NAVAL AIR TRAINING COMMAND

NAS CORPUS CHRISTI, TEXAS **CNATRA P-1204 (Rev. 09-16)**

FLIGHT TRAINING INSTRUCTION

INSTRUMENT T-45C MPTS and IUT

2016

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Subj: FLIGHT TRAINING INSTRUCTION, INSTRUMENT T-45C MPTS and IUT

1. CNATRA P-1204 (Rev. 09-16) PAT, "Flight Training Instruction, Instrument T-45C MPTS and IUT" is issued for information, standardization of instruction, and guidance for all flight instructors and student aviators within the Naval Air Training Command.

2. This publication shall be used as an explanatory aid to the T-45 MPTS and IUT Curricula. It will be the authority for the execution of all flight procedures and maneuvers herein contained.

3. Recommendations for changes shall be submitted via the electronic TCR form located on the CNATRA website.

4. CNATRA P-1204 (10-15) PAT is hereby cancelled and superseded.

M. B. TATSCH
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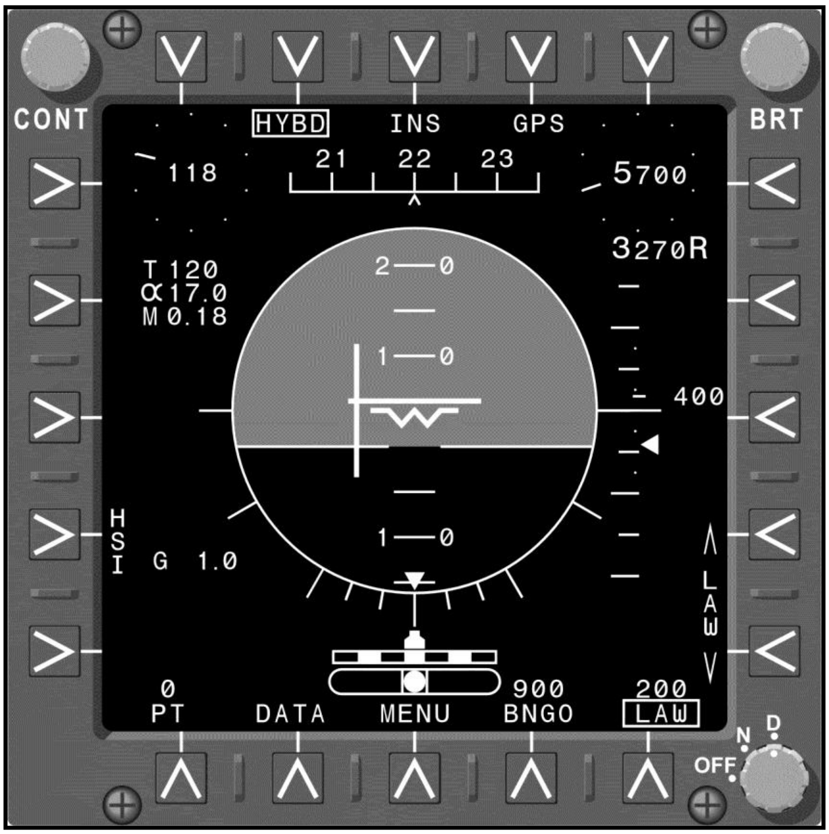
FLIGHT TRAINING INSTRUCTION

FOR

INSTRUMENT T-45C MPTS and IUT

P-1204



HOW TO USE THE FTI

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

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

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

INTRODUCTION

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

Basic Instruments (BI) places primary emphasis on aircraft ***control***. Here you will learn the fundamental procedures and patterns that enable you to progress to radio instrument navigation. In Radio Instruments (RI), you will acquire the complex skills to navigate by reference to radio instruments. In this stage, you will learn the procedures for planning local instrument navigation flights and for identifying your aircraft's position in relation to radio navigational aids on the ground.

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

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

In the Instrument Rating (IR) Stage, you will finally put together all of your instrument training from both primary and intermediate to gain your first NATOPS Standard Instrument rating. You will be required to have both the skill in the aircraft and the knowledge of the IFR environment to complete this stage of training. By relying on the information in this FTI and the experience you've gained on your training flights, you will be setup for success in this stage.

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

BACKGROUND

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

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

TRANSFER OF AIRCRAFT CONTROL

There will always be a positive three-way exchange of controls between yourself and the instructor. Though you will be unable to see your instructor because you will be under the hood, always say, *"I have the controls,"* or *"you have the controls"* when passing the controls between the cockpits.

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

SENSATIONS OF INSTRUMENT FLIGHT

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

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

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

MOTION

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

Linear Acceleration

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

Rotational Acceleration

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

False Sensations of Motion

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

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

WARNING

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

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

POSTURAL SENSE

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

SIGHT

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

FALSE SENSATIONS

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

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

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

OPTICAL ILLUSIONS

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

Some examples of optical illusions are:

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

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

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

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

MAINTAINING SPATIAL ORIENTATION

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

These simple precautions taken upon entry into instrument flight conditions can help you avoid disorientation:

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

2. Be wings level.

3. Have the aircraft trimmed for level flight.

4. Make all subsequent configuration changes while wings level.

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

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

FLIGHT PREPARATION

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

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

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Page No.	**Change No.**	**Page No.**	**Change No**
COVER	0		
LETTER	0		
iii – xviii	0		
1-1 – 1-9	0		
1-10 (blank)	0		
2-1	0		
2-2 – 2-3	0		
2-4 (blank)	0		
3-1 – 3-31	0		
3-32 (blank)	0		
4-1 – 4-6	0		
5-1 – 5-6	0		
6-1 – 6-68	0		
7-1 – 7-21	0		
7-22 (blank)	0		
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A-10 (blank)	0		
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INTERIM CHANGE SUMMARY

The following Changes have been previously incorporated in this manual:

CHANGE NUMBER	REMARKS/PURPOSE

The following interim Changes have been incorporated in this Change/Revision:

INTERIM CHANGE NUMBER	REMARKS/PURPOSE	ENTERED BY	DATE

TABLE OF CONTENTS

HOW TO USE THE FTI .... **iv**
INTRODUCTION .... **v**
LIST OF EFFECTIVE PAGES .... **xii**
INTERIM CHANGE SUMMARY .... **xiii**
TABLE OF CONTENTS .... **xiv**
TABLE OF FIGURES .... **xvii**

CHAPTER ONE - AIRCRAFT FLIGHT INSTRUMENTS **1-1**
100. INTRODUCTION 1-1
101. CONTROL INSTRUMENTS 1-1
102. PERFORMANCE INSTRUMENTS/DISPLAYS 1-1
103. POSITION INSTRUMENTS 1-1
104. ATTITUDE DIRECTOR INDICATOR (ADI) DISPLAY 1-1
105. HORIZONTAL SITUATION INDICATOR (HSI) DISPLAY 1-2
106. FUEL FLOW AND RPM GAUGES 1-5
107. STANDBY FLIGHT INSTRUMENTS 1-6
108. HEAD-UP DISPLAY (HUD) 1-6
109. INSTRUMENT SCAN 1-8

CHAPTER TWO - GROUND PROCEDURES **2-1**
200. INTRODUCTION 2-1
201. INSTRUMENT CHECKLIST 2-1
202. LOW ALTITUDE WARNING (LAW) 2-2
203. HOOD USE 2-2
204. COCKPIT LIGHTING 2-3

CHAPTER THREE - BASIC FLIGHT MANEUVERS **3-1**
300. INTRODUCTION 3-1
301. INSTRUMENT TAKEOFF (ITO) 3-1
302. LEVEL OFF CHECK 3-2
303. CONSTANT AIRSPEED CLIMBS AND DESCENTS 3-3
304. CONSTANT RATE CLIMBS AND DESCENTS 3-5
305. LEVEL TURNS 3-7
306. LEVEL SPEED CHANGES 3-10
307. "S" PATTERNS 3-13
308. SLOW FLIGHT MANEUVER 3-15
309. STALLS AND UNUSUAL ATTITUDE RECOVERIES 3-18
310. AEROBATICS 3-22
311. TRANSITIONS (CLEAN TO DIRTY) 3-26
312. OPTIMUM AOA DESCENT 3-27
313. MISSED APPROACH CLIMB OUT AND LEVEL OFF 3-28
314. FLIGHT WITH PARTIAL PANEL 3-29

CHAPTER FOUR - GENERAL COMMUNICATION PROCEDURES 4-1
400. INTRODUCTION 4-1
401. NAVIGATION & COMMUNICATION COCKPIT MANAGEMENT 4-1
402. IFR VOICE PROCEDURES 4-2

CHAPTER FIVE - INSTRUMENT FLIGHT PLANNING 5-1
500. INTRODUCTION 5-1
501. FACILITY REQUIREMENTS 5-1
502. ROUTE AND ALTITUDE 5-1
503. ALTERNATE 5-1
504. FILING MINIMUMS 5-2
505. FUEL REQUIREMENTS 5-3
506. TAKEOFF MINIMUMS 5-3
507. NOTAMS 5-4
508. FLIGHT PLANNING FORMS 5-5

CHAPTER SIX - FLIGHT PROCEDURES 6-1
600. INTRODUCTION 6-1
601. DEPARTURE PHASE 6-1
602. ENROUTE PHASE 6-6
603. LOST COMMUNICATIONS 6-7
604. PROCEEDING DIRECT TO A STATION 6-8
605. TACAN AND VOR/DME PROCEDURES 6-18
606. POINT-TO-POINT NAVIGATION 6-25
607. ARRIVAL PHASE 6-32
608. ENROUTE DESCENT 6-40
609. STAR 6-42
610. APPROACH PHASE 6-42
611. GROUND CONTROLLED APPROACH (GCA) 6-46
612. RADIO INSTRUMENT APPROACHES 6-51
613. VOR PENETRATION APPROACH 6-51
614. TACAN APPROACH 6-54
615. ILS APPROACH 6-57
616. NO-GYRO APPROACH 6-63
617. BINGO PROFILE 6-63
618. MINIMUM/EMERGENCY FUEL APPROACH 6-63
619. EMERGENCY OIL/PRECAUTIONARY INSTRUMENT APPROACH 6-64
620. PARTIAL PANEL APPROACHES 6-65
621. VISUAL MANEUVERS 6-65
622. MISSED APPROACH 6-68

CHAPTER SEVEN - SAFETY/EMERGENCY PROCEDURES 7-1
700. INTRODUCTION 7-1
701. PRIMARY INSTRUMENT FAILURE 7-1
702. TWO-WAY COMMUNICATION FAILURE 7-1
703. NAVIGATIONAL AID (NAVAID) FAILURE 7-1
704. ICING 7-2
705. TURBULENCE AND THUNDERSTORMS 7-2
706. MINIMUM FUEL ADVISORY 7-3
707. EMERGENCY FUEL 7-3
708. AIRCRAFT EMERGENCIES 7-4
709. GINA FAILURE 7-4
710. DISPLAY ELECTRONICS UNIT (DEU) FAILURE 7-5
711. GENERATOR FAILURE 7-5
712. HSI DISPLAY FAILURE 7-6
713. ADI DISPLAY FAILURE 7-9
714. TURN AND SLIP INDICATOR FAILURE 7-11
715. PITOT STATIC MALFUNCTIONS 7-12
716. MACH/AIRSPEED INDICATOR FAILURE 7-12
717. BAROMETRIC ALTITUDE FAILURE 7-13
718. VSI FAILURE 7-13
719. STANDBY GYRO FAILURE 7-14
720. AOA INDICATOR FAILURE 7-15
721. RADAR ALTIMETER FAILURE 7-16
722. VOR FAILURE 7-18
723. TACAN BEARING FAILURE 7-19
724. TACAN DME FAILURE 7-19
725. ILS GLIDESLOPE FAILURE 7-20
726. ILS LOCALIZER FAILURE 7-21
727. ILS MARKER BEACON FAILURE 7-21
728. FLIGHT WITH PARTIAL PANEL 7-21

APPENDIX A - GLOSSARY A-1

APPENDIX B - STUDY RESOURCES B-1

TABLE OF FIGURES

Figure 1-1 Attitude Director Indicator Display 1-3
Figure 1-2 Failed ILS Glideslope 1-3
Figure 1-3 Horizontal Situation Indicator Display 1-4
Figure 1-4 Data Entry Panel 1-5
Figure 1-5 MFD Engine Page 1-6
Figure 1-6 Head-Up Display 1-7

Figure 2-1 Instrument Training Hood 2-2

Figure 3-1 S-1 Pattern 3-13
Figure 3-2 S-3 Pattern 3-14
Figure 3-3 Slow Flight Maneuver 3-16
Figure 3-4 Wingover 3-23
Figure 3-5 Barrel Roll 3-25

Figure 5-1 IFR Filing Criteria 5-2
Figure 5-2 Fuel Card 5-4

Figure 6-1 Pilot NAV SID 6-2
Figure 6-2 Vector SID 6-4
Figure 6-3 Vector SID (2) 6-5
Figure 6-4 Proceeding Direct 6-9
Figure 6-5 Wind Drift Correction 6-11
Figure 6-6 30-Degree Method 6-13
Figure 6-7 Double Angle Off Bow Method 6-14
Figure 6-8 Course Intercept Immediately After Station Passage 6-16
Figure 6-9 45-Degree Method – Outbound 6-17
Figure 6-10 Radial-To-Arc Intercept 6-19
Figure 6-11 Maintaining an Arc (Chord Method) 6-21
Figure 6-12 Arc-To-Radial Intercept Procedure (1) 6-22
Figure 6-13 Arc-To-Radial Intercept Procedure (2) 6-24
Figure 6-14 Point-To-Point Navigation 6-26
Figure 6-15 Planimetric Point-To-Point Navigation 6-28
Figure 6-16 Waypoint Data Display 6-29
Figure 6-17 Global Positioning System Data Display 6-30
Figure 6-18 Waypoint Data Entry 6-31
Figure 6-19 Standard Holding Pattern (TACAN) 6-33
Figure 6-20 Non-DME Holding Pattern 6-34
Figure 6-21 Maximum Holding Airspeeds 6-35
Figure 6-22 No-Wind Holding Offset 6-36
Figure 6-23 Determining Holding Entry 6-37
Figure 6-24 Holding Entry 6-38
Figure 6-25 Wind Correction for Holding 6-39
Figure 6-26 Instrument Approach Chart 6-43

Figure 6-27 Airport Diagram 6-45
Figure 6-28 GCA Pattern 6-47
Figure 6-29 Radar Instrument Approach Minimums 6-48
Figure 6-30 Non-DME Penetration and Approach 6-53
Figure 6-31 TACAN Approach 6-55
Figure 6-32 ILS Indications 6-58
Figure 6-33 ILS Components 6-59
Figure 6-34 ILS Approach Plate 6-61
Figure 6-35 ILS Minimums 6-62
Figure 6-36 Circling Approach Maneuvers 6-67

Figure 7-1 Display Power Switch 7-6
Figure 7-2 Heading Input Failure Indications 7-7
Figure 7-3 Position Advisory Legend 7-8
Figure 7-4 Training Page – Frozen HSI 7-9
Figure 7-5 Attitude Advisory Legend 7-11
Figure 7-6 Failed 2" Standby Gyro 7-15
Figure 7-7 Failed AOA Indicator 7-16
Figure 7-8 Failed Radar Altimeter 7-17
Figure 7-9 BIT Page 7-17
Figure 7-10 Failed VOR 7-18
Figure 7-11 Failed TACAN Bearing 7-19
Figure 7-12 Failed ILS Glideslope Indication 7-20
Figure 7-13 Failed ILS Localizer 7-21

CHAPTER ONE
AIRCRAFT FLIGHT INSTRUMENTS

100. INTRODUCTION

Aircraft flight instruments are divided into three categories according to their specific function: control instruments, performance instruments, and position instruments. Except for engine instruments, all primary instrument flight information is presented on either the ADI display or the HSI display. The engine instruments are on the right side of the instrument panel and the standby instruments, airspeed, altitude display, attitude indicator, and vertical speed indicator (VSI) are located on the left side of the instrument panel. The magnetic compass is located on the canopy bow. Refer to the Forward and Aft Cockpit foldout in the T-45C NATOPS for specific instrument location.

101. CONTROL INSTRUMENTS

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

102. PERFORMANCE INSTRUMENTS/DISPLAYS

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

103. POSITION INSTRUMENTS

The position instruments convey the aircraft's location in space and will determine what control changes are required to achieve the desired aircraft performance. These instruments include altimeter, bearing pointers, TACAN, and Waypoint data blocks, Planimetric or Course Deviation Indicator (CDI) course lines, ILS azimuth and glideslope deviation bars. A course deviation situation steering arrow and azimuth and glideslope deviation bars are also displayed on the HUD.

104. ATTITUDE DIRECTOR INDICATOR (ADI) DISPLAY

The ADI display is the primary control instrument. It replicates a conventional electromechanical ADI instrument. It provides your primary indication for the aircraft's attitude using the horizon bar, bank pointer, pitch reference scale, and the attitude display. Whenever a deviation from a desired performance is indicated on one of the performance instruments, the correction should be made referencing the ADI display.

In addition to the typical ADI, the ADI display includes additional flight parameters (Figure 1-1). True airspeed, AOA, Mach, G, and peak G are shown digitally on the left-hand side of the display. Indicated airspeed and barometric altitude, trend indicators and a heading scale are across the top of the display. The digital indicated airspeed has a resolution of one kt. The indicated airspeed trend indicator wiper blade rotates clockwise for increasing airspeeds and counterclockwise for decreasing airspeed. The airspeed trend scale is graduated in 10-kt increments with multiples of 100 kts at the 12 o'clock position. The digital barometric altitude resolution is 20 ft. The barometric altitude trend indicator wiper blade rotates clockwise for increasing altitude and counterclockwise for decreasing altitude. The altitude trend scale is graduated in 100-ft increments with multiples of 1,000 ft at the 12 o'clock position. The heading scale, with heading numbers and scale tick marks, scrolls left or right above a fixed caret. A command heading bug, a vertical line, is referenced to the heading scale. The command heading is referenced to the selected navigation aid unless ILS or no steering is selected. With ILS or no steering selected, the command heading bug location is determined by the heading value set on the HSI display heading option. A digital radar altitude and a vertical velocity trend indicator are to the right of the display. The vertical velocity scale limits are -2,000 ft/min and 1,500 ft/min. Dashes are located at -2,000, -1,000 and 1,000 ft/min. Tics are located at -750, -250, 250, and 750 ft/min. The digital vertical velocity resolution is 10 ft/min. The vertical velocity caret is open when vertical velocity exceeds -2100 or + 1600 ft/min. The digital vertical velocity range is +/- 9,990 ft/min. A turn and slip indicator is at the bottom of the display. The shaded reference areas to the left and right of the shaded center marker represent a +/- 3 degrees per second turn rate (standard-rate turn). BNGO fuel and Low Altitude Warning (LAW) height settings are also on the ADI display. The ADI display pitch can be adjusted +/- 5 degrees in relation to the waterline with the "PT" selection. With a valid ILS channel station selected and ILS steering selected, ILS needles are shown. The needles are referenced to the waterline. The localizer and glideslope needles range +/- 1/2 inch from the waterline. Full deflection represents +/- 2.5 degrees of azimuth deviation (with a 5-degree localizer signal) and +/- 0.7 degrees of glideslope deviation. The localizer or glideslope needle will flash when limited. The needles for an invalid input are removed and an MFD advisory window, "GLIDESLOPE" (Figure 1-2), "LOCALIZER," OR "ILS" will flash on all MFDs. The advisory window will remain on the MFDs until either the REJ button is depressed or the failed data becomes valid again. The ADI display is normally placed on the left MFD to facilitate cross-checking the standby instruments on the left side of the main instrument panel.

105. HORIZONTAL SITUATION INDICATOR (HSI) DISPLAY

The HSI display performs the course deviation indication function of a conventional electromechanical instrument. With the capabilities of the Global Positioning/Inertial Navigation Assembly (GINA) and display electronic unit (DEU), additional display options and navigation information are available on the HSI display (Figure 1-3).

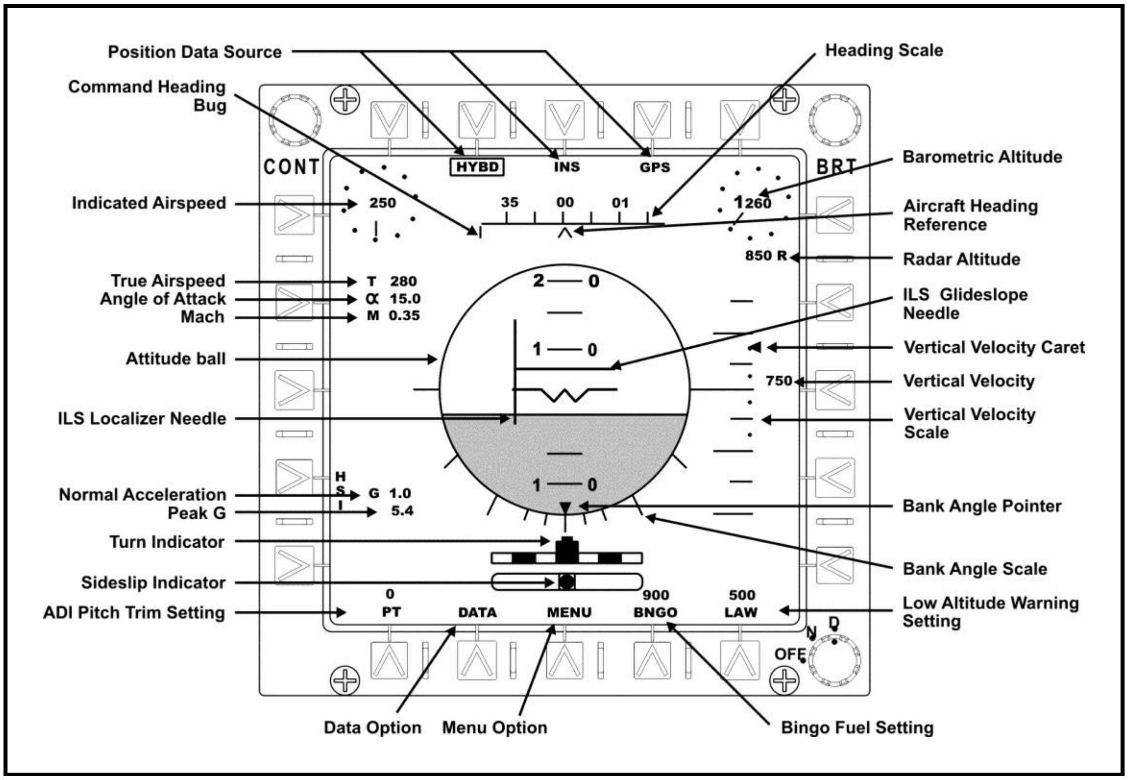

Figure 1-1 Attitude Director Indicator Display

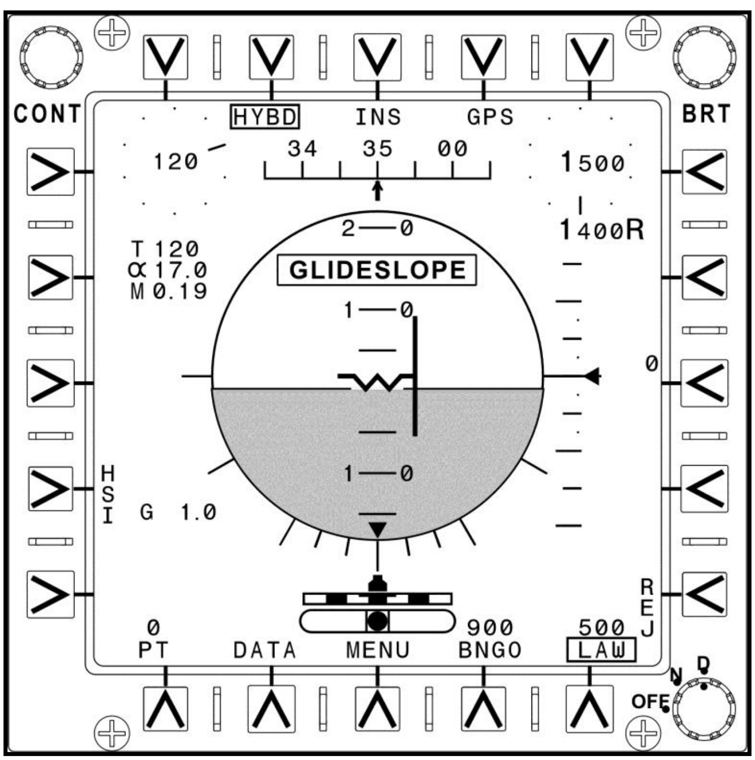

Figure 1-2 Failed ILS Glideslope

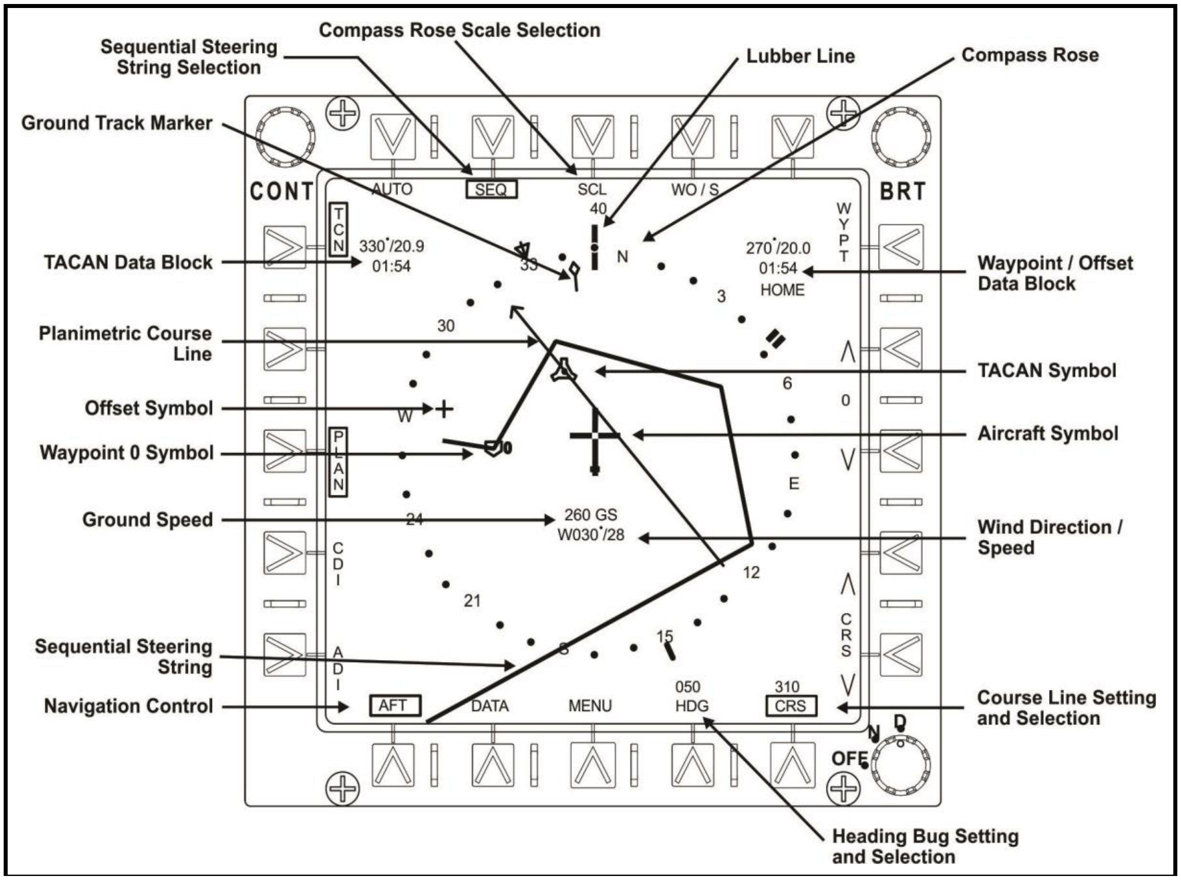

Figure 1-3 Horizontal Situation Indicator Display

The aircraft symbol is fixed in the center of the display, heading up. Groundspeed and wind direction/speed are below the aircraft symbol. The compass rose rotates according to the aircraft magnetic heading, referenced to a lubber line and the actual ground-track marker.

A split heading bug is located on the periphery of the compass rose. The heading bug is positioned according to the heading set with the increment and decrement arrows on the HSI display or by selecting HDG on the HUD data entry panel (DEP) (Figure 1-4) and entering the heading with the number keys. The head and tail of the TACAN bearing pointer are located on the outer edge of the compass rose. The head and tail of the VOR or waypoint bearing pointer are located on the inner edge of the compass rose. Only the bearing pointer for the selected steering reference is displayed. In the Course Deviation Indicator (CDI) mode, the inner bar represents deviation from the selected course. If TACAN or VOR is the selected steering, each dot represents 5 degrees of course deviation. For waypoint or waypoint offset steering, the scale varies based on landing gear position. With the landing gear up, full scale deflection of the inner CDI bar represents a +/- 4.0-nm cross track deviation. With the landing gear down, a full scale deflection represents a +/- 0.3-nm cross track deviation. When ILS is the ***only*** steering selected, the CDI deviation scale is relative and must be interpreted by the pilot depending on the width of the localizer course. If the localizer course is 5 degrees wide, a full scale deflection represents a 2.5-degree deviation. In addition to the typical CDI course line, a planimetric (PLAN) course line can be selected. The planimetric course line is only available for TACAN or Waypoint steering. The planimetric course line is drawn through the selected steering symbol (TACAN, waypoint, or waypoint offset). Course intercept angle and deviation are shown by the relationship of the planimetric course line to the aircraft symbol. The course line is only shown when CRS is selected on the HSI display. The course is set with the increment and decrement arrows on the HSI display or by selecting CRS on the HUD data entry panel and entering the course with the number keys. The scale of the compass rose can be set to 10, 20, 40, 80, 160, or 320 nautical miles. TACAN, waypoint, and waypoint offset symbols are shown within the compass rose relative to their bearing and distance from the aircraft symbol and the selected scale of the compass rose. Digital bearing, slant range distance, and time-to-go are provided for waypoints and valid TACAN stations. Digital bearing is also shown for a valid VOR station. A sequential steering string of two or more waypoints can also be displayed as a dashed line on the HSI display. Navigation control selection is also made on the HSI display indicating either FWD or AFT.

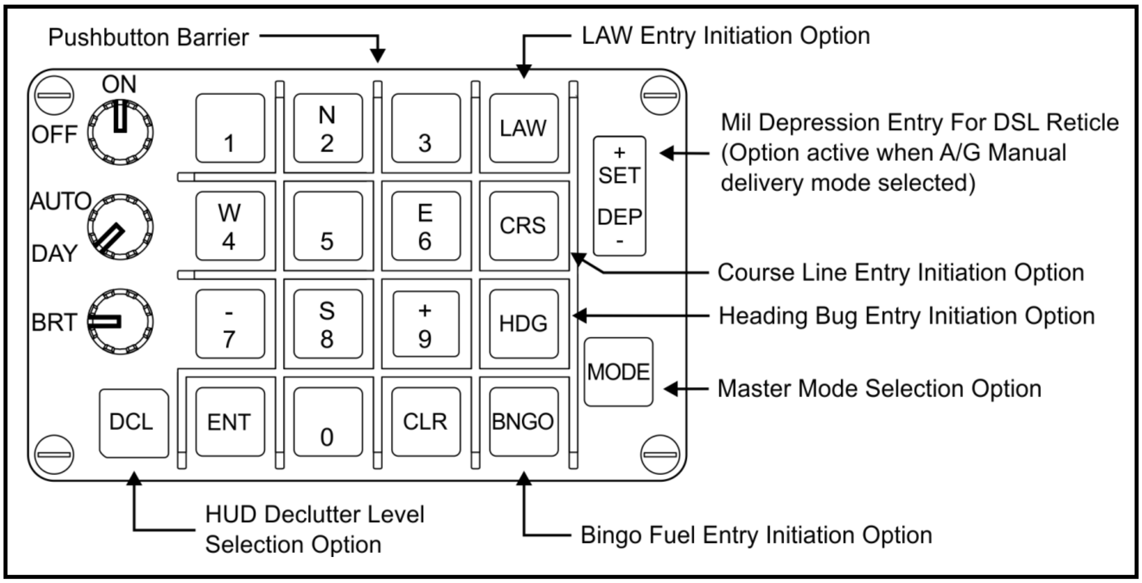

Figure 1-4 Data Entry Panel

106. FUEL FLOW AND RPM GAUGES

These instruments both provide a reference to the proper control of the aircraft's engine. In many of the different maneuvers, a specified RPM or fuel flow can be set to allow for the proper thrust to complete the maneuver. In some cases, a range can be used to allow for other possible variables. Fuel flow and RPM can also be monitored on the MFD ENGINE Page (Figure 1-5).

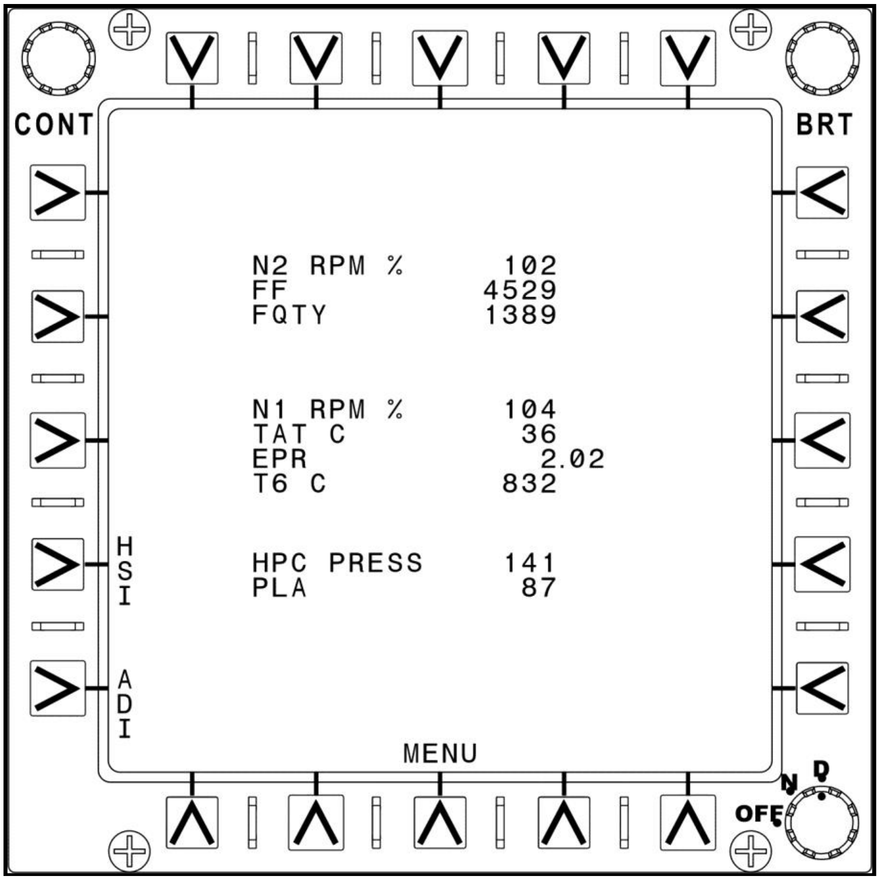

Figure 1-5 MFD Engine Page

107. STANDBY FLIGHT INSTRUMENTS

The standby instruments include airspeed, altimeter, VSI, turn and slip and attitude indicators. These instruments are used as a cross-check of multi-function display (MFD) indications or if there is a failure of the ADI display or failure of one or both of the MFDs. The standby performance instruments, airspeed, altimeter, and VSI all have lag. This factor must be accepted as an inherent factor. When the attitude and power are smoothly controlled, the lag factor is negligible and the indications on the performance instruments will stabilize or change smoothly.

108. HEAD-UP DISPLAY (HUD)

The head-up display (Figure 1-6) presents control, performance, and position information. The pitch ladder, AOA bracket, course deviation steering needle and dots, and ILS needles are referenced to the velocity vector. These symbols are referenced to the waterline of the aircraft if velocity vector information becomes invalid (velocity vector field-of-view limited). The pitch ladder attitude bars are in five-degree increments. Solid attitude bars represent a noseup pitch and dashed attitude bars represent a nose down pitch. The attitude bars are angled toward the horizon at one-half the pitch attitude, also the tips of the attitude bars point toward the horizon. The bank scale is located at the bottom of the HUD and indicates 0, 5, 15, 30, and 45 degrees of bank. The bank pointer limits and flashes at 47.5 degrees and is occluded at bank angles greater than 90 degrees (the bank scale on the ADI display is different than the bank scale on the HUD). The currently selected steering mode on the HSI display is displayed on the lower right side of the instantaneous field-of-view.

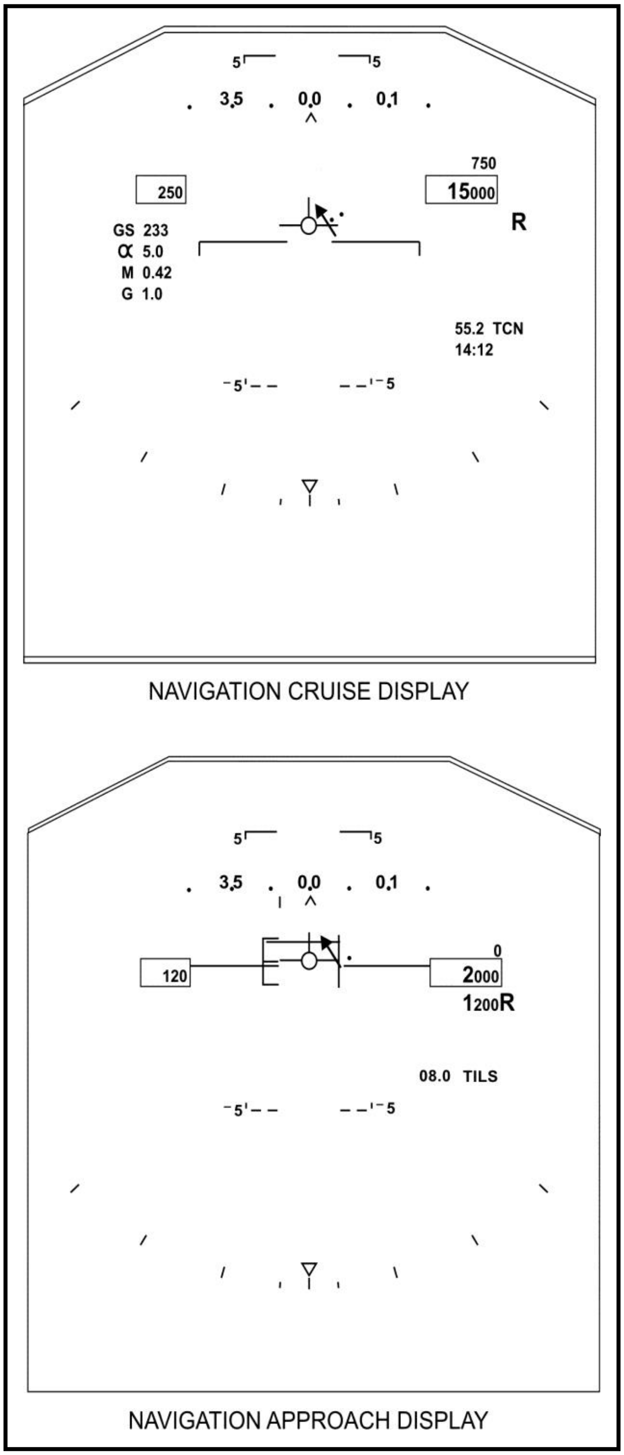

Figure 1-6 Head-Up Display

The displayed steering mode acronyms are:

TCN—TACAN

W##—Waypoint (waypoint number)

O##—Waypoint offset (waypoint number)

VOR—VOR

ILS—ILS only

TILS—TACAN and ILS

WILS—Waypoint and ILS

OILS—Waypoint offset and ILS

The distance and time-to-go to the selected steerpoint are displayed when applicable. When TACAN, waypoint or waypoint offset steering is selected, and course line (CRS) is selected on the HSI display, a situation steering arrow and two reference dots are displayed. Orientation of the situation arrow indicates the difference between the aircraft ground track and the selected course. The position of the arrow in relation to the two dots represents course deviation commensurate with the CDI scaling on the HSI display. The reference dots are removed when deviation from the selected course is within one degree with TACAN steering. With waypoint or waypoint offset steering selected, the dots are removed when course deviation is less than 0.4 nm, gear up, or 0.03 nm, gear down. When ILS needles are shown on the ADI display, they are also displayed on the HUD. The ILS needle scaling is commensurate with the scaling on the ADI display. The needles will flash when limited.

109. INSTRUMENT SCAN

During instrument flight, the pilot must divide his attention between the control, performance, and position instrument/displays. Proper division of attention and the sequence of checking the displays vary throughout the various phases of flight. There is no one set order for scanning the instrument/displays; it depends on the type of maneuver to be executed as to which instruments are of prime importance. The pilot should become familiar with the factors to be considered when dividing his attention between instrument/displays. The pilot should know the indications which will enable him to identify correct and incorrect scan techniques. The best way to improve proficiency is through practice. Some common errors in instrument scanning include the following: having no scan pattern plan, omitting a display entirely from the scan, fixating on a single or a few display indications, or misusing a display indication.

