

NAVAL AIR TRAINING COMMAND



NAS CORPUS CHRISTI, TEXAS

CNATRA P-765 (Rev. 04-11)

FLIGHT TRAINING INSTRUCTION



PRIMARY INSTRUMENT NAVIGATION

T-6B

2011



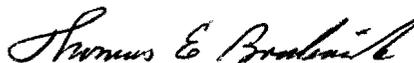
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Subj: FLIGHT TRAINING INSTRUCTION, PRIMARY INSTRUMENT
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1. CNATRA P-765 (Rev. 04-11) PAT, "Flight Training Instruction, Primary Instrument Navigation, T-6B" is issued for information, standardization of instruction, and guidance to all flight instructors and student military aviators within the Naval Air Training Command.
2. This publication is an explanatory aid to the T-B Joint Primary Pilot Training curriculum, and shall be the authority for the execution of all flight procedures and maneuvers herein contained.
3. Recommendations for changes shall be submitted via CNATRA TCR form 1550/19 in accordance with CNATRAINST 1550.6 series.
4. CNATRA P-765 (New 10-09) PAT is hereby cancelled and superseded.


THOMAS E. BRODERICK
Chief of Staff

Distribution:
CNATRA Website

FLIGHT TRAINING INSTRUCTION
FOR
PRIMARY INSTRUMENT NAVIGATION
T-6B



SAFETY/HAZARD AWARENESS NOTICE

This course does not require any safety precautions other than those normally found on the flightline.

FORWARD

Terminal Objective:

Upon completion of this course, the student will be able to safely pilot a T-6B, to include all phases of instrument flight from takeoff and departure, through instrument approaches and missed approaches.

Standards:

Conditions and standards are defined in CNATRAINST 1542.166 series.

Instructional Procedures:

1. This is a flight training course and will be conducted in the aircraft and the Unit Training Device (UTD)/Operational Flight Trainer (OFT) flight simulators.
2. The student will demonstrate a functional knowledge of the material presented through successful completion of the flight maneuvers.

Instructional References:

1. T-6B NATOPS Flight Manual
2. NATOPS Instrument Flight Manual
3. Local Standard Operating Procedures Instruction
4. Aeronautical Information Manual/Federal Aviation Regulations
5. OPNAVINST 3710.7 series

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INTERIM CHANGE SUMMARY

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CHAPTER ONE PRIMARY INSTRUMENT NAVIGATION

100. INTRODUCTION

This Flight Training Instruction (FTI) is a Naval Air Training Command directive published by Chief of Naval Air Training (CNATRA). The information and instructions are relative to all instructors and students operating T-6B aircraft in the Primary Phase of training in the Naval Air Training Command. It is very important that the factual material contained herein be thoroughly studied and retained.

This FTI does not contain all the information necessary for a student pilot to become a professional aviator. Rather, this instruction provides a focal point and reference manual for all other sources of technical information, outlining and amplifying the flight procedures where necessary. This manual is designed as a training tool and is not meant to establish policy concerning fleet operations. It is important to note that the emergency procedures shown are to aid in the topic discussion. For all emergencies, the NATOPS is the final authority. Through this cross-referencing and organization of information, the student pilot should be able to develop a thorough understanding of the manual and flight procedures that form the backbone of an aviation career.

101. INAV OVERVIEW

In the INAV (Instrument Navigation) Stage of Navy flight training, you will be introduced to the elements of flight under Instrument Flight Rules (IFR). The Contact Stage of training equipped you with basic flying skills. In INAV, these skills are further refined and built upon to enable you to accomplish a specific objective – to safely navigate from one point to another in Instrument Meteorological Conditions (IMC).

102. SCOPE OF INSTRUCTION

So far as is practical, all information and instructions governing T-6B aircraft procedures and the execution of curriculum maneuvers will be published for inclusion in this manual. Procedures peculiar to Whiting Field (TW-5) and Corpus Christi (TW-4) may be found in the TW-5 Fixed Wing Operating Procedures (FWOP) Manual or TW-4 Standardization Notes/NAS Corpus Christi Course Rules.

Terms that would be included ordinarily in a glossary for T-6B INAV training are defined as they are used throughout the text.

103. CURRICULUM RESOURCES**1. JOINT PRIMARY PILOT TRAINING (JPPT) SYSTEM CURRICULUM**

CNATRINST 1542.166. This pocket guide is the curriculum outline. It describes what the student aviator will do in the Primary phase of training. The maneuvers and exercises in the syllabus are described, as well as the standards of performance to be achieved. Each event lists all of the maneuvers to be performed. When there is no task listing in the description of an event, then another publication describes the conduct of that event.

2. NATOPS PROGRAM. Every student naval aviator (SNA) becomes familiar with Naval Air Training and Operating Procedures Standardization (NATOPS) early in his career. Each student will be issued a T-6B NATOPS Flight Manual before starting ground school. The NATOPS program is the responsibility of all who use it. NATOPS only works if everyone is involved. Even students have the responsibility to originate changes when errors or ambiguities are found in the NATOPS manual. See the squadron NATOPS officer regarding the correct procedure to submit a NATOPS change recommendation.

3. T-6B NATOPS FLIGHT MANUAL AND POCKET CHECKLIST. The T-6B NATOPS Flight Manual is the definitive instruction on the operation of the aircraft. The Pocket Checklist (PCL) is a convenient pocket sized listing of those items in the NATOPS Flight Manual that would be of particular concern while airborne or at a remote location. No student or flight instructor has the authority to deviate from NATOPS without specific written authority (except in specific situations). The NATOPS also lists the crew requirements for flying the aircraft. Both the NATOPS and the PCL list emergency procedures. Some of these procedures are listed in Boldface or with asterisks next to them. These items are memory items, and the student shall be able to recall and apply these procedures correctly. In addition to the emergency procedures, a pilot should be able to recall the Before Landing Checklist from memory. Other than these, checklists should be performed with the aid of the PCL or appropriate guide. Familiarity with the PCL should be acquired to ensure efficient use while airborne.

4. FLIGHT INFORMATION PUBLICATIONS (FLIP). Safely executing flight in Instrument Meteorological Conditions (IMC) requires superb knowledge, understanding, and utilization of numerous Department of Defense (DOD), US Navy, and civilian publications.

- | | | |
|----|------------------------------------------------|----------------------------|
| a. | Instrument Approach Plates | IAP (GPS, VOR, ILS, etc.) |
| b. | Standard Instrument Departure Procedure Plates | DP (contained in IAP book) |
| c. | Standard Terminal Arrival Plates | STAR (separate document) |
| d. | IFR Supplement | DOD Airport Directory |
| e. | Flight Information Handbook | FIH |
| f. | OPNAV 3710.7 | Navy Rulebook |

- | | | |
|----|------------------------------------|-------------------------|
| g. | US Navy Instrument NATOPS | Navy IFR Handbook |
| h. | FAR/AIM | FAA Rulebook & Handbook |
| i. | IFR Low Altitude Enroute Charts | Victor Airways |
| j. | IFR High Altitude Enroute Charts | Jet Airways (FL180) |
| k. | FAA Instrument Flying Handbook | FAA-H-8083-15 |
| l. | FAA Instrument Procedures Handbook | FAA-H-8261-1A |
| m. | FAA Aviation Weather Services | AC 00-45E |
| n. | FAA Aviation Weather | ASA-AC00-6A |

5. **CFR PART 91 – FAR / AIM (FEDERAL AVIATION REGULATIONS / AIRMAN'S INFORMATION MANUAL).** Part 91 contains some applicable flight rules not specifically addressed in OPNAV 3710.7. Naval Aviators must be thoroughly familiar and **MUST COMPLY** with this document.

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CHAPTER TWO FUNDAMENTAL INAV CONCEPTS

200. INTRODUCTION

Prior to the first instrument flight in the T-6B, there are several fundamental topics the student should review and understand. The procedures and concepts in this chapter provide students with essential tools required for Instrument Navigation.

201. T-6B COCKPIT INSTRUMENTATION

Instrument interpretation is one of the most important basic skill sets required for instrument flight. It begins with understanding how each instrument works, then applying this knowledge to: the performance of the aircraft, the particular maneuvers to be executed, the scan and control methods, and the operating conditions. For each maneuver, the student will learn what performance to expect and the combination of items that must be interpreted in order to control aircraft attitude during the maneuver.

The following flight instruments (located on the primary flight display [PFD]) will be used as “crosscheck” or performance instruments:

1. Attitude Indicator
2. Altimeter
3. Vertical Speed Indicator (VSI)
4. Airspeed Indicator
5. Heading Indicator
6. Rate of turn, and Sideslip Indicator

202. REAR COCKPIT DIFFERENCES

Students will fly most Instrument Stage sorties from the rear cockpit, and will therefore be required to familiarize themselves with the differences outlined in the T-6B NATOPS Flight Manual. The most important one worth noting is the ISS Mode Selector, located in the rear cockpit, left console, just behind the CFS handle. Prior to flying the student’s first Instrument flight, the instructor should give the student a rear cockpit differences familiarization to include the hazards of accidental CFS actuation while manipulating the ISS Mode Selector.

203. INSTRUMENT SCAN

Good instrument flight is attained by smooth “attitude control.” Attitude control is attained by setting a desired power and attitude combination, trimming for this new attitude, and confirming this attitude by crosschecking the instruments.

204. SCAN PATTERNS

In order to determine the aircraft’s attitude quickly and effectively, the student must know what instruments to scan for each particular maneuver. The following section lists the correct instruments or scan “pattern” for every situation.

The ball is centered using peripheral vision during any transition on the attitude indicator. Thus, consider the ball as part of the attitude scan during the initial transition. From then on, it is scanned with the turn needle.

Straight and Level Flight

To maintain straight and level flight, the student should be most concerned with those instruments that will aid in maintaining constant heading and constant altitude. The primary attitude instrument for both nose and wing position is the attitude indicator, which gives the most direct indication of attitude in relation to the horizon. Since straight and level flight maintains a constant heading, utilize the HSI as a wing position crosscheck instrument; in other words, any deviation from a constant heading on the HSI will indicate the wings are not in the level attitude, provided the aircraft is in balanced flight.

The nose position crosscheck in straight and level flight consists of using the altimeter in conjunction with the VSI. Any change in constant altitude flight will be indicated initially by a movement on the altimeter and VSI. The performance instrument will be the airspeed indicator, showing the result of attitude plus power applied. Additional scan instruments are the balance ball for balanced flight and the turn needle.

Level Turn

The level turn scan is similar to the straight and level scan in that the nose attitude is maintained on the attitude indicator and crosschecked with the altimeter and VSI. Wing attitude is maintained on the roll attitude indicator and angle of bank (AOB) indexer.

If a constant-rate turn is desired, the turn needle is utilized as the wing position crosscheck. Performance scan in a constant-rate turn also includes the HSI and clock to check the rate of turn. The ball is a peripheral attitude instrument when rolling into the turn on the attitude indicator, and then scanned with the turn needle throughout the maneuver.

Straight Climbs and Descents

During climbs and descents on a constant heading, the primary indicator for nose and wing position is the attitude indicator. The wing position is crosschecked on the HSI and the nose

attitude is crosschecked on the airspeed indicator. During constant-rate climbs and descents, also check performance with the altimeter and clock. The VSI may be used to crosscheck the rate of climb or descent. The additional scan includes the turn needle and balance ball.

Climbing or Descending Turns

The primary attitude instrument for nose and wing position is the attitude indicator. Nose attitude is crosschecked on the airspeed indicator and wing attitude is crosschecked on the roll attitude indicator and AOB indexer. If climbing or descending at a constant rate while in a constant-rate turn, performance must be checked by comparing the altimeter and HSI against the clock. In the four basic scan patterns discussed, there is a scan for every performance in normal flight conditions.

Scan Summary

Scan is the selective and systematic visual interpretation of attitude and maneuver performance crosscheck instruments, designed to provide the instrument pilot with an essentially real-time awareness of the aircraft attitude. Effective scan is accomplished in a planned rhythmic sequence for each of the major flight maneuvers.

All normal aircraft instrument flight maneuvers may be reduced to the following four general categories:

1. Straight and level.
2. Straight climb or descent.
3. Level turn, constant AOB or rated turn.
4. Climbing or descending turns.

Efficient Scan Patterns. The following guidelines will form the basis for the development of effective and efficient scan patterns.

1. When scanning nose or wing position crosscheck instruments, as well as performance or additional scan instruments, always recheck the attitude indicator for proper attitude indication before moving onto the next crosscheck instrument. This will keep your scan centered around the attitude indicator, which is the primary reference for both nose and wing position.
2. Always scan the nose crosscheck instrument first (after establishing and trimming), to hold the desired attitude on the attitude indicator, since nose attitude is most critical. The other crosschecks will confirm wing position and balanced flight.
3. Performance instruments must be included in a timely fashion to maintain stability of performance.

NOTE

A good scan will include approximately 50% of the time on the attitude indicator. Remember that all transitions are conducted while establishing attitude on the attitude indicator.

205. PAT PRINCIPLE

In most transitions from level flight, students will have to reset power, attitude and re-trim for the new attitude. The mechanics of transitions will be performed in a specific sequence:

Power

Attitude

Trim

Although power and attitude changes are almost simultaneous, lead with PCL movement, then set the new attitude while continuing to move the PCL to the desired power setting. After the power and attitude are set, trim.

206. SPATIAL DISORIENTATION

Spatial disorientation can be defined simply as a body sensation which tells the aviator that his aircraft is in a particular attitude, when the aircraft is actually in an entirely different position relative to the horizon. This false sensation is derived from a number of sources: the inner ear and vestibular stimulation are the most common.

Spatial disorientation usually does not occur when a pilot has visual reference to the horizon, or at least, the pilot pays little attention to his body feelings, since his sight simply overcomes them. Disorientation occurs when there is no reference to the horizon; however, this does not necessarily limit vertigo to flying in the clouds. It can occur when the aircraft flying under visual flight rules (VFR), on a day when there are large buildups, when flying above a layer of clouds, when flying in and out of a broken layer, or when launching at night with no clear horizon. Vertigo or the disorientation sensation is, and always will be, a factor in aviation, but is dangerous only when the pilot believes and flies his senses instead of the reliable instruments.

The spatial disorientation training in the T-6B will demonstrate and emphasize three specific facts:

1. A pilot's attitude sensations are generally unreliable.
2. The pilot cannot recover to straight and level flight using these sensations.
3. Instruments are the only way to recognize and recover from unusual attitudes.

207. VERTIGO DEMONSTRATION

The instructor will fly the aircraft through a series of smooth, easy maneuvers while the student closes his eyes. The student gives a running commentary of his sensations over the ICS. When disorientation is evident, the student will be informed to open his eyes and check his attitude. This will vividly emphasize the unreliability of body senses.

It should be noted that “eyes closed” simulates inattention to the instruments, which may occur any time a pilot is tuning radios, checking charts, or attempting to maintain VFR scan in marginal conditions. The maneuvers performed are smooth and constant, producing the typically smooth, insidious vertigo. They are not the accustomed violent maneuvers usually associated with unusual attitudes, which produce an immediate indication of abnormal flight. Instead, the simulated inattention induces real disorientation. The vertigo demonstration will not be graded. All aviators are susceptible to vertigo, and this demonstration is intended to emphasize that. Fatigue, turbulence, dim lighting, and IFR conditions all contribute to the onset of vertigo.

208. THE SIX Ts

The 6 Ts are a memory jogger for the pilot to use at various points during flight to remind him to execute certain procedures. These points include the Initial Approach Fix (IAF), station passage, Final Approach Fix (FAF), Holding Fix, and Missed Approach. The 6 Ts are:

1. **TIME** – note time/start clock as required.
2. **TURN** – to course as required.
3. **TIME** – note time/start clock as required.
4. **TRANSITION** – to appropriate speed and configuration/descend as required.
5. **TWIST** – CDI to desired course/intercept as required.
6. **TALK** – report to ATC position/time/intentions/configuration as required.

209. T-6B CONFIGURATIONS / SPEEDS

CRUISE CLIMB	180 KIAS/Clean MAX Power (100%) / 8° Nose High
TERMINAL DESCENT	200 KIAS/Clean Power as required
FAST CRUISE	240 KIAS/Clean Power as required (80%) / 1° Nose Low
NORMAL CRUISE	200 KIAS/Clean Power as required (54%) / 0° Nose High
HOLDING AIRSPEED	150 KIAS/Clean Power as required (33%) / 3.5° Nose Up
BASIC APPROACH CONFIGURATION (BAC)	120 KIAS/Gear down and Flaps to takeoff Power as required (35%)

Figure 2-1 Configurations/Speeds**NOTE**

Power settings are approximate and will vary with aircraft weight, altitude, etc. Make corrections as needed. Throughout this manual, when mandated by procedure to establish a specific power setting, a power setting within +3% is acceptable. The only exception is for procedures that mandate a 4-6 % power setting to simulate the feathered condition.

210. THE ONE-THIRD RULE

Since the airplane will continue turning as long as there is any bank, the rollout must be started before reaching the desired heading. The amount required to lead the heading will depend on the rate of turn and the rate at which the rollout will be made; however, a good rule of thumb is to start the rollout one-third the number of degrees of angle of bank in use. Example: If a 30° angle of bank turn was being used, the rollout would be started 10° prior to the desired heading. As the wings become level, the control pressures should be gradually and smoothly released so that the controls are neutralized as the airplane assumes straight-and-level flight. As the rollout is being completed, attention should be given to outside visual references as well as the PFD to determine that the wings are being leveled precisely and the turn stopped.

211. USE OF THE SPEED BRAKE

The speed brake is available for use during all instrument flights. Many times in flight a pilot will find himself high on energy with little time or distance left to correct the problem.

Examples include:

1. A late let down from ATC.
2. ATC requests to “keep the speed until the FAF”.
3. Lapse in situational awareness leading to the aircraft being fast on final with little or no time to configure the aircraft.

212. STANDARD CALLOUTS

Standard callouts may be pre-briefed or executed in accordance with local Standard Operating Procedures (SOP). Examples might include the flying pilot or non-flying pilot calling out over the ICS: 1000’ prior to level-off, 200’ prior to level-off, reaching decision altitude (DA) or minimum descent altitude (MDA), “CDI or glideslope alive”, and Basic Airwork deviations outside the Course Training Standard (CTS).

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CHAPTER THREE FLIGHT PLANNING PROCEDURES

300. INTRODUCTION

It is important to not focus solely on the FTI, but incorporate information from all available sources, both military and civilian. For example: OPNAV 3710.7, FAR/AIM, FIH, GP, Area Planning (AP), etc. Review NATOPS for servicing, local SOPs, Wing Stan Notes, and cross-country (CCX) instructions. All of these resources contain information, which you will need to be familiar with in order to have a successful event.

Many students will be afforded the opportunity to go cross-country during Instrument Navigation training. This can be one of the more enlightening and enjoyable aspects of training. During cross-country planning and execution, you will acquire a more thorough and accurate picture of Instrument Navigation Procedures in the “real world.”

301. WEATHER MINIMUMS

See OPNAV 3710.7 series.

302. FUEL PACKETS (GAS CARD)

Prior to departing on a cross-country or “out-and-in,” pick up a fuel packet. In the fuel packet there is a “jet fuel identi-plate,” used to pay for fuel at military bases. There is also a civilian credit card to purchase fuel from contract fuel suppliers at civilian fields. Additionally, there are various government forms that can be utilized for maintenance services and other bona fide official business expenses. At the completion of your CCX, be sure to turn in your fuel packet with receipts.

303. FLIP PUBLICATIONS

Make sure to bring the necessary FLIP publications to cover the entire route of flight and any possible contingencies. Possible considerations include, but are not limited to, low and high altitude enroute charts, high and low altitude approach plates, the IFR Supplement, SID/STARs and area charts. Check all pubs to ensure they will be current for the entire time span of the CCX. It is possible to take off on a three day CCX and have some of the pubs expire at the end of the first or second day. Bring at least one T-6B NATOPS Flight Manual and a Pocket Checklist for each pilot.

304. ROUTE OF FLIGHT

This will probably be the first time you fly a significant distance from homefield. No longer will you be operating in an area where you are familiar with area landmarks, suitable fields, radio and navigational aid (NAVAID) frequencies, etc. Mark your route of flight on your navigational charts. Note suitable emergency or divert fields near your route.

Be aware of which VORs along your route have voice capability in the event you lose both your UHF and VHF radios. ATC may attempt to contact you via a voice capable VOR. Additionally, certain VORs conduct scheduled weather broadcasts; utilize these to update and verify your formal weather briefing.

305. JET LOGS

Prepare a complete and accurate jet log for all portions of the flight (a copy should be made for the instructor as well). During flight, compare estimated values for times, groundspeed, fuel flow, etc. with the actual values observed. Modify your jet log as necessary.

306. PPR

To land, refuel or remain overnight at certain fields, prior arrangements must be made. This will be indicated in the IFR Supplement (or AP1) in the aerodrome remarks section. If permission is required, you will see a reference to PPR, which indicates “prior permission required.” Assist your instructor as directed in securing this permission. Base Operations at your destination field is normally your point of contact for obtaining permission. Very few civilian fields require PPR’s, however a phone call prior to launching is recommended.

307. NON-MILITARY AIRFIELD OPERATIONS

On CCX, you may be operating from non-military fields. Be aware that certain procedures and services may vary from local operations (i.e., availability of fire guards, follow-me trucks, Base Operations, and the weather office).

Keep in mind that your flight plan may not be closed automatically as it would be at a military field. The aircraft commander is still required to confirm the closeout via Tower, Ground, Base Operations, or a Flight Service Station (FSS). At non-military fields, you may have to file your flight plan with a Flight Service Station (FSS). For filing, utilize the civilian version of a DD-175. For weather services, OPNAV 3710.7 states, “Pilots are responsible for reviewing and being familiar with weather conditions for the area in which flight is contemplated. Where Naval Oceanography Command Services (NOCS) are locally available, weather briefings shall be conducted by a qualified meteorological forecaster. They may be conducted in person or by telephone, autograph, or weather vision. FAA weather briefings obtained from FSS or DUAT services may be used as a supplement to NOCS service briefing. If NOCS services are not locally available, an FAA approved weather briefing may be substituted.” Military weather and NOTAM briefing facilities are listed in the FIH and are just a phone call away. For more information, refer to the FIH Section C.

If the FSS is not at the field, the above procedures may be accomplished over the telephone. When filing via telephone, provide the necessary information by using the format on the back cover of the IFR Supplement entitled “Filing Flight Plans in Flight.”

Request NOTAM information from the FSS. If the information available is not sufficient, contact the nearest suitable military base.

3-2 FLIGHT PLANNING PROCEDURES

CHAPTER FOUR INAV DEPARTURE PROCEDURES

400. INSTRUMENT TAKEOFF (ITO) AND CLIMB

General. Safely transition to IMC from a normal takeoff (in visual meteorological conditions [VMC]).

Procedure. Perform a normal takeoff. After liftoff, use outside references and the attitude indicator to control attitude. Transition to instruments at the same rate as visual cues are lost. Initially raise the nose to approximately 8-10° nose high on the attitude indicator to establish a definite rate of climb. Trim and verify climb with altimeter and VSI, raise gear and flaps. Maintain initial attitude until reaching target climb speed (180 KIAS). Non-standard climb gradients on published departures may require adjustments to the climb profile.

Common Errors.

1. Failure to maintain directional control on takeoff roll through improper use of rudder.
2. Swerving or skipping on takeoff roll due to improper use of crosswind correction.
3. Applying insufficient rudder on liftoff and attempting to correct with wing low.

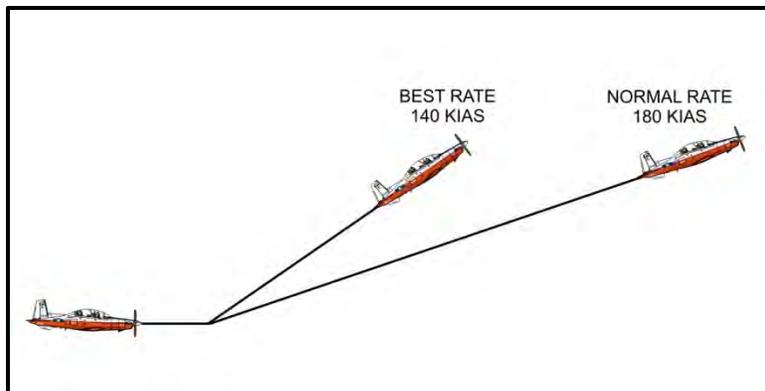


Figure 4-1 Climb Rate

NOTE

More efficient climbs may be required for obstacle clearance or specific requirements. The T-6B best rate of climb speed is 140 KIAS and 15° nose high (Figure 4-1).

401. LEVEL-OFF

General. Smoothly level-off at desired altitude with power set to attain or maintain desired airspeed.

Description. Change of pitch to reduce vertical speed at a specific altitude combined with power adjustment to meet desired airspeed.

Procedure. To level-off at airspeed below climb speed, lower the nose to level flight and reduce power below the setting required to maintain the lower airspeed. To level-off at a higher airspeed, leave the PCL at MAX or set power above the setting required to maintain the greater airspeed. Adjust power approaching target airspeed and trim. Use similar procedures for a level-off from a descent. One method is to use 10 percent of vertical speed (from VSI) as a lead point to begin level-off. For example, begin level-off 200' below desired altitude when VSI indicates 2000 feet per minute (FPM). At the lead point, cut the pitch in half, and then continue pitch change to smoothly level-off. If intermediate level-offs are required, it is permissible to maintain climb airspeed or accelerate to the appropriate cruise speed for that altitude.

IFR Departure methods: An instrument departure is a procedure used to ensure a safe climb out from an airport and to provide safe separation between aircraft. There are four common types of departures listed below.

NOTE

The Trouble T: An Obstacle Departure Procedure (ODP) that has been developed solely for obstacle avoidance will be indicated with the symbol “T” on IAP charts (approach plates) and Departure Procedure (DP) charts [ODP or Standard Instrument Departure (SID) plates]. The user of these should refer to the front section of his approach plate for specific information pertaining to the obstacle, and climb out required. Refer to AIM 5-2-8 for more information. OPNAV 3710.7 defines takeoff minima for Naval Aircraft.

1. Instrument Departure Procedures (DPs).

DPs are preplanned instrument flight rule (IFR) procedures which provide obstruction clearance from the terminal area to the appropriate enroute structure. There are two basic types of DPs.

- a. **Obstacle Departure Procedures (ODPs)** provide obstruction clearance from the terminal area to the appropriate enroute structure. Found in DOD FLIP approach plates, ODPs will be labeled with the word “OBSTACLE” in the title.

Example: GEYSER THREE DEPARTURE (OBSTACLE)

4-2 INAV DEPARTURE PROCEDURES

- b. **Standard Instrument Departures (SIDs)** are air traffic control procedures printed in graphic form for pilot use. SIDs provide obstruction clearance and a transition from the terminal area to the appropriate enroute structure. Found in DOD FLIP approach plates.

2. Radar Departure.

Many military and civilian fields have no published DPs. A radar departure is a procedure used in the absence of a DP, or if the pilot elects not to fly the published DP. The radar departure may use radar vector instructions or allow aircraft to proceed direct to a point along the flight plan route. The pilot can only expect a radar departure if it is requested in the remarks section of the flight plan; otherwise, a DP may be assigned by ATC if available.

3. Diverse.

The most basic of the four, you are cleared as filed on your flight plan.

- a. Initial turn is made at 400' AGL and a 200 feet per nautical mile (FPMN) climb rate is required.
 - i. For example, you file from Grand Junction CO to Salt Lake City Intl via Direct GJT V134 to FFU, then V21 to SLC direct KSLC.
 - ii. To convert FPMN to VSI:
 - (a) A climb out speed of 180 KIAS = 3 nautical miles (NM) per minute.
 - (b) $3 \text{ NM/min} * 200' / \text{NM} = 600' / \text{min}$ or 600 VSI at 180 KIAS.
- b. Upon contact with clearance, you are cleared "as filed, to 15,000 feet."
- c. In this case, takeoff, fly direct to GJT, then V134 to FFU, etc...

4. Visual Climb Over the Airport (VCOA).

In a VCOA, the pilot is responsible for climbing VFR above the airport to a predetermined altitude, then proceed outbound on an IFR flight plan. These clearances are usually left to the smaller airports, which do not possess a DP or approach control radar to provide vectors upon departure.

Example: "Navy 10, climb in visual conditions so as to cross the Beatty airport Southbound at or above 6000', then climb via the Beatty Three Three Zero to the Beatty VOR, then as filed, climb and maintain 15,000 feet."

402. FLYING THE DEPARTURE

General. Safely transition to enroute flight.

Procedure. It is important to stress proper preflight planning. The time to research a departure is not in the air (or even in the plane on the ground); this research should be performed prior to leaving Base Operations, or the Fixed Based Operator (FBO).

1. Review the entire departure procedure to include surrounding terrain, hazards and climb gradient requirements during preflight planning.
2. Set NAVAIDs and displays, as required, to fly the departure. If the FMS is being used to fly the SID, it must be retrieved from the FMS database.
3. Develop a plan for emergency return. Have an instrument approach plate open with the primary recovery approach displayed, just in case an immediate return to the departure field is required.

Common Errors.

1. Failure to understand or incomplete understanding of the departure.
2. NAVAIDs not set as required for the departure.

CHAPTER FIVE BASIC INSTRUMENT MANEUVERS

500. INTRODUCTION

Prior to performing precise instrument flying, one must master some basic instrument skills. What follows is a short discussion on some key instrument flying skills.

501. AIRSPEED CHANGES

General. Smooth, controlled, deliberate change of airspeed is an integral part of all instrument flying.

Description. Change of power setting to affect change in airspeed. At the completion of an airspeed change, power is set to maintain the new airspeed. Aircraft should be trimmed during airspeed changes and fine tuned at the target airspeed, normally practiced between 150-200 KIAS. The **Power-Attitude-Trim (P.A.T.)** principle applies.

Procedure. To increase airspeed in straight-and-level flight, advance the **Power** commensurate with the airspeed change required beyond the setting required to maintain the new airspeed. As airspeed increases, lift increases, so there is a climb tendency. Adjust pitch **Attitude** to maintain altitude and **Trim** out control pressures. Approaching target airspeed, reduce power to a setting estimated to maintain the new airspeed. Reduce airspeed in the same manner, but use an opposite power schedule. Adjustments to trim will be required almost continually during airspeed changes. Do not neglect the need for rudder trim. An increase in torque generally requires right rudder trim. Likewise, a reduction in torque requires left rudder trim. Speed brake may be used for rapid airspeed reductions. Late speed brake retraction near target airspeed may result in an overshoot of the targeted airspeed. Trim requirements and the possibility for spatial disorientation increase with use of the speed brake.

Common Errors.

1. Loss of heading control due to insufficient rudder, and/or rudder trim.
2. Loss of altitude control due to slow crosscheck.

502. CONSTANT AIRSPEED CLIMBS AND DESCENTS

General. Maintain constant airspeed during climb or descent.

Description. Climb or descend at a specific airspeed, normally practiced at 140-200 KIAS. The **Power-Attitude-Trim (P.A.T.)** principle applies.

