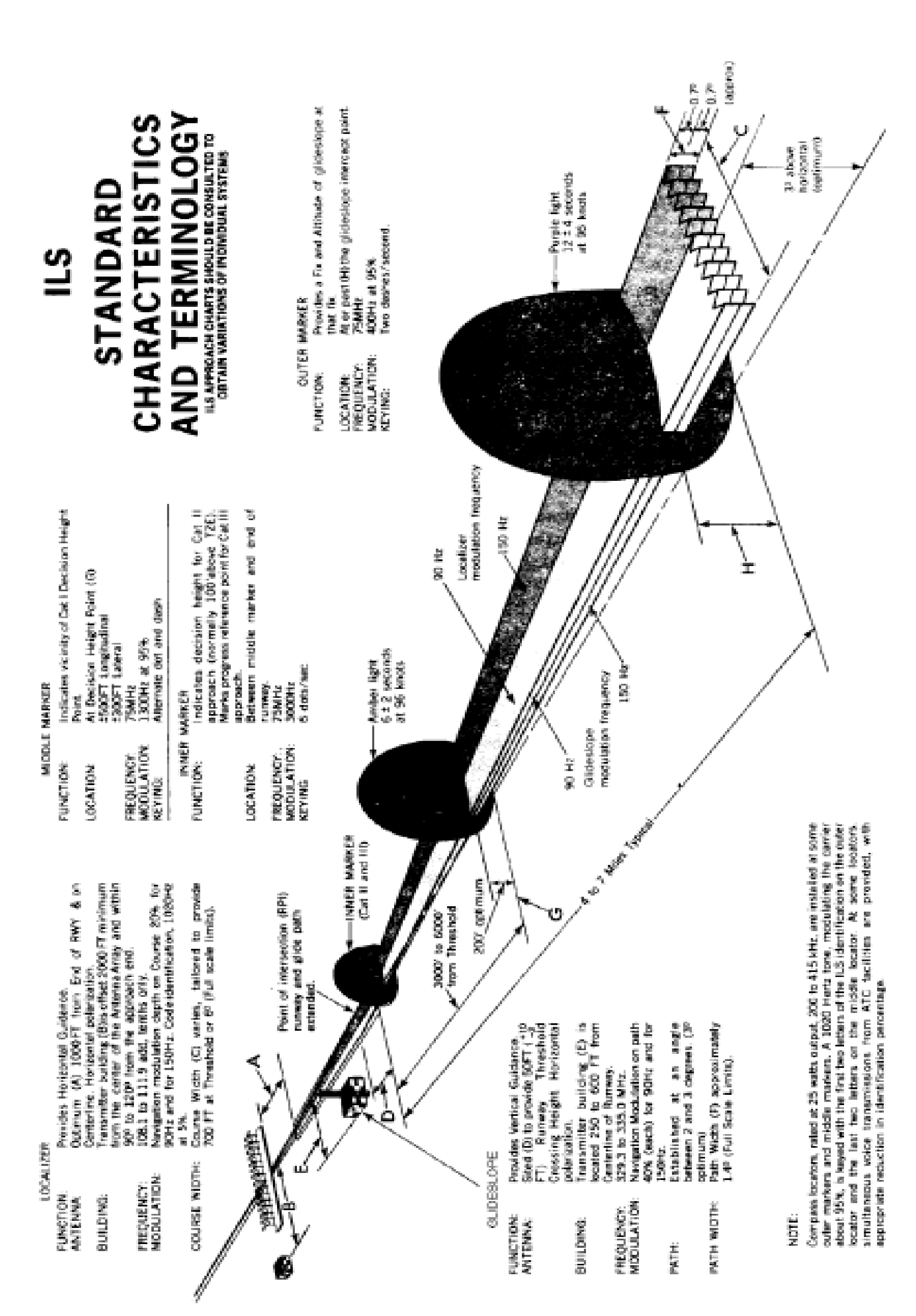


Figure 38: ILS COMPONENTS

Fly the portion of the approach prior to intercepting the localizer using VOR or TACAN (depending on the published procedure) (Figure 39). Prior to localizer intercept, ensure that you have tuned and identified the ILS frequency and have dialed in the correct final approach course on the HSI. Select MKR & VOR on the comm control panel to monitor the audio signals of the localizer signal and when passing, the outer, middle, and inner markers beacons.

If the penetration is performed on VOR, transition to landing configuration and on-speed, immediately after completing the penetration turn with the speed brakes retracted if used in the transition. If the penetration is performed on TACAN or VOR DME, slow to 200 KIAS, 5-7 DME prior to the FAF and then transition to landing configuration by 3-5 DME from the FAF. Speed brakes should be up or retracted if used before the FAF.

NOTE: Transition to landing configuration and on-speed for an ILS approach with DME is performed using the same procedures as TACAN or VOR DME.

Radar vector to ILS final - since a vector to an ILS final is a controlled, non-formalized procedure to a precision approach, pilots should use logic and common sense when determining an appropriate time to transition from 250 KIAS to the landing configuration and 150 KIAS and then to on-speed. As a rule-of-thumb, it is appropriate to initiate the transition to the landing configuration anytime the aircraft is established on a base leg or within 10 nm of the FAF and on an intercept heading to the FAC, within 10 nm. Transition to landing configuration 3-5 nm from the FAF. It is important not to transition late.

By the time you intercept the glidepath, you should be flying on-speed with the landing checklist completed (speed brakes retracted).

Immediately prior to glidepath intercept, as indicated by the GS pointer on the HSI and glideslope deviation bar on the ADI, verify on-speed with airspeed. As the GS pointer and deviation bar intercept the glidepath, extend the speed brakes and adjust pitch and power as required to maintain on-speed and stay on glidepath. Maintain course by making corrections using heading changes no greater than +/- 5 degrees from the WCH. At the FAF, start the clock, report FAF with gear if necessary to ATC and landing checklist complete on the ICS. Descend to the DH. Approaching the DH, start looking for the runway while monitoring your range indications, marker beacons and/or DME. Although you normally refer only to the barometric altimeter (using the current altimeter setting) to determine the DH, use radar altimeter as a backup but be aware of extreme terrain features which could make the radar altimeter a dangerous alternative.

The elapsed time clock is started when passing the FAF in case the glideslope signal information is lost during the approach. If this happens, you can (depending on minimums) continue flying the localizer only, using time to determine the MAP.

If, upon reaching the DH on an ILS approach or the MDA on a localizer approach, you do not have the runway environment in sight or you determine that you cannot make a safe landing, execute a missed approach.

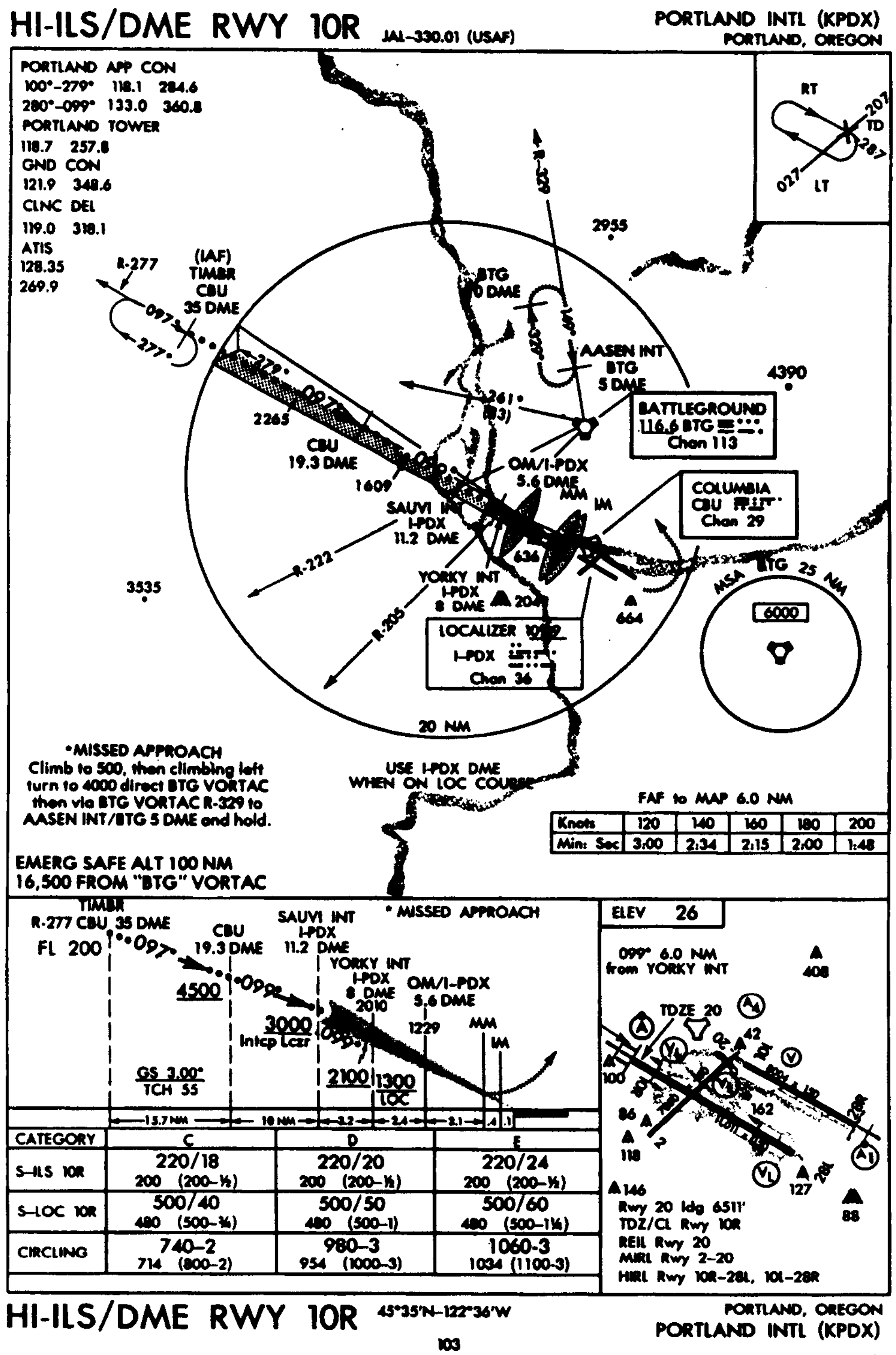


Figure 39: ILS APPROACH PLATE

No-Gyro Compass Approach

A no-gyro approach is an ASR/PAR performed when you lose primary heading information. During this approach, the controller will call your turns by transmitting "turn right/turn left" and "stop turn." Therefore, you must perform standard rate turns not to exceed 30 AOB in the pattern and half standard rate turns on final. A good technique is 30 degrees AOB in pattern, 20 degrees AOB base to final and 10 degrees on final (no more AOB than assigned heading change). It is extremely important that you maintain exact turn rates or wings level attitudes when flying the approach.