Scan Technique

A major factor influencing scan technique is the characteristic manner in which instruments respond to attitude and power changes. Because of signal filtering, raw data processing, and display time, there is inherent lag in a digital display. The lag will not appreciably affect the tolerances within which the pilot controls the aircraft; however, at times, a slight unavoidable delay in knowing the results of attitude and/or power changes will occur.

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

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

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CHAPTER TWO
GROUND PROCEDURES

200. INTRODUCTION

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

201. INSTRUMENT CHECKLIST

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

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

2. Set navigation equipment to local station.

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

4. Vertical speed indicator (VSI) - The VSI on the ADI display is set to zero with weight-on-wheels. Check the standby VSI for ZERO (note error if not zero).

5. Airspeed indication - Minimum airspeed indication on ADI display is 50 knots. Check standby airspeed indicator – ZERO.

6. ADI display - Ensure waterline is on the horizon. Adjust the standby AI; ensure waterline is on the horizon.

7. Altimeter - Set the standby altimeter to field barometric pressure. Note the barometric altitude on the ADI display. (Note error if not equal to field height. The aircraft is down for IFR flight if the error exceeds +/- 75 ft.). ADI display altitude is based on the barometric altimeter setting on the standby altimeter.

8. Clock - Set and running.

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

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

*11. Check turn needle and ball for proper function during turns while taxiing.

202. LOW ALTITUDE WARNING (LAW)

Procedures for Low Altitude Warning usage are outlined:

1. Takeoff - the LAW is set to 200 ft for low altitude warning during climbout.

2. Enroute - the LAW is set to 5,000 ft (platform) if above 5,000 ft; and at the desired altitude; minus approximately 10 percent if below 5,000 ft.

3. Penetration - during penetrations, the LAW advisory shall be set at 5,000 ft (platform) so the LAW advisory will serve as a warning to break the rate of descent.

4. Set the LAW to Height Above Touchdown (HAT) for precision approaches, Height Above Touchdown (HAT) minus 10% for straight in non-precision approaches and Height Above Airport (HAA) minus 10% for circling non-precision approaches.

(For airports at higher elevations; setting the RADALT/LAW at the MDA -10% would cause a warning well above the desired altitude.)

203. HOOD USE

You will perform the majority of your instrument flights in the T-45C "under the bag," simulating instrument conditions in a VFR environment (Figure 2-1). The T-45C NATOPS manual contains specific instructions on installing and stowing the hood. Become familiar enough with the operation of the hood so that it does not impair your performance in other aircraft duties.

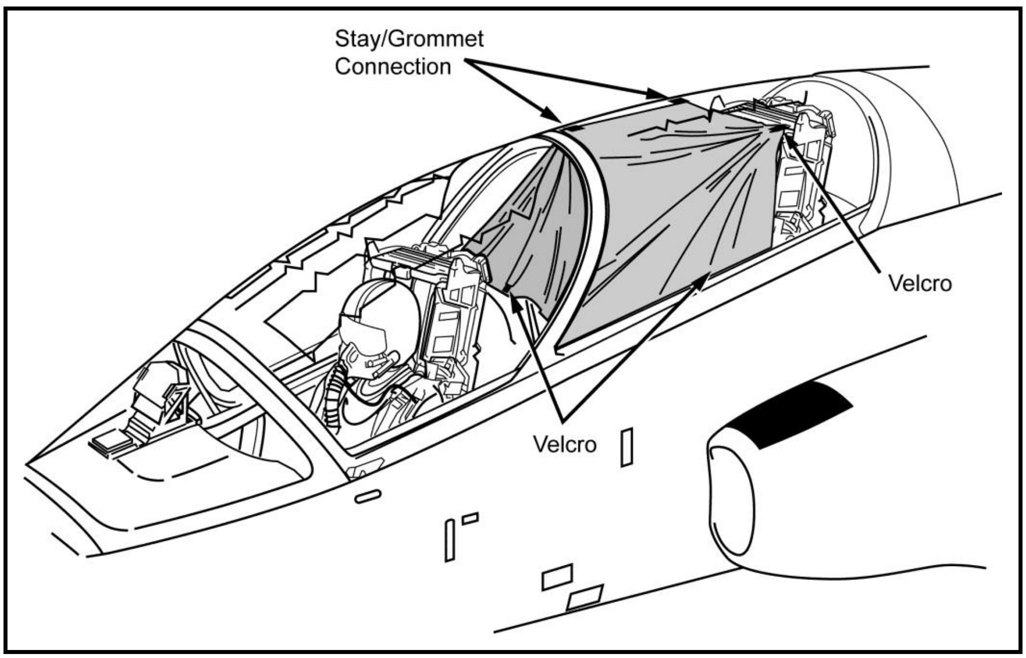

Figure 2-1 Instrument Training Hood

204. COCKPIT LIGHTING

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

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CHAPTER THREE
BASIC FLIGHT MANEUVERS

300. INTRODUCTION

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

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

NOTE

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

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

301. INSTRUMENT TAKEOFF (ITO)

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

For student instrument flights conducted from the aft cockpit, your instructor shall taxi, takeoff, and clean up the aircraft from the front cockpit. The instructor will then trim the aircraft for a 10-degree nose high (ADI/waterline), maximum rated thrust (MRT) climb and execute a positive three-way exchange of controls ***IAW the Aircrew Coordination paragraph in the Introduction Section of the Familiarization FTI.*** Exchange of controls should occur between approximately 200-230 KIAS.

When executing this maneuver from the front cockpit of the aircraft, utilize normal takeoff and crosswind takeoff procedures as described in the Familiarization FTI. Maintain a 10-degree noseup attitude (ADI /waterline) and check the altitude display and VSI prior to configuration changes and increase pitch as required to avoid settling as flaps/slats come up.

In the simulator, begin the ITO by lining the aircraft up on the centerline of the runway. Taxi straight ahead a short distance to ensure nose wheel is straight. Note that heading as displayed on the ADI and HSI is properly aligned with runway in use. Be aware that runways are numbered to the nearest 10 degrees, so you may see as much as 5 degrees difference in your heading system when aligned with centerline.

While holding the brakes, advance the power to MRT (maximum-rated thrust) and cycle the flight controls. Perform engine instrument checks and check that no warning or caution lights are illuminated, release the brakes, and start the takeoff roll. Maintain directional control with nose wheel steering while scanning the engine instruments and monitoring airspeed. At 120 KIAS, smoothly rotate to a takeoff attitude of 10 degrees nose up. Transition your scan to the ADI display for pitch, bank, heading and airspeed at rotation airspeed. Maintain directional control with the rudder and expect lift-off to occur at approximately 126-130 KIAS. Do not exceed optimum AOA during rotation or climb out. When safely airborne and a positive indication of climb on both the VSI and altitude display, retract the gear with a minimum of 100 ft AGL. Maintain initial climb attitude and accelerate to flaps/slats up speed and raise the flaps once above 140 KIAS and safely airborne, not to exceed 200 KIAS. From rotation speed until you clean up the aircraft, center your scan on the ADI display for pitch, bank, heading and airspeed; also check the altitude display and VSI prior to configuration changes. Report handle checked and aircraft clean prior to 200 KIAS. As the aircraft accelerates, hold your climb attitude and trim out stick pressure. Maintain the nose attitude of 10 degrees noseup until climb speed is attained. Five knots prior to desired climb speed, increase nose attitude to approximately 15-20 degrees to intercept and maintain climb airspeed.

NOTE

When crewed with an instructor pilot, you will be required to receive acknowledgement from your instructor prior to moving the landing gear handle or flaps/slats lever.

302. LEVEL OFF CHECK

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

NOTE

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

303. CONSTANT AIRSPEED CLIMBS AND DESCENTS

Constant airspeed climbs and descents will introduce you to the principle that changing the aircraft nose attitude (pitch) is the primary method of controlling airspeed when your aircraft is climbing or descending. Thus, the critical and challenging component of these maneuvers lies in establishing a pitch angle that results in a climb or descent with little or no change in airspeed. You will use constant airspeed climbs during departure and constant airspeed descents for cruise and penetration descents. Because you are using nose attitude (pitch) to maintain airspeed during these maneuvers, the primary instruments to scan are the ADI display for pitch and bank control and airspeed for performance. You will need to start picking up the altitude trend wiper blade in your scan as the maneuver progresses so that you can identify the point at which you'll transition to level flight. VSI indications are instantaneous, so avoid making abrupt adjustments or you will find yourself chasing it. Your scan should center on the ADI display ball and the altitude trend wiper blade during the period from lead point to assigned altitude because you will be trying to arrive at a pitch attitude that represents level flight at the same time you reach your altitude. To perform a smooth level off at the correct speed, you will always need to start your transition to level flight by coordinating power and nose attitude.

Constant Airspeed Climb

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

Constant airspeed climb—normal cruise entry and exit:

Throttle: MRT

Pitch: Initially 8-10 degrees noseup to maintain 250 KIAS, then as required to maintain airspeed. Beginning in RI stage, lower the nose to approximately 3 degrees and accelerate to 300 KIAS at 10,000 ft. Adjust nose and trim as necessary to maintain 300 KIAS climb until intercepting 0.75 indicated Mach number (IMN). This occurs at approximately 25,000 ft.

Level off: Lead by 10 percent of VSI.

Throttle: Cruise (see table of cruise airspeeds and fuel flows in INSTRUMENT FLIGHT PLANNING). For BI stage, maintain 250 KIAS in the climb. Plan to level at 250 KIAS at an altitude specified by your instructor. For level flight at 250 KIAS, set approximately 1,300 – 1,400 pph at 15,000 ft MSL.

Pitch: Adjust for level flight (approximately 3 degrees nose up)

Trim: Adjust for level flight

To initiate a climb from a cruise airspeed lower than desired climb airspeed, advance power to MRT while trimming the nose down as required to maintain level flight. When the airspeed approaches a 5-kt lead point, smoothly raise the nose to maintain climb airspeed (250 KIAS less than 10,000 ft MSL, 300 KIAS/ 0.75 IMN above). You are actually accomplishing two separate maneuvers in this instance: a level speed change followed by a constant airspeed climb. Your scan needs to change with the maneuver being performed. Be sure that your scan includes the ADI display for pitch, bank, and heading control. Use the ADI display VSI and altitude trend wiper blade for pitch performance during the acceleration to desired airspeed. During the climb, be sure that you scan the ADI display for pitch and bank control and the ADI display airspeed trend wiper blade for airspeed performance.

Constant Airspeed Descent

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

When beginning this maneuver from cruise airspeed, reduce power to idle and smoothly reduce pitch by 3-6 degrees to maintain 250 KIAS (approximately 2 degrees nose down). As in a constant airspeed climb, control airspeed by making small pitch changes. Use a lead point of 10 percent of the VSI for exiting the maneuver; when you reach the lead point, increase power to the cruise setting and establish a pitch attitude that results in level flight. Retrim the aircraft at the end of the maneuver.

Constant airspeed descent—normal cruise entry and exit:

Throttle: Reduce to idle

Pitch: Reduce by 3-6 degrees to maintain 250 KIAS (approximately 2 degrees nose down)

Level off: Lead by 10 percent of VSI

Throttle: Increase to cruise power (approximately 1300-1400 PPH at 15,000 ft MSL)

Pitch: Adjust for level flight (approximately 3 degrees nose up)

Trim: Adjust for level flight

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

304. CONSTANT RATE CLIMBS AND DESCENTS

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

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

Your primary scan for these maneuvers must include the ADI display for pitch, bank, heading control, climb or descent rate, and airspeed. VSI indications are instantaneous, so avoid making abrupt corrections or you will find yourself chasing it. The importance of keeping the aircraft correctly trimmed throughout these maneuvers can't be overemphasized. If you don't have the aircraft trimmed, it is much more likely that you'll end up chasing the performance instruments.

Constant Rate Climb. Entry speed for this maneuver is 200 KIAS (approximately 1,100 pph) at a specified altitude and heading. Initiate a 1,000-fpm climb by advancing power to approximately 1,500 pph and raising nose attitude by 2-3 degrees on the ADI display to maintain airspeed at 200 KIAS. Monitor your heading on the ADI display and ensure that it does not vary during the climb. As a heading reference, set your desired heading using the HDG option on the HSI display and deselect all navigation steering options on the HSI display. By doing this, the command heading bug on the ADI display is positioned at the heading you set on the HSI display HDG option.

NOTE

> During the climb, you will control airspeed with pitch and rate of climb with power.

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

Constant rate climb entry and exit:

Throttle: 1,500 pph

Pitch: Increase by 2-3 degrees to maintain 200 KIAS

Trim: Adjust for airspeed

VSI: Maintain 1,000-fpm climb

Level off: Lead by 10 percent of VSI

Throttle: Reduce to approximately 1,100 pph

Pitch: Lower to level flight attitude

Trim: Adjust for level flight

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

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

NOTE

During the descent, you will control airspeed with pitch and rate of descent with power.

A common mistake in this maneuver is to attempt to control airspeed with power and descent rate with pitch. Avoid making abrupt adjustments in response to VSI indications because you will find yourself chasing it.

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

Constant rate descent entry and exit:

Throttle: Reduce to 700 pph

Pitch: Decrease by 1-2 degrees to maintain 200 KIAS

Trim: Adjust for airspeed

VSI: Maintain 1,000-fpm descent

Level off: Lead by 10 percent of VSI

Throttle: Add power to approximately 1,100 pph

Pitch: Raise to level flight attitude

Trim: Adjust for level flight

305. LEVEL TURNS

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

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

Prior to entering a turn, trim your aircraft on the correct heading, airspeed, and altitude. When you transition into a turn, use the ADI display to establish the proper bank and pitch references, cross-check altitude trend indicator and VSI for a level turn. After you are established in the turn, include the airspeed trend indicator in your scan. Monitor the ADI display heading scale for roll-out point. Since the ADI display heading scale only shows +/- 15 degrees of heading from the heading reference, you will need to anticipate when your roll-out point will come into view or cross-check the HSI display to monitor the approach of your roll-out point. During the roll-out, use the ADI display to monitor both bank and pitch. As with all other instrument maneuvers, trim throughout the turn to keep pressure off the stick.

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

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

Use a lead point of approximately 10% of the angle of bank for initiating your roll-out. As you roll out of the turn, the vertical component of lift will increase and the aircraft will have a tendency to climb. To counteract this, lower the nose attitude back to level flight reference and reduce power to the pre-turn setting. Any aft stick or trim added during the turn will have to come out when the turn is complete.

Heading change of 30 degrees or more: 30 degrees AOB

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

Throttle: Increase as needed to maintain airspeed

Pitch: As required to maintain level flight

Lead point for roll-out: 10% AOB

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

The turn consists of two 30-degree angle of bank turns for 60 degrees of heading change each, two 45-degree AOB turns for 90 degrees of heading change each, and two 60-degree AOB turns for 120 degrees of heading change each. Since there are no 45-degree bank angle scale markers on the ADI display, you must place the bank angle pointer halfway between the 30-degree and 60-degree bank angle scale markers. Execute the turn reversals smoothly, with no straight-and-level legs. At the end of the maneuver, recover wings level on original heading.

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

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

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

Once you have made the necessary pitch and power changes, check the turn needle and adjust the bank as necessary to maintain 1 needle-width of deflection. Check that 20 seconds have elapsed on the clock for every 30 degrees of heading change. Always check the time when you reach the correct number of degrees of turn (not vice versa) to ensure that you are keeping your scan on the flight instruments rather than on the clock. Since the HSI display compass rose is numbered in 30-degree increments, it provides a good reference when you should check the clock.

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

Lead your roll-out by 10% of the angle of bank, simultaneously reducing power to the level flight setting if it has been advanced.

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

Rate: 1-1/2 degrees per second

Throttle: As required to maintain airspeed

Pitch: As required to maintain level flight

Lead point for roll-out: 10% AOB

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

Timed Turns Standard Rate. Use the same procedures and AOB limitations as 1/2 SRT except: establishing and maintaining a standard rate turn requires that you monitor the turn needle and adjust the bank angle as necessary to achieve a ***2*** needle-width deflection.

Bank angle: Approximately 20 percent of IAS

Rate: 3 degrees per second

Throttle: As required to maintain airspeed

Pitch: As required to maintain altitude

Lead point for roll-out: 20% AOB

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

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

NOTE

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

As the clock's second hand passes a cardinal point (3, 6, 9, or 12), smoothly roll into the turn, ***and do not lead time***. Adjust the bank angle as necessary to establish a 1/2 standard rate turn (approximately 25 degrees at 250 KIAS and 15,000 to 20,000 ft), and adjust pitch and power to maintain altitude and airspeed.

If just the heading is frozen or blanked, continue to use the attitude information on the ADI display, otherwise use the standby AI for attitude reference. Because of its smaller size, the standby AI will appear to move faster and less smoothly, and you should be careful not to over control the aircraft when flying partial panel. Correct only as necessary.

Roll out of the turn at the end of the computed time, readjusting pitch and power for level flight. Then check the standby compass to confirm that you are on the desired heading. It is very important, especially during partial panel work, that you keep the airplane trimmed at all times.

Bank angle: Approximately 10 percent of IAS

Throttle: As required to maintain airspeed

Pitch: As required to maintain altitude

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

306. LEVEL SPEED CHANGES

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

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

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

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

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

Pitch: Decrease as required to maintain level flight

Trim: As required

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

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

When making large or rapid airspeed decreases, reduce the throttle to idle and fully extend the speed brakes. When you extend the speed brakes, expect a pitchup and anticipate the need to retrim the aircraft to maintain altitude. Because the airspeed will rapidly decrease, you will need to use a 5-kt lead point to retract the speed brakes and reset the power to avoid undershooting your desired airspeed. Anticipate a pitch down when you retract the speed brakes. Use this method when you practice the speed change from 250 to 200 KIAS in the T-45C.

To execute a small change in airspeed:

Throttle: Below power setting for desired airspeed

Pitch: Increase as required to maintain level flight

Trim: As required

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

To execute large or rapid changes in airspeed:

Throttle: Power setting to idle

Speed brakes: Extend

Pitch: Increase as required to maintain level flight

Trim: As required

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

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

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

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

Throttle: MRT (for 20 KIAS increase or greater)

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

Clock: Every 20 seconds for 30 degrees of heading change

Pitch: As required to maintain altitude

Lead point for roll-out: 10% AOB

Lead point for power reduction: 5 kts

Trim: As required

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

Decelerating Timed Turn. Begin the decelerating airspeed turn by using a 3-second lead. Simultaneously reduce the throttle to idle while extending the speed brakes. Roll the aircraft to a bank angle giving a 1/2 standard rate turn (approximately 10 percent of the airspeed at altitude). When you extend the speed brakes, expect a pitchup and anticipate the need to retrim the aircraft to maintain altitude. You can accurately predict that the bank will require an increase in back stick to maintain level flight. As the airspeed decreases, the aircraft will tend to pitch down, requiring further back stick to maintain level flight. Include in your scan the ADI display for pitch and bank control, the altitude trend indicator and/or VSI for pitch performance information, the airspeed trend indicator for power performance information, and the clock for turn performance information. As airspeed falls, you will have to decrease bank angle to maintain a 1/2 SRT. Retract speed brakes and reset power 5 knots prior to desired airspeed. Anticipate a pitch down when you retract the speed brakes. Normally, this maneuver is performed from 250 to 200 KIAS.

Throttle: Power setting to idle

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

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

Pitch: As required to maintain altitude

Clock: Every 20 seconds for 30 degrees of heading change

Lead point for speed brake retraction: 5 kts

Lead point for roll-out: 10% AOB

Trim: As required

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

307. "S" PATTERNS

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

S-1 Pattern. The S-1 pattern consists of a 1,000-fpm descent for 1,000 ft followed by a 1,000-fpm climb for 1,000 ft (each maneuver lasting 1 minute in duration). This descent/climb sequence is performed a minimum of two times (Figure 3-1). Fly the entire maneuver on a constant heading and at a constant airspeed of 200 KIAS.

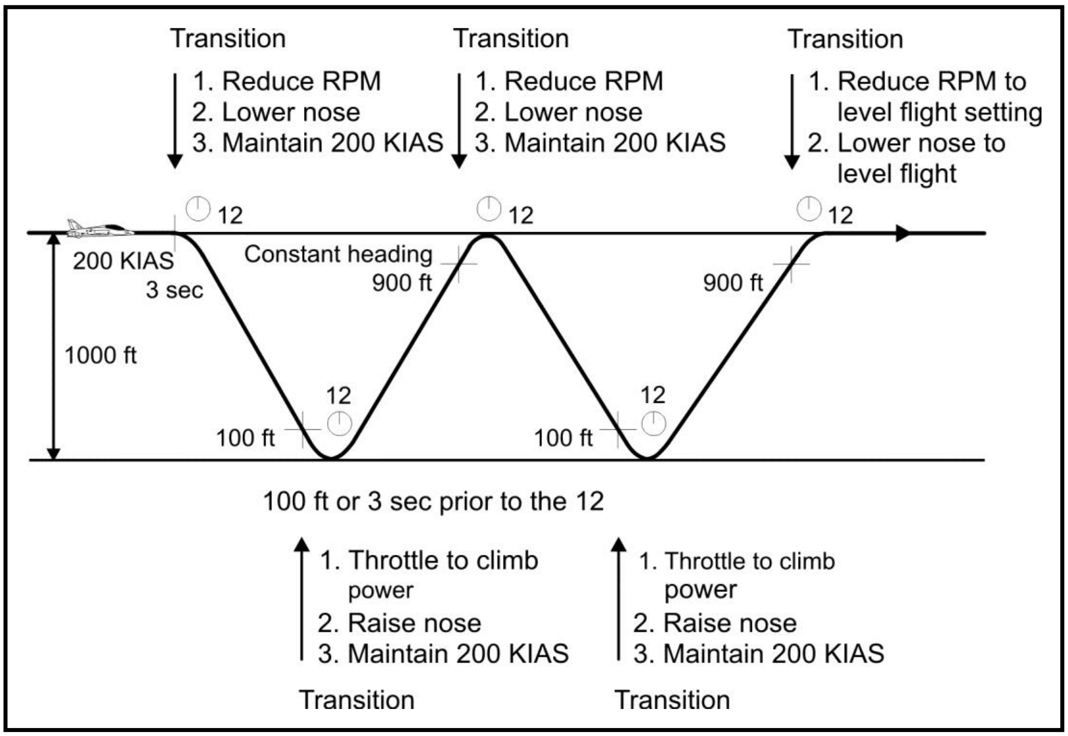

Figure 3-1 S-1 Pattern

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

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

Near the end of the last climb in the maneuver, prepare for the transition back to level flight: 3 seconds or 100 ft (whichever occurs first) prior to level off, reduce power to the level flight setting and begin lowering the nose to level flight attitude (approximately 5 degrees nose up). Be sure to control the rate of pitch change in order to reach level flight at the same time you reach level off altitude.

Power setting: Climb approximately 1,500 pph; Descent approximately 700 pph

Pitch: Climb = 2-3 degrees above level flight attitude; Descent = 1-2 degrees below level flight attitude

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

VSI: Steady at 1,000 fpm

Airspeed: 200 KIAS

Heading: Hold constant

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

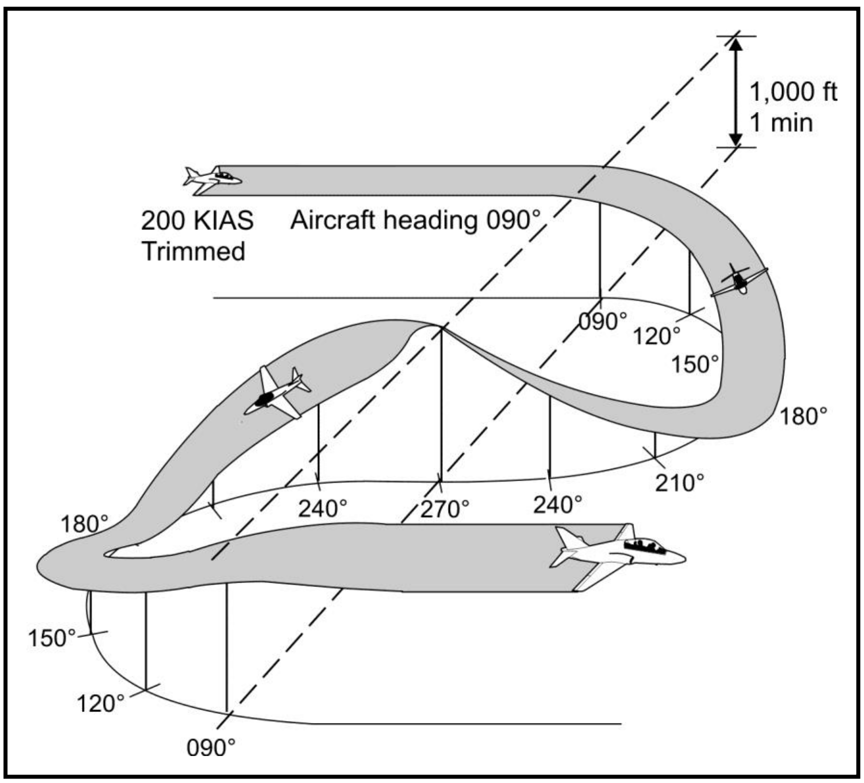

Figure 3-2 S-3 Pattern

Once established at 200 KIAS, trimmed, and on assigned heading, begin the maneuver using a 3-second lead on the clock and simultaneously initiating a timed 1/2 SRT and timed 1,000 fpm descent. Adjust the AOB and 200-kt descent rate to arrive at the transition point of the descent or climb on time and on heading (approximately 3 seconds prior to the twelve o'clock position, 5 degrees short of the 90-degree turn, and 100 ft prior to the end of the 1,000-ft descent). At the transition point, begin 200 KIAS, 1,000 fpm rate climb while continuing the 1/2 SRT in the same direction for another 90 degrees of turn. During the climb, adjust AOB to maintain rate of turn and power and pitch to maintain 200 KIAS, 1,000 fpm climb on the clock.

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

Power setting: Climb approximately 1,500 pph; descent approximately 700 pph

Pitch: Climb= 2-3 degrees above level flight attitude; Descent = 1-2 degrees below level flight attitude

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

Airspeed: 200 KIAS

Heading: 90 degrees of change for each climb and descent

NOTE

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

308. SLOW FLIGHT MANEUVER

The slow flight maneuver allows you to practice instrument landing procedures, at altitude, prior to your first actual instrument approach. Although this maneuver may appear complex, it is actually just a compilation of individual maneuvers that you have already performed (Figure 3-3).

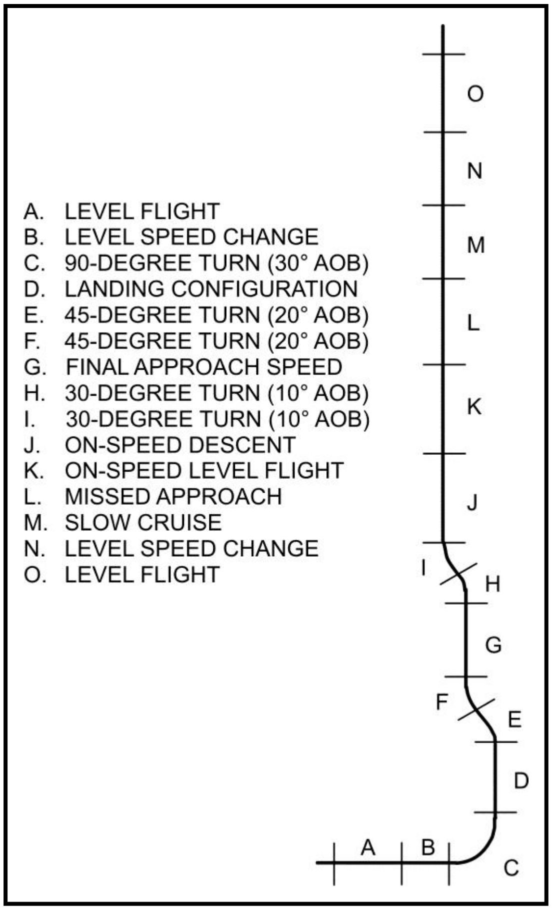

Figure 3-3 Slow Flight Maneuver

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

Next, roll into a 30-degree AOB turn and hold it for 90 degrees of heading change, adjusting pitch and power as needed to maintain altitude and airspeed. Lead the roll-out by 10% of your bank angle, readjusting pitch and power to maintain level flight.

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

Complete the landing checklist at this time.

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

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

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

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

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

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

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

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

1. Perform level speed change from 250 to 200 KIAS.

2. Execute level 30-degree AOB turn for 90 degrees of heading change.

3. Configure aircraft for landing and stabilize airspeed at 150 KIAS.

4. Perform level 20-degree AOB turn for 45 degrees heading change and reverse to original heading.

5. Slow to optimum AOA.

6. Perform level 10-degree AOB turn for 30 degrees and reverse to original heading.

7. Extend speed brakes and descend at 500 fpm for 1,000 ft with aircraft at optimum AOA.

8. Establish level flight at optimum AOA.

9. Advance throttle to MRT, retract speed brakes, initiate a climb, raise gear and flaps/slats, and climb at 200 KIAS to original altitude.

10. Establish level flight at slow cruise (200 KIAS).

11. Perform a level speed change from 200 to 250 KIAS.

309. STALLS AND UNUSUAL ATTITUDE RECOVERIES

Practicing stalls and unusual attitude recoveries will give you confidence and experience in recognizing abnormal situations and in promptly taking the appropriate corrective action. You will perform these maneuvers entirely on instruments. Stalls shall be conducted while VMC with a defined horizon.

STALLS

The stalls consist of recoveries initiated from two types of entries: clean and dirty. Prior to executing these stalls, complete the stall and aerobatic checklist. You must begin all stalls at a minimum altitude of 12,000 ft AGL.

Entry:

Stall and aerobatic checklist: Complete

Configuration: Clean

Altitude: 12,000 ft AGL minimum

Airspeed: 200 KIAS

Throttle: Idle rpm

Speed Brakes: Extended until 150 KIAS then retracted

Nose attitude: Adjust to maintain altitude

Trim: Do not trim into stall past 150 KIAS.

Wing attitude: Wings level

Stall and Aerobatic Checklist

1. Secure cockpit of foreign objects.

2. Secure map case.

3. Check fuel state.

4. Clear area.

Clean. Clean stalls are performed with gear up, flaps/slats retracted, and speed brakes in, and they are initiated at an airspeed of 200 KIAS. To commence the maneuver, reduce throttle to idle, extend the speed brakes to assist in slowing down, retract the speed brakes at 150 KIAS, keep the wings level, and maintain altitude. As the airspeed bleeds off, you will have to increase back stick pressure to hold altitude constant. Do not trim past 150 KIAS. Continue to maintain altitude through rudder shaker into the onset of buffet, and until a wing drop off or 30 units AOA is achieved, whichever occurs first. To recover, lower the nose to attain 20-21 units AOA. ***Simultaneously*** advance throttle smoothly to MRT, retract speed brakes and level the wings. Hold 21 units AOA until you see positive rates of climb on the VSI and altitude trend indicators.

Recovery:

Nose attitude: Lower until 20-21 units AOA achieved

Simultaneously:

Throttle: MRT

Speed brakes: Retract

AOB: level wings

AOA: Maintain 21 units

Altitude: Maneuver complete when positive rate of climb confirmed on VSI and altitude trend indicator

Dirty. The dirty stall and recovery demonstrates the proper techniques to employ if airframe buffet occurs while you are wings level in the landing configuration. Airframe pre-stall buffeting increases until the stall, so it serves as your warning that a stall is about to occur. This stall could result if the rudder shaker is inoperative or ignored.

Review the pre-stall and aerobatic checklist. Configure the aircraft for level flight with gear and flaps/slats down, speed brakes out, trimmed up and on speed with landing checks complete. Maintain on-speed AOA, wings level in the landing configuration then reduce throttle to idle RPM, and as aircraft decelerates, increase the nose attitude to maintain altitude. As with the other stall entry, you will have to increase back stick pressure as airspeed bleeds off to maintain altitude (do not trim into the stall). Continue to maintain altitude through rudder shaker into the onset of buffet, and until a wing drop off or 30 units AOA is achieved, whichever occurs first.

At the first indication of stall, normally associated with wing drop-off but no later than 30 units, simultaneously reduce nose attitude to attain 24 units AOA, simultaneously advance the power to MRT, level the wings and retract the speed brakes. Maintaining 24 units AOA precludes reentering airframe buffeting while minimizing the loss of altitude. Hold AOA at 24 units until you see a positive rate of climb indicated on both the altimeter and the VSI.

Entry:

Altitude: 12,000 ft AGL minimum

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

AOA: Optimum

Landing checklist: Complete

Stall and aerobatic checklist: Review

Throttle: Idle rpm

Nose attitude: Adjust to maintain altitude

Wing attitude: Wings level

Recovery:

Nose attitude: Lower until 23-24 units AOA achieved

Simultaneously:

Throttle: MRT

Speed brakes: Retract

AOB: level wings

AOA: Maintain at 23-24 units

Altitude: Maneuver complete when positive rate of climb confirmed on VSI and altitude trend indicator

UNUSUAL ATTITUDES

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

General procedures:

Controls: Neutralize

Attitude: Analyze and evaluate to determine best recovery

Airspeed: Limit in dives

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

Nose-High Recovery. Your primary concern when recovering from a Nose-High Unusual Attitude is to maintain the AOA between 5 and 10 units until you determine your airspeed and the correct procedure to execute. At slow speeds, very slight back stick pressure will cause a rapid increase in the AOA. Additionally, uncoordinated aileron and rudder inputs at slow speeds can introduce enough adverse yaw and increased AOA on the rising wing to cause a departure from controlled flight.

When given control of the aircraft, simultaneously neutralize the flight controls (e.g., ailerons, stabilator, rudder) and analyze the situation by scanning the appropriate instruments (e.g., ADI, AOA, airspeed, and altimeter). To recover from a nose-high condition, advance the power to MRT and retract the speed brakes to minimize loss of airspeed. If airspeed is 150 KIAS or greater, smoothly roll inverted to nearest horizon, apply positive g to bring the nose back to the horizon, don't exceed 17 units AOA. After the nose passes through the horizon, G may be reduced slightly but positive g should be maintained. At 150 KIAS, roll upright and return to level flight.

If upright and airspeed is less than 150 KIAS, maintain neutral aileron and rudder and push the nose over to maintain an AOA indication of between 5 and 10 units (you will be between 0 and 1g). Hold this AOA until the nose falls through the horizon, settles slightly below the horizon, and the aircraft accelerates to 150 KIAS. Then roll wings level and return to level flight.

If inverted, maintain neutral aileron and rudder and let the nose drop through the horizon while continuing to maintain no more than 17 units of AOA until the aircraft accelerates to 150 KIAS. Level the wings in the shorter direction, raise the nose to the horizon, and adjust the power for straight and level flight. Do not exceed optimum AOA. During recovery at low speeds, you must be careful not to stall the aircraft.

Nose-high upright recovery (less than 150 kts):

Controls: Neutralize

Attitude: Analyze and evaluate

Throttle: MRT

Speed brakes: Retract

AOA: Apply stick pressure to obtain 5-10 units

Nose: Lower to slightly below horizon

Airspeed: Minimum of 150 KIAS

Wings: Level in shortest direction

Nose: Pull to horizon - optimum AOA

Throttle: Adjust for level flight

Nose-high upright recovery (greater than 150 kts):

Controls: Neutralize

Attitude: Analyze and evaluate

Throttle: MRT

Speed brakes: Retract

Wings: Roll inverted to nearest horizon

AOA: Apply back stick to obtain optimum AOA

Nose: Pull through horizon

Airspeed: Minimum of 150 KIAS

Wings: Level in shortest direction

Nose: Pull to horizon - optimum AOA

Throttle: Adjust for level flight

Nose-high inverted recovery:

Controls: Neutralize

Attitude: Analyze and evaluate

Throttle: MRT

Speed Brakes: Retract

AOA: Apply back stick to obtain optimum AOA

Nose: Pull through horizon

Airspeed: Minimum of 150 KIAS

Wings: Level in shortest direction

Nose: Pull to horizon – optimum AOA

Throttle: Adjust for level flight

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

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

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

Nose-low recovery:

Controls: Neutralize

Attitude: Analyze and evaluate

Throttle: Retard to idle with airspeed above 150 KIAS

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

Wings: Roll level in shortest direction to horizon

Nose: Pull to horizon

Throttle: Adjust for level flight

310. AEROBATICS

You will perform aerobatics in the BI syllabus to learn the standard aerobatic maneuvers while improving your instrument scan and basic airwork, increasing your confidence and extending mastery over a larger portion of the maneuvering envelope. As aerobatic flight improves your coordination, your timing, and your ability to remain oriented, it also furthers your sense of feel for the T-45C. Practicing these maneuvers will also be helpful when recovering from unusual attitudes.

You must know, understand, and observe all restrictions pertaining to aerobatics and be thoroughly familiar with the capabilities and limitations of the T-45C aircraft (refer to NATOPS, Chapter 4).

Aerobatic maneuvers will be initiated from an altitude of at least 12,000 ft AGL so that you will be able to complete the maneuver and return to straight and level flight without descending below 10,000 ft AGL. You will have no visual reference outside the cockpit during the BI phase; the ADI will be your primary attitude reference during the maneuvers.

Wingover

The wingover is a 180-degree reversal of the direction of flight through the vertical as well as the horizontal plane. Perform it by combining a smooth climbing turn for 90 degrees and a smooth descending turn for 90 degrees, recovering at approximately the same airspeed and altitude at which you began the maneuver, but with a 180-degree heading change (Figure 3-4). The wingover develops your ability to control the aircraft smoothly in balanced flight through constantly changing attitudes and airspeeds. Perform the maneuver in either direction in a series of two (in opposite directions) so that the series is completed on the same heading at which the first wingover was started.

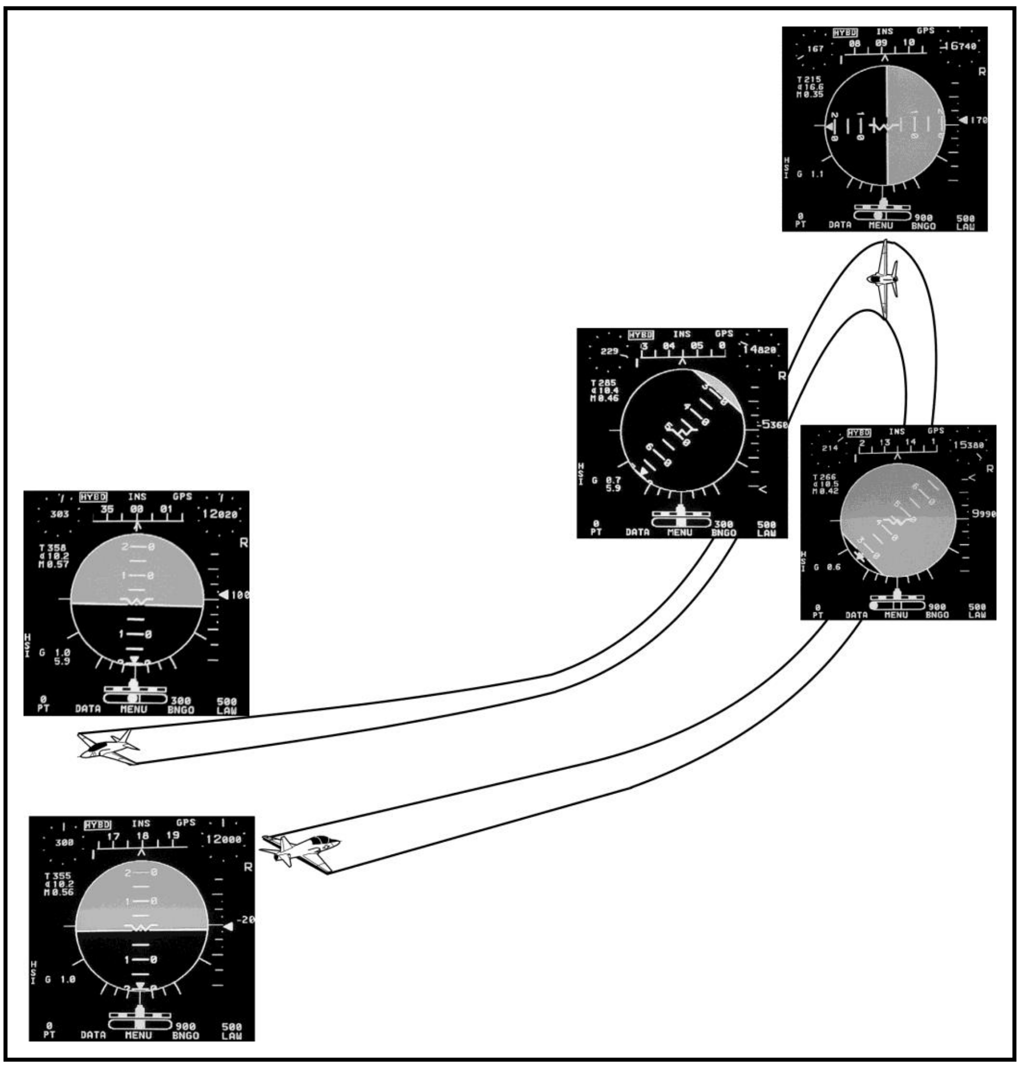

Figure 3-4 Wingover

Procedures

Complete the prestall and aerobatic checklist prior to performing the wingover. Begin the maneuver at 300 KIAS, on altitude, with the power set to approximately 89 percent RPM, and on a reference heading. Raise the nose smoothly, keeping the wings level, to approximately 20 degrees nose up attitude. As the nose continues up, initiate a slow roll in the direction of the maneuver. The nose should scribe an arc above the horizon, reaching a maximum pitch of 45 degrees at approximately 45 degrees of heading change and 45 degrees AOB.