Procedure. To climb, increase **Power**, raise pitch **Attitude** to maintain desired airspeed, and **Trim**. To descend, reduce **Power**, lower pitch **Attitude** to maintain desired airspeed, and re-**Trim**. The amount of pitch change varies with airspeed and power setting. Although airspeed is

constant, trim is required due to the power change. To maintain 200 KIAS, the “Rule of 100” provides approximate pitch and power combinations for descents in the T-6: (degrees nose low) multiplied by (percent torque) = 100. For example, use 10° pitch or 10% torque, 5° pitch and 20% torque.

Common Errors.

1. Loss of heading control due to insufficient rudder, and/or rudder trim.
2. Improper pitch and power setting used for desired airspeed.

503. RATE TURNS

General. Standard rate turns (SRT) and half standard rate turns ($\frac{1}{2}$ SRT).

Description. During normal IFR flight along airways, all turns will generally be performed at a specified rate, either standard or half standard rate. The SRT is 3° per second. At 3° per second, a turn of 180° will take one minute and a 360° turn will take two minutes. Figure 5-1 shows the AOB necessary to produce a 3° per second turn at various airspeeds. From the chart, notice that an aircraft operating at high airspeeds requires a steep AOB to produce a 3° per second turn. Steep turns are more difficult to fly than shallow turns, since they result in heavy load factors. For example, a 60° bank turn applies a force of two “Gs” to the aircraft and pilot. To avoid these “G” forces and provide better control, FAA publications recommend using either a **SRT or 30° AOB turn, whichever occurs first.**

Rate turns are practiced initially in level flight, crosschecking the nose with VSI and altimeter, and the wings on the turn needle. A one needle width deflection produces a $\frac{1}{2}$ SRT and a two needle deflection produces a full SRT. Performance for SRTs will be 30° heading change every 10 seconds. A $\frac{1}{2}$ SRT will require 20 seconds for every 30° of heading change. Since the AOB required to produce a constant rate turn will vary with airspeed, the student will need to utilize a method for determining proper bank for a specific needle deflection. A rule of thumb is to establish an AOB equal to 10% of the indicated airspeed for a $\frac{1}{2}$ SRT. For example, at 180 KIAS, 18° AOB should initially be established. This value would be doubled for a full SRT (36° AOB). However, as specified above, use a maximum of 30° AOB while flying instruments.

The above rule is known as the “10 percent rule” and is valid only during balanced flight. If calibrated correctly, the turn needle always shows the exact rate of turn (even in an unbalanced condition, but the AOB will vary according to the balance ball’s position).

TEMP °C ALTITUDE	IAS (KTS)	TAS (KTS)	AOB ½ SRT	AOB SRT
13	120	122	10	19
	150	152	11	22
	180	183	13	25
	1000	200	14	27
5	120	129	10	20
	150	162	12	23
	180	194	13	26
	5000	200	14	29
-5	120	140	11	21
	150	174	12	24
	180	209	14	28
	10000	200	15	30
-15	120	151	11	22
	150	189	13	26
	180	227	15	30
	15000	200	16	32
-25	120	164	12	23
	150	205	14	28
	180	246	16	32
	20000	200	17	34
-35	120	179	12	25
	150	224	15	29
	180	269	17	34
	25000	200	18	37
-45	120	196	13	27
	150	245	16	32
	180	294	18	36
	35000	200	20	40

Figure 5-1 Standard Rate Turn Chart

Procedure.1. **Half SRT**

- a. For practice, ½ SRTs will be started at 150 KIAS on a cardinal heading, with the clock reading XX:00 or XX:30, using a three second lead to compensate for attitude change. Roll into a turn on the attitude indicator using the 10 percent rule to establish the desired bank. Once the attitude is set on the attitude indicator, commence the crosscheck scan of turn needle for an exact one needle width deflection and altimeter and VSI for nose attitude.

- b. When the HSI is 30° past the cardinal heading, check for 20 seconds elapsed time on the clock. The next checkpoint is 60° of turn and the clock for 40 seconds of elapsed time. There are two valid reasons for checking the heading change against the clock, rather than checking the time prior to referring to the heading. The instruments are arranged on the panel in groups. The attitude indicator, HSI, altimeter, and airspeed indicator are grouped together. Thus, while scanning the instruments, you do not have to shift your point of vision very far to check the HSI. Since the clock tells you nothing about the aircraft attitude, the time spent scanning it is actually wasted. If the clock is checked only once every 20 seconds, rather than four or five times, you will be able to devote more time to the attitude instrument scan.
- c. When checking the HSI and clock, if the turn is less than ½ SRT, increase the AOB and check the turn needle for a greater deflection in order to catch up with the clock. When the turn has caught up with the clock, the AOB must be readjusted to maintain ½ SRT. To roll out of the desired heading, use the one-third rule for constant AOB turns.
- d. **Never use more than 20° of bank to catch up or less than 10° of bank to slow the rate.** If larger corrections are made, the rate of correction will be too rapid and cause the heading to be bypassed. Have patience, catch up slowly and deliberately.

2. Standard Rate Turns (SRT)

- a. Timed SRTs are accomplished in the same manner as ½ SRTs. Roll into the turn on the attitude indicator, doubling the 10 percent rule and crosscheck the turn needle for two needle width deflection, but do not exceed 30° AOB. Since the aircraft is turning twice as fast (3° per second), it will be necessary to check the clock every 30° for ten seconds of elapsed time. The scan pattern corrections for desired rate of turn and the procedure for leading the rollout on the desired heading are the same as the ½ SRT. Remember to crosscheck the nose attitude with altimeter and VSI, making power and attitude adjustments as necessary due to the resultant decrease in vertical lift.
- b. **Never use more than 30° of bank to catch up or less than 15° of bank to slow the rate.**

Common Errors.

1. Not using a three second lead.
2. Not relying on the wing attitude instrument (turn needle), but rather, trying to fly off of the performance instruments. The turn needle is one of the most accurate instruments in the aircraft, believe it. Remember, the performance checks are only read every 30°.
3. Unbalanced flight.
4. Overcorrecting AOB.

5-4 BASIC INSTRUMENT PROCEDURES

5. Improper nose attitude, losing altitude.

504. CONSTANT ANGLE OF BANK TURNS (CABT)

General. Make a controlled turn by use of instruments to a predetermined heading in balanced level flight.

Description. The ability to make a turn to a predetermined heading while maintaining one's altitude is an absolute must in the instrument environment. Unless directed otherwise by the instructor, make all turns in the instrument environment SRT or 30° AOB, whichever occurs first.

Procedures.

1. Establish an AOB on the attitude indicator and maintain that AOB throughout the turn. Crosscheck the nose position with the altimeter and VSI. Corrections to maintain altitude are made in the same manner as in straight and level flight.
2. To prevent turning beyond the desired heading, it is necessary to anticipate or lead the new heading. A rule of thumb is to lead this new heading by the number of degrees equal to one-third the AOB used in making the turn. For example, if the AOB is 30°, the rollout should be started 10° before reaching the desired heading.
3. In the example above, 10° prior to the specified rollout heading, shift scan completely to the attitude indicator and roll on it. This rule will be used during all turns to specified headings.

Common Errors.

1. Over-rotating the nose as the AOB is established, resulting in a climb. Most pilots have a tendency to pull back stick while rolling into a turn.
2. Looking away from the attitude indicator before the AOB is set, resulting in overbanking as the wings continue to roll.
3. Failure to roll out on the desired heading due to slow or improper scan.
4. Not rolling out on the attitude indicator. The most common error is to watch the heading readout during rollout. Thus, the wings do not level and the nose is raised or lowered.

505. STEEP TURNS

General. Maintain smooth, coordinated flight in turns to specific headings at steeper than normal bank angles.

Description.

Airspeed - 150 KIAS normally, other airspeeds permissible.

Attitude - 45° and 60° AOB.

Procedure. Enter a steep turn in the same manner as a normal turn. Anticipate the addition of power to maintain a constant airspeed. Pitch required in the turn is higher than wings level flight. Anticipate pitch change as VSI lags behind actual aircraft performance. Use a constant angle of bank during steep turns, and attempt to correct altitude deviations by adjusting the pitch attitude. If altitude gain or loss is excessive, a decrease or increase in bank may help correct the pitch attitude.

Use the known pitch and power settings in Figure 5-4. Add power passing 30° AOB. To roll out on the desired heading, lead the roll out by approximately 15° for a 45° AOB turn and 20° for a 60° AOB turn. Lead points should be adjusted as necessary if consistently rolling out short or past the desired heading.

Common Errors.

1. Loss of altitude control.
2. Unable to maintain desired angle of bank.
3. Slow to set or inability to set desired power setting.

506. VERTICAL S-1 PATTERN

General. Practice instrument crosscheck.

Description. This pattern is flown at 150 KIAS and on any numbered heading. It consists of a 1000 FPM descent for 1000', followed by a 1000 FPM climb for 1000'. This series of descents and climbs is performed twice.

Procedure.

1. Begin the pattern with the descent using a three-second lead prior to an even minute on the clock. Reduce the **Power** (applying simultaneous, proportional left rudder pedal control pressure) to approximately 15%, while simultaneously lowering the nose **Attitude** to the descending attitude, approximately 2° nose down, and re-**Trim**. After each 250' of altitude change, crosscheck the clock for 15 seconds of elapsed time.
2. The transition from the descent to the climb is started three seconds prior to the end of the descending minute or 50' prior to the end of the 1000' descent, whichever occurs first. Add power toward approximately 55% torque, while smoothly raising the nose toward the climbing attitude of approximately 4° nose up; re-trim for the 150 KIAS climbing attitude. As power is

added, backpressure must be simultaneously increased in order to prevent acceleration and delay in climb rate.

3. The transition from the climb to the descent is started three seconds prior to the end of the climbing minute or 50' prior to reaching the original altitude, whichever occurs first. The second transition to a climb is accomplished exactly as the first.

In both climb and descent, the final checkpoint (250' remaining prior to transition) is relatively inadequate for actual rate correction, as there is insufficient altitude remaining for a correction to be effective. The value of these points is for determining whether to transition on time or on altitude. For example, if in the climb, the altimeter reads 250' to go (750' in the climb) and ten seconds prior, transition on the clock.

4. Complete the pattern by simultaneously reducing torque in order to maintain 150 KIAS, 50' prior to reaching level-off altitude. Regardless of timing, lower the nose to maintain level flight attitude.

Common Errors.

1. Loss of heading control due to lack of rudder trim.
2. Slow to set or inability to set desired power setting.
3. Not crosschecking airspeed and VSI when making corrections.

507. UNUSUAL ATTITUDES

General. Recover to normal attitude with reference to instruments only.

Description. An unusual attitude is any unexpected or inadvertent attitude encountered during normal instrument flight. In IMC conditions, bank should normally be limited to 30° AOB and pitch limited to 10° nose low and 15° nose high. Possible causes of unusual attitudes include slow crosscheck, spatial disorientation, channelization on a subtask, and transition from VFR to IFR. The recovery is complete when desired attitude for normal instrument flight is attained.

Use the attitude indicator as the main recovery instrument after proper operation is verified, and it is confirmed that an unusual attitude exists. Compare the PFD indication with the backup flight instrument (BFI), and performance instruments to confirm an unusual attitude.

If operating properly, the attitude indicator is used to recover. The horizon bar is always visible, but in extreme nose high or nose low attitudes, it may be very near the bottom or top of the attitude indicator. In these cases, recovery chevrons point to the horizon and may be used to determine attitude.

Bank interpretation and control response are most important in recovering from unusual attitudes. In high performance aircraft, an inverted (beyond 90° of bank), diving attitude is the

most critical situation. Correction to an upright attitude (less than 90° bank) is the priority, and must be initiated before pitch correction.

Procedure. Perform recoveries as described below. In both a nose high and a nose low recovery, steps one and two are the same.

1. Recognize - Identify potential unusual attitude with attitude indicator and aircraft performance.
2. Confirm - Verify actual attitude with the BFI and performance instruments.

Nose High (Steps three through five should be performed almost simultaneously)

3. Relax back stick pressure, allowing the nose of the aircraft to fall to the horizon (maintain positive Gs).
4. Roll the aircraft towards, but not past 90° of bank.
5. If the aircraft is climbing, use power as required to maintain desired airspeed.
6. As the fuselage dot of the miniature aircraft approaches the horizon bar, adjust bank to establish a wings-level attitude. If airspeed is low (below 100 KIAS), the nose may continue below the horizon. Use only as much bank as needed to recover. It is not necessary to use 90° in all recoveries.

Nose Low

3. Roll toward wings level.
4. Start pull up when the wings are level. Reduce power and extend the speed brake if required.

Common Errors.

Nose High

1. Not rolling towards 90° of bank as needed in a nose high situation.
2. Pushing over in order to reach the horizon in a nose high situation.
3. Not adding power as needed.

Nose Low

Not setting the wings level prior to pulling the nose toward the horizon (rolling pull-out).

508. BACKUP FLIGHT INSTRUMENT (BFI) FLIGHT

General. Maneuver the aircraft by means of the backup flight instrument.

Description. Backup flight instrument flight begins upon failure of the primary attitude instrument, the PFD. The flight must now be continued and the aircraft attitude controlled by referring to the remaining instruments.

Procedure. For partial panel training, after noting a red X over the upper half of the PFD or when directed:

1. Smoothly level the wings with coordinated rudder and aileron and reposition the nose to the straight and level flight attitude by use of the BFI.
2. Complete the NATOPS emergency procedures as required.

Common Errors.

Over correcting or rushing into the emergency procedures prior to trimming the aircraft to straight and level flight.

509. GCA MANEUVER

The GCA maneuver closely resembles the procedures used for an instrument Ground Controlled Approach (GCA).

Procedure.

1. The GCA maneuver is begun at 200 KIAS, clean, on a cardinal heading and base altitude to simulate the radar downwind.
2. Make a SRT in either direction for 90° of heading change while maintaining altitude. Lead the rollout using the one-third rule.
3. Slow towards 150 KIAS by reducing power to 10-25% torque. With the power reduction, slight rudder / rudder trim will be required. Nose up trim will also be required in order to maintain altitude. Stabilize at 150 KIAS, power as required.
4. Make a SRT in the same direction as the previous turn for 90° of heading change. Again, lead the rollout using the one-third rule.
5. While maintaining heading and altitude, make a level transition to the Basic Approach Configuration (BAC):
 - a. Reducing power to 10-25% torque, add slight left rudder pressure and trim to compensate for the power reduction.

- b. Check airspeed below 150 KIAS, lower the landing gear, set the flaps to take-off (TO), and perform the Before Landing Checklist. As the flaps are lowered, the aircraft will have the tendency to gain altitude. To compensate for this added lift, pitch slightly nose down in order to maintain level flight.
 - c. As the aircraft slows, trim right rudder and nose up in order to maintain heading and altitude.
 - d. As airspeed bleeds off towards 120 KIAS, add power (approximately 35% torque) in order to maintain 120 KIAS. Re-trim as required.
6. Stabilize momentarily, then reduce power to approximately 24% torque, allow the nose to fall in order to maintain 120 KIAS, and descend 2000'. Establish a 600 FPM rate of descent on the VSI by adjusting power. Remember, nose controls airspeed, power controls rate of descent. Re-trim.
7. During the descent, the instructor will give heading changes of 3 to 10°.
8. After 2000' of altitude loss, perform a Missed Approach:
- a. Advance the power to MAX, coordinated right rudder pressure will be required to maintain balanced flight.
 - b. Simultaneously raise the nose of the aircraft to 10-15° nose high.
 - c. Check for a positive rate of climb on the VSI and the altimeter, then raise the gear and flaps prior to 150 KIAS.
9. Maintain 180 KIAS and climb (8-10° nose up) for 2000' on the last assigned heading used in the descent. Re-trim.
10. 200' prior to level-off, commence a transition back to 200 KIAS cruise.

Common Errors.

1. Not raising the nose high enough on the Missed Approach.
2. Slow to raise gear and flaps, resulting in over-speed.
3. Lack of rudder trim, leading to loss of heading control.

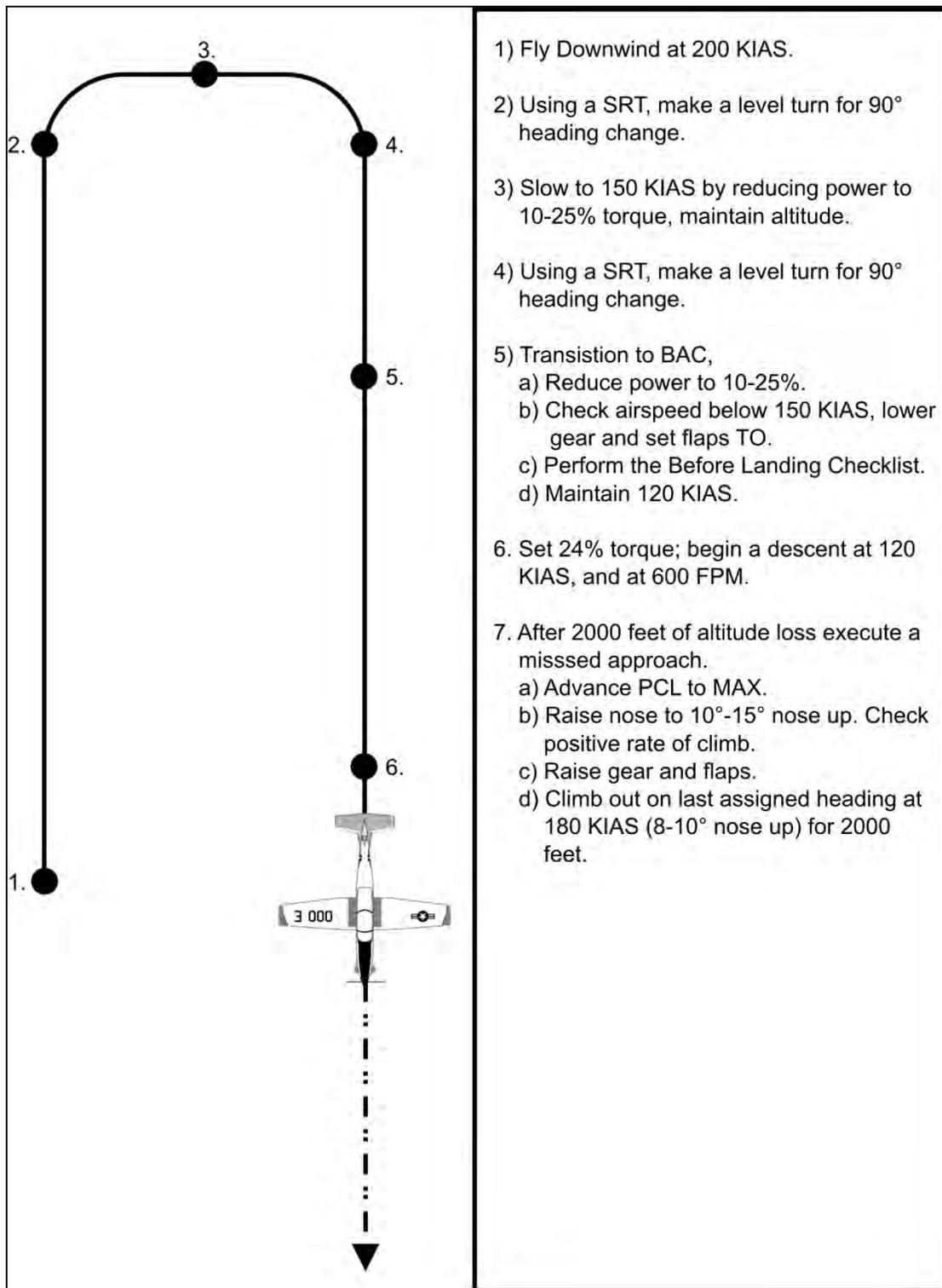


Figure 5-2 GCA Pattern

510. APPROACH PATTERN

The Approach pattern approximates the procedures required to execute an Instrument approach over a NAVAID.

Procedure.

1. The maneuver is started at 200 KIAS, straight and level flight on a cardinal heading.
2. Slow toward 150 KIAS by reducing power to 20% torque. With the power reduction, slight rudder / rudder trim will be required. Nose up trim will also be required to maintain altitude.
3. Upon reaching 150 KIAS, add power to approximately 33% torque in order to maintain 150 KIAS in level flight. Re-trim
4. Make a SRT to the right for 90° of heading change while maintaining altitude. Lead the rollout using the one-third rule.
5. After completing the turn, start the clock and begin timing for two minutes.
6. Descend for 1000' by reducing the torque to 15%. The rate of descent should be approximately 1000 FPM at 150 KIAS.
7. 100' prior to level-off altitude, slowly add power to 33% torque in order to maintain 150 KIAS at the level-off altitude.
8. At the end of two minutes timing, begin a left SRT for a heading change of 210°. Add power and trim up as required in order to maintain 150 KIAS.
9. Roll wings level after 210° of heading change, commence a descending transition to BAC:
 - a. Reducing power to 15% torque, add slight left rudder pressure and trim to compensate for the power reduction. Maintain altitude in order to expedite the deceleration of the aircraft.
 - b. Check airspeed below 150 KIAS, lower the gear, set flaps to TO, and perform the Before Landing Checklist. As the flaps are lowered, the aircraft will have the tendency to gain altitude. To compensate for this added lift, pitch slightly nose down in order to maintain level flight.
 - c. As the aircraft slows, trim right rudder and nose up in order to maintain heading and altitude. Allow airspeed to bleed off towards 120 KIAS.
 - d. At 120 KIAS, stop trimming up and allow the aircraft to descent for 1000'.

- e. 100' prior to level-off altitude, add power to 35% torque in order to maintain 120 KIAS at level-off altitude.
10. Reset and start the clock, begin a descent for 1000' by setting 15% torque. Allow the nose to fall in order to maintain 120 KIAS. Establish a 1000 FPM rate of descent on the VSI by adjusting power. Remember, nose controls airspeed, power controls rate of descent. Re-trim.
 11. 100' prior to level-off altitude, smoothly add power to 35% torque in order to maintain 120 KIAS at the level-off altitude.
 12. At the end of two minutes timing, execute a Missed Approach by:
 - a. Advance the power to MAX torque, coordinated right rudder pressure will be required to maintain balanced flight.
 - b. Simultaneously raise the nose of the aircraft to 10-15° nose high.
 - c. Check for a positive rate of climb on the VSI and the altimeter, then raise the gear and flaps prior to 150 KIAS.
 13. Maintain 180 KIAS and climb (8-10° nose up) for 2000' on the heading used in the descent. Re-trim.
 14. 200' prior to level-off, commence a transition back to 200 KIAS cruise.

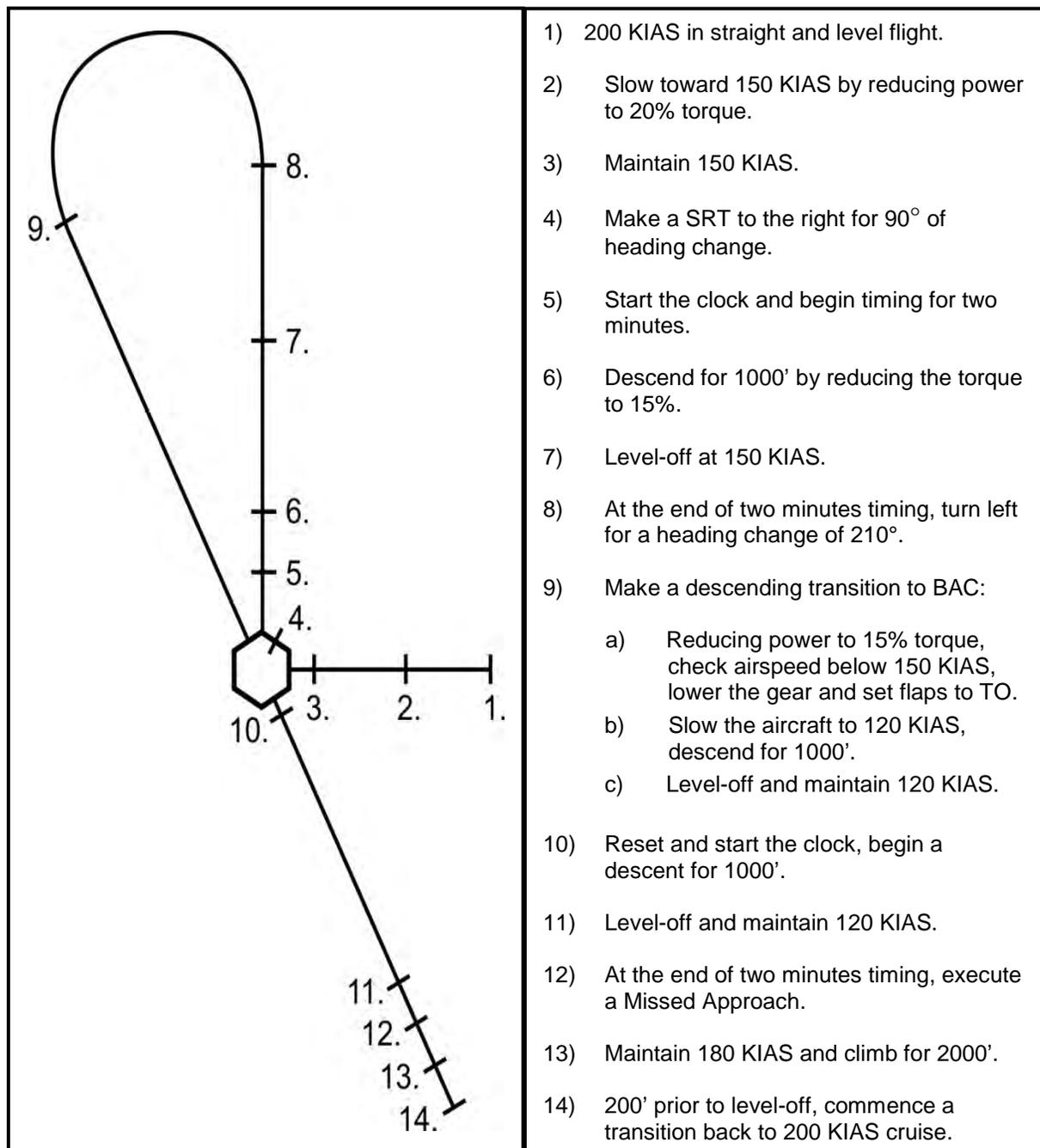


Figure 5-3 Approach Pattern

Maneuver	Airspeed (KIAS)	Gear	Flaps	Pitch (degrees)	Torque (approx)	VSI (FPM)
Vertical-S Up	150	Up	Up	4° NH	55%	1000
Vertical-S Down				2° NL	15%	
45° steep turn				3° NH	45%	
60° steep turn				4° NH	60%	
Penetration	200-250	UP	UP	As Required	As Required	2000-4000
Terminal Descent	200	UP	UP	5° NL	20%	
				10° NL	10%	
Basic Approach (level/configured)	120	DOWN	T/O	3° NH	35%	
Precision final				0°	24%	600
Nonprecision final				1° NL	15%	800-1000
Holding	150	UP	UP	2° NH	33%	

Figure 5-4 Configuration Chart

LEGEND

NL: Nose low

NH: Nose high

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CHAPTER SIX ENROUTE PROCEDURES

600. TRACKING

Description. Tracking is the process of flying direct to a station or waypoint, correcting for winds, such that the aircrafts track over the ground is the most direct route.

Procedure.

VOR

1. Tune and identify the station.
2. Turn to place the head of the VOR needle under the heading index of the HSI.

NOTE

Ensure that PFD source is set to VOR.

3. Set the course in the CDI that centers up the CDI.
4. Continue to track the course flying the heading that keeps the CDI centered up. This will in most cases require a crab into the wind.

FMS

1. Ensure that the direct to waypoint is the active waypoint in the FMS.
2. Turn to place the head of the FMS needle under the heading index of the HSI.

NOTE

Ensure that PFD source is set to FMS.

3. Center the FMS course needle.
4. Track the course, flying the heading that keeps the CDI centered up.

Common Errors.

1. Flying the bearing pointer (homing), not the CDI.
2. Failure to maintain the direct course.

601. STATION PASSAGE

Description. Station passage is defined as the moment the aircraft passes directly over or abeam the radio facility. VOR station passage is noted at the first positive change of the TO/FROM indicator to “FROM”.

602. OVER-THE-STATION INTERCEPT

Description. An over-the-station intercept is a procedure used to intercept and fly outbound on a specific radial immediately after station passage. This procedure is appropriate during airways navigation and instrument approaches that use VOR facilities for enroute navigation, initial approach fixes (IAF's), final approach fixes (FAF's) or Missed Approach procedures.

Procedure. Upon station passage, perform the following procedures (**6 Ts** as appropriate).

1. **TIME** - Depending on the situation, time will either be:
 - a. Noted, if needed for a future report.
 - b. Clock started, if needed for timing requirements.
 - c. Not required.
2. **TURN** - In the shortest direction to a heading that will parallel or intercept the outbound course. Turning to parallel is always acceptable while waiting for the bearing pointer to stabilize; however, when the new course is more than 90° different from the course used inbound to the NAVAID, turn to an intercept heading to expedite the course intercept. Consider the effects of airspeed, wind and magnitude of the turn when choosing an intercept heading. To prevent overshooting the new course, do not turn more than 45° beyond the heading required to parallel the new course.
3. **TIME** - Depending on the situation, time will either be:
 - a. Clock started, if needed for timing requirements.
 - b. Not required.
4. **TRANSITION** - Initiate speed, configuration or altitude transitions as required by the situation (once the transition is initiated, move on to the next step while completing the transition).
5. **TWIST / INTERCEPT** - Set the new course in the CDI and check for “FROM” indication. At this point, the bearing pointer should be stabilized, turn to an intercept heading (if not previously accomplished). Use the Double-the-Angle method, not to exceed 45°. To determine the Double-the-Angle intercept heading, note the number of radials between the tail of the bearing pointer and the new course (head of the course arrow). Move from the tail of the bearing

6-2 ENROUTE PROCEDURES

pointer to the head of the course arrow, continue moving to a heading that is “Double” the amount past the course arrow (not to exceed 45°). This is the intercept heading (Figure 6-1). Maintain the intercept heading until able to make a SRT onto the new course.

6. **TALK** - Make voice reports as required.

Common Errors.

Excessive delay in establishing aircraft on the desired course due to:

1. Using too much intercept resulting in overshooting the new course.
2. Taking too long to set an appropriate intercept.
3. Using an insufficient amount of intercept.



Figure 6-1 Double-the-Angle Intercept Outbound

603. RADIAL INTERCEPTS

General. A radial intercept is a procedure used to position the aircraft on a nearby radial when not at the station.

Description. Radial intercepts are performed in training to practice orientation around a NAVAID. These intercepts will be used when navigating on airways and on some instrument approaches. When flying a course using a NAVAID, the pilot is tracking on a radial inbound “TO” the NAVAID or outbound “FROM” the NAVAID. When outbound, the course is the

6-4 ENROUTE PROCEDURES

same as the radial being used. When inbound, the course is the reciprocal of the radial being used. The objective is to establish an intercept heading that will result in an appropriate angle and rate of intercept to the new course/radial.

Procedure.

1. Tune, Identify and monitor the NAVAID.
2. Set the new course in the CDI - The new course will be either:
 - a. The same as the radial for outbound intercepts.
 - b. The reciprocal of the radial for inbound intercepts (“inbound turn it around”).
3. Turn to an intercept heading – Look at the aircraft symbol in the center of the CDI and turn towards the CDI deviation bar (the direction of the new radial) to place the head of the course arrow in the top half of the HSI. This will prevent intercept angles that exceed 90°. The angle of intercept should be greater than the number of radials off the new course (not to exceed 90°). Ensure that the head of the bearing pointer is in a position to fall to the new course during inbound intercepts or the tail of the bearing pointer is in a position to rise to the new course during outbound intercepts (“HEADS WILL FALL, TAILS WILL RISE”).