BINGO Profile

The bingo profile for the T-45A is defined in NATOPS. During simulator flights, you may be asked to perform this maneuver. Refer to the NATOPS for all bingo procedures.

NOTE: The bingo profile does not include fuel which may be required for an instrument approach.

Simulated Minimum Fuel Approaches

On vectors for ILS or in the GCA box, remain in the clean configuration until 30 seconds before glidepath intercept. Select gear down, flaps to half and speed brakes in while adjusting attitude and power to maintain required VSI and optimum AOA (speed brakes will remain in for the rest of the approach). Initially, a significant forward stick pressure will be required to counter the ballooning effect and start the VSI down.

Simulated Minimum Fuel GCA

When a minimum fuel GCA is requested, ATC will give normal GCA box pattern vectors (intercept glidepath at approximately six miles from the end of the runway) and expect 200 KIAS until final. ATC should also provide a 30-second gear warning. Remember the call "Perform landing checks" is a required USN/USMC advisory call on base leg and does not mean to dirty up or reduce airspeed.

Simulated Minimum Fuel ILS

Request vectors to ILS final and advise ATC that you will maintain 200 KIAS until glidepath intercept. The glideslope needle emerging from the top of the HSI serves as a "30-second glidepath warning."

Simulated Emergency Fuel GCA

This GCA is designed to get you from altitude to the deck without any undue delay and is actually a practice procedure for dealing with emergency fuel situations. The controller will vector you direct to final approach with a glidepath intercept much closer to the runway than a normal GCA with a continuous turn from downwind to final. The controller will vector you to intercept a final at approximately four miles from the end of the runway at 800 ft AGL. The controller may ask how much fuel you have remaining in minutes and will attempt to get you on the deck prior to simulated fuel exhaustion. Request a 30-seconds prior to glidepath intercept call from the controller. You will remain in a clean configuration until the 30-second call is heard. Then select gear down, flaps to half and speed brakes in while adjusting attitude and power to maintain required VSI and optimum AOA (speed brakes will remain in for the rest of the approach). Initially, a significant forward stick pressure will be required to counter the ballooning effect and start the VSI down. Closer to the runway the "on glidepath" cross-section is much smaller. Therefore, it is important to set the appropriate VSI expeditiously once established on glidepath.

During practice simulated emergency fuel approaches (SEFs) at a foreign field, the pilot must advise ATC that the pilot assumes responsibility for obstruction clearance and will remain in VMC conditions. The IP should tell the controller that he wants a descent to 1,200 ft AGL on downwind, 800 ft AGL on base leg with a 3-4 nm final, and a 30-sec-to-glideslope gear warning.

Simulated Emergency Oil/Precautionary Instrument Approach

The emergency oil/precautionary instrument approach, like the emergency fuel instrument approach, will get you on the deck without any delays. It sets the power at an appropriate setting for an impending engine failure.

When given the simulated emergency, set the power to 86-88 percent RPM. 88 percent should be used with extreme flying conditions, i.e., high elevation or a hot summer day. If given outside the GCA box pattern, monitor and control airspeed with speed brakes as necessary to expedite landing without causing an unduly difficult transition to gear speed and the glidepath. In the GCA box, use the speed brakes to maintain 200 KIAS. When given the “up and on glidepath” (approximately 6 nm from touchdown) call on PAR, or as needles center on the ILS, lower gear and retract speed brakes. Lower the nose to maintain the glidepath at 175 KIAS. As desired, lower flaps to half, retract speed brakes and maintain glidepath at 175 KIAS. With field in sight and runway made, you may select flaps to full down. If flaps are selected full, this should be commenced prior to the landing flare. Also, if flaps are selected to full, a nosedown attitude will counter the ballooning action. Extend speed brakes and reduce power to idle at touchdown if no intent to go missed approach.

The low oil GCA is a precautionary approach (PA) (see NATOPS) modified for actual instrument conditions or night time. In a PA the aim point is short of the runway on a 10 degree (approximately) glideslope. However, the low oil approach “aimpoint” is the touchdown point for the PAR or ILS. Also, the glideslope is more shallow so the transition to half and full flaps is delayed to ensure that the airspeed does not bleed too rapidly.

If the landing environment is not in sight during an actual emergency, at decision height or a safe landing cannot be completed, execute a waveoff as follows; retract the speed brakes, raise the gear and slowly position the nose to a climb attitude. When above 300 ft AGL and indicating a positive rate of climb, raise the flaps, 140 KIAS minimum. Do not reset power. Use speed brakes as necessary to maintain 200 KIAS in the GCA box pattern.

Localizer Approach

The localizer approach uses the ILS equipment, minus glideslope signal generation equipment. You may have to perform this approach because of equipment failures in your aircraft, on the ground, or because the runway lacks a glideslope transmitter. The localizer approach is non-precision with minimums higher (Figure 40) than a full ILS approach to the same runway. The MAP is determined by timing from the FAF, by DME, or by radar. As in the ASR, plan your descent so that you are leveled off and on speed prior to the MAP.

CATEGORY	C	D	E
S-ILS 10R	220/18 200 (200-½)	220/20 200 (200-½)	220/24 200 (200-½)
S-LOC 10R	500/40 480 (500-¾)	500/50 480 (500-1)	500/60 480 (500-1¼)
CIRCLING	740-2 714 (800-2)	980-3 954 (1000-3)	1060-3 1034 (1100-3)

Figure 40: ILS MINIMUMS

Back Course Localizer Approach (BC LOC)

The back course localizer is established along the centerline of a runway in the opposite direction to the front course.

Caution should be taken when flying a back course LOC approach because of reverse sensing when the back course is selected in the HSI. To center the CDI, it will be necessary to steer the aircraft in the direction opposite the CDI deflection. An alternate procedure is to set the front course into the HSI. This will induce a normal sensing display in the HSI. Again caution should be taken because the Azimuth Deviation Bar in the ADI will continue to display reverse sensing.

Which ever procedure is used, a higher level of concentration is required from the pilot to maintain orientation and fly the approach correctly.

PARTIAL PANEL APPROACHES

In the T-45A you will be performing partial panel (standby AI) approaches which will require a major change in your scan. All ADI information is still available, but you'll have to get it from different instruments. Take attitude information from the standby AI and all heading and ILS steering information from the HSI. See "ADI Failure" and "Partial Panel".

VISUAL MANEUVERS

Visual maneuvers, IFR procedures executed in VMC conditions, are included here because once you reach the MAP or are cleared by ATC for a visual approach, you will complete your approach and landing VFR. It is important that you adjust your rate of descent to arrive at the MDA well ahead of reaching the MAP so that you have time to visually acquire the field. Non-precision approaches that have a visual descent point (VDP) require you to remain at the MDA until the visual descent point is passed. During low visibility, avoid the tendency to "duck under" or go low during the final approach to touchdown.

Contact Approach
The contact approach is an IFR procedure you can request when you are operating on an IFR flight plan in VMC conditions. To request a contact approach, you must be clear of the clouds with at least 1 sm of visibility and have an unobstructed view of the ground. In a contact approach you may deviate from the published approach procedure and proceed to landing via visual references. You may not perform a contact approach to an airport that lacks an authorized instrument approach procedure or conduct an approach to one airport and then, when "in the clear," discontinue that approach and proceed to another airport. The pilot must specifically request it and obtain clearance from approach control. During a contact approach, you are still operating under IFR, and ATC will ensure your separation from other aircraft. However, you are responsible for your own obstruction clearance. Radar service, if you are receiving it, will be terminated when you are told to contact the tower.

Visual Approach
In a visual approach, an aircraft on an IFR flight plan, operating in VMC conditions and having received an Air Traffic Control authorization, may deviate from the prescribed instrument approach procedures and proceed to the airport of destination by maintaining VFR conditions. ATC may initiate a visual approach, but you are never required to accept it.

Certain conditions must be met before you can fly a visual approach: 1) the field or a preceding aircraft must be in sight, 2) the ceiling must be at least 1,000 ft AGL and 3) there must be at least 3 sm visibility.

Circling Approach
The circling approach is used to align aircraft with the proper runway at the end of an instrument approach. The runway is often not the same one to which the instrument approach was flown. The minimums for a circling approach differ from the others published for a given runway. Circling minimums are higher than other instrument minimums and require you to remain VMC underneath while maneuvering to land.

Once you have elected to conduct a circling approach and have obtained clearance, descend to the circling minimums and visually acquire the runway. The applicable minimums are those published for the approach flown, and not necessarily the landing runway.

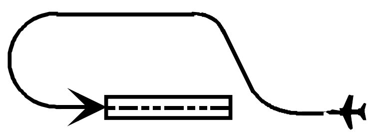
Once you descend to the MDA, determine if visibility is sufficient to safely complete the landing. If it is, choose the landing pattern (Figure 41) best suited to your situation, or the one directed by the controller. Stay at the MDA until you are in a position to execute a normal landing--ideally, the point at which you would intercept the normal glideslope to the runway. If weather permits, fly the circling maneuver at the normal VFR pattern altitude. Be sure to check the approach plate for any obstacles in the vicinity of the airport.

If you cannot safely complete the landing, execute a missed approach. The applicable missed approach procedures are those for the approach flown (not necessarily the landing runway).

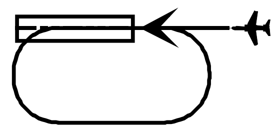
Flap Setting
Due to the number of approaches required in a given instrument training sortie, and the transit times to practice airfields, half flap approaches are sometimes necessary. However, approach configuration for full stop landings should be full flaps.

MISSED APPROACH

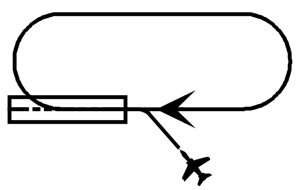
You will execute a missed approach any time you reach the MAP or DH on an approach and you do not have the runway environment in sight, you lose sight of the runway when circling, a safe landing is not possible, or when instructed by your controller to do so. If you execute a missed approach while circling to land, turn to fly over the airport center, then fly the published missed approach.