As the AOB continues to increase, start the nose smoothly downward toward the horizon.

After the 90 degrees of heading change, the nose passes through the horizon, with 90 degrees AOB and an airspeed of approximately 150-170 KIAS. Reverse the roll and begin to decrease the AOB as the nose falls through the horizon. The nose should scribe a similar arc below the horizon, reaching a maximum pitch of 45 degrees nose down at approximately 135 degrees of heading change and 45 degrees AOB.

Roll out of the maneuver at a constant rate, increasing back stick pressure to control airspeed and altitude. Upon completion of the maneuver, you should be in straight and level flight at 300 KIAS, 180 degrees from the original heading, and at approximately the same altitude as at the beginning of the maneuver.

Now immediately raise the nose to continue the maneuver in the opposite direction. Your aircraft should be on its original heading upon completion of the second wingover.

Techniques

When the wingover is introduced, visualize the aircraft's path with relation to the horizon. Once you are able to visualize this relation, the wingover is merely a matter of flying the aircraft through the pattern. As the aircraft's speed changes throughout the maneuver, you will have to adjust the amount of control deflection to maintain a constant rate of pitch and roll. As your bank angle increases, it is difficult to keep the nose coming up without drastically increasing your turn rate. If you are not getting 45 degrees nose up, you may be rolling too fast during the initial part of the maneuver.

Barrel Roll

In the barrel roll, you roll the aircraft 360 degrees about an imaginary point on the horizon that bears 45 degrees from the original heading of the aircraft. You practice it to further develop your confidence, coordination, and instrument scan while flying the aircraft through varying attitudes and airspeeds. The barrel roll also develops your ability to remain oriented while flying the aircraft in balanced flight through the inverted position (Figure 3-5).

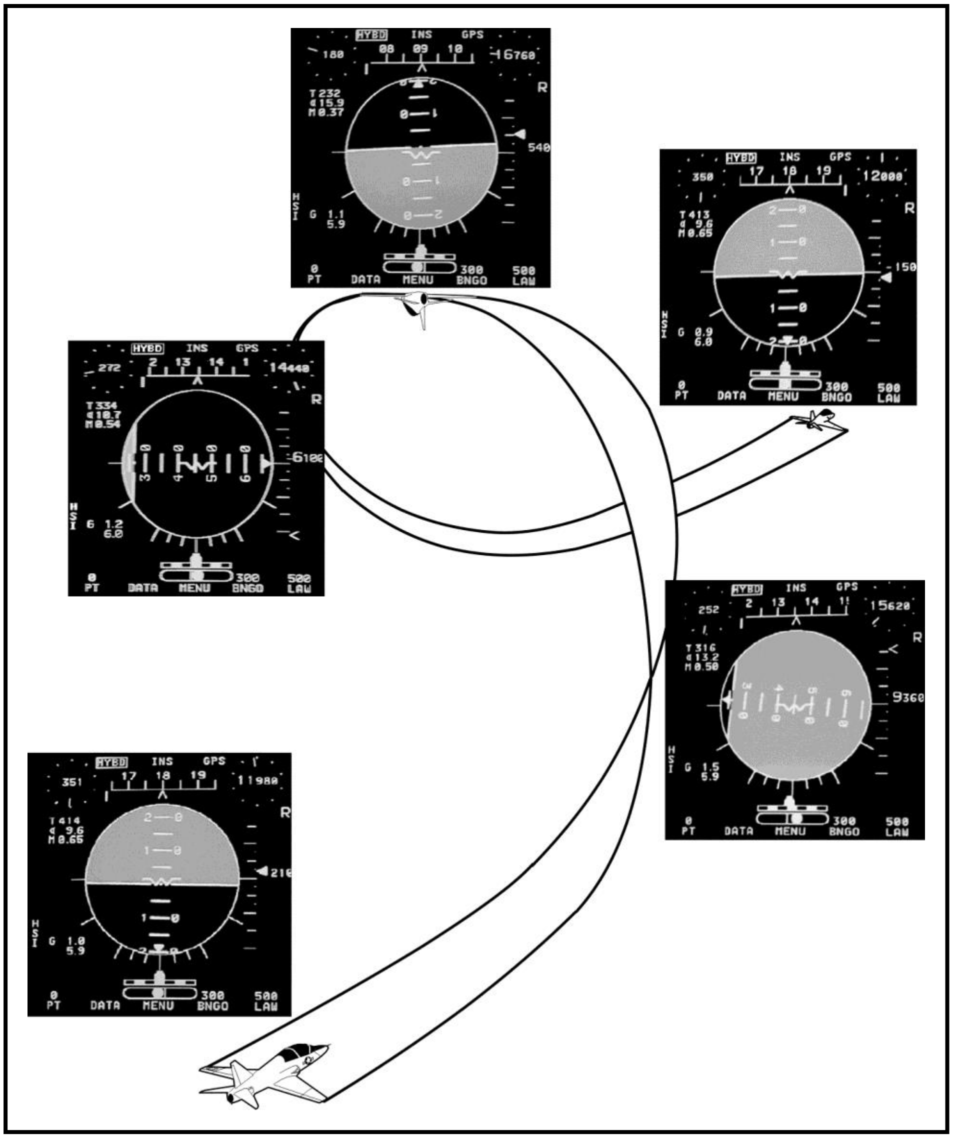

Figure 3-5 Barrel Roll

Procedures

Complete the prestall and aerobatic checklist prior to performing the barrel roll. Begin the maneuver at 350 KIAS, on altitude, with the power set at approximately 92 percent RPM, and on a reference heading. Smoothly bring the nose to approximately 30 degrees nose-high attitude while maintaining wings level. Passing 30 degrees nose up, initiate a smooth roll in the direction of the maneuver while scribing an arc around an imaginary 45-degree reference point. The nose will be at its highest when the aircraft is in 90 degrees AOB passing through 45 degrees of turn.

Continue at a constant rate of roll so that the aircraft is inverted wings level and 90 degrees off the original heading as the nose passes down through the horizon. Verify that your airspeed over the top is approximately 170-190 KIAS. Continue the roll so that the nose passes through the 45-degree nose down position below the imaginary 45-degree reference point with a 90-degree

AOB. Maintain constant nose movement and roll to exit the barrel roll at 350 KIAS at entry altitude and on entry heading.

Techniques

As in the wingover, you will have to adjust your control inputs to maintain a constant rate of roll and pitch as the airspeed changes during the maneuver. If you are not achieving 90 degrees of heading change as you roll inverted, you didn't maintain enough back stick when you were between 60 and 90 degrees AOB.

311. TRANSITIONS (CLEAN TO DIRTY)

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

As stick forces settle down, trim nose up as the aircraft decelerates. As airspeed approaches 160 KIAS, increase power for 150 KIAS (see table "Approximate Fuel Flow to Maintain Level Flight"). Decelerate to optimum AOA (no sooner than 10 nm, 30 degrees of final approach course (FAC)) by reducing power, adding noseup trim to maintain level flight, and then adding the appropriate amount of power to achieve level flight. ***Do not decelerate below 150 K1AS airspeed until the landing checklist is complete (except for the AOA check).*** The deceleration should be gradual to prevent settling. Significant power-on corrections will be required to stop settling. The large power addition must be followed immediately by a large counter correction. Subsequent corrections should dampen out (become smaller), bringing the power back to the appropriate setting.

APPROXIMATE FUEL FLOW TO MAINTAIN LEVEL FLIGHT

KIAS	CONFIGURATION	FUEL FLOW (PPH)
200	CLEAN	1,100
150	GEAR DOWN, FLAPS HALF	1,900
150	GEAR DOWN, FLAPS FULL	2,500
OPTIMUM AOA	GEAR DOWN, FLAPS HALF	1,800
OPTIMUM AOA	GEAR DOWN, FLAPS FULL	2,100
OPTIMUM AOA	GEAR DOWN, FLAPS HALF, BOARDS OUT	2,100
OPTIMUM AOA	GEAR DOWN, FLAPS FULL, BOARDS OUT	2,400

LANDING APPROACH SPEED: 17 UNITS AOA

GROSS WT. (POUNDS)	FULL FLAPS (KIAS)	HALF FLAPS (KIAS)	ZERO FLAPS (KIAS)	EMERG FLAPS (KIAS)
11,000	114	132	151	114
12,000	119	138	157	119
13,000	124	143	164	124
14,000	128	149	170	128
15,000	133	154	176	133

312. OPTIMUM AOA DESCENT

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

NOTE

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

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

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

When AOA and VSI values are moving in the same direction, energy can be traded with nose movement and a coordinated power adjustment as necessary. For example, trade increasing descent rate (VSI caret moving down) and decreasing AOA by adjusting the nose up. As descent rate decreases and AOA slows to optimum, adjust power as necessary to maintain desired VSI. Make this trade-off in a timely, controlled manner and avoid abrupt nose movements that rapidly change VSI. An optimum AOA descent will normally be used while descending to the MDA. Whenever you are in a descent, your VSI shouldn't be greater than your altitude, i.e., maximum of 2000 fpm at 2000 ft. This concept is called the "minute to live" rule. If you find yourself behind the aircraft and need to deviate from this rule, you should acknowledge it to your Instructor, minimize the amount of time you are outside the minute to live rule parameters, and strive to accomplish your glideslope correction prior to reaching 1000 ft AGL. Once inside the final approach fix, VSI should be limited to a maximum of 1000 fpm to the max extent practical. Approximately 100 feet prior to MDA, add about 300 pph fuel flow and apply slight backstick pressure to level off while maintaining optimum AOA. Slowly shift your scan outside to acquire the runway environment. If runway environment is not in sight by the missed approach point, or if you are not in a safe position to land, execute missed approach.

313. MISSED APPROACH CLIMB OUT AND LEVEL OFF

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

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

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

Throttle: MRT

Speed brakes: Retract

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

Climb: Confirm on altitude display and VSI

Gear: Raise with positive rate of climb

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

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

Airspeed (if remaining in pattern): 200 KIAS

Airspeed (if leaving pattern): 250 KIAS

You must comply with the controller's and/or published missed approach instructions.

314. FLIGHT WITH PARTIAL PANEL

In the T-45C, partial panel flight consists of flying without the ADI display. All flight maneuvers remain the same whether you are flying under full or partial panel conditions. In the event that the ADI display fails, you will have to substitute the standby AI, airspeed, altimeter, and VSI for information that was on the ADI display. Use the HSI display for your heading reference.

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

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

Be careful not to fixate on one standby instrument or the HSI display because of the resulting change in your scan pattern.

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

Unlike the ADI display, the standby AI provides only nose and wing attitude information. lf you lose the ADI display, you will have to use the turn and slip indicator above the standby altimeter to maintain 1/2 standard-rate and standard-rate turns. Because all heading information will be provided by the HSI display, you will have to give it greater emphasis in your scan. Also, with no ADI display, you do not have ILS glideslope information.

Common Error: Be careful not to overcontrol the aircraft. The small size, wide separation, and requirement to scan individual instruments may cause you to fixate on one instrument more than you would under full panel conditions, so you may tend to "chase" or eliminate from your scan one of the performance instruments.

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

You should realize that while operating under instrument conditions when any of the instruments are inoperative, the task of maintaining any attitude and performance becomes difficult. The situation in which one or both MFDs fail, or primary attitude, heading or performance indications freeze or are blanked, is referred to as a "partial panel" condition. If one MFD fails, you will normally select the HSI display on the operational MFD and use the standby AI for attitude information. Keep in mind that if you are on radar vectors for an ILS approach or in the GCA pattern, selecting the ADI on the remaining MFD would be more beneficial to your SA and ability to fly than the HSI. If both MFDs fail, you will have to rely on radar vectors and a GCA for navigation. Practice under partial panel conditions is not only desired but mandatory if you are to become an accomplished instrument pilot.

For the purpose of this course of instruction, consider partial panel flying as flight under instrument conditions while controlling the aircraft with the standby attitude and performance indicators, and the power instruments without the ADI display attitude reference or the HSI display in case of a GINA failure.

On any flight, failure of one or both of the multi-function displays (MFDs) could occur anytime. Therefore, you must be ready to continue controlled flight while handicapped by the loss of the information from these displays. In the event that you allow the aircraft to enter an "unusual attitude," positive recovery methods must be applied to return the aircraft to the desired altitude and heading. These recovery methods are discussed in this FTI. You must apply yourself at this time to the fundamental procedures of basic instrument flight under partial panel conditions.

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

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

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

Partial panel attitude may vary considerably from full panel if the standby AI was not properly set prior to takeoff or penetration. You may adjust your standby AI in flight by setting the pitch equal to that on the ADI during straight and level flight.

Unusual Attitude Recovery (Partial Panel). Partial panel unusual attitude recoveries employ the same procedures as described above, except that you will derive attitude information from the standby AI, altimeter, and airspeed indicator instead of the ADI display.

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

Partial Panel Missed Approach. Partial panel missed approach procedures are the same as full panel. Due to instrument lag, reference the standby altimeter for level off and hold attitude as the standby VSI stabilizes.

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CHAPTER FOUR
GENERAL COMMUNICATION PROCEDURES

400. INTRODUCTION

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

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

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

401. NAVIGATION & COMMUNICATION COCKPIT MANAGEMENT

Multiple NAVAID Management. Use TACAN, VOR/ILS, and waypoints to navigate airways and maintain orientation at airfields. Enroute, navigate primarily off the applicable TACAN and set the other navigation resource(s) to the next station. Since the T-45C GPS database isn’t certified for GPS Navigation and GPS approaches, you will be required to file and fly using either TACANs or VORTACs. If you want to proceed direct to a NAVAID that you currently aren’t receiving, you will be required to ask for an initial heading from ATC until you are receiving the new NAVAID. While you are on that ATC heading, you will be required to provide that information upon check in with each new controller. Remember that even though you can’t navigate using a waypoint, you can use the waypoint to provide SA to your route or airfields along the way. Waypoints are an excellent way to keep SA to your nearest diverts along your route in the event that weather or an emergency requires an immediate landing. During ILS vectors at the field, select TACAN and ILS steering. TACAN course deviation is displayed on the HSI display and ILS steering is displayed on the ADI display. If required, change from TACAN to ILS DME frequency on the base leg. During the approach phase, consider selecting NAVAIDs so one backs up another in case of failure. For example, if on HI TACAN penetration approach and TACAN bearing fails, have ILS in VOR to fly ILS or localizer as backup.

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

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

"CENTER HAWK TWO TWO ONE, REQUEST SWITCH, MONITOR GUARD TWO MIKES."

"HAWK TWO TWO ONE, APPROVED AS REQUESTED, REPORT BACK UP CENTER FREQUENCY."

"HAWK TWO TWO ONE, WILCO."

Select METRO frequency in AUX, T/R&G and deselect PRI or turn volume low after informing crew on ICS. After completing transmission to METRO, inform crew, deselect AUX, and reselect PRI (or turn up volume). *"CENTER, HAWK TWO TWO ONE BACK UP (FREQUENCY #)."*

During approaches, consider putting tower frequency in AUX (deselect) until approach directs switch and crew is informed *"SELECTING AUX."* After reporting missed approach to tower, deselect AUX; inform crew and select PRI.

402. IFR VOICE PROCEDURES

Reports that are made at all Times (Radar and Non-Radar):

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

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

3. When unable to descend or climb at a rate of at least 500 fpm.

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

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

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

7. When leaving any holding fix or point.

NOTE

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

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

NOTE

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

9. Any information relating to safety of flight.

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

NOTE

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

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

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

Reports Specific to Radar Environment

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

NOTE

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

Reports Specific to Non-Radar Environment

When radar contact has not been established by initial handoff:

1. Initial contact ***not at a fix***; report will include *"ATC (NAME), AIRCRAFT (IDENTIFICATION), ESTIMATING (TO THE NEXT IDENTIFIABLE PUBLISHED FIX OR REPORTING POINT AND TIME), (DESCENDING, CLIMBING, OR MAINTAINING ALTITUDE OR FLIGHT LEVEL)."*

2. Initial contact ***at a fix***; report will consist of a courtesy call only *"ATC (NAME), AIRCRAFT (IDENTIFICATION), AND (POSITION)."*

NOTES

1. If ATC states *"ROGER"* and does not state *"GO AHEAD,"* then no additional information is required at this time. Another courtesy call shall be made once the aircraft has reached the next designated reporting point "solid triangle" (low altitude structure), (There are no compulsory reporting points in the high altitude structure.)

2. If ATC states *"GO AHEAD,"* then a full position report is required.

3. Position report includes *"(POSITION), (TIME), (ALTITUDE), (NEXT COMPULSORY REPORTING POINT), (PLANNED TIME TO THAT POINT), (NEXT COMPULSORY REPORTING POINT)."* (P.T.A.P.T.P.)

NOTE

If radar contact is established or has been reestablished once lost along the route, pilots should discontinue position reports over designated reporting points in the low altitude structure. Pilots should resume normal non-radar position reporting when ATC advises *"RADAR CONTACT LOST"* or *"RADAR SERVICE TERMINATED."*

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

NOTE

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

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

Reports Specific to RVSM Operations

Pilot will report lack of RVSM approval (Negative RVSM):

1. On the initial call on any frequency in the RVSM airspace and…

2. In all requests for flight level changes pertaining to flight levels within the RVSM airspace and…

3. In all read-backs to flight level clearances pertaining to flight levels within the RVSM airspace and…

4. In read back of flight level clearances involving climbs and descents through RVSM airspace (FL290-410).

Change of Flight Plan

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

1. Change of route or destination - 13 items

2. Change from VFR to IFR only - 7 items

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

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

NOTE

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

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CHAPTER FIVE
INSTRUMENT FLIGHT PLANNING

500. INTRODUCTION

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

501. FACILITY REQUIREMENTS

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

502. ROUTE AND ALTITUDE

You must give primary consideration to enroute weather and winds when planning a flight. You will normally want to use the most direct route at the most favorable altitude for your fuel requirements. You will normally plan for a cruising altitude of either FL280 or FL290 depending on the distance of your destination. Though the service ceiling for the T-45C is much higher, the T-45C isn't RVSM capable due to its lack of multiple systems required by the FAA. Since the T-45C isn't RVSM capable, ATC has the option to either deny or allow you in RVSM airspace workload dependent. For this reason, you will not flight plan for cruising at a RVSM altitude.

503. ALTERNATE

You are required to plan for an alternate anytime your destination is forecast to be below a 3,000-ft ceiling and 3 miles visibility during the period from 1 hour prior to and 1 hour after your ETA. If your destination is forecast to be below published minimums, then your alternate must be above 3,000-3. If your destination is between published minimums and 3,000-3, your alternate must be forecast to be 300-1 above published minimums for a non-precision approach or 200-1/2 above published minimums for a precision approach. Check alternate weather for the time you would arrive there and ***not*** for the ETA at your destination. Refer to Figure 5-1 for single pilot restrictions.

NOTE

CNATRA regulations require that you always plan an alternate.

DESTINATION WEATHER ETA plus and minus one (1) hour	ALTERNATE WEATHER ETA plus and minus one (1) hour		
0-0 up to but not including published minimums	3,000-3 or better		
Published minimums up to but not including 3,000-3 (single-piloted absolute minimums 200-1/2)	NON-PRECISION	PRECISION	
		ILS	PAR
	*Published minimums plus 300-1	Published minimums plus 200-1/2	*Published minimums plus 200-1/2
3,000-3 or better	No alternate required		
*In the case of single-piloted or other aircraft with only one operable UHF/VHF transceiver, radar approach minimums may not be used as the basis for selection of an alternate airfield.			

Figure 5-1 IFR Filing Criteria

504. FILING MINIMUMS

When filing an IFR flight plan, base your weather requirement on the actual weather at your point of departure, existing and forecast weather for the entire route of flight, forecast weather at your destination and alternate from 1 hour before to 1 hour after your ETA. Figure 5-1 outlines the weather criteria to follow when selecting an alternate for an IFR flight.

The following are filing criteria for your destination:

1. Single-piloted aircraft (T-45C) absolute minimums are 200-1/2.

2. Use minimums for instrument approach to probable runway based on forecast surface winds.

3. Use the lowest minimums for any approach you and your aircraft are equipped to fly.

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

505. FUEL REQUIREMENTS

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

Use the STANDARD T-45C FUEL PLANNING DATA chart (Figure 5-2) to determine your fuel requirements for a flight. The JMPS computer flight planning program may be used for flight planning. JMPS provides more detailed fuel and position data as well as accurate computations for enroute winds, speed or altitude changes.

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

506. TAKEOFF MINIMUMS

Special Instrument Rating

1. No takeoff ceiling or visibility limits apply.

2. Takeoff dependent on judgment of pilot and urgency of flight.

Standard Instrument Rating

1. Lowest non-precision minimums for runway in use but not lower than 300-1.

2. If runway has a precision approach, takeoff is permitted to precision minimums or 200-1/2, whichever is higher.

REFERENCE INFORMATION

CTW-1 STANDARD T-45 FUEL PLANNING DATA

Actual performance will vary with prevailing temperature, winds, drag index and varying gross weight.

For initial planning only.

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

JP-4 = 6.5 LB/GAL JP-5 = 6.8 LB/GAL JP-8 (JET A+) = 6.7 LB/GAL

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

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

En route (Optimum Cruise @ 12K GW)

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

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

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

Figure 5-2 Fuel Card

507. NOTAMS

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

508. FLIGHT PLANNING FORMS

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

Weather Briefing (DD-175-1)

Naval Aviators are required to obtain a flight route weather brief from a DoD-qualified forecaster or approved forecasting service when any portion of the intended route is forecast to be under IMC. A DD-175-1 Flight Weather Briefing form is specifically required whenever a DD-175 Military Flight Plan form is filed. The primary source for weather briefing to Naval aircraft is through the Web-enabled FWB system (https://fwb.metoc.navy.mil) operated by the Naval Aviation Forecast Center (NAFC). If operating from locations without access to FWB, you may obtain route weather forecast support from NAFC via 1-888-PILOTWX. Additionally, an approved flight route weather briefing may be obtained via an FSS or through Air Force Weather and Marine Corps Services, where available. It is important that you become familiar with all the available charts and data available in the weather office so that you can have a complete picture of the expected weather during the flight.

Single-Engine Jet Log

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

Military Flight Plan (DD-175)

After planning your flight, complete a DD-175 and file it with Base Operations at least 30 minutes prior to your planned takeoff time (or as local directives require). The procedures and guidelines for completing and filing a DD-175 can be found in FLIP General Planning and OPNAVINST 3710.7. Departing a Civil Airfield an FAA Flight Plan Form 7233−1 will normally be filed through a Flight Service Station (FSS). The FSS is able to provide a telephonic weather briefing if required.

Stop-Over Flight Plan

When you are planning to land at one or more points prior to reaching your final destination, you may file a stopover flight plan. You are responsible for updating your weather briefing (DD-175-1) and NOTAMS at each stop. FSS offers Enroute Flight Advisory Service (EFAS) *"Flight Watch"* on frequency 122.0 MHz and on discrete high altitude frequencies, offering enroute weather updates and the collection of pilot weather reports (PIREPs).

Enroute Delay Flight Plan

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

CHAPTER SIX
FLIGHT PROCEDURES

600. INTRODUCTION

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

601. DEPARTURE PHASE

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

Departure Communication Procedures

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

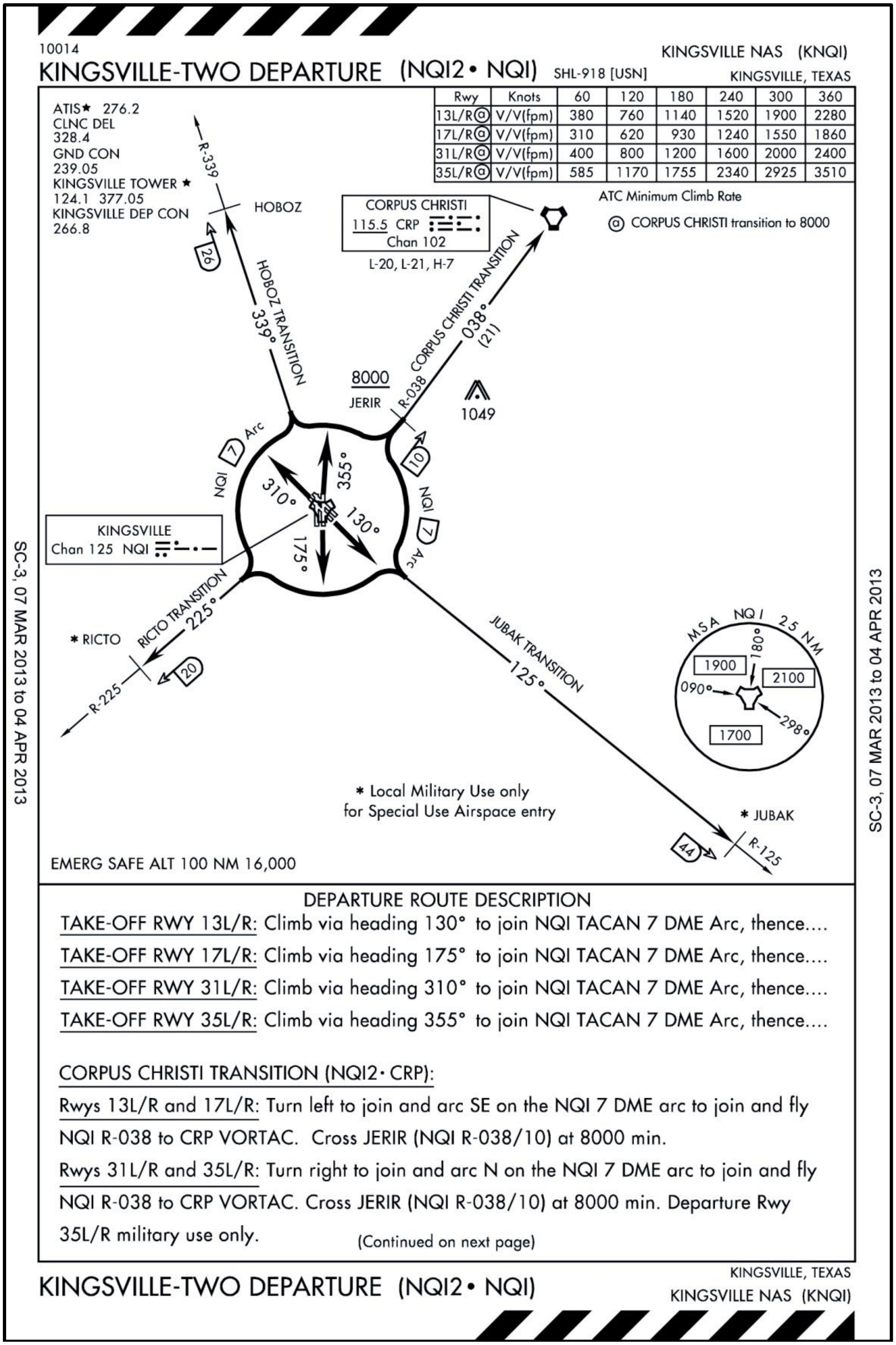
Your IFR clearance should contain the following information in order:

1. Aircraft identification
2. Clearance limit
3. Departure instructions or SID
4. Route of flight
5. Altitude
6. Special information, including departure frequency and IFF code

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

Standard Instrument Departure (SID)

The standard instrument departure (SID) is designed to expedite traffic from airfields and provide a set transition from takeoff to the enroute structure while ensuring adequate vertical and horizontal aircraft separation. The two types of SIDs are pilot nav (Figure 6-1) and vector (Figure 6-2).



Rwy	Knots	60	120	180	240	300	360
13L/R@	V/V(fpm)	380	760	1140	1520	1900	2280
17L/R@	V/V(fpm)	310	620	930	1240	1550	1860
31L/R@	V/V(fpm)	400	800	1200	1600	2000	2400
35L/R@	V/V(fpm)	585	1170	1755	2340	2925	3510

Figure 6-1 Pilot NAV SID

6-2 FLIGHT PROCEDURES

Procedures - SID preflight and pre-takeoff preparation

1. Identify frequencies used by ATC and ensure compatibility with communication equipment

2. Determine if your aircraft's performance is adequate to adhere to all restrictions

3. Identify routes, altitude, and specific restrictions

NOTE

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

Pilot Nav

For a pilot nav SID, you will use a prepublished route that supplies headings, altitudes, and reporting points for the transition from takeoff to the enroute structure. ATC can issue amendments to initial clearance anytime action is necessary to avoid conflict between aircraft. When a SID is changed, confirm what part of the SID is still in effect. If ATC desires to reinstate a canceled SID, departure control must state portion of routing that applies and restate altitude restrictions. The card is divided into two sections, with a pictorial representation on top and a textual description of the departure procedures on the bottom (Figure 6-1).

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

Vector

A vector SID is more flexible than a pilot nav SID, but at the cost of being more labor-intensive for the controller. In this type of SID, you will be given radar vectors and altitudes by the controller, who will constantly monitor your position (Figures 6-2 and 6-3).

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

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

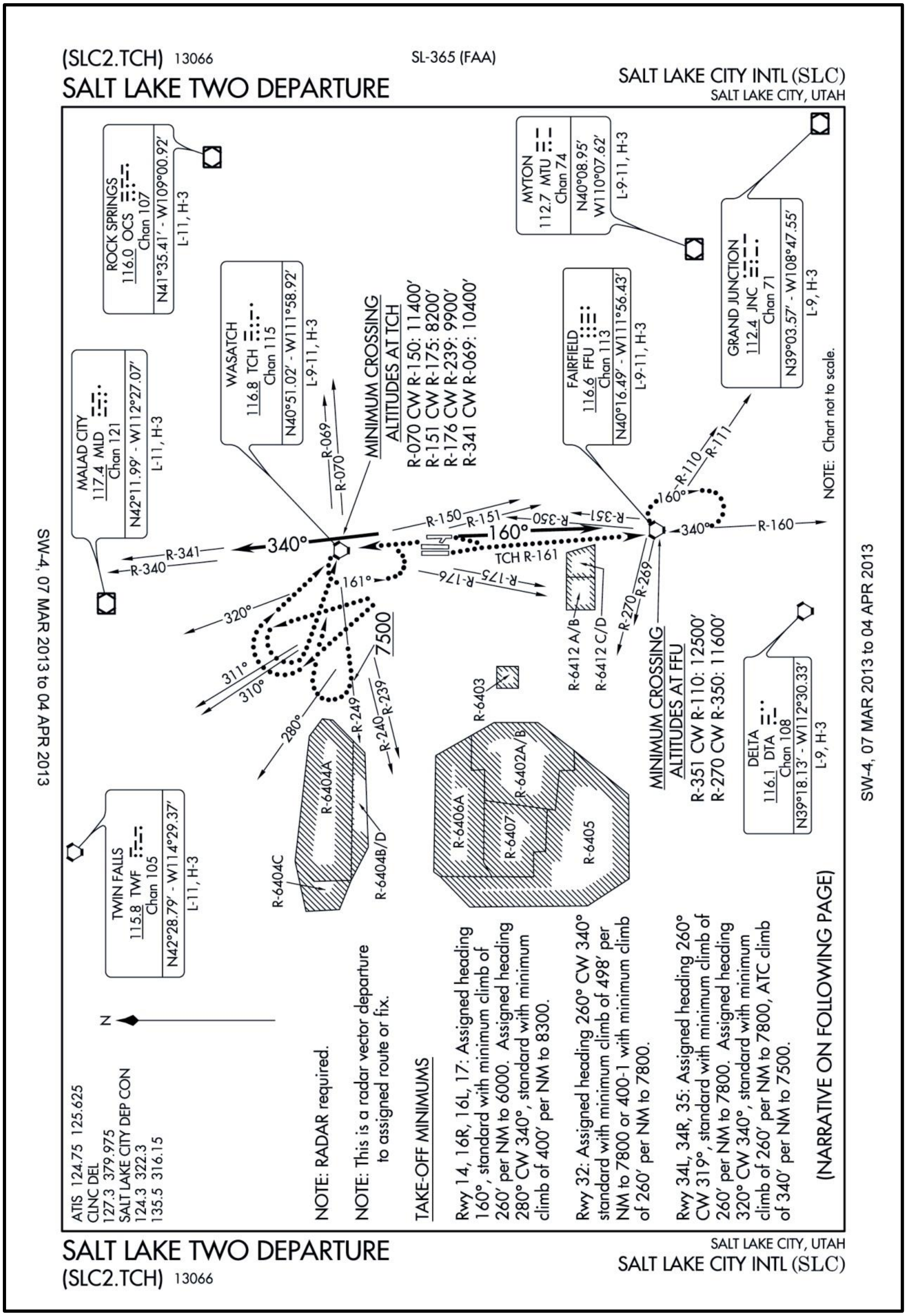


Figure 6-2 Vector SID

(SLC2.TCH) 13066 SL-365 (FAA)

SALT LAKE TWO DEPARTURE

SALT LAKE CITY INTL (SLC)
SALT LAKE CITY, UTAH

SW-4, 07 MAR 2013 to 04 APR 2013

DEPARTURE ROUTE DESCRIPTION

TAKE-OFF RUNWAY 14, 16L, 16R, 17: Climb heading 160° or as assigned, maintain 10000′ or assigned lower altitude. Thence . . . .

TAKE-OFF RUNWAY 32, 34L, 34R, 35: Climb heading 340° or as assigned, maintain 10000′ or assigned lower altitude. Thence . . . .

. . . . expect vectors to assigned route or fix. Expect clearance to filed altitude 10 minutes after departure. Aircraft filed heading 331° CW 109° expect radar vectors eastbound leaving 11000′ due to high terrain east of TCH VORTAC.

LOST COMMUNICATIONS: If not in contact with Departure Control 1 minute after take-off:
Runways 14, 16L and 17: Assigned heading 160°, turn right, thence . . . .
Runway 16R: Assigned heading 160°, turn left, thence . . . .
. . . . climb to 11000′ via TCH R-161 to FFU VORTAC. Aircraft departing FFU VORTAC R-111 CW R-269, climb on assigned route. All others continue climb in FFU VORTAC holding pattern (hold south, right turns, 340° inbound) to cross FFU VORTAC at or above: R-351 CW R-110, 12500′; R-270 CW R-350, 11600′.

Runway 14, 16L, 16R, 17: Assigned heading 280° CW 340°, fly assigned heading to 11000′. Then, aircraft heading 280° CW 310°, execute a climbing right turn thence . . . . aircraft heading 311° CW 340° execute a climbing left turn, thence . . . .

. . . .proceed direct TCH VORTAC. Cross TCH VORTAC at or above 11400′ and proceed on course.

Runway 32, 34L, 34R, 35: Climb direct TCH VORTAC. Aircraft departing TCH VORTAC R-240 CW R-340, climb on course. All others, continue climb via TCH R-249 to 7500′, then climbing right turn direct TCH VORTAC. Continue climb in TCH VORTAC holding pattern (hold south, left turn, 341° inbound) to cross TCH VORTAC at or above: R-070 CW R-150, 11400′; R-151 CW R-175, 8200′; R-176 CW R-239, 9900′; R-341 CW R-069, 10400′. Climb on course.

TAKE-OFF OBSTACLE NOTES

Rwy 14: Antenna 1349′ from DER, 544′ left of centerline, 42′ AGL/4263′ MSL.
Rwy 16L: Vehicle on road 124′ from DER, 14′ right of centerline, 15′ AGL/4239′ MSL.
Light pole 988′ from DER, 726′ right of centerline, 34′ AGL/4254′ MSL.
Pole 1024′ from DER, 689′ right of centerline, 34′ AGL/4254′ MSL.
Rwy 17: Vehicles on road beginning 335′ from DER, on centerline, up to 17′ AGL/4241′ MSL.
Rwy 32: ATC tower 5266′ from DER, 1767′ left of centerline 335′ AGL/4549′ MSL.
Crane 5195′ from DER, 1630′ left of centerline, 240′ AGL/4463′ MSL.
Flag on obstacle light 5153′ from DER, 1619′ left of centerline, 249′ AGL/4463′ MSL.
Aircraft beginning 989′ from DER, 722′ left of centerline, up to 79′ AGL/4306′ MSL.
Rwy 34R: Post 13′ from DER, 349′ right of centerline, 3′ AGL/4227′ MSL.
Rwy 35: Post 56′ from DER, 249′ left of centerline, 2′ AGL/4220′ MSL.

SW-4, 07 MAR 2013 to 04 APR 2013

SALT LAKE TWO DEPARTURE
(SLC2.TCH) 13066

SALT LAKE CITY, UTAH
SALT LAKE CITY INTL (SLC)

Figure 6-3 Vector SID (2)

602. ENROUTE PHASE

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

Enroute Navigation

As you are navigating to your destination, it is important not to become complacent and continually keep SA to your route, fuel, and diverts. This can be accomplished by proper NAVAID management, as discussed on page 4-1, and 15 minute Ops and Fuel checks. During your Ops and Fuel checks, it is important to note your current fuel state, engine operation, current volts, and fuel required to reach destination.

Enroute Cruise

Level off at enroute altitude at "optimum cruise," IMN for cruise altitude. Use the fuel chart found in Figure 5-2 for cruise settings.

Enroute Communication Procedures

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

1. When operating in a radar environment and no position reporting is required: *"[NAME] CENTER, [AIRCRAFT IDENTIFICATION] AT/CLIMBING TO/DESCENDING TO/PASSING [ALTITUDE] FOR [ALTITUDE].”*

2. When a position report is required: *"[NAME] CENTER, [AIRCRAFT IDENTIFICATION], [POSITION], [ALTITUDE].”*

3. When no position report is required, but you're not in radar contact: *"[NAME] CENTER, [AIRCRAFT IDENTIFICATION], ESTIMATING [REPORTING POINT] AT [TIME] [ALTITUDE].”*

When operating in a non-radar environment, you will give position reports to center at designated compulsory reporting points along your route of flight. The report is always preceded by a courtesy call which includes *"[NAME] CENTER, [AIRCRAFT IDENTIFICATION], [POSITION].”* If center's reply is *"[ROGER],”* then no further information is required or wanted from the pilot. If center states *"[GO AHEAD],”* then the full position report is given. The report includes the following information:

a. Identification

b. Position

c. Time

d. Altitude/FL

e. Position - (Next reporting point)

f. Time

g. Position - (Name only of next succeeding reporting point)

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

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

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

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

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

603. LOST COMMUNICATIONS

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

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

If you lose communications enroute, first try to contact center on the last assigned frequency, then on an appropriate frequency listed in the FLIP Enroute IFR Supplement. If you are unable to reestablish contact with center, attempt to call the nearest FSS on 255.4 or 122.2, monitor the

appropriate VOR frequency (as center may issue instructions over this frequency), or as a last resort, transmit on guard.
If you have lost your transmitter but are still receiving, you can expect ATC to attempt to determine if you are receiving by requesting that you do one or more of the following: squawk ident on your IFF, change your IFF squawk, switch IFF squawk to standby, or by requesting that you execute turns.

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

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

1. **Route:**

    a. Route assigned in the last ATC clearance

    b. If on a vector, direct to the point specified in the vector clearance

    c. In absence of assigned route, by the route given in an expected further routing (EFR)

    d. In absence of EFR or assigned route, by route filed in flight plan

2. **Altitude** (at the highest of the following):

    a. Altitude or flight level last assigned

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

    c. Altitude ATC says you may expect in a further clearance.

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

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

604. PROCEEDING DIRECT TO A STATION

There are two ways to fly to a NAVAID – by homing and by proceeding direct. The difference between the two is that in the presence of a crosswind, a homing aircraft will fly an arcing route (therefore not maintaining a given course) to the station instead of flying in a straight line (Figure 6-4).