OUTBOUND INTERCEPTS

1. Use a 45 degree intercept by turning to place the head of the course arrow on the appropriate 45° tick mark on the HSI compass rose (Figure 6-2).



Figure 6-2 45° Intercept Outbound

2. When close to the station, if the CDI is already moving towards the centered position, use a Double-the-Angle intercept. To determine the intercept heading, note the number for radials

between the tail of the bearing pointer and the new course (head of the course arrow). Move from the tail of the bearing pointer to the head of the course arrow, continue moving to a heading that is “Double” that amount past the course arrow (not to exceed 45°). This is the intercept heading (Figure 6-1).

INBOUND INTERCEPTS

1. Use a 45° intercept by turning to place the head of the course arrow on the appropriate 45° tick mark on the HSI compass rose (Figure 6-3).



Figure 6-3 45° Intercept Inbound

2. When close to the station, if the CDI is already moving towards the centered position, use a Double-the-Angle intercept. To determine the intercept heading, note the number for radials between the head of the bearing pointer and the new course (head of the course arrow). Move from the head of the course arrow to the bearing pointer, to a heading that is “Double” that amount from the head of the course arrow (not to exceed 45°). This is the intercept heading (Figure 6-4).



Figure 6-4 Double-the-Angle Intercept Inbound

3. Turn onto new course/radial. Maintain the intercept heading until able to make a SRT onto the new course. The rate of bearing pointer and CDI movement will increase close to the station due to radial spacing.
4. Track on the desired course/radial.

Common Errors.

Setting the wrong course into the CDI during inbound radial intercepts (not using the reciprocal of the radial for the new course).

604. RADIAL / ARC INTERCEPTS

Description. On some approaches, missed approaches and departure procedures, you will be required to fly from a radial onto an arc. In this situation, you have to decide when to start your turn off of the radial onto the arc.

Procedure. In the following example, consider an aircraft tracking outbound from a station, flying at 180 KIAS, and turning onto an arc.

Determining Lead DME

1. Determine the turn radius of the aircraft (for 90° of turn). This is 0.5% of the groundspeed.
In this example: 0.5% of 180 = 0.9 NM
2. In this case, start the turn 0.9 NM prior to the arcing DME.

It should also be noted that this is a no wind calculation. In the aircraft, you will need to take winds into account.

605. ARCING

General. To fly in an arc at a set distance from a NAVAID.

Description. Arcing is defined as flying at a constant distance from a NAVAID by reference of DME from that station. Arcing about a station may be required to comply with an ATC clearance and is an integral part of many approaches, departure procedures, and arrivals. In practice, you do not actually fly a “perfect arc,” but by varying AOB and heading, a close approximation of an arc can be achieved.

Procedure.

1. Proceed direct to the arc (radial and DME that defines the beginning of the arc).
2. Calculate the lead-point.
3. Determine the direction of turn at the lead-point.
4. At the lead-point, start a SRT in the appropriate direction. Continue the turn to place the head of the bearing pointer on the 90° benchmark.
5. Check DME.
 - a. If **DME is less** than desired, the aircraft is inside the arc. To correct back to the arc, simply maintain the heading. If excessively inside the arc (0.5 DME or more inside the arc), make a turn to place the head of the bearing pointer up to 15° below the 90° benchmark to return the aircraft back to the arc. Approaching the arc, lead the turn onto the arc and resume Arcing Procedures.
 - b. If **DME is greater** than desired, the aircraft is outside the arc. To correct, turn to place the head of the bearing pointer up to 15° above the 90° benchmark.
6. Once established on the ARC in a no-wind situation, remain on the arc by altering aircraft heading and/or bank to maintain the head of the bearing pointer on or near the 90° benchmark. When altering aircraft heading, consider the position of the bearing pointer relative to the 90° benchmark. In a no-wind situation:
 - a. Head of the bearing pointer **ON** the 90° benchmark.....DME constant.
 - b. Head of the bearing pointer **BELOW** the 90° benchmark.....DME increases.
 - c. Head of the bearing pointer **ABOVE** the 90° benchmark.....DME decreases.

6-8 ENROUTE PROCEDURES

Common Errors.

1. Not providing adequate lead for turns, thus overshooting the arc.
2. Turning in the wrong direction to get back on the arc. Remember the head of the needle points at the station.

606. ARC / RADIAL INTERCEPTS

General. To determine the lead turn required in order to align the aircraft on a course off of an arc.

Description. On some approaches, missed approaches and departure procedures, you will be required to fly an arc and then intercept a radial (inbound or outbound) from that arc. In this situation, you have to decide when to start your turn off the arc to intercept the radial.

Procedure. In the following example, consider an aircraft on the 12 DME arc flying at 180 KIAS, turning onto a course inbound.

Determining Lead Radial

1. Determine the number of radials per mile. Recall from the 60-to-1 rule, that 60 divided by DME equals the number of radials in one mile.

In this example: $60/12 = 5$ radials per mile on the 12 DME arc.

2. Determine the turn radius of the aircraft (for 90° of turn). This is 0.5% of the groundspeed.

In this example: 0.5% of 180 = 0.9 NM.

3. Multiply the turn radius by the number of radials per mile.

$0.9 \text{ NM} * (5 \text{ radials /NM}) = 4.5 \text{ radials}$

4. In this case, start the turn 4.5 radials prior to the intended course.

It should also be noted that this is a no wind calculation. In the aircraft, you will need to take winds into account.

607. INTERSECTIONS

General. An intersection is a point defined by any combination of courses, radials, or bearings of two or more NAVAIDS.

Description. With DME available, an intersection may be identified as a radial and distance from a station. The station used to navigate on the airway is called the primary station. If a

station off the airway is used to identify the intersection, it is called the secondary station. Intersections are used to help determine the aircraft's position along airways.

Procedure.

1. Determine the ETA to the intersection.
2. Three to five minutes prior to the ETA:
 - a. Tune and identify the secondary station, and check the position of the VOR needle. Do not change the course in the CDI.
 - b. If the tail of the needle is not within 10° of the intersection radial:
 - i. Retune the primary station and continue to track.
 - ii. Wait a maximum of one minute.
 - iii. Retune the secondary station, and once again, check to see if the tail of the needle is within 10° of the intersection radial.
 - iv. Keep repeating until the tail of the needle is within 10° of the intersection radial.
 - c. If the tail of the needle is within 10° of the intersection radial:
 - i. Set the desired course in the CDI.
 - ii. Hold the drift corrected heading carefully. This is the only means of remaining on the airway.
 - iii. If passing straight through the intersection, wait for the CDI to center and note the time. Other than using the FMS, this will be the only means of remaining on course. If turning at the intersection, lead the turn to roll out on the new course and note the time when wings level, regardless of the position of the CDI. The distance to the secondary station must be considered when determining the number of degrees to lead the turn to the new course.
 - iv. If passing straight through the intersection, retune the primary station after passing the intersection.
3. Give a voice report if required.
4. If already passed the intersection, make the turn to the new course if required, estimate the time the intersection was passed, retune the NAVAID as required, and continue to track and give a voice report if required.

608. POINT TO POINT

General. Fly in the most direct path from a starting point to a radial and DME from a station.

Description. If cleared direct to the fix, the pilot may be radar vectored or employ Point to Point (PTP) navigation. When cleared direct from one point to another, you must determine the heading to fly. One method of determining this is to plot both points on a suitable chart and connect them with a straight line. The heading to fly is the heading along this line. An alternate method, which eliminates cumbersome charts and line drawing, will require you to visualize the aircraft's present position and the desired fix on the compass card of the HSI. This method may be used to navigate directly to any fix within reception range of the NAVAID. The following concepts will aid in developing this ability.

1. The station is always at the center of the compass card. The compass card is merely a compass rose around the station.
2. The fix having the greater distance is always established on its radial at the outer edge of the compass card.
3. The remaining fix is established along its radial at a proportional distance from the center of the compass card.

When applying the above concepts, the compass card can be thought of as a chart. On this chart, the aircraft's present position, the desired fix, and the station (at the center) can be plotted. With an actual chart, draw a line between the two fixes to determine the no-wind heading. Using the compass card, visualize this line between fixes. The following example (Figure 6-1) demonstrates the procedures for flying from one fix to another fix. The aircraft is on the 180° radial at 20 NM and you want to navigate to the 90° radial at 10 NM.

Procedure.

1. Tune and identify the NAVAID.
2. Set the desired radial in the CDI.
3. Turn to a heading approximately halfway between the head of the bearing pointer and the head of the CDI.
 - Adjustments may be made to the rollout heading. If going to a smaller DME, favor the head of the needle. If going to a larger DME, favor the desired radial.
4. Update the heading enroute and make appropriate corrections (pencil method).

The Pencil Method

5. Establish the fix with the greater distance (20 NM) at the edge of the compass card on its radial (180°).

6. Establish the remaining fix (90° radial/10 NM) along its radial at a proportionate distance from the center of the card (halfway).
7. Draw an imaginary line with the aid of a pencil, finger, etc., **FROM** the aircraft's present position **through** the next fix. Move the "line" to the center of the card and read the no-wind heading to the desired fix (approximately 30° in this case).

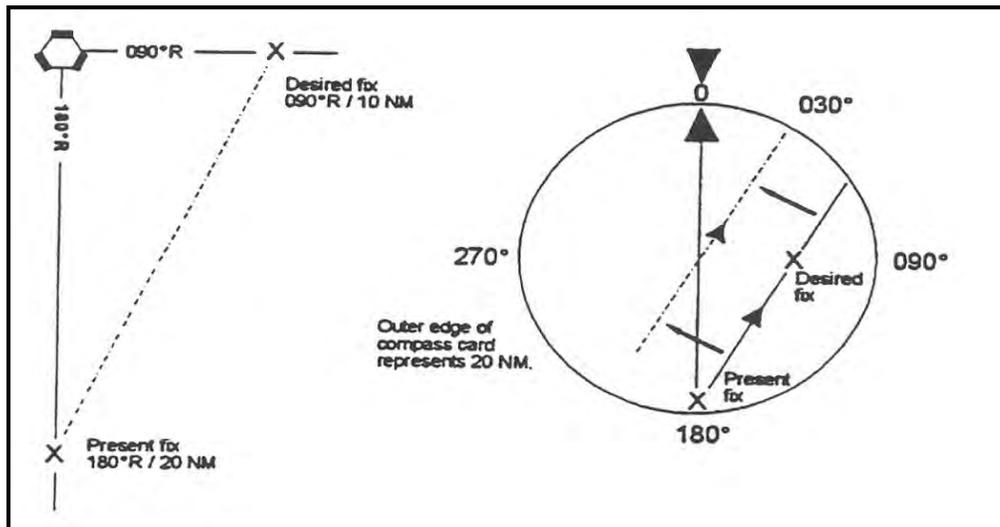


Figure 6-5 Point to Point

NOTE

The Instrument Approach Plate may be used as an aid to visualize present position and the initial heading required to fly to the fix.

8. Turn to this updated heading.
9. Visually determine if the line that connects the two fixes is vertical. This line represents the desired track. If it is vertical, you are on the correct heading at that instant. Apply any wind corrections that are required to remain on the proper track.
10. If the line is not vertical, turn the aircraft to make it so. This can be done without the aid of a straightedge. If the line tilts right, turn right to make the line vertical. If the line tilts left, turn left to make the line vertical.

Corrections

As the aircraft approaches the point, it will be necessary to determine which will be reached first – the radial or the DME. To come as close as possible to the new point, it will be necessary to judge the rate at which the DME is moving and the rate at which the aircraft is crossing radials. If it is determined that one rate is moving faster than the other, it may be that the aircraft will reach the DME or radial first, rather than simultaneously. Keep the following in mind when trying to hit a point:

DME/Radial Rate of Change

1. When the needle is closer to the heading index than the 90° benchmark, i.e., above the 45° benchmark, the DME will change faster than the radials. The opposite is true when the needle is nearer the 90° benchmark, i.e., when the needle is below the 45° benchmark.
2. Remember, when the head of the needle is above the 90° benchmark, the DME will get smaller. When the head of the needle is below the 90° benchmark, the DME will get larger. The only exception to this rule is in the case of strong winds.
3. To get DME to “speed up,” turn to place the needle closer to the heading index. This will slow the rate at which the aircraft is crossing radials. When going inbound, you will be working the head of the needle.

NOTES

1. When going outbound, reference the tail of the needle.
2. With needle at the 45° benchmark, rate of DME and radial change are equal. With needle anywhere else, DME and radial change rates are inversely proportional (if DME rate is increased, radial change rate decreases).
4. You will not necessarily be able to determine the exact heading to roll out on as you are adjusting heading, but that is not as important as altering heading before it is too late. Once on the new heading, let things settle down (i.e., cross a few radials; let a few tenths of DME pass) then update again by trying to determine if the aircraft will hit the radial or DME first. Remember, the goal is getting as close as possible to the point. Continually update until crossing the point. If the solution does not work out exactly, plan to arrive either at the desired DME or radial prior to the fix. If arriving at the DME first and **within 30 radials** of the desired radial, turn to arc toward the fix. If arriving at the radial first, turn to track inbound/outbound to the fix.

Common Errors.

1. Failing to expedite the first three steps. Remember, there is plenty of time to refine the solution once proceeding in the general direction.
2. Reversing the direction of the imaginary no-wind heading line by extending the imaginary line from the fix through the present position.
3. Failing to make frequent updates. As the aircraft gets closer to the station, more frequent updates will be required to ensure an accurate solution.
4. Placing the wrong fix at the outer edge of the HSI card.
5. Proceeding to the reciprocal of the radial/DME instead of the radial/DME.

6. Attempting to arc to the fix when not within 30 radials of the desired fix.
7. Failing to make timely and accurate wind drift corrections enroute to the fix.

CHAPTER SEVEN HOLDING PROCEDURES

700. HOLDING

Objective. Holding is a predetermined maneuver which keeps aircraft within a specified airspace while awaiting further clearance from Air Traffic Control.

Discussion. Holding can be accomplished at an intersection, GPS Waypoint, DME fix, or navigation facility. When ATC clears an aircraft to hold, a specified airspace oriented around the holding fix is reserved, clear of other traffic. The extent of the cleared airspace is based on the maximum holding airspeed, as listed in the FLIP GP and FAA AIM. Maximum airspeed for aircraft is as follows:

0-6000' MSL	200 KIAS
6001-14,000' MSL	230 KIAS
Above 14,000' MSL	265 KIAS
USAF Airfields	310 KIAS (unless otherwise depicted)
USN Airfields	230 KIAS (unless otherwise depicted)

NOTE

Slow to holding airspeed three minutes prior to reaching the holding fix. In the T-6B, students may use 5 NM prior.

Clearance: ATC should issue holding clearance at least five minutes before the aircraft reaches the clearance limit. The elements of the holding clearance are as follows:

1. The direction to hold from the holding fix. This is the general compass location in terms of the eight cardinal compass points (i.e., N, NE, E, SE, etc.).
2. The name of the holding fix (may be omitted if included at the beginning of the transmission as the clearance limit).
3. The radial, course, bearing, airway, or route on which the aircraft is to hold.
4. Leg length in miles if DME is to be used.
5. Direction of turn if left turns are to be made (referred to as non-standard holding).
6. Time to expect further clearance and any pertinent additional delay information (times are given in ZULU/GMT).

NOTES

1. If the holding pattern is charted and the controller does not issue complete holding instructions, the pilot is expected to hold as depicted on the appropriate chart. When the pattern is charted, the controller may omit all holding instructions except the charted holding direction and the statement "AS PUBLISHED" (i.e., "HOLD EAST AS PUBLISHED").
2. Request expected further clearance time if not automatically provided by ATC. This time will be used to depart the holding pattern (proceed enroute or to commence the approach if holding at destination) in the event of communications failure.

Orbits: For training purposes, the holding pattern will be broken down into three types of orbits, which are accomplished sequentially:

1. **Entry Orbit:** Establishes the aircraft inbound on the holding course.
2. **No-wind Orbit:** Determines the initial corrections required to compensate for existing winds.
3. **Correction Orbit(s):** Update and refine the wind corrections.

Timing: Timing, if used, is adjusted on the outbound leg of each Correction Orbit to maintain the following leg lengths inbound:

<u>Altitude (MSL)</u>	<u>Inbound leg length</u>
At or below 14,000' MSL	1 minute
Above 14,000' MSL	1 1/2 minute

Procedure.

1. Copy and read back holding clearance.
2. Determine the holding course and reciprocal of the holding course.
 - a. The holding course is the inbound course to the holding fix (Figure 7-1).
 - b. The reciprocal of the holding course is used to determine the direction of entry turn. When the holding fix is a NAVAID, the reciprocal will be the same as the radial (Figure 7-1).

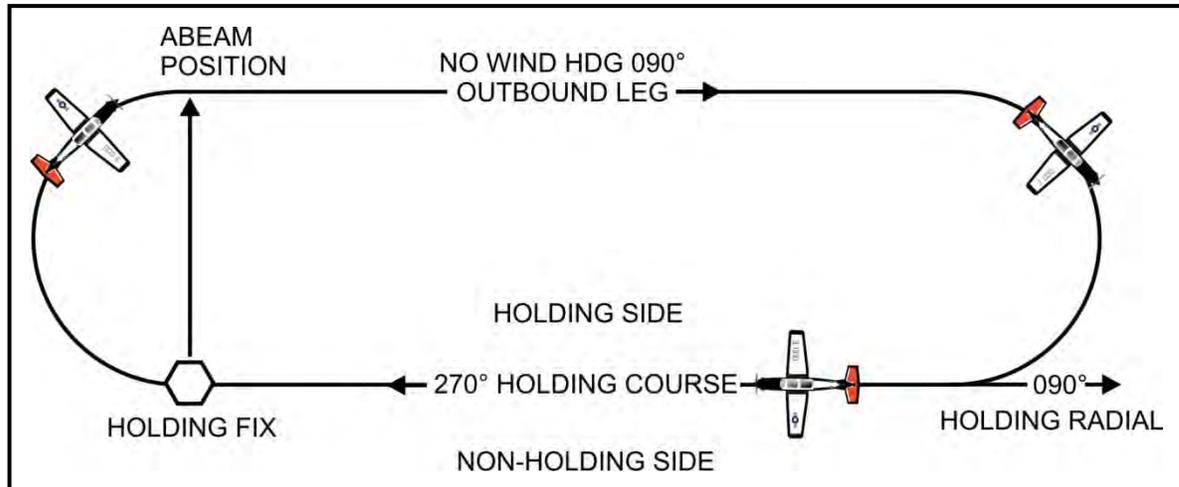


Figure 7-1 Holding Pattern

3. Determine the direction of the entry turn.

The position of the reciprocal of the holding course in relation to the HSI heading index at initial holding fix passage will determine the direction of entry turn. There will be certain cases in which the reciprocal will fall on, or very close to, a sector boundary. If the reciprocal is within 5° of a boundary, the entry procedures for either section are acceptable.

a. **Standard Holding** (Figure 7-2)

- i. **Sector A (TEARDROP).** If the reciprocal is between the heading index and 70° to the right of the heading index, make a Teardrop entry. This is accomplished by turning in the shortest direction (left or right) to a heading that is 30° less than the reciprocal of the holding course.
- ii. **Sector B (PARALLEL).** If the reciprocal is between the heading index and 110° to the left of the heading index, make a left turn to parallel the reciprocal of the holding course.
- iii. **Sector C (DIRECT ENTRY).** If the reciprocal of the holding course does not meet the criteria listed in (i) or (ii) above, turn right to the reciprocal of the holding course.

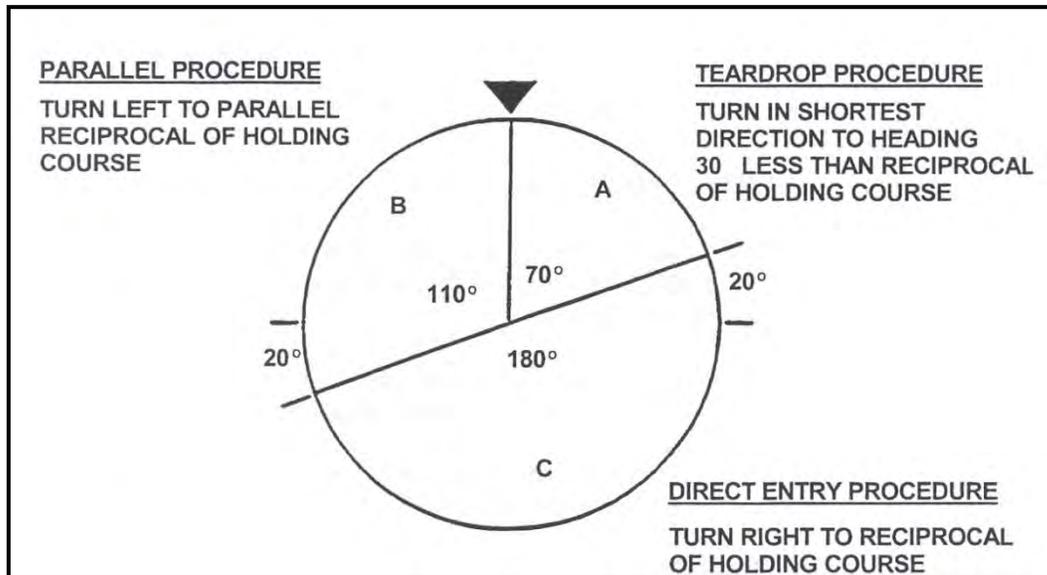


Figure 7-2 Standard Holding

- b. **Non-Standard Holding** (Figure 7-3)
- i. **Sector A (TEARDROP).** If the reciprocal is between the heading index and 70° to the left of the heading index, make a Teardrop entry. This is accomplished by turning in the shortest direction (left or right) to a heading that is 30° more than the reciprocal of the holding course.
 - ii. **Sector B (PARALLEL).** If the reciprocal is between the heading index and 110° to the right of the heading index, make a right turn to parallel the reciprocal of the holding course.
 - iii. **Sector C (DIRECT ENTRY).** If the reciprocal of the holding course does not meet the criteria listed in (i) or (ii) above, turn left to the reciprocal of the holding course.

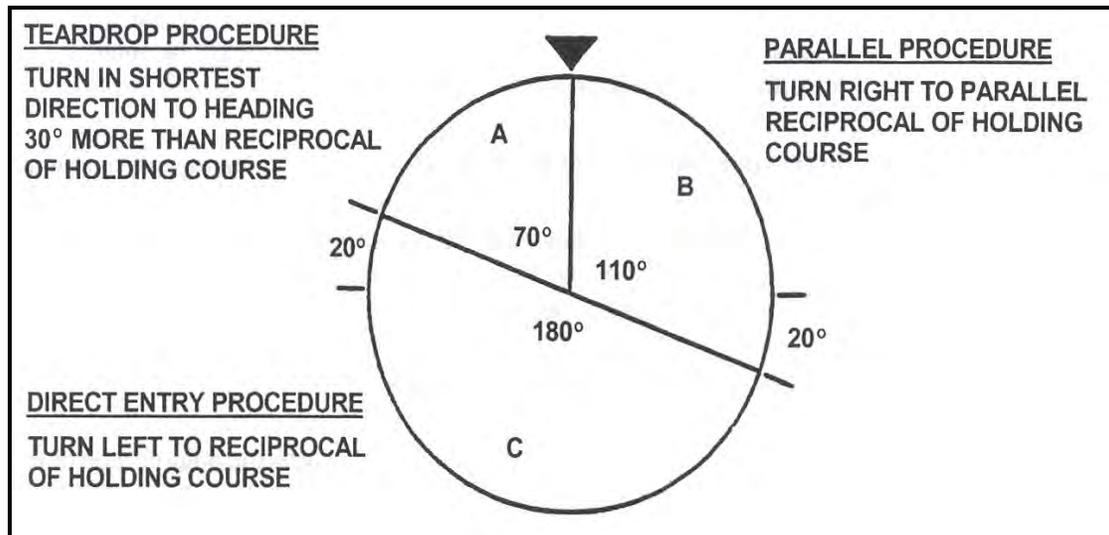


Figure 7-3 Non-standard Holding

4. **Entry Orbit.** The first time the aircraft crosses the holding fix commence the entry orbit.
 - a. Perform the following (6 Ts):
 - i. **TIME** – Note the time.
 - ii. **TURN** – In the direction previously determined. With the exception of a Teardrop entry, the heading will be the same as the reciprocal of the holding course.

NOTE

Make all turns during entry and while holding at a standard rate or 30° bank angle, whichever requires the least AOB.

- iii. **TIME** – Start timing when wings level or abeam the station (head of the needle on or below the 90° benchmark), whichever occurs last.
- iv. **TRANSITION** – If not already at 150 KIAS, make the correction.
- v. **TWIST** – Twist the CDI to the holding course. This may be done any time after the initial turn, but must be completed prior to the inbound turn.
- vi. **TALK** – Give the voice report.
- b. After completion of outbound timing or at the specified DME, turn to intercept the holding course inbound. To remain within holding airspace, a turn in the proper

direction must be made. The direction of turn will be determined as follows:

Determine the aircraft's present position. Do this by visualizing the aircraft on the tail of the needle. Turn toward the holding radial. In Figure 7-4 (A), the aircraft is on the 70° radial and the holding radial, 90°R is to the right, indicating a right turn. In Figure 7-4 (C), the aircraft is on the 110° radial and the holding radial, 90°R is to the left, indicating a left turn.

Remember: **TAIL – RADIAL – TURN**

If the aircraft is on the holding radial, turn towards the holding side of the pattern to remain within protected airspace. Figure 7-4 (B) illustrates this situation.

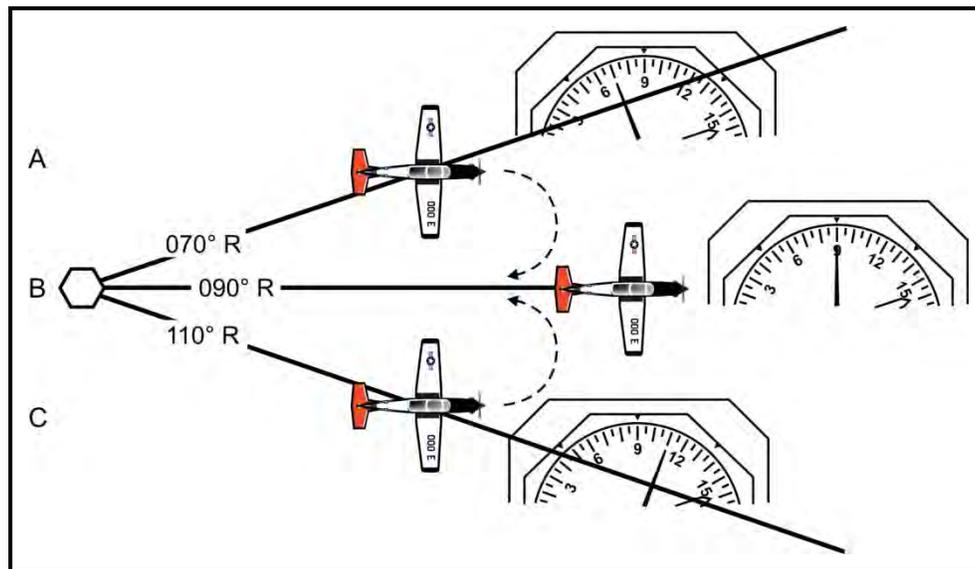


Figure 7-4 Determining Turn Direction

- c. During the last half of the turn, check the position of the head of the needle relative to the holding course to determine whether or not the aircraft will roll out on the holding course. If the aircraft is on the holding course at the completion of the turn, simply track inbound on the holding course. If not on course, stop the turn with a double-the-angle intercept for VOR holding at a NAVAID. When holding at a radial/DME from a NAVAID and turning to intercept the inbound course, an intercept greater than “double-the-angle” will be required. This is to compensate for the greater spacing between radials when holding away from the station. In this type of holding, a 30-45° angle of intercept will establish the aircraft on the inbound course. Once established on course, commence tracking inbound to the holding fix. **It is critical to establish the aircraft on course prior to crossing the holding fix.**

In Figure 7-5 (A), the aircraft will be on the holding course at the completion of the turn. Although the head of the needle is not directly on 270° at the point illustrated, it will fall the remaining few degrees during the completion of the turn. Figure 7-5 (B)

shows an undershoot situation. The head of the needle is on 255° , 15° away from the holding course of 270° . Stopping the turn on 240° (15° away from 255°) sets up a double-the-angle intercept. Check to be sure the head of the needle is in a position to fall to the desired course. Figure 7-5 (C) is an overshooting situation. Again, the turn is continued until a double-the-angle intercept is established.

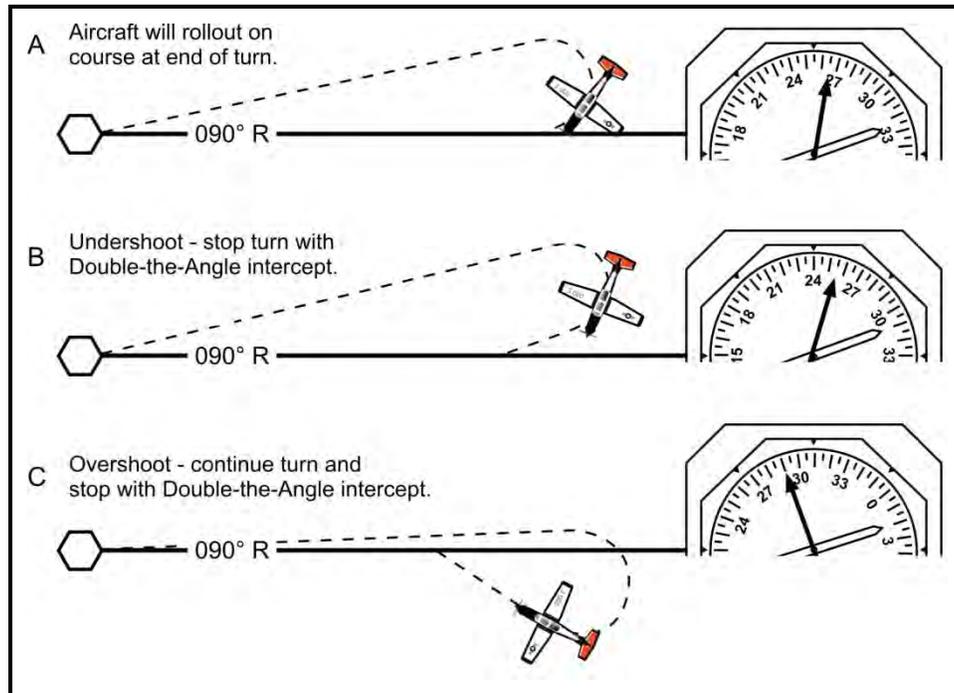


Figure 7-5 Turning Inbound to Holding Fix

5. No-wind Orbit.

- The second time the aircraft crosses the station, commence the “no-wind” orbit. This orbit is flown as if there were no wind. Commence the “no-wind” orbit as follows:

NOTE

It is extremely important to hold a SRT at a constant airspeed (150 KIAS unless fuel is a factor) throughout all turns. If the AOB and airspeed varies during the turn, it is difficult to determine the wind for the correction orbit.