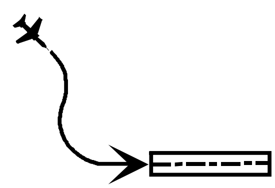
Close-in Contact Circling Approach.



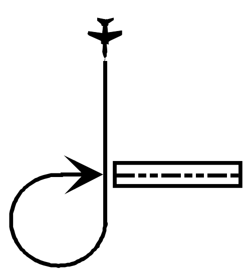
Too High For Straight-In or Late Sighting of Runway.



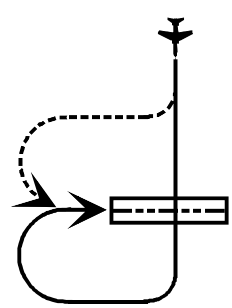
Runway Sighted Too Late For a Base Leg Turn.



Runway Sighted in Time to Set Up Base Leg.



Approach Course Crosses Landing Runway Near Threshold.



Solid Line Shows Preferential Method When Landing Will Be Made At Right Angle To Approach Course. Dashed Line Is Alternate.

Figure 41: CIRCLING APPROACH MANEUVERS

NOTES

SAFETY/EMERGENCY PROCEDURES

Flying your aircraft safely in the instrument environment requires thorough flight planning, understanding of all aircraft and ground equipment, and following proper instrument flight procedures. When faced with an in-flight emergency, prioritize your actions, follow NATOPS emergency procedures, and remember that you must always first aviate, then navigate, and finally communicate.

Consider this situation: you are flying in instrument conditions from a southwest NAS to a west coast NAS when one hour from your destination you experience a hydraulic failure. While reading this simple scenario, you should have already been prioritizing an action list and critically analyzing your options. Fly the aircraft, assess its impact, and take the necessary steps to get your aircraft safely on deck. Do not hesitate to get assistance from ground agencies or other aircraft and always back yourself up by double-checking the procedures in the NATOPS pocket checklist.

PRIMARY INSTRUMENT FAILURE

You must report the loss of any primary flight instrument or navigation system to the controlling agency, and you may ask the controller for assistance. In some instances, you can compensate for a flight instrument failure by substituting another primary or backup instrument; nevertheless, if you are IFR or expect to encounter IFR conditions, you should consider the failure of any primary flight instrument to be of a critical nature and therefore expedite getting your aircraft on the deck safely.

If you are VMC when a failure occurs, remain VMC and land as soon as practicable. If you are in IMC or have to reenter IMC, assess the impact of the failed instrument(s) on your ability to control the aircraft. You will have to either continue IMC or proceed to VMC (fuel permitting) if able.

TWO-WAY COMMUNICATION FAILURE

If you lose two-way communications while on an IFR flight plan, you are required to squawk mode 3, code 7600, and make all calls in the blind.

If you are able, continue your flight under VMC, land as soon as practicable, and notify ATC.

NAVIGATIONAL AID (NAVAID) FAILURE

Since the T-45A is equipped with both TACAN and VOR, it is unlikely that you will ever experience a total navigational aid failure. If you lose one system, you still have the remaining system as a backup. You must, however, notify ATC of the loss of any primary navigation system.

Should you lose both systems, notify ATC and request assistance. Under most circumstances, ATC will be able to give you radar vectors to VMC or to a landing.

ICING

Avoid icing conditions whenever possible. Accumulation of ice on aircraft surfaces will result in an increase in weight, drag, and stall speed. In icing conditions, stall may occur at a lower than normal angle of attack. Engine icing can significantly reduce thrust and damage the engine. Icing can be detected visually or (in the case of engine icing) by an increase in EGT or reduced engine performance and a decrease in airspeed. If you encounter icing, check that the pitot heat is on and immediately maneuver to exit the icing conditions. In the T-45A engine, anti-ice is automatic and is applied anytime the engine is running. Icing may cause pitot static failure indicated by airspeed falling to zero, and frozen baro altimeter and VSI.

NOTE: OPNAVINST 3710.7 states that flights shall be planned to circumvent areas of forecast atmospheric icing and thunderstorm conditions whenever practicable.

TURBULENCE AND THUNDERSTORMS

If you should find yourself in a thunderstorm, unusual attitudes and structural damage could result. However, if you follow NATOPS procedures, you can successfully survive inadvertent thunderstorm penetration. You should establish a power setting and pitch attitude for penetration prior to entering the storm. In moderate turbulence, changes in attitude are not violent, but some changes in altitude are unavoidable and pressure instruments will fluctuate. In severe turbulence, these effects are greatly increased in amplitude and intensity. Preparation before entering a thunderstorm may be generalized into four basic steps. The first letter of each step spells HALT: Heat, Airspeed/Attitude, Light, and Tight.

1. **Heat**
   a. **Pitot heat switch - CHECK ON**
2. **Airspeed/Attitude**
   a. **Maintain airspeed of 250 KIAS.**
   b. **Go on instruments and stabilize airspeed and attitude prior to penetrating the storm.**
   c. **Adjust ADI reference.**
   d. **Fly on a heading calculated to provide the quickest passage through the storm at an altitude affording the least turbulence and icing while clearing all ground obstacles by a wide margin.**
   e. **Avoid the upper 2/3 of a mature cell (turbulence and hail) and freezing level +/- 2,000 ft (lightning).**
3. **Light**
   a. **Turn all cockpit lights to bright including floodlights.**
4. **Tight**
   a. **Lower the seat to prevent striking the head against the canopy and to reduce the blinding effect of lightning.**
   b. **Tighten lap belts.**

While in a storm, you should proceed as follows:

1. **Maintain constant power and pitch attitude.**
2. **Concentrate on maintaining a straight and level aircraft attitude by referencing the ADI.**
3. **Be prepared for turbulence, hail, rain, and lightning.**

4. **Do not chase the airspeed indicator, altimeter, or VSI as this could result in unusual aircraft attitudes and excessive g loads.**

5. **In order to minimize the g imposed on the aircraft and pilot, use the smallest pitch corrections possible to maintain level flight.**

6. **Be prepared for pitot static failure due to icing.**

MINIMUM FUEL ADVISORY

You are required to advise ATC when your fuel status has reached a state where, upon reaching your destination, you cannot accept any undue delay. This advisory does not reflect an emergency situation, but it does indicate that an emergency situation could develop as the result of any delays in approach handling. It will not result in special handling or a traffic priority. ATC will ensure that you are handled so as to avoid any delays requiring excess fuel consumption.

EMERGENCY FUEL

If your fuel state reaches the point that you need special handling and/or priority handling (emergency fuel) to land safely, you should declare “emergency fuel” to ATC. ATC will then provide priority handling to assist you in expediting your approach and landing.

AIRCRAFT EMERGENCIES

An aircraft emergency occurring during a cross-country flight may present several problems in addition to those encountered on local flights. Complicating factors include; strange fields, long distances, unknown weather conditions, and unfamiliar terrain. Thorough knowledge of emergency procedures and careful preflight planning will reduce, but not eliminate, these complications.

If an immediate landing is required, use any runway of suitable length. On a short runway, land as close as possible to the runway threshold and use maximum braking.

If an ejection occurs, search and rescue (SAR) capabilities may be limited. You may find yourself in a survival situation for an extended period of time, and your preflight preparation should include this possibility.

SAHRS FAILURE
Indications: Steady off flags in the ADI, HSI and "CONTR AUG" caution light with master alert (when less than 217 KIAS and flaps other than up).

The procedure for dealing with a SAHRS failure is:

1. Use the standby AI and standby compass for attitude and heading information.
2. Select COMP on the SAHRS control unit.
3. Maintain VFR flight conditions, if possible.
4. Report the instrument failure to ATC.
5. Land as soon as practicable.

Transition to standby AI and wet compass: if NAV flag is not visible, TACAN/VOR bearing and TACAN range will be accurate. However, the HSI card will freeze. #1 and #2 bearing pointers will no longer point to the station; but the tails will properly indicate correct radial. ILS will be inoperative.

When able, inform ATC of primary attitude and heading indicator failure, request a no-gyro ground controlled approach. If this service is unavailable, use tail of bearing pointer to ascertain position and perform timed turns to predetermined headings on the magnetic compass. Remember, the magnetic compass gives erroneous indications during turns. Check magnetic compass heading during wings level, balanced flight with zero VSI for most accurate reading.

Stuck HSI Card TACAN Arcing
To arc, note radial and make a 90 degree timed turn (30 second SRT) left or right. To determine heading, add 90 degrees for clockwise arc or radial minus 90 degrees to arc counter clockwise. To maintain arc, hold AOB that keeps range at desired DME. Watch for tail to rise to lead radial and perform timed turn to inbound heading.

HSI FAILURE

A failed HSI could cause loss of VOR and TACAN, as well as heading and course deviation information. In the event that the compass card freezes or displays erroneous information, obtain heading information from the ADI and cross-check the standby compass.

Figure 42 shows one of the possible indications of a failed HSI. Remember that the OFF flag does not have to be present for the indicator to give false readings because it only indicates the status of electrical power and SAHRS validity signals.

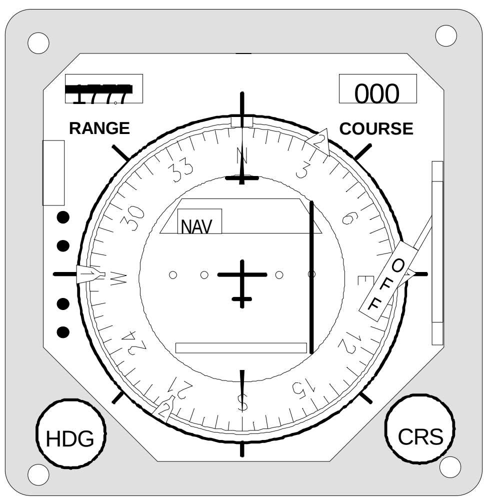


Figure 42: FAILED HSI

The procedure for dealing with a HSI failure is:

1. Determine the nature of the malfunction.
2. Use backup navigation instruments as appropriate.
3. Report the failure to ATC.
4. Maintain VFR conditions, if possible.
5. Land as soon as practicable.