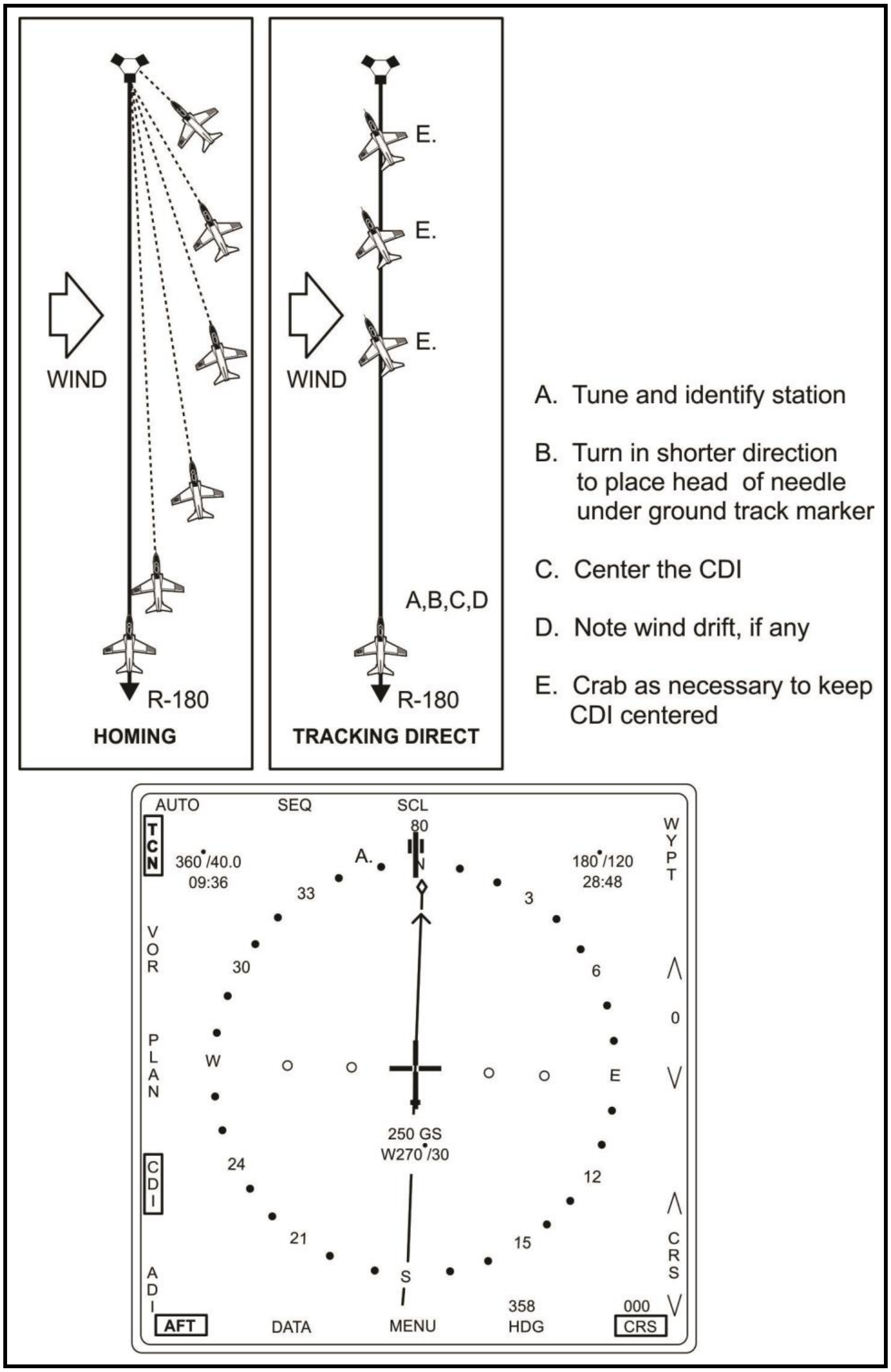


Figure 6-4 Proceeding Direct

To proceed direct to a station, first tune and identify the station and then turn the aircraft in the shortest direction to place the VOR or TACAN bearing pointer under the lubber line (heading

index) at the top of the HSI display. (If you were to stop at this point and fly to the station, keeping the bearing pointer at the top of the HSI display, you would be homing.)
Once the bearing pointer is centered at the top of the HSI display, use the course selection option on the HSI display and increment or decrement the course until the CDI or Planimetric course line is centered with the course line arrow pointing to the lubber line. Note the position of the ground track marker. Turn the aircraft to place the ground track marker under the lubber line and maintain a wind-corrected heading that will track the selected course to the station by crabbing as necessary to keep the course line centered.

Indications of Station Passage

When flying VOR or VOR/DME, station passage is indicated when the bearing pointer falls past the 90-degree reference benchmark on the periphery of the compass rose.

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

Wind Drift Correction

Determining wind-corrected heading (WCH) is the technique you will use to compensate for crosswinds when maintaining a course on a radial. To compensate for wind, use a WCH that stops drift from your course. The difference between WCH and desired course is called "crab angle" (Figure 6-5).

The difference between the lubber line and the ground track marker is your "crab angle." To compensate for crosswinds using the ground track marker, first establish the aircraft on a radial tracking on course, course line centered, inbound or outbound from a station. Check the position of the ground track marker for an indication of drift. If the ground track marker indicates a drift, turn the aircraft to place the ground track marker under the bearing pointer. Maintain the heading under the lubber line. Continuously monitor the course line to ensure that you are maintaining the desired course. Adjust your heading to maintain a centered course line. The amount of crab angle required will vary with wind strength and direction and may change while the course is being tracked.

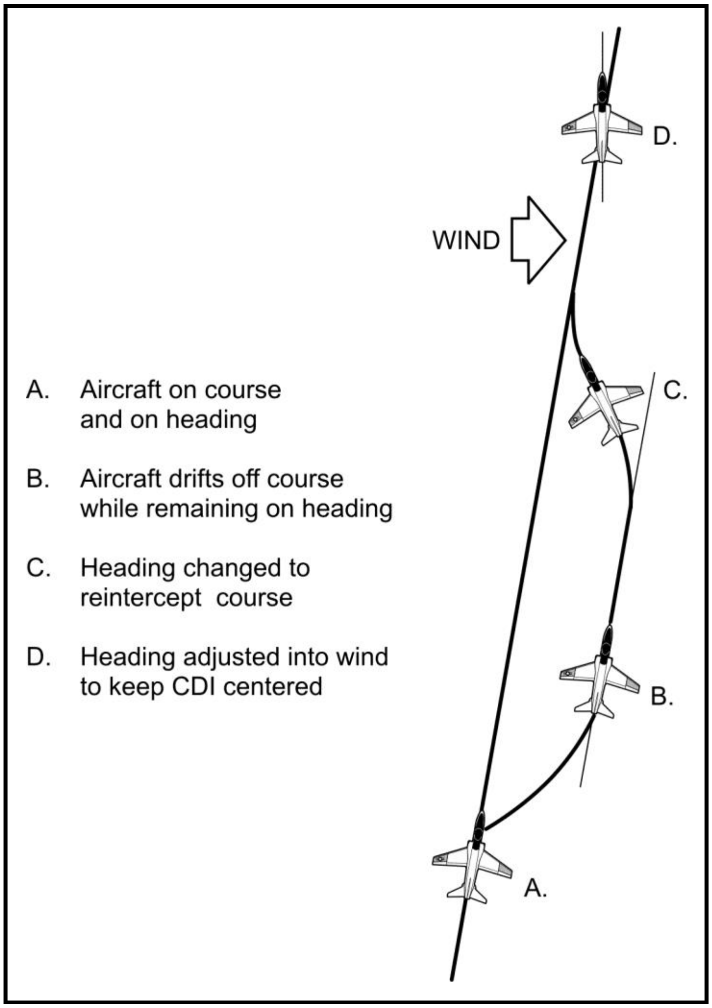


Figure 6-5 Wind Drift Correction

Course Intercepts

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

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

Much like intercepting an arc from a radial, which will be discussed later, the lead point for intercepting the new course is calculated by taking 1 percent of your groundspeed and using that number for the lead point. For intercept angles of less than 90 degrees, use an applicable ratio of this formula (e.g., a 45-degree intercept would require one-third as much lead as a 90-degree intercept). You will calculate lead point either in radials or DME, depending on the maneuver you're performing.

The HSI display provides two indications that will assist you in determining lead point. First, the bearing pointer will give you the relative speed at which you are approaching the desired course. By observing the rate at which the bearing pointer approaches the desired course, you can determine when to initiate your turn. Second, the course line provides the relative speed at which you are approaching the desired course. The CDI course line starts to move once you are within 10 degrees of that course. When you are 60 nm from the station, the radials are 1 nm apart and at 30 nm, they are 1/2 nm apart. Therefore, the CDI will move rapidly when you are close to a station and more slowly when the station is distant. Use the HSI display scale selection and relative position of the aircraft symbol to the Planimetric course line to judge the distance and intercept angle from the desired course.

Inbound Intercepts

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

30-Degree Method

Once you have tuned the station, select the desired CRS, then look from the desired course on the compass card to the head of the bearing pointer used and 30 degrees beyond. The heading located 30 degrees beyond the bearing pointer is the heading you will fly to the intercept. Turn the aircraft to this heading and maintain it until you reach the lead point and then complete the intercept (Figure 6-6). You look from the ***desired course to the bearing pointer***.

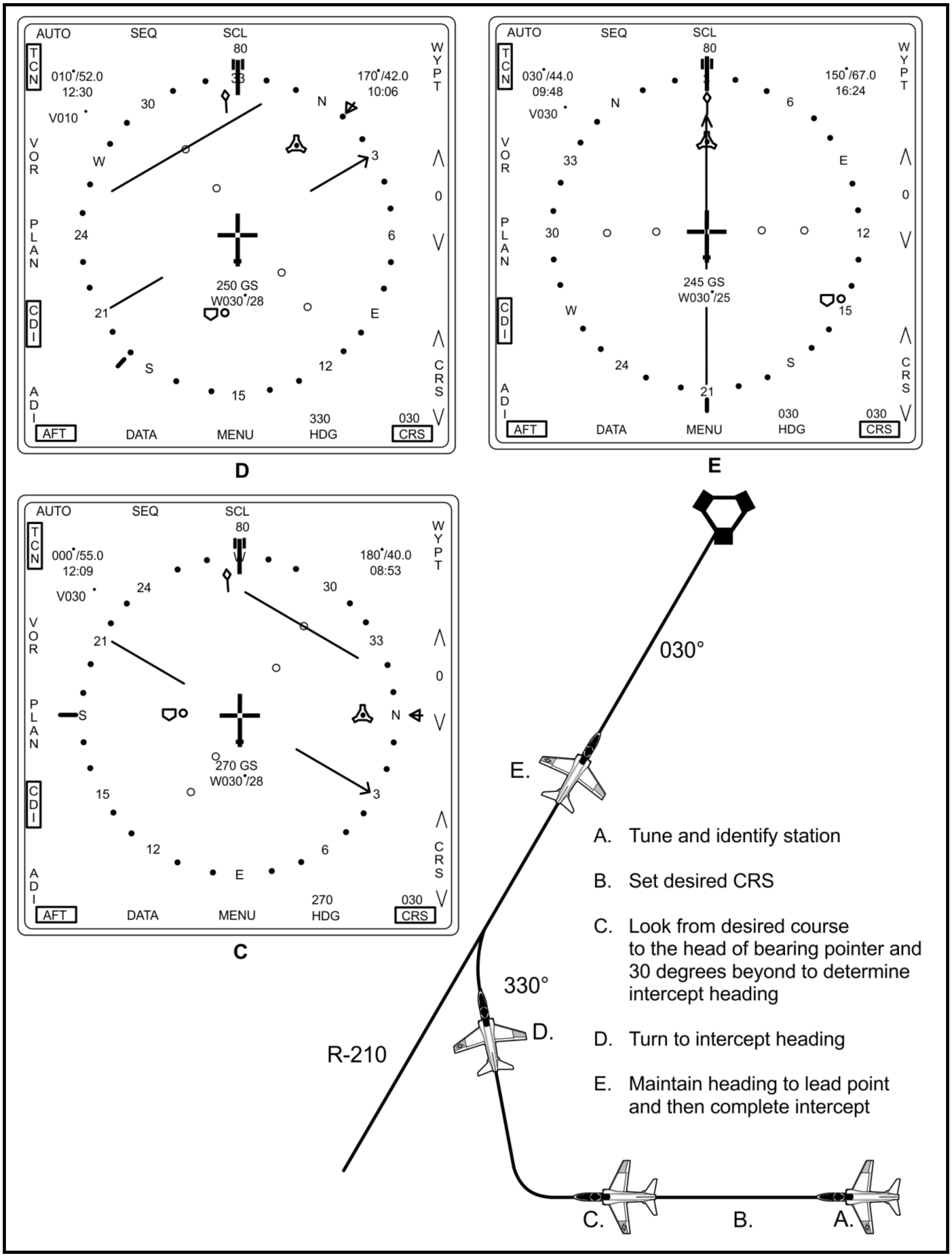


Figure 6-6 30-Degree Method

Double Angle off the Bow Method

As with the 30-degree method, begin this intercept by tuning the station and set the desired inbound CRS. Now look from the desired course on the compass card to the head of the bearing pointer used and an equal number of degrees beyond. The heading located an equal number of degrees beyond the head of the bearing pointer is the heading you will fly to the intercept (max/45 degrees). Turn the aircraft to this heading and maintain it until you reach the lead point and then complete the intercept (Figure 6-7). You look from the ***desired course to the head of the bearing pointer***.

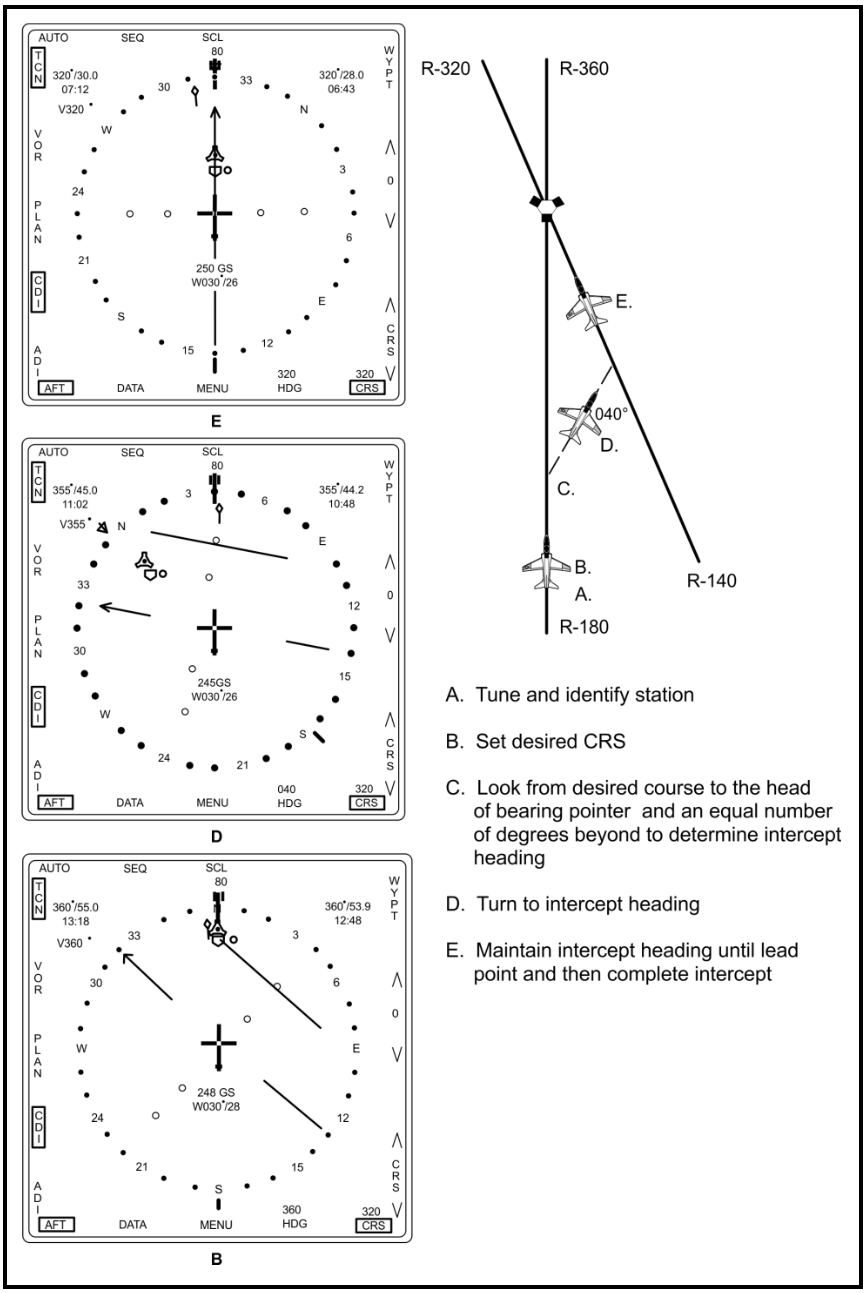


Figure 6-7 Double Angle Off Bow Method

Outbound Intercepts

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

Course Intercept Immediately After Station Passage

First, tune and identify the station if you have not already done so. When station passage occurs, turn parallel to your desired course and enter the desired course (radial) on the HSI display or DEP. Now look from the tail of the bearing pointer used to the desired course and an equal number of degrees beyond, but not more than 45 degrees, to determine the intercept heading. Turn to and maintain the intercept heading until you reach the lead point and then turn to intercept the desired course (Figure 6-8). You look ***from the tail of the bearing pointer to the desired course***.

45-Degree Method

You will find this procedure useful when intercepting an outbound radial of a VOR or TACAN station that is some distance away. As with the other intercept procedures, you must first ensure that the station is properly tuned and identified and then set the desired course (radial) on the HSI display or DEP. To determine the intercept heading, look from the tail of the bearing pointer used to the desired course and ***45 degrees*** beyond. Now turn to and maintain the intercept heading until you reach the lead point (Figure 6-9).

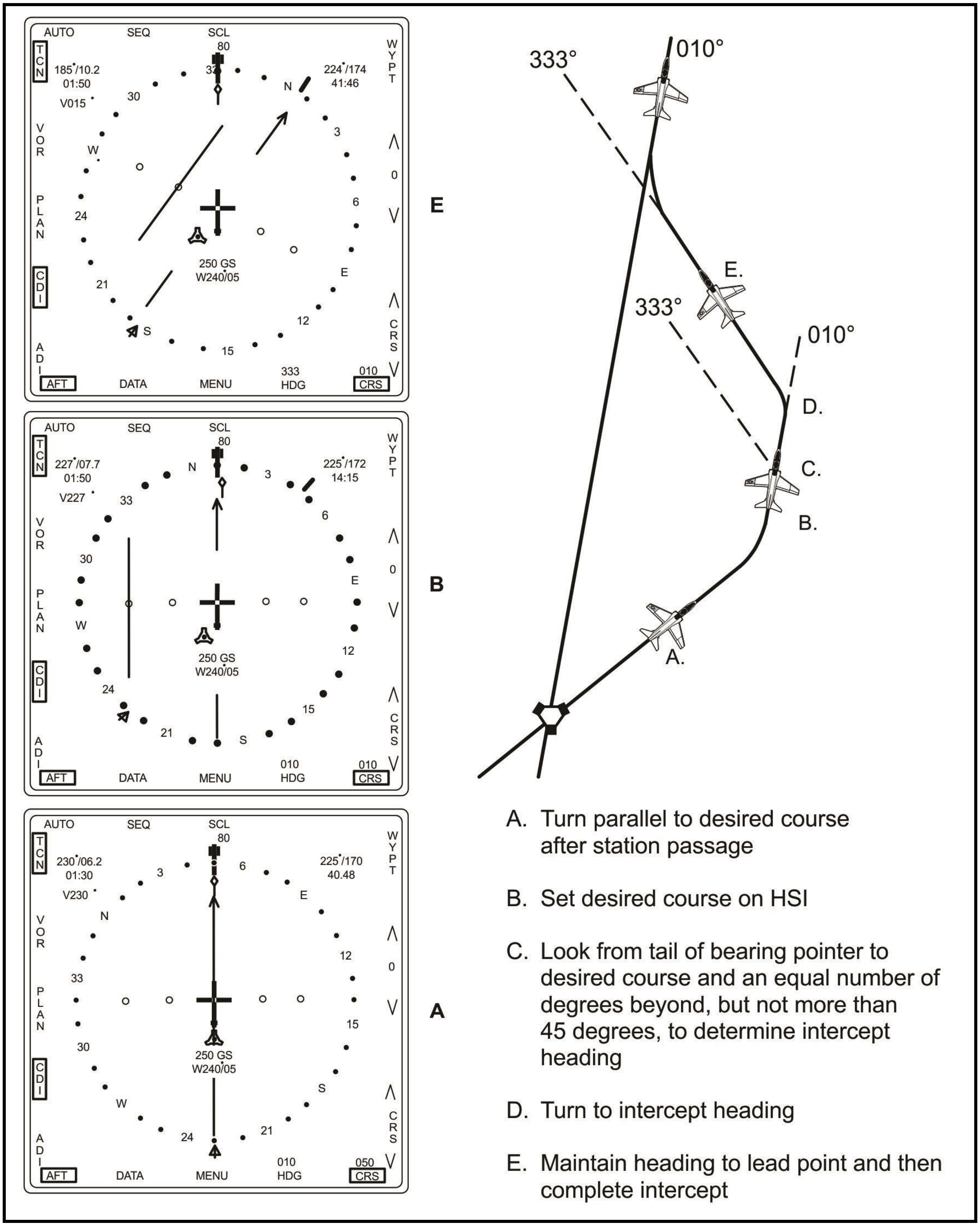


Figure 6-8 Course Intercept Immediately After Station Passage

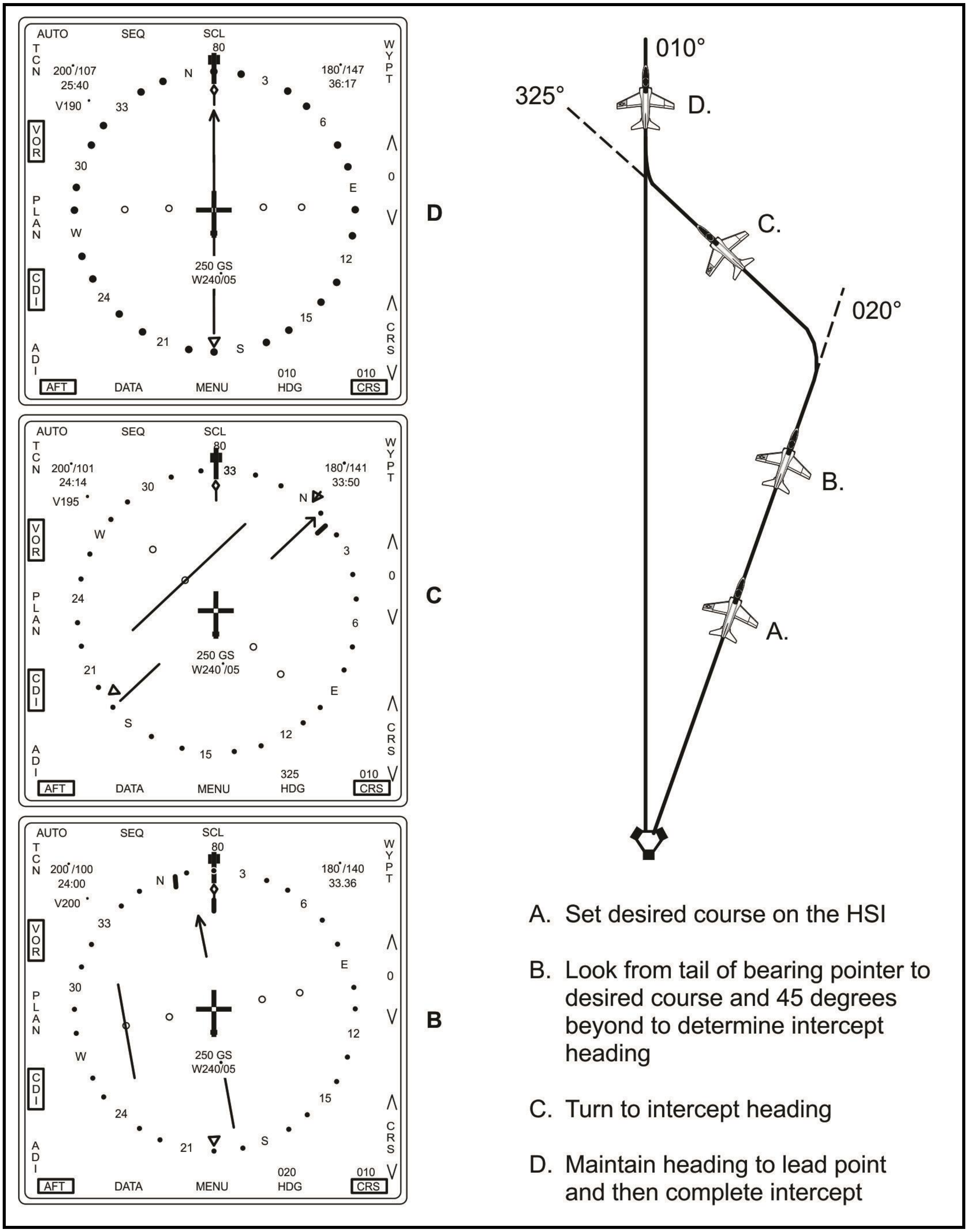


Figure 6-9 45-Degree Method – Outbound

605. TACAN AND VOR/DME PROCEDURES

Adding range information to instrument navigation enables you to perform several other navigational procedures, including flying an arc around a station, proceeding point-to-point, or determining groundspeed, if the groundspeed indication on the HSI display is not displayed.

Groundspeed Checks

You must recall two facts to perform a TACAN groundspeed check: first, your DME from the station must be greater than or equal to your altitude in thousands of feet (in order to limit the impact of slant range on your calculation); second, you must be flying either directly to or directly from a station to get an accurate groundspeed check. If you are arcing or cutting across radials, your check will be inaccurate. The GINA also calculates groundspeed. But unlike the groundspeed check you do, the aircraft does not have to proceed direct to or from the station for the system to calculate a valid groundspeed. The time-to-go in the TACAN data block is computed from slant range to the station and computed groundspeed. Therefore, the time-to-go displayed in the TACAN data block is only valid if the DME from the station is greater than or equal to your altitude in thousands of feet. The time-to-go in the waypoint data block is not based on slant range so it is always valid.

To perform a groundspeed check, start your timing when the DME displays a whole number. After a predetermined time (in minutes), record the DME that has elapsed.

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

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

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

For example: 12 nm in 3 minutes = 4 nm/min X 60 = 240 kts

NOTE

ATC can also provide you with groundspeed from radar.

Intercepting an Arc from a Radial

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

The turn to intercept an arc from a radial will normally be at approximately 90 degrees (Figure 6-10). When intercepting an arc, you have to calculate the lead point at which you initiate the turn in order to intercept it at the correct distance. To determine the lead point, use 1 percent of your groundspeed. For example, whether flying inbound or outbound at a groundspeed of 250 kts, your lead point will be 2.5 DME prior to the desired arc. When inbound to the arc, ***add*** the 1 percent to the arc DME and when outbound, ***subtract*** 1 percent from the arc DME when calculating the lead point.

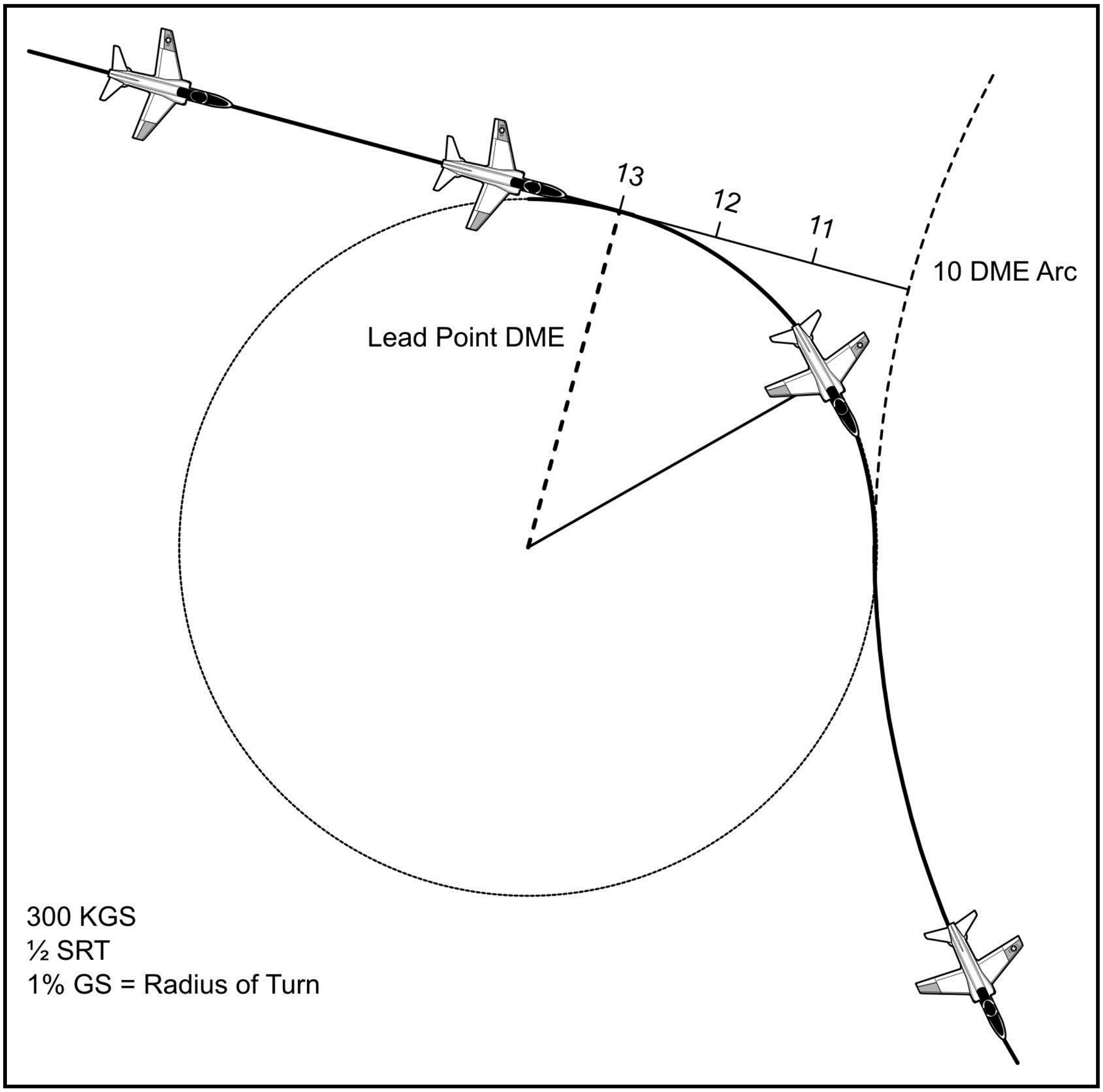


Figure 6-10 Radial-To-Arc Intercept

When you reach the lead point, initiate a 1/2 SRT turn in the proper direction and maintain it until the bearing pointer nears the 90-degree benchmark on the HSI display. You may have to modify your turn rate/AOB somewhat in order to arrive on the arc at the proper DME.

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

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

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

3. Turns of 30 degrees or less require very little lead.

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

Chord Method. (Normally used for arcs of greater than 12 DME) To maintain an arc using the chord method, fly a series of short, straight legs connected by small turns that take you slightly inside and outside the actual arc (Figure 6-11). To use the chord method: first, ensure that the station is tuned and identified; then determine direction of turn and calculate lead point. Initiate the turn at the lead point (when DME equals radius of arc, plus or minus the LPC) using a 1/2 SRT. Roll out from your interception turn when the bearing pointer is 5-10 degrees ahead of the 90-degree benchmark at the correct DME. Maintain your heading until the bearing pointer has moved to 5-10 degrees behind the 90-degree benchmark and then turn until the bearing pointer is once again positioned 5-10 degrees ahead of the 90-degree benchmark.

Repeat this procedure as long as you are flying on the arc. The length of the legs will decrease as you fly arcs closer to a station until you reach a point where this method loses its advantage over the angle of bank method described below.

If a crosswind makes holding your DME difficult, you may need to increase or decrease the number of degrees you place the bearing pointer ahead of the 90-degree benchmark or the number of degrees that you allow it to move behind the 90-degree benchmark to avoid having to make heading changes too frequently to maintain the arc.

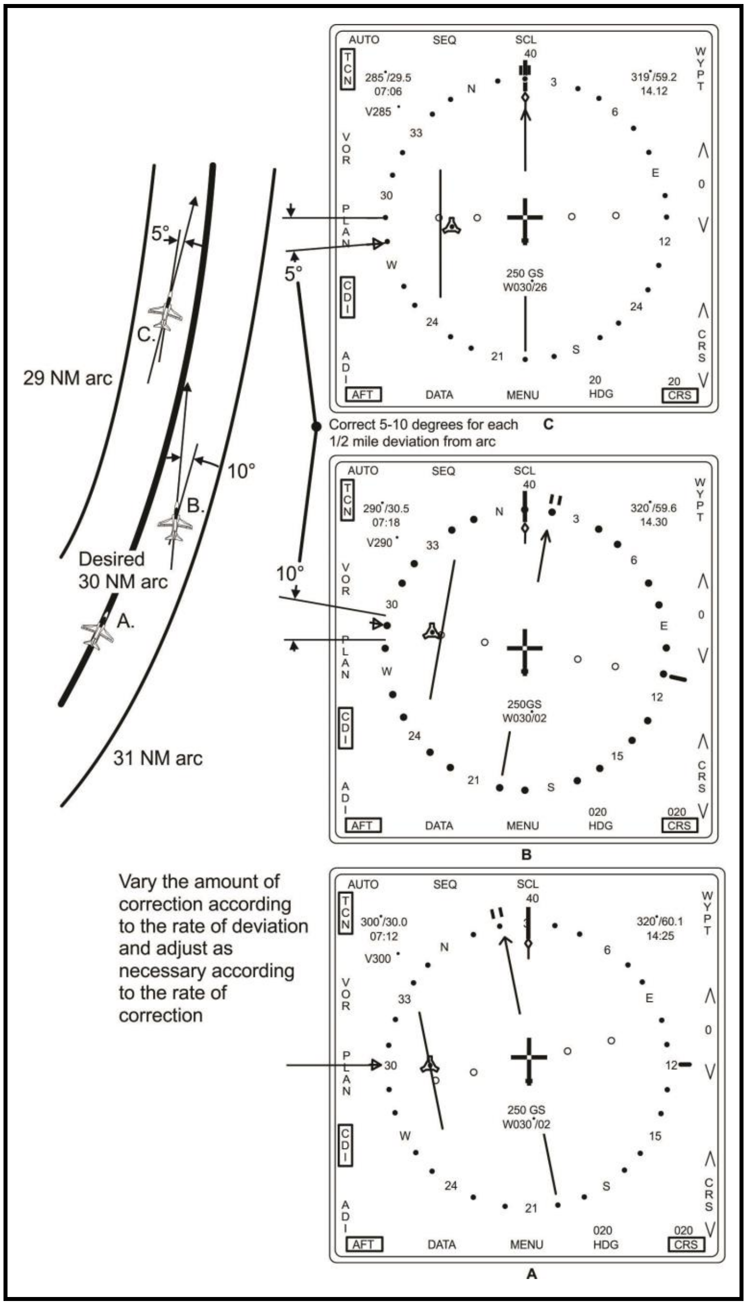


Figure 6-11 Maintaining an Arc (Chord Method)

Angle of Bank Method

To maintain an arc using the angle of bank method, first ensure the station is tuned and identified. Next, determine direction to turn and lead point. At the lead point, turn and position the bearing pointer on the 90-degree benchmark and keep it there by holding the aircraft in a shallow turn. The closer you are to a station, the greater your bank angle will be. The angle of bank method is normally used inside of 12 DME. Outside of 12 DME, the bank angle required to maintain an arc will probably be too small to hold accurately.

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

Intercepting a Radial from an Arc

When intercepting a radial from an arc, you must determine which way you have to turn to intercept and fly the radial in the correct direction (Figure 6-12). Since you will most often be performing an arc as part of an approach or departure procedure, you can obtain this information from the appropriate approach plate or SID. To turn from an arc to a radial, your main consideration is to determine the proper lead in radials. Radials diverge as you get further from a station and are 1 nm apart at 60 DME. Take this divergence into account when calculating your lead point for the turn.

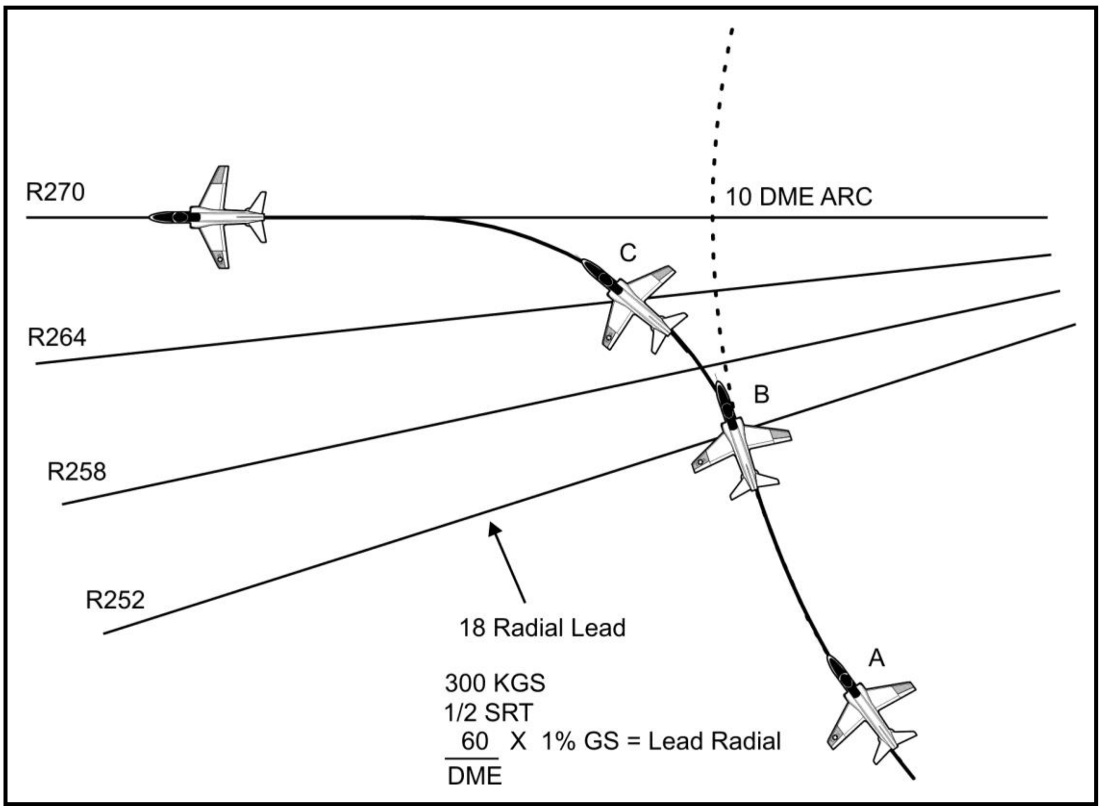


Figure 6-12 Arc-To-Radial Intercept Procedure (1)

To calculate the lead point for intercepting a radial from an arc, first you must calculate or estimate the groundspeed. Then apply the following formula:

Divide the arc DME into 60, then multiply the quotient by 1 percent of the groundspeed.

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

When making your intercept turn, you can also use the movement of the bearing pointer and course line as a guide to determine when to initiate the turn. Use the HSI display scale and relative position of the Planimetric course line to initiate and execute the radial intercept. When you are flying close to the station, you must initiate the intercept turn before the CDI course line begins to move. Therefore, the turn must be initiated at the calculated lead point. Figure 6-13 depicts the HSI display indications during the intercept procedure.

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

For radial intercepts from arcs ***less*** than 10 DME, a correction factor must be applied to the arc-to-radial formula to account for the turn to the radial being more or less than 90 degrees. In the case of a turn inbound, the turn will actually be more than 90 degrees, and the correction factor will be ***added*** to the standard 90-degree arc-to-radial formula. In the case of an outbound turn, the turn will actually be less than 90 degrees, and the correction factor will be ***subtracted*** from the standard 90-degree arc-to-radial formula.

The correction factor is calculated as follows:

Inbound turn correction factor = ([90 + Lead (radials)] / 90) x (Turn Radius)

Outbound turn correction factor = ([90 - Lead (radials)] / 90) x (Turn Radius)

Example:

An inbound turn of more than 90 degrees on a 10 DME arc at 250 KGS:
Correction Factor = ([90 + 15/ 90) x 2.5 = 2.9

Therefore, the correct lead for an inbound turn at 10 DME =

15 (lead for 90 degree turn on 10 DME arc) + 2.9 = 17.9, or approximately 18 radials (see chart below)

An outbound turn of less than 90 degrees on a 10 DME arc at 250 KGS:
Correction Factor = ([90 - 15/90) x 2.5 = 2.08

Therefore, the correct lead for an outbound turn at 10 DME =

15 (lead for 90-degree turn on 10 DME arc) -2.1 = 12.9, or approximately 13 radials (see chart below)

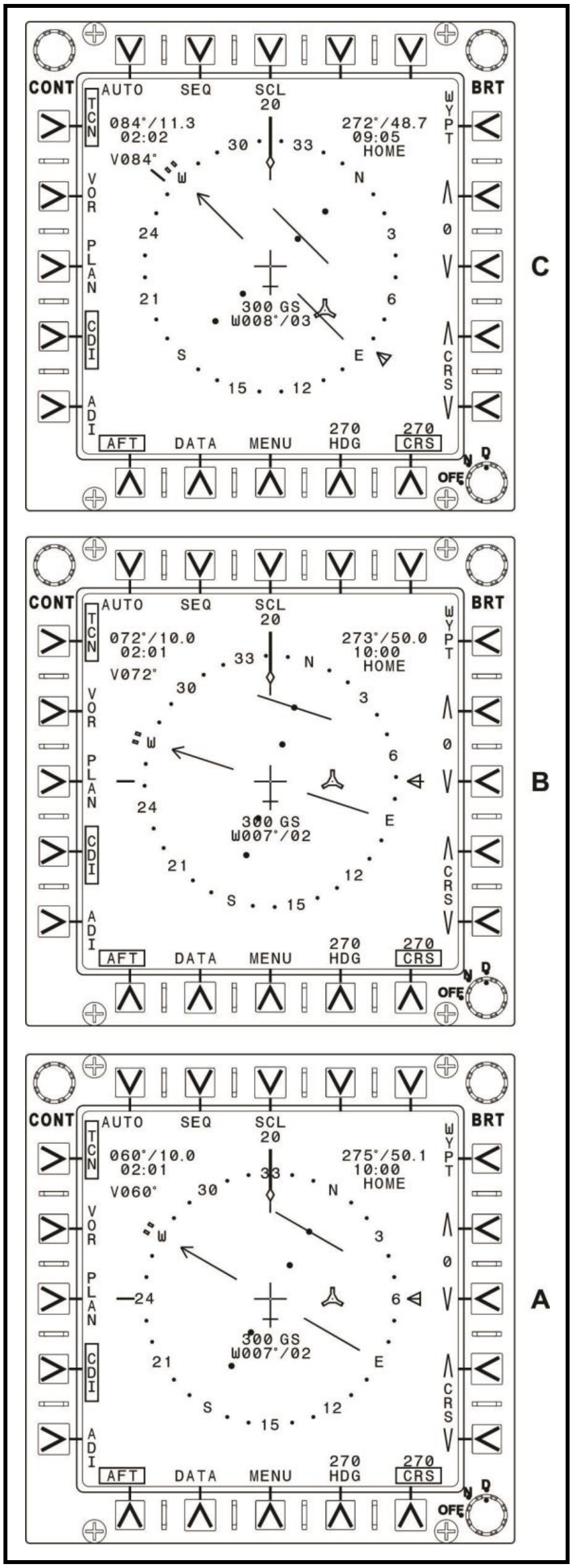


Figure 6-13 Arc-To-Radial Intercept Procedure (2)

Approximate Lead Radials for 250 KGS Arcing Around a NAVAID:

ARC DME	INBOUND TURN 90 DEGREE TURN	INBOUND TURN (>90 DEGREES)	OUTBOUND TURN (<90 DEGREES)
20	7.5	N/A	N/A
15	10	N/A	N/A
10	15	~18	~13
7	21	~27	~16
5	30	~40	~20

606. POINT-TO-POINT NAVIGATION

As you approach a terminal area, the controller may clear you either to a holding fix or to the IAF. When cleared direct to a fix, you will have to use radar vectors, traditional point-to-point navigation, or waypoint offset navigation to navigate to the fix.