- Roll out of the turn on the outbound heading to parallel the holding course. This heading will be the same as the reciprocal of the holding course.
- Start the outbound leg timing (if required), when wings level or abeam the station, whichever occurs last.

- d. At the completion of outbound leg timing or at the specified DME, turn towards the holding radial to intercept the holding course inbound. Remember: **TAIL – RADIAL – TURN**. At the completion of the turn, the aircraft will either be inbound on the holding course or have an intercept set.
- e. Once wings level inbound, start timing if required.
- f. Upon rolling wings level, check the position of the head of the needle relative to the holding course. If they differ, note the number of degrees difference. This will determine the amount of heading correction to use on the outbound leg of the correction orbit. Do this as quickly as possible.
- g. If an intercept is required on the turn inbound, there are winds and corrections need to be made. Use the following method to determine what direction the wind is FROM: While the intercept angle is set, visualize a line drawn from the tail of the needle through the radial to the nearest cardinal heading. The wind is FROM this approximate direction. Remember: **TAIL – RADIAL – WIND**. For ease in computing headings on correction orbits, always think of the wind as being from North, South, East or West and not from the left or right.
- h. Establish the aircraft on the holding course and track inbound to the holding fix.
- i. At station passage, note how much time has elapsed (if required) on the inbound leg. Determine the difference between the elapsed time and the desired inbound timing. Use this correction factor for timing on the outbound leg of the correction orbit.
- j. Figure 7-6 illustrates a typical no-wind orbit. The inbound turn resulted in an overshoot and a double-the-angle intercept was set. The Tail–Radial–Wind rule indicates a wind from the North. With a 15° heading correction factor, the inbound timing of 50 seconds indicates a 10 second timing correction factor.

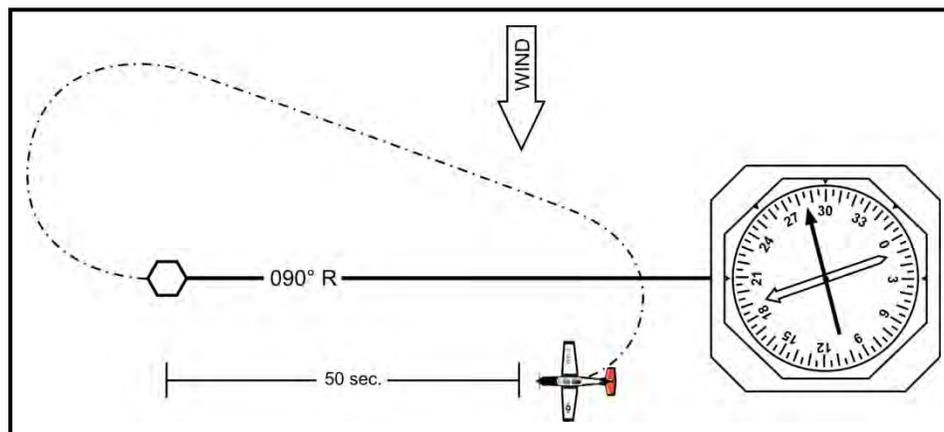


Figure 7-6 No-Wind Orbit

6. Correction Orbit.

- a. The third and subsequent orbits in holding are called correction orbits. Correction orbits are flown by applying the correction factors determined on the previous orbit to the outbound leg of the holding pattern.
- b. Using Figure 7-7 as an example, apply the heading correction to the outbound leg. The wind is from the North and the correction factor is 15°. The no-wind outbound heading would be 90°, and 15° North of this is 75°. Therefore, use 75° as an outbound heading on the correction orbit.
- c. The inbound leg in Figure 7-7 took 50 seconds, indicating a tailwind component with a 10 second correction factor. To make the inbound leg a full 60 seconds, increase the outbound timing. Apply the 10 second factor to 60 seconds (original outbound timing). The outbound timing on the correction orbit is then 70 seconds. If the inbound leg of the “no-wind” orbit was longer than 60 seconds, use the timing correction factor to shorten the next outbound leg.

NOTE

For simplicity, wind is thought of as being from a cardinal heading in holding. An examination of Figure 7-7 shows the wind must actually be from the northeast, since the inbound leg was 50 seconds; however, for ease in determining heading corrections, it is best to think of winds as being from cardinal headings.

- d. If the outbound heading correction was sufficient, the aircraft will be on course at the completion of the inbound turn. When tracking inbound to the holding fix, a correction into the wind of approximately one-third of that used on the outbound leg should keep the aircraft on course.
- e. If the corrections determined in the no-wind orbit do not put the aircraft on desired course and timing on the first “correction orbit” inbound leg, you must “re-correct” the next outbound leg. The amount, direction, and time to correct are determined exactly as in the no-wind orbit, but the corrections must be applied to the heading and timing used on the previous outbound leg (**not the no-wind outbound leg**). It may take several orbits to get the heading and timing exactly right. Figure 7-8 shows a correction orbit that worked out perfectly, a rare case in practice.

TRIPLE THE DRIFT - Alternate Crosswind Component Correction Method

An acceptable alternate method for correcting for the crosswind component while holding is the Triple the Drift Method, which may be used for VOR, VOR/DME, and GPS Holding. In this case, on the outbound leg of the Correction Orbit, turn to the reciprocal of the holding course, plus or minus the triple-drift correction factor. For example, assume the aircraft is established on a holding course of 270° and a 5° right (to the North) drift correction (i.e., heading 275°) is required to maintain course. Applying a triple-drift correction (5° X 3), a 15° left (still to the

North) correction to the outbound heading is required, making the outbound heading 075°. Apply the triple-drift correction immediately after rolling out on the outbound leg of the Correction Orbit, but do not begin the triple-drift timing until passing abeam the holding fix. Maintain the triple-drift correction for one minute once you commence timing on the outbound leg (or until the expiration of outbound timing, whichever occurs first). After one minute of triple-drift correction, fly a single-drift heading to compensate for wind (this also applies to VOR/DME and GPS holding).

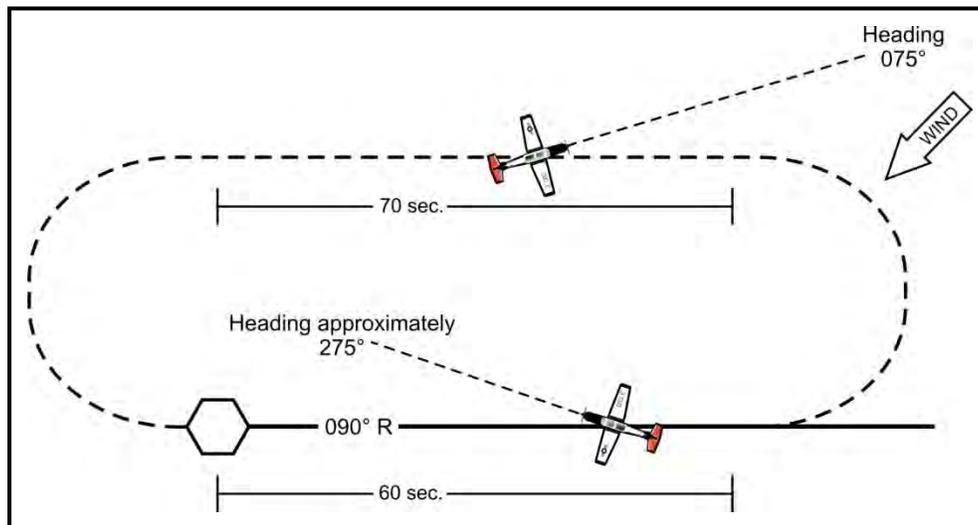


Figure 7-7 Correction Orbit

7. Confirm expected further clearance (EFC) time.
 - Confirm EFC time with approach control at least five minutes prior to the EFC. Receipt of EFC is not a clearance to commence approach at that time unless you have lost communications with ATC.
8. Cleared out of holding.
 - a. It is very important to listen to the approach clearance once established in holding. If established in a published holding pattern and subsequently cleared for the **Holding Pattern Approach**, commence the approach from within the holding pattern and descend to the IAF altitude at pilot's discretion. If established in a holding pattern and subsequently cleared for an approach **other than a Holding Pattern Approach**, maintain last assigned altitude or the published minimum holding altitude, whichever is lower, until established on a segment of the approach.
 - b. Airspeed when departing holding is at pilot's discretion. This decision should be based on your intentions departing holding (continue enroute or commence an approach) and the aircraft position in relation to the instrument approach (if conducting an approach from holding).

Common Errors.

1. Improper entry into holding.
2. Twisting in the reciprocal vice the course.
3. Starting the outbound leg timing when the wings roll level vice when the wings roll level or abeam the station, whichever occurs last.
4. Misinterpreting wind direction/improper use of the Tail–Radial–Wind method.
5. Attempting to correct for crosswind by shallowing or steepening the turn inbound. This may work, but it leads to sloppy airwork, and should not be practiced.
6. Not intercepting the holding course on each orbit. If the aircraft is not established on the holding course at station passage, the wind corrections determined will not be accurate.
7. Using an insufficient intercept angle to acquire the inbound course.
8. Not holding SRTs and constant airspeed during all turns. It is difficult to correct for winds if airwork is not consistent throughout the orbit.

701. HOLDING DURING ADVERSE WIND CONDITIONS

It is not unusual for winds aloft to attain velocities in excess of 20 knots. In these circumstances, some modifications to the holding procedures discussed earlier may be necessary. Just how much will depend on wind speed and direction. The instructor will provide guidance on how to correct for excessive winds.

You should be able to predict high winds prior to entering the holding pattern. Pay attention to the forecast winds aloft. During the enroute phase, a high crosswind component would be indicated by the need for an abnormally large drift correction. A high headwind or tailwind would be indicated by a groundspeed that differs significantly from predicted values.

702. VOR DME HOLDING / TACAN HOLDING

Objective. To hold at a fix defined as a radial and DME from a station.

Discussion. This type of holding was developed in order to hold aircraft off of a TACAN station. As learned in ground school, a TACAN station has a larger cone of confusion as compared to a VOR station. As a result, holding at a TACAN station requires holding at a specific radial and DME away from the station. This procedure has been adapted to holding off of a radial and DME from a VOR. The holding pattern can be orientated on any course, radial or route, directed by the controller, or as published on either an enroute chart or an approach plate (Figure 7-8).

This form of holding is commonly encountered at the Initial Approach Fix (IAF) for an Arcing or Straight-in Approach Procedure. ATC will normally clear an aircraft from its present position direct to the IAF for holding. Employ Point to Point procedures. An example is depicted using the VOR DME / TACAN RWY 17 approach at Corpus Christi, TX, (Figure 7-9).

Holding at an enroute fix, utilizing DME is also possible. Figure 7-10, holding at REDDI, is an example of this situation.

Procedure. Procedures are basically the same as VOR station holding; however, the following amplifying information is provided:

1. Certain holding patterns will be published as a part of an approach plate or a low altitude chart. ATC will not issue a detailed holding clearance for these patterns. A sample of this type clearance would be:

APPROACH CONTROL: "Navy 123, Corpus Approach, hold as published at the Initial Approach Fix (or IAF Name) for the VOR DME / TACAN RWY 17/23 approach at destination. Time now 57, expected further clearance time 20"

2. The holding clearance, if not "hold as published," will specify the length of the legs.

NOTE

If the holding fix is on an airway, you may not be assigned a holding radial. Use the radial that defines the airway. If leg lengths are not depicted or assigned, use timing appropriate for the assigned altitude.

A sample clearance:

APPROACH CONTROL: "Navy 123, Houston Center, hold south of REDDI on V115, use three mile legs, time now 57, expected further clearance at time 20."

3. Turns are commenced upon reaching specified DME (timing is not involved if the leg lengths are specified by DME). The radius of turn will carry the aircraft slightly beyond these points. ATC is aware of this.

4. When turning to intercept the inbound course during this type of holding, an intercept greater than "double-the-angle" will be needed. Normally a 30-45° angle of intercept will establish the aircraft on the inbound course. Lead the turn to establish the aircraft on the inbound course. This is to compensate for the greater spacing between radials when holding away from the station. For example, at 2 NM from the station, a 6° course error represents one-fifth NM off course. 20 NM from the station, the same 6° is 2 NM off course. Discuss this with the instructor to determine the appropriate amount of intercept.

5. Determine wind direction using the same method from VOR station holding (**TAIL–RADIAL–WIND**). During VOR over the station holding, the number of degrees of crab, used on the outbound leg, equals the number of degrees off course after the inbound turn on the no-wind orbit. This will not work as well in holding away from the station due to the greater radial spacing further from the station.

The following method will aid in determining wind corrections. Refer to Figure 7-9. Here, the aircraft is holding between 10 to 14 DME on the 038° radial.

- Determine the outermost leg length - in this case, 14 DME.
- Determine the length of the holding pattern - 4 NM.
- Divide the outermost leg length by the length of the holding pattern. $14 \div 4 = 3.5$ degrees. This is the correction factor for every radial the aircraft is off course.

For example: The aircraft has just completed the outbound leg of the no-wind orbit at 14 DME. During the turn onto the holding radial, it is determined that the aircraft is 4° off course. Use the normal tail-radial-wind method to determine wind direction.

Apply the wind correction on your correction orbit: 4° error x 3.5 correction factor = 14° crab angle into the wind on the outbound leg of the correction orbit. Use half (7°) the crab angle on the inbound leg. The holding course is relative to the holding fix - NOT the station.

NOTE

If leg lengths are not specified, consider using Triple the Drift Method described above for wind corrections.

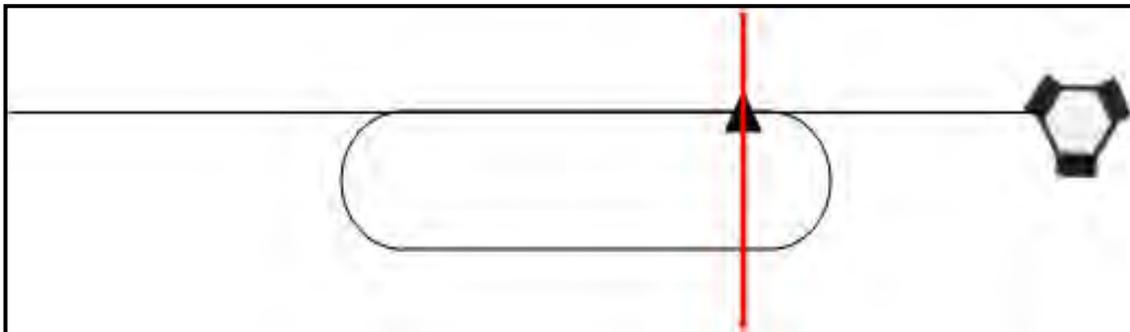


Figure 7-8 VOR DME / TACAN Holding Fix

Common Errors.

- Holding on the wrong side of the DME fix.
- Using an insufficient intercept angle to acquire the inbound course.

703. CLEARANCE FOR AN APPROACH WHILE IN HOLDING

If established on a **Published Holding Pattern** and subsequently cleared for the approach, you may commence the approach from within the holding pattern.

It is very important to listen to the approach clearance once established in holding. Listed below are possible types of clearances that may be received:

“Navy 123, Pensacola Approach, at the completion of this turn in holding you are cleared for the _____ approach.”

or

“Navy 123, Pensacola Approach, at IAF name, you are cleared for the _____ approach.”

In the two cases above, the pilot would complete his turn in holding and commence the approach at the IAF. Listen for any altitude restrictions from ATC.

“Navy 123 Pensacola Approach, you are cleared for the _____ approach.”

In this case, the pilot is NOT required to complete the turn in holding and he **may**:

1. **Turn** immediately towards the IAF.
2. **Descend** to the published minimum holding altitude. For those holding patterns where there is no published minimum holding altitude, the pilot, upon receiving an approach clearance, must maintain the last assigned altitude until leaving the holding pattern and established inbound on a published segment of the approach. Thereafter, the published minimum altitude of the route segment being flown will apply.

If holding at the IAF, **not in a published** holding pattern, and subsequently cleared for the approach. The pilot may:

1. **Turn** to the IAF.
2. **DO NOT DESCEND** until on a published segment of the approach (most likely on the arc).

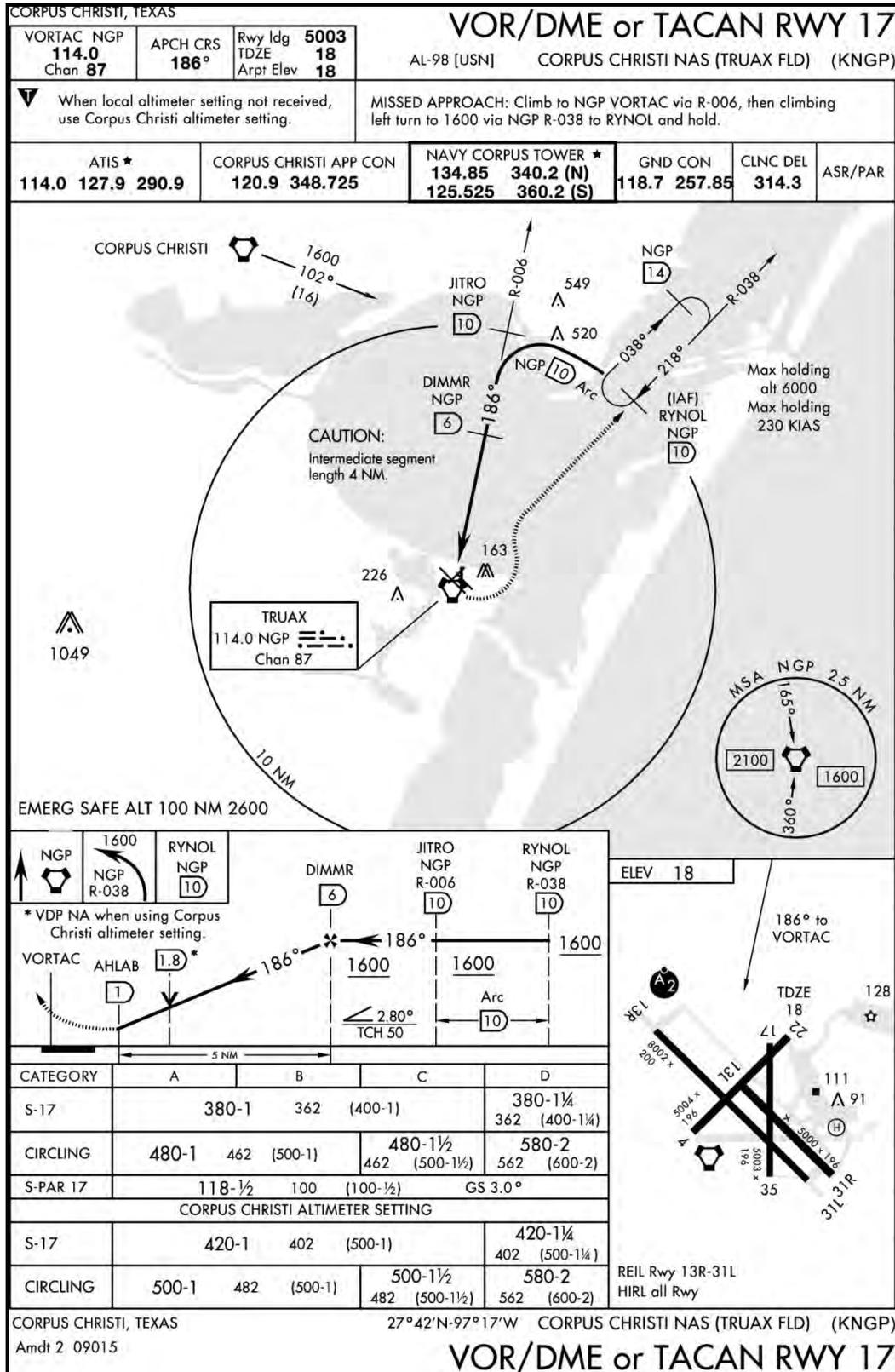


Figure 7-9 VOR/DME or TACAN RWY 17 (KNGP)

To level-off:

5. 50' prior to level-off altitude, begin the transition by resetting power to 33% torque.
6. Raise the nose set level flight.
7. Re-trim.

Common Errors

1. Fixating on altitude, thereby failing to maintain AOB in the SRTs.
2. Neglecting timing and/or wind corrections. Continue flying the pattern while in the descent.
3. Failure to maintain 150 KIAS in the descent.

NOTE

Wind corrections at one altitude may not work at a lower altitude. Heading and timing adjustments may be required. If these adjustments do not work, fly a complete no-wind orbit again to determine the new winds.

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CHAPTER EIGHT TERMINAL PROCEDURES

800. INTRODUCTION

The most challenging phase of any sortie normally takes place in the terminal area. The keys to successful terminal area-operations are to stay ahead of the aircraft, maintain constant situational awareness, and **KNOW THE PROCEDURES**.

801. AUTOMATIC TERMINAL INFORMATION SYSTEM (ATIS)

About 100 NM away from the destination or drop-in airfield, get the current Automatic Terminal Information System (ATIS)/Automated Surface Observing System (ASOS)/Automated Weather Observation System (AWOS) and check it against the approach weather minimums. Normally, you will check ATIS on one radio while monitoring the ATC frequency on the other radio (i.e., use VHF for ATIS and UHF for ATC).

802. DESCENT CHECKLIST

After initiating descent into the terminal area or establishing contact with the destination Approach Control, perform the Descent Checklist.

803. STANDARD TERMINAL ARRIVALS

General. Efficiently transitioning an aircraft from the enroute phase of flight to the instrument approach phase of flight.

Description. A Standard Terminal Arrival Route (STAR) is an ATC coded IFR arrival route established for application to arriving IFR aircraft destined for more busy airports. The purpose is to simplify clearance delivery procedures and facilitate transition between enroute and instrument approach procedures. It is important to note the clearance given. A clearance of “descend via XYZ STAR” will required the pilot to meet the altitude restrictions on the STAR. A clearance of “fly the XYZ STAR” requires the pilot to fly the depicted route but maintain assigned altitudes.

Procedure. STARs may be flown off of traditional NAVAIDs or by use of GPS navigation.

1. GPS

- a. Load the STAR into the FMS.
- b. Select FMS as the NAV source.
- c. Review the STAR.

2. Traditional NAVAIDs

- a. Select VOR as the NAV source.
- b. Review the STAR.

Common Errors.

1. Inability to load the FMS properly.
2. Not understanding the clearance given by ATC (descent via XYZ STAR vice fly XYZ STAR).

804. ENROUTE DESCENT

Description. There are many different ways to make an enroute descent. The basics never change - exchanging potential energy in the form of altitude, for kinetic energy in the form of airspeed.

Procedure.

1. Report leaving the assigned altitude.
2. Lower the nose and trim as the aircraft accelerates.
3. Adjust the nose in order to maintain the desired rate of descent (1000-4000 FPM).
4. 1000' prior to level-off altitude, adjust the rate of descent in order to capture the assigned altitude.

Common Errors.

1. Not completing the Descent Checklist.
2. Loss of heading control, due to lack of rudder trim with the change in airspeed.

805. TERMINAL DESCENT

General. Transition the aircraft from an intermediate altitude to the approach phase of flight.

Description: A terminal descent is a procedure used to descend to a lower altitude when in contact with the destination approach controller and in the terminal phase of flight. A terminal descent provides a slower rate of descent than the enroute descent.

Procedure.

1. Report leaving the assigned altitude.

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2. Reduce the power as required.
3. Lower the nose as required to maintain 200 KIAS.
4. Trim.
5. 100' prior to assigned the altitude, raise the nose and set the power as required.
6. Trim.

806. INSTRUMENT APPROACH BRIEF

Prior to commencing an instrument approach, the student will brief the instructor on the particulars of the approach. The brief should include the following:

1. Approach name and page number.
2. NAVAIDS required.
3. Course to set in CDI.
4. Weather minimums.
5. Segment altitudes, including decision height (DH) and minimum descent altitude (MDA).
6. Timing.
7. Missed Approach or Climbout instructions.
8. Unusual or other noteworthy items peculiar to the approach.

807. INSTRUMENT APPROACH PLATES

Each instrument approach plate consists of five sections:

1. Pilot Briefing Information
2. Plan view
3. Profile view
4. Landing minima section
5. Aerodrome sketch

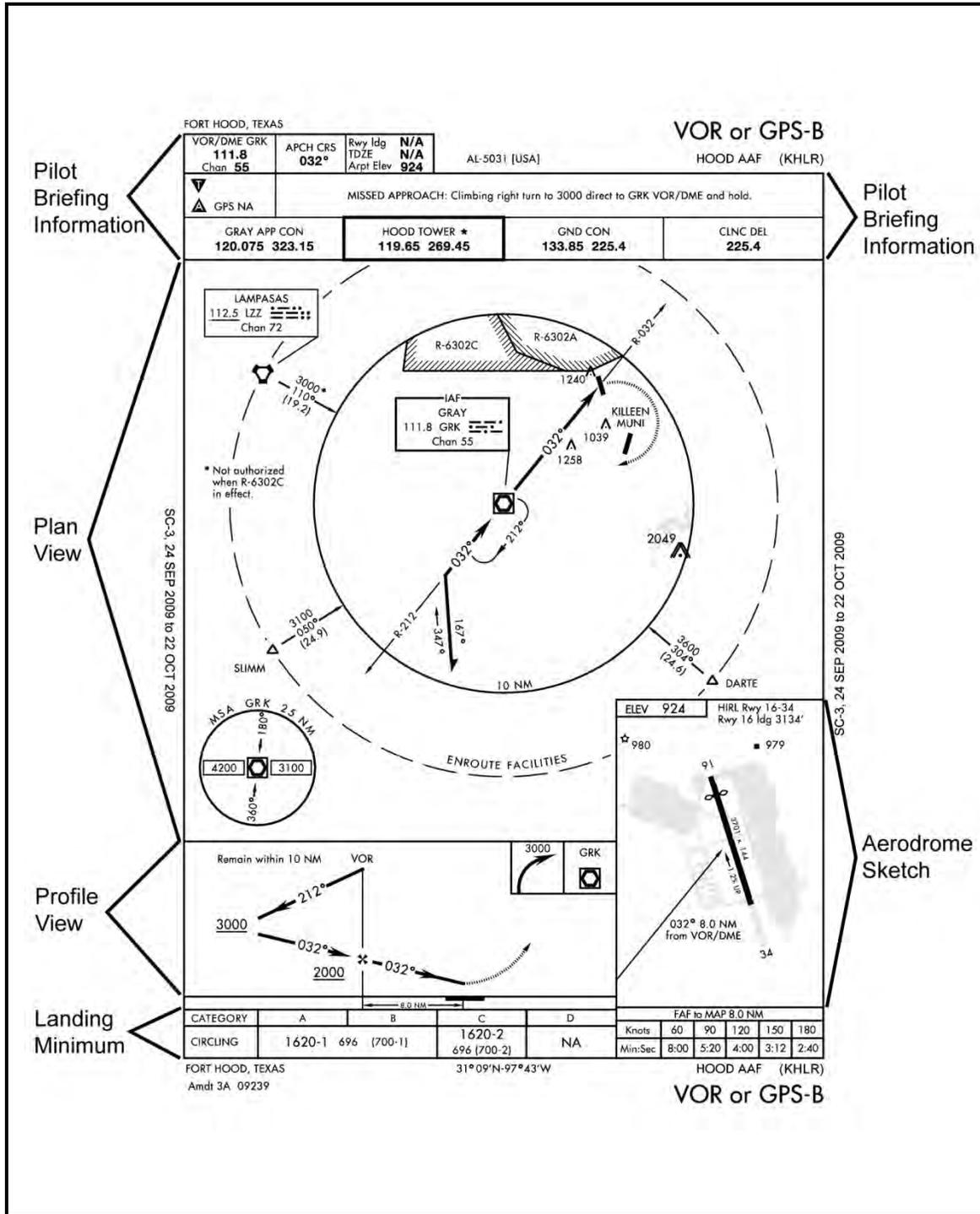


Figure 8-1 Approach Plate Sections

808. PILOT BRIEFING INFORMATION

The pilot briefing information format consists of three horizontal rows of boxed procedure-specific information along the top edge of the chart. Altitudes, frequencies and channel, course and elevation values (except height above threshold [HAT] and height above airport [HAA]) are charted in bold type. The top row contains the primary procedure navigation information, final approach course, landing distance available, touchdown zone and airport elevations. The middle row contains procedure notes and limitations, icons indicating if non-standard alternate and/or take-off minimums apply, approach lighting, and the full text description of the Missed Approach procedure. The bottom row contains air to ground communication facilities and frequencies in the order in which they are used during an approach with the tower frequency box bolded.

JACKSON, WYOMING		AL-504 (FAA)		RNAV (GPS) X RWY 1 JACKSON HOLE (JAC)	
WAAS CH 58299 W01A	APP CRS 006°	Rwy ldg 6300 TDZE 6431 Apt Elev 6451			
 Circling NA east of Rwy 1-19. Inoperative table does not apply.  If local altimeter setting not received, procedure NA. Baro-VNAV NA below -27°C (-16°F). DME/DME RNP- 0.3 NA.			MALS 	MISSED APPROACH: Climb to 14000 direct QUIRT and via 088° track to DNW VOR/DME and hold, continue climb-in-hold to 14000.	
ATIS 120.625	SALT LAKE CENTER 133.25 285.6	JACKSON TOWER* 118.075 (CTAF) 0	GND CON 124.55	UNICOM 122.95	

Figure 8-2 Pilot Briefing Information

809. PLAN VIEW

The majority of instrument flight procedure charts contain a reference or distance circle. In such cases, only the data within the reference circle is drawn to scale. This circle is centered on an approach fix and normally has a radius of 10 NM, unless otherwise indicated (Figure 8-3, note the 10 DME radius is in reference to the VORTAC, not the airfield). When a route segment, outside the circle, is not to scale the  symbol interrupts the segment. Obstacles close-in to the airport that cannot be properly depicted in the plan view are shown on the airport sketch. Some of these obstacles could be controlling obstructions for instrument procedures.

NOTE

The plan view may also specify equipment required to fly the approach, i.e., ADF OR RADAR REQUIRED. This may be for IAF or FAF identification, but not used for final approach course guidance, so it is not listed in the margin.