ADI FAILURE

Because the ADI is the primary attitude and heading reference, losing it will force you to alter your instrument scan pattern significantly. You will have to include the standby AI and devote more time to the HSI.

The first and most important step in dealing with an ADI failure is to establish an attitude reference on the standby gyro. The remainder of the procedure is also important, but this step is vital. See the “Partial Panel” section of this FTI for further information.

Figure 43 shows one of the possible indications of a failed ADI. Remember that the OFF flag does not have to be present for the indicator to give false readings; the flag only indicates the status of electrical power, SAHRS validity signals, and internal error detection circuitry. Most of the time you will be able to detect and ADI failure from outside references, but in IMC conditions, uncommanded changes in heading and attitude indications may be your tip-off that the ADI has failed.

The procedure for dealing with an ADI failure is:

1. Use the standby attitude indicator (AI) for attitude reference.
2. Use the HSI for your primary heading reference.
3. Maintain VFR conditions, if possible.
4. Check the electrical system.
5. Report the instrument failure to ATC.
6. Watch for possible progressive failure of the SAHRS system.
7. Land as soon as practicable.

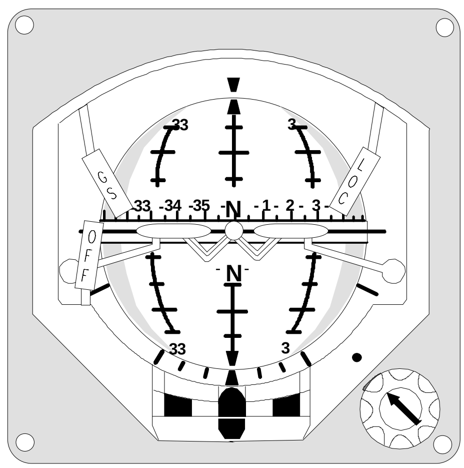


Figure 43: FAILED ADI

TURN AND SLIP INDICATOR FAILURE

In the event that the turn needle fails, you will have to use bank angle and airspeed for 1/2 standard and standard rate turns. Be aware that the turn indicator is an integral part of the ADI, so even though it has its own power source, its failure may indicate other ADI problems.

There is no specific procedure for a slip indicator malfunction because it is unlikely to fail unless it is physically damaged and because it does not serve an important enough function to warrant any remedial actions.

The procedure for dealing with a turn and slip indicator failure is:

1. Check the ADI for correct indications.
2. Beware of possible electrical problems.
3. Use the ADI and airspeed for turn rate reference.

PITOT STATIC MALFUNCTIONS

If the entire pitot static system fails, you will lose the Mach/airspeed indicator, barometric altimeter, and VSI in both cockpits. Verify the failure of any pitot static instrument by cross-checking indications with the other cockpit, if possible.

You can compensate for the loss of the airspeed indicator by flying the equivalent angle of attack for climb, cruise, descent, and landing.

You have two ways to make up for the loss of the barometric altimeter. First, you can use the radar altimeter for height above ground up to 5,000 ft AGL. Second, you can use the cabin pressure altimeter for altitude information up to 25,000 ft MSL if the cockpit has been depressurized. Remember that the cabin pressure altimeter does not compensate for local barometric pressure and should only be considered accurate to +/- 500 ft.

To compensate for the loss of the VSI, use the clock to time the amount of altitude change occurring over a specific period of time. For example, if you were to descend 200 ft in 15 seconds, your rate of descent would be 800 ft per minute.

The procedure for dealing with a pitot static system failure is:

1. Check that PITOT HEAT is ON.
2. Compare instruments in both cockpits. Use AOA, the radar altimeter, and/or cabin pressure altimeter to calculate the approximate airspeed and altitude.
3. Report the failure to ATC.
4. Maneuver to exit icing conditions (if applicable).
5. Remain VMC, if possible.
6. Join with wingman if possible.

MACH/AIRSPEED INDICATOR FAILURE

An airspeed indicator failure, by itself, requires only that you fly AOA rather than airspeed. Consult NATOPS for equivalent AOA for the T-45A in various flight conditions.

The procedure for dealing with a Mach/airspeed indicator failure is:

1. Check that PITOT HEAT is ON.
2. Report the failure to ATC.
3. Fly AOA in place of airspeed.
4. Watch for indications of pitot static system problems.
5. Land as soon as practicable.

BAROMETRIC ALTIMETER FAILURE
You have two options to make up for the loss of the barometric altimeter.

First, you can use the radar altimeter for height above ground for altitudes up to 5,000 ft AGL. Remember that you must add ground elevation to radar altitude to approximate mean sea level (MSL) altitudes.

Second, you can obtain backup altitude information from the cabin pressure altimeter. This instrument should be considered accurate to +/- 500 ft and is primarily useful at altitudes above 5,000 ft AGL where the radar altimeter is useless. Remember that in order to use the cabin pressure altimeter above 5,000 ft MSL, you will have to depressurize the cockpit.

Don't forget to cross-check your other pitot static system instruments (ASI and VSI) to ensure that they are operating correctly.

Because the barometric altimeter includes an IFF altitude encoder, you may need to disable the IFF altitude function by placing the M-C MODE SELECT/TEST switch on the IFF control panel to OUT.

The procedure for dealing with an altimeter failure is:

1. Check that PITOT HEAT is ON.
2. Report the failure to ATC.
3. Use the radar and the cabin pressure altimeters to determine altitude (depressurize cockpit if required).
4. Be aware that the IFF altitude may also be in error.
5. Land as soon as practicable.

VSI FAILURE
If you lose the VSI, use the clock to gauge the amount of altitude change occurring over a specific period of time. For example, if you were to descend 200 ft in 15 seconds, your rate of descent would be 800 ft per minute. You can also use this procedure to check the accuracy of a suspect VSI.

It is also important that you determine whether other instruments in the pitot static system are operating correctly. What may appear to be a stuck or erroneously indicating VSI could be part of a larger pitot static system problem.

NOTE: With a failed VSI your PAR approach capability will be severely limited.

The procedure for dealing with a VSI failure is:

1. Check that PITOT HEAT is ON.
2. Cross-check the altimeter and clock for vertical velocity reference.
3. Watch for other indications of possible pitot static problems.

STANDBY GYRO FAILURE

As opposed to an ADI failure, a standby gyro failure is not a significant problem. With this failure, you cannot use the standby AI as a cross-check for the ADI. Of course, if the ADI has previously failed or if its indications are suspect, a standby gyro failure becomes a serious matter.

Figure 44 shows one of the possible indications of a failed standby gyro. Remember that the power off flag does not have to be present for the indicator to give a false reading because the flag signifies only a lack of electrical power.

NOTE: After loss of power with the “power off” flag in view, the 3 inch standby gyro will continue to provide reliable altitude reference for up to 3 minutes after failure. In cockpits where the new 2-inch standby gyro is installed, it will continue to provide reliable altitude reference for up to 9 minutes after failure.

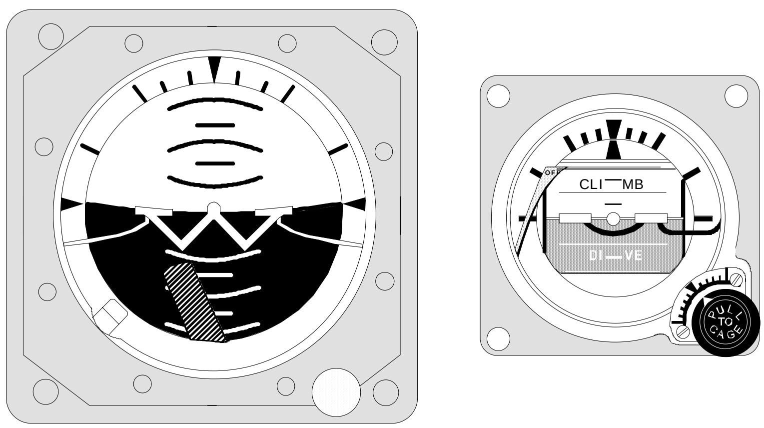


Figure 44: FAILED 3” STANDBY GYRO/FAILED 2” STANDBY GYRO

The procedure for dealing with a standby gyro failure is:

1. Use the ADI.
2. Check the electrical system.
3. Watch for possible progressive failure.

AOA INDICATOR FAILURE

The loss of the AOA indicator will mainly affect your approach scan: you will have to fly airspeed instead of AOA. So you omit the AOA indicator and indexer from your scan, and focus on the Mach/airspeed indicator instead.

Figure 45 shows one of the possible indications of a failed AOA indicator. Remember that the OFF flag does not have to be present for the indicator to give false readings because the flag indicates only a lack of electrical power.

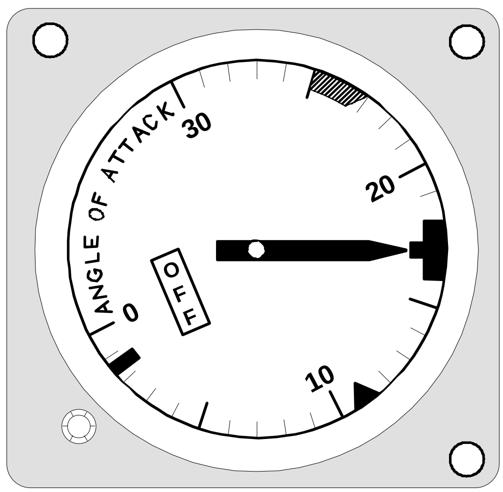


Figure 45: FAILED AOA INDICATOR

The procedure for dealing with an AOA indicator failure is:

1. Use the Mach/airspeed indicator.
2. Fly calculated approach speeds, using the airspeed indicator.

RADAR ALTIMETER FAILURE

With a failed radar altimeter, you lose your height above ground reference. If you are aware of your location and the local terrain, this danger is minimized. Remember that if you have any doubt about your position or the topography of the surrounding area, you should notify the controlling agency and immediately climb to a safe altitude. Once you are sure of the local surface elevation and have confirmed that the barometric altimeter has the correct setting, you should be able to use it for all altitude references. However, remember that where the radar altimeter supplies height above terrain, the barometric altimeter gives height above sea level.

Figure 46 shows one of the possible indications of a failed radar altimeter. The OFF flag does not have to be present for the indicator to give false readings. The flag indicates a power failure, that the system is turned OFF, aircraft attitude greater than +/- 40 degrees in pitch or roll, or aircraft higher than 5,000 ft AGL.