Traditional Point-To-Point Navigation

For traditional Point to Point (PTP) navigation, the turn to an initial heading should be initiated as soon as possible once cleared. The following steps (Figure 6-14) are used to accomplish the PTP procedure: First, tune and identify the appropriate TACAN or VOR/DME equipped station. The aircraft HSI display will function as a plotting board. Set the desired (new) radial in the CDI to aid in visualizing the location of the target fix. Place the station at the center of the compass rose. Of note, the HSI display scale and the scale you use for a PTP calculation do not have to be the same. Make your initial turn to a heading approximately halfway between the head of the bearing pointer and the head of the CDI. Realize that adjustments may be needed to rollout heading depending on DME. If going to a smaller DME, favor the head of the needle. If going to a larger DME, favor the desired radial. Once your initial turn has been made, then update your heading to ensure a direct course to your target fix. To do this, first establish the fix with the greater distance at the edge of the compass card on its radial. Put the remaining fix along its radial at a proportionate distance from the center of the card. Once the fixes are determined, connect them with an imaginary line or with the aid of a straight instrument such as a pencil. Move the line to the center of the HSI display, paralleling the original imaginary line, and read the course to the target fix where the line intersects the outside edge of the compass rose. Turn the aircraft to the new heading. To determine if you are on the desired course, the imaginary line that connects the two fixes should be vertical. If it is not vertical, adjust your heading to make the imaginary line vertical. Once the imaginary line is vertical, you are on the correct no-wind heading and should apply a wind-corrected heading as required to maintain the track. Continue to check/update your course to the new fix using the PTP procedure periodically as needed.

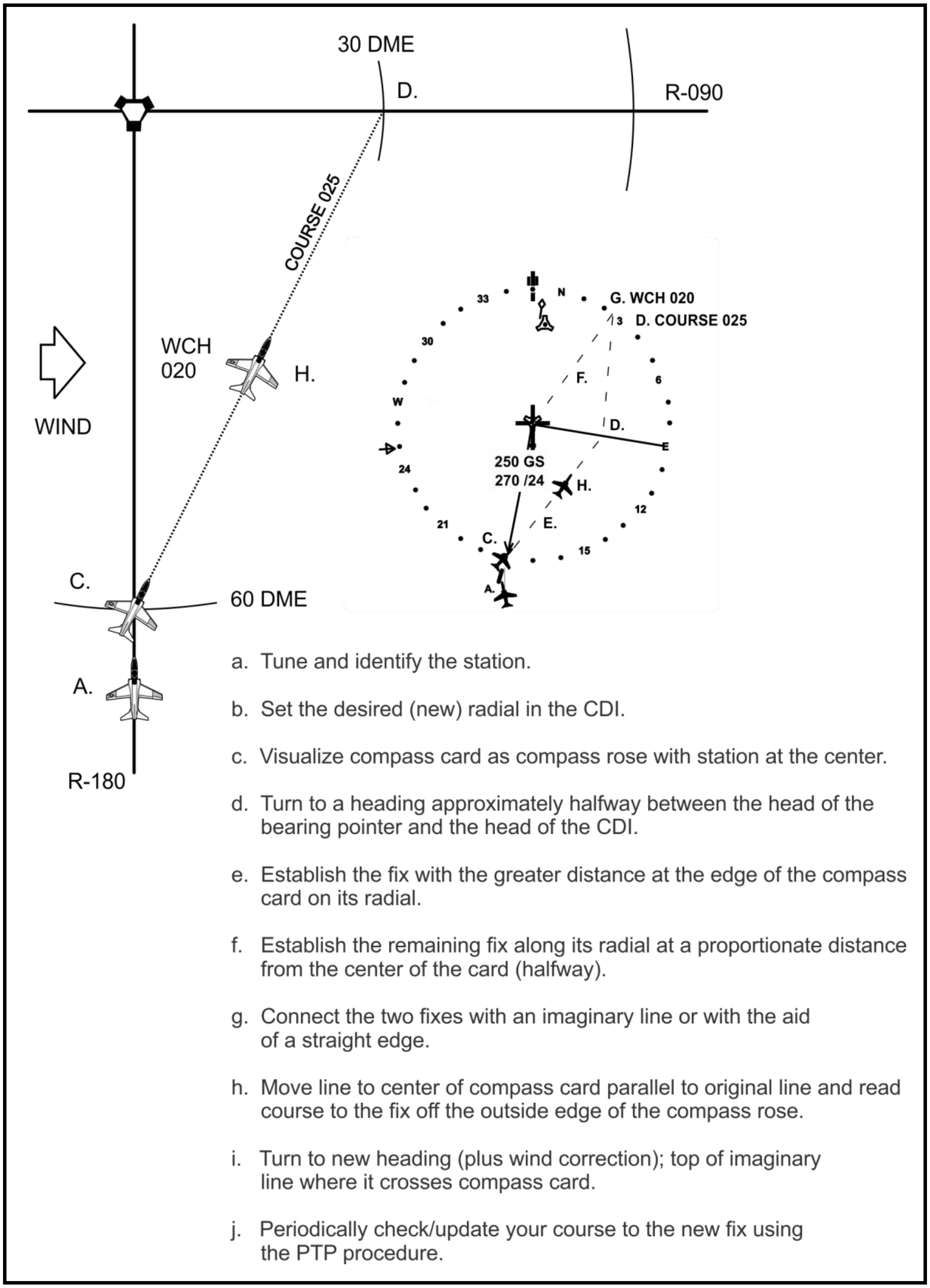


Figure 6-14 Point-To-Point Navigation

Planimetric Point-to-Point Navigation

The following steps (Figure 6-15) are used to accomplish the point-to-point procedure using the planimetric steering mode of the HSI. First, tune and identify the appropriate TACAN station. In this case, the aircraft HSI will function more like a map. The aircraft will be at the center of the display as depicted and the navigational aid will be in its actual location relative to the aircraft. Enter the desired course via the DEP and select planimetric mode on the HSI. Adjust the scale setting of the HSI to allow you to visualize the fix within the outer limits of the display. Based on the scale setting, visualize a point at the desired distance from the TACAN station along the planimetric line. Extend an imaginary line from the aircraft, at the center of the display, through the desired fix and out to the edge of the compass rose. This is your course to the fix.

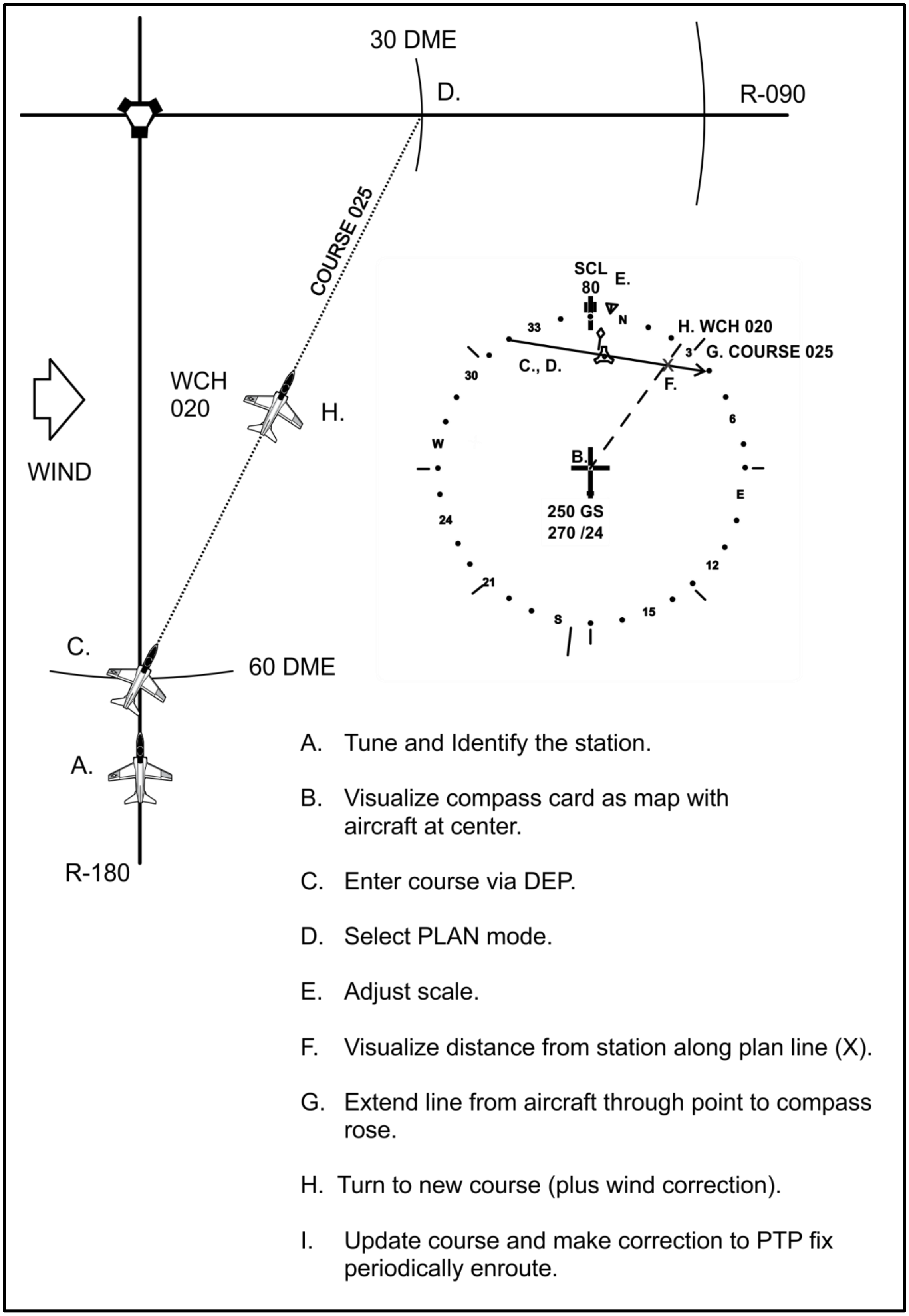


Figure 6-15 Planimetric Point-To-Point Navigation

Waypoint Offset Point-To-Point Navigation

The following steps are used to set up steering to a waypoint offset. First, select a waypoint that represents the location of the appropriate navigation aid that defines the fix. If the waypoint is one of the active waypoints, select that waypoint number with the increment/decrement arrows on the HSI display. Second, from the HSI, ADI, or MENU display, select DATA. On initial selection of DATA, the system defaults to the waypoint selection; on subsequent selections of DATA, the display returns to the last selected sublevel format, WYPT, ACFT, or GPS. If required, select WYPT (Figure 6-16).

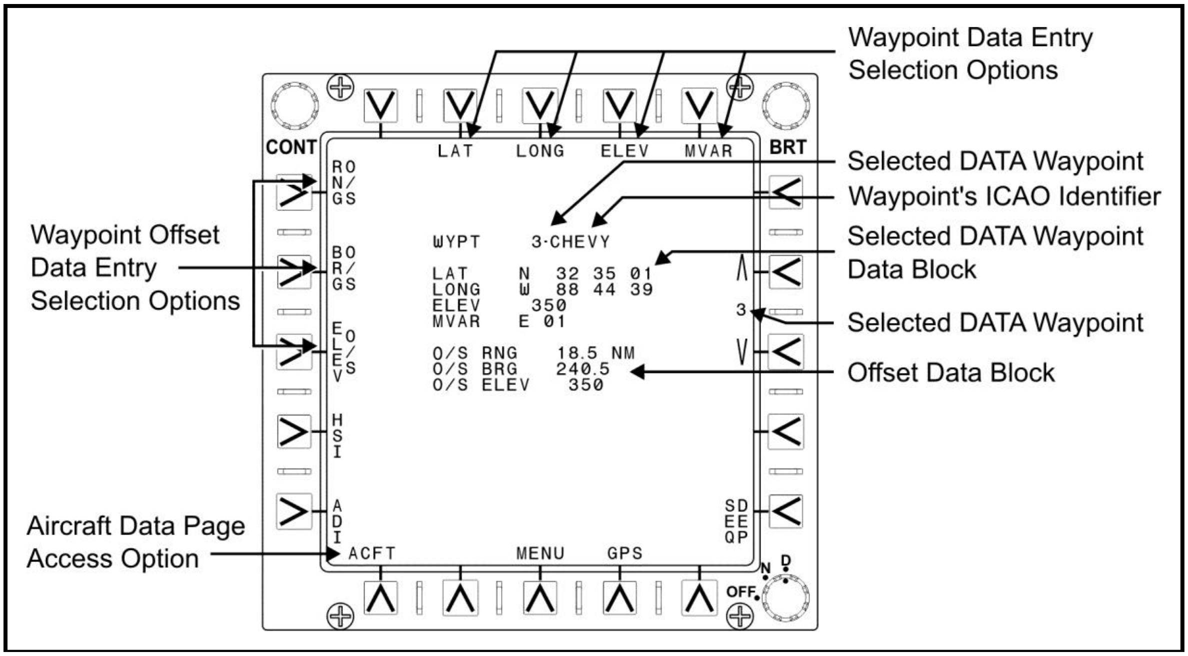


Figure 6-16 Waypoint Data Display

Third, enter the bearing and range of the fix for the waypoint that defines the navigation aid. The offset entry options are located on the left bezel of the MFD range: (RNG O/S), magnetic bearing (BRG O/S), and elevation (ELEV O/S). Offset data entry, using the DEP and scratchpad, is enabled when one of the O/S options is selected. No offset data is displayed if range is set at 0.0 nm. Range is limited to 0.0-99.9 nm in tenth of a mile increments. Bearing is 000-359.9 degrees in tenths of a degree increment (360 may be entered for 000). The decimal is not displayed on the scratch pad, but is automatically entered before the last digit after the data is entered into the system. The decimal is displayed in the offset data block. Elevation initializes to the associated waypoint elevation and is limited from -999 to 9,999 ft in one-ft increments. Don't change elevation; it is not used for waypoint offset steering. Changing the position of the waypoint after entering offset data automatically sets offset data for that waypoint to zero and all offset data is blanked. Fourth, select HSI and select WO/S. The waypoint bearing pointer and waypoint data block provide steering information to the fix.

If there is no active waypoint for the navigation aid, this waypoint data must be transferred from the Mission Data Loader (MDL) if the navigation aid is one of the 200 waypoints in the MDL or the latitude, longitude, and magnetic variation of the navigation aid can be manually entered.

To transfer data from the mission data loader, select DATA from the HSI, ADI, or MENU. Then select GPS to bring up the Global Positioning System Data Display (Figure 6-17).

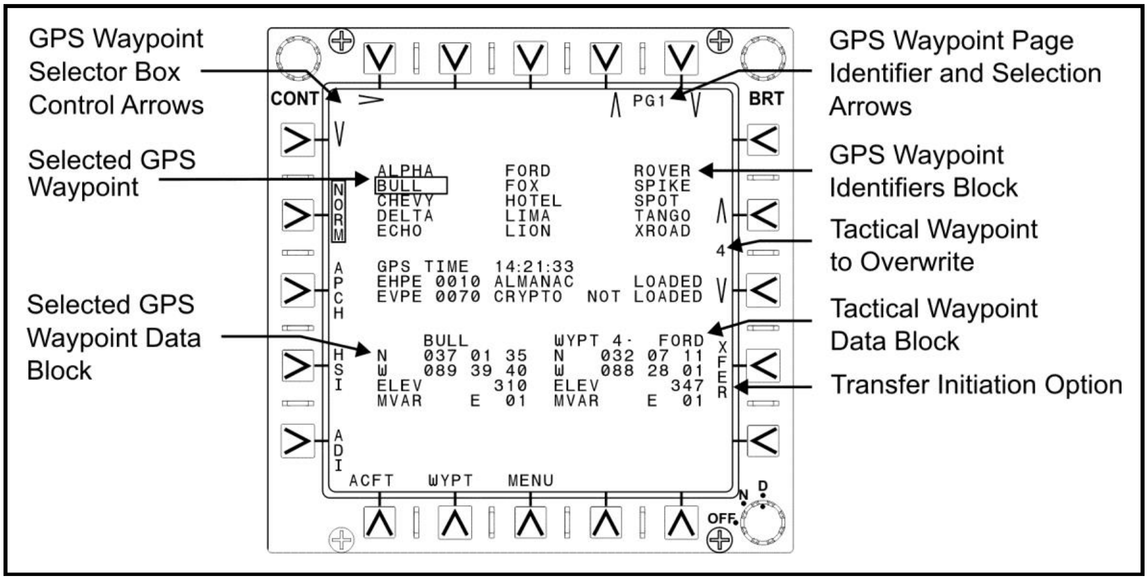


Figure 6-17 Global Positioning System Data Display

The first fifteen waypoints in the mission data loader are displayed at the top of the screen in the GPS waypoint identifiers block. The waypoints are in alphabetical order by column. The desired page of the GPS waypoint identifiers is selected with the increment/decrement arrows in the upper right of the display. Individual GPS waypoint information is selected by locating the selector box around the desired GPS waypoint with the selector box control arrows in the upper left corner of the display. The selected GPS waypoint data is shown in the selected GPS Waypoint Data Block. Using the increment/decrement arrows on the right side of the display, select the tactical waypoint you want to overwrite; the tactical waypoint data is shown in the Tactical Waypoint Data Block. Press the push-button next to XFER to copy the waypoint data from the GPS mission data block into the Tactical Waypoint Data Block. Verification of a successful transfer of waypoint information is accomplished by comparing the two waypoint data blocks. They should be the same.

If the navigation aid is not one of the 200 waypoints in the MDL, you can manually enter the latitude, longitude, and magnetic variation for the navigation aid. To do this, select DATA from the HSI, ADI, or MENU. Then select WYPT if required (Figure 6-16). Manual waypoint data entry starts by selecting the desired waypoint number with the increment/decrement arrows on the right of the display. When the desired waypoint is displayed, all parameters for that waypoint may then be changed by selecting data options at the top of the display: LAT (latitude), LONG (longitude), ELEV (elevation), or MVAR (magnetic variation).

Selecting a data option enables the scratchpad on the MFD and HUD; other data options are blanked (Figure 6-18). New data is entered with the push-buttons on the data entry panel (DEP). When the ENT push-button on the DEP is pressed, the scratchpad is removed, waypoint data is updated with the new value, the option is unboxed, and the other blanked options are redisplayed. (Note: Waypoint elevation is only used for CCIP bombing computations; not for waypoint steering or time-to-go computations.)

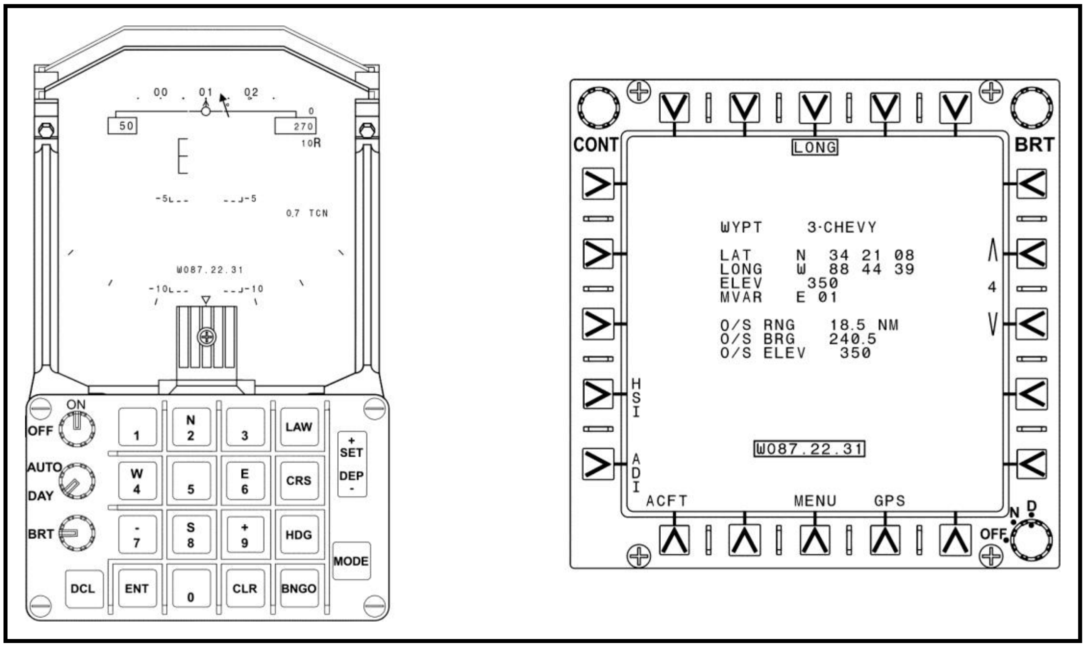


Figure 6-18 Waypoint Data Entry

Once the latitude, longitude, and magnetic variation of the navigation aid are entered as an active waypoint, the bearing and range of the fix can be entered as previously described in this FTI.

TACAN Offset Point-to-Point Navigation

TACAN offset steering can also be used to navigate to a desired point. In this case, select TCN from the DATA page and enter the desired range and bearing of the offset. Range is entered in tenth of a mile increments and bearing is entered in whole degrees only. Altitude is not required. Once a TACAN offset is entered, the associated offset symbol (X) will be displayed on the HSI relative to the TACAN symbol and TO/S steering will be available if TCN is the selected steering option. The offset will be displayed in the same relative position on the HSI for any TACAN station selected as long as a valid signal is being received. Selecting TO/S steering will provide system needle steering to the offset as well as bearing to, range and time to go to the fix in place of the TACAN information. ***Be careful to deselect TO/S steering once approaching the fix*** so that you don't inadvertently continue navigating based on the offset instead of the actual NAVAID.

NOTE

Waypoint and TACAN offset steering should be used to ***refine*** your initial point-to-point solution determined using one of the previously described procedures. A jet aircraft traveling at high altitude will cover several miles, possibly in the wrong direction, in the time it takes to type in an offset. An initial rough heading to the offset should be established prior to any data entry. Maintain good situational awareness based on the HSI display and keep the bigger picture in mind as you conduct a point-to-point. If the system steering doesn't make sense based on your initial heading, double check your entries while continuing to navigate via the TACAN and HSI.

607. ARRIVAL PHASE

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

Holding

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

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

TACAN/VOR DME Holding

When you are instructed to hold in relation to a TACAN or VOR DME station, the radial, DME of the holding fix, and DME limits of the pattern will be published (as on an approach plate) or will be assigned to you by the controller (Figure 6-19). If no DME leg length is assigned timing, use 1 minute legs at 14,000' MSL and below, and use 1-1/2 minute legs above 14,000' MSL.

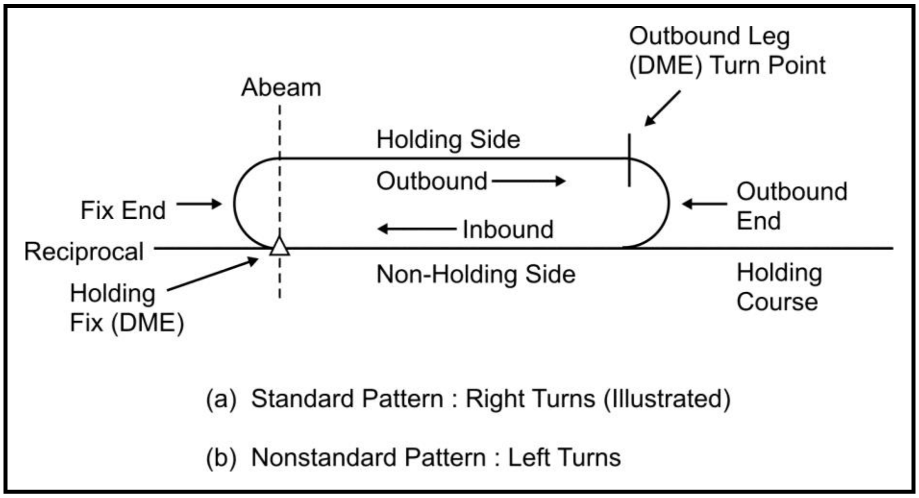


Figure 6-19 Standard Holding Pattern (TACAN)

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

1. Direction of holding from the fix (e.g., W, NE, East)

2. Radial and DME of the holding fix

3. Outbound leg length or the outer limit of the pattern in nm (applicable DME)

4. Altitude

5. Direction of turns (if nonstandard, pilot request, or controller considers information necessary)

6. Expected further clearance (EFC) time

VOR Holding

The VOR holding clearance is essentially the same as that for TACAN/VOR DME except that VOR holding will not include leg lengths. Unlike DME-based patterns, VOR patterns are located over the station because there is no distance reference available to establish the holding fix (Figure 6-20). The difference between VOR holding and TACAN/VOR DME holding is that instead of measuring leg lengths with DME, you'll have to time the legs. Leg times are 1-1/2 minutes above 14,000 ft MSL and 1 minute at 14,000 ft MSL and below. These times apply only to the initial outbound leg and all subsequent inbound legs. You may have to adjust your outbound time (due to head wind or tailwind components) to achieve the necessary inbound time. Outbound leg timing begins when you are abeam the fix or when you roll wings level out of the turn, whichever occurs ***last***.

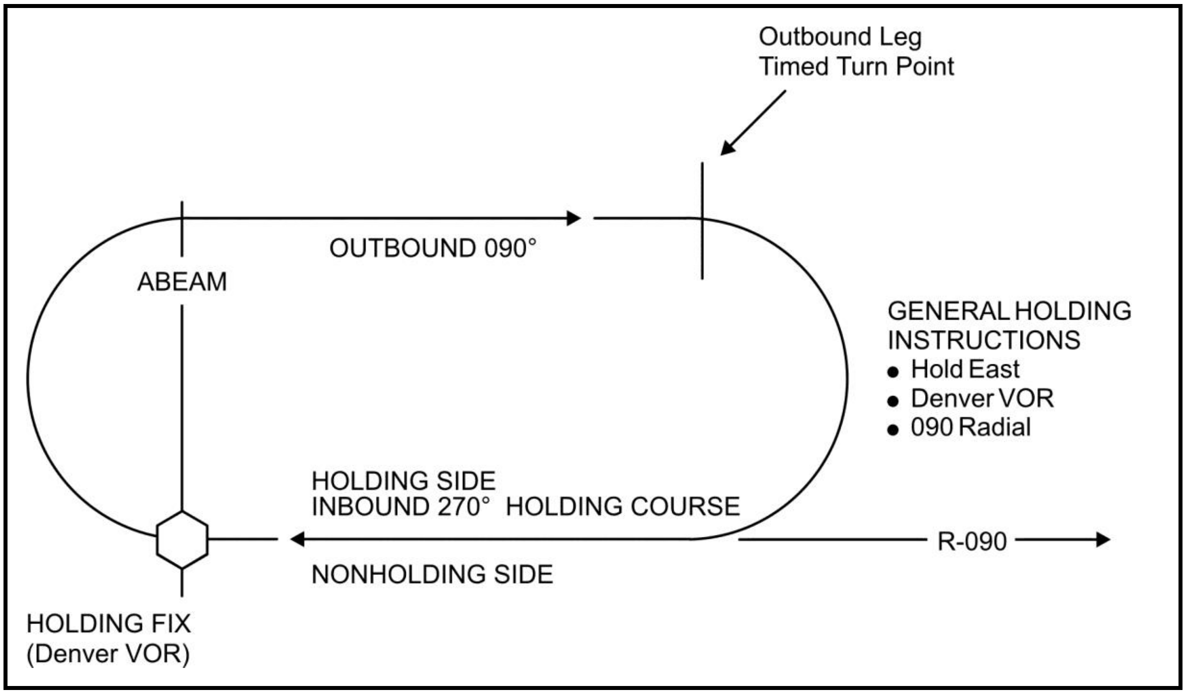


Figure 6-20 Non-DME Holding Pattern

General Holding Procedures

The basic procedures for flying a holding pattern (Figure 6-19) are as follows: First, begin slowing to holding airspeed no sooner than 3 minutes from the holding fix. Next, from your holding clearance, or published holding procedure, determine the type of holding to be used. From your heading, determine the appropriate entry procedure. Upon arrival at the holding fix, note the time and initiate the entry procedure. If timing is used for the pattern vice DME, note the time wings level or abeam the holding fix, whichever occurs last on the entry procedure heading outbound and on subsequent outbound orbits. Set inbound holding course on the HSI display or the DEP. Turn inbound when the appropriate time outbound has elapsed for the holding altitude and begin timing inbound wings level. All turns in holding are made at no more than 30 deg AOB. Communicate entering holding, if required, once established in the pattern. On subsequent orbits, adjust heading and or timing as required for winds to maintain a holding pattern track and time.

Communication Procedures for Published Holding

ATC should issue a holding clearance at least five minutes before the aircraft reaches a clearance limit. If the holding pattern is charted and the controller doesn't 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" (e.g., hold east as published). Controllers must always issue complete holding instructions when pilots request them. Of note, the controller will only indicate turn direction if holding is nonstandard by stating, "*LEFT TURNS,"* in the clearance at the pilot's request, or if the controller considers it necessary.

Communication Procedures for Exiting Holding

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

EXAMPLE: *"HOUSTON CENTER, HAWK TWO ZERO ONE, WAADE, FLIGHT LEVEL TWO ONE ZERO, TIME ONE THREE FIVE ZERO ZULU."*

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

Holding Airspeeds

If you have been cleared to a holding fix or have not received further clearance while enroute, begin slowing to holding airspeed no sooner than three minutes prior to a holding fix. Since holding is a delaying or loitering maneuver until further clearance is received, it is flown at an airspeed approximating maximum endurance. Maximum holding airspeed for this aircraft as published by the FAA is 230 kts. Maximum endurance airspeed in the T-45C is 14 units; for simplicity, procedural holding airspeed for the T-45C is 200 KIAS regardless of altitude, not to exceed 14 units AOA. If turbulence is encountered, hold at 250 KIAS per NATOPS and notify ATC; the T-45C NATOPS recommended turbulence penetration airspeed is 250 KIAS. When higher speeds are no longer necessary, return to normal holding airspeed and notify ATC.

Entry Procedures

To enter holding, use one of three possible procedures, depending on your heading relative to the holding pattern when you arrive over the fix. (The discussions of entry procedures on the following pages assume a ***standard*** [right-hand] pattern; reverse the turns for a ***nonstandard*** [left-hand] pattern.) In each procedure, you cross the fix and turn outbound on the appropriate heading. At holding fixes that are not over NAVAIDs, an outbound offset should be determined prior to the entry (Figure 6-22). Turn inbound to intercept the holding course at the appropriate DME or time (Figures 6-19 and 6-20).

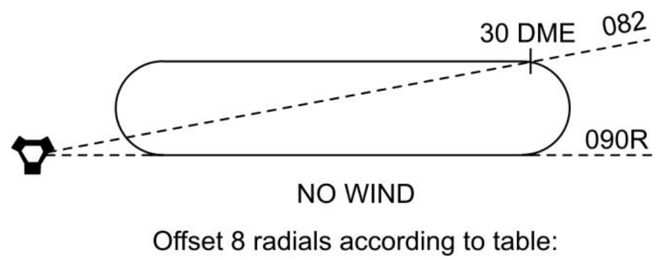
Altitude (MSL)	Airspeed (KIAS)
MHA – 6,000’	200
6,001’ – 14,000’	230
14,001 and above	265

Figure 6-21 Maximum Holding Airspeeds

NOTES

Holding patterns at Navy fields only − 230 KIAS maximum, unless otherwise depicted

Holding patterns at USAF airfields only − 310 KIAS maximum, unless otherwise depicted



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

Figure 6-22 No-Wind Holding Offset

No-Wind VOR/TACAN DME Entry Offset

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

The quickest and most accurate method of determining which type of entry to perform is to use the HSI display compass rose as a plotting board (Figure 6-23). For a standard holding pattern, locate the holding radial on the compass rose. If the reciprocal of the holding course is located within an area of 70 degrees to the right of aircraft heading at the holding fix, perform a teardrop entry. If the reciprocal of the holding course is located within an area of 110 degrees to the left of aircraft heading, perform a parallel entry. If the reciprocal of the holding course is located outside an area of 110 degrees to the left and 70 degrees to the right of aircraft heading, perform a direct entry. For nonstandard pattern (left turns), reverse the 70-and 110- degree lines. Additionally, most approach plates include a holding entry diagram to aid you in determining which type of entry to perform.

NOTE

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

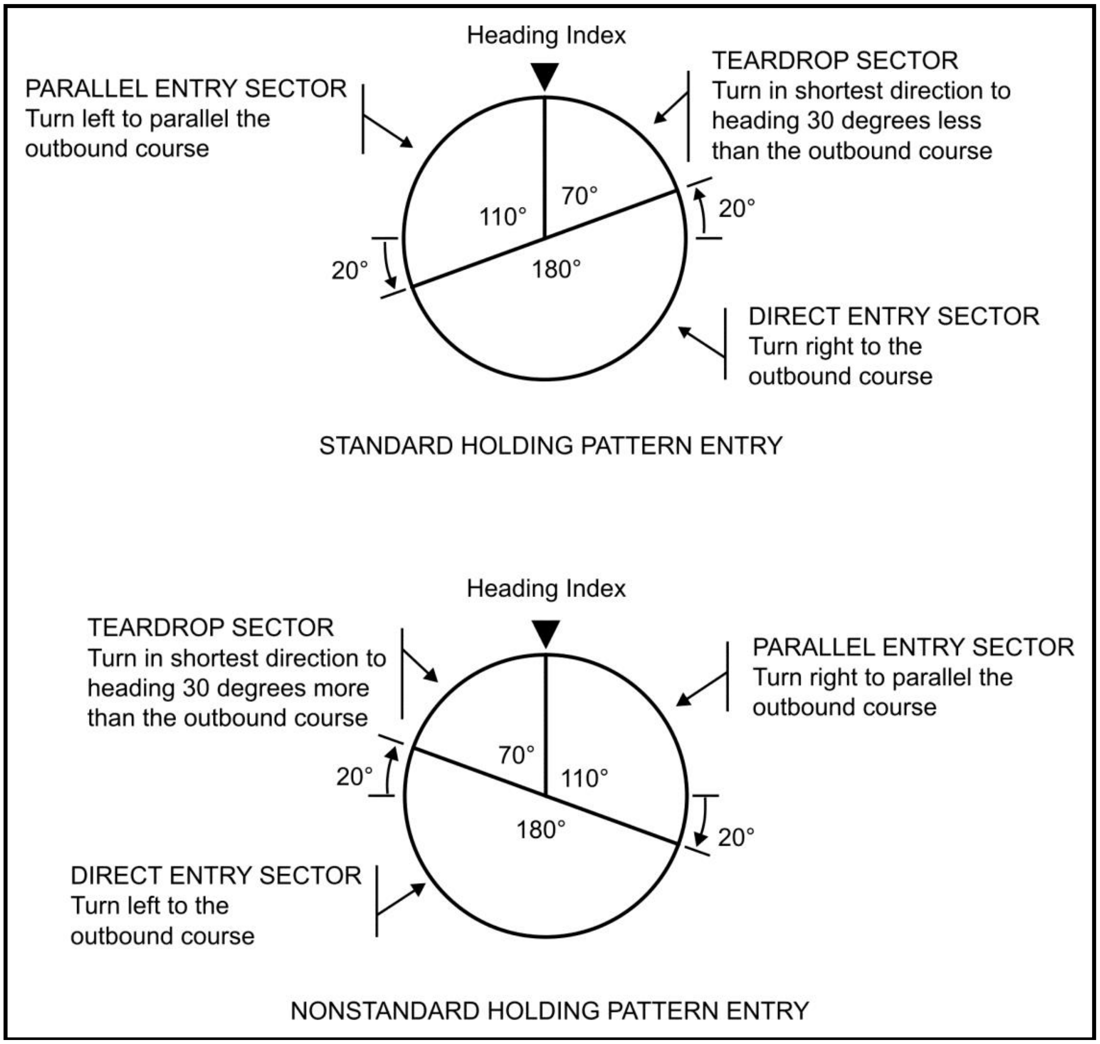


Figure 6-23 Determining Holding Entry

1. **Parallel Procedure**: When approaching the holding fix from anywhere in sector (A), the parallel entry procedure would be to turn to a heading to parallel the holding course/radial outbound on the nonholding side (See Figure 6-24). Wings level (VOR only) time for one or one and one half minutes (depending on the altitude), at end of timing (VOR) or outbound DME (TACAN) turn in the direction of the holding pattern through more than 180 degrees, and return to the holding fix or intercept the holding course inbound.

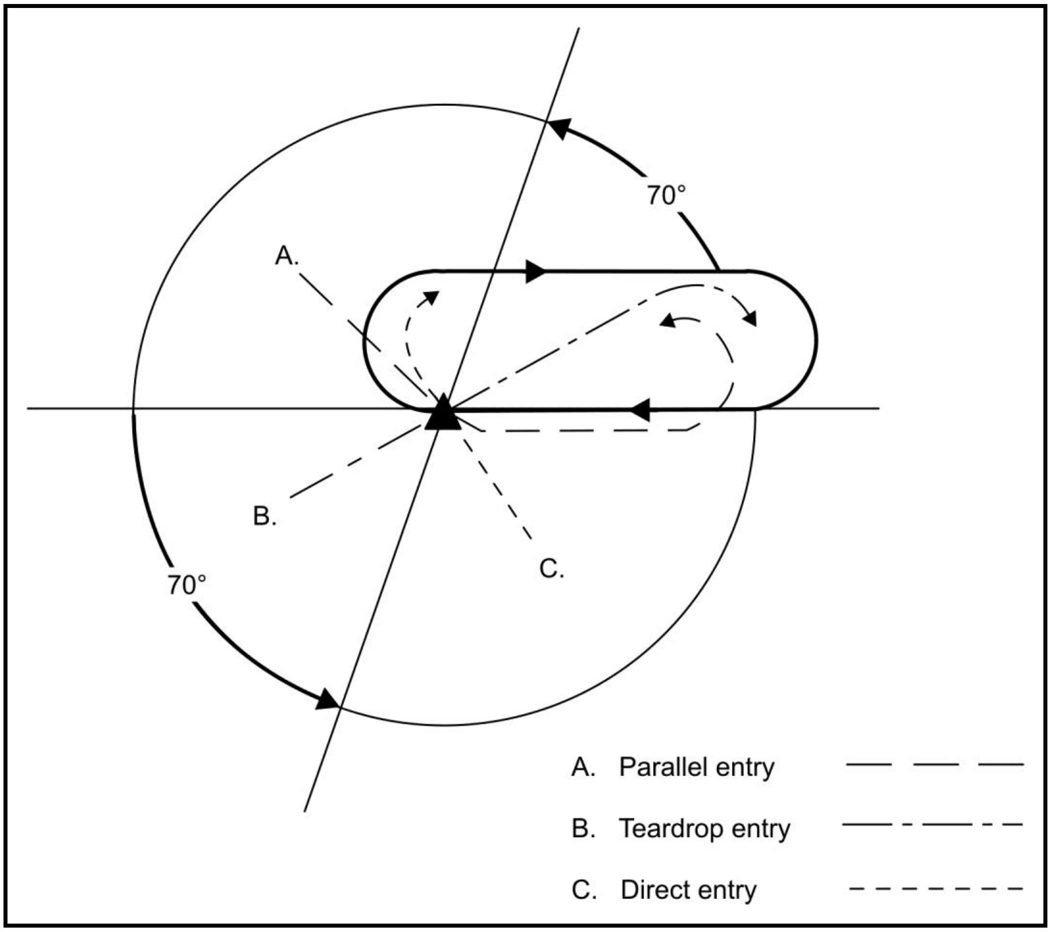


Figure 6-24 Holding Entry

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

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

Wind Drift Correction Techniques. You may have to compensate for two different wind effects while flying a correct holding pattern—headwinds or tailwinds, and crosswinds. Headwinds or tailwinds will only be a factor on non-DME patterns, for which you will have to adjust the outbound leg for a correct inbound time. Compensate for crosswinds in order to arrive at an outbound position from which a turn inbound will place the aircraft on the holding course. This is normally accomplished by utilizing a larger (approximately two to three times) drift correction on the outbound leg. See Figure 6-25.