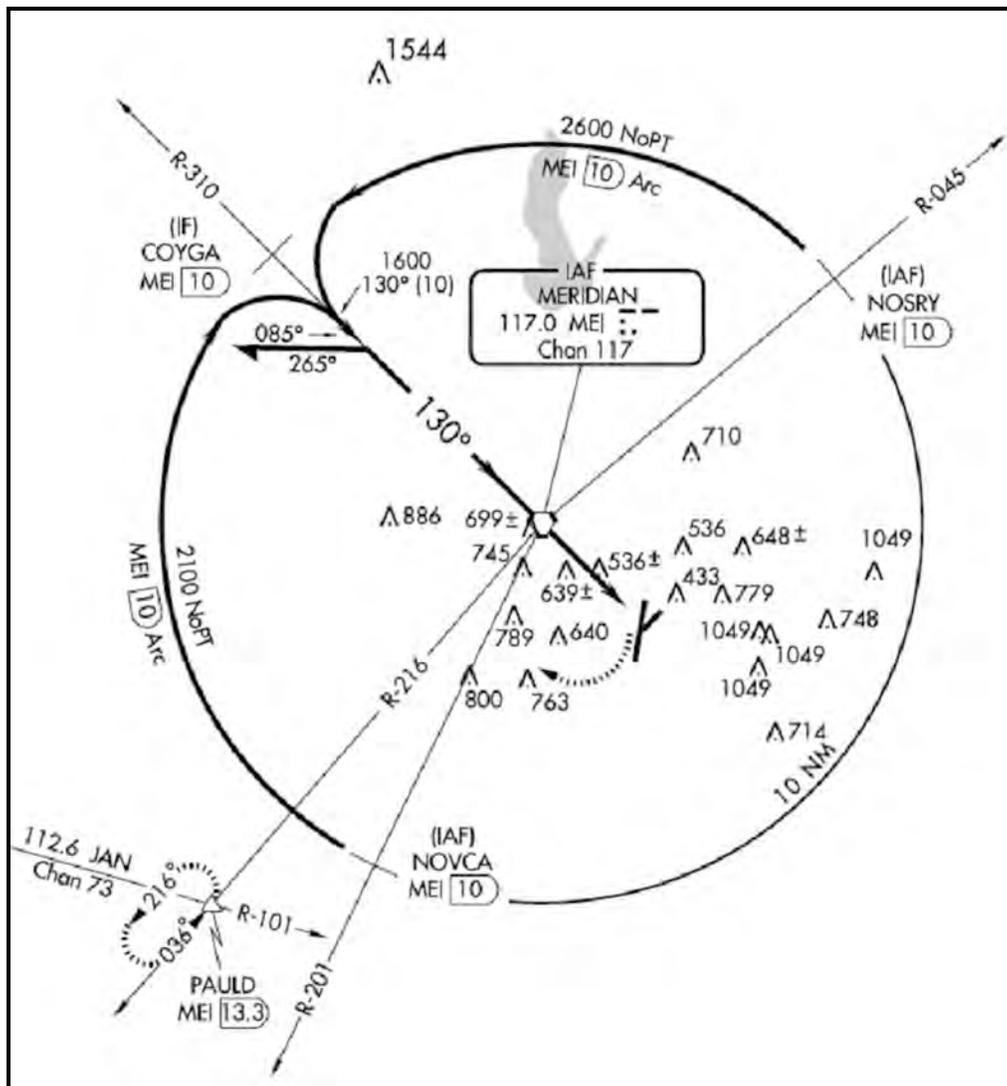


Figure 8-3 Plan View with 10 DME radius

Terrain Depiction will be depicted in the plan view portion of all IAPs at airports that meet the following criteria:

1. If the terrain within the plan view exceeds 4,000' above the airport elevation.
2. If the terrain within a 6.0 NM radius of the Airport Reference Point (ARP) rises to at least 2,000' above the airport elevation.

810. PROFILE VIEW

The Profile View shows a side view of approach procedures (Figure 8-4). The profile view contains:

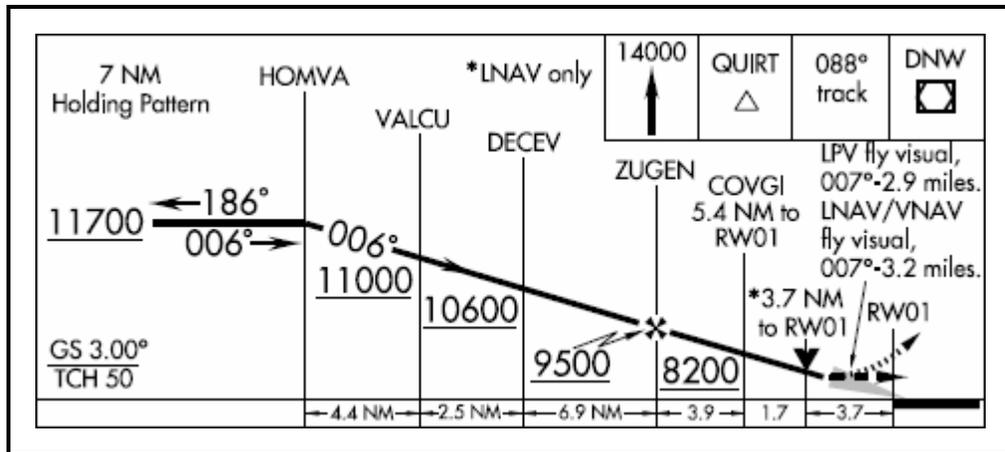


Figure 8-4 Profile View

1. IAF (altitude not specified for all approaches).
2. Course information.
3. Procedure Turn maneuvering area; Procedure Turn must be completed within this distance.
4. Procedure Turn altitude.
5. FAF altitude.
6. FAF symbol; denotes location of FAF.
7. Visual Descent Point (VDP); if used.
8. Missed Approach Point (MAP).

In addition to the full text description of the Missed Approach procedure contained in the notes section of the middle-briefing strip, the steps are also charted as boxed icons in the chart profile view (Figure 8-5). These icons provide simple-to-interpret instructions, such as direction of initial turn, next heading and/or course, next altitude, etc.

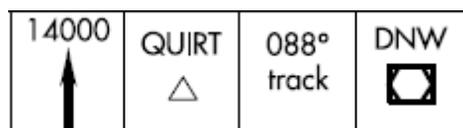


Figure 8-5 Missed Approach Procedure, Boxed Icons

811. LANDING MINIMA SECTION

Standard Landing Minima: Located below the profile view, the minima section contains the following (Figure 8-6a):

1. Aircraft Approach Category.
2. Minimum Descent Altitude (MDA); expressed as an MSL altitude. Descent below this altitude is unauthorized until the runway environment is in sight and the aircraft is in a position to maneuver safely to land.
3. Visibility required for the approach in statute miles. Runway visual range (RVR) in hundreds of feet may be used in place of visibility for Straight-in approaches only.
4. Height Above Touchdown (HAT); height of MDA (or DH) above highest elevation in touchdown zone (used with straight-in minima).
5. Ceiling and visibility; used for filing purposes and commencing an approach.
6. Height Above Airport (HAA); height of MDA above published airport elevation (used for circling minima).
7. PAR or ASR minima; if applicable.

NOTES

1. In the landing minima section, large type altitudes are MSL and small type are AGL.
2. HAT is associated with Straight-in approaches. HAA is associated with Circling approaches. MDA is associated with Non-precision (no glideslope) approaches.

CATEGORY	A	B	C	D	E
S-ILS 13	* 243/24 200 (200-½)				
S-LOC 13	480/24	437 (500-½)	480/40 437 (500-¾)	480/50	437 (500-1)
CIRCLING	500-1 457 (500-1)	520-1 477 (500-1)	580-1½ 537 (600-1½)	740-2¼ 697 (700-2¼)	860-3 817 (900-3)

Figure 8-6a Landing Minima

RNAV Landing Minima: RNAV instrument approach procedure charts now incorporate all types of approaches using Area Navigation systems, both ground based and satellite based.

The standard format for RNAV minima (and landing minima) is as shown in Figure 8-6b.

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RNAV minima are dependent on navigational equipment capability, as stated in the applicable NATOPS Flight Manual.

NOTE

The T-6B is certified to fly RNAV GPS approaches to LNAV MDA minimums.

CATEGORY	A	B	C	D
LPV DA	7393-2 962 (1000-2)			
LNAV/VNAV DA	7470-2 1039 (1100-2)		7470-3 1039 (1100-3)	
LNAV MDA	7640-11/4 1209 (1200-11/4)	7640-11/2 1209 (1200-11/2)	7640-3 1209 (1200-3)	
CIRCLING	7640-11/4 1189 (1200-11/4)	7640-11/2 1189 (1200-11/2)	7640-3 1189 (1200-3)	

Figure 8-6b IFR RNAV Landing Minima

Aircraft Approach Category – a grouping of aircraft based on an approach speed of 1.3 times the stall speed in the landing configuration at maximum gross weight. Each category provides 300’ of obstacle clearance at MDA within the circling radius.

NOTES

1. The T-6B is an Approach Category B aircraft based on approach speed of 91 to < 121 KIAS.
2. If flying faster approach speeds, you can always go up a category, but never down.

812. AERODOME SKETCH

The aerodrome sketch is provided on each approach plate in the left-hand corner. It shows the runways, taxiways, airport lighting, control tower, vertical obstructions, and the field elevation. All elevations are in feet above Mean Sea Level (MSL).

Note the timing “FAF to MAP” information at the bottom of the aerodrome sketch. This table is used to determine the timing from the FAF to the MAP, at various ground speeds. For example, with an approach speed of 120 KIAS and 10 knots of headwind, groundspeed becomes 110 knots.

The timing in this case must be interpolated: 110 knots = 2 min 20 seconds.

Timing should always be used, when available, as a back up on DME approaches in case the DME should fail.

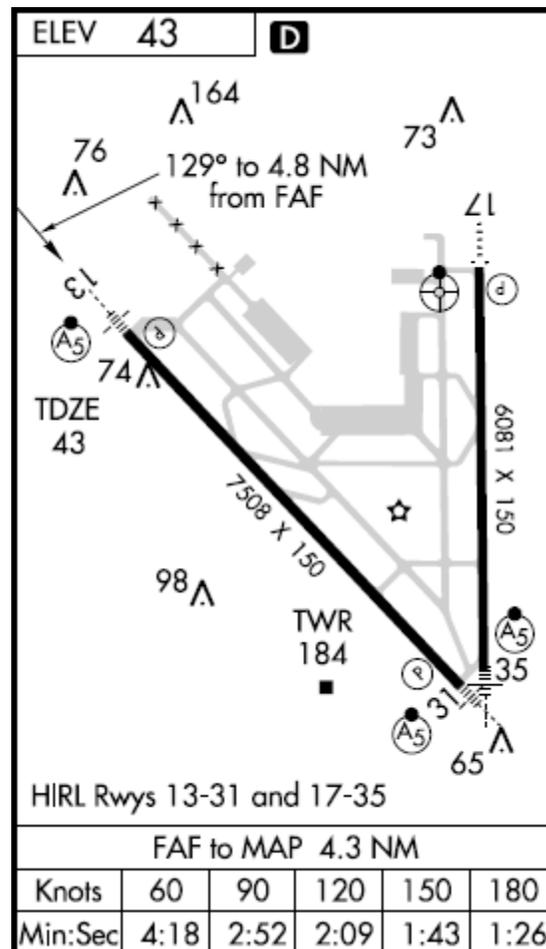


Figure 8-7 Aerodrome Sketch

813. PROCEDURE TURN APPROACH

General. Reverse the aircraft heading within assigned airspace in order to align it with the final approach course.

Description. A Procedure Turn approach is an instrument maneuver used to reverse direction to establish an aircraft inbound on the intermediate or final approach course. Procedure Turns are depicted by a “barb” symbol on the approach plate, that indicates which side of the outbound course to complete the turn (Figure 8-8). Headings are provided to reverse course using a 45/180 degrees type maneuver. However, the point at which the turn may be commenced and the type and rate of turn, are left to the discretion of the pilot, as long as the Procedure Turn is executed on the proper side of the outbound course and the “Remain Within” distance (normally 10 NM) is not exceeded. Options include the 45/180 degrees course reversal, the racetrack pattern, or the

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80/260 degrees course reversal. In Primary, only the 45/180 degrees course reversal will be practiced. Do NOT execute a Procedure Turn when:

1. Radar vectors to the final approach course are provided.
2. A Holding Pattern is specified in lieu of a Procedure Turn.
3. Approach can be made from a properly aligned Holding Pattern.
4. The procedure specifies “No PT,” no Procedure Turn.
5. ATC issued timed approach.

Procedure. The following procedures assume clearance for the DAYTONA BEACH INTERNATIONAL VOR RWY 16 approach (Figure 8-8) has been received and you are proceeding to the IAF.

1. Approximately 5 NM prior to the IAF, slow to 150 KIAS. At the IAF, indicated by station passage, execute the 6 Ts (basically an Over-the-Station Intercept):
 - a. **TIME** – As required; note the time of commencing the approach.
 - b. **TURN** – in the shortest direction to parallel the outbound course (336°). If the outbound course is more than 90° from the course used inbound to the IAF, turn to an intercept heading not to exceed 45°.
 - c. **TIME** – Start timing for one (1) minute outbound when wings level or abeam the station, whichever occurs last.

NOTE

Comply with the “remain within distance” if stated on the approach plate.

- d. **TRANSITION** – If a descent is necessary at the IAF, set approximately 15% torque, lower the nose, and descend at 150 KIAS.

NOTE

Comply with any additional altitude restrictions imposed by ATC.

- e. **TWIST**
 - i. Set CDI to the outbound course (336°).
 - ii. Use “Over-the-Station Intercept” procedures to establish the aircraft on course outbound. The objective is to be established on the outbound radial by the end of one minute.

- f. **TALK** – Give the appropriate voice report if required.
2. **Level-off** at Procedure Turn altitude (1600').
 - a. 100' prior to Procedure Turn altitude, add power smoothly towards 33% torque as you raise the nose to level flight attitude and re-trim.
 - b. **Maintain Procedure Turn altitude until you are established on the inbound course.**

NOTE

The aircraft is not considered “established on course” until the head of the bearing pointer is within five radials of the inbound course. With the CDI set correctly, the course deviation bar will be between the “one dot” and “centered” position.

3. At the end of outbound timing, execute the 45/180 degrees course reversal by turning to the heading depicted next to the “barb” symbol (291°). Start the clock as you roll wings level and maintain this heading for one (1) minute. Twist in the inbound course (156°) in the CDI.
4. At the end of one (1) minute timing, execute a 180° turn in a direction opposite the first turn (i.e., turn away from the station).
 - a. If the head of the needle is not within 5° of the inbound course, stop the turn on the heading depicted on the barb (111°).
 - b. If the head of the needle is within 5° of the inbound course, you should roll out with a double-the-angle intercept. If you overshoot the inbound course, continue the turn and establish an intercept.
5. As you intercept the inbound course, turn and track inbound.
6. Once established on the inbound course, and within 5 NM of the FAF (when DME is available), configure to BAC.
7. Comply with the remainder of the Low Altitude Instrument Approach Procedures.

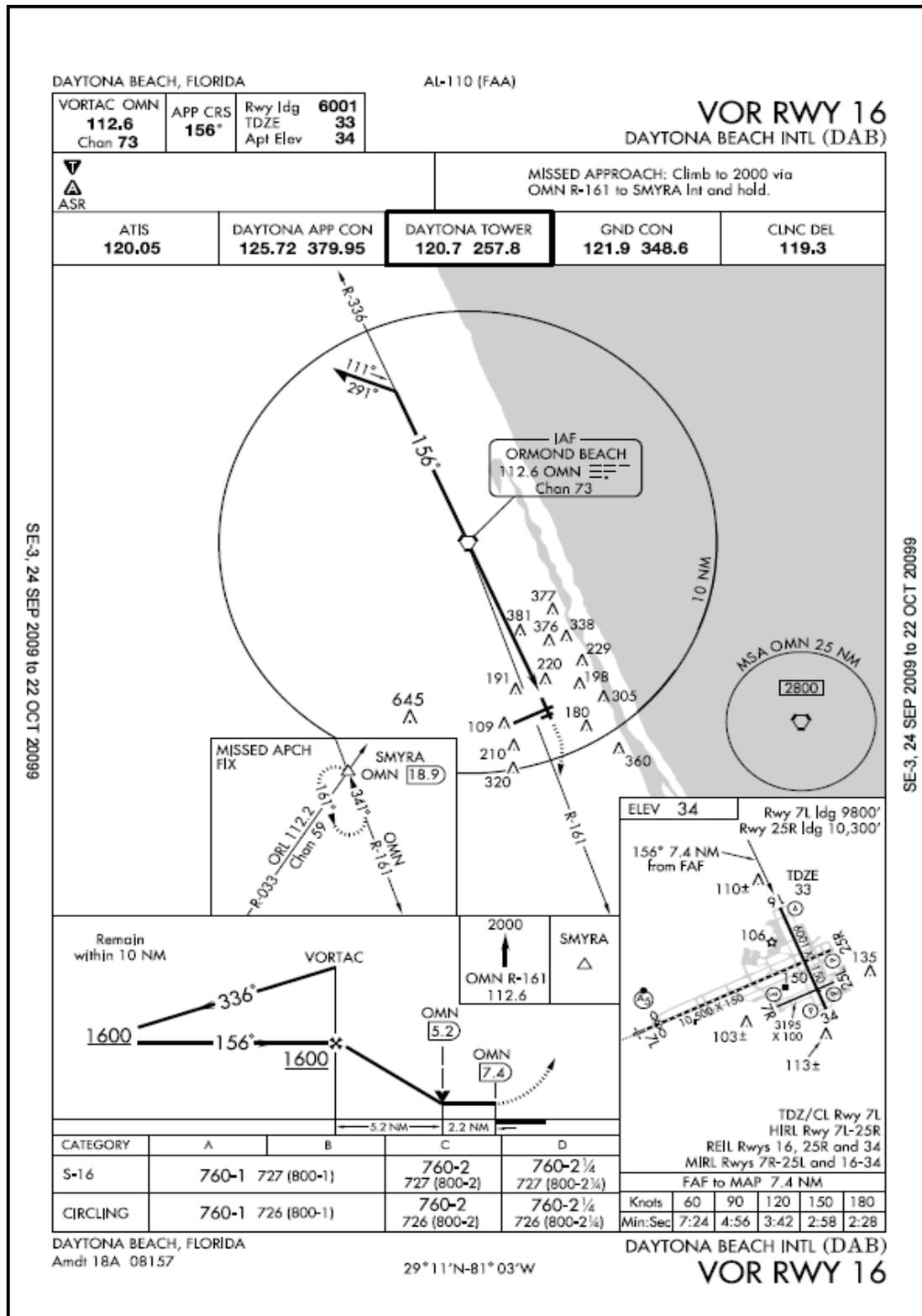


Figure 8-8 VOR 16 (KDAB)

814. TEARDROP APPROACH

General. Reverse the aircraft heading in order to align it with the final approach course.

Description. A Teardrop approach makes use of an outbound to inbound radial intercept maneuver to reverse course and establish the aircraft inbound on the intermediate and final approach course. Do not exceed the “Remain Within” distance.

Procedure. The following procedures assume clearance for the ROBINS AFB VOR RWY 15 approach (Figure 8-9) has been received and you are proceeding to the IAF.

1. Approximately 5 NM prior to the IAF and commencing approach, slow to 150 KIAS. At the IAF, indicated by station passage, execute the 6 Ts (basically an Over-the-Station Intercept):
 - a. **TIME** – Not required; time of commencing the approach is not reported to the controlling agency.
 - b. **TURN** – Turn in the shortest direction to parallel the outbound course (295°). If the outbound course is more than 90° from the course used inbound to the IAF, turn to an intercept heading not to exceed 45°.
 - c. **TIME** – Start timing for two (2) minutes outbound when wings level or abeam the station, whichever occurs last.

NOTE

In strong winds or at indicated speeds greater than 150 KIAS, you may have to adjust outbound timing to comply with any “Remain Within” distance associated with the approach. Normally, a (2) two minute timing outbound will be sufficient.

- d. **TRANSITION** – If a descent is necessary at the IAF, set approximately 15% torque, and descend at 150 KIAS.

NOTE

Comply with any additional altitude restrictions imposed by ATC.

- e. **TWIST**
 - i. Set the outbound course (295°) into the CDI.
 - ii. Use “Over-the-Station Intercept” Procedures to establish the aircraft on course outbound. The objective is to be established on the outbound radial by the end of one minute.

- f. **TALK** – give the appropriate voice report if asked to report “VOR outbound.”
2. **Level-off** at Procedure Turn altitude (2300').
 - a. 100' prior to Procedure Turn altitude, add power and raise the nose to maintain 150 KIAS in level flight. Continue to re-trim.
 - b. Maintain Procedure Turn altitude until you are established on the inbound course.

NOTE

The aircraft is not considered “established on course” until the head of the bearing pointer is within five radials of the inbound course. With the CDI set correctly, the course deviation bar will be between the “one dot” and “centered” position.

3. After 1 ½ minutes of outbound timing, twist inbound course into the CDI (134°).
4. At two (2) minutes of outbound timing, execute a turn in the direction depicted (in this case, turn right).
 - a. If the head of the needle is not within 5° of the inbound course, stop the turn with a 45° intercept.
 - b. If the head of the needle is within 5° of the inbound course, you should roll out with a double-the-angle intercept. If you overshoot the inbound course, continue the turn and establish an intercept.
5. Once established on the inbound course, turn and track inbound, and configure to BAC when within 5 NM of FAF (when DME is available). Maintain altitude until reaching 120 KIAS, then commence descent if required (in this case to 1500' MSL).
6. Comply with the remainder of the Low Altitude Instrument Approach Procedures.

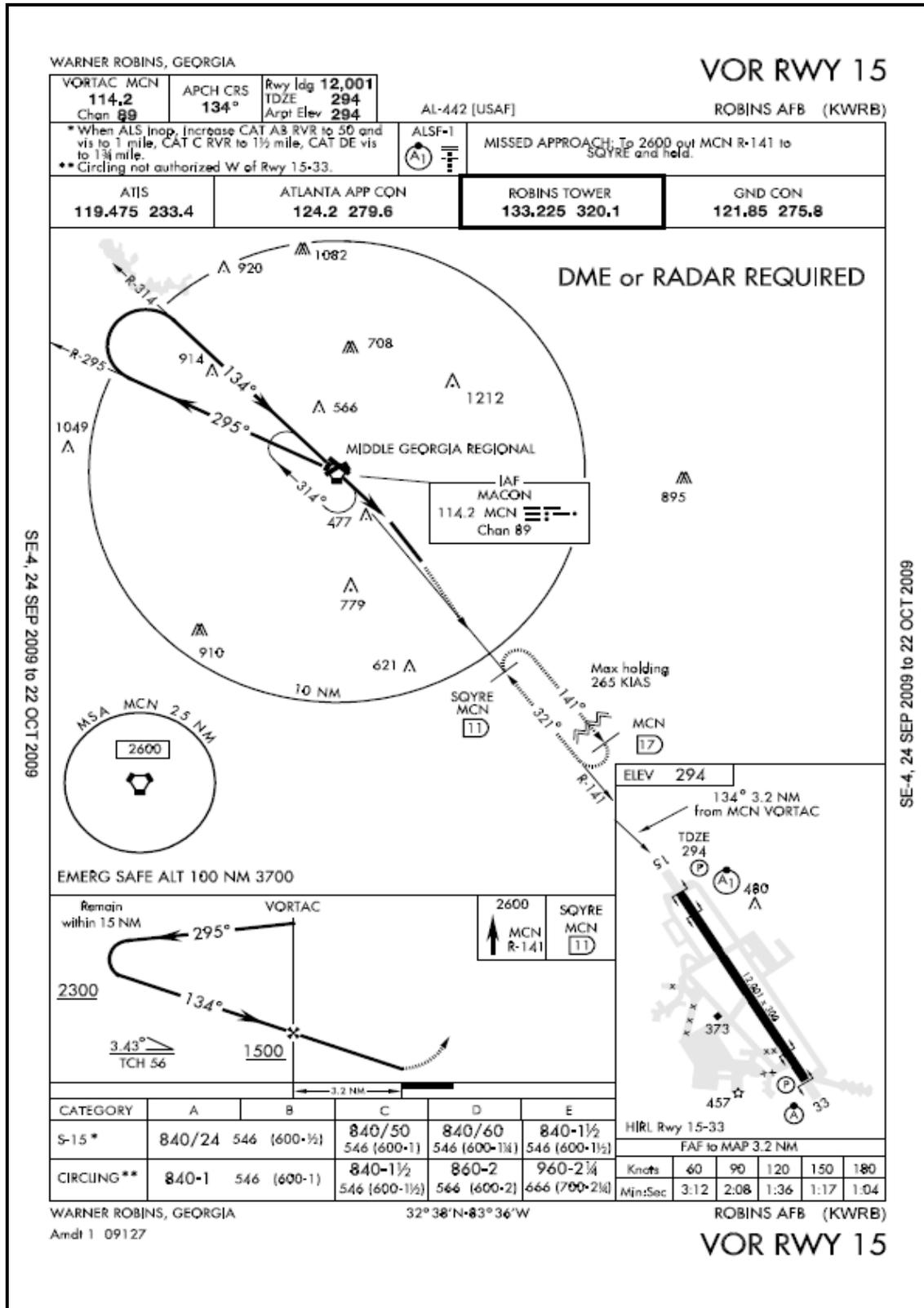


Figure 8-9 VOR RWY 15 (KWRB)

815. ARCING APPROACH

General. Establish the aircraft inbound on the final approach course.

Description. An Arcing approach makes use of an arcing maneuver to position the aircraft inbound on the final approach course. Arcing approaches are normally identified by VOR/DME or TACAN in the approach plate margin, meaning DME is required.

Arcing Speed. When executing Arcing approaches, maintain 150 KIAS until the lead turn onto the final approach course has been made, or until 5 NM prior to FAF.

NOTE

Use Radial/Arc and Arc/Radial intercepts to make the turn onto and off of the arc.

Procedure. The following procedures assume clearance for the VOR/DME Z or TACAN Z RWY 13R (KNGP) approach (Figure 8-10) has been received and you are proceeding direct to the IAF.

1. At the IAF:
 - a. **TIME** – Not applicable.
 - b. **TURN** – Turn in order to place the VOR needle at the 90° benchmark.
 - c. **TIME** – Not applicable.
 - d. **TRANSITION** – Comply with any altitude restrictions as required.

NOTE

On some approaches, the transition at the IAF could involve a descent and/or a reduction in airspeed.

- e. **TWIST** – Ensure the inbound course (143°) is set in the CDI.
 - f. **TALK** – Give the appropriate voice report if required.
2. Anticipate interception of the final approach course (referencing the tail of the VOR/DME needle and the CDI) while on the arc. Remember, the turn onto final approach course is a 90° intercept.
 3. When within 5 NM of FAF, make a level or descending transition to BAC.

NOTE

On some approach charts, a published lead radial (designated “lr-xxx”) is provided as an advisory point for turning onto the inbound course. These designated lead radials are based on the performance of the aircraft for which the approach was designed. For instance, at Eglin AFB, the approaches and lead radials were designed with the performance of the F-15 in mind. For this reason, published lead radials shall not be used in the T-6B. The pilot may elect to calculate the lead radial based on airspeed and distance from the NAVAID.

4. Once established inbound, comply with the remainder of the Low Altitude Instrument Approach Procedures.

Common Errors.

1. Overshooting the arc or final approach course due to insufficient lead or slow scan of instruments.
2. Failure to descend to minimum altitudes for the various approach segments.

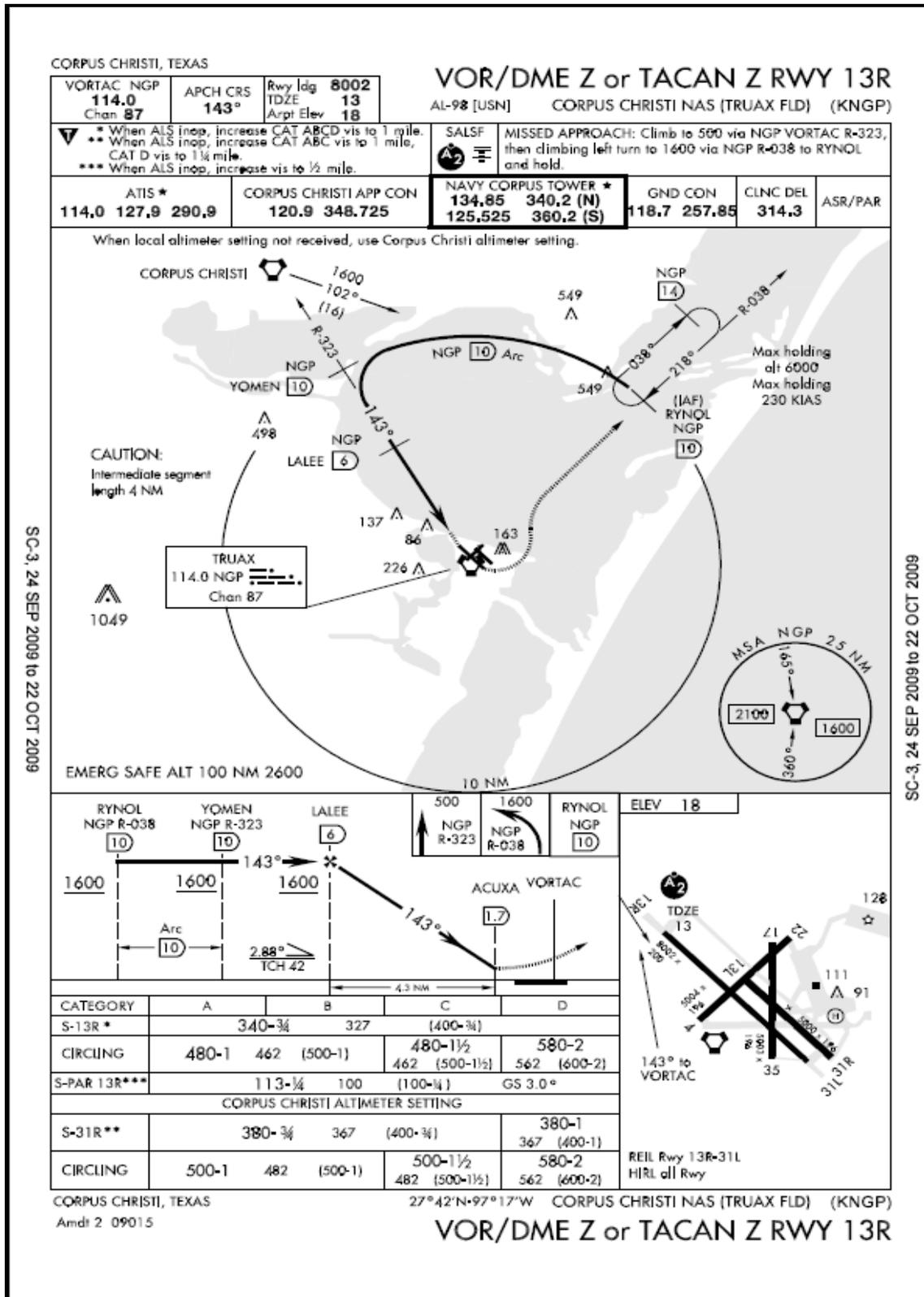


Figure 8-10 VOR / DME Z 13R (KNGP)

816. HOLDING PATTERN APPROACH (HILO)

General. The Holding Pattern/Holding In Lieu Of (HILO) procedure turn approach is used to establish and orient the aircraft in a position to commence the approach.

Description. A Holding Pattern approach uses a published holding pattern to reverse course and establish the aircraft inbound on the intermediate or final approach course. Holding Pattern approaches are printed using a normal holding pattern track with a heavy line indicating “In lieu of Procedure Turn.” The entry turn and maneuvering in holding requires normal holding procedures. Only one turn in the Holding Pattern is expected unless more turns are necessary to lose excessive altitude or to become better established on course, in which case, ATC must be advised. Descent from the minimum holding altitude may be commenced at the holding fix (“Case I” below and Figure 8-11) or on the inbound leg (“Case II” below and Figure 8-11).