The procedure for dealing with a radar altimeter failure is:

1. Use the barometric altimeter.
2. Confirm the correct altimeter setting.

VOR FAILURE

A failed VOR system may be indicated by the loss of the aural identification or by the presence of a red NAV flag on the HSI. If the VOR equipment fails, you will also lose ILS localizer information because both are driven by the same circuitry. Keep in mind that altitude affects reception, so the VOR signal may be occluded if you are operating at low altitude.

Figure 47 shows one of the possible indications of a failed VOR system. Remember that the NAV flag does not have to be present for the VOR bearing pointer to give false readings because the flag indicates only that the information supplied to the HSI is sensed to be invalid.

The procedure for dealing with a VOR failure is:

1. Cycle the frequency selector.
2. Check with ATC to see if the station is in operation or select another station.
3. Use TACAN (if available) or request radar vectors.

TACAN BEARING FAILURE

A TACAN bearing failure (Figure 48) is indicated by the No. 2 bearing pointer searching, CDI going to random positions, loss of audio identification, and NAV flag in view.

The procedure for dealing with a TACAN bearing failure is:

1. Cycle the channel selector.
2. Check with ATC to see if the station is in operation or select another station.
3. Select the VOR navigation system (if available) or request radar vectors.

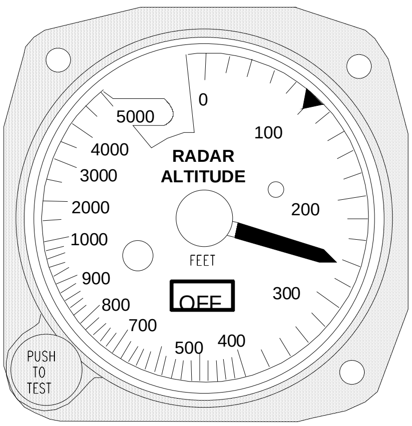


Figure 46: FAILED RADAR ALTIMETER

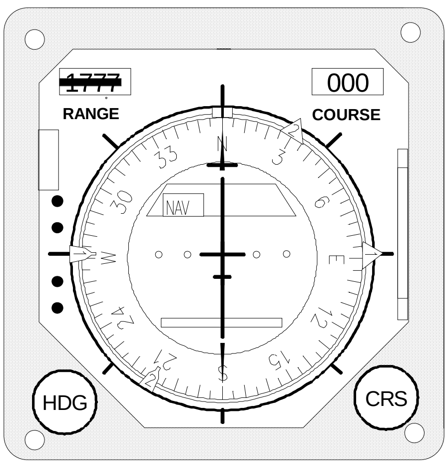


Figure 47: FAILED VOR

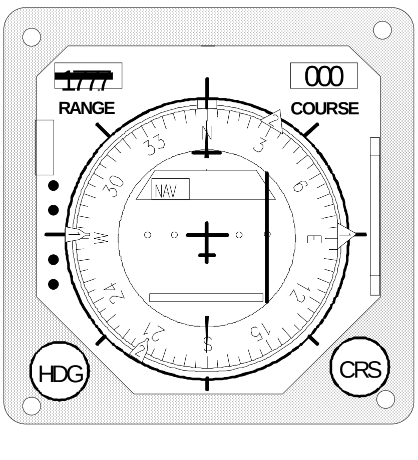


Figure 48: FAILED TACAN BEARING

ILS GLIDESLOPE FAILURE

Loss of ILS glideslope signal is indicted by the appearance of the GS flags on the HSI and ADI and the loss of glideslope indications on these instruments. With this failure, you have the choice of downgrading your approach to a localizer only, discontinuing the approach, or flying another type of approach (TACAN, VOR, PAR, or ASR) depending on the situation and availability of approaches. Remember that if you downgrade to a localizer only, you will have to adjust your approach minimums.

VOR/ILS receiver failure - See NATOPS, Chapter 21

Figure 49 shows the location of the GS flag on the HSI. A similar flag is located on the ADI.

ILS LOCALIZER FAILURE - See NATOPS, Chapter 21

Figure 50 shows the location of the NAV flag on the HSI and LOC flag on ADI. Remember, a LOC flag on the ADI serves the same function in the event of a localizer failure.

ILS MARKER BEACON FAILURE

If you lose ILS marker beacon indications, you may still be able to complete your approach, if you can use TACAN/DME, radar, or TACAN crossing radials to determine marker beacon positions. Remember that you may have to adjust your approach minimums when you lose marker beacon indications.

FLIGHT WITH PARTIAL PANEL

See "Basic Instrument Maneuvers" section of this FTI for further information.

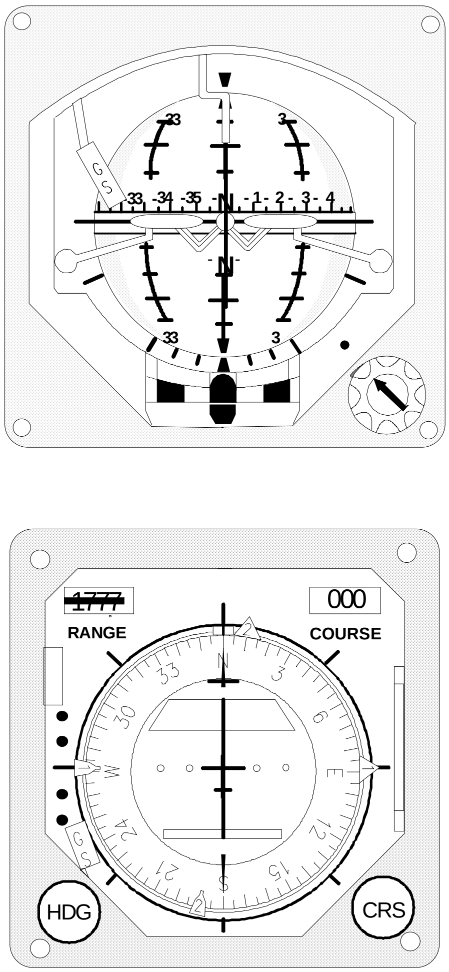


Figure 49:
FAILED ILS GLIDESLOPE INDICATOR

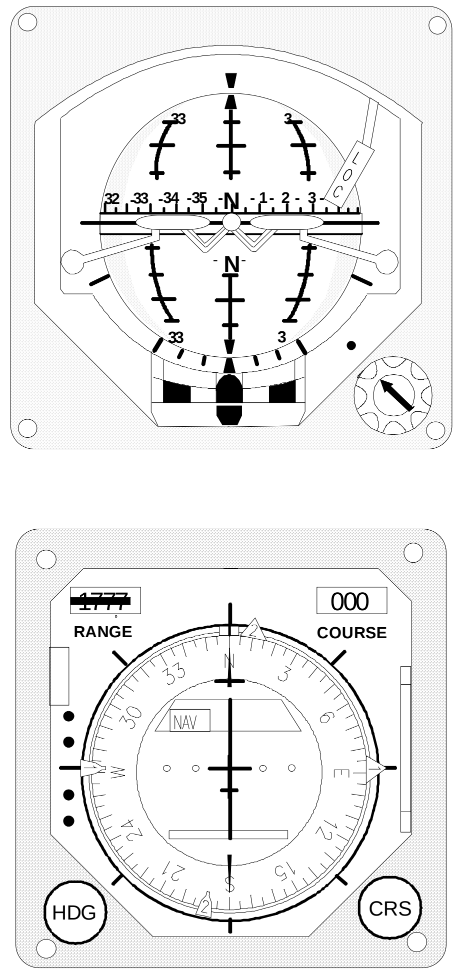


Figure 50:
FAILED ILS LOCALIZER

SELF-TEST

INSTRUMENT TAKEOFF AND CLIMB WITH SID / INSTRUMENT TAKEOFF PROCEDURES

1. What instruments do you need in your scan at this point?

   ANSWER: ADI, AOA, airspeed

2. At what point in the ITO do you retract the flaps/slats?

   ANSWER: When wings are level at a minimum of 140 KIAS, 300 ft AGL and safely airborne

3. What is the maximum airspeed below 10,000 ft?

   ANSWER: 250 KIAS

4. What indications are required before you can raise the gear?

   ANSWER: Positive rate of climb on VSI and altimeter, safely airborne, and a minimum of 100 ft AGL

STANDARD INSTRUMENT DEPARTURES

5. What are the two basic types of SIDs?

   ANSWER: Pilot nav and vector

6. During a radar-vector departure, where do your instructions originate?

   ANSWER: ATC controller (Departure control)

7. What is the primary difference between a pilot nav and a vector SID?

   ANSWER: The pilot is responsible for following the published instructions in a pilot nav and following the controller's instructions for a vector SID.

8. What information must the pilot repeat during instrument flight?

   ANSWER: Headings, altitudes, and altimeter settings, and must acknowledge all radio calls

9. How do you determine the lead point to intercept an arc from a radial?

   ANSWER: 1 percent of ground speed = DME lead

10. How do you determine the number of radials of lead required to intercept a radial from an arc?

    ANSWER: 60 divided by DME of arc, multiplied by 1 percent of ground speed = number of lead radials

11. Leads to arcs/radials are based on what rate of turn?

    ANSWER One-half standard rate

GCA PROCEDURES / PRECISION RADAR APPROACHES (PARs)

12. What is the primary difference between a PAR and an ASR?

    ANSWER: You will be provided with glidepath information on a PAR.

13. What should your AOB be in the GCA pattern?

    ANSWER: 30 degrees AOB in the initial pattern, 20 degrees AOB when dirty, and no more than 10 degrees AOB on final.

14. How are rate of descent and AOA controlled on the glidepath?

    ANSWER: Rate of descent is controlled with power and AOA is controlled with nose attitude.

15. What information must the pilot repeat during any GCA approach?

    ANSWER: Headings, altitudes, and altimeter settings until instructed otherwise

SURVEILLANCE RADAR APPROACHES (ASRs)

16. Are recommended altitudes automatically provided in an ASR?

    ANSWER: No, only if requested by the pilot.

17. What AOB is used in the pattern and why?

    ANSWER: 30 degrees AOB. The controller needs to know your rate of turn for alignment purposes.

