NAVAL AIR TRAINING COMMAND

NAS CORPUS CHRISTI, TEXAS **CNATRA P-480 (Rev 02-23)**

FLIGHT TRAINING INSTRUCTION

BASIC INSTRUMENT AND RADIO INSTRUMENT TH-73A

2023

DEPARTMENT OF THE NAVY
CHIEF OF NAVAL AIR TRAINING
250 LEXINGTON BLVD SUITE 179
CORPUS CHRISTI TX 78419-5041

CNATRA P-480 CH-1
N714
10 Aug 23

CNATRA P-480 (Rev. 02-23) CHANGE TRANSMITTAL 1

Subj: FLIGHT TRAINING INSTRUCTION, BASIC INSTRUMENT, AND RADIO INSTRUMENT, TH-73A

Encl: (1) Change 1 Pages iv – v, ix, 2-5, 3-11, 3-16 - 3.17, and 3-24

1. Purpose. To publish Change 1 to the basic publication.

2. Action.

   a. Remove pages iv – v, ix, 2-5, 3-11, 3-16 - 3.17, and 3-24 and replace with pages in enclosure (1).

   b. Record Change 1 on the Summary of Changes page.

3. Future printing of this Flight Training Instruction will incorporate the change. CNATRA POC is Lt Kolby White, N714. He can be reached by phone or email at, (361) 961-1003, DSN 861-1003 or kolby.w.white1@navy.mil.

T. ATHERTON
By direction

Releasability and distribution:
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05 May 22

CNATRA P-480 (New 05-22)

Subj: FLIGHT TRAINING INSTRUCTION, BASIC INSTRUMENT AND RADIO INSTRUMENT, TH-73A

1. CNATRA P-480 (New 05-22) PAT, "Flight Training Instruction, Basic Instrument and Radio Instrument, TH-73A," is issued for information, standardization of instruction, and guidance to all flight instructors and student aviators within the Naval Air Training Command.

2. This publication will be used as an explanatory aid to support the flight training curriculum. It will be the authority on the execution of all flight procedures and maneuvers herein contained.

3. Recommendations for changes shall be submitted via the electronic Training Change Request (TCR) form located on the Chief of Naval Air Training (CNATRA) website.

4. CNATRA P-480 (New 05-22) PAT is a new publication.

T. P. ATHERTON
By direction

Releasability and distribution:
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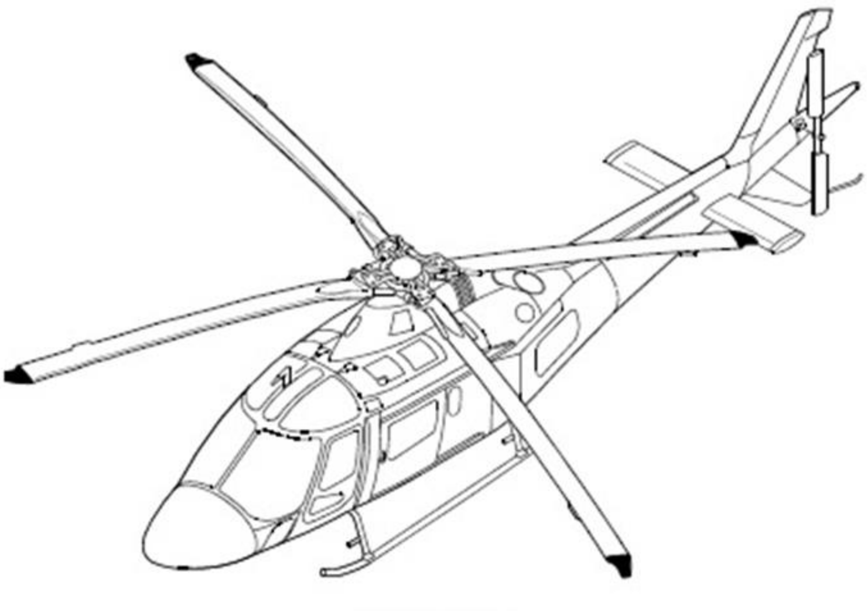
FLIGHT TRAINING INSTRUCTION

FOR

BASIC INSTRUMENT AND RADIO INSTRUMENT

TH-73A

P-480



LIST OF EFFECTIVE PAGES

Dates of issue for original and changed pages are:

Original…0…05 May 22
Revision...1...23 Feb 23
Change Transmittal…1…10 Aug 23

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 114 CONSISTING OF THE FOLLOWING:

Page No.	Change No.	Page No.	Change No.
COVER	0	4-1 – 4-22	0
CHANGE LETTER	1	5-1 - 5-6	0
LETTER	0	6-1 – 6-6	0
BLANK	1	7-1 – 7-5	0
iii	0	7-6 (blank)	0
iv - v	1	8-1 – 8-3	0
vi - viii	0	8-4 (blank)	0
ix	1		
x (blank)	0		
1-1 – 1-3	0		
1-4 (blank)	0		
2-1 – 2-4	0		
2-5	1		
2-6 – 2-21	0		
2-22 (blank)	0		
3-1 – 3-10	0		
3-11	1		
3-12 – 3-15	0		
3-16 – 3-17	1		
3-18 – 3-23	0		
3-24	1		
3-25 – 3-31	0		
3-32 (blank)	0		

INTERIM CHANGE SUMMARY

The following Changes have been previously incorporated in this manual:

CHANGE NUMBER	REMARKS/PURPOSE
1	Changes made per change transmittal letter (10 Aug 23)

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

INTERIM CHANGE NUMBER	REMARKS/PURPOSE	ENTERED BY	DATE

INTRODUCTION

Congratulations! Assuming your familiarization flights are complete, you are now entering a new phase in flight training: basic and radio instruments. Learning to safely fly the helicopter is no small feat; however, learning to operationally fly the helicopter from point A to point B in poor weather conditions, day and night, is not only a fundamental skill required in naval aviation, it also defines a ***professional naval aviator***. As you progress through flight training, more demand will be placed on your overall flying abilities (aviation, navigation, and communication skills) not to exclude situational awareness, CRM, and decision-making processes. Overall, your goal is to successfully complete this phase of flight training and earn your Standard Instrument Rating, a major step toward earning your wings of gold.

SCOPE

This publication contains maneuver descriptions encompassing the Instrument events for both helicopter and simulator listed in the Advanced Multi-Service Pilot Training System Curriculum (CNATRAINST 1542.186 series); however, it does not contain maneuver descriptions previously covered in other Flight Training Instruction (FTI) publications. It is your responsibility to have a thorough knowledge of the contents within all FTIs.

CHANGE RECOMMENDATIONS

Change recommendations to this publication may be submitted by anyone to the Commander, Training Air Wing FIVE, using the Training Change Request (TCR) process, which improves training curricula and its associated training publications. This includes all personnel involved at every level of flight training. A TCR can be submitted online (https://www.cnatra.navy.mil/tip.asp) or by submitting a form to the squadron or wing standardization personnel. Remember, no TCR is too small!

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INTRODUCTION TO INSTRUMENT FLIGHT

100. INTRODUCTION

Up to this point, your helicopter training has focused on flying using visual references external to the helicopter. The next phase in becoming a professional Naval Aviator requires that you become well versed in flying maneuvers based solely on reference to the flight instruments. The Basic Instrument (BI) portion of the syllabus intends to master the instrument scan through benign maneuvers and repetitive practice. The scan and trim techniques you acquire in BIs will allow you to excel in all follow-on training in the syllabus, particularly Radio Instruments (RI), NVG, and Formation flight.

The skills you cultivate in BIs and RIs are not only important in flight school, but will continue to be vital throughout your aviation career. Every year squadrons report close calls via Hazard Reports (HAZREP) in which the pilots became disoriented and avoided Controlled Flight Into Terrain (CFIT) by returning to a BI scan. More crucially, Naval Aviation is littered with mishaps caused by pilots failing to maintain a good instrument scan, resulting in the loss of aircraft, crew, and passengers.

Put forth the effort to practice your instrument scan during the BI and RI stages. As you progress through your career, you will rely on your scan during every flight, and it may be the skill that saves your life.

101. INSTRUMENT SYLLABUS EXPECTATIONS

The instrument portion of the syllabus is perhaps the most grueling and academically intense portion of flight school. Each flight requires a significant amount of planning and study. To successfully optimize learning during the flight, students must sufficiently prepare.

Discussion Items

Each brief will contain several discussion items. You are responsible for having a working knowledge of each discussion item. If you do not understand something about a discussion item or have questions, ask the instructor during the brief. As long as you have prepared, the instructor will be happy to clear up any confusion and help you further understand the topic. When preparing for the flight brief, there are several references that you should consult depending on the topic.

1. **FTI**: The FTI contains all the procedures expected to brief and perform over the course of an instrument flight.

2. **NATOPS**: The NATOPS manual is not limited to systems, limits, and emergency procedures. It also contains information about instrument flight, weather considerations, and flight characteristics that you may be required to discuss during an instrument brief.

3. **CNAF M-3710.7**: The CNAF M-3710.7 contains all of the flight rules and regulations that govern Naval Aviation. You should become intimately familiar with the information in this publication throughout the instrument syllabus.

4. **IFR En route Supplement, Flight Information Handbook (FIH), and other Department of Defense (DoD) Flight Information Publication (FLIP)**: The DoD FLIPs also include important information about military flights, airports, weather, and emergencies.

5. **Federal Aviation Regulations (FAR)/Aeronautical Information Manual (AIM)**: The FAR/AIM includes all the flight rules and regulations that govern flight in the National Airspace. In any case, that is not covered by CNAF M-3710.7; the FAR/AIM is the governing document.

6. **Rotary-Wing Operating Procedures (RWOP) and Standard Operating Procedures (SOP)**: The RWOP and SOPs contain guidance concerning local rules and regulations relating to NAS South Whiting Field (KNDZ) and the Pensacola training area, including information pertaining to instrument flights and training.

Flight Plan Preparation

The day before each RI flight, you should contact your instructor to discuss the flight plan for the next day (refer to the Multi-Service Pilot Training System [MPTS] for further guidance). When you call your instructor, have an idea of what you want to do. Look back at your previous grade sheets to determine what type of approaches you still need to complete in the flight block and plan a route that will allow you to accomplish them. Ensure you check and account for the weather when planning your route. When you contact the instructor, they may adjust your plan depending on other factors, but for the most part, instructors will be amenable to what you have planned and pleased to see that you are taking the initiative and thinking ahead.
Students shall bring the following to every RI flight brief:

1. A Jet Log of the route to be flown

2. A DD Form 1801 of the route to be flown

3. A DD Form 175-1 weather brief for the flight area

4. An electronic or paper copy of the Navlog for the route to be flown

5. An electronic or paper copy of the DD Form 1801 for the route to be flown

6. An electronic or paper copy of DD Form 175-1 weather brief for the flight area

After completing the flight plan and deciding what approaches you will conduct, look over the approaches and become familiar with them. Think through the setup for each approach. Consider what the Time, Turn, Time, Transition, Twist, Talk (6Ts) will be at each major point in the approach. Practice standardized radio calls, particularly the long approach clearance calls. Chair flying in this manner will better prepare you for the flight ahead. Some students may even elect to write the pertinent information, such as NAVAID frequencies and the Final Approach Course (FAC), for each approach on a kneeboard to use as a reference during the flight.

Simulators

Simulators provide a tremendous opportunity for learning the procedures and flight techniques used in the instrument syllabus. They are a useful tool for working out knowledge and procedural issues before getting into the helicopter. You should prepare for a simulator event with the same level of effort as a flight event. Refer to the MPTS for specific guidance on simulator event expectations and requirements. The simulators are conducted as though they are actual flights.

Flights

Following the brief, you will be responsible for filing the flight plan, either as a unique flight plan or one of the canned routes in the RWOP with Base Operations. After listening to the Automated Terminal Information Service (ATIS) in the helicopter, you will contact Clearance Delivery or Ground to receive your flight clearance prior to calling Ground for taxi. During the taxi to the hold short line, you or the instructor will complete the Instrument Flight Checklist while the other pilot taxies the helicopter. After takeoff, Tower will instruct you to switch to the Departure frequency. Check-in with the Departure controller by stating your current altitude and the altitude to which you are climbing.

Instrument approach procedures will be conducted in a logical, standardized flow to prevent incorrect NAVAID or radio setup that will be described in more depth in Chapter Four. When preparing for an approach, pass the controls to the instructor and go through the "**W**e **R**eally **N**eed **T**o **B**rief" (WRNTB) mnemonic. Ensure you have the weather for the airport at which you will shoot approaches. You can listen to ATIS between approach frequencies when Air Traffic Control (ATC) tells you to switch, utilize an alternate radio to monitor the ATIS, or you can request one minute off frequency to tune up ATIS. After you complete the approach setup, brief the approach to the crew and take the flight controls back from the instructor. If the approach terminates in a climb out, begin the climb and turn to the initial climb out heading. Once the helicopter is established on the climb out, pass the controls to the instructor to begin the setup for the next approach.

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CHAPTER TWO
BASIC INSTRUMENT MANEUVERS

200. INTRODUCTION

The BI syllabus aims to build the instrument scan and trim skills necessary to progress to RIs. BIs also provide the foundation for all other phases of flight, including NVGs, Formation, and Search and Rescue. The BI scan is the tool that may save a pilot's life in emergency situations or Inadvertent Instrument Meteorological Conditions (IIMC). The BI syllabus begins with simple maneuvers, such as the Level Speed Change, and then progresses to more complicated maneuvers, like the Oscar Pattern. This progression allows you to develop the scan and trim techniques for the smooth basic air work needed to excel in RIs and throughout your career.

201. HELICOPTER ATTITUDE INSTRUMENT FLIGHT

Attitude instrument flight in a helicopter differs from fixed-wing aircraft in that the fuselage moves independently from the rotor disk. While gravitational, centrifugal, and aerodynamic forces tend to align the fuselage in an attitude that corresponds to the rotor attitude, these two attitudes are not in a fixed corresponding relationship as they are in an airplane. Since the attitude indicator does not directly measure the rotor attitude, the pilot must frequently scan secondary instruments on the PFD and MFD as shown in Figure 2-1, such as the airspeed indicator, turn and slip indicator, and Vertical Speed Indicator (VSI), which measure the rotor attitude indirectly.

Figure 2-1 Pilot PFD and MFD

The attitude indicator provides an estimate of the current rotor attitude. However, because it is only an estimate, it is not possible to set a specific attitude and torque and expect the helicopter to behave consistently. Increasing collective pitch causes the nose to pitch up, yaw right, and roll right. Decreasing collective pitch has the opposite effect. While the attitude hold function of the AFCS will limit this effect, it still must be anticipated and accounted for. This is why scanning airspeed, ball, heading, and so on is necessary along with the attitude indicator. Other variables such as ambient weather conditions, helicopter center of gravity, and gross weight will also cause significant changes in the attitude and torque required to maintain a given flight regime.

Despite its limitations, the attitude gyro is a useful tool that can aid pilots in spatial orientation and a reasonable estimation of rotor attitude. It is one of many key elements in an effective instrument scan. Pilots must develop an effective instrument scan to avoid fixating on the attitude gyro.

202. INSTRUMENT SCAN TECHNIQUES

The primary difference between the integrated scan used in the day familiarization phase and the scan used in instrument flight is that the focus is on the flight instruments only, instead of scanning outside the helicopter with the instruments as a backup.

Instrument pilots must learn to deliberately scan the flight instruments in order to gain the information they need at the right time. When using a deliberate scan, the pilot looks at the most relevant instrument at the time based on the maneuver. For example, when making a power adjustment, the pilot should scan the ball to ensure it stays centered. When adjusting helicopter pitch, the pilot should scan the VSI and airspeed to make sure the pitch change has the desired effect.

A deliberate instrument scan includes both position and rate instruments. Position instruments are those indications that tell you where the helicopter is right now as shown in Figure 2-2. They include heading indicators, Course Deviation Indicators (CDI) and Horizontal Situation Indicators (HSI), altimeters, and clocks or timers. Rate instruments are those instruments that indicate a helicopter’s rate of change in position as shown in Figure 2-3. In other words, rate instruments tell you where the helicopter is going. They include the airspeed indicator, VSI, and the turn and slip indicator.

Figure 2-2 Position Instruments (Altimeter, Heading Indicator, HSI)

Figure 2-3 Rate Instruments (Airspeed, Turn and Slip Indicator, VSI)

A proficient instrument pilot will scan the rate instruments more often than the position instruments to understand where the helicopter is going and what the control inputs are doing to the helicopter flight parameters. This allows the pilot to predict upcoming errors and correct them before they occur. For example, during a Turn Pattern, the pilot scans the altitude and notes that the helicopter is at the correct altitude. Following that, they scan the VSI and see a 300-Feet per Minute (fpm) rate of descent. Because they included the VSI in their scan, they are able to increase the collective and arrest the rate of descent before the altitude descends below the assigned parameter. This may seem obvious as you read it, but many competing distractions make simple scan procedures like those above easily forgotten in flight.

A deliberate scan also helps prevent fixation and omission. Fixation occurs when a pilot concentrates on one instrument too often or for too long. For example, during a Level Speed Change, a pilot may concentrate on airspeed in order to stop decelerating at exactly the right time. However, if the pilot does not scan effectively, they may end up 15 to 20 degrees off heading because the ball is out. Instead of focusing on airspeed, the pilot should scan airspeed once to ensure it is decelerating, scan the ball to make sure it is centered, scan the heading, and then return to the airspeed to check on its progress. Verbalizing errors seen in your instruments is a useful technique to prevent fixation. By scanning in this manner, the pilot can keep track of the deceleration while simultaneously maintaining other flight parameters.

Omission occurs when a pilot leaves a parameter out of the scan. For example, during a Turn Pattern, the pilot may have introduced the correct Angle of Bank (AOB) and be on altitude and airspeed. However, if the pilot omits the ball from their scan, the helicopter heading may not actually turn. Instead, it will fly in a straight line, but in out of balanced flight.

203. TRIM TECHNIQUES DURING INSTRUMENT FLIGHT

Trim techniques during instrument flight are identical to those used during day familiarization flights. When making the larger control inputs and power adjustments required by BI Maneuvers, pilots should use the Press, Set, Stabilize, Release method of trimming:

1. **Press** the Force Trim button on the cyclic.