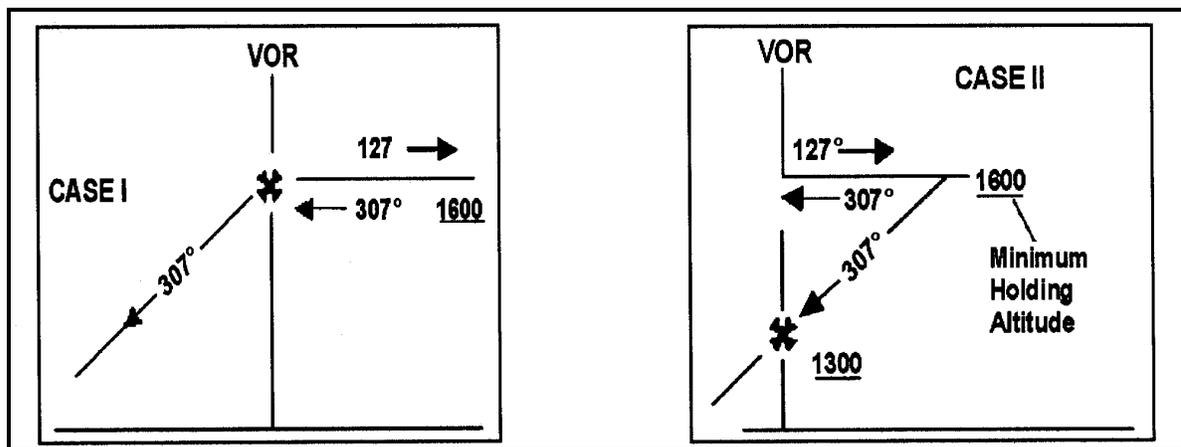


Figure 8-11 Holding Fix Descent

Unlike the Teardrop and Procedure Turn approaches, the Holding Pattern approach will always have a FAF depicted on the approach.

NOTE

Established in a holding pattern (as depicted in Figure 8-12) and subsequently cleared for the approach, do not execute a procedure turn. Use Holding Pattern/HILO approach procedures.

Procedure. The following procedures assume clearance for the MARIANNA MUNI VOR or GPS-A approach (Figure 8-12) has been received and you are proceeding to the IAF.

1. Approximately 5 NM prior to the IAF, slow to 150 KIAS. At the IAF, indicated by station passage, execute the 6 Ts.
 - a. **TIME** – Not required, since time of commencing the approach is not reported to the controlling agency.

- b. **TURN** – Use normal Holding Pattern entry procedures to determine the entry heading and turn direction. Turn in the shortest direction to your entry heading.
- c. **TIME** – Start timing as required when wings level or abeam the station, whichever occurs last.
- d. **TRANSITION** – If a descent is necessary at the IAF, set approximately 15% torque, lower the nose, and descend at 150 KIAS.

NOTE

Comply with any additional altitude restrictions imposed by ATC.

- e. **TWIST** – Enter in the depicted inbound course (316°) into the CDI.
 - f. **TALK** – Give the appropriate voice report if required.
2. Determine the correct direction of turn to intercept the inbound course (316°) in accordance with holding procedures. **TAIL–RADIAL–TURN!**
 3. Start the turn at the completion of your outbound timing. Roll out with a double–the–angle intercept. It is critical to establish the aircraft **on** the inbound course prior to crossing the station.
 4. Once established inbound, and when within 5 NM of FAF (when DME is available), configure to BAC. Comply with the remainder of the Low Altitude Instrument Approach Procedures.

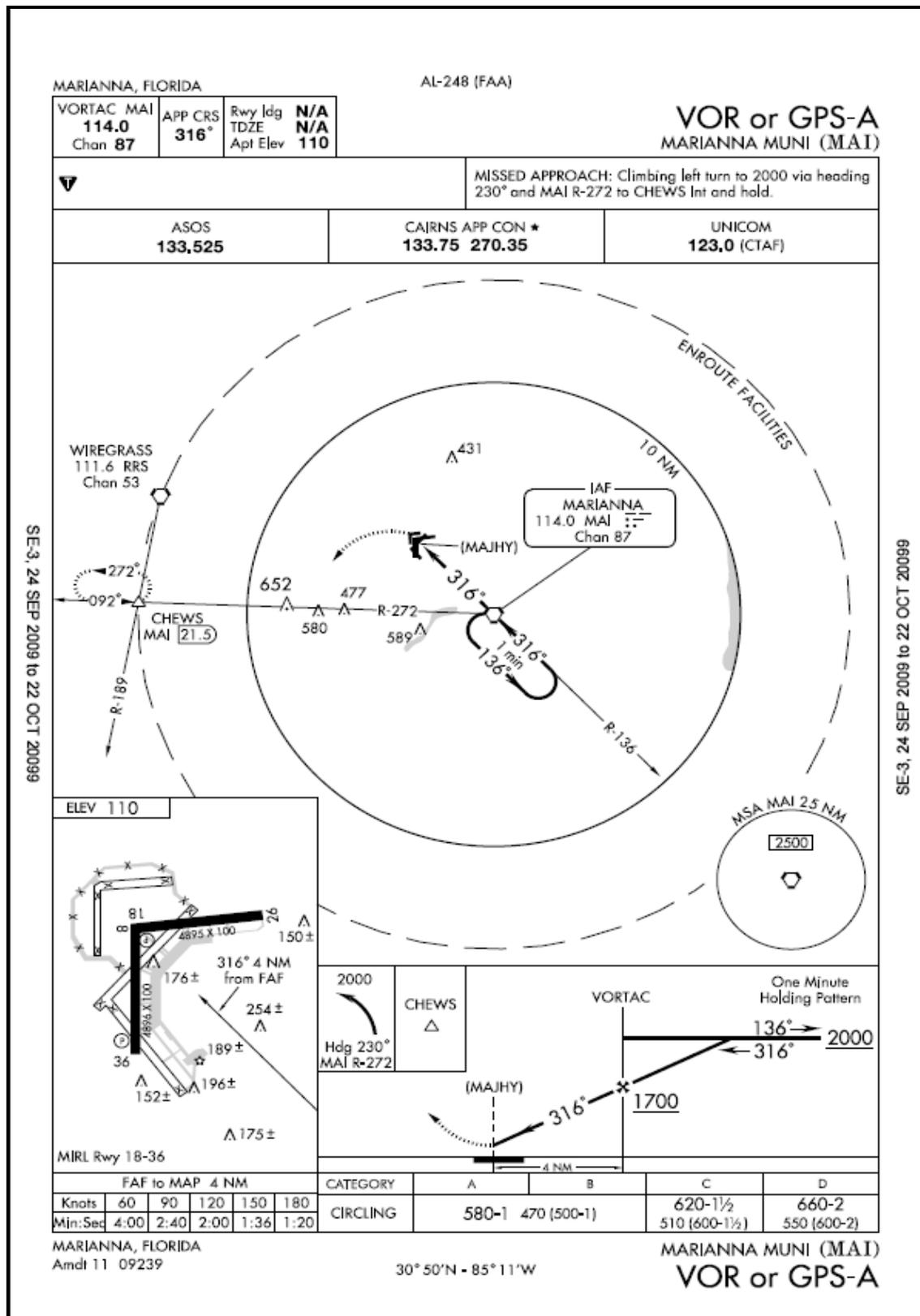


Figure 8-12 VOR or GPS-A (KMAI)

817. STRAIGHT-IN APPROACH

General. Establish the aircraft inbound on a Straight-in approach.

Description. A Straight-in approach is an Instrument approach conducted by proceeding to the FAF at a prescribed altitude and continuing inbound on the final approach course to the airport without making a Procedure Turn. These approaches utilize intersections, VOR/DME fixes, and other NAVAIDS as an IAF that may or may not be aligned with the final approach course. These approaches sometimes have IAFs located on an airway (including IAFs located on an arc) to simplify the transition from the enroute phase to the terminal phase of flight without having to execute a Procedure Turn type approach.

NOTE

A Straight-in procedure **does not** mean the approach must be completed with a Straight-in landing or made to straight-in landing minimums.

Generally, there are two basic differences in Straight-in approaches:

1. Approaches that have the IAF aligned with the final approach course (Figure 8-13).
2. Approaches that do not have the IAF aligned with the final approach course. The term “No PT” designated along a track arrow (thick arrow) from a point identified as the IAF, originating from a feeder NAVAID identified as the IAF (Figure 8-14) or an enroute feeder fix identified as “IAF” (Figures 8-15), indicates you will not fly a Procedure Turn type approach.

NOTE

The absence of the “No PT” designation, at the enroute feeder fix or “IAF” for a feeder NAVAID, indicates that the feeder fix or NAVAID is solely used to direct the aircraft to an IAF along a designated track and altitude. If cleared for an approach while tracking inbound to the IAF from a feeder fix (**thin** arrow, NOT designated “NO PT” or “IAF”), you may descend to the altitude depicted along the feeder, or IAF crossing altitude, whichever is higher. Upon arrival at the IAF, perform the appropriate approach procedures.

Straight-in approaches may display an arrival holding pattern at the IAF. TACAN or VOR/DME is usually required since the IAF, step-down fixes, and FAF are determined by DME. A variation to this typical approach would be, a VOR approach utilizing intersections formed by radial cuts from another facility to provide an IAF or FAF, such as the AUBURN VOR RWY 29 (Figure 8-13).

Procedure. The following procedures assume that you arrived at the IAF, MINIM, and cleared for the STARKVILLE/OKTIBBEHA VOR or GPS-B straight-in approach (Figure 8-15).

1. At the IAF (Using an enroute feeder fix that is identified as either “NO PT” or “IAF” – such as “MINIM”):

- a. **TIME** – Not required.
- b. **TURN** – Turn in shortest direction to intercept the initial approach course (258°).
- c. **TIME** – If required.

NOTE

When distance from the IAF to the Final Approach Fix is excessive (i.e., more than 5 NM), cruise airspeed should be maintained and landing configuration delayed until within 5 NM of the FAF. If DME is not available, the time required to fly to a point within 5 NM can be estimated at a rate of 3.0 miles per minute if flying at 180 KIAS. In this example, approximately 6 minutes are required to proceed to a point within 5 NM of the FAF. (24 – 5 = 19 NM; 19 / 3 = 6+20 minutes). Timing is not required if DME is available, but should be used as a backup in case DME fails.

- d. **TRANSITION**
 - i. If a descent is required, establish the aircraft on course, and then use terminal descent procedures to descend to the altitude specified (1900') and level-off at normal cruise airspeed.

When within 5 miles of the FAF:

- ii. Make a level or descending transition to BAC.
- e. **TWIST**
 - i. Twist the initial approach course (IAC) into the CDI (258°).
 - ii. Turn to intercept the initial approach course. Track inbound to the FAF.
- f. **TALK** – Give the appropriate voice report if required.

2. Comply with any altitude restrictions on the approach.

3. Once established inbound, comply with the remainder of the Low Altitude Instrument Approach Procedures.

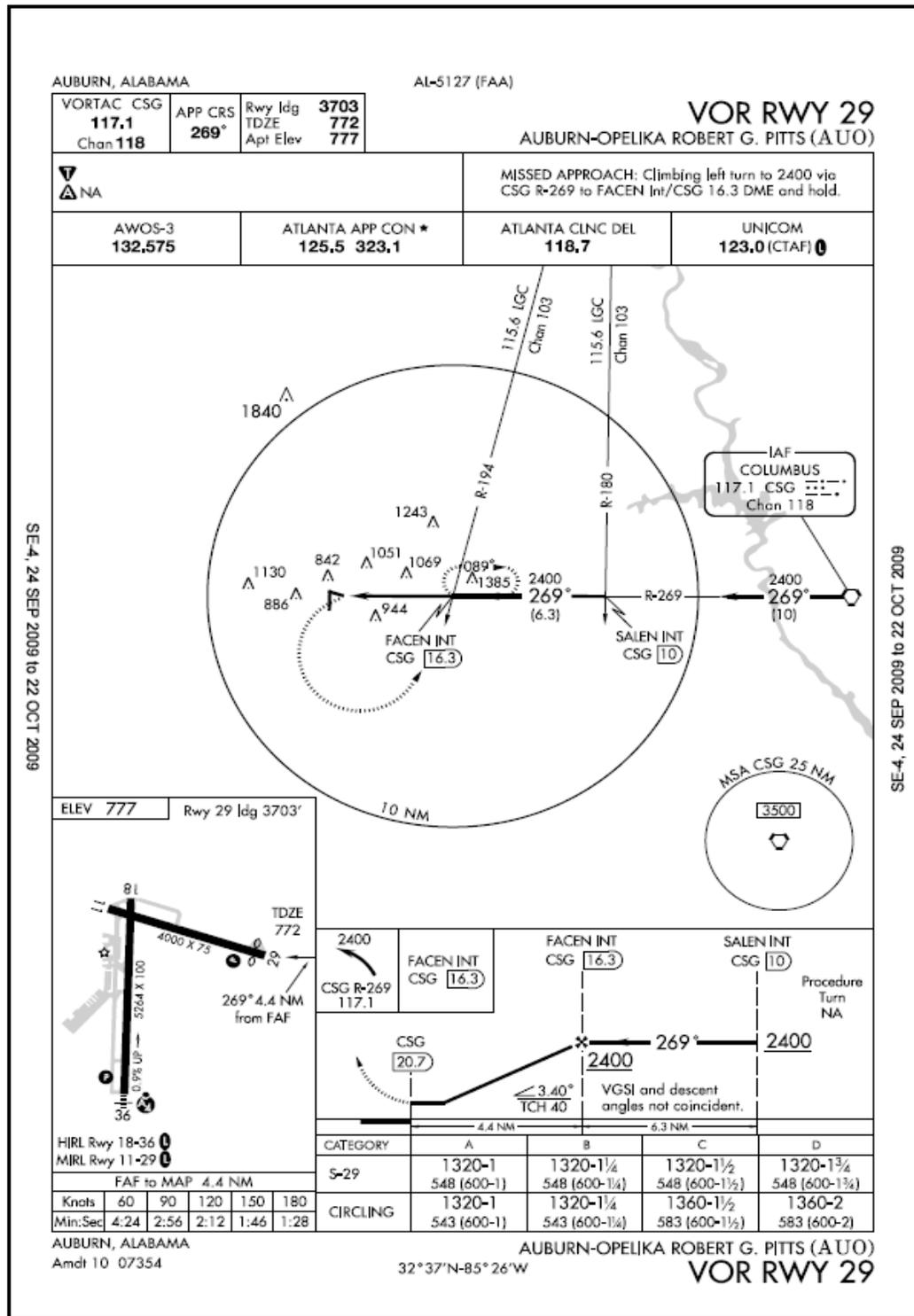


Figure 8-13 VOR RWY 29 (KAUO)

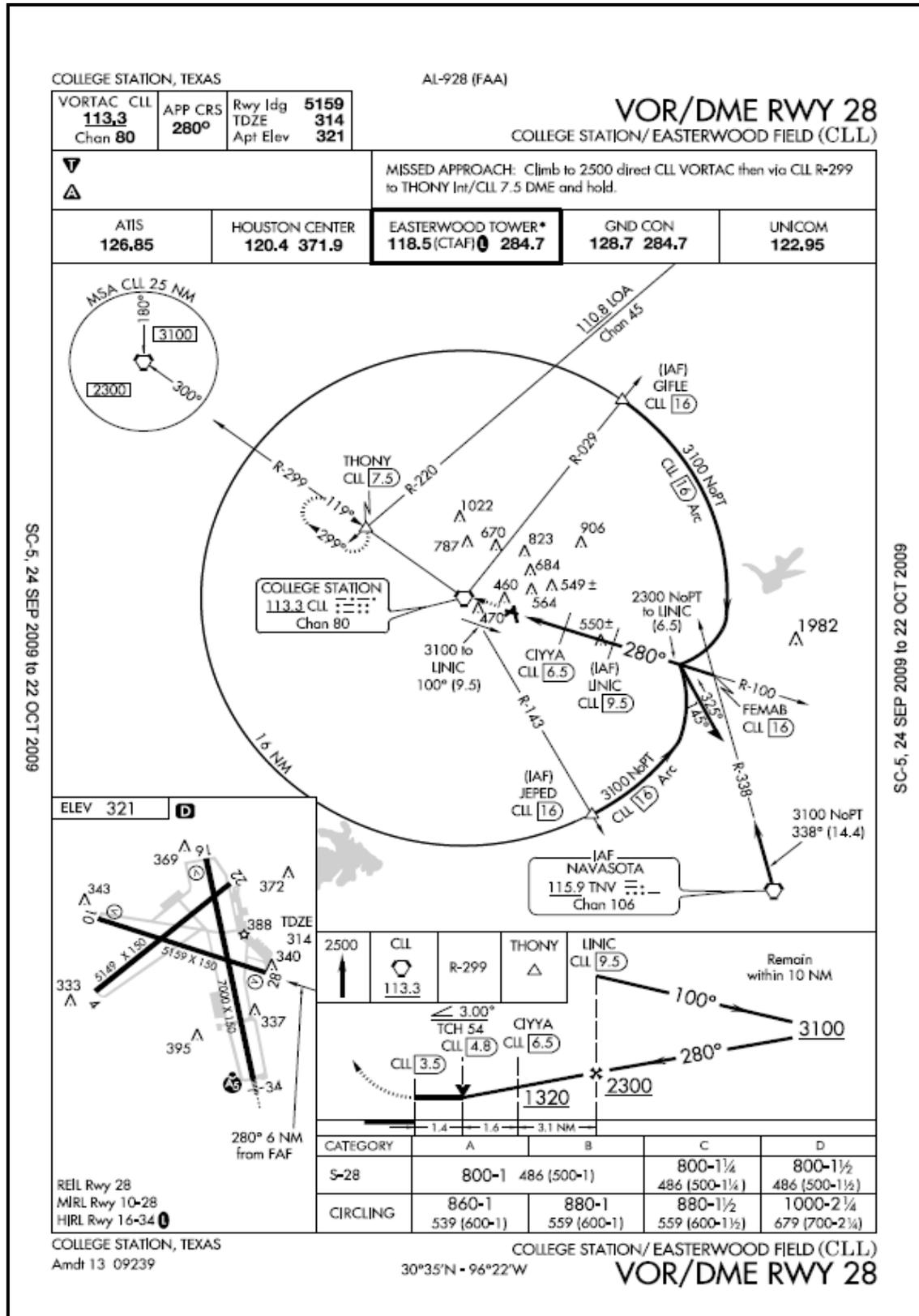


Figure 8-14 VOR/DME RWY 28 (KCLL)

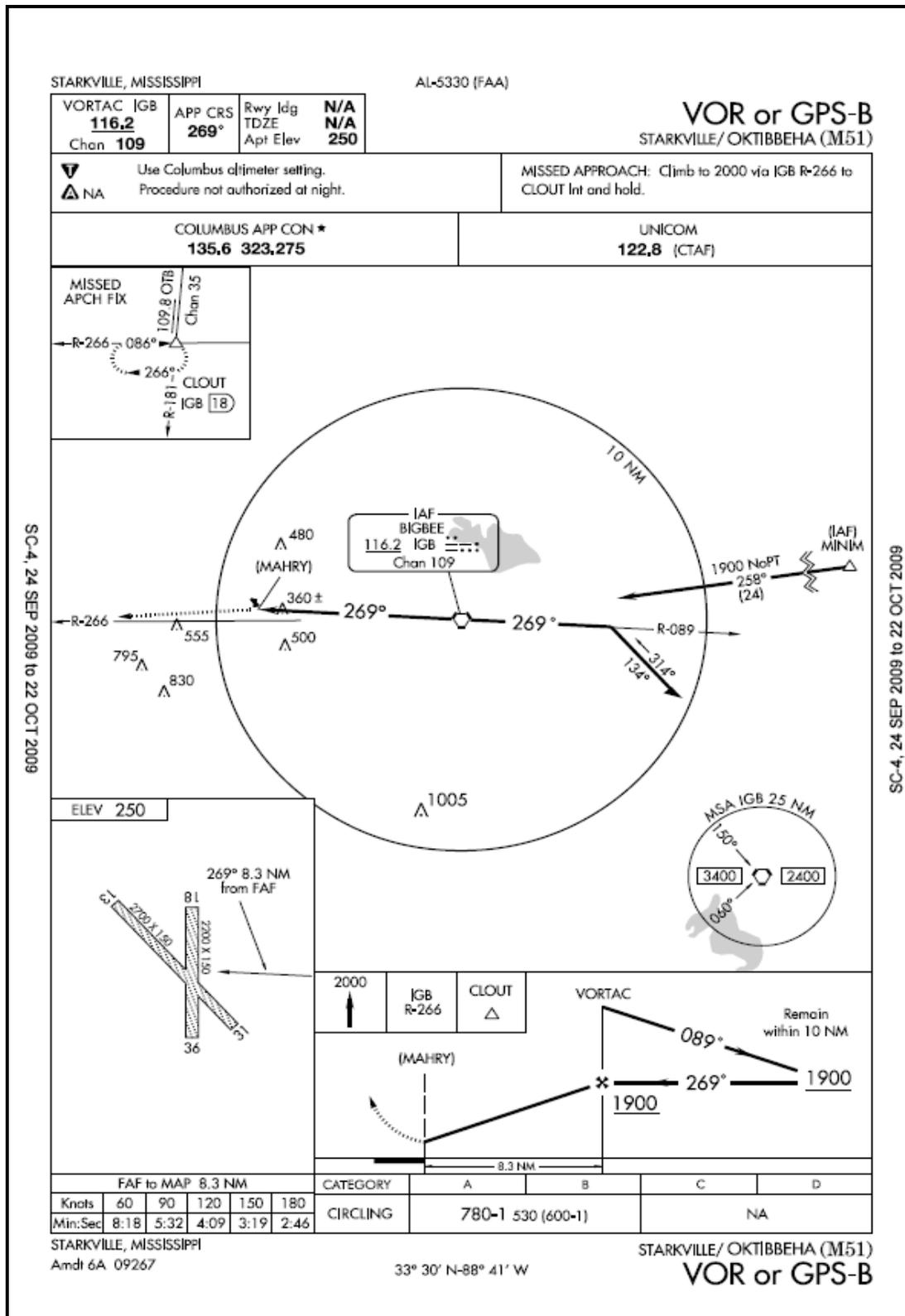


Figure 8-15 VOR or GPS-B (M51)

818. RADAR VECTORS TO FINAL APPROACH COURSE

General. Navigate to the final approach course following controller instructions.

Description. Radar vectors to final approach course is a procedure used by approach control to increase the arrival rate of aircraft and to establish aircraft on the final approach course through the most expeditious routes consistent with traffic situations.

Although this routing does expedite arrival at your destination, it has one characteristic of which you should be aware – the lack of published minimum altitudes until joining a segment of a published approach. Approach control has the statutory responsibility for ensuring terrain clearance while vectoring you for the approach. This is done using Minimum Vectoring Altitude (MVA) charts superimposed on radar displays.

Pilots should never fully relinquish the responsibility for terrain clearance to an outside agency. Maintain situational awareness and crosscheck terrain clearance altitude by using all available NAVAIDS. Never blindly follow vectors from a controller – be aware of what lies ahead on your assigned heading. If in doubt, query the controller.

Procedure. (Figure 8-16) Fly 200 KIAS on downwind and 150 KIAS on base. Keep a high level of situational awareness and know where the aircraft is in relation to the final approach fix.

1. Tune and identify the appropriate NAVAID.
2. Check the PFD is configured properly.
3. Set the final approach course into the CDI.
4. Follow radar vectors given by approach control.
5. If a lower altitude is assigned, perform a terminal descent.
6. Transition to BAC:
 - a. When within 5 NM of the FAF and aircraft heading is within 90° of the final approach course, or
 - b. Once established on final if no FAF is depicted.
7. When cleared for the approach, maintain the last assigned altitude and heading given by ATC until established on the approach. As the CDI begins to center, and you are cleared for the approach, you are expected to turn onto the final approach course and track it inbound.
8. Once established inbound, comply with the remainder of the Low Altitude Instrument Approach Procedures.

Common Errors.

1. Poor orientation, loss of SA.
2. Not setting the correct NAV source in the PFD.
3. Failure to transition to BAC at the appropriate time.
4. Failure to intercept the approach course once cleared for the approach. Be alert for CDI movement and lead the turn sufficiently to roll out on course.

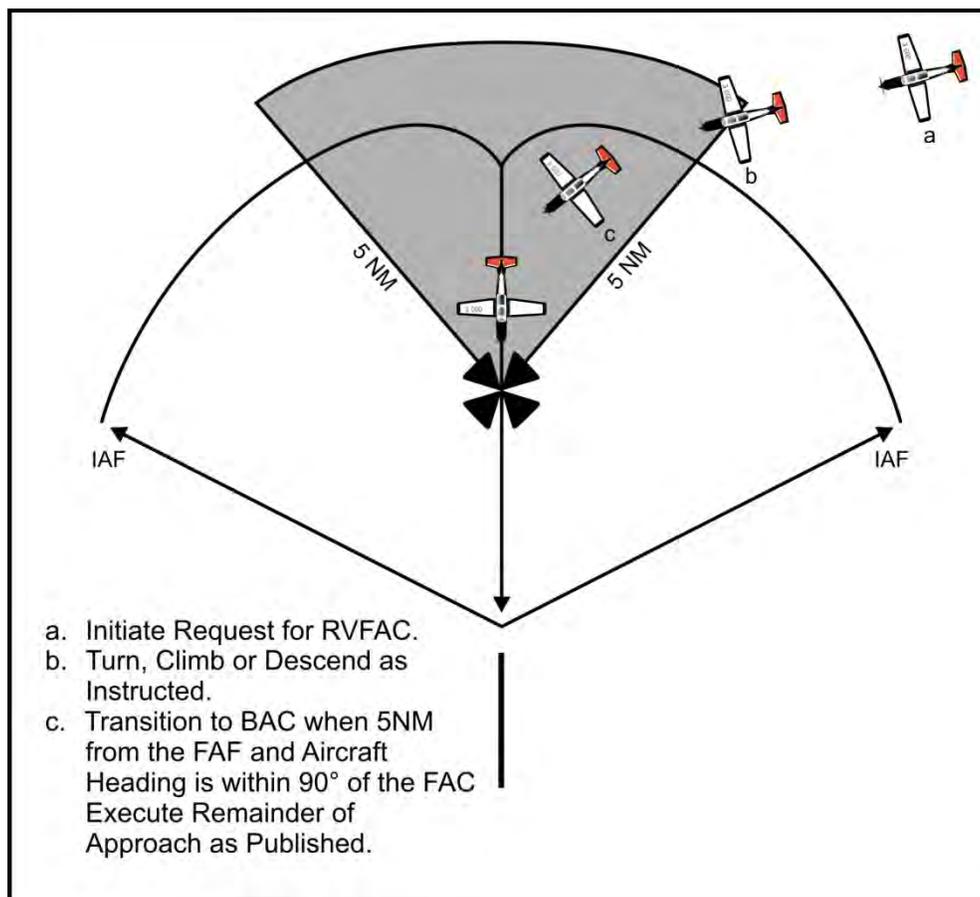


Figure 8-16 RVFAC (FAF Depicted)

819. HIGH ALTITUDE APPROACH

Description. A high altitude instrument approach enables an aircraft to transition from the high altitude structure to a position on the final approach course for landing. These approaches are routinely executed by high performance military aircraft into military aerodromes for the following reasons: to maintain efficient fuel consumption, to maintain higher TAS, and to avoid low altitude weather until closer to the destination.

The procedures used to execute a High Altitude Instrument approach combine a penetration descent with Instrument Approach Procedures (typically a Teardrop or Arcing approach). For this reason, High Altitude approaches normally require higher rates of descent and indicated airspeeds than Low Altitude approaches until the transition to BAC. Once the aircraft is configured to BAC, procedures for both High and Low Altitude Instrument approaches are the same.

Procedure. (Figure 8-17, HI-VOR RWY 19 Forest Sherman Field Pensacola NAS)

1. Inbound to the IAF, complete the Descent Checklist.
2. At the IAF, execute the 6 Ts:
 - a. **TIME** – not required; time of commencing approach is not reported.
 - b. **TURN** – turn in the shortest direction to parallel the course.

NOTES

1. The penetration course is depicted on high altitude IAP charts by a bold-dotted track (Figure 8-17).
2. If the outbound course is more than 90° from the course used inbound to the IAF, turn to an intercept heading not to exceed 45°.
 - c. **TIME** – as required.
 - d. **TRANSITION** – Initiate the penetration by reducing power as required to meet a target descent rate (2000-4000 FPM). Fly 200-250 KIAS, use speed brake as required.
 - e. **TWIST** – set the appropriate course in the CDI and establish an intercept heading (if not previously accomplished).
 - f. **TALK** – make the appropriate report if required.
3. Manage energy to comply with all course, altitude, and DME restrictions. Lead the level-off from penetration by 1000'. Level segments of the penetration may be flown at normal cruise.
 - a. **Teardrop Penetration**

At one-half your initial altitude or reaching the published penetration turn, fly the penetration turn in the published direction. A 30° AOB turn is normally used during the penetration. During the last half of the turn, note the position of the head of the needle:

If the head of the needle is not within 5° of the inbound course, stop the turn with a 45° intercept.

If the head of the needle is within 5° of the inbound course, continue the turn and roll out with a double-the-angle intercept.

b. **Penetration including an Arcing Maneuver**

When turning 90° onto an arc from a radial using SRT, the amount of lead (in nautical miles) should be 0.5% of groundspeed. Do not exceed 30° AOB or SRT, whichever occurs first.

NOTE

Some high altitude approach charts have penetration instructions printed in the profile view of the approach chart. Review and comply with all printed instructions.

4. Once established inbound, comply with the remainder of the Low Altitude Instrument Approach procedures.

NOTE

High altitude approach charts do not contain landing minimums for category B aircraft. T-6Bs should use category C minimums.

820. STRIKE TOP-OFF INSTRUMENT APPROACH PROCEDURES

Description. Students selected for the Strike Pipeline will fly additional instrument sorties in order to prepare them for advanced jet training.

Procedures.

1. Events will be flown from the front cockpit.
2. Students will train and practice single seat procedures.
3. Events should be flown within the high-altitude structure. If available, high-altitude approaches should be used.
4. All instrument approaches will be flown at 200-250 KIAS, with a transition to BAC within 5 NM prior to the FAF by setting the PCL to idle and extending the speed brake. All other procedures remain the same.