18. For a GCA, what information must the controller provide the pilot prior to final approach?

    ANSWER:
    1. Type of approach (precision or surveillance)
    2. Runway
    3. Location of MAP (surveillance only)
    4. Advisory to perform landing check (USN/USMC controllers only)
    5. Missed approach instructions and lost comm instructions
    6. Position information and heading changes as necessary to keep you on course

19. What are the lost comm time intervals for a PAR?

    ANSWER: 60 seconds in pattern, 5 seconds on final

20. What are the lost comm time intervals in an ASR?

    ANSWER: 60 seconds in pattern, 15 seconds on final

PROCEDURES/SCAN TECHNIQUES FOR PERFORMING MISSED APPROACH

21. When is a missed approach required?

    ANSWER:
    1. MAP or DH reached without visual contact with runway environment
    2. Safe landing not possible
    3. Directed by tower

STALLS AND UNUSUAL ATTITUDES/STALLS ON INSTRUMENTS

22. What is the procedure when the wing drops off during a clean stall?

    ANSWER: Add MRT and lower the nose to attain 20-21 units AOA and level wings.

23. What is the minimum altitude (AGL) to begin all stalls?

    ANSWER: 10,000 ft

24. What is the configuration for dirty stall entry?

    ANSWER: Gear down, flaps/slats down, speed brakes out

UNUSUAL ATTITUDE RECOVERIES

25. What is the procedure for performing nose-high upright recoveries?

    ANSWER:
    1. Neutralize controls
    2. Analyze and evaluate
    3. Add MRT and retract the speed brakes
    4. Apply forward stick pressure to maintain 5-10 units AOA
    5. Lower nose to slightly below horizon
    6. At minimum of 150 KIAS level wings in shortest direction
    7. Pull to horizon
    8. Readjust power for normal flight

26. What is the first step in recovering from all unusual attitudes?

    ANSWER: Neutralize controls

27. Define the term “neutral controls.”

    ANSWER: The stick and rudder held centered

PARTIAL PANEL UNUSUAL ATTITUDE RECOVERIES

28. What will be the only significant change when performing unusual attitudes partial panel?

    ANSWER: The standby AI will be substituted for the ADI.

29. Once the desired course has been set in the course selection window, how is the intercept heading determined for an inbound TACAN/VOR double angle off the bow intercept?

    ANSWER: Look from the desired course to the head of the No. 1 bearing pointer and an equal number of degrees beyond.

30. On the penetration checklist, what is the reason for checking the compass?

    ANSWER: To ensure HSI and ADI agree with the standby compass.

31. What should the pilot communicate to approach control during a radar handoff?

    ANSWER:
    1. Call sign
    2. Assigned altitude
    3. ATIS information (if received)
    4. Approach request

32. On a VOR/DME approach, why should you start the clock at the FAF?

    ANSWER: So you have a means of identifying the MAP in the event of DME failure.

33. On a VOR approach, why should you start the clock at the FAF?

    ANSWER: The time from the FAF is the only means of identifying the MAP.

34. During flight planning for the destination airfield, which items must be check in both NOTAMS and IFR supplement?

    ANSWER:
    1. Hours of operation/landing restrictions
    2. Status of runways
    3. NAVAIDs
    4. Emergency equipment

35. For what time and location do you check forecast weather?

    ANSWER: Route of flight, destination at ETA +/- hours, alternate at ETA +/- hour.

36. What FLIP publication may be used to convert RVR to statute mile visibility?

    ANSWER: FLIP high/low altitude (Terminal).

37. What are takeoff minimums for a pilot with a standard instrument rating?

    ANSWER: 300 ft ceiling and 1 sm visibility.

38. What fuel requirements must be determined for departure to destination?

ANSWER: Start, taxi, takeoff fuel, fuel to climb, enroute fuel, enroute descent, approach fuel, required reserve.

39. When determining the type of approach, why would you review the landing minimums for your aircraft category?

ANSWER: To determine the lowest MDA/DH approach.

NOTES

APPENDIX A

(BIFP)

Study Resources for Basic Instrument Flight Procedures:
[A] NATOPS Instrument Flight Manual, NAVAIR 00-80T-112
[B] Instrument FTI
[C] T-45A NATOPS Flight Manual, A1-T45AB-NFM-000
[D] Personal Engineering Notes

BIFP-01: "Instrument Takeoff, Climb, SIDs, and Arcing Procedures" 1.3 hr Classroom

Lesson Preparation:
[A] Paragraphs 17.2.1 "Pretakeoff Procedures", 17.2.1.1 ITO Procedures (Fixed Wing)", and 27.2 Departure through 27.2.2 "Standard Instrument Departure (SID)"
[B] Paragraphs "Instrument Takeoff (ITO)" through "Constant Airspeed Climbs and Descents", and paragraphs under "Outbound Intercepts"

Lesson Objectives for BIFP-10X exam preparation:
* Recall procedures for performing an instrument takeoff
* Recall procedures for performing a standard instrument departure
* Recall procedures for radial to arc intercept
* Recall procedures for flying a TACAN/VOR DME ARC
* Recall procedures for arc to radial intercept

BIFP-02: "Introduction to Basic Instruments" .7 hr CAI

Lesson Preparation:
[A] Chapter 13 "Attitude Instruments", Chapter 14 "Performance Instruments", Chapter 15 "Position Instruments", Chapter 16 "Attitude Instrument Flying"

Lesson Objectives for BIFP-10X exam preparation:
* Identify the location, purpose, and function of the flight control instruments
* Identify the location, purpose, and function of the flight performance instruments
* Identify the location, purpose, and function of the flight position instruments
* Recall instrument scan procedures/techniques

BIFP-03: "Instrument Turns" .8 hr CAI

Lesson Preparation:
[A] Paragraphs 17.3.1.1 "Maintaining a Desired Heading" through 17.3.2.4 "Turning Performance"

Reinforcement:
[C] Review Turn Performance Charts

Lesson Objectives for BIFP-10X exam preparation:
* Recall procedures for controlling aircraft heading and turn rate
* Recall procedures for performing turn pattern
* Recall procedures for performing standard rate turns
* Recall procedures for performing 1/2 standard rate turns
* Recall procedures for performing partial panel timed turns

BIFP-04: "Basic Flight Maneuvers and Transitions" .8 hr CAI
Lesson Preparation:
[A] Paragraphs 17.4 "Climbs and Descent" through 17.4.2.1 "Climbing and Descending Turns"
Lesson Objectives for BIFP-10X exam preparation:
* Recall procedures for controlling aircraft altitude and rate of climb/descent
* Recall procedures for performing level speed changes
* Recall procedures for performing level speed change in 1/2 standard rate turns
* Recall procedures for performing slow flight maneuver

BIFP-05: "S Patterns" .8 hr CAI
Lesson Preparation:
[B] "S Patterns"
Lesson Objectives for BIFP-10X exam preparation:
* Recall procedures for performing the S-1 pattern
* Recall procedures for performing the S-3 pattern

BIFP-06: "TACAN and VOR Procedures" 1.5 hr Classroom
Lesson Preparation:
[A] Chapter 20 "VHF Omnidirectional Range (VOR)" through Chapter 21 "Tactical Air Navigation (TACAN)"
[B] Paragraphs "Proceeding Direct To A Station" through "Intercepting a Radial from an Arc"; "Approach Phase" through "Ground Controlled Approach (GCA)"; "TACAN and VOR/DME Procedures" through "ILS Approach"; and "Visual Approach" through "Missed Approach"
Lesson Objectives for BIFP-10X exam preparation:
* Recall procedures for using CDI
* Recall procedures for TACAN/VOR tracking
* Recall procedures for correcting for wind drift using TACAN/VOR/VOR DME
* Recall reasons for each item on the penetration checklist
* Recall communication procedures for approach
* Recall procedures for performing TACAN/VOR DME approach
* Recall procedures for performing VOR approach

BIFP-07: "GCA Procedures" 1.2 Classroom
Lesson Preparation:
[A] Section 24.3 "Radar Approach Procedures"
[B] "Ground Controlled Approach (GCA)" through "GCA Pattern"
Reinforcement:
Ground-controlled approach procedures and the basic flight maneuver within the more complex maneuvers of the previous lessons
Lesson Objectives for BIFP-10X exam preparation:
* Recall procedures for performing descent/penetration to approach
* Recall (flight path) information provided on a PAR approach
* Recall procedures for a PAR approach
* Recall communication procedures for a PAR approach
* Recall (flight path) information provided for an ASR approach
* Recall procedures for flying an ASR approach
* Recall communication procedures for an ASR approach
* Recall procedures for performing missed approach

BIFP-08: "Stalls, Unusual Attitudes, and Acrobatics" 1.1 hr Classroom

Lesson Preparation:

[A] Chapter 19 "Unusual Attitudes"

[B] "Stalls and Unusual Attitude Recoveries" through "Unusual Attitude Recovery (Partial Panel)"

Reinforcement:

Incorporate procedures concerning stalls and unusual attitudes from Fam lessons into what you have just learned so that you will be able to perform recoveries in both VMC and IMC.