2. **Set** the desired roll rate, pitch attitude, or pedal position.

3. **Stabilize** in the new position.

4. **Release** the Force Trim.

After making the initial input, take a moment to observe how the helicopter reacts and then adjust the trim position as necessary. Use the four-way trim switch to make small adjustments to refine the trim position throughout the maneuver.

204. CHAIR FLYING IN BASIC INSTRUMENTS

One helpful technique to aid in building an effective instrument scan is to chair fly the individual maneuvers while practicing a deliberate scan. As you think through each maneuver, consider what flight control inputs you will make and where you will direct your scan as you make the movements.

For example, when initiating a climb to begin a Vertical S-1 Pattern, you will need to raise the collective to increase power. As you increase power, deliberately scan the ball to ensure you have put in enough left pedal to keep it centered. After that, scan the VSI to ensure that you have achieved the desired rate of climb, followed by scanning the HSI to make sure your heading has not drifted. Lastly, you will want to scan the airspeed indicator to ensure you are maintaining the correct airspeed.

Several maneuvers include "Scan Techniques" in the Amplification and Technique sections of the FTI. Use these as a guide to begin to build a deliberate scan, but continue to refine your scan as you learn what techniques work best for you. Sometimes sitting in front of a picture of the flight display can help in visualizing what an effective scan might look like. Developing a deliberate scan, such as the one above, will help you avoid glancing wildly around the flight instruments as you attempt to remain on parameters during BI Maneuvers.

205. INSTRUMENT TAKEOFF

Maneuver Description: An Instrument Takeoff (ITO) is a transition to forward flight using the flight instruments as the primary reference.

Application: The skills practiced in an ITO will help students build an effective instrument scan. They also lay the groundwork for procedures frequently performed in fleet helicopters, such as night shipboard takeoffs, degraded visual environment takeoffs (brownout or whiteout conditions), and transitions to forward flight from a hover after conducting an overwater rescue.

Procedures

1. After obtaining a takeoff clearance and hover torque is noted, the instructor will position the helicopter on the runway aligned with the runway heading and conduct a vertical landing. The instructor will then transfer the controls to the student.

2. Trim the controls in the neutral position.

3. Smoothly raise the collective until the aircraft is light on the skids while adjusting the controls to prevent drift or yaw.

4. As the helicopter leaves the ground, smoothly and slowly pitch forward until the nose is on the horizon.

    a. Simultaneously continue to raise the collective to 10% above hover torque.

    b. Maintain up to 10% above hover torque, and confirm the helicopter is climbing.

    c. Remain wings level and maintain runway heading using the pedals.

5. Upon reaching translational lift, smoothly lower the nose to 3–5 degrees nose below the horizon.

6. Maintain runway heading using the pedals with wings level until reaching 70 KIAS.

7. Upon reaching 70 KIAS, center the ball and maintain runway heading with wing attitude.

8. Climb to 400 feet Above Ground Level (AGL) by the departure end of the runway before making an initial turn

NOTE

When conducting VMC departures at South Whiting Field, turns may need to be made sooner than 400' AGL to de-conflict with the pattern traffic. The instructor will aid the student in determining when to initiate the turn.

Amplification and Technique

- Before takeoff, determine hover torque by performing a five-foot hover check.
- The pilot must continue to scan and control torque throughout the maneuver. However, the PAC may request that the PNAC provide torque advisories through the initial power pull.
- As the helicopter passes through translational lift, some nose attitude adjustment will be necessary to prevent the nose from pitching up (due to the pendulum effect) and slowing the helicopter acceleration. Reposition the nose to 3–5 degrees nose down.
- Maintain runway heading with pedals and wings level attitude until reaching 70 KIAS. Attempting to maintain runway heading using AOB will induce a slide that will move the helicopter away from the center of the runway.

Common Errors and Safety Notes

1. Pitch attitude adjustments must be smooth and controlled.

   a. An excessive nose-low attitude at low altitude may complicate an autorotation in the event of an engine failure during the transition to forward flight, or it might drive the helicopter to the ground if insufficient power is used.

   b. Allowing the nose to pitch up as the helicopter passes through translational lift will cause the helicopter to accelerate more slowly, resulting in a more vertical climb than is desirable.

2. Avoid lateral drift on takeoff.

   a. Runway heading must be maintained with pedals.

   b. If the PAC attempts to use the cyclic to maintain heading, the helicopter will begin to drift and may slide off the runway and into an area where obstacle clearance is not guaranteed during takeoff.

3. Avoid aft drift on takeoff.

   a. Establish a basic instrument scan.

   b. Focusing on a spot on the runway through the chin bubble with result in aft drift as the helicopter leaves the deck.

206. LEVEL SPEED CHANGE

Maneuver Description: During a Level Speed Change, the pilot accelerates and decelerates the helicopter to specific airspeeds while maintaining a constant altitude and heading, using flight instruments as the sole reference.

Application: The piloting skills used in a Level Speed Change apply to all phases of instrument flight, particularly accelerating to cruise airspeed after a climb and decelerating to holding or approach airspeed while maintaining an assigned heading and altitude.

Procedures

1. Trim the helicopter at 90 KIAS on assigned heading and altitude.

2. Accelerate to 100 KIAS while maintaining constant heading and altitude.

3. Decelerate to 70 KIAS while maintaining constant heading and altitude.

4. Accelerate to 90 KIAS while maintaining constant heading and altitude.

Amplification and Technique

- Begin on parameters with a good 90 KIAS attitude trimmed in, so you are not constantly fighting to return to the correct heading and altitude.

- When adjusting airspeed, use the Press, Set, Stabilize, Release method of trimming to trim the new desired attitude.

    - Acceleration will require a slightly more nose-down attitude than a stabilized 90 KIAS attitude.

    - Deceleration will require a slightly more nose-up attitude than a stabilized 90 KIAS attitude.

    - Before beginning a Level Speed Change, it may be helpful to note the 90 KIAS attitude to use as a reference as you perform the maneuver.

- While adjusting pitch, simultaneously raise or lower the collective as appropriate to prevent an unwanted climb or descent.

- As the airspeed approaches the new desired airspeed, refine the trim position and power to stabilize for a few seconds at that airspeed.

- **Scan Technique:** While making power changes, scan the ball to ensure it remains centered to prevent heading drift.

- Once the ball is centered, scan the VSI to ensure the pitch and power changes have not introduced an unwanted rate of climb or descent. Use the VS trend arrow to immediately stop any change in VSI.

- Continue to scan both the ball and VSI throughout the maneuver.

Common Errors and Safety Notes

1. **Fixating on airspeed:** Reference airspeed throughout the maneuver, but the bulk of the scan should be spent on other rate instruments, such as the VSI and heading indicator, to maintain good basic air work parameters.

2. **Failure to anticipate the new airspeed and overshooting:** As the helicopter approaches the new desired airspeed, the pilot must adjust the attitude, trim, and power to stabilize. Pilots who do not anticipate with power and trim adjustments will frequently accelerate or decelerate beyond the desired airspeed.

3. **Failure to stabilize at each new airspeed:** Adjusting the attitude, trim, and power allows the helicopter to stabilize at each airspeed before moving on to the next portion of the maneuver. If the helicopter is not properly trimmed, it is exceedingly difficult to maintain a precise airspeed.

4. **Rushing the maneuver:** After making a trim and power input, wait a moment while continuing your scan to the results of those inputs, then make another attitude or power adjustment as required. Rushing the maneuver will cause the helicopter to react faster than you can scan, and basic air work will suffer accordingly.

207. TURN PATTERN

Maneuver Description: The Turn Pattern as shown in Figure 2-4, allows the pilot to practice turns at increasing AOBs while maintaining a constant airspeed and altitude using the flight instruments as sole reference.

Application: The piloting skills used in the Turn Pattern are directly applicable to all phases of instrument flight when maneuvering the helicopter.

Procedures

1. Trim the helicopter in level flight at 90 KIAS on assigned altitude and a cardinal heading.

2. Turn in either direction at 10 degrees AOB for 90 degrees of heading change.

3. Reverse the turn to 10 degrees AOB for 90 degrees of heading change in the opposite direction.

4. Reverse the turn to 20 degrees AOB for 180 degrees of heading change.

5. Reverse the turn to 20 degrees AOB for 180 degrees of heading change in the opposite direction.

6. Reverse the turn to 30 degrees AOB for 360 degrees of heading change.

7. Reverse the turn to 30 degrees AOB for 360 degrees of heading change in the opposite direction.

8. Roll out on the original heading at 90 KIAS on the assigned heading.

9. Maintain 90 KIAS and assigned altitude throughout the maneuver.

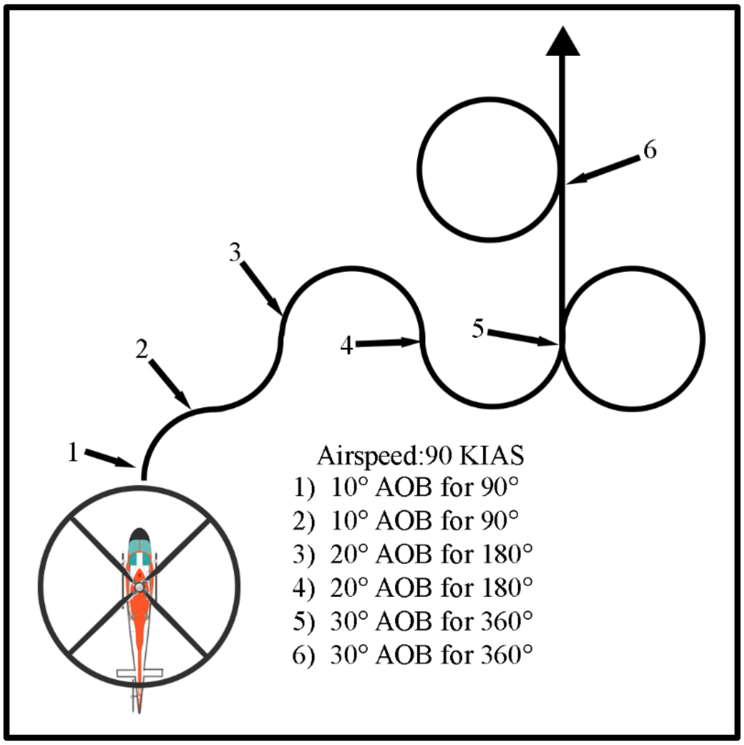

Figure 2-4 Turn Pattern

Amplification and Technique

- Begin in a trimmed 90 KIAS attitude. This provides a benchmark trim position from which airspeed adjustments can be made throughout the maneuver.

- Anticipate turn reversals by half the AOB. For example, during a 20-degree AOB turn, lead the reversal by 10 degrees of heading.

- As the AOB increases, more power will be required to maintain level flight.

    - 10-degree AOB turns require little or no increase in power to maintain 90 KIAS and level flight.

    - 20-degree AOB turns will require some power increase, but the amount will vary based on the ambient conditions.

    - 30-degree AOB turns will require a significant increase in power to maintain level flight.

- During turn reversals, anticipate the need for a small amount of forward cyclic and a power reduction to avoid ballooning. The amount of power taken out will depend on how much additional power was required to maintain level flight. Be prepared to increase power again as you increase the AOB in the opposite direction.

- **Scan Technique:** After each reversal, scan the ball to ensure it is still centered.

    - If the ball is not in the center, all other corrections will be more difficult.

    - After ensuring the ball is centered, scan the VSI to ensure that the reversal has not introduced an unwanted climb or descent.

Common Errors and Safety Notes

1. Failure to maintain 90 KIAS. During steep turns, pilots commonly correct altitude and VSI errors by using aft cyclic instead of increasing power to maintain altitude.

2. Failure to maintain altitude. Pilots tend to omit the VSI from their scans, causing altitude deviations.

3. Ballooning during reversals due to poor power management and scan breakdown. Pilots may focus on the attitude gyro during reversals, causing all other aspects of basic air work to deteriorate.

208. VERTICAL S-1 PATTERN

Maneuver Description: The Vertical S-1 Pattern as shown in Figure 2.5, allows the pilot to practice a standard rate climb and descent while maintaining a constant heading and airspeed, using the flight instruments as the sole reference.

Application: The piloting skills used in the Vertical S-1 are directly applicable to all phases of instrument flight, particularly those that require the pilot to maintain a specific rate of descent, such as while executing an ILS or PAR.

Procedures

1. Trim the helicopter in level flight at 90 KIAS on the assigned heading and altitude.

2. Three seconds prior to starting the timer, adjust the collective to initiate a 500 fpm climb or descent, maintaining a constant heading and airspeed.

3. Continue the climb/descent for one minute, leveling off 500 feet from the starting altitude.

4. Fly straight and level at 90 KIAS for one minute.

5. Three seconds prior to one minute of straight and level flight, adjust the collective to initiate a 500 fpm climb or descent (the opposite direction from the first half of the maneuver), maintaining a constant heading and airspeed.

6. Continue the climb/descent for one minute, leveling off on the original altitude.

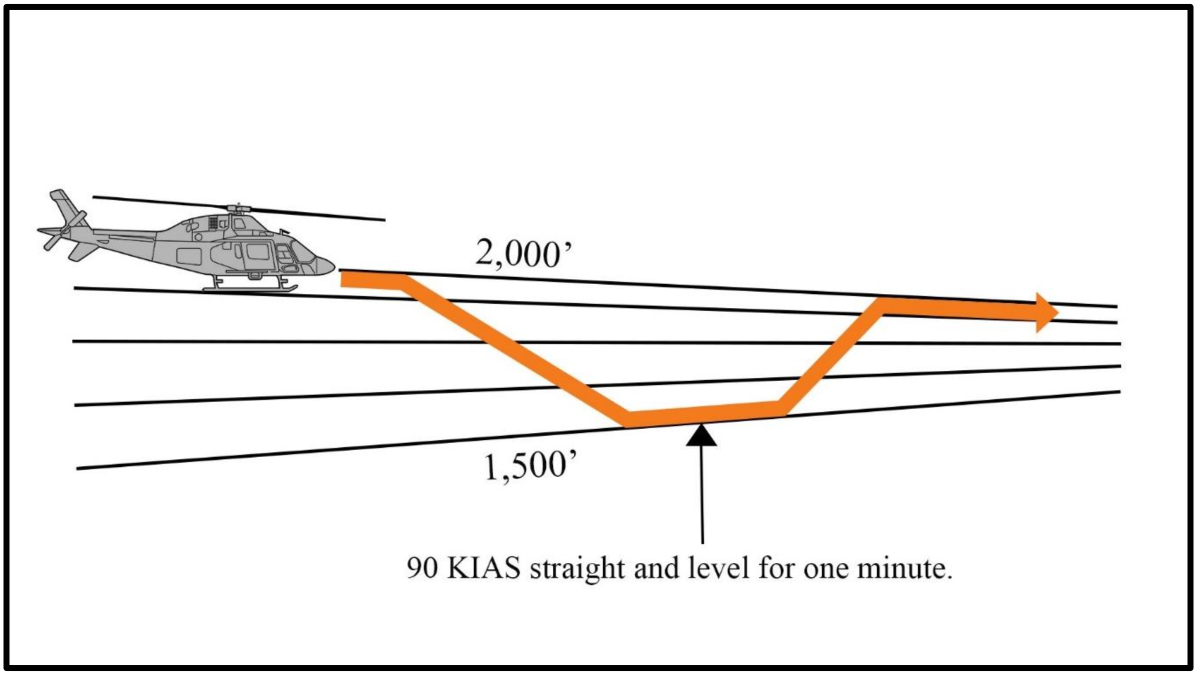

Figure 2-5 Vertical S-1 Pattern

Amplification and Technique

- Prior to beginning the maneuver, the student may ask the instructor to provide a five-second count down before beginning the count-up timer.

- It is vital to establish a trimmed 90 KIAS attitude before beginning the maneuver so that a trim reference position exists throughout the maneuver.

- Check performance periodically to ensure that the helicopter is at the appropriate altitude for the elapsed time. Every 15 seconds is a good benchmark.

    - In a 500 fpm climb, the helicopter should climb 125 feet every 15 seconds.

- If the helicopter is ahead or behind on altitude, smoothly adjust power to establish an appropriate VSI setting to return to the desired performance.

  - The goal is to level off on parameters after exactly one minute of timing.
  - After the correction is complete, re-adjust power to return to a 500 fpm rate of climb/descent.

- Adjust power to begin the level off at 10 percent of the VSI prior to the desired altitude. For example, if the helicopter is descending at 500 fpm, begin the level off 50 above the desired altitude.

- **Scan Technique:** Power adjustments will affect the ball and the pitch attitude.
  - During any power change, scan the ball to ensure it is still centered.
  - After scanning the ball, scan the VSI to ensure the power change was effective and then scan airspeed to ensure it is still 90 KIAS.

Common Errors and Safety Notes

1. Pilots may allow the VSI to drop out of their scan, allowing the helicopter to deviate from parameters without realizing it.
2. Failure to keep the ball center during power changes will allow the helicopter to deviate from assigned heading.
3. Failure to readjust power after a correction is complete. Pilots may make an appropriate correction, but after noting that they are back on timing, they will neglect to return the VSI to 500 fpm.

209. OSCAR PATTERN

Maneuver Description: The Oscar Pattern as shown in Figure 2-6, allows the pilot to practice a standard rate climb and descent while maintaining a standard rate turn and constant airspeed using the flight instruments as the sole reference.

Application: The piloting skills in the Oscar Pattern are directly applicable to all phases of instrument flight, particularly those that require the pilot to maintain a rate of climb or descent while executing a turn to a new heading, such as on an instrument climb out.