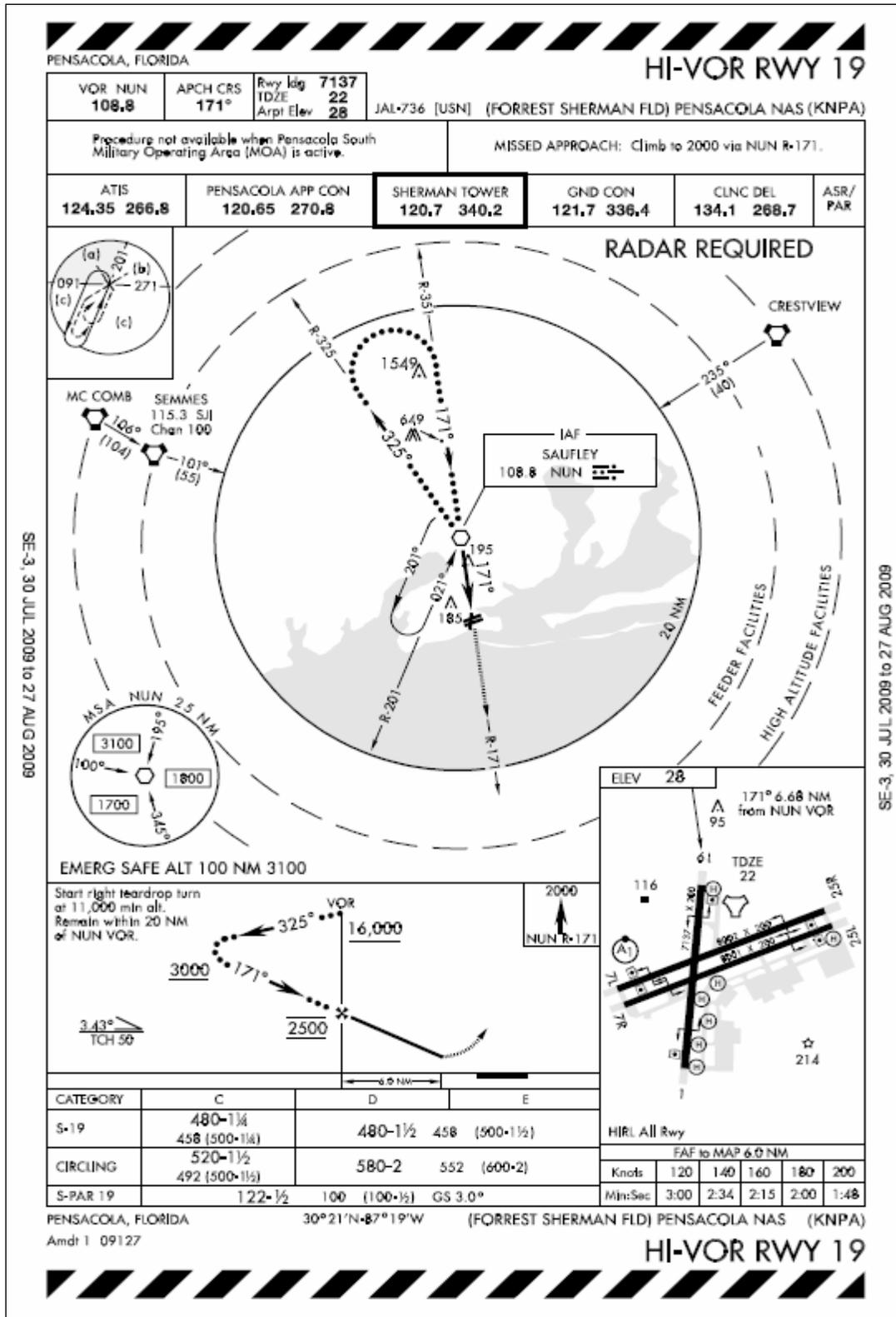


Figure 8-17 High Altitude Approach (KNPA)

CHAPTER NINE FINAL APPROACH PROCEDURES

900. INTRODUCTION

The previous chapter covered how to safely navigate to the final approach fix. This chapter will cover the segment between the FAF to the MAP. This segment of the approach is the most demanding, as the aircraft is slow, low, and configured.

901. VOR APPROACH

General. Fly the aircraft in a controlled and predictable manner to the MAP at the MDA in order to set the aircraft up for landing.

Description. VOR approaches come in many different forms. Below is a list of some of the variations you may encounter as you go through training.

1. Many VOR approaches require a small course change at the final approach fix.
2. Some VOR approaches do not have an FAF.
3. Some VOR approaches have DME, some do not.
4. Timing may be required to identify the MAP.

Procedure. In the following example (Figure 9-1), the aircraft is at the FAF, configured to BAC.

1. Perform 6 Ts:
 - a. **TIME** – Start timing, may be needed as a backup to identify the MAP if DME fails.
 - b. **TURN** – Turn in shortest direction to parallel the final approach course (156°).
 - c. **TIME** – Not required.
 - d. **TRANSITION** – Set 15% torque, trim nose up for 120 KIAS, and allow the nose to fall in order to achieve 800-1000FPM rate of descent.
 - e. **TWIST** – If not already done, twist the final approach course (FAC) into the CDI (156°) and set an intercept heading as required.
 - f. **TALK** – Give the appropriate voice report if required.
2. 100' prior to MDA, slowly add power to arrest the rate of descent.

3. At the MDA (700'), set 35% torque and level-off. Proceed to the MAP (7.4).

NOTE

Do not descend below the MDA, even if the field is in sight, until reaching the VDP. In this example, a VDP of 5.2 is calculated using procedures outlined in Appendix B.

4. If the field is in sight and a safe landing can be made, maneuver to land. If not, execute a Missed Approach.

Common Errors.

1. Excessive corrections over or near the VOR.
2. Failure to back up DME with timing.

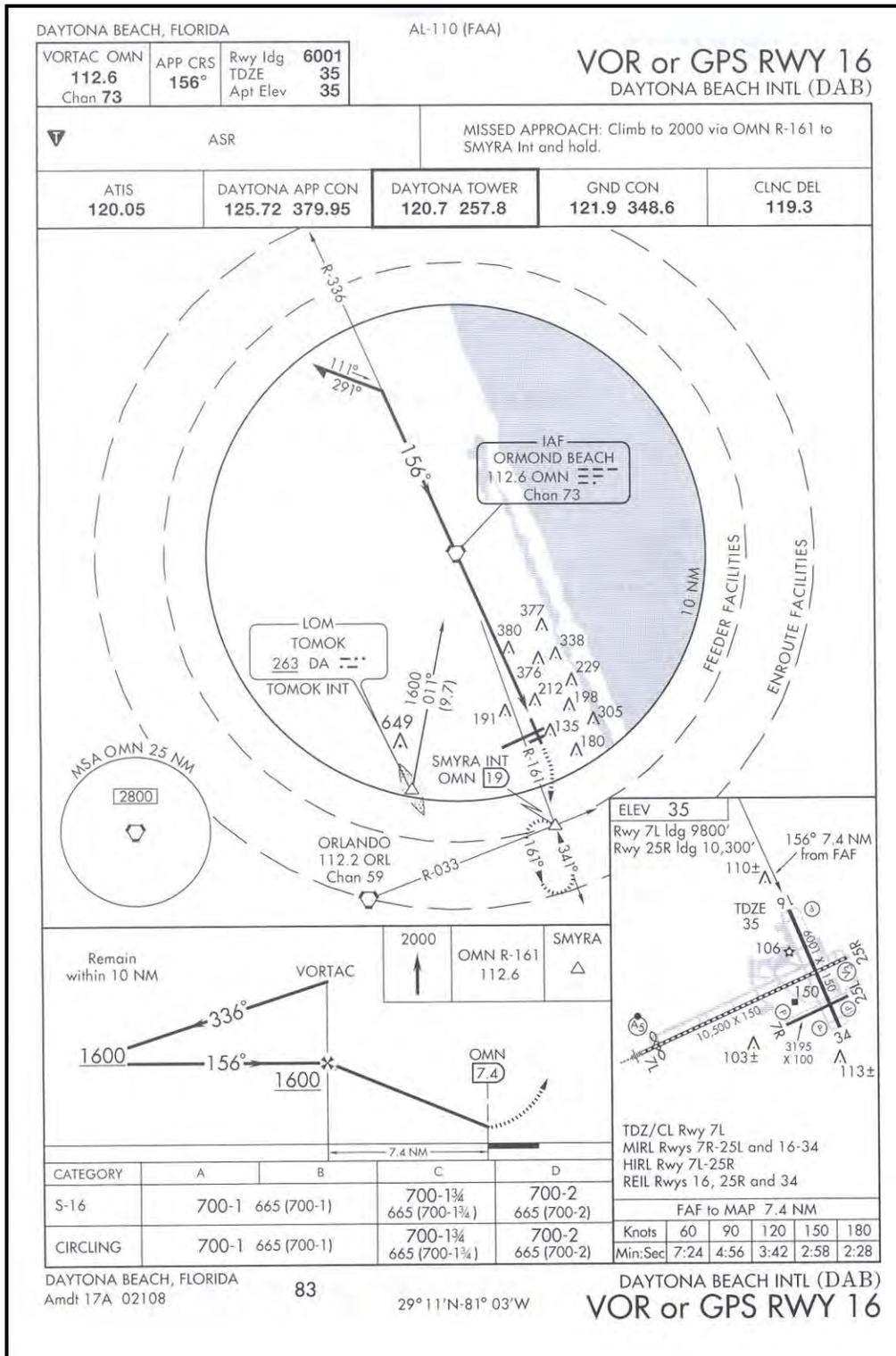


Figure 9-1 VOR or GPS RWY 16 (KDAB)

902. INSTRUMENT LANDING SYSTEM (ILS)

General. Fly the aircraft in a controlled and predictable manner to the decision altitude (DA) in order to set the aircraft up for landing.

Description. The ILS is designed to provide an approach path for exact alignment and descent of an aircraft on final approach to a runway. The system can be divided functionally into three parts:

1. Guidance information: localizer, glideslope.
2. Range information: DME, marker beacon, GPS waypoint.
3. Visual information: approach lights, touchdown and centerline lights, runway lights.

NOTES

1. The ILS FAF is at glideslope intercept, when at or below the published glideslope intercept altitude as indicated by the lightning bolt symbol. The localizer FAF is normally indicated by a maltese cross. For many ILS approaches, the glideslope intercept point and FAF for the localizer approach are not co-located. Whether executing the ILS or the localizer approach, you must start back-up timing at the non-precision FAF (not glideslope intercept). This procedure allows you to identify the non-precision MAP, provided there is a timing block depicted on the approach plate.
2. If executing an ILS approach and glideslope indications fail, revert to localizer procedures and minimums.

Procedure. Use Figure 9-2 for the following example: the aircraft is being vectored on downwind for an ILS approach to Runway 13 at Corpus Christi International. As a memory aid for the ILS and the LOC, use **D LIDS**.

Vector on Downwind: *“Navy 123, fly heading 310, descend and maintain 3000 feet.”*

200 KIAS, Clean.

1. Set NAVAIDS up for the ILS. Perform **D LIDS** check.

D – DME Hold - NA.

L – Localizer set 110.3 (i-CRP).

I – Inbound course, set CDI 129°.

D – Display: Set the NAV source to VOR. The PFD should show LOC when a localizer frequency is set in the VOR.

S – Speeds, fly downwind 200 KIAS.

9-4 FINAL APPROACH PROCEDURES

Vector onto Base: *“Navy 123, fly heading 040.”*

2. Slow toward 150 KIAS.
 - a. Upon making the turn to base, set 10-25% torque, allow the aircraft to slow. If a descent or more rapid deceleration is required, a lower power setting or the use of the speed brake may be needed.
 - b. Descend when directed by ATC.

Dogleg: On a dogleg to final, ATC will normally give clearance for the approach. Most clearances follow a standard format. For example:

“Navy 123, fly heading 090, maintain 2000’ until established, cleared for the ILS Runway 13 Approach at Corpus Christi International.”

On final:

3. As the CDI comes alive, turn onto final in order to capture the inbound course.
4. When established on final and within 5 NM of the FAF, configure to BAC.

Methods for determining when within 5 NM of the FAF

- a. DME (not all ILS approaches provide DME)
- b. GPS waypoint
- c. Established at the published glideslope intercept altitude and the glideslope indication is “alive” (green diamond starts to move down from the top of the glideslope case).
- d. Controller radar identification

Alternate Method: Set descent power (24%) prior to configuring to BAC, configure to BAC based on glideslope intercept (1 ½ to 1 dot). This will allow the pilot to make few and small power changes from the final approach fix in.

5. At glideslope intercept, set power to 24% and descend on glideslope.

NOTE

In the case of a strong headwind/tailwind, more/less power may be required.

6. Corrections for glideslope should be made with power; corrections for airspeed should be made with pitch attitude. Of course, these two performance indicators affect each other. For example, if below glide slope by a half dot and 10 KIAS fast, the proper correction would be to trim nose up until on speed while crosschecking glideslope.

7. At the localizer FAF (6.2 DME), begin timing as a backup to the ILS should the glideslope fail.
8. Track the localizer inbound. Make small corrections. The localizer becomes very sensitive as the aircraft gets closer to the field.
9. Follow the glideslope down to the decision altitude (DA) of 243'.
10. If the runway environment is in sight and a safe landing can be made, descend below the DA and transition for a landing. If not, execute a Missed Approach.

Common Errors.

1. Lack of altitude/heading control while trying to setup the approach.
2. Missed radio calls due to task saturation.
3. Flying through the final approach course.
4. Over correcting during the final approach phase of flight.

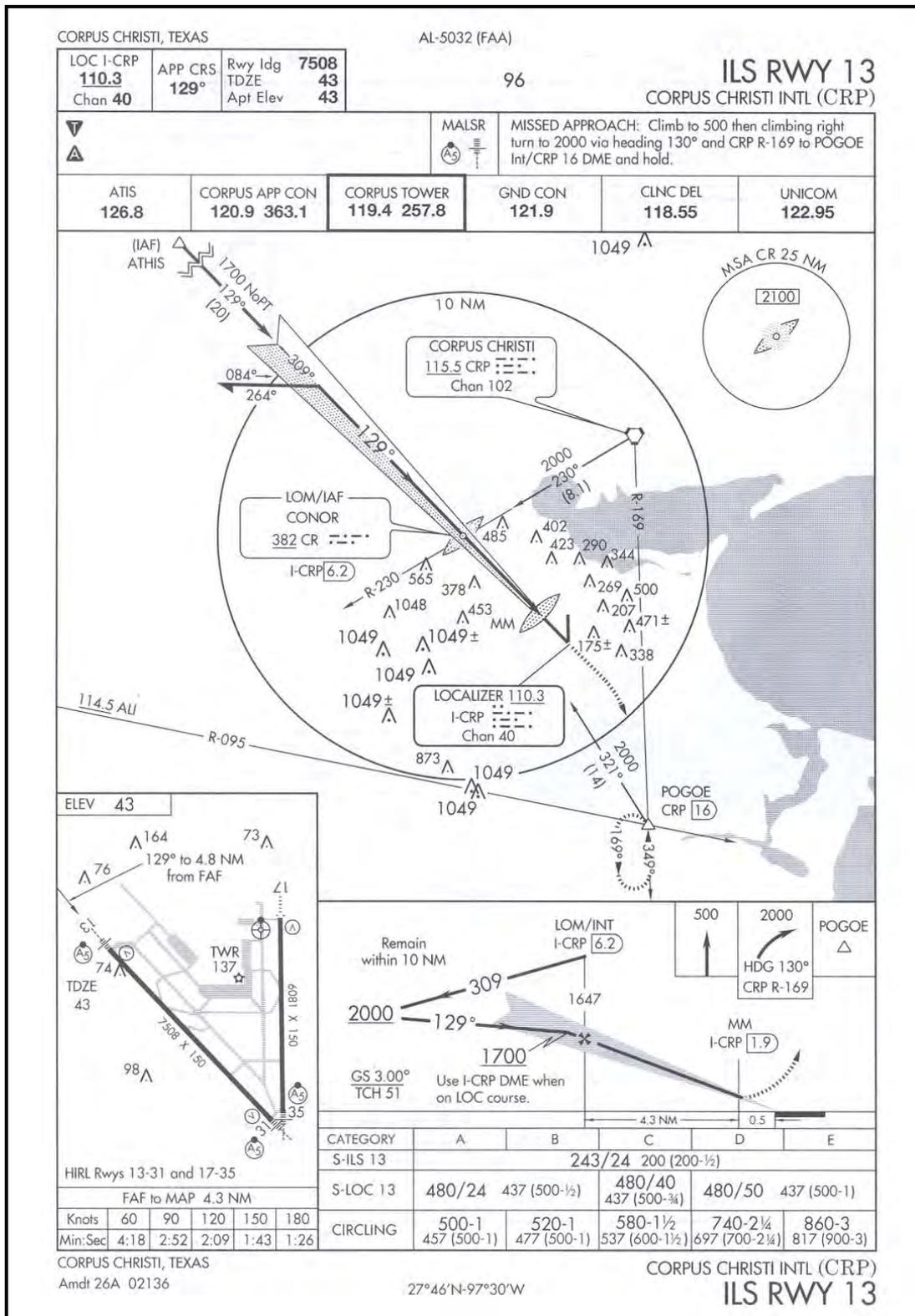


Figure 9-2 ILS RWY 13 (KCRP)

903. LOCALIZER APPROACH

General. Fly the aircraft in a controlled and predictable manner to the MAP at the MDA in order to set the aircraft up for landing.

Description. A localizer approach is similar to an ILS, the major difference being the lack of a glideslope indication.

NOTE

If executing a localizer approach and DME defines the MAP, use DME as the primary means of MAP identification. If DME indications fail, use timing from the non-precision FAF to identify the MAP (provided there is a timing block depicted on the approach plate).

Procedure. The procedures for a LOC approach are very similar to the ILS. For this discussion, use the same approach from the previous ILS example, Figure 9-2 (CRP LOC 13)

Downwind: Fly the downwind vector at 200 KIAS.

1. Set NAVAIDS up for the LOC. Perform **D LIDS** check.

D – DME Hold - NA.

L – LOC set 110.3.

I – Inbound course, set CDI 129°.

D – Display: Set the NAV source to VOR. The PFD should show LOC when a localizer frequency is set in the VOR.

S – Speeds, fly downwind 200 KIAS.

Base: “Navy 123, Fly heading 040.”

2. Upon making the turn to base, set 10-25% torque in order to slow toward 150 KIAS. If a descent or more rapid deceleration is required, a lower power setting or the use of the speed brake may be needed.

Dogleg: See ILS example above.

On final:

3. As the CDI comes alive, turn onto final in order to capture the inbound course.
4. When established on final and within 5 NM of the FAF, configure to BAC.

At the FAF (6.2 DME)

9-8 FINAL APPROACH PROCEDURES

5. Perform the 6 Ts.
 - a. **TIME** – Start timing, may be needed as a backup to ID the MAP.
 - b. **TURN** – Should not be required since the aircraft is on the final approach course.
 - c. **TIME** – Not required.
 - d. **TRANSITION** – Set 15% torque, trim nose up for 120 KIAS, and allow the nose to fall in order to achieve 800-1000 FPM rate of descent.
 - e. **TWIST** – Should already be done.
 - f. **TALK** – Give the appropriate voice report if required.
6. 100' prior to MDA, slowly add power to arrest the rate of descent.
7. At the MDA, (480') set 35% torque in order to maintain 120 KIAS, maintain level flight to the MAP (1.9).
8. If the field is in sight and a safe landing can be made, maneuver to land. If not, execute a Missed Approach.

Common Errors.

1. Lack of altitude/heading control while trying to setup the approach.
2. Missed radio calls due to task saturation.
3. Flying through the final approach course.
4. Over correcting during the final approach phase of flight.
5. Failure to back up DME with timing.

904. BACK COURSE LOCALIZER

Description. A variant of the LOC approach is the LOC-BC or “back course” approach. Localizer antennae are positioned at the opposite end of the runway from the approach direction and are aligned with the runway centerline. Every localizer transmitter radiates a signal in two directions, one being the “front course” and the other being the “back course.” For example, an ILS RWY 26 with a centerline heading of 260, the antenna is located at the RWY 8 end of the runway and radiates a front course in the direction of 080 for runway 26. The back course radiates in a direction of 260. If an IAP has been charted for this back course, then you can fly it just as you would a LOC approach, with one important exception: **YOU MUST SET THE FRONT COURSE IN THE CDI.** If the front course is not used, the CDI will give reverse sensing. Consider the approach in Figure 9-3.

Procedure. The same **D LIDS** check applies.

D – DME hold not required.

L – LOC set 111.7 (i-CLL).

I – Inbound course, SET FRONT COURSE in the CDI – 343°.

D – Display: Set the NAV source to VOR. PFD should show LOC as a localizer frequency set in the VOR.

S – Speeds - same airspeeds apply as in a front course localizer.

All remaining steps are the same.

Common Errors.

- Setting the back course in the CDI.

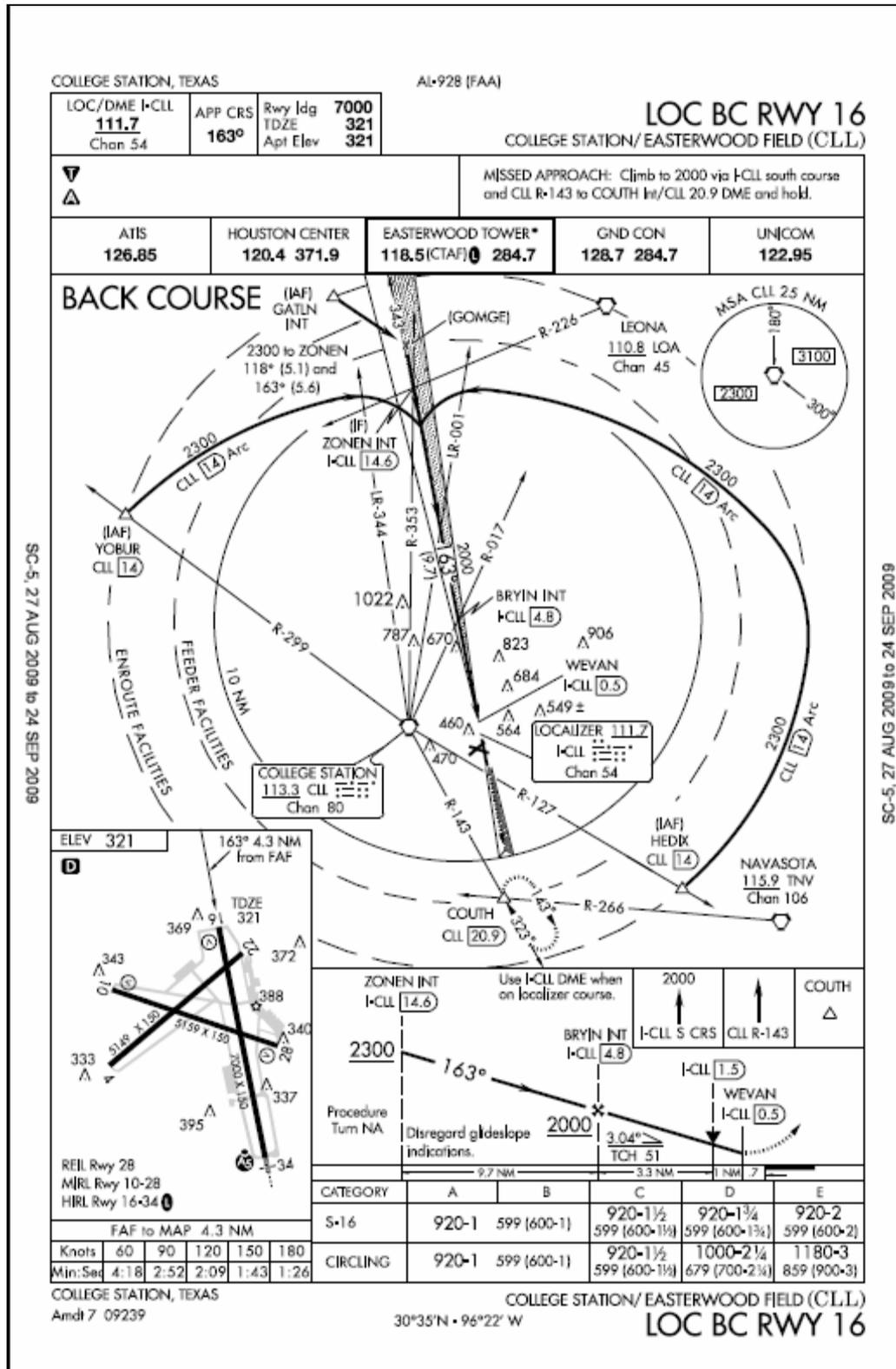


Figure 9-3 LOC BC 16 (KCLL)

905. RADAR APPROACHES

Radar approaches fall into two classes:

1. Precision Approach Radar (PAR) approaches provide course, range, and glideslope information.
2. Airport Surveillance Radar (ASR) approaches provide course and range information only, and are thus non-precision approaches.

906. PRECISION APPROACH RADAR (PAR)

Description. The PAR approach uses ground radar to vector the aircraft to a position to land. You have been introduced to vectoring procedures during radar vectors to final approach course. During the radar vector procedure, the approach controller used radar to direct the aircraft onto a segment of a standard Instrument Approach Procedure. During a radar approach, the controller directs the aircraft to a position from which a safe landing can be made.

Preflight – Radar instrument approach minimums are published in the front of FLIP Terminal Instrument Approach Procedures (approach plates) and sometimes in the minimums section of the approach plate. Published information includes the Decision Altitude (DA), weather minimums, and glideslope angle. With glideslope angle and groundspeed, the pilot can determine the rate of descent required to maintain glideslope on final using the rate of descent table (also in the back of the approach plates).

Familiarize yourself with this information as part of your preflight planning when a radar approach (PAR or ASR) is available at your destination or alternate.

For the purposes of illustration, consider the PAR approach to RWY 19L at NAS Meridian MS (Figure 9-4).

NOTE

The T-6B is considered a single-piloted aircraft. OPNAV 3710.7 requires that single-piloted aircraft use 200' ceiling/HAT and ½ mile/2400' RVR as absolute minimums for instrument approaches. Consider the above example. When you reach the published DA of 417' MSL, you will be at a HAT of 100' AGL. In order to meet the 200' HAT absolute minimum, you must increase the DA. In this case, an increase of 100' is necessary. This would result in a modified DA of 517' MSL, resulting in a HAT of 200' AGL. In addition, the minimum visibility required to commence the approach becomes ½ mile instead of the ¼ mile.

RADAR INSTRUMENT APPROACH MINIMUMS						
MERIDIAN NAS (KNMM), (Mc CAIN FIELD), MS (12 JUL 01 USN)						ELEV 317
RADAR - (E) 134.1 266.8 300.4 310.8 322.0 325.2 328.4 346.0 363.6 ▽						
	RWY	GS/TCH/RPI	CAT	DA/ MDA-VIS	HAT/ HATH/ HAA	CEIL-VIS
PAR ¹	19L ²	3.0°/45/1060	ABCDE	417-½	100	(100-½)
	1L ²	3.0°/34/744	ABCDE	455-½	200	(200-½)
	1R	3.0°/38/888	ABCDE	471-¾	200	(200-¾)
	19R	3.0°/36/854	ABCDE	495-¾	200	(200-¾)
ASR ¹	19L ³		AB	780-½	463	(500-½)
			C	780-¾	463	(500-¾)
			D	780-1	463	(500-1)
			E	780-1¼	463	(500-1¼)
	1L ³		AB	740-½	485	(500-½)
			C	740-¾	485	(500-¾)
			D	740-1	485	(500-1)
			E	740-1¼	485	(500-1¼)
	28		ABC	680-1	374	(400-1)
			DE	680-1¼	374	(400-1¼)
	19R		AB	700-1	405	(400-1)
			CD	700-1¼	405	(400-1¼)
		E	700-1¾	405	(400-1¾)	
1R		AB	700-1	429	(400-1)	
		C	700-1¼	429	(400-1¼)	
		DE	700-1¾	429	(400-1¾)	
CIR ¹	19L/R, 1L/R, 28		AB	820-1	503	(600-1)
			C	820-1¼	503	(600-1¼)
			D	880-2	563	(600-2)
			E	980-2¼	663	(700-2¼)

¹CAT E Cir not auth W of Rwy 1L-19R. ²When ALS inop, increase vis ½ mile. ³When ALS inop, increase vis ¾ mile. ⁴No-NOTAM MP sked: PAR Tue 1300-1700Z++, PAR apch not avbl dur this time.

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Figure 9-4 Radar Instrument Approach Minimums

Procedure.

1. Request vectors for the PAR. The following approach information will be provided by ATC.
 - a. Type of approach. *“This will be a PAR approach to Runway 19L.”*
 - b. Altimeter setting.
 - c. Ceiling and visibility if below 1000’ (or below highest circling minimum, whichever is greater) or visibility less than 3 miles.
 - d. Special weather observations.

- e. Airport conditions important to the safe operation of aircraft.
 - f. Lost Communication Procedures (i.e., *“If no transmissions received for more than one minute in the pattern or five seconds on final, attempt contact on backup frequency and proceed VFR. If IMC, proceed with the ILS 19L approach.”*).
 - g. Missed Approach instructions.
2. Comply with vectors provided by approach control and the final approach controller. Maintain situational awareness at all times.
3. On downwind fly 200 KIAS.

NOTES

- 1. Army and Navy final controllers are required to **advise** pilots to *“Perform landing checks”*.
- 2. Configurations and airspeeds may vary in the GCA pattern as dictated by local directives.
- 4. Upon making the turn to base, set 10-25% torque and slow towards 150 KIAS. If a descent or more rapid deceleration is required, a lower power setting or the use of the speed brake may be needed.
- 5. Once established on final, configure to BAC.
- 6. Expect a frequency change to the final controller on final or dog-leg to final.
- 7. Begin descent when the final controller advises that you are “on glidepath.”
 - Reduce power 24%, allow the nose to fall, trim to maintain 120 KIAS.
- 8. For glidepath deviations, make appropriate corrections. Maintain 120 KIAS and continue to comply with assigned headings.

NOTE

Use the Power + Attitude = Performance principle. Control airspeed with pitch attitude and glideslope with power.

9. At the DA (as determined by the altimeter or the controller advising you that you are at DA, whichever occurs first), if the runway environment is not in sight or you are not in a position to make a safe landing, then execute the Missed Approach instructions.

Common Errors.

1. Not following instructions given by the controller.
2. Late to configure and getting behind the aircraft.

907. AIRPORT SURVEILLANCE APPROACH (ASR)

Description: A surveillance approach is a non-precision approach in which the controller provides navigational guidance in azimuth only. Airport surveillance radar is less precise than precision radar. This accounts for the higher minimums on ASR approaches. It is a good practice to “back up” any Radar approach with a published non-precision approach, if possible.

Procedure:

1. Execute the same steps 2-6 as in the PAR.
2. Begin descent when directed to “descend to your minimum descent altitude.”

Reduce power to 15%, allow the nose to fall, trim to maintain 120 KIAS (recommended altitude advisories will be given if requested).

3. 100’ prior to MDA, initiate level-off by adding power to 35% and raising the nose.
4. Level-off at MDA.
5. The controller will tell you when you are at the MAP. If the runway is not in sight or you are not in a position to make a safe landing, execute the Missed Approach instructions.

Common Errors.

1. Not flying the headings assigned by the controller.
2. Late to configure and getting behind the aircraft.

908. NO-GYRO APPROACH

Description. The No-Gyro approach is used when experiencing heading indicator malfunctions. In this case, the word “gyro” refers to your directional gyro, which provides heading input to the PFD. It is conceivable that during flight your heading indication could fail, while all other systems essential to flight remain normal. Under such conditions, ATC can provide a No-Gyro approach.

The radar controller, seeing your track on radar, can apply a procedure very similar to timed turns. In this case, the controller tells you when to start and stop your turns. These No-Gyro vectors can be used to vector you to VFR conditions for a visual landing or vector you through a Ground Controlled Approach (GCA). The same glideslope and DA/MDA that apply to the

standard GCA also apply to the No-Gyro approach. This information should be reviewed prior to any GCA.

Procedure.

Review the GCA Procedures from this chapter. No-Gyro Procedures are the same with the following exceptions:

1. Make a specific request for a “No-Gyro PAR/ASR” when you contact approach control.
2. Make all turns at standard rate until on final approach, then make turns at half-standard rate, unless otherwise instructed by ATC.
3. Roll into turns promptly and verbally acknowledge ATC upon hearing the words “turn right” or “turn left”. Roll wings level and acknowledge on receipt of the words “stop turn.”