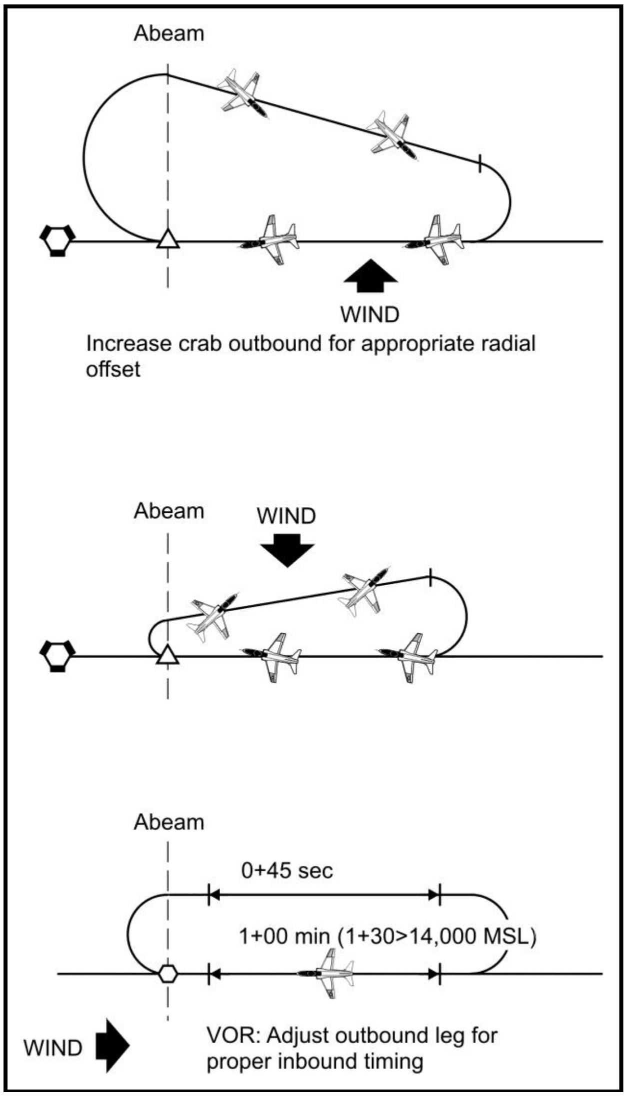


Figure 6-25 Wind Correction for Holding

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

Penetration from Holding

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

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

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

Descending at idle, 250 KIAS with speed brakes extended yields approximately 4,000 fpm or 1,000 ft of altitude loss for each nautical mile (no wind). Idle, 250-kt clean descent yields approximately 2,000 fpm or 1,000 ft of altitude loss for every two nautical miles.

NOTE

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

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

Passing 5,000' AGL in any descent, the LAW should be allowed to sound. At this point retract speed brakes (if extended), shallow rate of descent (minute to live) and report *"Platform."* Reset the LAW in accordance with your wing SOP. Always honor the minute to live rule.

608. ENROUTE DESCENT

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

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

Enroute Descent Planning

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

Procedure: To calculate VSI, divide “altitude to lose” by “minutes to go” to get desired rate of descent in fpm. For example, cruising at FL300 and center clears you to "descend and maintain 15,000 ft" in the next 50 miles. Substituting these numbers into our equation: (-15,000 ft/50 nm) (5 nm/min) equals -1,500 ft per min. Of course, the specific VSI depends on groundspeed, but the following table provides a rough approximation.

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

Fuel Flow (pph)	Airspeed (KIAS)	VSI (fpm)	DME to lose 1 K
500 (idle)	250	-2,500	2.5
500 (idle), BDS	250	-6,000	1
500 (idle)	14 units AOA	-1,500	3-4
700 (75%)	250	-2,000	2.5

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

Max Range Descent. Goal: Use less fuel while maximizing distance traveled. NATOPS lists the max range descent airspeed and descent point in the BINGO tables for various airspeeds and configurations. Max range descent AOA (L/D Max square at 14 units) will be higher than the max range cruise AOA (triangle at 12-13 units). ATC typically plans for 2 nm/ 1000' descent profile or about 70 - 80 from 35000'. A max range descent from 35,000' would cover approximately 100 nm no wind according to the BINGO charts, so you will need to ask for an earlier descent in this case. Don't forget to factor in any distance you may need after level off to configure the aircraft and line up on final approach course.

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

All Descents. Passing 5000' AGL in any descent, the LAW should be allowed to sound. At this point retract speed brakes (if extended), shallow rate of descent (minute to live) and report "*PLATFORM*." Reset the LAW in accordance with your wing SOP. Always comply with the minute to live rule.

609. STAR

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

Use of STARs requires pilot possession of at least the APPROVED textual description. As with any ATC clearance or portion thereof, it is the responsibility of each pilot to accept or refuse an issued STAR. Pilots should notify ATC if they do not wish to use a STAR by placing "NO STAR" in the remarks section of the flight plan or by the less desirable method of orally stating the same to ATC. This option may result in terminal delays and holding.

610. APPROACH PHASE

Instrument approaches enable you to transition from IMC to a visual landing while providing terrain clearance and separation from air traffic. Part of the FLIP series, instrument approach procedure charts are divided into two categories, high altitude (Figure 6-26) and low altitude.

Consider the following factors as you select an instrument approach:

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

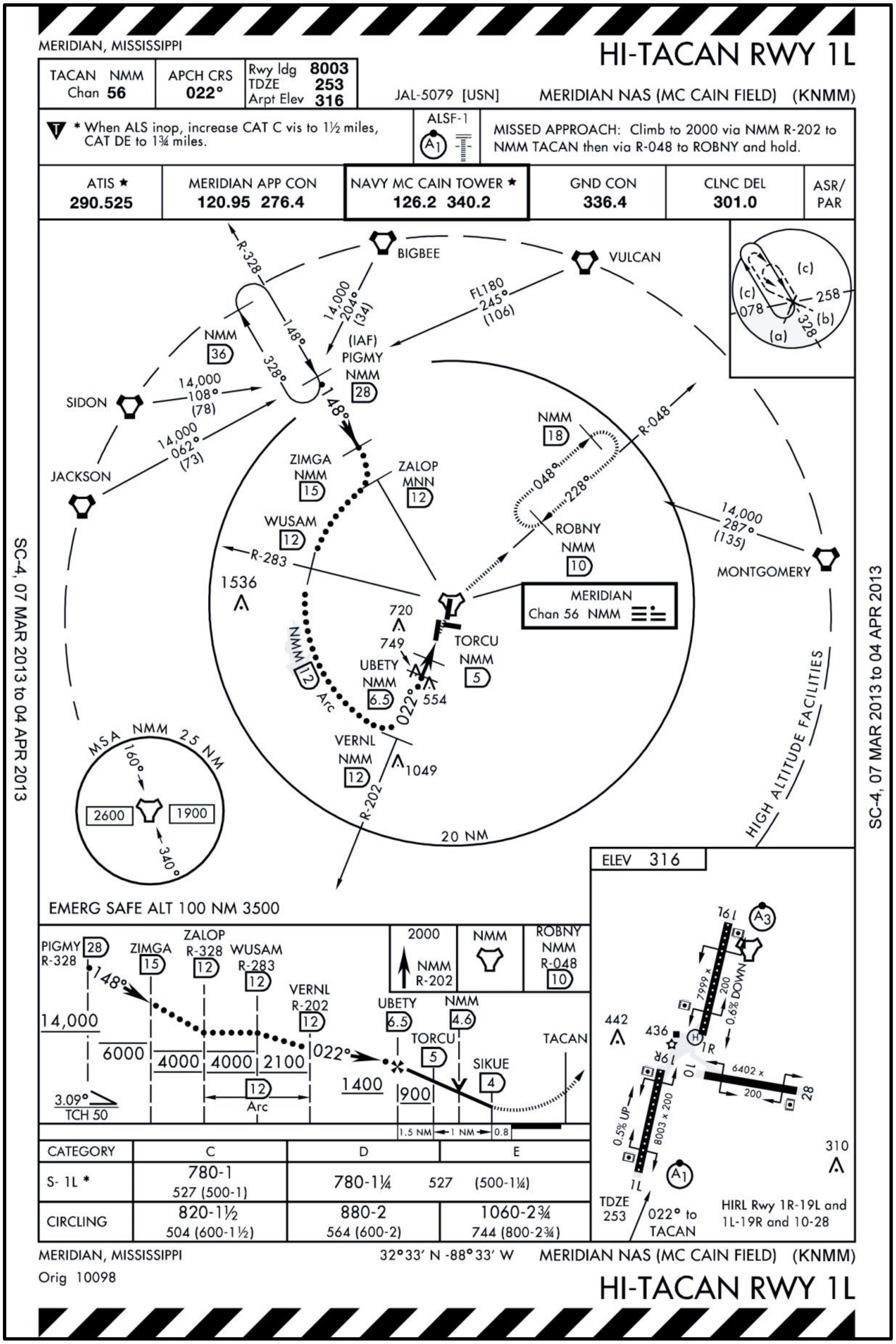


Figure 6-26 Instrument Approach Chart

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

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

In addition to approach procedures, instrument approach charts also provide a diagram of the airport (Figure 6-27) showing runway lengths, taxiways, obstructions, arresting gear and barrier locations, approach lighting configuration, buildings, structures, and ground tract from FAF to runway.

Before commencing an instrument approach, you must know the approach procedure in use and complete the "***WARP***" checklist: confirm the ***W***eather, ***A***ltimeter setting, ***R***unway in use, and perform ***P***enetration checks.

After determining which approach you desire to fly, request clearance to commence the approach. Clearance for an approach does ***not*** constitute clearance to land or give you priority over VFR traffic in the landing pattern; only the control tower may grant you clearance to land. However, the approach control facility (e.g., a radar controller) can relay landing clearance to you.

NOTES

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

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

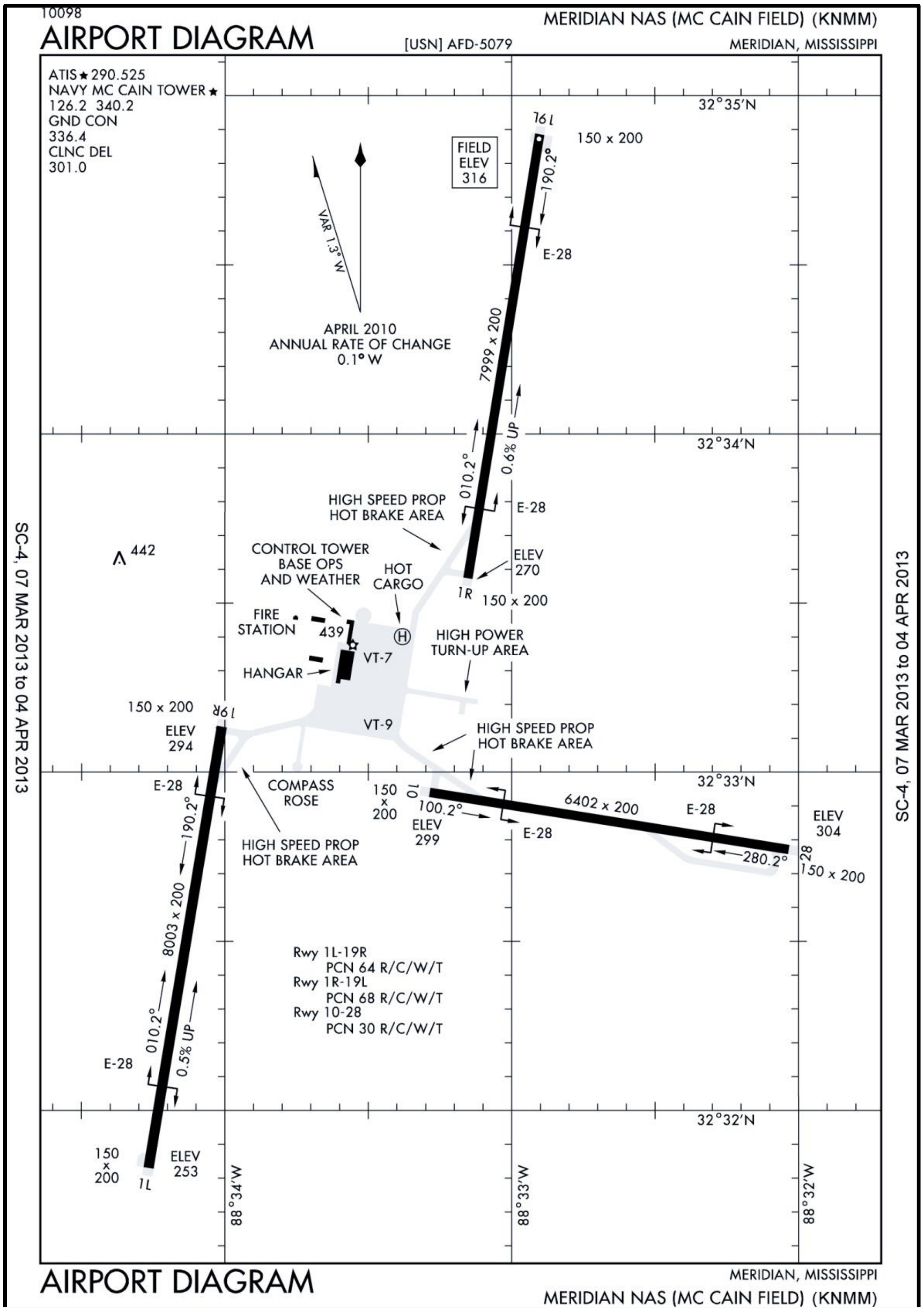


Figure 6-27 Airport Diagram

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

MASTER ARM switch ....SAFE

CONTROL AUG switch ....ALL

Canopy defog and cockpit temperature .... .AS REQUIRED

Weather/field conditions ....CHECKED

NAVAIDs .... TUNED/IDENTIFIED

Steering Option .... .AS REQUIRED

Navigation Source ....AS REQUIRED

Wet Compass, ADI display, HSI display ....ALIGNED

Barometric Altimeter ....SET AS REQUIRED

LAW... SET TO 5000' (PLATFORM) OR AS REQUIRED

Fuel... ...CHECKED

Approach clearance time ....NOTE AND PLAN HOLDING

Approach Communication Procedures

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

611. GROUND CONTROLLED APPROACH (GCA)

There are two basic types of ground-controlled approaches—the precision radar approach (PAR) and the surveillance radar approach (ASR). A PAR provides you with precise course, glidepath, and range information and is classified as a precision approach.

An ASR (commonly referred to as a surveillance approach) provides lower resolution course and range information only (no glideslope) and is classified as a non-precision approach.

NOTE

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

Both the PAR and ASR approaches are divided into two segments, initial pattern and final approach. Refer to Figure 6-28 for an illustration of the GCA pattern.

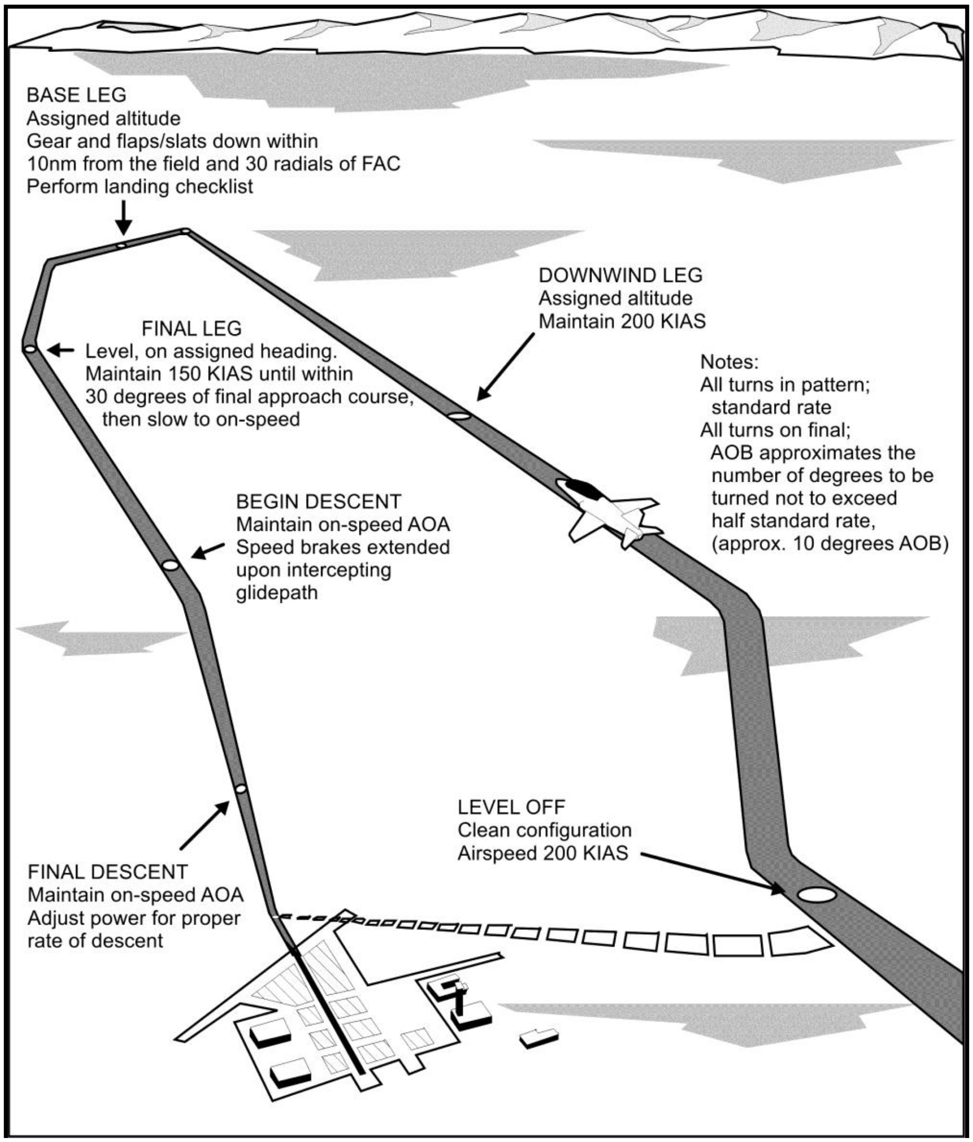


Figure 6-28 GCA Pattern

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

Radar approach minimums can be found in the FLIP instrument approach procedure publications, both on the approach plates and in the radar approach minimums section (Figure 6-29). Although some published approach minimums are lower than 200-1/2, you are limited to absolute minimums of 200-1/2 when single-piloted.

RADAR INSTRUMENT APPROACH MINIMUMS

DAVIS-MONTHAN AFB (KDMA), AZ (Tucson) (Amdt 1, 10294 USAF) ELEV **2704**

RADAR[1] - (E) 118.5 125.1 318.1 297.2

	RWY	GS/TCH/RPI	CAT	DH/ MDA-VIS	HAT/ HATh/ HAA	CEIL-VIS
PAR	12	3.0°/59/950	ABCDE	**2839**/40	250	(200-¾)
	30	3.0°/59/1320	ABCDE	**2954**/40	250	(300-¾)

[1]No NOTAM MP 1100-1300Z dly. PAR opr 1700-0300Z wkd or termination of A10 flying (contact scheduling for times at DSN 228-5777).

FALLON NAS (KNFL), (VAN VOORHIS FIELD), NV (12152 USN) ELEV **3934**

RADAR[1] - (E) 118.3x 121.875x 262.8x 275.6x 310.6x 345.2x

	RWY	GS/TCH/RPI	CAT	DH/ MDA-VIS	HAT/ HATh/ HAA	CEIL-VIS
PAR	31L	3.5°/55/906	ABCDE	**4126**-¾	200	(200-¾)
	31R	3.5°/54/872	ABCDE	**4128**-¾	200	(200-¾)
	7	3.0°/36/672	ABCDE	**4129**-¾	200	(200-¾)
	13L	3.0°/46/885	ABCDE	**4134**-¾	200	(200-¾)
	13R	3.0°/48/915	ABCDE	**4134**-¾	200	(200-¾)
ASR	31L		ABCDE	**4220**-1	294	(300-1)
	31R		ABCDE	**4240**-1	312	(400-1)
	13R		ABCDE	**4280**-1	346	(400-1)
	13L		ABCDE	**4280**-1	346	(400-1)
	7		AB	**4340**-1	411	(500-1)
			CDE	**4340**-1⅛	411	(500-1⅛)
CIR	ALL RWY		AB	**4400**-1	466	(500-1)
			C	**4400**-1½	466	(500-1½)
			D	**4560**-2	626	(700-2)
			E	**4960**-3	1026	(1100-3)

CAUTION: ATC Missed Approach Minimum Climb Rate to 7400

	Rwy	Knots	60	120	180	240	300	360
PAR/ASR	7	FPM	260	520	780	1040	1300	1560
	13L/R	FPM	260	520	780	1040	1300	1560
	31L/R	FPM	270	540	810	1080	1350	1620

[1]No-NOTAM MP sked: PAR-2200-0000Z++ Thu, ASR-1500-1700Z++ Wed, when ceil-vis 3000-5 and above.

Figure 6-29 Radar Instrument Approach Minimums

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

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

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

1. Type of approach to expect (precision or surveillance)

2. Duty runway

3. Location of the missed approach point (MAP) (surveillance only)

4. Advisory to perform landing check (USN/USMC controllers only)

5. Missed approach and lost communication instructions

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

As you commence your final approach, the final controller will perform a radio check; *"THIS IS MCCAIN FINAL CONTROLLER. HOW DO YOU HEAR?"* You should respond with *"LOUD AND CLEAR, THREE DOWN AND LOCKED"* (or position of gear). The controller may also tell you that you need not acknowledge further transmissions. On final approach, the controller is required to make contact with you at least every 5 seconds on a PAR or 15 seconds on an ASR. If you lose contact with the controller for the respective amount of time for the approach being flown, attempt to recontact and if not successful, execute the lost communication instructions.

GCA Pattern. The entry configuration for the GCA pattern is as follows:

Airspeed: 200 KIAS

Gear: Up

Speed brakes: In

Flaps/slats: Up

Available NAVAIDS: Tuned

Normally, you fly the first leg of the pattern (the downwind leg) straight and level at 200 KIAS and pattern altitude. At the end of the downwind leg, the controller will direct a turn to base leg. At the end of the base leg, the controller will direct a turn to either a dogleg or the final approach course. Once established on base leg or on a dogleg to the FAC, unless directed by ATC, stay clean and at 200 KIAS until you are within 10 nm of the field and 30 radials of the final approach course. When within those parameters, transition to landing configuration, speed brakes retracted, slow to 150 KIAS, and complete the landing checklist (speed brakes retracted). You will have to retrim the nose to maintain level flight. When within 10 nm and on an intercept heading that is within 30 degrees of the final approach course, slow to on-speed.

NOTES

1. USN/USMC controllers will state "*PERFORM LANDING CHECKS*" on the base leg; this is only a reminder and does not direct the pilot to dirty up. If the controller says, *"SLOW TO APPROACH SPEED,"* the controller is directing this for sequencing and the aircrew must comply or state that they are unable.

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

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

PAR Final Approach. At the beginning of a PAR final approach, you will be straight and level, on-speed, and normally at approximately 1,500 ft AGL. Restrict AOB to the approximate number of degrees to be turned, not to exceed 1/2 SRT (approximately 10 degrees). Verify gear down, flaps at half or full. Trim aircraft for hands off level flight. When the controller informs you that you are *"ON GLIDEPATH,"* extend the speed brakes and adjust power as required to establish a descent. Forward stick pressure will initially be required to counter the pitch up caused by speed brake extension. Report, *"SPEED BRAKES FULL, LANDING CHECKLIST COMPLETE,"* on the ICS.

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

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

ASR Final Approach. On the ASR final approach, the controller cannot furnish glideslope information. It will be up to you to establish and maintain the correct rate of descent. The controller will identify the missed approach point (MAP) in nautical miles from the end of the runway, and will direct the descent by stating, *"BEGIN DESCENT."* On pilot request, the controller will provide recommended altitudes each mile on final. Recommended altitudes decrease 300 ft per mile (approximates a 3-degree glideslope). In order to smoothly level at MDA prior to the MAP, your altitudes should be slightly lower than those recommended. Depending on your groundspeed, a descent rate of 800-1000 fpm will allow you to descend to the MDA prior to reaching the MAP. Approximately 100 feet prior to MDA, add about 300 pph fuel flow and apply slight backstick pressure to level off at MDA. Upon reaching the MAP, if you do not have the runway in sight or are otherwise unable to perform a safe landing, execute the missed approach as instructed.

612. RADIO INSTRUMENT APPROACHES

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

Plan ahead by reviewing the procedures for the chosen approach before arriving at the IAF and stay ahead of the aircraft during the approach. Use all available NAVAIDs during the approach as backups in the event of equipment malfunction. If, for example, you are flying an ILS approach at a field that also has a TACAN, you should also tune the TACAN and select the steering as required to comply with the approach. During navigation to FAC with both TCN and ILS steering selected, TACAN deviation will be displayed on the HSI and LOC deviation will be displayed on the ADI. When established on ILS or LOC FAC, you would deselect TCN steering so both ADI and HSI show LOC deviation.

613. VOR PENETRATION APPROACH

VOR navigational aids supply you with bearing information to the VOR station you have tuned. Instrument approaches flown to these facilities usually rely on direct overflight of the station during the approach (Figure 6-30).

High altitude VOR approaches usually involve a tear drop procedure to intercept the final approach course. Consideration should be given to the depicted radial separation available to complete the turn. Recognizing that radial separation widens as you move farther from the station, the descent profile may require modification to provide sufficient maneuvering room. A 250 KIAS, 30 degree AOB course reversal will require a turn diameter between 4 and 5 miles at medium altitudes. Low altitude approaches usually involve a procedural turn (i.e., 45/180 or 80/260). AIM states, "when the approach procedure involves a procedure turn, a maximum speed of not greater than 200 knots (IAS) should be observed from first overheading the course reversal IAF through the procedure turn maneuver to ensure containment within the obstruction clearance area."

Before beginning the approach, set the outbound penetration course on the HSI display. The HSI must be in the CDI mode to get VOR information displayed.
Begin the approach when you pass over the station on the altitude and heading prescribed by the approach plate. Once you regain the VOR signal and are established on the outbound course, commence a high altitude penetration by lowering the nose and accelerating to 250 KIAS. At 250 KIAS, reduce power to flight IDLE, lower the nose and extend the speed brakes. Adjust nose attitude as required to maintain 250 KIAS and 4,000-6,000 fpm descent (approximately 10 degrees nose down). When a penetration turn altitude is not published, start the turn after descending one half the total altitude between the IAF and FAF altitudes. Before reaching the penetration turn altitude set the final approach course in the HSI. Do not exceed 30 degrees AOB to intercept the final and do not descend below the depicted turn completion altitude until established on the final approach course.

NOTE

Do not exceed the "minute-to-live" rule in the penetration descent.

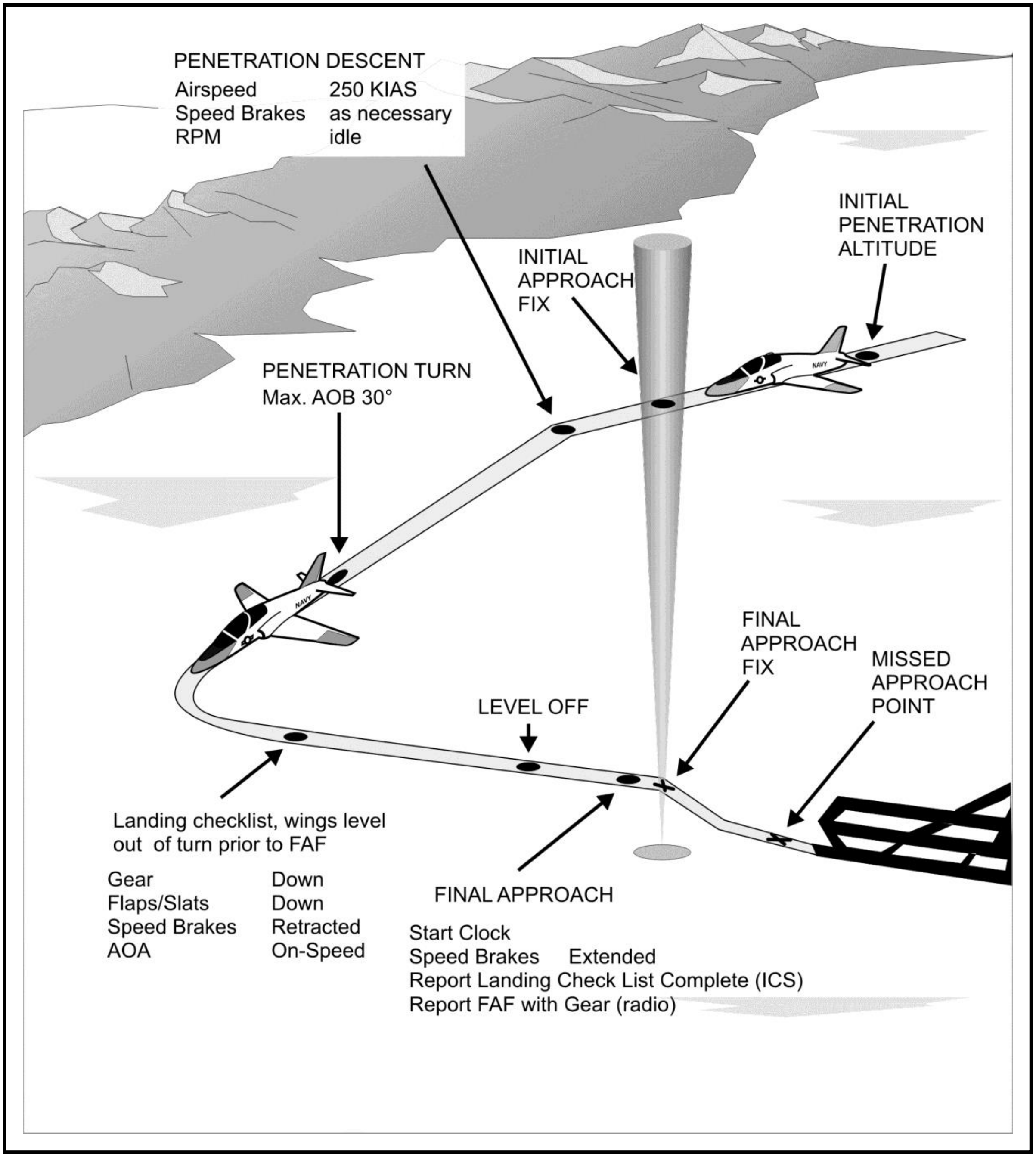


Figure 6-30 Non-DME Penetration and Approach

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

1. If the approach has a FAF (station located away from the field), station passage is normally the FAF and timing will determine the MAP. After completing the penetration turn, transition to the landing configuration, and check speed brakes retracted, prior to reaching the FAF.

2. At station passage, start timing to the MAP, basing your timing on groundspeed and the FAF to MAP table on the approach plate under the sketch. Extend speed brakes, reduce power if necessary, and transition to descend on-speed to MDA. (Do ***not*** exceed 1,000 fpm.) Report FAF with gear to ATC and landing checklist complete on the ICS. Continue to a landing if you visually acquire the runway up to the MAP and you are in a position to land or maneuver to land safely. If you do not have the runway environment in sight when at the MAP (i.e., time expires), execute a missed approach.

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

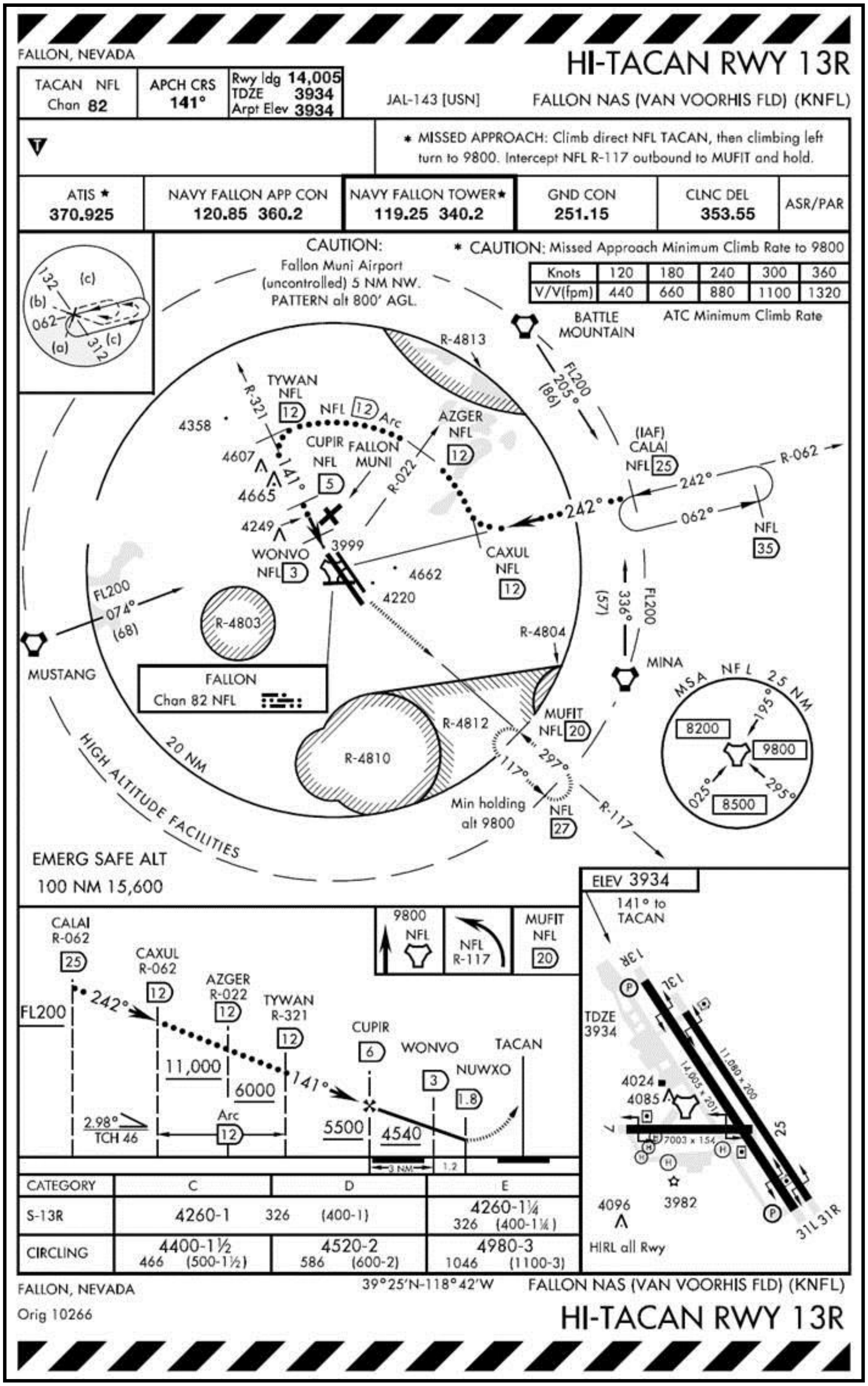
4. When executing a low altitude TACAN, VOR, ILS or LOC approach requiring the aircraft to remain within 10 nm of the IAF/field on a procedural turn, maintain a maximum of 200 KIAS during the procedure.

NOTE

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

614. TACAN APPROACH

TACAN (and VOR/DME) navigation equipment supplies both range and distance information, making arcing approaches possible. Because range information is available, you can determine the fixes (IAF, FAF, and MAP) defined by DME (Figure 6-31).



CATEGORY	C	D	E
S-13R	4260-1 326 (400-1)		4260-1¼ 326 (400-1¼)
CIRCLING	4400-1½ 466 (500-1½)	4520-2 586 (600-2)	4980-3 1046 (1100-3)

Figure 6-31 TACAN Approach

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

When executing a HI TACAN/VOR DME approach, before reaching the IAF, complete the "WARP" checks, set the published penetration course in the HSI display and select CDI mode. At the IAF, intercept and maintain the approach course as published. Lower the nose and accelerate to 250 KIAS, if necessary. At 250 KIAS reduce power to idle, extend the speed brakes and lower the nose to maintain 250 KIAS (approximately 10 degrees nose down). Report leaving altitude to ATC when commencing the approach. Retract the speed brakes when no longer required and raise nose to maintain 250 KIAS (Approximately 2 degrees nose down). Anticipate reaching 5000 feet AGL, allow the LAW to sound, report "Platform" and retract the speed brakes, if still extended. Shallow descent IAW the minute to live rule and reset the LAW to the next altitude restriction as directed in your wing's SOP. Lead all turns onto and off of the arc by 1% of your ground speed.

NOTE

Published "Lead Radials" (LR's) provide 2.0 nm lead to assist in turning to an intermediate or final approach course. The decelerating level speed change in a 1/2 standard rate turn practiced in BI will advance the aircraft approximately 2 NM. Slightly more lead will be required if turns are flown at 250 KIAS.

At 5-7 nm prior to the FAF, slow to 200 KIAS. Configure the aircraft for landing 3-5 nm prior to FAF and perform landing checklist (Speed brakes retracted). Maintain published course and altitude to the FAF. Lead all level offs by 10% of your VSI.

When executing a low altitude TACAN/VOR DME approach, the procedures are essentially the same as those used for a high altitude penetration. When designing low altitude approaches, a 200 knot Terminal Instrument Procedures (TERPS) speed criteria is used. As discussed earlier, approaches involving a procedure turn should be flown at a maximum airspeed of 200 KIAS. A long No PT track or arc may be flown at a higher airspeed if traffic permits. Consideration should be given to the larger turn radius required at the higher speed. Speed brakes may be unnecessary prior to the FAF if slowing from 250 KIAS is not required prior to transitioning to the landing configuration.

At the FAF, start the clock, extend speed brakes, report landing checklist complete on the ICS and make gear down call to ATC. Forward stick pressure will be required to counter the pitch up due to speed brake extension. Descend to the MDA and start looking for the runway while monitoring your DME for the MAP. Plan your descent to be in level flight at the MDA prior to reaching the MAP. From the FAF, maintain precise course, speed, and rate of descent control. Do ***not*** exceed 1,000 fpm. Keep heading changes small so you don't chase the final approach course on the HSI display or the course situation steering arrow on the HUD.

Approximately 100 feet prior to the MDA, add about 300 pph fuel flow and apply slight backstick pressure to level off at MDA. When you reach the MAP, if you don't have the runway environment in sight or determine that a safe landing is not possible, execute a missed approach.

615. ILS APPROACH

Glideslope and Localizer needles are displayed on the ADI display and HUD, and localizer deviation is displayed on the HSI when an ILS frequency is selected on the VOR control panel and ILS is the **o*nly*** selected steering. TACAN or WYPT can be selected in conjunction with ILS steering. In this case, TACAN or waypoint course deviation is shown on the HSI and ILS deviation is shown on the ADI. The HUD displays both TACAN and waypoint steering arrow and ILS needles (Figure 6-32).

The ILS approach is a precision approach in which you are provided precise glideslope, azimuth (course), and range information. The ILS (Figure 6-33) is composed of three elements: the localizer transmitter, the glideslope transmitter, and marker beacons. As with any approach, you should back up the ILS approach with any other available NAVAIDs.

The localizer transmitter provides azimuth information to the HSI course line when ILS is the only steering selection, to the azimuth deviation bar on the ADI display, and to the HUD for maintaining alignment with the approach course. The localizer signal has a maximum range of 18 nm from the station if you are within 10 degrees either side of the course centerline.