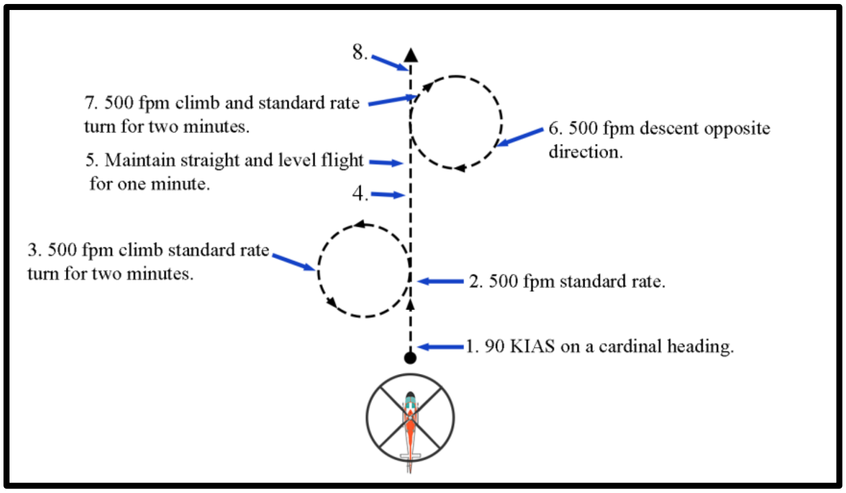

Figure 2-6 Oscar Pattern

Procedures

1. Trim the helicopter in straight and level flight at 90 KIAS on a cardinal heading.

2. Three seconds prior to starting the timer, adjust the collective to establish a 500 fpm climb or descent while simultaneously entering a standard rate turn in either direction.

3. Maintain the 500 fpm climb/descent and standard rate turn for two minutes (1,000 feet of altitude change and 360 degrees of heading change).

4. Roll out on the original cardinal heading and level off after 1,000 feet of altitude change.

5. Maintain straight and level flight for one minute.

6. Three seconds prior to one minute of straight and level flight, adjust the collective to establish a 500 fpm climb or descent while simultaneously initiating a standard rate turn in the opposite direction from the first half of the maneuver.

7. Maintain the 500 fpm climb/descent and standard rate turn for two minutes.

8. Roll out on the original cardinal heading and level off at the original altitude.

Amplification and Technique

- Prior to beginning the maneuver, the student may ask the instructor to provide a five-second count down before beginning the count-up timer.

- Check performance periodically to ensure the helicopter is on the correct parameters for the elapsed time. Every 15 seconds is a good benchmark.

  - The helicopter should climb or descend 125 feet and turn 45 degrees every 15 seconds.

- If the helicopter is off the desired parameters at a timing checkpoint, adjust the AOB and the VSI to regain the correct parameters.
  - The goal is to level off and roll out on parameters after exactly two minutes of timing.
  - If the desired altitude or heading has not been reached at the end of two minutes, continue the maneuver until reaching the desired parameters.
  - After making a successful correction, ensure you take the correction out and return the VSI to 500 fpm or the turn rate indicator to a standard rate.
- Lead the rollout by half the number of degrees AOB for a standard rate turn (e.g., for 12 degrees AOB, begin the rollout 6 degrees prior to the desired altitude).
- It is important to establish standard rates when commencing the maneuver. Missing the first timing checkpoint because you are concentrating on rates is acceptable. However, timing checkpoints must be scanned no later than the first thirty-second interval.
- **Scan Technique:** When beginning the maneuver or making corrections, focus on the rate instruments (VSI, turn rate indicator, and airspeed) to ensure those parameters are where you want them.
  - After making a correction, scan the rate instruments again to ensure you have returned them to normal parameters.
  - Combine the scan techniques described in the previous maneuvers to build an effective Oscar Pattern scan.

Common Errors and Safety Notes

1. Fixating on one parameter of the maneuver (for example, the turn) while allowing the other parameter (altitude) to deteriorate outside parameters.

2. Failure to maintain a standard rate turn and 500 fpm climb/descent. Pilots will frequently neglect to scan the VSI and turn rate indicator in order to focus on position instruments. This results in the pilot's inability to anticipate deviations and preemptively correct them.

3. Failure to readjust power or AOB after a correction is complete. Pilots may make an appropriate correction, but after noting that they are back on timing, they will neglect to return the VSI to 500 fpm or the turn rate indicator to a standard rate.

210. EMERGENCY STANDBY INSTRUMENT SYSTEM FLIGHT

Maneuver Description: During Emergency Standby Instrument System (ESIS) Flight, the pilot will maintain assigned flight parameters using only the ESIS as shown in Figure 2-7.

Application: In the event of a dual PFD and MFD failure, the pilot must fly using the ESIS as a primary reference.

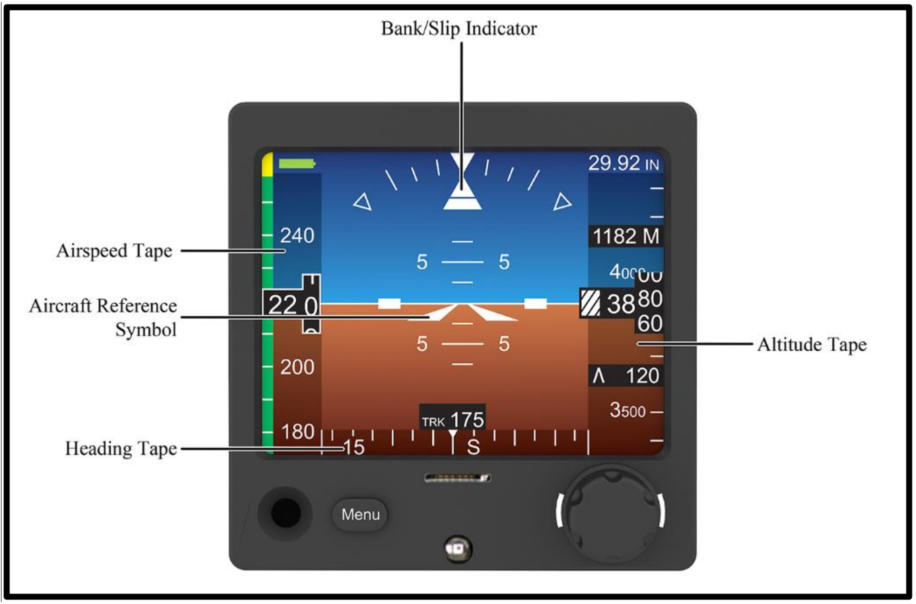

Figure 2-7 EFD-750 ESIS Screen

Procedures

1. The instructor will simulate a dual PFD and MFD failure causing the student to transition to an ESIS scan.

2. The instructor will assign the student flight parameters to maintain with sole reference to the ESIS.

3. At the completion of the maneuver, the instructor will end the simulated PFD and MFD failures, and the student will return to a normal instrument scan.

Amplification and Technique

- The ESIS is small but provides attitude, airspeed, heading, and turn/slip information.

- Use small, controlled inputs to avoid over-controlling.

- The ESIS does not provide instrument navigation information, so if the pilot must execute an instrument approach, it must be either an Airport Surveillance Radar (ASR) or a PAR.

- The pilot must scan all parameters while using the ESIS to maintain basic air work within parameters.

    - The slip indicator (ball) on the ESIS is the bottom half of the triangular roll indicator.

211. UNUSUAL ATTITUDE RECOVERY

Maneuver Description: The Unusual Attitude Recovery Procedures enable the pilot to regain a normal flight attitude using the flight instruments as sole reference.

Application: Practicing spatial disorientation recovery techniques enables the pilot to recover from unintentional, undesirable, or unsafe helicopter attitudes that they might encounter in instrument conditions due to a failure of the attitude indicator or internal or external factors leading to a disorienting physiological condition.

Procedures

The instructor will initiate the maneuver using one of three methods:

- **Method 1:** The instructor will fly the helicopter into an unusual attitude while the student looks away from the displays.

    - When the desired attitude has been reached, the instructor will pass control of the helicopter to the student, who will then recover from the unusual attitude.

- **Method 2:** The student will maintain control of the helicopter and close their eyes.

    - The instructor will direct a series of control inputs that places the helicopter in an unusual attitude.

    - The instructor will then direct the student to open their eyes and recover the helicopter.

- **Method 3:** The instructor simulates succumbing to spatial disorientation while the student focuses on other cockpit tasks, such as a checklist or approach set up.

    - The instructor makes incorrect control inputs that place the helicopter in an unusual attitude.

    - The student should note the deviations, make verbal calls to correct the instructor, and then take the controls and recover the helicopter.

After recognizing the unusual attitude or being told to recover, the student shall accomplish the following:

1. **Level the wings:** Roll to wings level.

2. **Level the nose**: Place the nose of the helicopter on the horizon.

3. **Center the ball:** Ensure the ball is centered.

4. **Set power for 90 KIAS.**

5. **Stop any climb or descent and achieve 90 KIAS.**

6. **Recheck the wings, nose, and ball.**

7. **Execute** a 500 fpm climb or descent to return to the base recovery altitude.

8. **Execute** a level standard rate turn to base heading.

Amplification and Technique

- Students should expedite through the first four steps verbalizing, "*Level the wings, level the nose, center the ball, set power"* as they accomplish each step.

- Make smooth, moderate control inputs to avoid over-correcting and achieving an opposite unusual attitude. For example, over-correcting from a descending left turn could result in a climbing right turn if corrections were made too abruptly or with too great of magnitude.

- At the instructor's discretion, once the helicopter is in a level attitude, base recovery altitude and heading can be established simultaneously.

- Most helicopters are equipped with independently operating attitude gyros, meaning the attitude information derives from different sources.

  - If the information from one attitude gyro is suspect (usually accompanied with a CAS message), the pilots should cross-check it against the other attitude gyro.

  - If one pilot's attitude gyro is operating correctly, both pilots should draw data from the operating Air Data Attitude Heading Reference System (ADAHRS).

- During a nose-high unusual attitude, it is acceptable to maintain a small AOB and allow the nose to fall down to the horizon before rolling wings level.

  - This technique avoids a Low-G pushover and allows the pilot to maintain a positive G-load on the helicopter while recovering from an unusual attitude.

Common Errors and Safety Notes

- It is vital that any rate of descent is arrested during an unusual attitude recovery.
  - Pilots will often perform "Level the wings, level the nose, center the ball, set power" without reference to the VSI.
  - This results in the helicopter achieving a normal attitude but continuing a potentially deadly descent toward the ground.
- In a nose-high attitude, avoid pushing the nose over into a potential Low-G situation.
- During unusual attitude recoveries, airspeed should not decrease below 40 KIAS.

CRM

- The PAC alerts the PNAC if they begin to encounter recognized spatial disorientation. (Situational Awareness/Communication)
- PNAC verbally notifies the PAC of deviations from established parameters. (Assertiveness)
- If the PAC experiences spatial disorientation, PNAC provides PAC verbal corrections and control movements. (Assertiveness)
- PNAC assumes the controls in a timely manner if the PAC fails to respond to verbal corrections to recover from an unusual attitude or if the helicopter is in an unsafe flight regime.

212. ELECTRONIC STANDBY INSTRUMENT SYSTEM UNUSUAL ATTITUDE RECOVERY

Maneuver Description: The ESIS Unusual Attitude Recovery Procedures enable the pilot to regain a normal flight attitude using the ESIS as sole reference.

Application: Practicing spatial disorientation recovery techniques enables the pilot to recover from unintentional, undesirable, or unsafe helicopter attitudes that they might encounter in instrument conditions due to a failure of the attitude indicator or internal or external factors leading to a disorienting physiological condition.

Procedures

For an ESIS Unusual Attitude Recovery, utilize the same procedures as the full panel Unusual Attitude Recovery. The only difference is the pilot will conduct the maneuver with sole reference to the ESIS.

1. **Level the wings:** Roll to wings level.

2. **Level the nose:** Place the nose of the helicopter on the horizon.

3. **Center the ball:** Ensure the ball is centered.

4. **Set power for 90 KIAS.**

5. **Stop any climb or descent and achieve 90 KIAS.**

6. **Recheck the wings, nose, and ball.**

7. **Execute** a climb or descent to return to the base recovery altitude.

8. **Execute** a level standard rate turn to base heading.

Amplification and Technique

- Students should still expedite through the first four steps of the maneuver while verbalizing, *"Level the wings, level the nose, center the ball, set power"* as they perform each step.

- The ESIS does not include a VSI, so pilots should pay close attention to the altitude indicator to ensure that a climb or level flight is established during the procedure.

Common Errors and Safety Notes

- In a nose-high attitude, avoid pushing the nose over into a potential Low-G situation.

- During unusual attitude recoveries, airspeed should not decrease below 40 KIAS.

213. INSTRUMENT AUTOROTATION PROCEDURES

Maneuver Description: The instrument autorotation is an autorotative descent established with sole reference to flight instruments. After the helicopter descends to VMC, the pilot transitions to a VFR scan and performs a normal autorotative landing. Students will perform instrument autorotations in the simulator only.

Application: Practicing instrument autorotations develops confidence and the ability to execute a safe autorotative descent and piloting skills to fly a stabilized autorotation profile, in the event of an engine failure under IMC.

Procedures

1. The instructor will initiate the maneuver by inducing an engine failure or an emergency that ultimately leads to an engine failure.

2. Establish a stable autorotative descent.

3. Turn to the last known wind direction.

4. Direct the PNAC to lock shoulder harnesses, transmit a mayday call, and switch the transponder to emergency.

5. If VMC is encountered above 300 feet AGL, transition to an outside scan and execute an autorotative landing.

6. If still in IMC when passing 300 feet AGL:

   a. Level the wings even if not headed into the wind.

   b. At 150 feet AGL, initiate a cyclic flare (maximum 20 degrees nose-up) in order to reduce the rate of descent and reduce groundspeed.

7. At 15 feet AGL, coordinate up collective and forward cyclic to slow the rate of descent and lower the nose to level (less than seven degrees nose-up). Maintain heading with pedals.

8. Level the skids prior to touchdown.

   a. Use collective as necessary to cushion the landing.

   b. Touchdown with less than 15 knots of ground speed.

Amplification and Technique

- To establish an autorotative descent, smoothly lower the collective to the full down position while simultaneously adding right pedal to maintain balanced flight. Adjust the pitch attitude to an 80-90 KIAS descending attitude and adjust the collective to maintain Nr between 90–110 percent (target 100–102 percent). If the minimum rate of descent or max glide is desired, adjust airspeed and N_r as per NATOPS.

- Since the PAC workload is high, they may simply direct the PNAC to "Lock, Talk, and Squawk."

- At some time during the maneuver, the helicopter will enter VMC.

  - When the helicopter breaks out, the PAC must immediately transition to a VMC scan while maintaining a safe autorotative profile.

  - Both pilots should begin looking for the best possible landing site available.

Common Errors and Safety Notes

- The collective must be lowered immediately following the engine failure to preserve main rotor Revolutions Per Minute (RPM).

- Even if the PAC does not direct it, the PNAC should make an emergency radio call and squawk 7700.

- The PAC must maintain normal autorotative parameters throughout the maneuver by referencing the flight instruments including N_r, airspeed, and balanced flight.

CRM

- PNAC scans outside to locate VMC and reports breaking out. (Situational Awareness, Communication)

- PAC transitions to visual procedures once VMC. (Mission Analysis, Adaptability/Flexibility)

- PAC/PNAC ensures the flare is initiated by 150 feet AGL. (Communication)

- PNAC backs up the flying pilot on the gauges and reports critical altitude (e.g., "150 feet, flare"). (Situational Awareness, Communication)

214. MANEUVER COMPLETE REPORT

At the end of each basic instrument maneuver, the student should perform a maneuver complete report. The maneuver complete report consists of the following components:

1. Report "maneuver complete."

2. Check the gauges.

3. Scan the Engine Instruments and Crew Alerting System (EICAS) window for warning, caution, and advisory messages.

4. Check the fuel quantity.

5. Note the time.

For example, "Maneuver complete, gauges in the green, no EICAS messages, fuel 450 pounds, time 1439."

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CHAPTER THREE
INSTRUMENT SKILLS

300. INTRODUCTION

All RI procedures require a set of basic skills in order to accomplish the flight successfully. Many of the following maneuvers will be familiar to you from Primary Flight Training. The chapter intends to refresh your knowledge on the required skills and expand your understanding to include helicopter-specific considerations.

301. LEVEL STANDARD RATE TURNS TO A HEADING

Maneuver Description: A standard rate turn is a three degree per second turn to a predetermined heading. Altitude and airspeed remain constant throughout the turn.

Application: Standard rate turns are used in every aspect of instrument flight, including procedure turns, holding patterns, and Ground Controlled Approaches (GCA). They are standardized maneuvers that enable ATC to predict an aircraft's location and can be used independently of the heading indicator if necessary.

Procedures

1. When assigned a new heading, enter a standard rate of turn using the turn/slip indicator.

2. Three seconds prior to starting the clock, smoothly roll the helicopter into a standard rate turn using the turn rate indicator as a reference.

3. Maintain an AOB that results in a standard rate turn.

4. Check the progress of the turn at least every 15 seconds for 45 degrees or 10 seconds for 30 degrees of turn. Adjust AOB to complete the turn-on time. Always keep the ball centered.

5. At a heading equal to one-half the AOB prior to the desired heading, roll to wings level.

Amplification and Technique

- The AOB required to maintain a standard rate turn varies with airspeed. The greater the airspeed, the greater the AOB required to maintain a standard rate.

- Rollout headings should be one-half the AOB prior to the desired heading. For example, if you are using 12 degrees AOB to maintain a standard rate, begin to roll out six degrees prior to the desired heading.

302. NAVAID ORIENTATION

Maneuver Description: Orientation is the procedure for determining a helicopter's position with respect to the NAVAID.

Application: Aviators must remain oriented throughout every instrument flight. Determining the helicopter's position in relation to a NAVAID is a key element in situational awareness. Additionally, accurate NAVAID orientation enables the pilot to determine their own helicopter's position in relation to other aircraft. This is particularly important when operating near a ship or in a tactical environment.

Procedures

1. Tune and identify the NAVAID station.

2. Ensure the appropriate needle is displayed on the HSI.

3. Determine the radial and Distance Measuring Equipment (DME) of the helicopter's current position.

Amplification and Technique

- The tail of the needle indicates the radial on which the helicopter is located. The head of the needle indicates the course to the station.

- The DME shows slant range distance from the station.

- TACAN/VOR stations should not be used for navigation unless identified, even if it appears to indicate correct information.

- The HSI can also display GPS information from the Flight Management System (FMS). Ensure the correct navigation source is selected from the Omni Bearing Selector (OBS) NAV source menu.

303. HOMING

Maneuver Description: Homing refers to flying toward a station without any wind correction.

Application: Homing allows a helicopter to fly toward a station but results in a curved path because the pilot does not use a wind correction.