Lesson Objectives for BIFP-10X exam preparation:

* Recall procedures for performing stalls on instruments
* Recall procedures for performing unusual attitude recoveries
* Recall procedures/techniques for performing unusual nose-high recoveries
* Recall procedures/techniques for performing nose-low recoveries
* Recall procedures/scan techniques for performing nose-high recoveries partial panel
* Recall procedures/scan techniques for performing nose-low recoveries partial panel
* Recall procedures for performing aerobatics under innstrument conditions
* Recall procedures/techniques for performing aileron roll
* Recall procedures/techniques for performing wingovers
* Recall procedures/techniques for performing loop
* Recall procedures/techniques for performing barrel roll
* Recall procedures/techniques for performing half-cuban eight
* Recall procedures/techniques for performing immelmann
* Recall procedures/techniques for performing split-s

BIFP-09 "Instrument Failures" Workbook

Lesson Preparation:

[A] 17.6.1 "Heading Indicator Failure" and 17.6.2 "Attitude Indicator Failure"

Reinforcement:

Review your Engineering notes on "Flight Instrument Malfunctions"

Lesson Objectives for BIFP-10X exam preparation:

* Recall procedure for SAHRS failure
* Recall procedure for HSI failure
* Recall procedure for ADI failure
* Recall procedure for turn and slip indicator failure
* Recall procedure for pitot static malfunctions
* Recall procedure for airspeed indicator failure
* Recall procedure for altimeter failure
* Recall procedure for VSI failure
* Recall procedure for standby gyro failure
* Recall procedure for AOA indicator failure
* Recall procedure for radar altimeter failure
* Recall procedure for VOR failure
* Recall procedure for TACAN bearing failure
* Recall procedure for ILS glideslope failure
* Recall procedure for ILS localizer failure
* Recall procedure for ILS marker beacon failure
* Recall procedures for flight with partial panel

(RIFP)

Study Resources for Radio Instrument Flight Procedures:

[A] NATOPS Instrument Flight Manual, NAVAIR 00-80T-112
[B] INav Lesson Guides
[C] T-45A NATOPS Flight Manual, A1-T45AB-NFM-000
[D] Instrument FTI

RIFP-01 "Introduction to Radio Instruments" 2.5 Classroom

Lesson Preparation:

[A] 20.3 "Procedures" through 20.3.12 "Holding"
[A] 21.2.3 "TACAN Procedures" through 21.2.3.9 "TACAN Holding"
[A] 27.2.2 "Standard Instrument Departure"

Lesson Objectives for RIFP-5X exam preparation:

* Recall procedures for a standard instrument departure
* Recall procedures for performing radial intercepts
* Recall indications of station passage on the TACAN/VOR/VOR DME
* Recall procedures for flying a TACAN/VOR DME arc
* Recall voice procedures associated with instrument navigation
* Recall procedures for computing ground speed using TACAN/VOR DME
* Recall procedures for correcting for wind drift using TACAN/VOR/VOR DME
* Recall procedures for performing TACAN/VOR DME point-to-point navigation (and update)
* Recall procedures for performing direct routing
* Recall procedures/IAS for flying TACAN/VOR DME holding
* Recall procedures/IAS for flying VOR holding
* Recall (flight path) information for an ILS approach
* Recall procedures for an ILS approach
* Recall procedures for performing back course (LOC) approach
* Recall procedures for performing transition from instrument to visual scan
* Recall procedures for performing a circling approach
* Recall procedures for performing missed approach
* Recall procedures for climb, cruise, and descent profiles
* Recall procedures for performing partial panel approaches
* Recall procedures for performing minimum fuel/emergency fuel inst. approach
* Recall procedures for performing emergency oil/precautionary instrument approach
* Recall procedures for coping with NAVAID failures

RIFP-02 "TACAN and VOR Procedures" .5 CAI

Lesson Preparation:

[A] 20.3 "Procedures" through 20.3.12 "Holding"
[A] 21.2.3 "TACAN Procedures" through 21.2.3.9 "TACAN Holding"
[A] 27.2.2 "Standard Instrument Departure"

Lesson Objectives for RIFP-5X exam preparation:

* Recall procedures for radial to arc intercept
* Recall procedures for performing radial intercepts
* Recall procedures for flying TACAN/VOR DME arc
* Recall indications of station passage on the TACAN/VOR/VOR DME
* Recall procedures for computing ground speed using TACAN/VOR DME
* Recall procedures for correcting for wind drift using TACAN/VOR/VOR DME
* Recall procedures for performing TACAN/VOR DME point-to-point navigation (and update techniques)
* Recall procedures for proceeding direct to a station

RIFP-03 "TACAN and VOR Holding Procedures" .5 CAI

Lesson Preparation:

[A] 20.3.12 "Holding"

[B] Review INav lesson guide concerning entry procedures, airspeeds, timing, and distances for holding.

Lesson Objectives for RIFP-5X exam preparation:

* Recall procedures/IAS for flying TACAN/VOR DME holding
* Recall procedures/IAS for flying VOR holding

RIFP-04 "TACAN/VOR/ILS/PAR/ASR Approach Procedures" 1.0 hr CAI

Lesson Preparation:

[A] 21.2.4 "TACAN Approach Procedures"

[A] 23 "Instrument Landing System (ILS)"

[A] 24.3 "Radar Approach Procedures"

[A] 29 "Terminal Procedures"

Reinforcement:

Break the approach maneuvers presented in this lesson down into the basic flight maneuvers we have covered in previous lessons.

Lesson Objectives for RIFP-5X exam preparation:

* Recall communication procedures for approach
* Recall procedures for performing TACAN/VOR DME approach
* Recall procedures for performing VOR approach
* Recall procedures for flying an ASR approach
* Recall procedures for a PAR approach
* Recall (flight path) information for an ILS approach
* Recall procedures for an ILS approach
* Recall procedures for performing transition from instrument to visual scan
* Recall procedures for performing a circling approach
* Recall procedures for performing missed approach

(ANFP)

Study Resources for Radio Instrument Flight Procedures:

[A] NATOPS General Flight and Operating Instructions Manual, OPNAVINST 3710.7
[B] NATOPS Instrument Flight Manual, NAVAIR 00-80T-112
[C] Instrument Flight FTI

ANFP-01 "Planning for Airways Navigation Mission" 2.7 Classroom

Lesson Preparation:

[A] Sections 4.3 "Flight Planning" and 4.3.1 "Preflight Planning"
[A] Section 4.5 "Flight Plan Modification"
[A] Sections 4.6 "Other Preflight Requirements" through 4.6.4.3 "Delays"
[B] Chapter 25 "Flight Planning"
[C] "Instrument Flight Planning", "Flight Procedures", "Safety/Emergency Procedures"

Reinforcement:

Review the procedures for completing the Single-Engine Jet Flight Log and DD-175

ANFP-01 (Cont.)

Lesson Objectives for ANFP-02X exam preparation:

* Recall FLIPs required for flight planning
* Recall items to be checked for destination airfield
* Determine weather criteria for flight
* Recall takeoff minimums as defined in OPNAVINST 3710.7
* Determine alternate routes/airfields
* Plan route of flight
* Recall procedures for performing an enroute descent
* Determine fuel requirements for route of flight
* Prepare single-engine jet log
* Recall procedures for completing DD-175
* Recall instrument approach criteria outlined in OPNAVINST 3710.7
* Recall procedures for modifying route of flight and destination
* Recall procedures for lost communications situations
* Recall procedures for mission cockpit management
* Recall procedures for performing IFR to a contact approach
* Recall procedures for performing visual approach
* Recall procedure for performing a circling approach
* Recall procedures for performing missed approach
* Recall procedures for terminal communications

GLOSSARY

A

Airport Advisory Area: The area within ten statute miles of an airport without a control tower or where the tower is not in operation and on which a flight service station is located.

Airport Elevation/Field Elevation: The highest point of an airport's usable runways measured in ft MSL.

Airport Surveillance Radar (ASR): Radar providing position of aircraft by azimuth and range data without elevation data. Used for terminal approach and departure control. (See Surveillance Approach.)

Air Route Traffic Control Center (ARTCC): A facility established to provide traffic control service to IFR flights operating within controlled airspace, principally during the enroute phase of flight.

Airway: Class E airspace or portion thereof established in the form of a corridor equipped with radio navigational aids.

Alert Area: An airspace which may contain a high volume of pilot training activities or an unusual type of aerial activity, neither of which is hazardous to aircraft.

Alternate Airfield: An airport specified in a flight plan to which a flight may proceed if the destination is below minimums or safety considerations preclude a landing.

AOA: Angle of attack.

AOB: Angle of bank.

Approach Control: A term used to indicate an air traffic control unit providing approach control service, without specifying the unit.

Approach Control Service: Service provided by a terminal area traffic control facility for arriving and/or departing IFR flights and, on occasion, VFR flights.

ASR: See Airport Surveillance Radar.

ATC: See Air Route Traffic Control Center.

Automatic Terminal Information Service (ATIS): A continuous broadcast of recorded, non-control information in selected high activity terminal areas. Its purpose is to improve controller effectiveness and to relieve frequency congestion by automating the repetitive transmission of essential but routine information.

B

BIT: Built-in test. Self-testing capabilities contained within an instrument or system.

C

Caution Area: An area within which military training activities, though not hazardous, are of interest to nonparticipating pilots.

Ceiling: The height above the earth's surface of the lowest layer of clouds or other obscuring phenomena. This layer is described as "broken," "overcast," or "obscuration" and not classified as "thin" or "partial."

Circling Approach: A maneuver initiated by the pilot to visually align the aircraft with a runway for landing. This maneuver may be made only with ATC authorization and if the pilot has established the required visual reference to the airport.

Class D Airspace: That airspace which surrounds tower controlled airfields and extends 4.4 nm in radius from the center and to 2,500 ft above the airport. Radio communication with the tower is required within this airspace. (Depicted as a segmented blue line on low altitude enroute charts)

Clearance Limit: The fix to which an aircraft is cleared when issued an ATC clearance.

Compulsory Reporting Point: A point the passage of which must be reported to ATC, unless in radar contact.

Contact Approach: A pilot-requested approach wherein an aircraft on an IFR flight plan, operating clear of the clouds with at least 1 sm visibility and having ATC authorization, may deviate from the prescribed instrument approach procedure and proceed to the airport of destination by visual reference to the surface.

Controlled Airspace: Airspace designated as Class A through Class E within which some or all aircraft may be subject to air traffic control.

Course: A magnetic direction to fly in relation to a radio navigational facility. Note that a course is not simply a heading. For flight inbound on a radial, the course is the reciprocal of the radial. For flight outbound, the course and the radial are the same.

D

Decision Height (DH): The altitude during a precision approach at which a pilot must decide whether to execute a missed approach or to continue the approach (weather and safety permitting).

Departure Control: Air traffic control service provided to pilots departing an airport.

DH: See Decision Height.

DME: Distance measuring equipment. (See TACAN.)

DME Fix: A geographical position determined by reference to a navigational aid and defined by a specified distance in nautical miles and radial in degrees from said aid. For example: a DME fix located 10 nm west of the NSE VORTAC on the 270-degree radial would be written as NSE 270 010.

Dogleg: A vector to the final approach course (usually within 30 degrees of runway heading).

E

EFC: See Expected Further Clearance Time.

Emergency Fuel: An emergency situation which the pilot cannot accept any delays and requires the most direct and expeditious routing for landing.

Emergency Safe Altitude: An altitude expressed in 100-foot increments providing 1,000 ft (2,000 ft in designated mountainous areas) of clearance over all obstructions/terrain within a 100-nautical mile radius.

Expected Further Clearance Time (EFC): The time at which it is expected that additional clearance will be issued to an aircraft.