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

NOTE

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

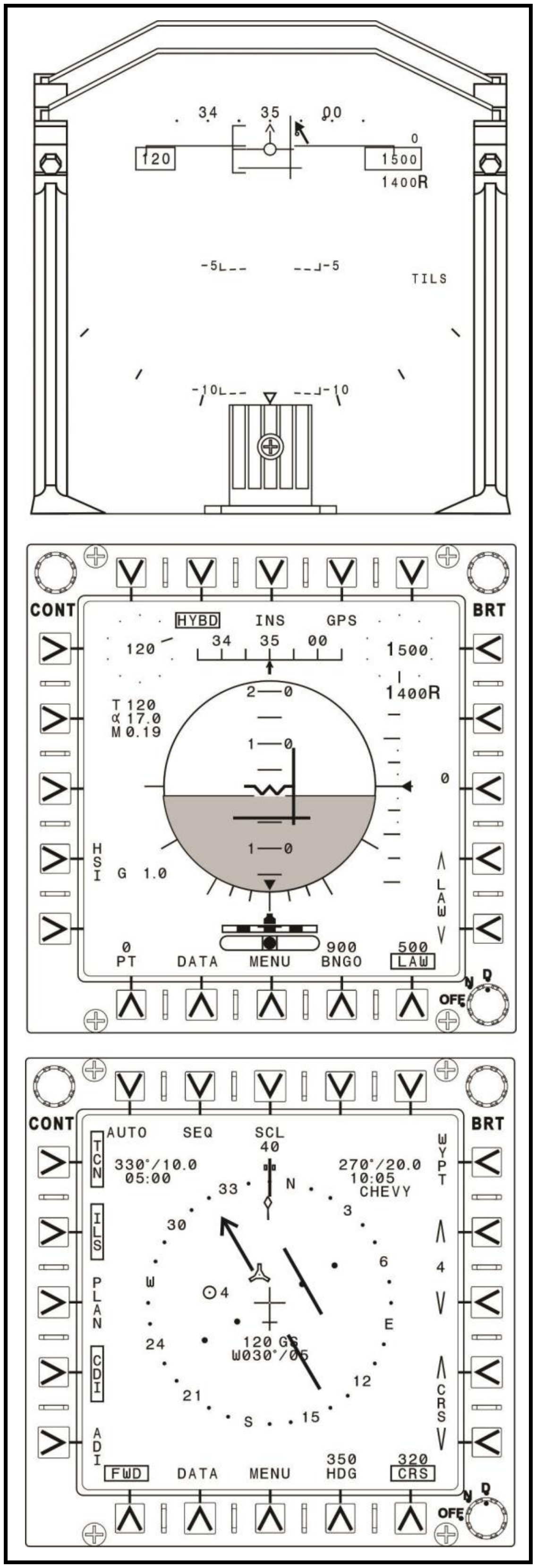
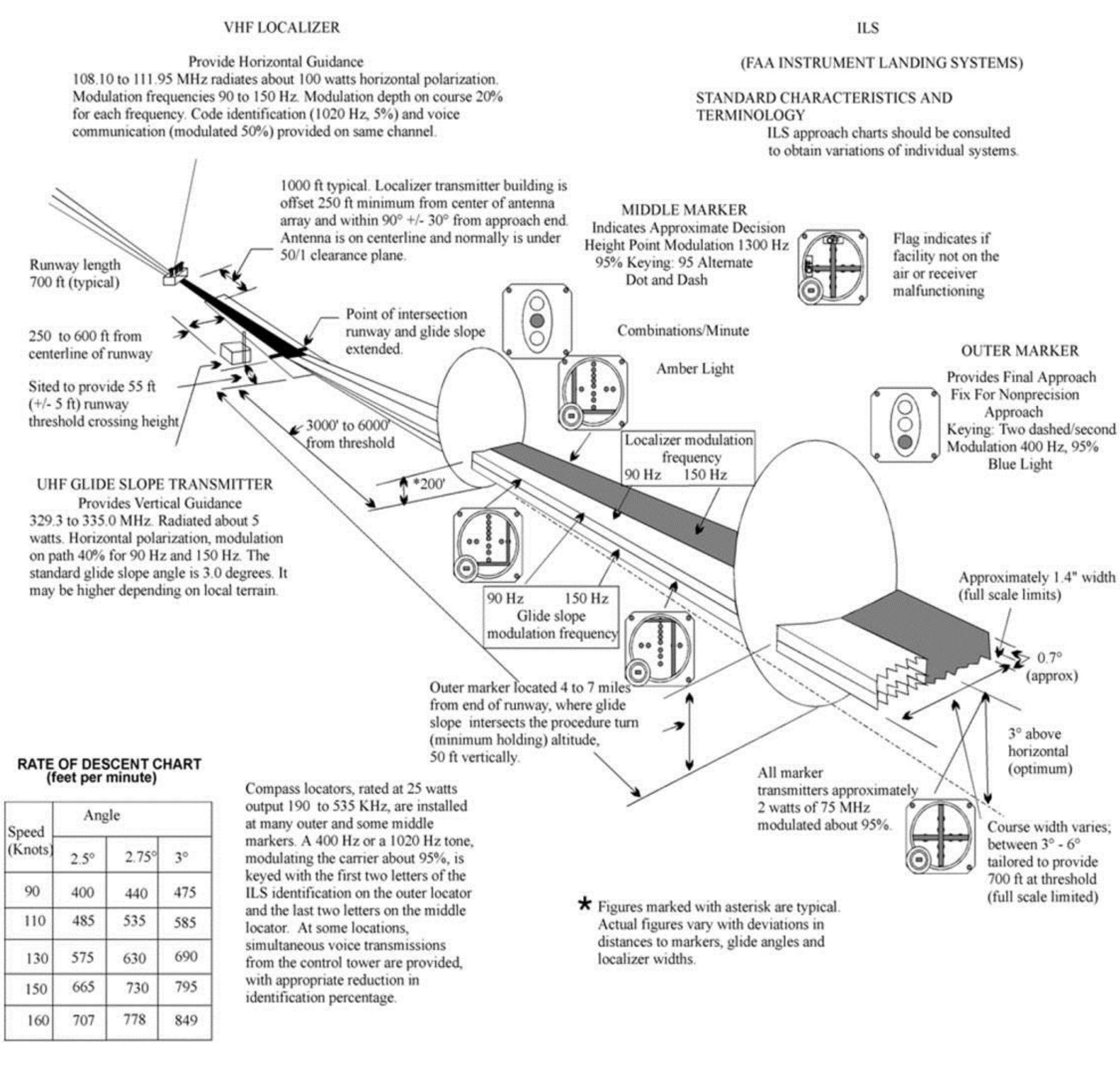


Figure 6-32 ILS Indications



Speed (Knots)	Angle		
	2.5°	2.75°	3°
90	400	440	475
110	485	535	585
130	575	630	690
150	665	730	795
160	707	778	849

Figure 6-33 ILS Components

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

Fly the portion of the approach prior to intercepting the localizer using VOR or TACAN (depending on the published procedure) (Figure 6-34). If you are using VOR prior to localizer intercept, ensure that you have tuned and identified the ILS frequency. Upon selecting an ILS frequency, the VOR steering selection will automatically change to ILS steering. Set the ILS final approach course on the HSI display course selection so ILS azimuth deviation is correctly shown on the CDI. If you are using TACAN prior to localizer intercept, select TACAN and ILS steering. TACAN course information is shown on the HSI display, DME is shown on the HSI display and the HUD, and ILS information is shown on the ADI display and the HUD (Figure 6-32). Select MKR and VOR on the comm control panel to monitor the audio signals of the localizer signal and when passing the outer, middle, and inner marker beacons.

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

NOTE

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

Radar vector to ILS final - since a vector to an ILS final is a controlled, nonformalized procedure to a precision approach, pilots should use logic and common sense when determining an appropriate time to transition from 250 KIAS to the landing configuration and 150 KIAS and then to on-speed. As a rule of thumb, it is appropriate to initiate the transition to landing configuration anytime the aircraft is on base leg or when within 10 nm of the field, within 30 radials of FAC, and within 90 degrees of heading from FAC. In any case, transition to the landing configuration should occur no later than 3-5 miles prior to the FAF/GS intercept. It is important not to transition too late so you have time to complete the landing checklist and slow to on speed prior to GS intercept.

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

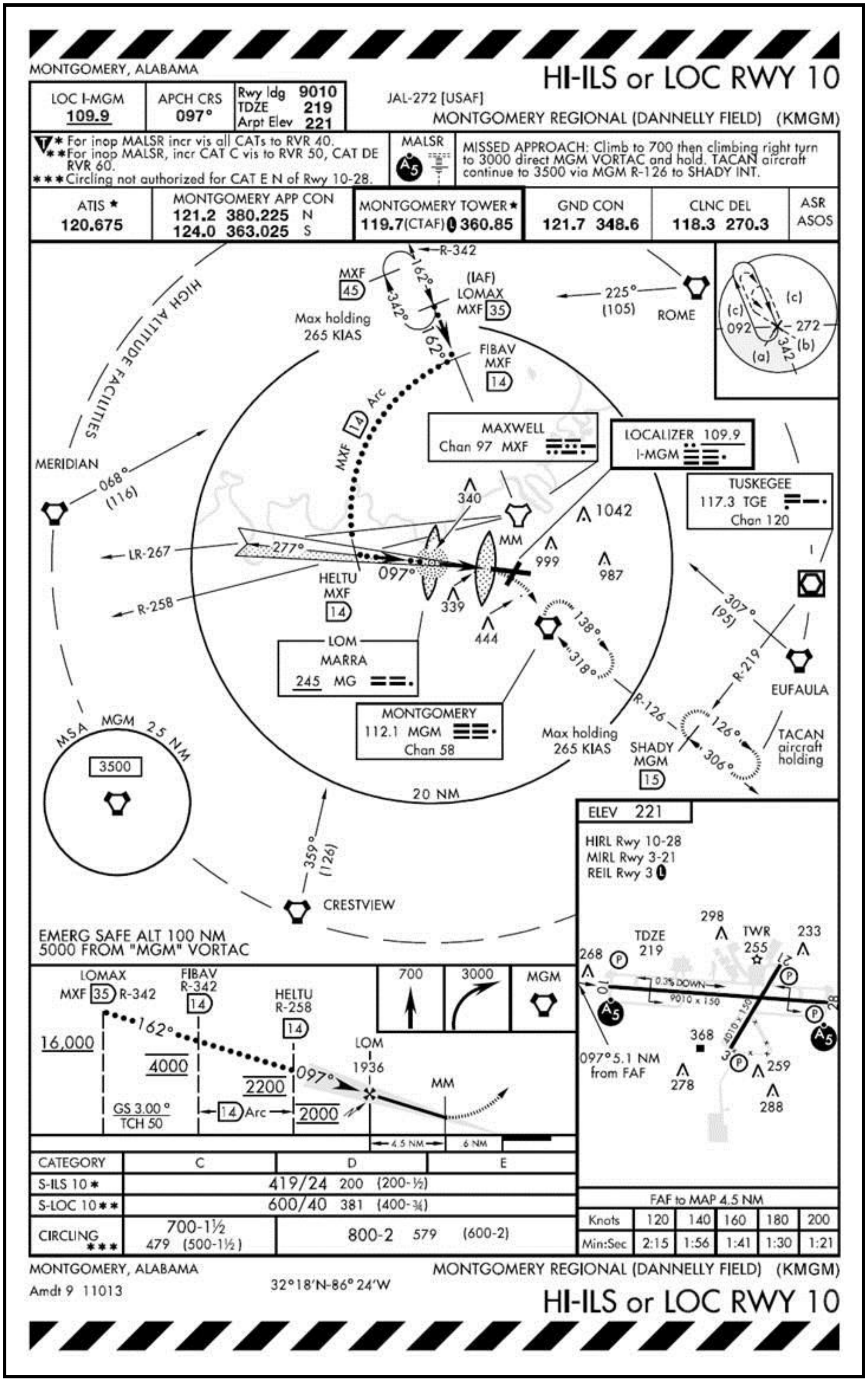


Figure 6-34 ILS Approach Plate

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

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

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

Localizer Approach. The localizer approach uses the ILS equipment, minus glideslope signal generation equipment. You may have to perform this approach because of equipment failures in your aircraft, on the ground, or because the runway lacks a glideslope transmitter. The localizer approach is non-precision with minimums higher (Figure 6-35) than a full ILS approach to the same runway. The MAP is determined by timing from the FAF, by DME, or by radar. As in the ASR, plan your descent so that you are leveled off and on speed at the MDA prior to the MAP.

← 4.5 NM → .6 NM

CATEGORY	C	D	E
S-ILS 10 *	419/24 200 (200-½)		
S-LOC 10 **	600/40 381 (400-¾)		
CIRCLING ***	700-1½ 479 (500-1½)	800-2 579 (600-2)	

FAF to MAP 4.5 NM

Knots	120	140	160	180	200
Min:Sec	2:15	1:56	1:41	1:30	1:21

MONTGOMERY, ALABAMA MONTGOMERY REGIONAL (DANNELLY FIELD) (KMGM)

Figure 6-35 ILS Minimums

Back Course Localizer Approach (BC LOC). The back course localizer is established along the centerline of a runway in the opposite direction to the front course.

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

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

616. NO-GYRO APPROACH

A no-gyro approach is an ASR/PAR performed when you lose primary heading information. During this approach, the controller will call your turns by transmitting *"TURN RIGHT/TURN LEFT"* and *"STOP TURN."* Therefore, you must perform standard rate turns not to exceed 30 AOB in the pattern and half standard rate turns on final. A good technique is 30 degrees AOB in the pattern, 20 degrees AOB base to final, and 10 degrees on final.

617. BINGO PROFILE

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

NOTE

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

618. MINIMUM/EMERGENCY FUEL APPROACH

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

Simulated Minimum Fuel GCA. When a minimum fuel GCA is requested, ATC will give normal GCA box pattern vectors and expect 200 KIAS until final. ATC can provide a 30-second gear warning if requested. The call *"PERFORM LANDING CHECKS"* is a required USN/ USMC advisory call on base leg and does not mean to dirty up or reduce airspeed.

Simulated Minimum Fuel ILS. Request vectors to ILS final and advise ATC that you will maintain 200 KIAS until glidepath intercept. The glideslope needle starting to move down serves as a "30-second glidepath warning."

Simulated Emergency Fuel GCA. This GCA is designed to get you from altitude to the deck without any undue delay and is actually a practice procedure for dealing with ***emergency*** fuel situations. Traffic permitting, the controller will vector you direct to final approach at minimum vectoring altitude with a glidepath intercept much closer to the runway than a normal GCA with a continuous turn from downwind to final. The controller will vector you to intercept final at approximately four to five miles from the end of the runway. Anticipated glidepath intercept distance may be determined as 1 nm per 300 feet of altitude above the runway TDZ elevation, assuming a standard 3 degree glideslope angle.

The controller may ask how much fuel you have remaining in minutes and will attempt to get you on the deck prior to simulated fuel exhaustion. Request a 30-second prior to glidepath intercept call from the controller. You will remain in a clean configuration until the 30-second call is heard. Then select gear down, flaps to half, and speed brakes in while adjusting attitude and power to maintain required VSI and optimum AOA. Initially, a significant forward stick pressure will be required to counter the ballooning effect and start the VSI down. Closer to the runway, the "on glidepath" cross section is much smaller. Therefore, it is important to set the appropriate VSI expeditiously once established on glidepath.

During practice simulated emergency fuel approaches (SEFs) at a foreign field, the pilot must advise ATC that the pilot assumes responsibility for obstruction clearances and will remain in VMC conditions.

619. EMERGENCY OIL/PRECAUTIONARY INSTRUMENT APPROACH (Simulated Low Oil GCA)

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

When given the simulated emergency, set the power to 78-87 percent RPM per NATOPS (85-87 recommended). Engine seizure is delayed by minimizing RPM, minimizing throttle movements and maintaining 1 “G” flight. Approximately 86-87% should be used to max extent possible with extreme weather conditions (i.e., high elevation and/or hot summer day) and if warranted, power changes should be made with smooth, slow throttle movements. If given outside the GCA box pattern, monitor and control airspeed with speed brakes as necessary to expedite landing without causing any unduly difficult transition to gear speed and glidepath. In the GCA box, use the speed brakes to maintain 200 KIAS. When given the “up and on glidepath” call (approximately 6 nm from touchdown) on a PAR or as the needles center on the ILS, simultaneously lower the landing gear, retract speed brakes and lower the nose to maintain glidepath. This configuration should yield 175 KIAS. As desired, lower flaps to half and use speed brakes as necessary to maintain glidepath at 175 KIAS. With field in sight and runway made, you may select flaps to full down. If flaps are selected full down, a nose down attitude is required to counter the ballooning action. Extend speed brakes to full and reduce power to idle at touchdown if no intent to go missed approach.

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

If, during an actual emergency, the landing environment is not in sight at decision altitude, or a safe landing cannot be completed, or for training, execute a waveoff as follows: simultaneously retract the speed brakes and raise the landing gear then slowly raise the nose to a climb attitude.

When above 300 ft AGL and indicating a positive rate of climb, raise the flaps (140 KIAS minimum). Power should not be reset unless a positive of climb is ***not*** achieved. If unable to climb, a slow, smooth power addition to minimum RPM required for climb should be made.

620. PARTIAL PANEL APPROACHES

In the T-45C you will be performing partial panel (standby AI) approaches which will require a major change in your scan. Depending on the failure, a frozen attitude indication or an MFD failure, you may have to get some or all information that is on the ADI display from the standby instruments (attitude, airspeed, VSI, and altitude). Heading and navigation information, except for ILS, is on the HSI display. If both MFDs fail, you will have no navigation information and will have to rely on radar vectors to a PAR or ASR approach. See "ADI Display Failure" and "Partial Panel."

621. VISUAL MANEUVERS

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

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

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

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

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

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

Once you descend to the MDA, determine if visibility is sufficient to safely complete the landing. If it is, choose the landing pattern (Figure 6-36) best suited to your situation, or the one directed by the controller. Stay at the MDA until you are in a position to execute a normal landing—ideally, the point at which you would intercept the normal glideslope to the runway. If weather permits, fly the circling maneuver at the normal VFR pattern altitude. Be sure to check the approach plate for any obstacles in the vicinity of the airport.

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

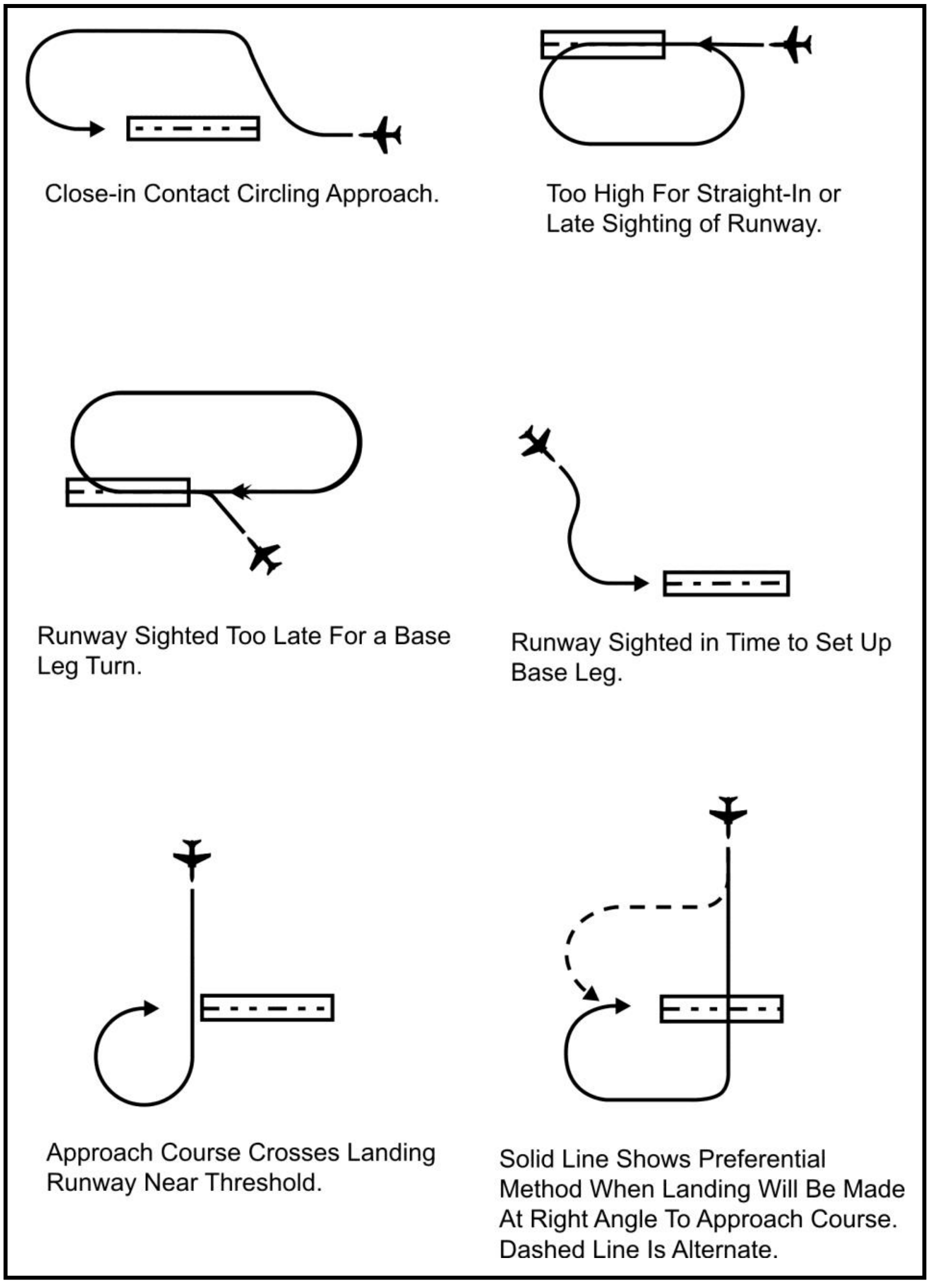


Figure 6-36 Circling Approach Maneuvers

HUD Use. During visual maneuver, HUD attitude, navigation, and performance instrument information can be used to assist in the transition from a head-down instrument scan to a visual scan. Only use the HUD information as a reference, your primary flight reference instruments are the ADI display and HSI display during an instrument approach.

Flap Setting. Due to the number of approaches required in a given instrument training sortie, and the transit times to practice airfields, half flap approaches are normally performed.

Approach configuration for full stop landings should be full flaps.

622. MISSED APPROACH

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

CHAPTER SEVEN
SAFETY/EMERGENCY PROCEDURES

700. INTRODUCTION

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

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

701. PRIMARY INSTRUMENT FAILURE

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

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

702. TWO-WAY COMMUNICATION FAILURE

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

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

703. NAVIGATIONAL AID (NAVAID) FAILURE

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

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

704. ICING

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

NOTE

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

705. TURBULENCE AND THUNDERSTORMS

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

1. **Heat**

   – Pitot heat switch - CHECK ON

2. **Airspeed/Attitude**

   a. Maintain airspeed of 250 KIAS.

   b. Go on instruments and stabilize airspeed and attitude prior to penetrating the storm.

   c. Adjust ADI display reference.

   d. Fly on a heading calculated to provide the quickest passage through the storm at an altitude affording the least turbulence and icing while clearing all ground obstacles by a wide margin.

e. Avoid the upper 2/3 of a mature cell (turbulence and hail) and freezing level +/- 2,000 ft (lightning).

3. **Light**

– Turn all cockpit lights to bright including floodlights.

4. **Tight**

a. Lower the seat to prevent striking the head against the canopy and to reduce the blinding effect of lightning.

b. Tighten lap belts.

While in a storm, you should proceed as follows:

1. Maintain constant power and pitch attitude.

2. Concentrate on maintaining a straight-and-level aircraft attitude by referencing the ADI display.

3. Be prepared for turbulence, hail, rain, and lightning.

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

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

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

706. MINIMUM FUEL ADVISORY

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

707. EMERGENCY FUEL

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

708. AIRCRAFT EMERGENCIES

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

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

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

709. GINA FAILURE

Indications: If the GINA experiences loss of position or attitude information, the POSITION or ATTITUDE advisory is shown on all MFD displays. All waypoint, time-to-go, and wind direction and speed information is blanked from the displays. If one portion of the GINA, Global Positioning System (GPS) or Inertial Navigation System (INS) fails, Hybrid (HYBD) is automatically deselected and the operating position data source, GPS or INS, is selected. With a failure of one portion of the GINA, there is no immediate degradation in the position data information. The only indication is that the position data source automatically switched from HYBD to INS or GPS.

The procedure for dealing with a GINA failure is:

1. Use standby AI for attitude information.

2. Continue to use TACAN or VOR for navigation information.

3. With only a standby AI, maintain VFR flight conditions if possible.

4. Report the loss of the primary attitude instrument.

5. Land as soon as practicable with a primary attitude failure.

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

710. DISPLAY ELECTRONICS UNIT (DEU) FAILURE

The DISPLAY POWER switch is a three-position switch: NORMAL, RESET and ORIDE. In NORMAL, the DEU, both left MFDs, SADS, and VCR/CEU are powered by the 28-VDC essential bus through a two-minute delay relay. Following a generator failure, the DEU, both left MFDs, SADS, and VCR/CEU will operate for two minutes and then shut down. If ORIDE is selected before expiration of the two-minute timer, that relay is overridden. Selecting RESET momentarily interrupts power to the DEU and commands the DEU to perform a restart. Keep the DISPLAY POWER switch in RESET for five seconds before returning it to NORMAL. On the ground after returning the switch to NORMAL, the HUD display should return in 30 seconds and the MFD displays in 60 seconds. In the air, the HUD display should return in five seconds and the MFD displays in eight seconds.

Following a catastrophic DEU failure, all MFD and HUD displays are lost. Selecting RESET on the DISPLAY POWER switch may enable recovery of the displays; however, from a practical standpoint, it is unlikely that selecting RESET will result in system recovery. As explained above, RESET only recycles power to the DEU. With no operable HUD or MFD displays, you should maintain (or proceed to) VMC and land as soon as practical. If there are MFD and HUD displays when RESET is selected, the DEU and all MFDs immediately drop off line. After a few seconds, the DEU, all MFDs, and the HUD will be restored to their last pilot selected mode/display.

If you refer to the BIT page and note that an overheat (OVRHT) status is displayed for the DEU, but no AV HOT caution light, it means that the DEU cooling fan has failed and a complete DEU failure is increasingly possible. In such a circumstance, you should maintain (or proceed to) VMC and land as soon as practical.

If a degraded (DEGD) status is displayed for the DEU on the BIT page, a comprehensive cross-check should be made of all pertinent MFD and HUD displays to determine what data is blanked or possibly corrupt. If only a portion of the DEU malfunctions, or a discrete input to the DEU is invalid or failed, only data associated with that aspect will be blanked on the displays. Be certain to check the BIT page for degraded equipment, and cross-check or revert to standby instruments as appropriate to the particular situation.

711. GENERATOR FAILURE

With a generator failure, both right MFDs and the HUD drop off line. The DEU, both left MFDs, and SADS remain powered by the 28-VDC essential services bus for two minutes. If airborne when a generator failure occurs, all training failures are automatically deselected and the left MFDs switch to the ADI display. After two minutes, the DEU, both left MFDs and SADS drop off line. The ORIDE position on the DISPLAY POWER switch (Figure 7-1) allows the pilot to override the two-minute relay and maintain power to the DEU, both left MFDs, and SADS beyond two minutes.

Figure 7-1 Display Power Switch

712. HSI DISPLAY FAILURE

Just like the T-6B, the HSI display in the T-45C is a page of computer-generated information derived from several different electronic sources which is then compiled by the DEU for display on an MFD. An invalid signal from a particular source (e.g., GINA) results in that information not being displayed. In the case of invalid GINA-derived position information, the HSI display will cease displaying position data as shown in Figure 7-2.

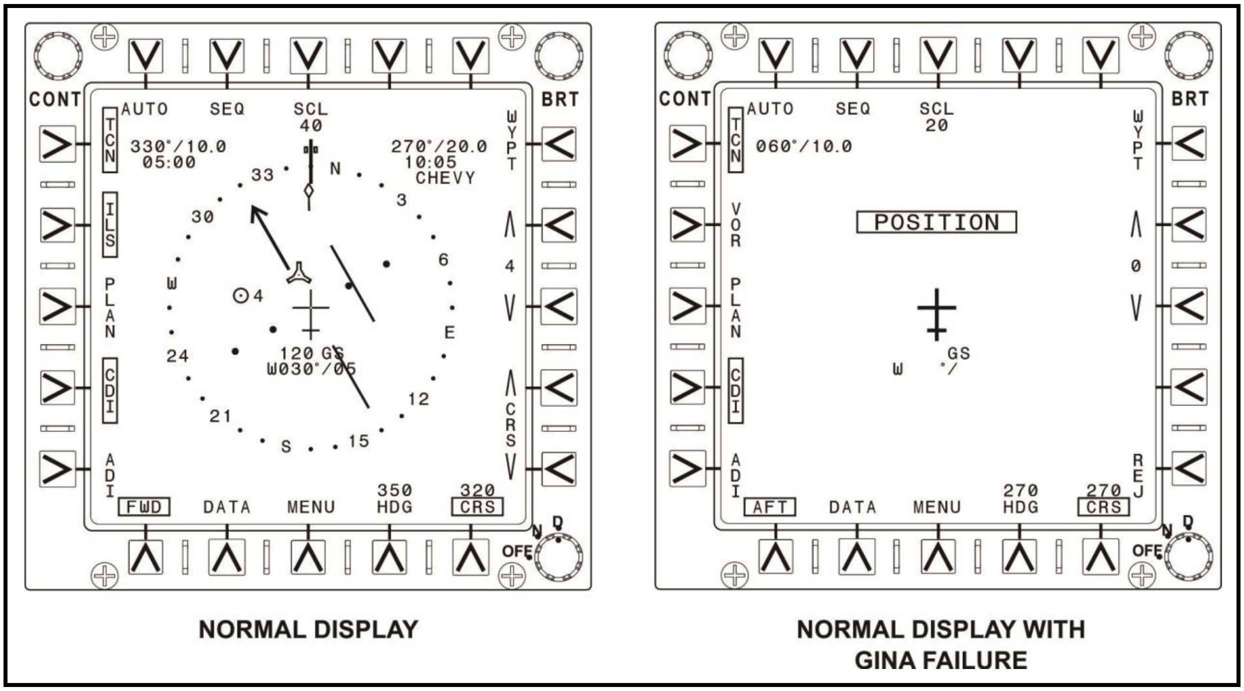


Figure 7-2 Heading Input Failure Indications

A total failure of the HSI display may be the result of an MFD failure, rather than anything unique to the HSI. To analyze the problem, select the HSI display on another MFD.

System advisory legends appear simultaneously on all four MFDs. There are nine possible advisories; however, only two are closely related to the HSI display.

First, the POSITION advisory legend means the DEU has sensed that position data has transitioned from valid to invalid. The exact nature of any particular invalidity must be determined by the pilot. It may be very obvious, or more subtle. Data that the DEU can recognize as invalid will be restricted from being displayed. Nonetheless, when a POSITION advisory appears (Figure 7-3), carefully crosscheck all displayed position-related data, as well as noting what data is missing from the display.

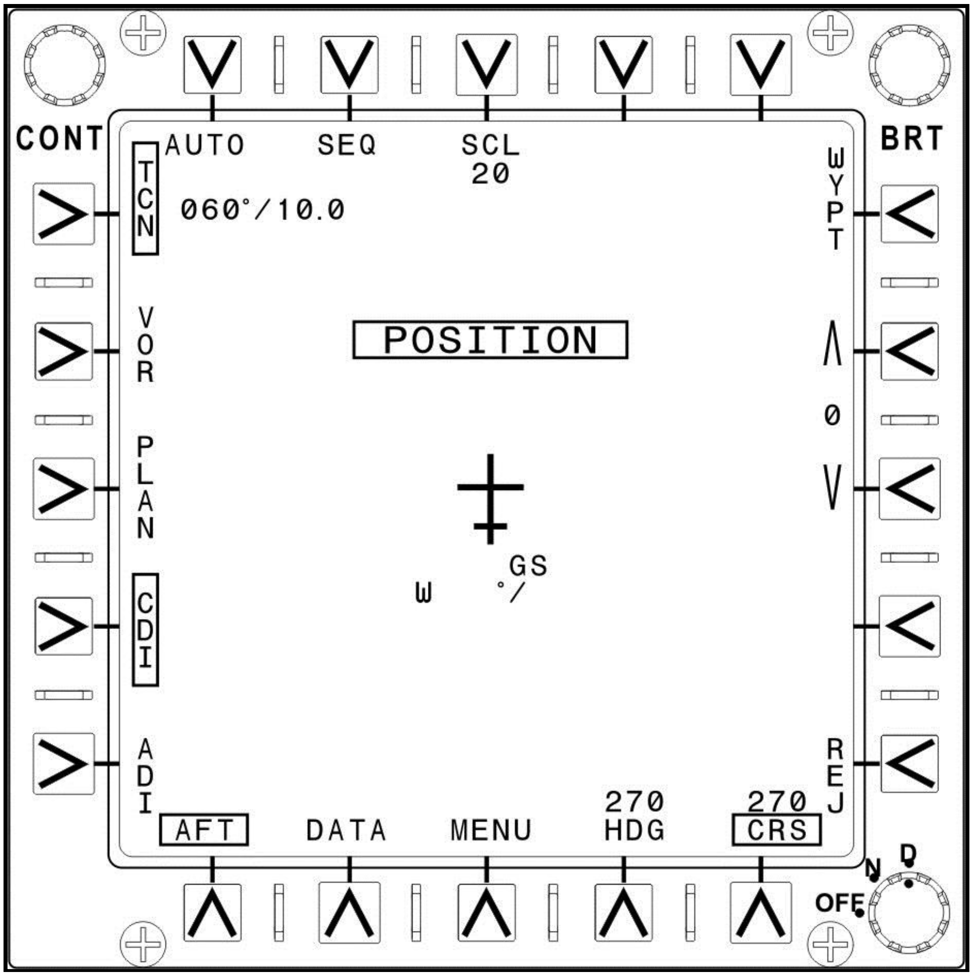


Figure 7-3 Position Advisory Legend

A failed HSI is caused by the GINA losing positional data (Figure 7-2). Without positional data, the DEU doesn't display the VOR bearing or waypoints. TACAN digital bearing and range are displayed because they are direct inputs to the DEU and don't require positional data from the GINA to be displayed.

The second advisory is the LAW advisory. The implication for the pilot is that the aircraft may not be positioned where he thinks it is positioned. This could result from a navigation error or possibly a problem with a navigation system. Immediately take appropriate action to ensure aircraft safety, then determine why the plane got into a LAW advisory circumstance. If the reason is not clear and acceptable, be certain to cross-check and analyze all navigation and position information.

An advisory display can be removed by pressing the REJECT (REJ) option displayed in the lower right-hand corner of an MFD display (Figure 7-3). Only one advisory can be displayed at a time. If more than one is applicable to the moment, the advisory with the highest priority will be displayed first. Pushing REJECT will sequence the display to the next advisory notice. If no others are in sequence, the MFDs will be cleared of all advisory windows.

TACAN Arcing with a "Frozen HSI display compass rose"

NOTE

> At times when flying the T-45C, your instructor will want to use the training mode to alter the MFD displays visible to you. Examples include a no-gyro approach or some other scenario maneuver with a partial-panel display situation. In the "real world," the DEU will stop displaying data that it determines invalid. If you have a heading problem, you can expect that the MFD-displayed compass rose will disappear; however, in the training mode, the compass rose will freeze, rather than disappear (Figure 7-4).

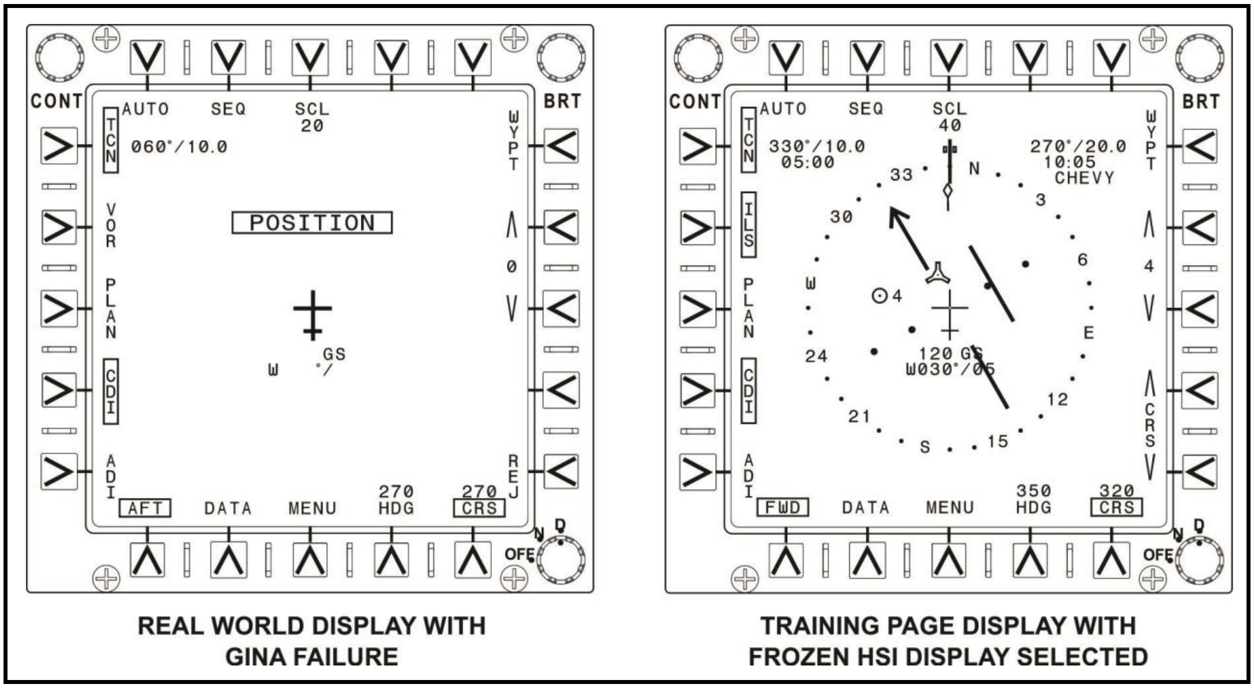


Figure 7-4 Training Page – Frozen HSI

To arc, note the TACAN radial the plane is on. Make a 90-degree timed turn left or right (30 seconds at a 3-degree per second SRT bank angle). To determine heading, add 90 degrees for clockwise arc or radial; minus 90 degrees to arc counterclockwise. To maintain the arc, hold the AOB that keeps the desired TACAN DME range. On the HSI, watch for the tail of the TACAN bearing pointer to rise toward the top of the compass rose. Appropriately lead your desired TACAN radial, performing a timed turn to inbound heading.

713. ADI DISPLAY FAILURE

Because the ADI display is the primary attitude, heading, airspeed, altitude, and VSI reference, losing part or all of the ADI display forces you to significantly alter your instrument scan pattern.

You will have to get some or all of the information that was on the ADI display from the standby instruments and the HSI display or HUD.

The ***first and most important step*** in dealing with an ADI display failure is to establish and maintain attitude control by looking outside the cockpit (if possible) and referencing the standby AI. Also, bring the other standby instruments into your scan, as required. The remainder of the attitude failure procedure is also important, but this first step is vital. See the "Partial Panel" section of this FTI for further information.

The procedure for dealing with an ADI display failure is:

1. Use the standby attitude indicator (AI) for attitude reference.

2. Use other standby instruments as required.

3. Use the HSI display for your primary heading reference.

4. Maintain VMC, if possible.

5. Check the electrical system.

6. Report the instrument failure to ATC.

7. Land as soon as practicable.

The advisory window that is particularly pertinent to the ADI is ATTITUDE. It is displayed when the DEU senses attitude data transitions from valid to invalid (Figure 7-5). Whenever you see the ATTITUDE advisory window, immediately cross-check outside the cockpit (if possible) and the standby AI to determine actual aircraft attitude and to maintain aircraft control.

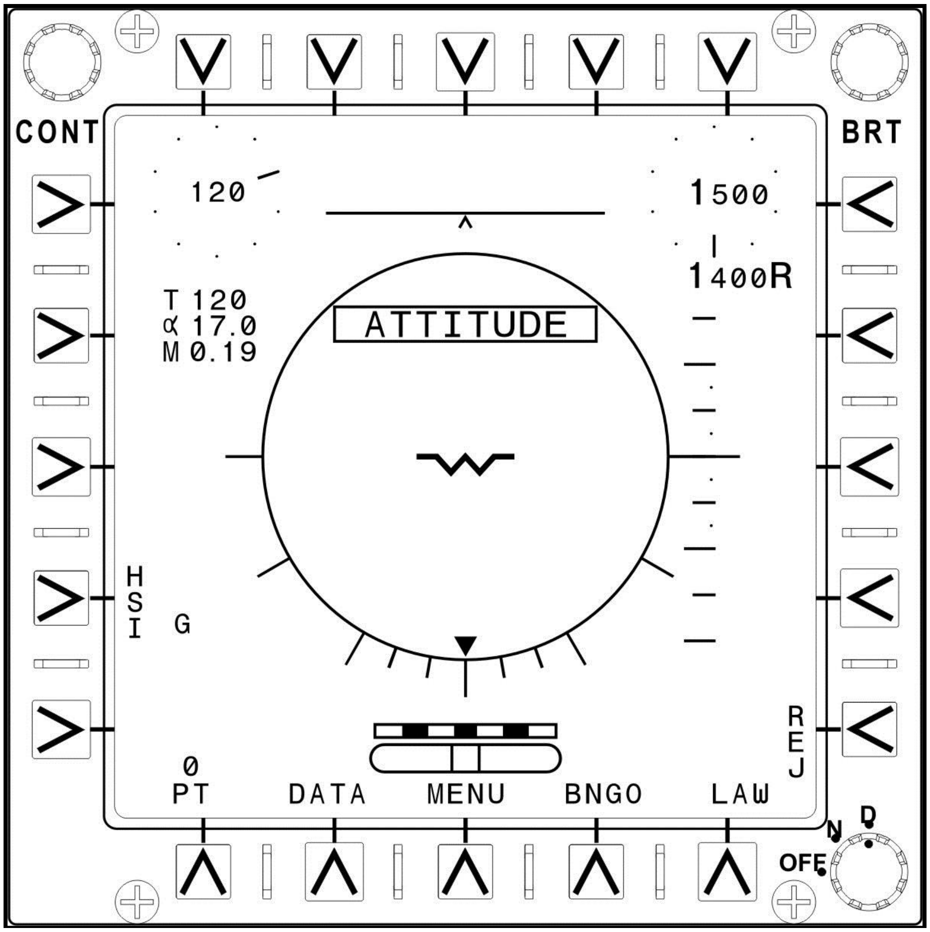


Figure 7-5 Attitude Advisory Legend

714. TURN AND SLIP INDICATOR FAILURE

In the event that the ADI display turn needle or slip indicator fails, you will have to use the turn and slip indicator on the instrument panel. If both turn needles are inoperative, use bank angle and airspeed for 1/2 standard and standard rate turns.