Procedures

1. Turn to place the head of the needle at the 12 o'clock index.

2. Maintain the head of the needle at the 12 o'clock index.

Amplification and Technique

- Homing is not an approved IFR procedure and should be used only when very close to the station.

304. TRACKING

Maneuver Description: Tracking as shown in Figure 3-1, is the procedure for determining a wind-corrected heading that will allow the helicopter to fly directly toward a station.

Application: Tracking is used throughout the instrument environment to follow airways and execute instrument approach procedures.

Procedures

1. After intercepting the desired radial, maintain a heading toward the station.

2. Ensure that the course needle is twisted to the correct radial.

3. As the CDI begins to move away from the center, turn toward the CDI to regain the desired radial.

4. When re-established on the radial, adjust the helicopter heading slightly into the wind to maintain a centered CDI.

5. Continue to monitor the CDI and adjust the helicopter heading as required to maintain the desired radial.

Amplification and Technique

- This procedure can be done without a CDI by monitoring the tail of the bearing needle.
    - o As the tail begins to move away from the desired radial, turn to regain the radial.
    - o When choosing which direction to turn, remember, “The head falls, the tail rises.” and “tail, radial, turn.” Adjust the aircraft's heading towards the wind (tail) to go back to the initial radial.
    - o Follow the same procedure as above to establish a helicopter heading slightly into the wind to maintain the tail of the needle on the desired radial.
- PFD wind indicator provides useful wind information that can be used to estimate the heading correction necessary to maintain the desired radial.

- The radials are very narrow close to the station. Pilots must be careful not to over correct.

- Allow time for the corrections to take effect.

    - Rushing a correction may result in too large an angle and overshooting the desired radial.

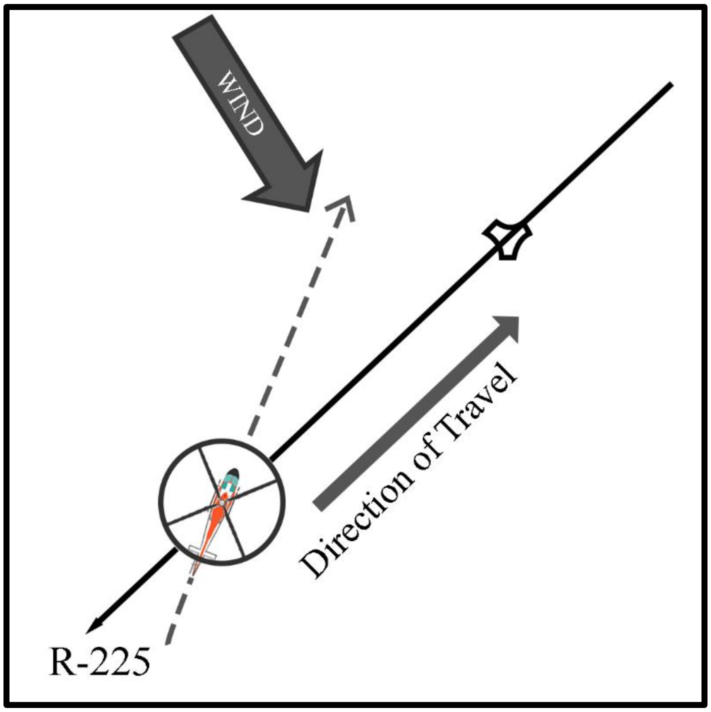

Figure 3-1 Tracking

305. RADIAL INTERCEPTS

Maneuver Description: Radial intercepts enable the pilot to fly toward a specific radial and begin tracking it.

Application: Radial intercepts are common in all aspects of instrument flight, including following airways and executing instrument approach procedures. There are three types of course intercepts: inbound, outbound, and over-the-station (a particular type of outbound). The inbound procedures are shown in Figure 3-2 and outbound procedures in Figure 3-3.

INBOUND AND OUTBOUND INTERCEPT PROCEDURES

Tune and identify the NAVAID.

Ensure the appropriate needle is displayed on the HSI.

1. Determine what radial the helicopter is currently on and the desired radial to intercept.

2. Twist the desired radial into the course needle.

3. Turn in the shortest direction to an appropriate heading to intercept the radial.

4. As the helicopter approaches the desired radial, turn to intercept the radial.

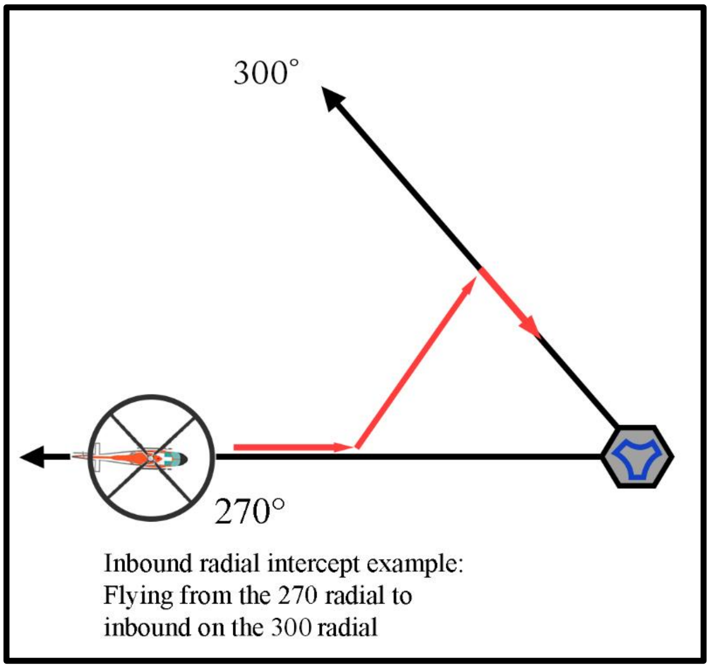

Figure 3-2 Inbound Radial Intercept

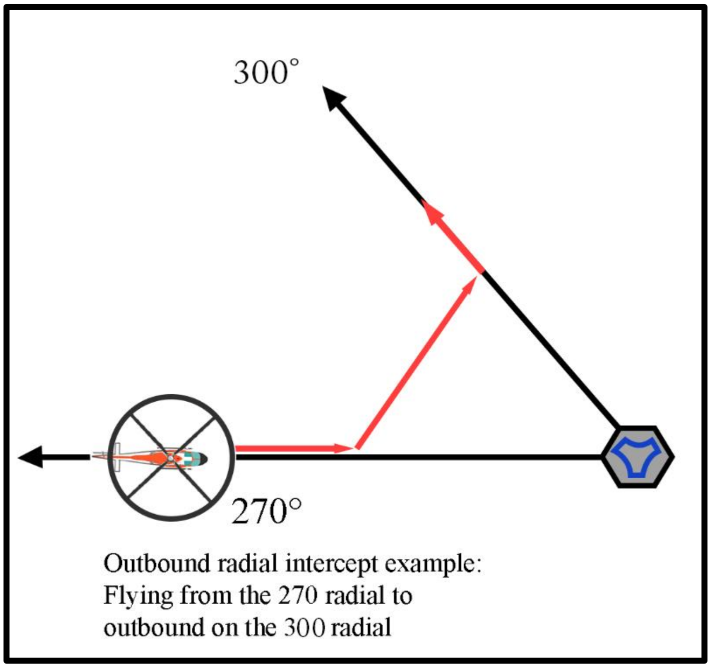

Figure 3-3 Outbound Radial Intercept

Amplification and Technique

- Based on the distance from the station and depending on how fast the pilot wants to intercept the radial, the intercept angles may vary from a few degrees up to 90 degrees. The closer the helicopter is to the station, the smaller the necessary intercept angle.

- As the helicopter approaches the desired radial, pay attention to how quickly the CDI is centering. This will determine how quickly the heading will need to be adjusted to intercept the radial without overshooting.

Radial Intercept Procedures

Depending on the difference between the radial we are on and the radial we want to intercept, there are 3 basic radial intercept procedures.

1. Standard Inbound and Outbound Intercept procedures.

   This procedure is used when we need to intercept an outbound or inbound radial that is within 45 radials from our present radial.

2. Arcing Procedure

   This procedure is used when the difference between the current radial the desired radial to intercept is between 45 and 120 degrees.

3. Over the Station Intercept procedure.

This procedure is used when the difference between the radials is greater than 120 degrees or when crossing over a station.

Standard Inbound Intercept Procedure

1. Twist the desired OBS course in the CDI.

- The course inbound is 180 degrees opposite from the radial inbound you want to track. For example, if you want to track the 030-radial inbound, your OBS course should be set to 210.

2. Turn in the direction of the desired radial and roll out with an appropriate intercept angle. To intercept the new course, the head of the RMI (Radio Magnetic Indicator) needle should be in the top part of the HSI. The desired radial should be above the tail of the RMI needle (tail rises), and the inbound course should be below the head of the RMI needle (head falls).

3. As the helicopter approaches the desired radial, the CDI will start to center. Turn to place the head of the CDI and the tail of the RMI needle at the top of the HSI. Track the new radial outbound.

Standard Outbound Intercept Procedure

1. Twist the desired OBS course in the CDI.

- The course outbound is the same as the outbound radial you want to track. For example, if you want to track the 330-radial outbound, your OBS course should be set to 330.

2. Turn in the direction of the desired radial and roll out with an appropriate intercept angle. To intercept the new course, the tail of the RMI needle should be in the top part of the HSI. The desired radial should be above the RMI's tail (tail rises).

3. As the helicopter approaches the desired radial, the CDI will start to center. Turn to place the head of the CDI and the tail of the RMI needle at the top of the HSI. Track the new radial outbound.

Arcing Procedure

If the difference between the radials is between 45 and 120 degrees, utilize the arcing method, as shown in Figure 3-4. The arcing method is exactly that: flying an arc around the NAVAID to the desired radial.

1. For both inbound and outbound tracking, turn toward the desired radial to a heading that places the head of the needle on the 90-degree benchmark of the RMI.

2. Twist the desired OBS course in the CDI.

3. Adjust the heading as required to maintain the needle at the 90-degree benchmark until approaching the desired radial.

4. For an inbound intercept, turn to put the head of the RMI needle and the head of the CDI at the top of the HSI.

5. For an outbound intercept, turn to put the tail of the RMI needle and the head of the CDI at the top of the HSI.

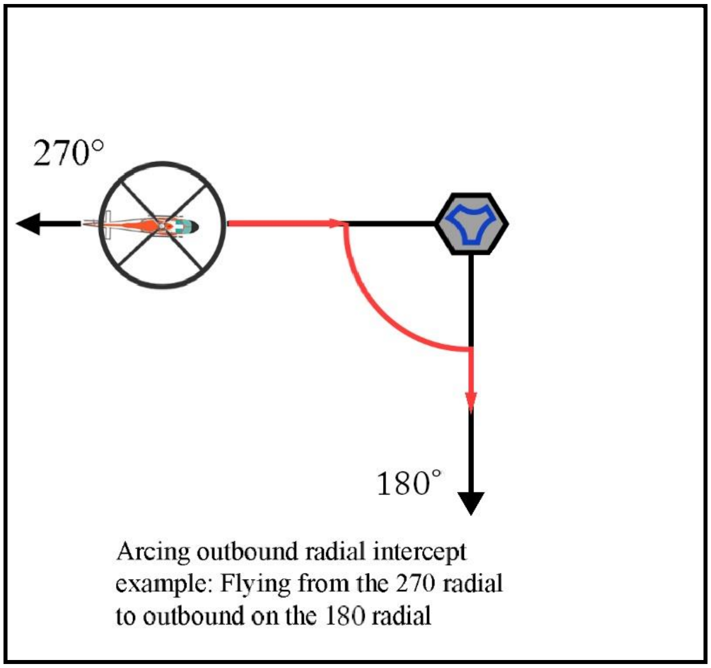

Figure 3-4 Arcing Outbound Radial Intercept

Over-the-Station Intercept Procedures

Use over-the-station intercepts when the difference between the radials is greater than 120 degrees or when crossing over a station. An example is shown in Figure 3-5.

1. Begin by tracking directly to the station.

2. After station passage, turn to parallel the desired radial.

3. Twist the desired OBS course in the CDI.

4. Turn toward the desired radial using a 15 to 30-degree intercept.

5. Approaching the radial, adjust the helicopter heading to intercept the radial and track outbound.

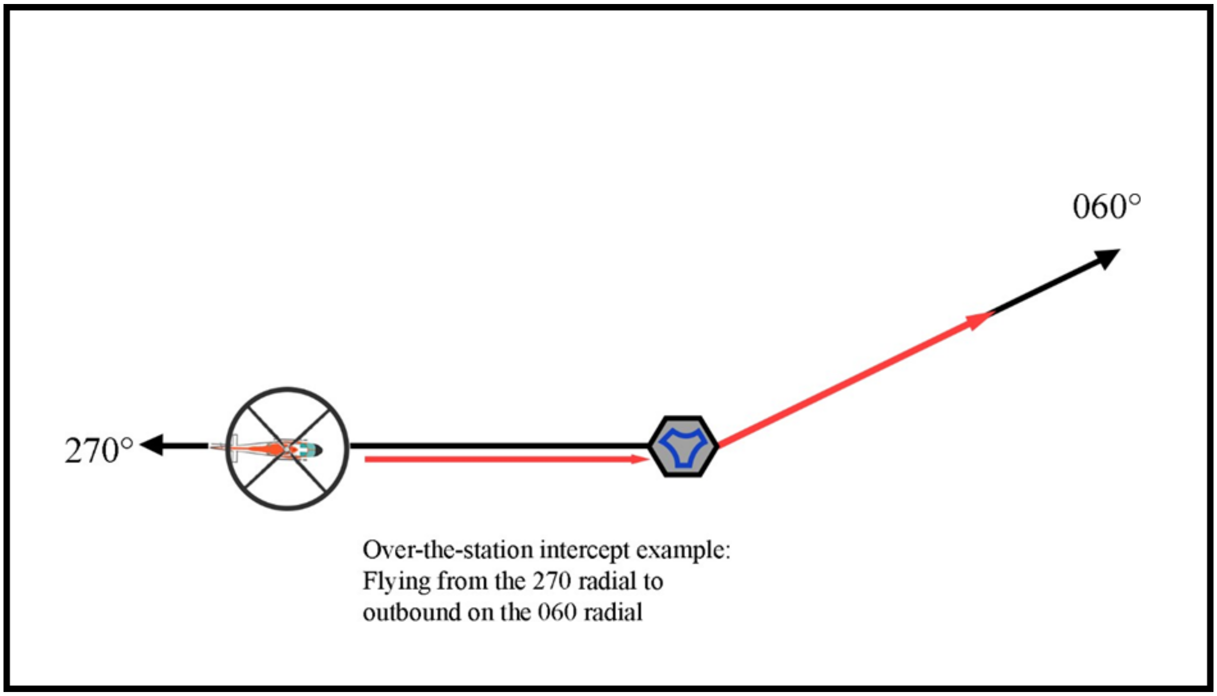

Figure 3-5 Over-the-Station Intercept

Amplification and Technique

- The helicopter is very close to the station when using over-the-station procedures to intercept an outbound radial so the CDI will center quickly. Use a small intercept angle to avoid overshooting the desired outbound radial.

- Station passage for a TACAN is minimum DME. Station passage for a VOR is the TO flag swapping to a FROM flag. When the helicopter is close to the station, the needle will oscillate, and DME will change rapidly. Hold the inbound heading and refrain from chasing the needle.

306. POINT-TO-POINT NAVIGATION

Maneuver Description: Point-to-point includes navigating the most direct path from one radial/DME location to another radial/DME location referencing the same NAVAID.

Application: Pilots are sometimes required to navigate directly from their current location to a specific fix defined by a radial/DME. This can occur during instrument flights or when navigating in the vicinity of a TACAN-capable ship.

Procedures

To calculate a point-to-point solution, you will use the RMI.

RMI Point-to-Point Method

1. Assume the NAVAID is located at the center of the HSI.

2. Determine your Radial/DME fix and the desired Radial/DME fix.

3. Determine which fix has the greater DME from the station. That fix will be located on the appropriate radial at the edge of the HSI.

4. Place the closer fix on the appropriate radial at a proportional distance from the center.

For Example:

> If the further fix is at 9 DME and the closer fix is at 3 DME, the 9 DME fix would be on the edge of the HSI, and the closer fix would be a third of the distance from the center to the edge.

5. Draw a mental line from your Radial/DME fix to your desired Radial/DME fix. It may be helpful to use a pencil or your finger to connect the two points on the HSI.

6. Without changing the angle of the pencil, slide it to the center of the HSI. The pencil is now pointing at the approximate heading for the point-to-point. This example is shown below in Figure 3-6.

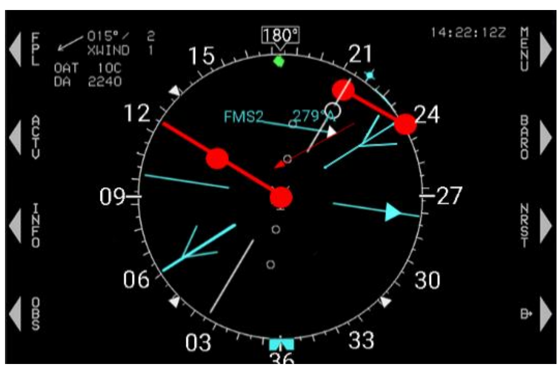

Figure 3-6 HSI Point-to-Point Flying from 240 Radial at 10 DME to 210 Radial at 8 DME

Amplification and Technique

- Point-to-point calculations do not take crosswinds into account. Therefore, to perform a point-to-point calculation accurately, the heading must be updated frequently.

- Always read in the direction from the helicopter position to the desired fix.

- As you approach the fix, determine if DME or radial information is changing more quickly. Then, adjust the heading to equalize the rates of change.

307. COURSE REVERSAL PROCEDURE

Maneuver Description: While conducting an instrument approach, a course reversal procedure allows the pilot to reverse the aircraft's initial course in order to intercept the Final Approach Course (FAC). The Federal Aviation Administration (FAA) does not specify how to execute a course reversal as long as the helicopter remains within the protected airspace. However, when the Instrument Approach Procedure (IAP) specifies the type of course reversal procedure, you must do it as published. There are several ways to conduct a course reversal:

- 45 Degree Procedure Turn (Default if not specified as Tear Drop or Hold in Lieu of Procedure Turn)
- Tear Drop
- Hold In Lieu of Procedure Turn (HILPT)

Application: Course reversal procedures are used when approaching an ILS, LOC, or VOR approach from the opposite direction of the FAC.