F

FAF: See Final Approach Fix.

Feeder Route: A route depicted on instrument approach procedure charts that designates routes for an aircraft to proceed along from the enroute structure to the initial approach fix (IAF).

Final Approach Course (FAC): The segment of an instrument approach between the final approach fix and the missed approach point.

Final Approach Fix (FAF): The fix from/over which the final portion of an instrument approach is executed.

Final Controller: The controller who provides final approach guidance using radar equipment.

Fix: A geographical position determined by reference to one or more NAVAIDS. A fix can be defined as overhead the NAVAID, a radial and distance from the NAVAID, or a crossing point of two radials from two NAVAIDS.

Flight Level (FL): A surface of constant atmospheric pressure related to the standard pressure datum of 29.92" Hg.

Flight Plan: Specified information relative to the intended flight of an aircraft provided to the cognizant air traffic service unit.

Flight Service Station (FSS): A facility operated by the FAA to provide flight assistance service.

G

Ground Controlled Approach (GCA): A radar approach system whereby a controller interprets a radar display and transmits approach instructions to the pilot to place the aircraft in a position for landing. The approach may use surveillance radar (ASR) providing course and range information or precision approach radar (PAR) providing course, range, and glideslope information. Do not request a GCA approach; instead, you should specifically request either a PAR or an ASR approach.

H

HAA: See Height Above Airport.

HAT: See Height Above Touchdown.

Heading: The direction in which the longitudinal axis of the aircraft is pointed, usually expressed in degrees from magnetic North.

Height Above Airport (HAA): Indicates the height of the MDA above the published airport elevation; published in conjunction with circling minimums.

Height Above Touchdown (HAT): Indicates the height of the DH or MDA above the highest elevation in the touchdown zone; published in conjunction with straight-in minimums.

Holding Fix: A specified fix used as a reference point to establish and maintain the position of an aircraft while holding.

Homing: Flight toward a NAVAID without correcting for wind by adjusting the aircraft heading to maintain a relative bearing of zero degrees.

I

IAF: See Initial Approach Fix.

IFR Aircraft: Aircraft conducting flights in accordance with instrument flight rules.

ILS: Instrument Landing System.

IMC: See Instrument Meteorological Conditions.

Initial Approach: That part of an instrument approach procedure consisting of the first approach to the first navigational facility associated with the procedure or to a predetermined fix.

Initial Approach Fix (IAF): The fix depicted on an instrument approach plate that identifies the beginning of the initial approach segment.

Instrument Meteorological Conditions (IMC): Weather conditions (visibility, ceiling, and cloud clearance) below the minimums for flight under visual flight rules (VFR).

Intersection: An intersection is a point along an airway at which two or more radials from two or more stations cross. An intersection may also be defined as a radial/DME fix. Intersections are used to indicate fixed positions along the airways.

J

Jet Routes: A high altitude route system at or above 18,000 ft MSL up to FL 450, predicated on a network of designated VOR, TACAN, and/or VORTAC facilities.

Joint Use Restricted Area: An area wherein an aircraft may operate if prior permission has been granted by either the restricted area “using agency” or ATC.

L

Localizer Approach: A non-precision instrument approach which utilizes only the course guidance component of an ILS system. (due to ground facility equipment or aircraft ILS glideslope failure). The missed approach point (MAP) is determined by timing, DME or by radar.

M

Mandatory Altitude (Instrument Approach): The MSL altitude above a geographical location which an aircraft must maintain during a portion of an instrument approach. A mandatory altitude is depicted by a number with a line above and below it.

MAP: See Missed Approach Point.

Maximum Altitude (Instrument Approach): The MSL altitude above a geographical location which an aircraft may not exceed during a portion of an instrument approach. The requirement for a maximum altitude may be created by airspace separation criteria. On an approach plate, a maximum altitude is depicted by a number with a line above it.

MDA: See Minimum Descent Altitude.

MEA: See Minimum Enroute Altitude.

Military Operations Area (MOA): An airspace area established for the purpose of segregating certain military training activities from airspace containing IFR aircraft. Nonparticipating IFR traffic may be cleared through an active MOA if ATC can provide adequate IFR separation.

Minimum Descent Altitude (MDA): The lowest altitude, expressed in ft MSL, to which descent is authorized on final approach or during a circling-to-land maneuver in the execution of a published non-precision approach procedure.

Minimum Enroute Altitude (MEA): The altitude established between NAVAIDS or reporting points on airways, air routes, or advisory routes that meets obstruction clearance requirements and assures acceptable NAVAID signal reception.

Minimum Fuel: Indicates that the aircraft's fuel supply has reached a state that, upon reaching the destination, the pilot can accept little or no delay. This advisory does not reflect an emergency situation but merely indicates an emergency situation is possible should any undue delay occur.

Minimum Safe Altitude (MSA): An altitude, expressed in 100-foot increments, providing 1,000 ft of clearance over all obstructions/terrain within a 25-mile radius of the NAVAID on which the instrument approach is centered.

Minimum Vectoring Altitude (MVA): The lowest MSL altitude at which an IFR aircraft will be vectored by a radar controller, except as otherwise authorized for radar approaches, departures, and missed approaches.

Missed Approach: A maneuver conducted by a pilot when an instrument approach cannot be completed to a landing.

Missed Approach Point (MAP): A point on an instrument approach at which you must execute missed approach procedures if you have not established the visual references required for landing.

MOA: See Military Operations Area.

MSA: See Minimum Safe Altitude.

N

Navigational Aid (NAVAID): An electronic device that provides position data to an aircraft.

Non-Precision Approach: A standard instrument approach where no electronic glideslope is provided, e.g., VOR, TACAN, or ASR approaches.

P

PAR: Precision approach radar.

Penetration: That portion of a published high altitude terminal instrument approach that prescribes the descent path from the fix on which the procedure is based to a fix or altitude from which an approach to the airport is made.

Platform: Defined as 5,000 ft AGL and comes from carrier operations. Point at which speed brakes are retracted and rate of descent is reduced to 2,000 fpm while maintaining 250 KIAS on a carrier controlled approach.

PPR: Prior permission required.

Precautionary Approach-USN: A procedure designed to afford a pilot experiencing engine-related flight difficulties a means of landing safely and expeditiously while providing a safe ejection altitude.

Precision Approach: A descent in an approved procedure for which the navigational facility alignment is normally on the runway centerline and glideslope information is provided. ILS and PAR are precision approaches.

Prohibited Area: A designated airspace in which the flight of aircraft is prohibited.

R

Radar Contact: Phrase used by air traffic controllers to indicate that an aircraft is identified on the radar display and that radar service can be provided until radar identification is lost or terminated. When the aircraft is informed of “radar contact,” reporting over compulsory reporting points is automatically discontinued.

Radar Contact Lost: Phrase used by ATC to inform a pilot that radar identification of his or her aircraft has been lost and that the pilot must begin making position reports over compulsory reporting points.

Radar Hand-off: Transfer of radar control from one ATC facility to another without interruption.

Radar Vector: A heading issued to an aircraft to provide navigational guidance by ground radar.

Radial: A magnetic bearing extending from a VOR, VORTAC, or TACAN.

Reporting Point: A specified geographical location in relation to which the position of an aircraft can be reported. Compulsory reporting points are indicated by solid triangles and non-compulsory reporting points by open triangles.

Restricted Area: An airspace designated for other than air traffic control purposes over which the flight of aircraft is restricted in accordance with certain specified conditions.

Runway Heading: The magnetic direction indicated by the runway number. When cleared to "fly/ maintain runway heading," pilots are expected to comply by flying the heading indicated by the runway number without applying any drift correction.

Runway Visual Range (RVR): A value, reported in hundreds of ft, that represents the horizontal distance a pilot will see down the runway from the approach end. RVR, in contrast to prevailing or runway visibility, represents what a pilot in a moving aircraft should see looking down the runway and is horizontal, not slant, visual range. RVR for a specific field and runway would be found in FLIP high/low altitude terminal procedures (approach plates).

S

SAR: Search and rescue.

SID: See Standard Instrument Departure.

Single Frequency Approach: A service provided to single-piloted jet aircraft during the hours of darkness or when the aircraft is in instrument weather conditions that permits the use of a single UHF frequency during approach, normally beginning at the start of penetration and continuing to touchdown.

Spatial Disorientation: A condition that exists when a pilot does not correctly perceive his position, attitude, or motion relative to the earth.

Special Use Airspace: Airspace wherein certain activities must be confined because of their nature and/ or wherein limitations are imposed upon aircraft operations that are not a part of those activities.

Standard Instrument Departure (SID): Preplanned coded air traffic control IFR departure routing, preprinted for pilot use in graphic and textual or textual form only.

STAR: A STAR is a pre-planned instrument flight rule (IFR) air traffic control arrival procedure published for the pilot's use in graphical and/or textual form. STARs provide transition from the enroute structure to an outer fix or an instrument approach fix/arrival waypoint in the terminal area. Its purpose is to simplify clearance delivery procedures.

Station: A radio navigational aid. (See Navigational Aid.)

Straight-In Approach: An instrument approach where the final approach is begun without first having executed a procedure turn. This type of approach is not necessarily completed with a straight-in landing or made to straight-in landing minimums.

Surveillance Approach (ASR): An instrument approach conducted in accordance with directions issued by a controller referring only to a surveillance radar display. (See GCA.)

T

TACAN: Tactical air navigation. A UHF electronic air navigation aid that provides suitably equipped aircraft a continuous indication of azimuth and distance to the station.

Track: The actual flight path of an aircraft over the ground.

V

Vertigo: The sensation of dizziness and the feeling that oneself or one's environment is whirling about.

Visual Approach: An approach wherein an aircraft on an IFR flight plan, operating in VFR conditions under control of an air traffic control facility and having an air traffic control authorization, may proceed to the airport of destination under VFR conditions.

Visual Descent Point (VDP): A defined point on the final approach course of a non-precision straight-in approach procedure from which normal descent from the MDA to the runway touchdown point may be commenced, provided the approach threshold of that runway, the approach lights, or other markings identifiable with the approach end of that runway are clearly visible to the pilot.

Visual Meteorological Conditions (VMC): Basic weather conditions prescribed for flight under visual flight rules (VFR).

VOR: VHF Omnidirectional Range, an electronic air navigational aid which transmits 360 degrees of azimuth, oriented to magnetic north.

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