CHAPTER TEN

GPS APPROACH PROCEDURES

1000. INTRODUCTION

Prior to conducting any Global Positioning System (GPS) approach training, it is essential that the student read the T-6B NATOPS Flight Manual GPS section and be thoroughly familiar with the components and operation of the FMS and GPS. Some basic concepts follow.

Two major types of GPS approaches exist, GPS stand-alone, and GPS overlay approaches. The skills and knowledge required to fly these approaches are basically the same, however, some small procedural changes exist between these GPS approaches.

1001. GPS STAND-ALONE APPROACHES

The GPS stand-alone approach is commonly known as the terminal arrival area (TAA) or “Basic T” approach (Figure 10-1). The objective of the TAA is to provide a seamless transition from the enroute structure to the terminal environment for arriving aircraft equipped with GPS. GPS TAA approaches make use of both Fly-Over and Fly-By waypoints. Fly-By waypoints are used when an aircraft should begin a turn to the next course prior to reaching the waypoint separating the two route segments. This is known as turn anticipation and is compensated for in the airspace and terrain clearance. Approach waypoints, except for the Missed Approach waypoint (MAWP) are normally Fly-By waypoints. Fly-Over waypoints are used when the aircraft must fly over the waypoint prior to executing a turn. Approach charts depict Fly-Over waypoints with a circle around the waypoint.

The “T” design will normally have from one to three IAF's; an intermediate fix (IF) that serves as a dual purpose IF/IAF; a FAF, and a MAP, usually located at the runway threshold. The three IAF's are normally aligned in a straight line perpendicular to the intermediate course, which is an extension of the final course leading to the runway, forming a “T.” The standard TAA consists of three areas defined by the extension of the IAF legs and the intermediate segment course. These areas are called the straight-in, left-base, and right-base areas. TAA lateral boundaries are identified by magnetic courses TO the IF/IAF.

The TAA procedure is a portion of the new and rapidly evolving GPS arrival procedure program. For the most current and in-depth information on the TAA approach, consult the AIM.

1002. GPS OVERLAY APPROACHES

Overlay approaches consist of GPS waypoints overlaid on conventional (VOR, VOR/DME, etc.) non-precision approaches (Figure 10-2). Though overlays have the same minimums as the underlying approach, they offer the opportunity to fly an instrument approach procedure using GPS. Because GPS approaches are designed as a TO-TO system (meaning you navigate to one fix, cross it, and proceed to the next fix), overlays are not a perfect fit with the underlying procedure. Some conventional approaches, for example, have no FAF. Without a FAF, the GPS would not be able to navigate to the fix, nor would it know when to switch the CDI sensitivity.

This problem is solved by inserting a synthetic, GPS-specific, “sensor final approach fixes” on approach overlays when required. For specific GPS and FMS functionality, refer to the T-6B NATOPS Flight Manual.

WARNINGS

1. GPS overlay approaches that contain final approach step-down fixes may not have corresponding waypoints in the associated GPS approach. It is the pilot's responsibility to identify these points relative to charted GPS waypoints.
2. The GPS always displays distance to the active waypoint, which is different than the DME distance from the NAVAID on the instrument approach procedure. Pilots must use extreme caution to preclude either a dangerously early or late descent on final.

NOTE

The T-6B is certified to fly RNAV GPS approaches to LNAV MDA minimums.

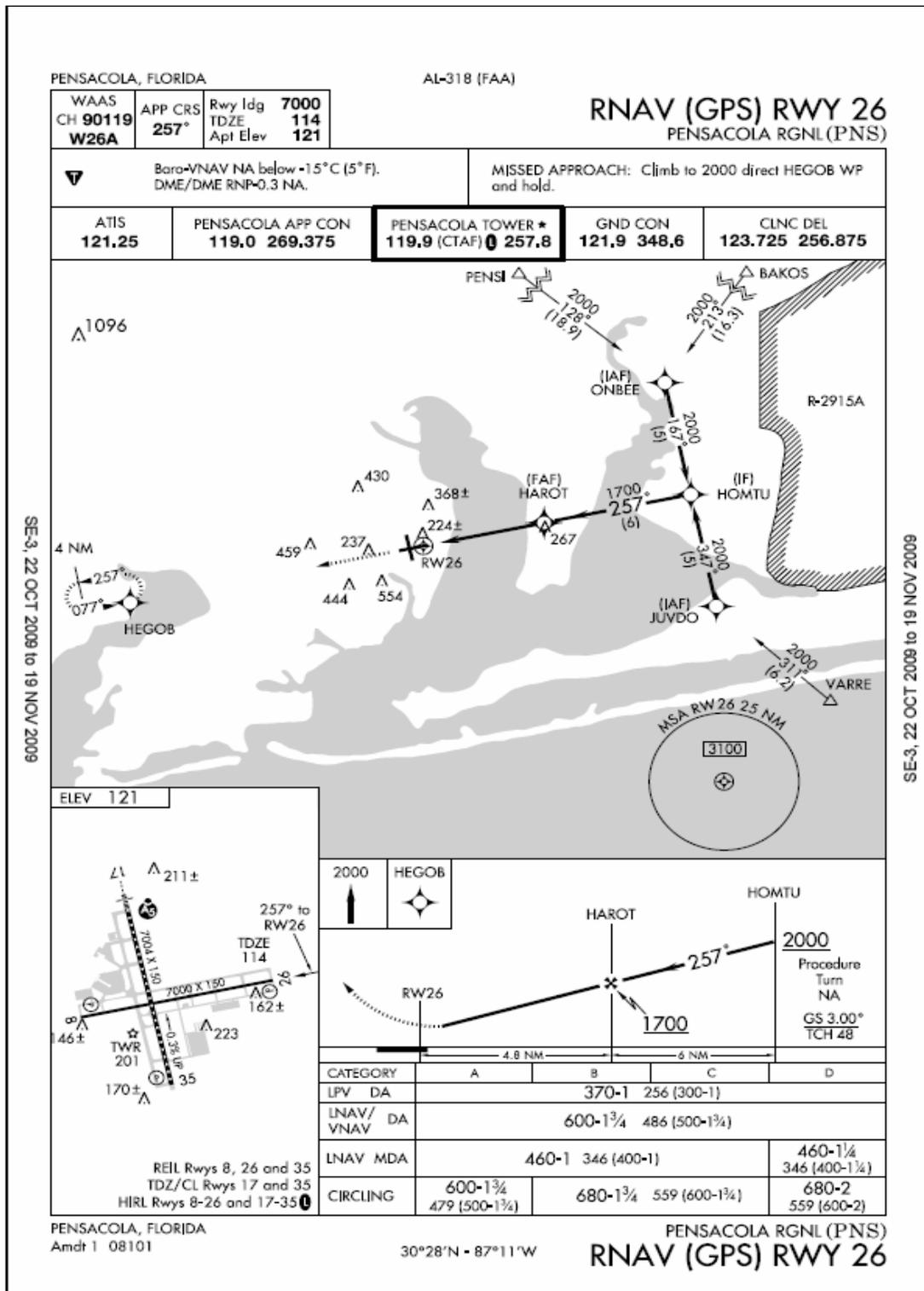


Figure 10-1 “T” Approach RNAV RWY 26 (KPNS)

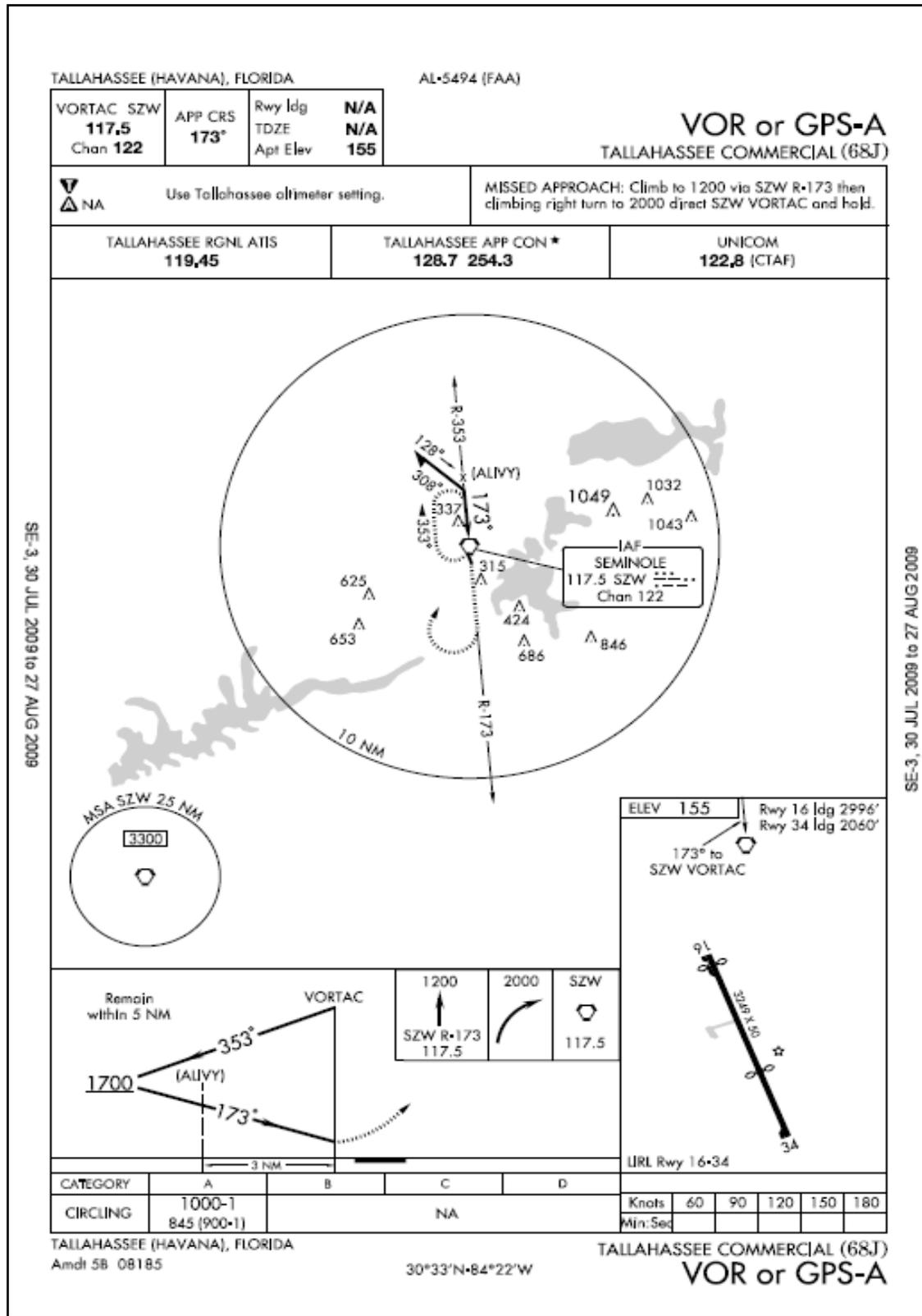


Figure 10-2 GPS Overlay Approach (68J)

10-4 GPS APPROACH PROCEDURES

1003. GPS APPROACHES

As a memory aid, use Little Dogs Dig Holes (**LDDH**) to aid in setting up and flying GPS approaches.

Procedure. GPS approaches can be performed as a full procedure approach or radar vectors to final.

We will discuss both using Figure 10-3 (RNAV RWY 14 Mobile Downtown) as an example.

GPS Full Procedure

Upon receiving approach clearance, perform step 1 if not already done.

1. **L** – Load GPS approach.

Follow ATC instructions to proceed direct to NOTNE, perform steps 2 through 4.

Within 5 NM of NOTNE, slow the aircraft in order to overfly NOTNE at 150 KIAS.

2. **D** – Direct to IAWP, in this case NOTNE.
3. **D** – Display – NAV source should be set to FMS.
4. **H** – Hold – If a turn in holding is required, ensure that NOTNE is loaded as a holding fix (NOTNE/H, 140° inbound course set).

Upon over flight of NOTNE, perform a holding entry turn.

- Perform the 6Ts.

Passing NOTNE for the second time (inbound on the approach), the GPS should cycle to the next waypoint, HUTIP, in this case the FAWP (FAF).

5. Descend and configure as required.
 - a. Set 15% torque and descend to 1500’.
 - b. Within 5 NM of the FAWP (HUTIP), configure to BAC.
 - c. Within 2 NM of the FAWP, the approach should go active, and CDI sensitivity transitions to approach mode.

Passing the FAWP, HUTIP.

6. Perform the 6Ts.
 - a. Set 15% Torque, descend at 120 KIAS.
 - b. No course change is required. On some GPS overlay approaches, a course change might be required passing the FAWP.
 - c. Note the 580' step down fix.
7. 100' prior to the MDA, slowly add power to arrest the rate of descent.
8. At the MDA (400'), add power to maintain altitude.
9. Fly at the MDA to the MAWP.
10. Upon reaching the MAWP, if the runway is not in sight or the aircraft is not in a position to make a safe landing, execute the Missed Approach.

NOTE

The GPS system will **NOT** automatically sequence to any waypoints required to execute the Missed Approach procedure. Automatic sequencing will cease at the MAP. If a Missed Approach is required, the pilot must manually sequence the system to the Missed Approach WPT.

GPS Vectors to Final

Upon receiving approach clearance, perform step 1 if not already done:

1. **L** – Load GPS approach.
2. **D** – Direct to FAWP, in this case HUTIP.
 - Change the CDI to the inbound course to HUTIP, in this example, 140°.
3. **D** – Display – NAV source should be set to FMS.
4. **H** – Hold – Not required.
5. Descend and configure as required.
 - a. Within 5 NM of the FAWP, configure to BAC.
 - b. Within 2 NM of the FAWP, the approach should go active, and CDI sensitivity transitions to approach mode.

Passing the FAWP HUTIP:

6. Perform the 6Ts.
 - Set 15% torque, descend at 120 KIAS.

Steps 7 - 10 remain the same.

1004. LOSS OF GPS INTEGRITY**Prior to the FAWP:**

If a GPS integrity warning occurs prior to the FAWP, or system sensitivity does not change to APR mode within 2 NM of the FAWP:

1. Transition to a backup approach if available.

NOTE

This does not, for example, give the pilot the option to fly an ILS approach if the clearance given was to a RNAV approach. If however, the clearance given was to an overlay approach, the pilot may transition to the underlying NAVAID and continue on the approach. If a different approach is required, the pilot must make that request to the controlling agency.

10-8 GPS APPROACH PROCEDURES

2. Proceed on approach clearance to the FAWP.
3. Continue to the MAWP at the FAWP altitude.
4. At the MAP, execute a Missed Approach.

NOTE

Inform the controlling agency as soon as practical.

Inside the FAF:

A GPS integrity warning occurring after the FAWP is a serious situation. Pilots must be prepared to take immediate action.

1. Transition to your backup approach, if available (see note from step one above).
2. Climb to the Missed Approach altitude.
3. Proceed to the MAWP.
4. At the MAWP, execute a Missed Approach.

NOTE

Inform the controlling agency as soon as possible.

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CHAPTER ELEVEN TRANSITION TO LANDING AND MISSED APPROACH

1100. INTRODUCTION

The transition to the visual segment on an instrument approach begins once the field is in sight, and you are in a safe position to land.

1101. STRAIGHT IN APPROACHES

On PAR, ASR, ILS or Localizer approach, the aircraft should be very close to being lined up on centerline when you gain visual reference to the runway environment. The transition, in this case, should be relatively simple. All that is normally required is an airspeed reduction, while continuing the descent from the DH/MDA to intercept a normal visual glidepath. If not depicted on the approach, a VDP should be calculated. Even if the runway is in sight, you should remain at the MDA until reaching the VDP, then make a normal descent to the runway.

On some VOR and GPS Straight-in approaches, the final approach course may be as much as 30° off runway heading. In this case, it will be necessary to continue on the final approach course until you can make a turn to line up on centerline.

Some Non-precision approaches have MDAs of 800' or higher. At typical approach airspeeds in the T-6B (120 KIAS), this could require descent rates in excess of **1600 FPM** if you do not break out prior to the MAP. Typically, if you gain sight of the runway at the MAP itself, a safe landing may not be possible. Remember, just because the runway environment is in sight at the MAP, does NOT mean a safe landing can be made.

1102. CIRCLING MANEUVERS

Description. Prior to commencing an approach that will end in a circling maneuver, a plan should be formulated on how the circle will take place. Consider the following:

1. Winds: Will they push the aircraft towards or away from the runway?
2. Runway alignment with respect to the approach being flown.
3. Airport environment: mountains, trees, towers, etc.

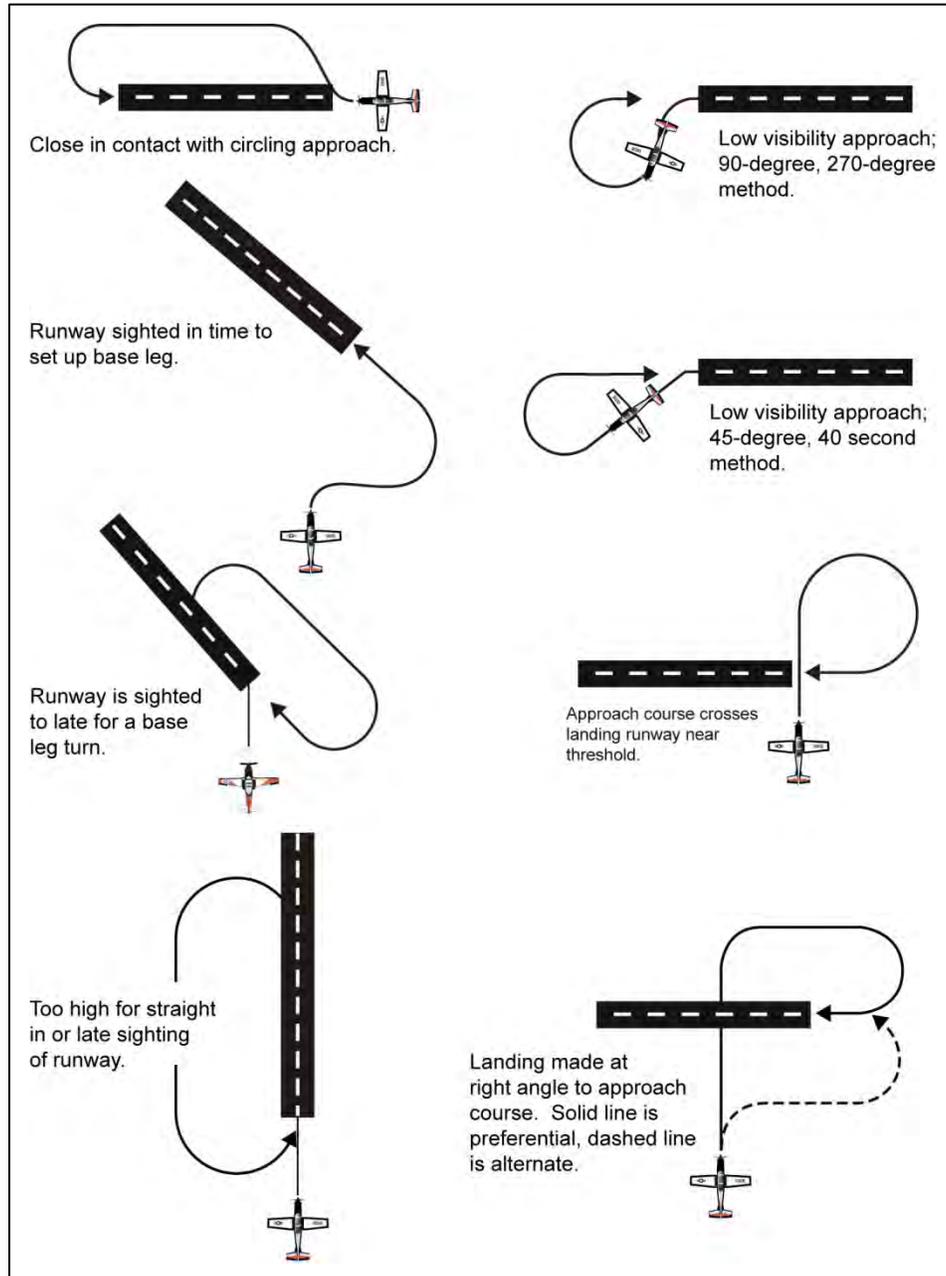


Figure 11-1 Circling Maneuvers

Procedure. Upon breaking out of the weather, locate the intended runway in use. Remain at or above the circling altitude until the aircraft is in a position to land. Every effort should be made to fly normal VFR checkpoints (i.e., 180, 90, final).

11-2 TRANSITION TO LANDING AND MISSED APPROACH

NOTE

Because of obstacles near the airport, a portion of the circling area may be restricted by a procedural note (i.e., “Circling NA E of RWY 17–35”). It is the pilot’s responsibility to review any circling restrictions for the intended airport. These restrictions can be found in the Approach Plates, AP1, IFR Supplement or current NOTAMs.

Circling Minimums:

Published circling minimums provide a 300’ obstacle clearance when pilots remain within the appropriate area of protection (Figure 11-2).

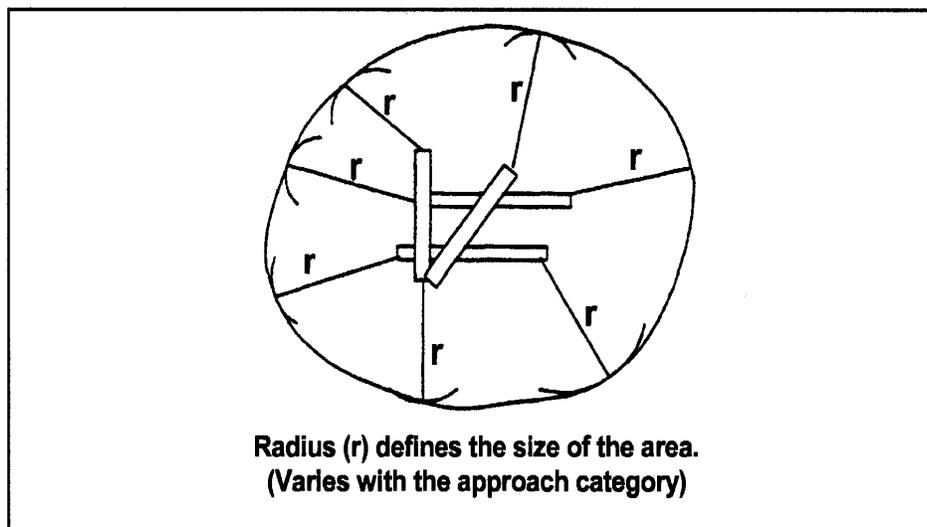


Figure 11-2 Circling Approach Area

Missed Approach from a Circling Maneuver:

If visual reference with the runway environment is lost while circling to land from an instrument approach (unless the inability to see an identifiable part of the airport results only from a normal bank of the aircraft during the circling approach), the Missed Approach specified for that particular procedure must be followed (unless an alternate Missed Approach procedure is specified by ATC).

To get established on the prescribed Missed Approach course, the pilot should make an initial climbing turn toward the landing runway and continue the turn until he is established on the Missed Approach course. Because there are many variations to the circle-to-land maneuver, different patterns may be required to become established on the prescribed Missed Approach course (Figure 11-3).

Adherence to these procedures will assure that an aircraft will remain within the circling and Missed Approach obstruction clearance areas.

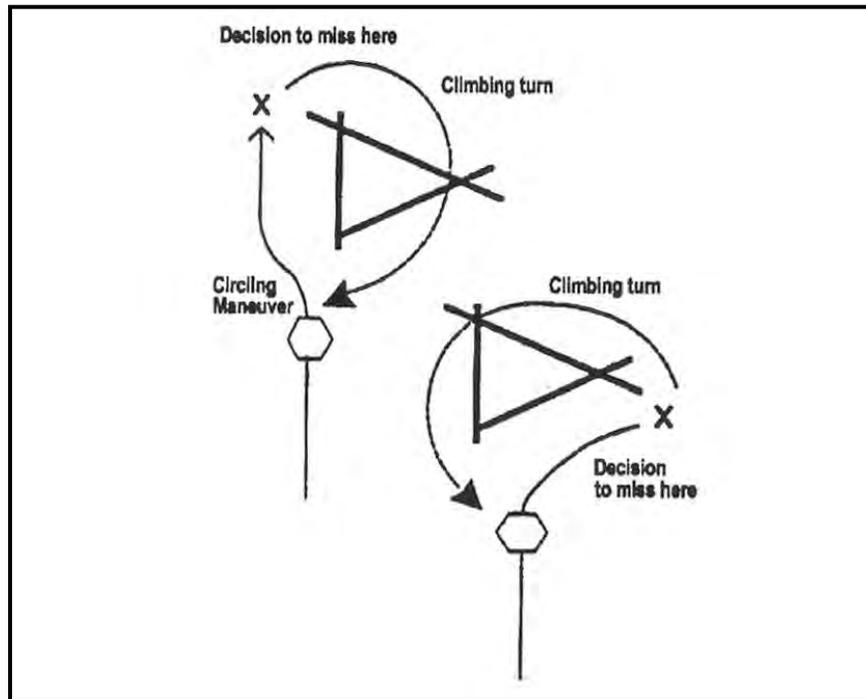


Figure 11-3 Missed Approach from a Circling Maneuver

NOTE

At locations where ATC Radar Service is provided, ATC may provide modified climbout instructions in lieu of the published Missed Approach procedure.

1103. MISSED APPROACH

Description. A Missed Approach is a procedure used to discontinue an instrument approach if the runway environment is not in sight, or the aircraft is not in a position to make a safe landing. The primary concern, if unable to land, is to climb to a safe altitude. Therefore, establishing and maintaining a positive rate of climb should be your first priority if a Missed Approach is commenced. Your second priority should be to turn the aircraft (if required) to intercept the Missed Approach course or to the designated heading.

The Missed Approach instructions are found in the profile view of the approach plate. The student shall review the Missed Approach prior to the FAF, or once established on final, if no FAF is depicted.

11-4 TRANSITION TO LANDING AND MISSED APPROACH

NOTE

When flying practice approaches, ATC frequently assigns climbout instructions that differ from the published Missed Approach procedures. You are expected to fly the assigned climbout instructions vice Missed Approach procedures when executing a Missed Approach.

Missed Approach Prior to the FAF

If executing an instrument approach and full scale deflection of the CDI occurs PRIOR to the FAF, the pilot should make every attempt to return back onto course. If unable to reestablish the aircraft on course, do not descend below the FAF altitude, inform ATC, and follow ATC instructions.

Missed Approach Between the FAF and MAP

If executing an instrument approach and full scale deflection of the CDI occurs at any time between the FAF and the MAP, begin an IMMEDIATE climb to the depicted Missed Approach altitude (or altitude ATC has assigned in the event of a Missed Approach), fly to the MAP and execute the Missed Approach procedure. Advise ATC at the earliest opportunity. Set an intercept heading to establish the aircraft back on the final approach course.

WARNING

Obstacle clearance is not ensured when the aircraft is off the published portions of an approach. With full scale deflection of the CDI in areas of high terrain or obstacles, a climb to the Minimum Safe Altitude (MSA) may be required.

Procedure. At the MAP, if sufficient visual cues are not available, or a safe landing cannot be made, execute a Missed Approach as follows:

1. Increase PCL to MAX.
2. Raise the nose to a positive climbing attitude (10-15° nose up).
3. Check for a positive rate of climb (check the altimeter and VSI).
4. Raise the landing gear and flaps.
5. Start a SRT toward the Missed Approach course or heading. Stay on the attitude indicator and maintain the climbing attitude.

6. Establish an intercept to the Missed Approach course or continue the turn to the designated heading as required.
7. Make the “Missed Approach” report to Tower.
8. Level-off at Missed Approach altitude.
9. If directed to contact approach control, inform them of your Missed Approach and state your intentions.

Options include:

- a. **Request the same approach.** If you flew a bad approach due to your own poor basic airwork, you might request to fly the same approach again.
 - b. **Request a different approach** with lower minimums, if available.
 - c. **Proceed to your alternate.** If weather and/or fuel considerations dictate that you proceed to your alternate, coordinate with ATC to obtain clearance.
10. Update the weather as appropriate.

Common Errors.

1. Poor Instrument Scan/Poor Airwork.
2. Slow to establish a climb.
3. Not distinguishing the differences between a depicted heading and a radial outbound.
4. Not trimming as the aircraft accelerates.

**APPENDIX A
GLOSSARY**

A100. NOT APPLICABLE

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APPENDIX B 60-TO-1 RULE

B100. 60-TO-1 RULE APPLICATIONS

Mathematical Basis for 60-to-1 Rule: Circle Circumference = 2 x radius x 3.14 = 6.28 x radius

Therefore, @ 60 NM, 1 degree = $\frac{6.28 \times 60 \text{ NM}}{360 \text{ degrees}}$ - 1.05 NM/degree \approx 1 NM

To:	Use:								
Horizontal									
Convert Airspeed to NM / Min	$\frac{NM}{Min} = \frac{KTAS}{60}$ where $KTAS \approx KIAS + \frac{3.5 \times FL}{10}$ for T-6 airspeeds -OR- $KTAS \approx 1.2 \times KIAS$ (a more rough estimate)								
Calculate Lead Radials for Turn Radius	$Lead\ Radials = TR \times Radials / NM$ where: $TR = Turn\ Radius\ (in\ NM)$ $\approx (NM/Min) - 2$ -or- $\approx (NM/Min)^2 \times 0.1$ (better for low-speed calculations)								
Calculate Holding or PT Teardrop Angle	“Rule of 4s” $Teardrop\ Angle / 10 + Holding\ Pattern\ Length\ (minutes) \approx 4$ $1\ min \Rightarrow 30^\circ\ Teardrop$ $1-1/2\ min \Rightarrow 25^\circ\ Teardrop$ $2\ min \Rightarrow 20^\circ\ Teardrop$								
Calculate Crosswind (XW)	$XW \approx [(Rwy\ Hdg - Wind\ Dir) + 20]\% \times Wind\ Velocity$ -OR- (Clock Method) <table style="margin-left: 40px;"> <tr><td>15° off</td><td>⇒ 25% of the wind</td></tr> <tr><td>30° off</td><td>⇒ 50% of the wind</td></tr> <tr><td>45° off</td><td>⇒ 75% of the wind</td></tr> <tr><td>≥ 60° off</td><td>⇒ 100% of the wind</td></tr> </table>	15° off	⇒ 25% of the wind	30° off	⇒ 50% of the wind	45° off	⇒ 75% of the wind	≥ 60° off	⇒ 100% of the wind
15° off	⇒ 25% of the wind								
30° off	⇒ 50% of the wind								
45° off	⇒ 75% of the wind								
≥ 60° off	⇒ 100% of the wind								
Calculate Crab	$Crab \approx \frac{XW}{NM/Min}$								
Vertical									
Calculate VDP	$Distance\ from\ Runway\ (NM) \approx \frac{HAT\ (100s\ of\ feet)}{Gradient}$ (“GUS wears a HAT”)								
Calculate Gradient	$Descent\ Gradient \approx \frac{100s\ of\ feet}{Distance\ in\ NM}$								
Calculate VSI	$VSI \approx \frac{NM}{Min} \times 100\ ft \times Gradient$								

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