Amplification and Technique:

- The 45 degree procedure turn, tear drop, or HILPT are required maneuvers when depicted on the approach chart unless cleared by ATC for a straight-in approach.
- The course reversal procedure must remain within the protected airspace depicted in the approach plate’s profile view. Look for the “Remain within XX NM.” to determine within how many NM the course reversal procedure must be completed.
- When conducting a HILPT, the holding pattern direction must be flown as depicted, and the specified leg length or timing must not be exceeded.
- Depending on the inbound course to the IAF, a course reversal procedure might not be required. On the approach plate, look for “No PT.” If “No PT” is noted on the approach plate for your arrival course or arrival sector, do not fly the course reversal procedure. In addition, when on Radar Vectors To Final (RVTF), a course reversal procedure is not required.
- The pilot may elect to use a course reversal procedure when it is not required by the IAP but must first receive an amended clearance from ATC. If the pilot is uncertain whether the ATC clearance intends for a course reversal procedure to be conducted or to allow for a straight-in approach, the pilot must immediately request clarification from ATC.

45 Degree Procedure Turn

Maneuver Description: The 45 degree procedure turn, as shown in Figure 3-7, utilizes the 45-180 degree turn benchmarks printed on the instrument approach plate in order to conduct a course reversal.

Procedures

1. Upon crossing the IAF, turn to intercept the outbound course of the instrument approach.

2. When wings level or abeam the station (whichever occurs last), start the clock and time for two minutes.

3. After two minutes, turn 45 degrees toward the protected side of the procedure turn (the outbound heading depicted on the barb).

4. After rolling out on the outbound heading, start the clock and time for one minute.

5. After one minute of timing, initiate a turn in the opposite direction of the previous turn (turn to the inbound heading depicted on the procedure turn barb).

6. Maintain the inbound heading until intercepting the FAC.

7. Continue with the approach in accordance with the instrument approach procedures.

Amplification and Technique

- It is imperative that pilots remain oriented while on a procedure turn. Think through the headings and direction of turns prior to commencing the procedure to remain oriented throughout.

- The 6Ts are an excellent mnemonic device to help maintain orientation and avoid missing any steps while performing a procedure turn. They can be used at the IAF, when turning outbound on the barb, and when turning back inbound on the barb.

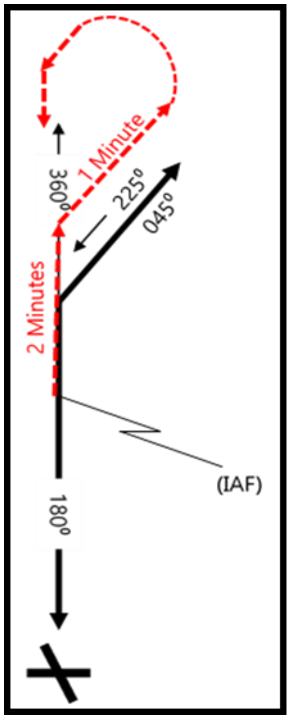

Figure 3-7 45 Degree Procedure Turn

<u>At the IAF</u>:

1. **TIME:** Note.

2. **TURN:** Turn to intercept the outbound course of the instrument approach.

3. **TIME:** Start timing for two minutes.

4. **TRANSITION:** Slow to 90 KIAS for the approach, descend to the next stepdown if required, and perform the Landing Checklist.

5. **TWIST:** Twist the outbound course of the instrument approach into the CDI and track outbound.

NOTE

For an ILS or LOC approach, in order to prevent CDI reverse sensing always twist the FAC into the CDI.

6. **TALK:** As required.

<u>When Turning Outbound on the Barb</u>:

1. **TIME:** Note two minutes of timing complete.

2. **TURN:** Turn to the outbound heading depicted on the barb.

3. **TIME:** Start timing for one minute.

4. **TRANSITION:** Maintain 90 KIAS and adjust altitude as required.

5. **TWIST:** Twist/verify the FAC is in the CDI.

6. **TALK:** Not required.

When Turning Inbound on the Barb:

1. **TIME:** Note one minute of timing complete.

2. **TURN:** Turn in the opposite direction, to the inbound heading on the barb.

3. **TIME:** Not required.

4. **TRANSITION:** Maintain 90 KIAS and adjust altitude as required.

5. **TWIST:** Ensure the FAC is twisted in the CDI.

6. **TALK:** As required.

Teardrop

Maneuver Description: When a teardrop course reversal procedure is depicted on the IAP as in Figures 3-8, unless otherwise authorized by ATC, the procedure must be executed as depicted. The teardrop course reversal procedure consists of a departure from an IAF on the published outbound course followed by a turn toward and intercepting the FAC at or prior to the intermediate fix.

Procedures

1. Upon crossing the IAF, turn to intercept, and track the outbound course.

2. At the depicted DME or fix, start a standard rate of turn as depicted to intercept the FAC.

3. Continue with the approach in accordance with the instrument approach procedure.

Amplification and Technique

- It is imperative that pilots remain oriented while on a teardrop course reversal. Think through the headings and direction of turns prior to commencing the procedure to remain oriented throughout.

- Use the 6Ts to avoid missing any steps while performing the teardrop course reversal. They can be performed at the IAF and when turning inbound.

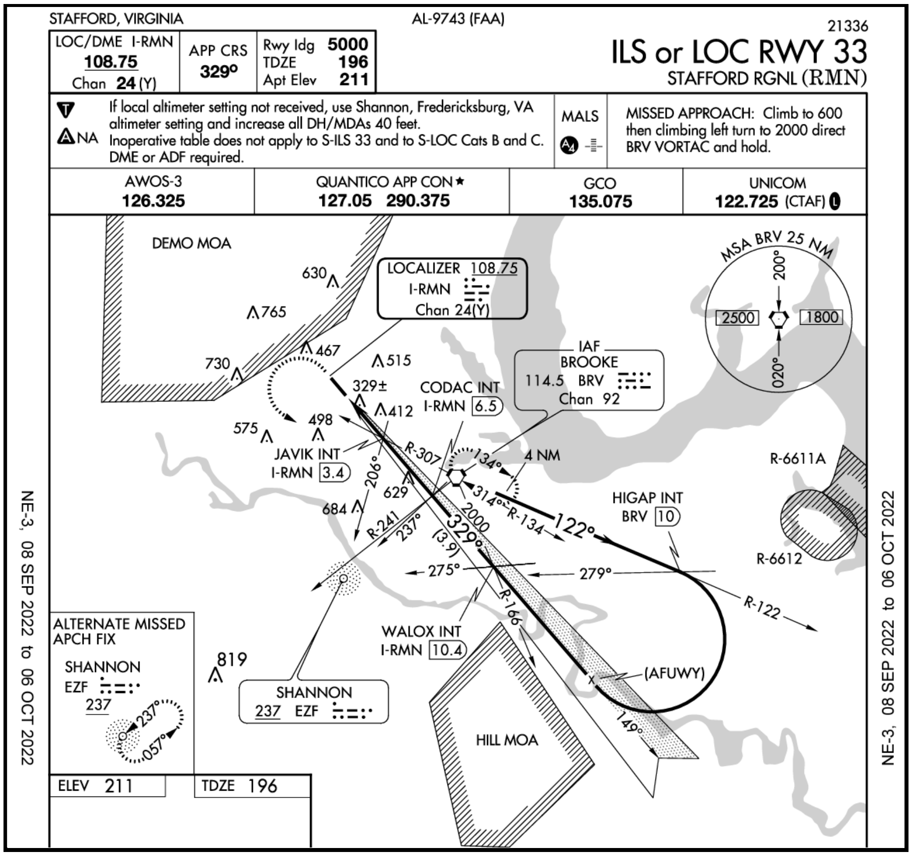

Figure 3-8 Teardrop Course Reversal

<u>At the IAF</u>:

1. **TIME:** Note.

2. **TURN:** Turn toward and intercept the outbound course.

3. **TIME:** Not required.

4. **TRANSITION:** Slow to 90 KIAS for the approach, descend to the next stepdown if required, and perform the Landing Checklist.

5. **TWIST:** Twist the CDI to the outbound course.

6. **TALK:** As required.

At the depicted DME or fix- Turn Inbound:

1. **TIME:** Not required

2. **TURN:** Turn to intercept the FAC.

3. **TIME:** Not required.

4. **TRANSITION:** Maintain 90 KIAS and adjust altitude as required.

5. **TWIST:** Verify the OBS NAV source is set properly and twist the CDI to the FAC.

6. **TALK:** As required.

Hold In Lieu of Procedure Turn or Racetrack

Maneuver Description: A HILPT may be specified for a course reversal in IAPs. In such cases, the holding pattern is established over an intermediate fix or a final approach fix. For a HILPT, the holding pattern direction must be flown as depicted, and the specified leg length or timing must not be exceeded.

Procedures

1. Upon crossing the IAF, use the entry procedure described in this FTI for holding to turn to the outbound heading.

2. At the completion of the outbound leg turn inbound to intercept the FAC.

3. When established on the FAC, continue with the approach in accordance with the instrument approach procedure.

Amplification and Technique

- It is imperative that pilots remain oriented when entering the hold. Plan the entry procedure and think through the headings and direction of turns before reaching the entry point or IAF.

- The 6Ts are an excellent mnemonic device to help maintain orientation and avoid missing any steps while performing a HILPT. They can be used at the IAF, when turning outbound, and when turning back inbound at the completion of the outbound leg.

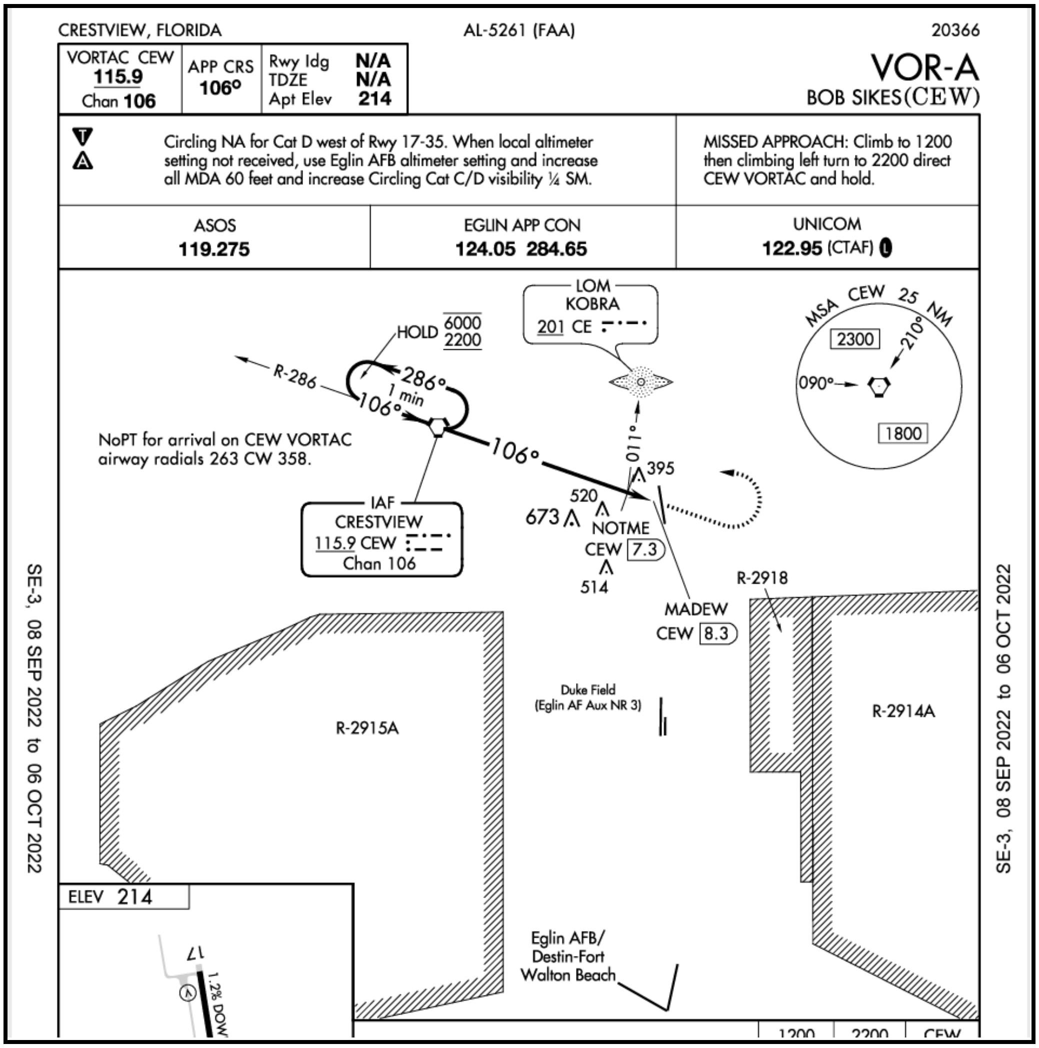

Figure 3-9 HILPT / Racetrack Course Reversal

<u>At the IAF</u>:

1. **TIME:** Note.

2. **TURN:** Turn to the entry outbound heading.

3. **TIME:** If required, start the clock and time for one minute as described in this FTI for holding.

4. **TRANSITION:** Slow to 90 KIAS for the approach, descend to the next stepdown if required, and perform the Landing Checklist.

5. **TWIST:** Twist the CDI to the inbound course.

6. **TALK:** As required.

At the completion of the outbound leg (Timing or DME):

1. **TIME:** Note

2. **TURN:** Turn to intercept the FAC.

3. **TIME:** If required, start the clock and time for one minute.

4. **TRANSITION:** Maintain 90 KIAS and adjust altitude as required.

5. **TWIST:** Ensure the FAC is twisted in.

6. **TALK:** As required.

308. ARCING PROCEDURE

Maneuver Description: Arcs are an instrument procedure that requires the pilot to fly around a NAVAID while maintaining a constant DME.

Application: Arcs are part of an approach procedure and enable the pilot to maneuver to the FAC on TACAN and occasionally for VOR/DME approaches.

Procedures

1. **Turning onto an Arc (Lead Distance):** When turning onto the arc from a radial, the pilot must join the arc by anticipating the turn to avoid overshooting the published DME. The lead distance can be calculated by using a simple equation based on the turn radius of a standard rate turn for 90 degrees.

$$\text{Lead Distance} = 0.5\% \times \text{Ground Speed}$$

Using this equation, a helicopter traveling at 120 knots ground speed begins the turn onto an arc at 0.6 DME prior to the arc DME. A helicopter traveling at 90 knots ground speed would turn onto the arc 0.45 DME (round to .5 DME) prior. If ground speed is not readily available, use Indicated Airspeed (IAS) instead. This equation does not account for wind, so the pilot may need to adjust the AOB throughout the turn.

2. **Departing an Arc onto a Radial (Lead Radial):** When departing an arc to track a radial, the pilot must lead the turn by a few radials to avoid overshooting the desired radial. The ***Rule of Thumb*** assumes that the helicopter is traveling at 100 knots ground speed, is turning 90 degrees off the arc, and is using a standard rate turn. To use the Rule of Thumb, divide 30 by the DME of the arc and lead the turn off the arc by that number of radials.

Radials to Lead by = 30/ DME of the Arc

To fly an arcing approach, accomplish the following:

1. Proceed to the radial and DME where the arc begins.

2. While en route to the arc, determine the lead distance to turn onto the arc and the lead radial to turn off the arc based on ground speed and arc DME.

3. At the appropriate lead distance, turn onto the arc until the head of the needle is at the 90-degree benchmark.

4. Adjust the helicopter heading to maintain arc DME.

There are two ways to maintain DME on an arc:

i. Make a series of small turns to maintain the head of the needle on the 90-degree benchmark at all times.

ii. Make larger turns to place the head of the needle 5–10 degrees above the 90-degree benchmark and hold that heading while allowing the needle to fall to 5–10 degrees below the 90-degree benchmark.

5. While on the arc, twist the CDI to the radial at the end of the arc.

6. At the lead radial, turn off the arc and intercept the new radial.

Amplification and Technique

- It is important to stay oriented on the arc to avoid turning in the wrong direction.
    - Before entering the arc, find the helicopter position on the approach plate and determine which direction you will turn to join and leave the arc.
    - As an aid, remember that the head of the needle will always point toward the NAVAID and the center of the arc.
- Twist in the new desired radial and use the RMI pointer needle to anticipate turning off the arc.
    - The rate at which the CDI is centering can be used to adjust the AOB to roll out on the desired radial.
- Use the 6Ts to remain oriented and avoid missing any steps while performing the arc. They can be performed when joining the arc and when leaving the arc.

When Turning on the Arc (Lead Distance Point):

1. **TIME:** Note the time.

2. **TURN:** Turn onto the arc so that the head of the needle is at the 90-degree benchmark.

3. **TIME:** Not required.

4. **TRANSITION:** Slow to 90 KIAS, descend to the next stepdown altitude and perform the Landing Checklist.

5. **TWIST:** Twist the CDI to the course to be flown after the arc.

6. **TALK:** Not required.

When Turning Off the Arc (Lead Radial Point):

1. **TIME:** Not required.

2. **TURN:** Turn off the arc to intercept the radial.

3. **TIME:** Not required.

4. **TRANSITION:** Maintain 90 KIAS and descend to the next stepdown altitude.

5. **TWIST:** Ensure the correct course is twisted in.

6. **TALK:** As required.

309. HOLDING

Maneuver Description: Holding is the airborne delay of an aircraft at some identifiable fix such as a station, waypoint, intersection, IAF, or a radial/DME as specified by a controlling agency, en route chart, or approach plate while awaiting further clearance.

Application: Holding may be assigned on short notice due to an unforeseen traffic conflict or another aircraft receiving emergency priority handling. The following procedural sequence will allow you to quickly determine the holding entry and establish the pattern without relying on drawing out the pattern beforehand.