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

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

1. Check the ADI display for correct indications.

2. Use the turn and slip indicator on the instrument panel.

3. Use the ADI display and airspeed for turn rate reference.

715. PITOT STATIC MALFUNCTIONS

If the entire pitot static system fails, you will lose the Mach/airspeed indicator and barometric altitude readout on the ADI display and HUD. The VSI on the ADI display gets its information from the rate gyros in the GINA. In addition the standby altimeter, airspeed indicator and VSI could be affected. Verify the failure of any pitot static instrument by cross-checking indications with the other cockpit, if possible.

You can compensate for the loss of the airspeed indication by flying the equivalent AOA for climb, cruise, descent, and landing (refer to the NATOPS Pocket Checklist for AOA/airspeed equivalents). You can also use the ground speed displayed on the HSI as an aid in this situation. Factoring in known winds, it will give you an approximation of your true airspeed.

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

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

1. Check that PITOT HEAT is ON.

2. Compare instruments in both cockpits. Use AOA, the radar altimeter, and/or cabin pressure altimeter to calculate the approximate airspeed and altitude.

3. Report the failure to ATC.

4. Maneuver to exit icing conditions (if applicable).

5. Remain VMC, if possible.

6. Join with wingman if possible.

716. MACH/AIRSPEED INDICATOR FAILURE

Use the standby airspeed indicator if the airspeed indication is blanked on the ADI display. If both the airspeed indication and standby airspeed indicator fail, AOA must be used in place of airspeed. Consult NATOPS for equivalent AOA for the T-45C in various flight conditions. You can also use the ground speed displayed on the HSI as an aid in this situation. Factoring in known winds, it will give you an approximation of your true airspeed.

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

1. Check that PITOT HEAT is ON.

2. Check standby airspeed indicator.

3. Report the failure of all airspeed indications to ATC.

4. Fly AOA in place of airspeed.

5. Watch for indications of pitot static system problems.

6. Land as soon as practicable.

717. BAROMETRIC ALTITUDE FAILURE

You have two options to make up for the loss of barometric altitude.

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

Second, you can obtain backup altitude information from the cabin pressure altimeter. This instrument should be considered accurate to +/- 500 ft.

Cross-check your other pitot static system instruments (A/S and VSI) to ensure that they are operating correctly.

The procedure for dealing with an altimeter failure is:

1. Check that PITOT HEAT is ON.

2. Report the failure to ATC.

3. Use the radar and the cabin pressure altimeters to determine altitude.

4. Be aware that the IFF altitude may also be in error.

5. Land as soon as practicable.

718. VSI FAILURE

If you lose the VSI, use the clock to gauge the amount of altitude change occurring over a specific period of time.

For example, if you were to descend 200 ft in 15 seconds, your rate of descent would be 800 ft per minute. You can also use this procedure to check the accuracy of a suspect VSI.

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

NOTE

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

The procedure for dealing with a VSI failure is:

1. Check standby VSI.

If standby VSI is also inoperative,

2. Check that PITOT HEAT is ON.

3. Cross-check the altimeter and clock for vertical velocity reference.

4. Watch for other indications of possible pitot static problems.

719. STANDBY GYRO FAILURE

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

Figure 7-6 shows one of the possible indications of a failed standby gyro. The power off flag does not have to be present for the indicator to give a false reading because the flag signifies only a lack of electrical power.

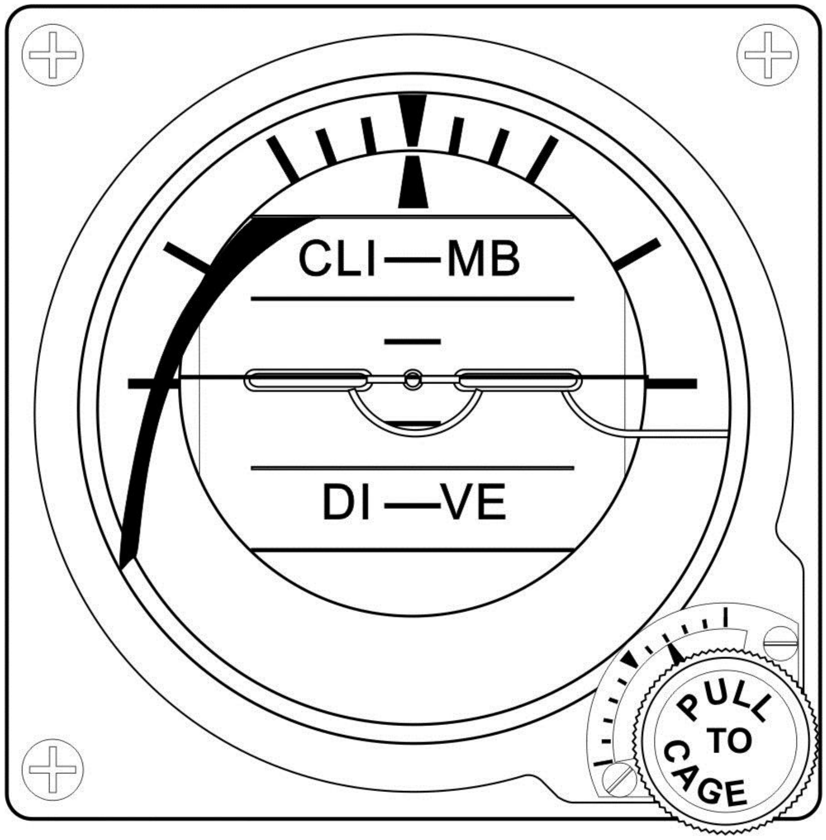


Figure 7-6 Failed 2" Standby Gyro

NOTE

After loss of electrical power with the "power off" flag in view, the 2-inch standby gyro will continue to provide reliable attitude reference for up to 9 minutes after failure.

The procedure for dealing with a standby gyro failure is:

1. Use the ADI display.

2. Check the electrical system.

3. Watch for possible progressive failure.

720. AOA INDICATOR FAILURE

The loss of the AOA indicator will mainly affect your approach scan; you will have to use the digital AOA indication on the ADI display. If the AOA indicator, AOA indications on the ADI and HUD displays all fail, you will have to fly airspeed instead of AOA. In this case, omit the AOA indicator and indexer from your scan, and focus on the airspeed trend indicator.

Figure 7-7 shows one of the possible indications of a failed AOA indicator. The OFF flag does not have to be present for the indicator to give false readings because the flag indicates only a lack of electrical power.

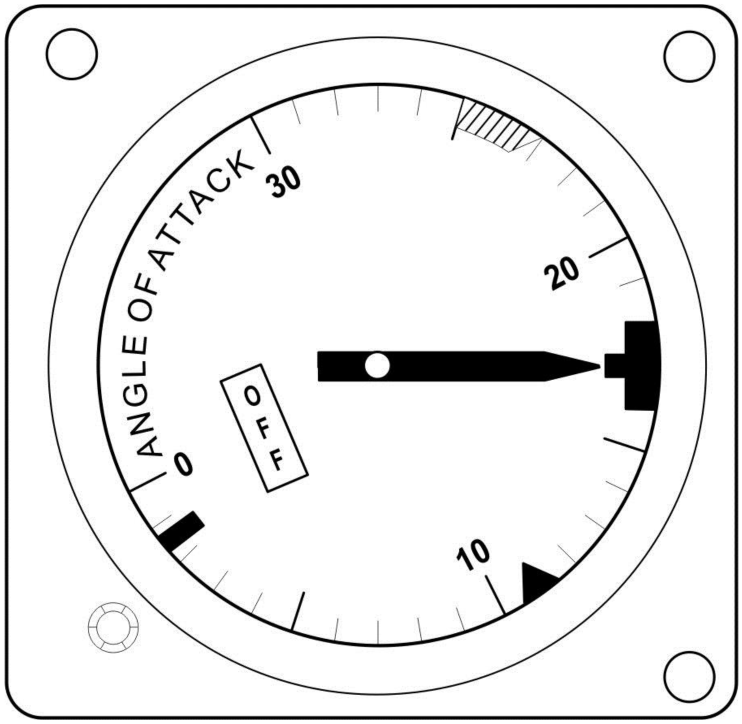


Figure 7-7 Failed AOA Indicator

The procedure for dealing with an AOA indicator failure is:

1. Use the indicated airspeed trend indicator.

2. Fly calculated approach speeds using the airspeed trend indicator.

721. RADAR ALTIMETER FAILURE

With a failed radar altimeter, you lose your height above ground reference (Figure 7-8). If you are aware of your location and the local terrain, this danger is minimized. If you have any doubt about your position or the topography of the surrounding area, you should notify the controlling agency and immediately climb to a safe altitude. Once you are sure of the local surface elevation and have confirmed that the standby altimeter has the correct setting, you should be able to use it for all altitude references.

Recall that while the radar altimeter supplies height above terrain, the barometric altimeter gives height above sea level.

The radar altitude numbers are blanked if the radar altimeter fails and the aircraft attitude is not greater than +/- 40 degrees in pitch or roll, or aircraft is higher than 5,000 ft AGL. The "R" is blanked if the radar altimeter is turned OFF.

The procedure for dealing with a radar altimeter failure is:

1. Use the barometric altitude.

2. Confirm the correct altimeter setting.

3. Ensure that radar altimeter is not turned off by referencing the BIT page (Figure 7-9).

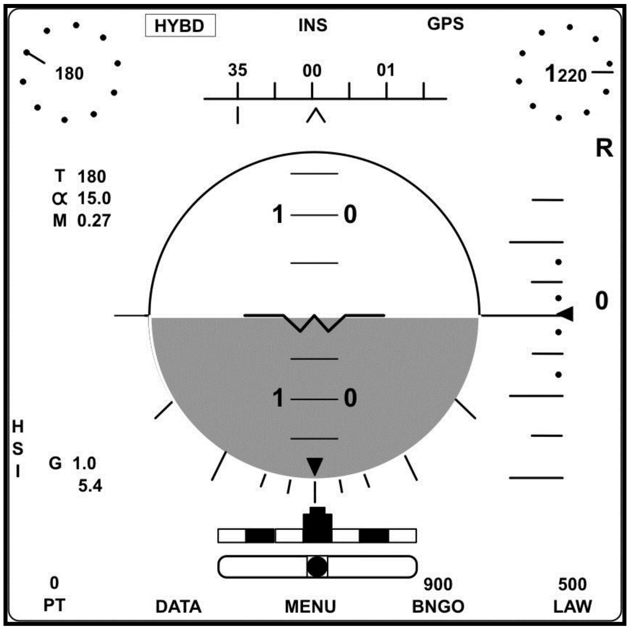


Figure 7-8 Failed Radar Altimeter

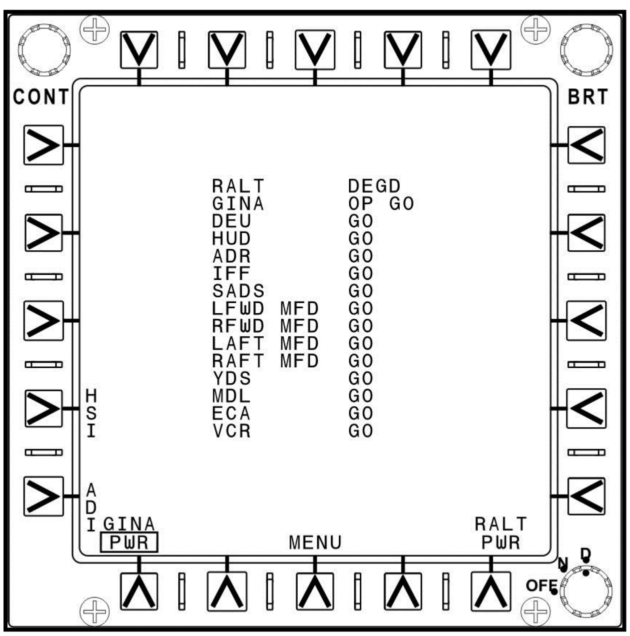


Figure 7-9 BIT Page

722. VOR FAILURE

A failed VOR system may be indicated by the loss of the aural identification and blanking of the digital VOR bearing. If VOR steering is selected, the VOR bearing pointer and inner bar of the CDI are blanked. Keep in mind that altitude affects reception, so the VOR signal may be occluded if you are operating at low altitude.

Figure 7-10 shows one of the possible indications of a failed VOR system.

The procedure for dealing with a VOR failure is:

1. Check that you have navigation control in your cockpit.

2. Cycle the frequency selector.

3. Check with ATC to see if the station is in operation or select another station.

4. Use TACAN (if available), waypoint, or request radar vectors.

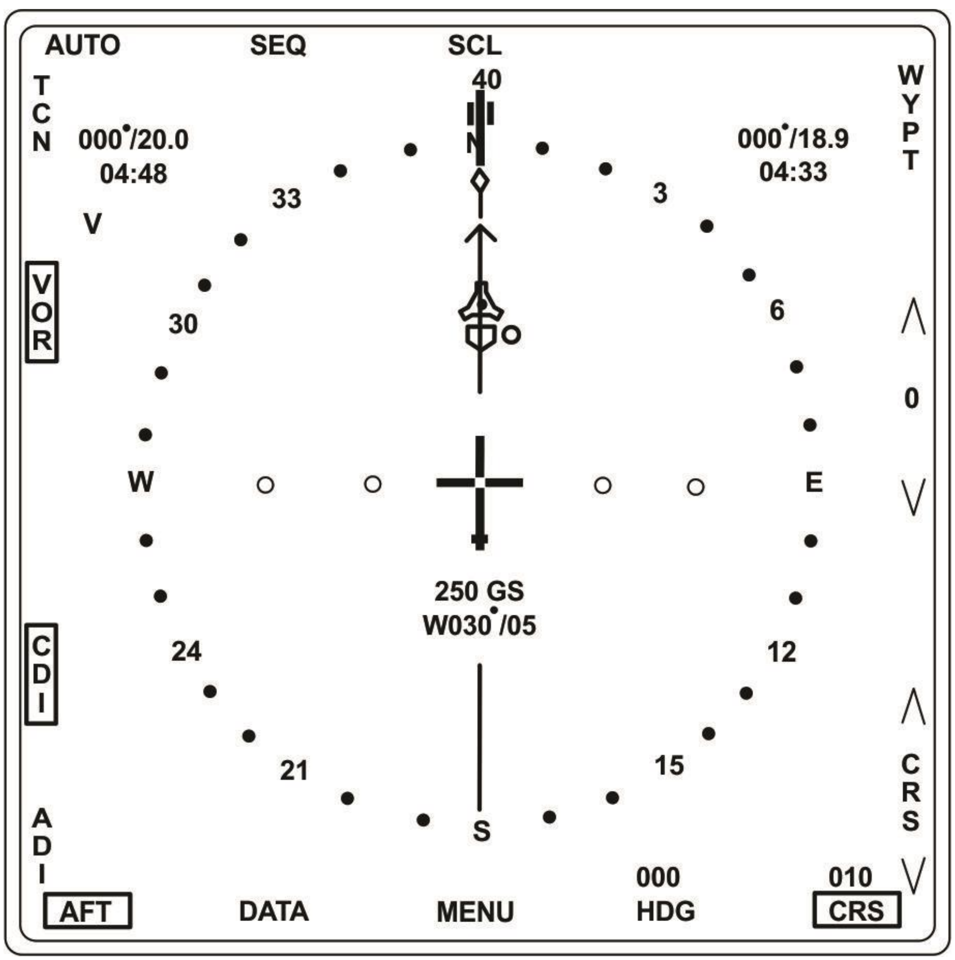


Figure 7-10 Failed VOR

723. TACAN BEARING FAILURE

A TACAN bearing failure (Figure 7-11) is indicated by the blanking of azimuth in the TACAN data block and loss of audio identification. If TACAN steering is selected, the TACAN bearing pointer, the Planimetric course line or inner bar of the CDI on the HSI display, and the course deviation situation steering arrow on the HUD are blanked.

The procedure for dealing with a TACAN bearing failure is:

1. Check that you have navigation control in your cockpit.
2. Cycle the channel selector.
3. Check with ATC to see if the station is in operation or select another station.
4. Select the VOR navigation system (if available), waypoint, or request radar vectors.

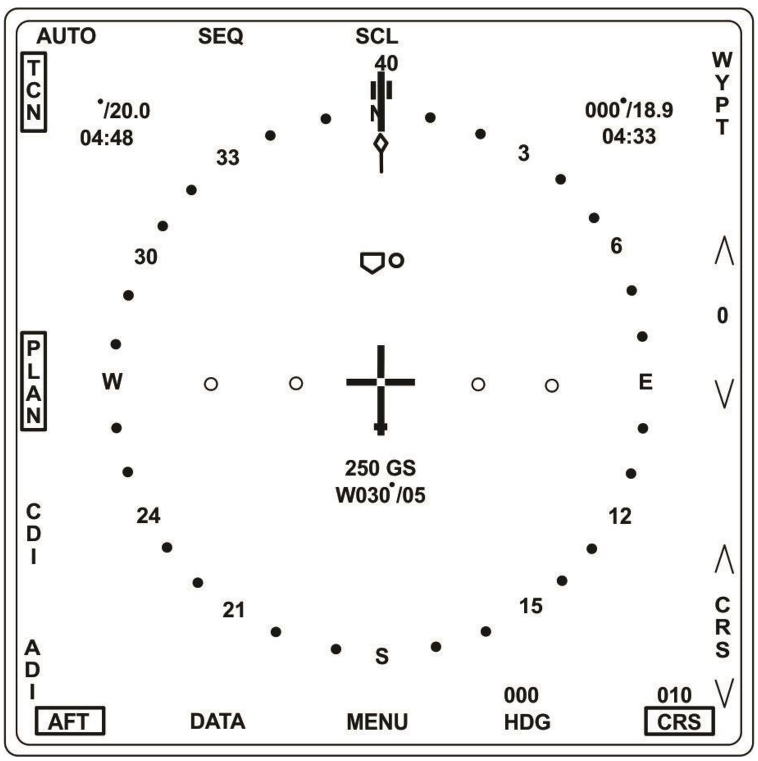


Figure 7-11 Failed TACAN Bearing

724. TACAN DME FAILURE

A TACAN DME failure is indicated by the blanking of DME in the TACAN data block. If this occurs, back up distances with the GPS/INS by entering the coordinates for the desired TACAN station taken from the enroute chart. DME failure also results in loss of the time-to-go data and the removal of the TACAN station symbol from the HSI.

725. ILS GLIDESLOPE FAILURE

Loss of ILS glideslope signal is indicated by the appearance of the "GLIDESLOPE" advisory window on all MFDs and blanking of the glideslope needle on the ADI display and HUD. With this failure, you have the choice of downgrading your approach to a localizer only, discontinuing the approach, or flying another type of approach (TACAN, VOR, PAR, or ASR) depending on the situation and availability of approaches. The GLIDESLOPE advisory legend will be removed if glideslope data becomes valid or the REJ button is depressed on any MFD.

Figure 7-12 shows a glideslope failure on the ADI display and the HUD. Assuming that the glideslope data remains invalid, the REJ button on any MFD must be pressed to remove the "GLIDESLOPE" advisory window in this example.

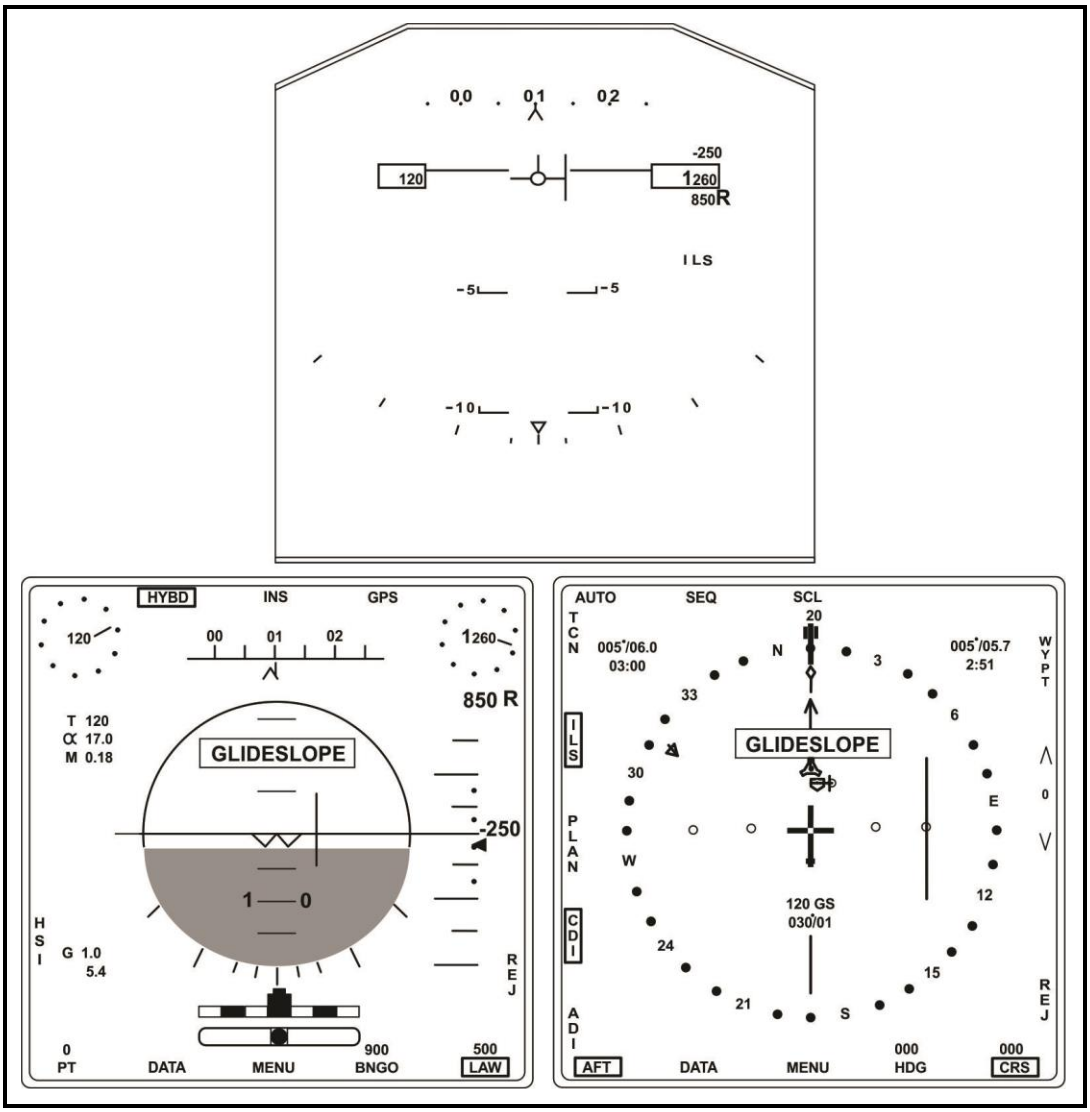


Figure 7-12 Failed ILS Glideslope Indication

726. ILS LOCALIZER FAILURE

Loss of the localizer signal is indicated by the appearance of the "LOCALIZER" advisory window displayed on all MFDs, and localizer and glideslope needles on the ADI and the HUD are removed. If ILS steering is selected, the inner portion of the CDI is also removed. With a localizer failure (Figure 7-13), you will have to discontinue the approach or fly another type approach. If both the glideslope and localizer signals are lost, the "ILS" advisory window is displayed and both localizer and glideslope needles are removed from the ADI display and HUD.

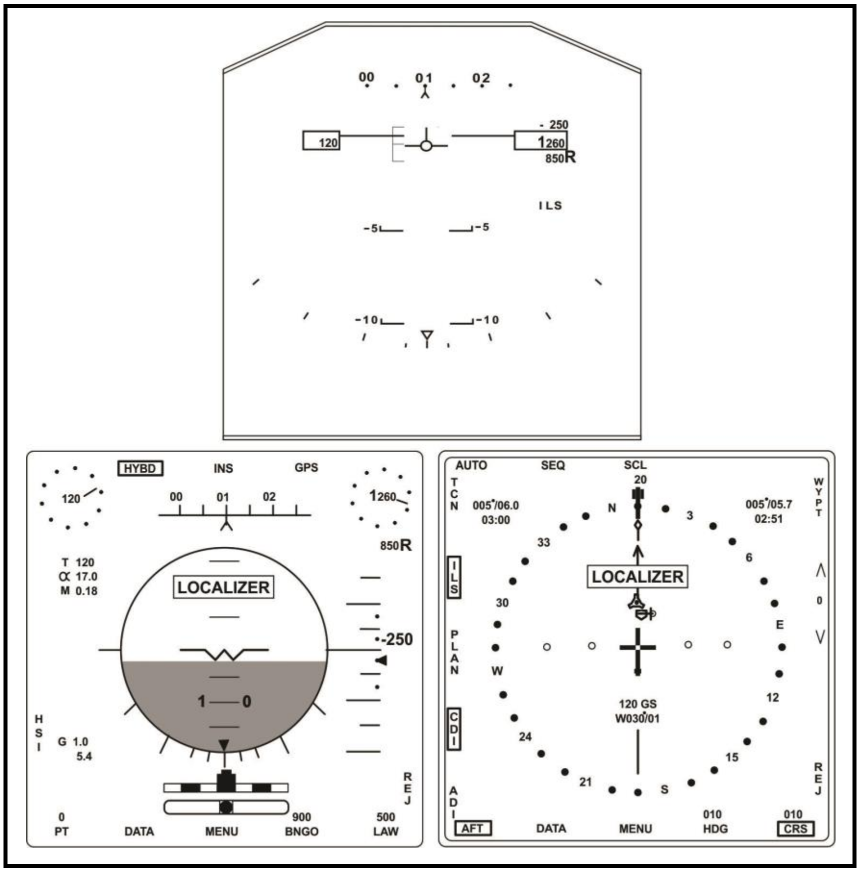


Figure 7-13 Failed ILS Localizer

727. ILS MARKER BEACON FAILURE

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

728. FLIGHT WITH PARTIAL PANEL

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

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APPENDIX A
GLOSSARY

A

Airport Elevation/Field Elevation: The highest point of the usable runways measured in feet MSL.

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

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

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

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

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

AOA: Angle of attack.

AOB: Angle of bank.

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

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

ASR: See Airport Surveillance Radar.

Air Traffic Control (ATC): Any of the controlling agencies providing direction and traffic separation for aircraft.

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

B

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

C

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

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

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

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

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

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

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

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

D

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

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

DME: Distance measuring equipment. (See TACAN.)

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

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

E

EFC: See Expected Further Clearance Time.

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

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

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

F

FAF: See Final Approach Fix.

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

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

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

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

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

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

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

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

G

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

H

HAA: See Height Above Airport.

HAT: See Height Above Touchdown.

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

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

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

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

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

I

IAF: See Initial Approach Fix.

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

ILS: Instrument Landing System.

IMC: See Instrument Meteorological Conditions.

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

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

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

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

J

Jet Routes: A high altitude route system at or above 18,000 ft MSL up to FL450, predicated on a network of designated VOR, TACAN, and/or VORTAC facilities.

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

L

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

M

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

MAP: See Missed Approach Point.

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

MDA: See Minimum Descent Altitude.

MEA: See Minimum Enroute Altitude.

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

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

Minimum Enroute Altitude (MEA): The lowest published altitude between radio fixes which assures acceptable navigational signal coverage and meets obstacle clearance requirements between those fixes.

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

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

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

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

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

MOA: See Military Operations Area.

MSA: See Minimum Safe Altitude.

N

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

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

P

PAR: Precision approach radar.

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

Planimetric Course Line: A course line that is drawn through the TACAN, waypoint, or waypoint offset symbol. Course intercept angle and deviation are shown by the relationship of the Planimetric course line to the aircraft symbol.

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

PPR: Prior permission required.

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

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

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

R

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

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

Radar Handoff: Transfer of radar control from one ATC facility to another without interruption.

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

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

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

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

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

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

S

SAR: Search and rescue.

SID: See Standard Instrument Departure.

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

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

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

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

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

Station: A radio navigational aid (See Navigational Aid).

Straight-In Approach: An instrument approach where the final approach is begun without first having executed a procedure turn. This type of approach is not necessarily completed with a straight-in landing or made to straight-in landing minimums.

Surveillance Approach (ASR): An instrument approach conducted in accordance with directions issued by a controller referring only to a surveillance radar display (See GCA).

T

TACAN: **Tac**tical **A**ir **N**avigation. A UHF electronic air navigation aid that provides suitably equipped aircraft a continuous indication of azimuth and distance to the station.

Track: The actual flight path of an aircraft over the ground.

V

Vertigo: The sensation of dizziness and the feeling that oneself or one's environment is whirling about.

Visual Approach: An approach wherein an aircraft on an IFR flight plan, operating in VFR conditions under control of an air traffic control facility and having an air traffic control authorization, may proceed to the airport of destination under VFR conditions.

Visual Descent Point (VDP): A defined point on the final approach course of a non-precision straight-in approach procedure from which normal descent from the MDA to the runway touchdown point may be commenced, provided the approach threshold of that runway, the approach lights, or other markings identifiable with the approach end of that runway are clearly visible to the pilot.

Visual Meteorological Conditions (VMC): Basic weather conditions prescribed for flight under visual flight rules (VFR).

VOR: VHF omnidirectional range, an electronic air navigational aid which transmits 360 degrees of azimuth, oriented to magnetic north.

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APPENDIX B
STUDY RESOURCES

(BIFP)

Study Resources for Basic Instrument Flight Procedures:

[A] NATOPS Instrument Flight Manual, NAVAIR 00-80T-112
[B] Instrument FTI
[C] T-45C NATOPS Flight Manual, A1-T45C-NFM-000
[D] Personal Engineering Notes
[E] Aeronautical Information Manual, FAA (current issue)
[F] Air Traffic Control Manual, FAA 7110.65C

T-45C MPTS & IUT BIFP-01: "Instrument Takeoff and Climb with SID." 1.3 hr. Classroom

Lesson Preparation:

* [A] Read paragraphs 17.2.1, 17.2.1.1, and 27.2 through 27.2.2
* [B] Read "Instrument Takeoff (ITO)" paragraph through "Constant Airspeed Climbs and Descents" section, and paragraphs under "Outbound Intercepts"

Lesson Objectives:

* Recall procedures for performing an instrument takeoff
* Recall procedures for performing a standard instrument departure
* Recall procedures for intercepting and maintaining arcs on SIDs
* Recall procedures for intercepting radials on SIDs

T-45C MPTS BI1102: "Introduction to Basic Instruments." 0.7 hr. CAI

Lesson Preparation:

* [A] Read Chapters 13, 14, 15, and 16

Lesson Objectives:

* Identify the location, purpose, and function of the flight control instruments
* Identify the location, purpose, and function of the flight performance instruments
* Identify the location, purpose, and function of the flight position instruments
* Recall instrument scan procedures/techniques
* Demonstrate procedures for entering instrument mission data into display system

T-45C MPTS BI1103: "Instrument Turns." 0.8 hr. CAI

Lesson Preparation:

* [A] Read paragraphs 17.3.1.1 through 17.3.2.4

Reinforcement:

* [C] Review Turn Performance Charts (34-5 through 35-11)

Lesson Objectives:

* Recall procedures for controlling aircraft heading and turn rate
* Recall procedures for performing turn pattern
* Recall procedures for performing standard rate turns

* Recall procedures for performing 1/2 standard rate turns
* Recall procedures for performing partial panel timed turns

T-45C MPTS BI1104: "Basic Flight Maneuvers and Transitions." 0.8 hr. CAI

Lesson Preparation:
* [A] Read Instrument Groupings, and Climbs and Descents section
* [B] Read Constant Airspeed Climbs and Descents, Constant Rate Climbs and Descents, Level Speed Changes, and Slow Flight sections

Lesson Objectives:
* Recall procedures for controlling aircraft altitude and rate of climb/descent
* Recall procedures for performing level speed changes
* Recall procedures for performing level speed change in 1/2 standard rate turns
* Recall procedures for performing slow flight maneuver

T-45C MPTS BI1105: "S Patterns." 0.8 hr. CAI

Lesson Preparation:
* [B] Read sections on "S" Patterns

Lesson Objectives:
* Recall procedures for performing the S-1 pattern
* Recall procedures for performing the S-3 pattern

T-45C IUT BIFP-05: "Instrument and GPS/INS Failures." 2.0 hr. CAI

Lesson Preparation:
* [A] Read paragraphs 17.6.1 and 17.6.2
* [C] Read paragraphs 15.22, GINA Failure, and 21.3.2.4, GINA Alignment

Reinforcement:
* [D] Review Eng-20 and Eng-25

Lesson Objectives:
* Recall procedures for GINA failure
* Recall procedures for HSI failure
* Recall procedures for ADI failure
* Recall procedures for turn and slip indicator failure
* Recall procedures for pitot static failure
* Recall procedures for airspeed indicator failure
* Recall procedures for altimeter failure
* Recall procedures for VSI failure
* Recall procedures for standby attitude indicator (AI) failure
* Recall procedures for AOA indicator failure
* Recall procedures for radar altimeter failure
* Recall procedures for VOR failure
* Recall procedures for TACAN bearing failure
* Recall procedures for ILS glideslope failure
* Recall procedures for ILS localizer failure

* Recall procedures for ILS marker beacon failure
* Recall procedures for flight with partial panel

T-45C MPTS BI1107: IUT BIFP-02: "TACAN and VOR Procedures." 1.5 hr. Classroom

Lesson Preparation:
* [A] Read Chapters 20 and 21
* [B] Read Enroute, Arrival, Approach Phases

Reinforcement:
* [E] Review Section 8, "Arrival Procedures"
* [F] Review Section 14, "Approaches"

Lesson Objectives:
* Recall operating characteristics of the TACAN, VOR, VOR/DME
* Recognize TACAN/VOR cone-of-confusion
* Recall TACAN navigation procedures
* Recall VOR navigation procedures
* Recall procedures for using CDI
* Recall procedures for TACAN/VOR tracking
* Recall navigation procedure to compensate for wind drift
* Recall reasons for each item on the penetration checklist
* Recall communication procedures for approach
* Recall procedures for performing TACAN/VOR DME approach
* Recall procedures for performing VOR approach

T-45C IUT BIFP-06: "ILS Procedures" 0.5 hr Classroom

Lesson Preparation:
* [A] Read paragraphs 20.3 through 20.3.12, 21.2.3 through 21.2.3.9, and 27.2.2
* [B] Review Flight Procedures

Lesson Objectives:
* Recall function and use of ILS equipment
* Recall flight path information for an ILS approach
* Recall procedures for an ILS approach
* Recall procedures for performing a localizer approach
* Recall procedures for performing back course (LOC) approach

T-45C IUT BIFP-03: "GCA Procedures" 1.2 Classroom

Lesson Preparation:
* [A] Read section 24.3
* [B] Read Approach Communication Procedures and Ground-Controlled Approach sections

Reinforcement:
* Review ground-controlled approach procedures

Lesson Objectives:
* Recall procedures for performing descent/penetration to approach
* Recall flight path information provided on a PAR approach

* Recall procedures for a PAR approach
* Recall communication procedures for a PAR approach
* Recall flight path information provided for an ASR approach
* Recall procedures for flying an ASR approach
* Recall communication procedures for an ASR approach
* Recall procedures for performing missed approach

T-45C MPTS BI1106: IUT BIFP-04: "Stalls, Unusual Attitudes & Aerobatics" 1.1 hr Classroom

Lesson Preparation:
* [A] Read Chapter 19
* [B] Slow Flight, Stalls & Unusual Attitudes, Partial Panel

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

Lesson Objectives:
* Recall procedures for performing stalls on instruments
* Recall procedures for performing unusual attitude recoveries
* Recall procedures/techniques for performing unusual attitude recoveries
* Recall procedures/techniques for performing nose-low recoveries
* Recall procedures/scan techniques for performing nose-high recoveries partial panel
* Recall procedures/scan techniques for performing nose-low recoveries partial panel
* Recall procedures for performing aerobatics under instrument conditions
* Recall procedures/techniques for performing wingover
* Recall procedures/techniques for performing barrel roll

T-45C MPTS BI1108: "GCA-ILS Procedures." 1.5 hr Classroom

Lesson Preparation:
* [A] Read Sections 20.3 through 20.3.12, 21.2.3 through 21.2.3.9, 24.3, and 27.2.2
* [B] Read Approach Communication Procedures and Ground-Controlled Approach sections
* [B] Review Flight Procedures section

Reinforcement:
* Review ground-controlled approach procedures

Lesson Objectives:
* Recall procedures for performing descent/penetration to approach
* Recall flight path information provided on a PAR approach
* Recall procedures for a PAR approach
* Recall communication procedures for a PAR approach
* Recall flight path information provided for an ASR approach
* Recall procedures for flying an ASR approach
* Recall communication procedures for an ASR approach
* Recall procedures for performing missed approach
* Recall function and use of ILS equipment
* Recall flight path information for an ILS approach

* Recall procedures for an ILS approach
* Recall procedures for performing a localizer approach
* Recall procedures for performing back course (LOC) approach

T-45C MPTS BI1109: "Instrument & GPS/INS Failures"

Lesson Preparation:
* [A] Read paragraphs 17.6.1 and 17.6.2

Reinforcement:
* Review your Engineering notes on "Flight Instrument Malfunctions."

Lesson Objectives:
* Recall procedures for GINA failure
* Recall procedures for HSI failure
* Recall procedures for ADI failure
* Recall procedures for turn and slip indicator failure
* Recall procedures for pitot static malfunctions
* Recall procedures for airspeed indicator failure
* Recall procedures for altimeter failure
* Recall procedures for VSI failure
* Recall procedures for standby attitude indicator (AI) failure
* Recall procedures for AOA indicator failure
* Recall procedures for radar altimeter failure
* Recall procedures for VOR failure
* Recall procedures for TACAN bearing failure
* Recall procedures for ILS glideslope failure
* Recall procedures for ILS localizer failure
* Recall procedures for ILS marker beacon failure
* Recall procedures for flight with partial panel

(RIFP)

Study Resources for Radio Instrument Flight Procedures:

[A] NATOPS Instrument Flight Manual, NAVAIR 00-80T-112
[B] Instrument FTI
[C] T-45C NATOPS Flight Manual, A1-T45C-NFM-000
[D] INav Lesson Guides
[E] FLIP Enroute HI ALTITUDE Chart H-5/6
[F] FLIP Enroute HI ALTITUDE Chart H-6/7

T-45C MPTS & IUT RIFP-01: "Introduction to Radio Instruments." 2.5 hr. Classroom

Lesson Preparation:
* [A] Review paragraphs 20.3 through 20.3.12, 21.2.3 through 21.2.3.9, and 27.2.2
* [B] Review Flight Procedures section

Lesson Objectives:
* Recall procedures for a standard instrument departure
* Recall procedures for performing radial intercepts

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

<u>T-45C MPTS & IUT RIFP-02: "TACAN and VOR Procedures." 0.5 hr. CAI</u>

Lesson Preparation:
* [A] Review paragraphs 20.3 through 20.3.12, 21.2.3 through 21.2.3.9, and 27.2.2
* [B] Review Flight Procedures section
* [E] Have available when taking lesson

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

<u>T-45C MPTS & IUT RIFP-03: "TACAN and VOR Holding Procedures." 0.5 hr. CAI</u>

Lesson Preparation:
* [A] Read Section 20.3.12
* [C] Read Sections 2.4.3 and 21.3.1

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

Lesson Objectives:

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

T-45C MPTS & IUT RIFP-04: "TACAN/VOR/ILS/PAR/ASR Approach Procedures." 1.0 hr. CAI

Lesson Preparation:

* [A] Read Chapters 21.2.4, 23, 24.3, and 29
* [B] Review Flight Procedures
* [F] Have available when taking lesson

Reinforcement:

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

Lesson Objectives:

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

(ANFP)

Study Resources for Airways Navigation Flight Procedures:

[A] NATOPS Instrument Flight Manual, NAVAIR 00-80T-112
[B] Instrument Flight FTI
[C] T-45C NATOPS Flight Manual, A1-T45C-NFM-000
[D] NATOPS General Flight and Operating Instructions Manual, OPNAVINST 3710.7
[E] DOD FLIP IFR Supplement, DOD FLIP high altitude approach plates, DOD FLIP low altitude approach plates, and FLIP General Planning

T-45C MPTS & IUT/ANFP-01: "Airways Navigation Flight Procedures." 2.7 hr. Classroom

Lesson Preparation:

* [A] Read Chapter 25
* [B] Read Instrument Flight Planning, Flight Procedures, Safety/Emergency Procedures sections
* [D] Read Sections 420 and 428

Reinforcement:

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

Lesson Objectives:

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