Procedures

1. **Determine the outbound heading for the assigned holding pattern.** The outbound heading is the heading while flying away from the holding fix. This heading is either the same heading as the holding radial or the reciprocal of the holding radial. The easiest way to determine the outbound heading is to listen to the holding clearance and visualize the holding

pattern on an approach plate, chart, or kneeboard. For example, if instructed to hold northeast of a fix on the 030 radial at 10 miles, the outbound heading is 030. If instructed to hold southwest on the 030 radial at 10 miles, the outbound heading is 210 (the reciprocal of 030). If holding on the station side (holding course away from NAVAID), the outbound heading is always the reciprocal of the radial. If holding to a fix on the non-station side (holding course toward NAVAID), the outbound heading is the same as the radial you have been cleared to hold on.

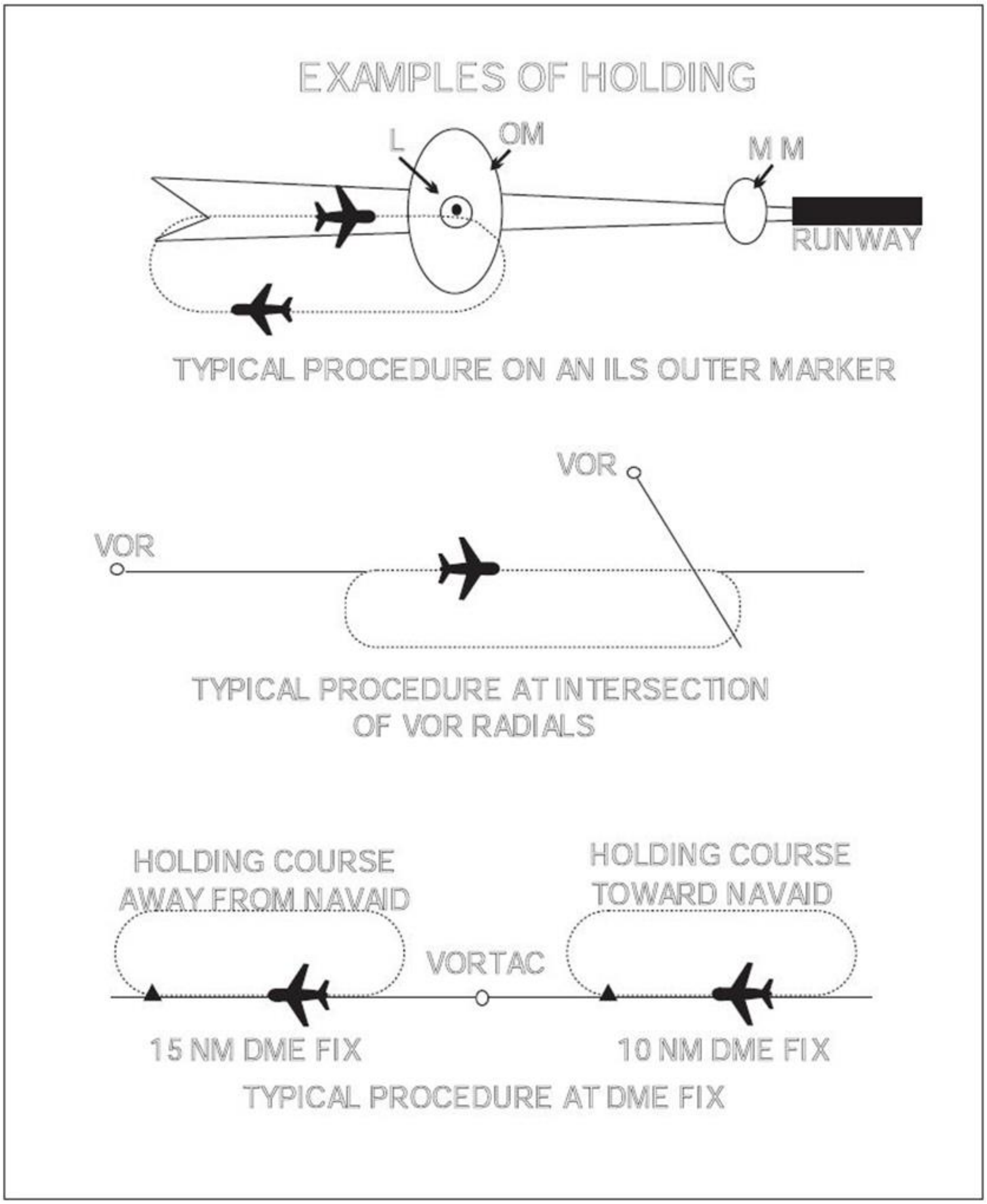

Figure 3-10 Examples of Holdings

2. **Determine the holding entry.** When approaching the holding fix (on the heading you will cross the fix), superimpose the appropriate standard or non-standard holding entry pie diagram over the holding fix. Rotate the entire diagram to align the inbound leg of the diagram with the assigned hold inbound course and determine from which sector you are approaching the holding fix. Based on the approaching sector, complete the entry procedure. The region of the diagram where the outbound heading falls determines the entry orbit. If the outbound heading falls within five degrees of two entry sectors, either entry may be used. It is preferable to choose a teardrop entry over a parallel entry if it is an option. There are three different entry orbits:

a. **Parallel Entry:** When approaching the holding fix from the parallel sector in Figures 3-11 or 3-12, turn to the outbound heading on the non-holding side to parallel the holding course outbound. Maintain the outbound heading for one minute or for the assigned/depicted DME or distance.

b. **Teardrop Entry:** When approaching the holding fix from the teardrop sector in Figures 3-11 and 3-12, turn outbound on the holding side, 30 degrees away from the holding radial. For a standard holding, subtract 30 degrees from the outbound holding heading. For a non-standard holding, add 30 degrees to the outbound holding heading. Maintain the outbound heading for one minute or for the assigned/depicted DME or distance.

c. **Direct Entry:** When approaching the holding fix from the direct sector in Figures 3-11 and 3-12, turn to the outbound heading on the holding side for one minute or for the assigned/depicted DME or distance.

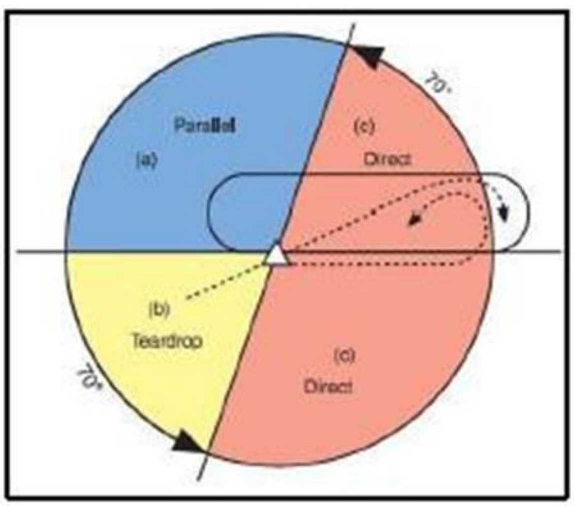

Figure 3-11 Standard Holding Entry Sector Diagram

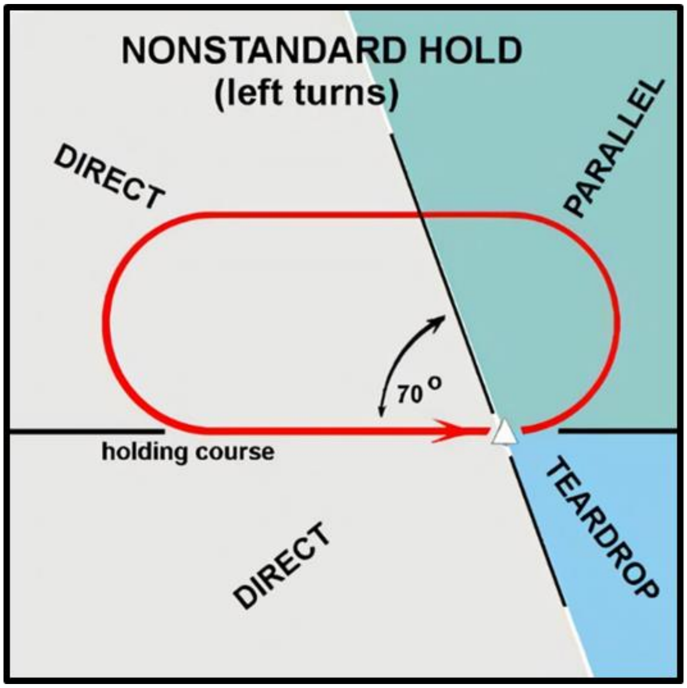

Figure 3-12 Non-Standard Holding Entry Sector Diagram

A useful and more practical way to visualize the appropriate holding entry is to overlay your right hand on the RMI card for standard turns or the left hand on the RMI card for non-standard (left) turns, as depicted in Figure 3-13 and Figure 3-14 and determine in which sector the *outbound holding* heading falls.

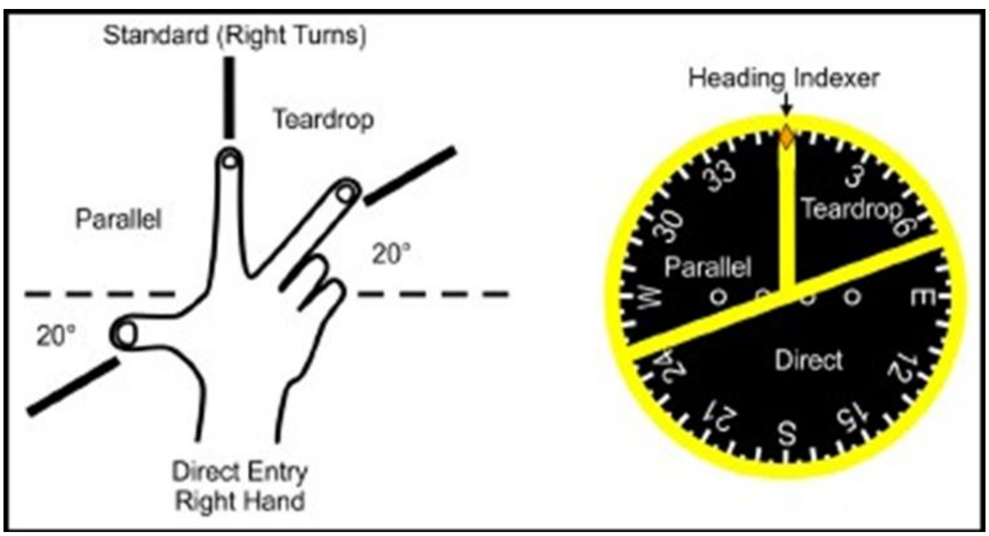

Figure 3-13 Standard Entry Diagram on HSI/CDI Display

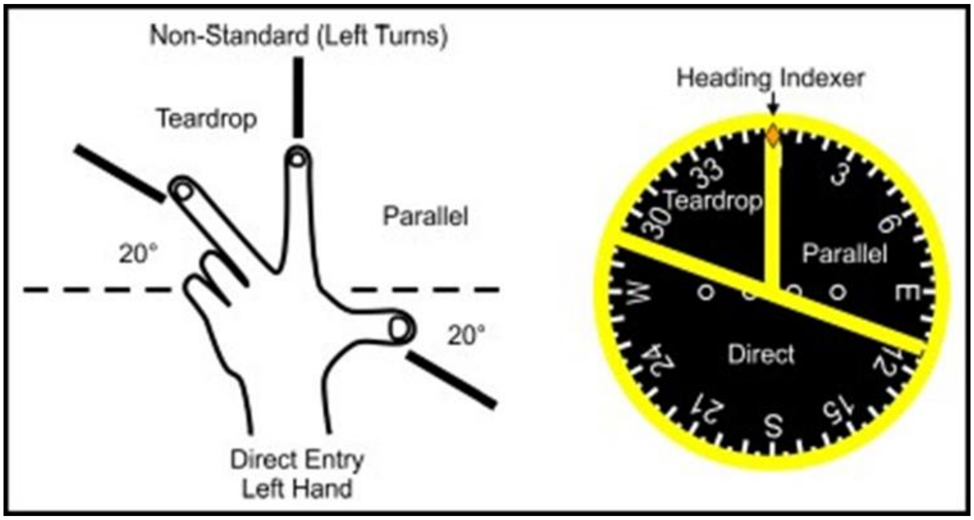

Figure 3-14 Non-Standard Entry Diagram on HSI/CDI Display

3. **Fly the holding pattern.** Upon crossing the holding fix, perform the 6 T's.

- **TIME.** Note the time on initial arrival over holding fix (for Position, Time, Altitude [PTA] report).
- **TURN.** Turn to the appropriate outbound heading.
- **TIME** (VOR). Begin timing when over the fix (for a teardrop entry) or abeam the fix, whichever occurs later. If the abeam position cannot be determined, start timing when the turn to outbound is completed.
- **TRANSITION.** Slow to 90 KIAS for a holding delay and HILPT course reversal procedure.
- **TWIST.** Set the CDI to the inbound course.
- **TALK.** Make a voice report (PTA).

For training purposes, the holding pattern is broken down into three types of orbits, which are accomplished sequentially.

- ***Entry orbit.*** Fly the no wind outbound entry procedure heading. When reaching one minute or required DME outbound, turn toward and intercept the holding radial or bearing (remember tail-radial-turn to establish the direction of turn). Track inbound to the fix.
- ***No wind orbit.*** The no wind orbit is flown to determine wind direction and calculate the crab angle required to maintain the desired radial or bearing. When reaching the holding fix for the second time, turn in the pattern direction to the no-wind outbound

heading. At the end of the outbound leg, turn toward the holding radial/bearing using a standard rate of turn (exceeding a standard rate turn is acceptable when required by wind conditions). Roll out with an intercept as needed for the holding radial and start timing, if required. As you intercept the inbound radial, note the wind direction. This can be done by determining the direction from the tail of the RMI needle to the holding radial and continuing in that direction to determine where the winds are originating (tail-radial-wind). This determines the quadrant the wind is coming from, which can be verified against the weather information from the nearest airport (ATIS, Automated Surface Observing System [ASOS], etc.) and from the wind information provided by the aircraft FMS. There are three possible outcomes:

- On course with no crosswind component
- Undershoot with a crosswind from the non-holding side of the pattern
- Overshoot with the crosswind component from the holding side of the pattern

Intercept the radial and apply a crab correction into the wind to maintain the inbound course.

- ***Wind corrected orbit.*** When reaching the holding fix, note the time needed to fly inbound (VOR). Use this information to adjust the outbound timing to ensure one-minute timing inbound. If the time inbound is more than one minute (headwind component), the outbound time will be determined by subtracting the extra time inbound. For example, if the inbound time is 70 seconds, the outbound time will be adjusted to 50 seconds. If the time inbound is less than one minute (tailwind component), the outbound time will be determined by adding the extra time inbound. For example, if the inbound time is 55 seconds, the outbound time will be adjusted to 65 seconds. To determine the outbound heading correction, *double* the amount of the crab angle used to track the inbound course and apply it to the outbound course into the wind. Monitor the wind corrections on subsequent orbits to refine the wind corrections for accuracy.

Amplification and Technique

- The following information will be given in a holding clearance when the holding pattern is not depicted:
  - Direction of the holding pattern from the holding fix
  - Name of the holding fix
  - Bearing, radial, airway, or route on which the helicopter is to hold
  - Leg length in miles if DME or Area Navigation (RNAV) is used

- Left turns if a non-standard pattern is used
- Expected further clearance time
- Holding altitude (not required if remaining at present altitude)

ATC may omit all holding instructions for published holding patterns except holding direction and the statement "as published."

- Unless otherwise instructed by ATC, pilots are expected to hold as depicted or in a standard pattern.

- If you receive a clearance limit (i.e., cleared to a point short of the filed destination) and holding instructions have not been issued, hold as depicted at that fix. If no pattern is depicted, ask for holding instructions prior to reaching the fix. If unable to receive holding instructions prior to reaching the fix, hold in a standard pattern on the course on which the helicopter approaches the fix. Maintain the last assigned altitude unless otherwise directed.

- When directed to hold, determine the impact of a delay on fuel state and current helicopter status prior to accepting a holding clearance. If you determine that you cannot accept a delay due to the fuel state, notify ATC immediately.

- During an unplanned holding delay, consider holding at the maximum endurance airspeed to preserve fuel on board.

- The helicopter is abeam when it is positioned exactly 90 degrees relative to the holding bearing/radial, not necessarily when the needle passes through the 3:00/9:00 (or 90/270) position on the RMI. Remember, your position is always on the tail of the needle. (The TO-FROM flag is not used to indicate the abeam position).

- ***At the end of each outbound leg, always turn toward the holding radial (tail-radial-turn) regardless of the pattern direction.*** If the proper inbound course is twisted into the HSI (VOR, TACAN, GPS), this turn will be toward the deviation bar. If you are on the radial at the end of the outbound leg, turn toward the protected side of the pattern.

- Make all turns during entry and while holding at a standard rate (three degrees per second). Ensure you maintain constant airspeed on the inbound and outbound legs. Failure to do so will result in incorrect timing when performing one-minute legs.

- Update expected further clearance (EFC) time at least five minutes prior to EFC.

- While in holding, plan ahead for the follow-on navigation or approach. If you plan on executing an approach after holding, prepare for the approach (WRNTB, WAR, etc.) while holding.

- Report leaving holding (PTA format not required).

310. FUEL BURN RATE CALCULATIONS

Description: Determine how much fuel the helicopter is burning per hour using actual fuel amounts over a period of time to determine aircraft endurance and aircraft range.

Application: Pilots should always be aware of how quickly the helicopter is using fuel. In the event of unexpected weather or an emergency, the pilot will use the calculated fuel burn to determine how long the helicopter can remain airborne or how far it can fly. Fuel planning, fuel burn rate calculations, tracking, and managing the fuel on board are all critical skills that a pilot must have. Fuel burn calculation starts with a detailed fuel planning requirement and by determining the minimum fuel requirement for your flight. Actual flight conditions may be different than planned, so it is important to verify the fuel burn rate throughout the flight. During your flight should always:

1. Track helicopter's fuel burn rate and fuel quantity.

2. Determine how much fuel you have burned and how much fuel you have available.

3. Determine the helicopter's endurance based on the fuel onboard and the fuel burn rate.

4. Determine if you can get to your destination and plan for any flight plan deviations as necessary.

To accomplish all the above steps, the pilot must perform fuel consumption checks and keep a fuel log.

Procedures

1. Before takeoff, note the time and the current fuel onboard,

VV4E017 Fuel Log	
Fuel on Board	Time
850 lbs	0925

2. Perform fuel consumption checks at regular intervals, for example, every 20 or 30 minutes,

VV4E017 Fuel Log	
Fuel on Board	Time
850 lbs	0925
725	0945
640	0958

3. Subtract the fuel burned from the last fuel check,

Fuel burned in 20 minutes is: $850 - 725 = 125\ lbs$

4. Calculate the fuel burn rate per hour,

For your first fuel check after 20 minutes of flight (1/3 of one hour/60 minutes), you have used 125 lbs of fuel. Fuel Burn Rate is: 125 x 3 = 375 lbs/hr. To be conservative, always round up fuel burn rate. For example, a fuel burn rate of 375.2 lbs/hr will be rounded up to 376 lbs/hr. If using irregular timing intervals first divide this timing into 60 and then multiply by the amount of fuel burned. For example, after your second fuel check it's been 33 minutes since takeoff and you have burned 210 lbs of fuel. Divide the time into 60 (60 / 33 = 1.82) and multiply this by the fuel you have used (210 x 1.82 = 382.2 = 383 lbs/hr).

5. Calculate how much fuel you can burn,

Suppose you have to be on deck with 170 lbs (50 lbs NATOPS requirements plus 20 minutes fuel reserve at 360 lbs/hr, which is 120 lbs). You will have 640 – 170 = 470 lbs of fuel available.

6. Calculate the aircraft endurance,

Using the fuel burn rate and the fuel available on board, you can calculate the aircraft's endurance by dividing the fuel on board by the fuel burn rate.

$$\text{Endurance: } {}^{470}\!/_{383} = 1.23\ hrs\ of\ endurance.$$

To be conservative, always round down the endurance. 1.23 hrs rounded down is 1.2 hrs (1 hour and 12 minutes of endurance). Now determine if you have enough endurance to accomplish the event.

7. Repeat the above steps multiple times during the flight and make the appropriate flight plan deviations as necessary.

Amplification and Technique

- To perform fuel calculations, you must have a calculator available. Download the calculator app on your iPad.
- When determining fuel burn rate, use interval times that allow easy and quick calculation. Use 15, 20, or 30 minutes between fuel checks.
- Use cruise fuel consumption checks to determine the most accurate fuel burn rate. Initial flight fuel burn rate calculation might be affected by the initial climb-out procedure and might not be a good representation of the overall fuel burn rate. Cruise fuel burn rate calculations are a better representation of the overall fuel burn rate.
- Compare planned fuel calculation to the fuel burn rate calculations. Looking at the fuel planned vs. actual fuel used allows the pilot to make quick and critical decisions.

311. APPROACH TIMING CALCULATIONS

Description: Determine the correct timing to identify the Missed Approach Point (MAP) on a Localizer or VOR approach.

Application: When using timing to identify the MAP, the pilot must know the helicopter's current headwind component and ground speed. Before initiating an approach that requires timing, the student or the observer must calculate the FAF to MAP timing. Use We Really Need To Brief (WRNTB) acronyms to remember timing calculations.

NOTE

> SNAs are not required to come up with precise mathematical timing. The SNAs goal is to estimate a realistic timing by interpolating the Approach Timing Table. Timing is not a precise method to determine the MAP due to the many variables that affect timing, such as wind and aircraft airspeed control.

Procedures

1. Before initiating the approach, retrieve airport wind information via the aircraft's Flight Information Services – Broadcast (FIS-B), ATIS, AWOS, or ASOS weather services.

2. Retrieve FAC from the approach plate.

3. Using figure 3-15 wind direction diagram determine the head/tail wind component. Remember you control the scale on the diagram so use a factor that will keep the plotted point toward the outside. For example, if the winds are 10kts use the "50" ring and make your factor a 2. The wind direction diagram is available in the TW-5 In Flight Guide.

4. Subtract the headwind component or add the tailwind component to the helicopter approach speed to determine the aircraft's Ground Speed (GS) when on the approach's FAC.

5. Use the approach timing table to approximate FAF to MAP timing.

Example:

On the wind direction diagram in Figure 3-15, notice "direction of flight/runway." This is your FAC.

Calculate the head/tail wind component for a FAC of 030° and surface wind of 090°/20Kts. The approach speed is 90 KIAS. After calculating the helicopter GS, determine the FAF to MAP timing.

1. Determine the wind direction relative to the FAC (angle between the FAC and the wind): 060°

2. Plot on the 060° relative wind the intensity of the wind: 20 Kts

3. On the vertical axis of the diagram read the tailwind component: 10 Kts headwind. On the lateral axis read the crosswind component: 18 Kts

4. Calculate the FAC's GS. Subtract headwind components from helicopter IAS or add tailwind components to helicopter IAS: 90 – 10 = 80 Knots GS.

5. Use 80 Kts GS to determine approach timing by using the approach timing table.

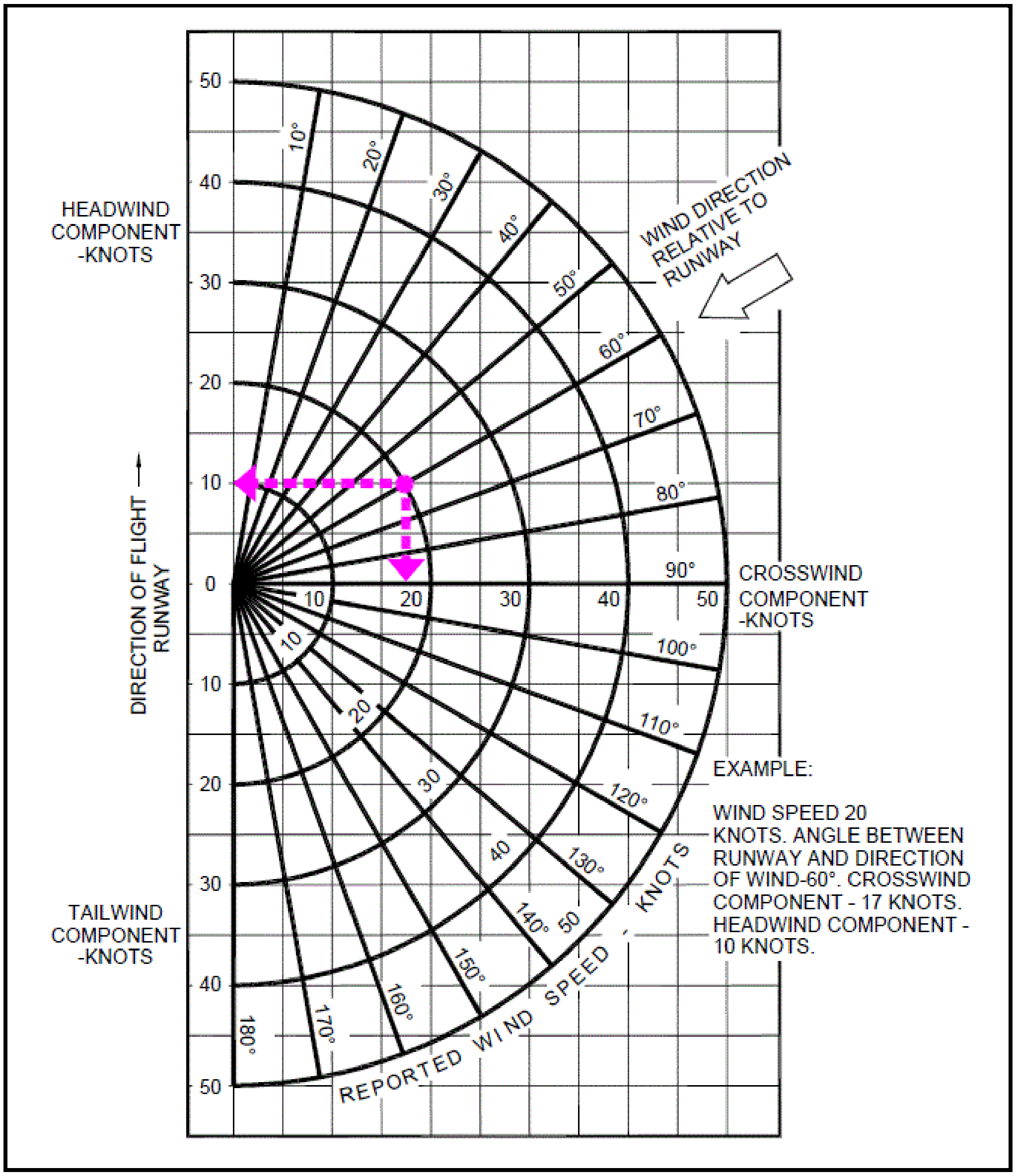

Figure 3-15 Wind Direction Diagram

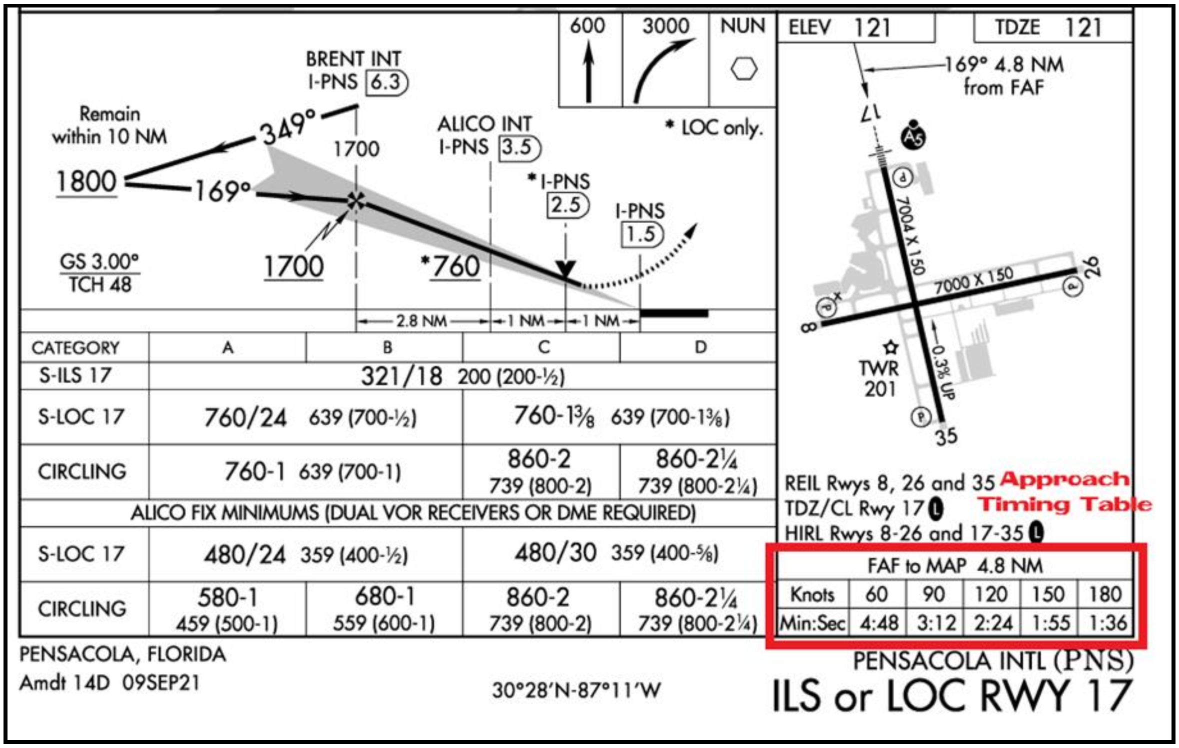

Figure 3-16 Approach Timing Table

For the above example a groundspeed of 80 Kts the approach timing is approximately 3 minutes and 40 seconds.

Amplification and Technique

- The FAF to MAP distance is located below the airport diagram on the approach plate.

- An alternate method to calculate timing is to divide the FAF-MAP distance by the GS (Time to MAP = $\frac{Distance\ FAF\ to\ MAP}{Ground\ Speed}$). The time will be in hours, and you will need to convert it in seconds. You might need a calculator to use this method.

Example: FAF to MAP distance is 4.8 NM, and the GS on the FAC is 80 Kts.

$$\text{Time to MAP} = \frac{4.8}{80} = 0.06\ hrs = 3\ minutes\ and\ 36\ seconds\ (3 + 36)$$

To convert hours into minutes and seconds multiply the hours by 60 (0.06 x 60 = 3.6 minutes), take the decimal minutes, and multiply them by 6 (6 x 6 = 36 seconds) = 3 minutes and 36 seconds.

- Loading the approach in the FMS allows for MAP identification. It can be used as the primary method for MAP identification. Back up the MAP with time.

- GS must be used to calculate timing, but the approach must be flown using IAS.

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CHAPTER FOUR
RADIO INSTRUMENT APPROACH PROCEDURES

400. INTRODUCTION

Instrument approaches are an integral part of every Naval Aviator's education. During the BI phase, you will review the necessary skills to complete a TACAN or VOR approach. As you advance into the RI phase, you will review and build upon the BI phase skills to conduct other types of instrument approaches, including ILS, localizer, and GPS approaches.

Instrument approaches can be broken into four phases: approach setup and brief, transition from the en route environment, approach execution, and actions at the MAP.

401. APPROACH SETUP AND BRIEF

A meticulous cockpit setup is vital to successfully executing an instrument approach. Pilots must plan and prepare for the approach well before the IAF. There are several useful acronyms to aid in remembering the required tasks.

WRNTB

This acronym is easily remembered by using the mnemonic "**W**e **R**eally **N**eed **T**o **B**rief," which stands for Weather, Request, NAVAIDs, Timing, and Brief.

1. **W**eather: Obtain weather for the destination airport using ATIS, ASOS, Automated Weather Observing System (AWOS), or, if unable to receive any of those, ask ATC. At a minimum, obtain **WAR** (**W**eather, **A**ltimeter, and **R**unway in use) to make an informed decision on which approach to shoot at the destination.

2. **R**equest: Request the approach upon check-in with the appropriate controlling agency.

3. **N**AVAIDs: Set up the navigational aids for the approach to be flown. Use the acronym **TIN-STM** during setup.

4. **T**iming: Compute timing from the FAF to MAP if it is required for the approach.

5. **B**rief: Ensure the crew is aware of the plan by briefing the approach.

TIN-STM

Use TIN-STM to assist with cockpit setup for the instrument approach. It is also useful during an instrument departure or anytime switching NAVAIDs. It stands for **T**une, **I**dentify, **N**eedles, **S**elect, **T**wist, **M**inimums.

1. **T**une: Tune the NAVAID frequency.

2. **I**dentify: Ensure the appropriate NAVAID identifier is displayed on the PFD. If it is not displayed, listen to the Morse code identifier via the Radio Management Panel.

3. **N**eedles: Ensure the correct pointer needles (VOR1, VOR2, TCN1, or ADF1) are displayed on the HSI. There is no option for a GPS needle. The active waypoint will appear as a star on the HSI showing the direction to the active waypoint.

4. **S**elect: Select the appropriate navigation source (FMS, VLOC1, VLOC2, or TCN1) for the course needle.

5. **T**wist: Twist in the appropriate course.

6. **M**inimums: Set the Barometric Altimeter bug (MIN ALT) to the Decision Height (DH) or Minimum Descent Altitude (MDA), as appropriate.

Approach Brief

Verbalizing the approach brief allows the PNAC to create a shared mental model for the crew. It also serves as a final check of the approach plan and setup. The approach brief should be concise and hit the most important pieces of information on the approach plate. There is no expectation for the PAC to memorize the approach plate. Instead, the PAC should ask the PNAC for any required information, such as FAF and MAP locations, step-down altitudes, or clarify anything forgotten.

If the approach changes due to weather, approach clearances, or other factors, brief the new approach to the crew. Avoid adding extra information to the approach brief; expect that your copilot understands the procedures. Be concise when speaking on ICS to avoid blocking radio calls.

Brief the following items prior to commencing an instrument approach:

1. Approach Name

2. Approach weather minimums vs. current weather conditions

3. FAF and FAC

4. Definition of the MAP (DH, DA, MDA, and DME, or MDA and timing) and Approach Lighting System, if applicable

5. Terminal Procedures once the airport environment is in sight

Example:

“This will be the COPTER TACAN 004 to South Whiting. The weather required for the approach is 400 and 1/2. The current weather is 800 and 5. The Final Approach Fix is NELOE, and the FAC is 004. The Missed Approach Point is WUBLA at 2.2 DME off of the NSE TACAN with an MDA of 560 feet. When we break out, runway 5 will be off the nose. We can anticipate a left turn to intercept the right base for runway 5 spot 1 for the line. Are there any questions?"

402. TRANSITION FROM THE EN ROUTE ENVIRONMENT

There are several ways to transition from the en route environment to the destination airport's terminal environment, including feeder routes, radar vectors, and Standard Terminal Arrival Routes (STARs). The instructions from ATC may be based on the filed IFR flight plan, airspace traffic separation requirements, and/or controller workload. During the flight, remain flexible, listen to radio calls, and comply with ATC's instructions even if they are different than expected.

403. FLYING THE INSTRUMENT APPROACH

After completing the approach set up, approach brief, and receiving ATC's clearance for the approach, it is time to execute the approach.

6Ts

Although the steps to fly an instrument approach may vary slightly based on the NAVAID in use and the procedures required, using the 6Ts will help the pilot remain oriented throughout the approach. The 6Ts will be used twice during each approach: at the IAF (or on the base leg if receiving radar vectors to final) and at the FAF. The 6Ts are also useful during other phases of the approach, such as entering a course reversal procedure or holding pattern.

Depending on the situation, you may not have an action for every T, but verbally acknowledging each item ensures no step is missed and builds a consistent habit pattern.

1. **TIME**: Start timing at the FAF or note the entry time for a holding pattern.

2. **TURN**: Turn to intercept the course or heading.

3. **TIME**: Note time or start timing during a holding pattern or course reversal procedure outbound (wings level or abeam the fix outbound).

4. **TRANSITION**: Decelerate to approach speed, descend, and/or complete Landing Checklist as required ("Lower, Slower, Landing Checks").

5. **TWIST**: Set desired course in HSI.

6. **TALK**: Make any required radio calls or perform a gas and gauges check.

Terminal Procedures

At the MAP, determine if the runway environment is in sight and a safe landing can occur. The PAC must transition to landing based on ATC's landing clearance. Anticipating what the terminal environment will look like and what maneuvering will be required (if any) to transition to a safe landing will reduce pilot workload while flying from IMC into VMC. This is why Terminal Procedures are a part of the instrument approach brief.

Using the Airport Diagram on the instrument approach plate can help you visualize a flight path based on ATC's approach clearance. An example Airport Diagram is shown below in Figure 4-1. Know the runway in use (which should have been gathered with WAR for the approach brief), the approach lighting system, and whether the landing clearance is for a straight-in, circle-to-land, or sidestep maneuver.

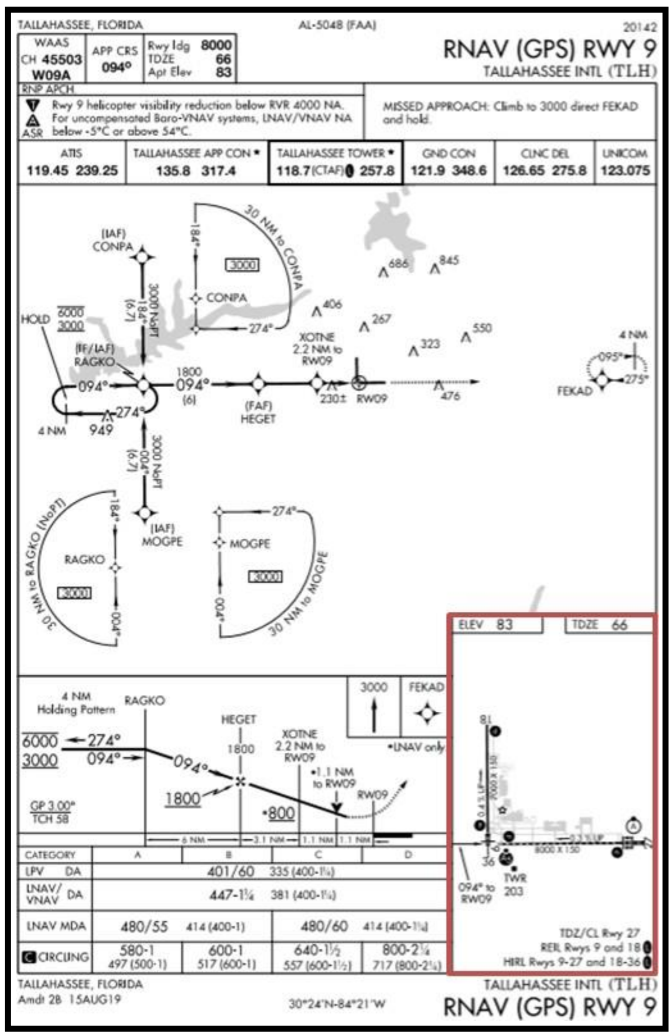

Figure 4-1 Airport Diagram Example on the KTLH RNAV (GPS) RWY 9 Approach Plate

Missed Approach

At the MAP, if the pilot does not have the runway environment in sight, a safe landing is not possible, or if directed by ATC, the pilot shall execute the missed approach procedure. A good acronym for executing a missed approach is PASTT Gas and Gauges. It is important to be methodical and complete each step to start an expeditious climb away from obstacles and communicate follow-on intentions to ATC.

PASTT Gas and Gauges

- **P**OWER: Set climb power setting.
- **A**TTITUDE: Adjust the nose attitude for a climb.
- **S**EARCHLIGHT: Turn off.
- **T**URN: As required, to comply with missed approach or climb out instructions.
- **T**ALK: Make missed approach radio call with the reason for missed approach and your intentions.
- **GAS**: Note quantity.
- **GAUGES**: Check all instruments to ensure normal operation.

404. CRM IN THE INSTRUMENT ENVIRONMENT

CRM is vital during an IFR flight. There are no single-seat helicopters in Naval Aviation, so Advanced Helicopter Training is the time to cultivate a multi-person crew mentality. In the fleet, both pilots and any aircrew onboard work as a team to complete the mission.

CRM in the NATOPS Brief

Good instrument CRM begins during the NATOPS brief. During the brief, assign tasks to the crewmembers and discuss the PNAC's role in copying clearance, tuning avionics, and other tasks requested by the PAC. By performing these tasks, the PNAC allows the PAC to focus on flying the helicopter safely. BI and RI flight crews include an observer, who is a member of the crew as well. If tasked, the observer can help calculate timing for approaches or fuel burn in addition to providing a lookout for traffic.

Discuss when the PAC can expect the PNAC to question flight parameter exceedances. The PNAC should back the PAC up on the flight instruments throughout the flight to ensure the PAC does not deviate from the assigned parameters. The deviations that trigger a comment from the PNAC or aircrew will vary from flight to flight based on the mission, but for instrument flight, the following parameters are typically used:

- Altitude errors in excess of 100 feet
- Airspeed errors in excess of 10 KIAS
- Heading errors in excess of 10 degrees
- Rate of climb or descent greater than 1,000 fpm
- AOB in excess of 30 degrees

Decide if the pilots will transfer controls at the bottom of the instrument approach. When ceilings and visibility are low, the PNAC may take the controls when they have the runway in sight. The previous PAC maintains an instrument scan in case the helicopter re-enters IMC while maneuvering to land. The new PAC maintains a VFR scan and lands the helicopter. If the crew experiences IMC or loses sight of the airfield after the controls have been transferred, the pilot who remained on the instrument maintains an instrument scan, takes the controls, and executes the missed approach. This technique enables one pilot to maintain an instrument scan while the other maintains an outside scan. By transferring controls, the pilots limit the possibility of spatial disorientation as they switch from instrument scans to VFR scans and back. The discussion of whether or not to transfer controls may be revisited in flight, but it should first be addressed during the NATOPS brief to set the crew’s expectations for the day.

CRM during the Flight

The flight should follow through with a strong CRM environment established during the brief. Every pilot has their own techniques when it comes to CRM, but there are several things that pilots can do to encourage good CRM amongst the crew.

When executing a control transfer, use a positive, three-way change of controls with a quick synopsis of the current flight regime. For example, “You have the controls. Heading 180, descending to 1,700 feet.”

Part of CRM is deciding who will fly when. When preparing for an instrument approach, the pilot who is going to fly the approach typically sets up and briefs the approach. However, the PAC may ask the PNAC to perform a portion of the setup. In training, the instructor will expect the student to pass the controls in order to set up and brief the approach. Before passing the controls, complete the departure or climb-out procedures from the previous approach.

During the approach, the PNAC should follow along on the approach plate and provide information to the PAC as required. Although the PAC typically briefs it, there is no expectation that the PAC has memorized the approach. When the PAC needs information about the approach, such as the next step down or the DME of the FAF, they should ask the PNAC to read the information from the approach plate. The PNAC should be tracking the approach and anticipating the PAC’s information requests. For example, after passing the FAF, the PNAC may remind the PAC of the MDA before the flying pilot asks.

4-6 EMERGENCIES IN IMC

405. TACAN/VOR APPROACH

Description: TACAN and VOR approaches are non-precision approaches that utilize NAVAIDs for lateral guidance on the FAC. TACAN and VOR/DME approaches provide slant range distance information used to identify certain fixes along the approach path and FAC. Pure VOR approaches (no distance information available) utilize timing started at NAVAID station passage to identify the MAP. Both TACAN and VOR approaches are flown to a MDA.

Procedures

1. Before reaching the IAF, execute WRNTB (**W**e **R**eally **N**eed **T**o **B**rief).

   a. **W**EATHER: Obtain current weather information to determine **W**eather, **A**ltimeter, and **R**unway in use (**WAR**). Consider listening to one turn in ATIS prior to switching the frequency to the terminal area controller.

   b. **R**EQUEST: Communicate approach request with ATC.

   c. **N**AVAIDs: Tune required NAVAIDs using the TIN-STM acronym.

   d. **T**IMING: Compute timing for the approach, if required.

   e. **B**RIEF: Communicate the Approach Brief to the crew and discuss PNAC responsibilities.

2. At the IAF (or on the base leg during vectors to final), execute the 6Ts.

   a. **TIME**. Note time.

   b. **TURN**. Turn as required to intercept the approach course. The turn will depend on whether the pilot is conducting a full procedure turn, an arc, or vectors to final.

   c. **TIME**. Start timer outbound when wings level or abeam the station as required for a procedure turn.

   d. **TRANSITION**. Decelerate to a final approach speed of 90 KIAS, descend if required, and complete the Landing Checklist (“Lower, Slower, Landing Checks”).

   e. **TWIST**. Set desired course on the HSI. This may be the outbound course on the procedure turn, the radial at the end of an arc, or the FAC, depending on the approach procedure.

   f. **TALK**. Make voice report to ATC, as required, or request a gas and gauges check.

3. Recheck the approach procedure depicted on the approach plate, comply with altitude restrictions, and make voice reports as directed. Proceed to the FAF.

4. At the FAF, execute the 6Ts.

   a. **TIME**. Start the timer for a VOR approach, as required.

   b. **TURN**. Intercept the FAC.

   c. **TIME**. Ensure the timer is counting.

   d. **TRANSITION**. Descend to the MDA, adhering to intermediate altitude restrictions if published. Review that the Landing Checklist is complete.

   e. **TWIST**. Set FAC on the HSI.

   f. **TALK**. Make voice report, as required.

5. Maintain the MDA until reaching the MAP (DME or timing). At the MAP, transition to a visual scan with runway environment in sight or execute the Missed Approach.

Amplification and Technique

- Transition from the en route structure to the IAF may occur in the following ways:

  - ***Radar vectors to the FAC***. ATC vectors the helicopter to intercept the FAC, expediting the approach and eliminating the need for a course reversal procedure. Maintain cruise airspeed until cleared for the approach, then execute the 6Ts with emphasis on TRANSITION ("Lower, slower, Landing Checks").

  - ***ATC clearance direct to the IAF***. In this case, the pilot should expect to execute the published approach, including the course reversal procedure, unless instructed otherwise. The approach may include a procedure turn, a hold-in-lieu of a procedure turn, or an arc (see Chapter Three for review). Depending on the angle of approach to the IAF, the approach may say "No Pt," which means no procedure turn/course reversal procedure is required. After crossing the IAF proceed to the FAF as depicted on the IAP.

- VOR approaches with no DME provide no range information between the NAVAID and the helicopter. Therefore, it is prudent to plan a comfortable rate of descent inside the FAF to ensure you reach the MDA prior to arriving at the MAP. The intent is to have sufficient time to visually acquire the runway environment.

- Cockpit organization is imperative for successfully completing an instrument approach. If time permits, consider setting up backup NAVAIDs to increase situational awareness during the approach.

- TACAN and VOR approaches require the pilot to track a radial. Make wind corrections as needed to maintain the published radial on the approach plate.

- The tail of the TACAN or VOR needle indicates the helicopter's current radial. This is the primary course indicator. If any disparity exists between the CDI/HSI and the TACAN or VOR needle, utilize the needle for navigation.

- If a Visual Descent Point (VDP) is depicted on the instrument approach, do not descend below the MDA until at the VDP or beyond it.

- If time permits, load the approach in the FMS.

Common Errors and Safety Notes

- The barometric altimeter minimum bug is set during TIN-STM to back up the crew and prevent flying below the MDA. Even if you reach the MDA prior to the MAP, it is critical you maintain that altitude until the airport is in sight for terrain avoidance.

- Ensure the correct RMI's navigation needle is selected from the bottom DECLUTTER menu on the PFD to ensure accurate NAVAID information for the approach.

CRM

- PNAC reviews the instrument approach and sets up NAVAIDs. (Situational Awareness)

- PNAC gives the Approach Brief to the crew. (Communication)

- PAC/PNAC asks the controller for clarification of instructions as needed. (Assertiveness)

- PAC directs the PNAC to start timing when appropriate. (Communication)

- PNAC follows the approach on the plate and provides information to the PAC as necessary. (Communication)

- PAC ensures Landing Checklist complete. (Situational Awareness)

- PNAC looks out for the runway environment and reports "runway in sight." (Situational Awareness)

References

- *NIFM, Chapter 22 TACAN Approach Procedures*

- *AIM, Chapter 1 Section 1 Navigation Aids*
- *AIM, Chapter 5 Section 4 Arrival Procedures*
- *AIM, Chapter 5 Section 5 Pilot/Controller Roles and Responsibilities*

406. RNAV (GPS) APPROACH

Description: The two GPS onboard the TH-73A utilize satellite and Wide Area Augmentation System (WAAS) information to provide precise navigation guidance in flight. There are several types of RNAV approaches, and the TH-73A is capable of conducting all of them. Keep in mind that each type has its own equipment requirement and weather minima. However, for any RNAV approach, the helicopter must have Receiver Autonomous Integrity Monitoring (RAIM) capability and a current navigation database. The system will default to an approach with vertical guidance if one is available (i.e., Localizer Performance with Vertical [LPV]). LPV approaches with DA equal to or less than 300 ft AGL are logged as precision approaches. All other RNAV approaches are designated as non-precision approaches. The types of RNAV approaches include:

- **Lateral Navigation (LNAV):** Lateral guidance only with uniform sensitivity along FAC. Flown to an MDA.
- **Localizer Performance without Vertical Guidance (LP):** Lateral guidance only with sensitivity increasing closer to the runway. Flown to an MDA.
- **Lateral Navigation/Vertical Navigation (LNAV/VNAV):** Lateral and vertical navigation provided. Internally generated glideslope derived from WAAS information. Flown to a Decision Altitude (DA).
- **Localizer Performance with Vertical Guidance (LPV):** Highly accurate lateral and vertical guidance provided. Uses WAAS and angular guidance to increase sensitivity closer to the runway, with similar accuracy to an ILS. Flown to a DA.

Procedures

1. Before reaching the IAF, execute WRNTB (**W**e **R**eally **N**eed **T**o **B**rief).

    a. **W**EATHER: Obtain current weather information to determine **W**eather, **A**ltimeter, and **R**unway in use (**WAR**). Consider listening to one turn in ATIS prior to switching the frequency to the terminal area controller or use secondary VHF/UHF radio to obtain weather information.

    b. **R**EQUEST: Communicate approach request with ATC.

    c. **N**AVAIDs: Load the approach in the FMS using TIN-STM acronym. Keep in mind that no bearing pointer needles are required to shoot the approach.

NOTE

The Genesys FMS allows the pilot to select Vectors to Final (VTF) as the IAF transition. This loads an extended FAC from the FAF to account for intercepting the final at any point. Because of the approach layout for KNDZ and proximity to R-2915A, do NOT load VTF for the RNAV 32 at KNDZ because the FAC will draw into the restricted area.

d. **T**IMING: Not required.

e. **B**RIEF: Communicate the Approach Brief to the crew and delegate copilot duties.

2. At the IAF (or on the base leg during vectors to final), execute the 6Ts.

a. **TIME**. Note time.

b. **TURN**. Turn as required to intercept the approach course. The turn will depend on whether the pilot is executing the full procedure or vectors to final.

c. **TIME**. Not required.

d. **TRANSITION**. Decelerate to the final approach speed of 90 KIAS, descend if required, and complete the Landing Checklist ("Lower, Slower, Landing Checks").

e. **TWIST**. Not Required, but verify the active waypoint is correct.

f. **TALK**. Make voice report, as required.

3. Recheck the approach procedure depicted on the approach plate, comply with altitude restrictions, and make voice reports as directed. Proceed to the FAF.

4. Prior to reaching the FAF, ensure the GPS is in approach mode. ***If the GPS is not in approach mode within 2 NM of the FAF, DO NOT commence the approach***. The data the GPS is providing is incorrect or not accurate enough to safely conduct the approach.

5. At the FAF, execute the 6Ts.

a. **TIME**. Not required.

b. **TURN**. Intercept the FAC.

c. **TIME**. Not required.

d. **TRANSITION**. Descend to the DA or MDA. Review that the Landing Checklist is complete.

e. **TWIST**. Not Required, but verify the active waypoint is correct.

f. **TALK**. Make voice report, as required.

6. If flying an LPV or LNAV/VNAV approach, follow the course and glideslope information to the DA. If flying an LP or LNAV approach, descend to the MDA while adhering to any published step-down altitudes on the FAC.

7. At the MAP, transition to a visual scan with runway environment in sight or execute the missed approach.

Amplification and Technique

- There are multiple ways to load a GPS approach. Practice loading approaches using the Partial Task Trainer (PTT) or reference the Genesys Pilot's User Guide to learn how to manipulate flight plans and load instrument approaches in the TH-73A.

- When shooting multiple practice approaches, review the flight plan frequently. Delete any waypoints or instrument approaches that are no longer needed to prevent confusion and inadvertently selecting the wrong waypoint.

- If being vectored to a particular leg on the approach, ensure that leg is activated. The FMS will not automatically sequence ahead if ATC vectors the helicopter in front of the active leg.

Common Errors and Safety Notes

- To conduct an RNAV approach, the GPS must be in approach mode. The GPS will not transition to approach mode if it has lost RAIM capability or a waypoint other than the FAF is active. If the GPS is not in approach mode and the cause cannot be determined and rectified, do not continue with the approach. Contact ATC and request a different approach.

- As the GPS transitions from terminal mode to approach mode, the CDI/HSI may move further away from center as the scale changes. Make small course corrections during the scale change to avoid over-correcting.

CRM

- PNAC reviews the instrument approach and sets up NAVAIDs. (Situational Awareness)

- PNAC gives the Approach Brief to the crew. (Communication)

- PAC/PNAC asks the controller for clarification of instructions as needed. (Assertiveness)

4-12 EMERGENCIES IN IMC

- PNAC follows the approach on the plate and provides information to the PAC as necessary. (Communication)
- During vectors to final, PAC ensures the correct leg is active. (Situational Awareness)
- PNAC ensures that approach mode is active within two NM of the FAF. (Situation Awareness)
- PAC ensures Landing Checklist complete. (Situational Awareness)
- PNAC looks out for the runway environment and reports “runway in sight.” (Situational Awareness)

References

- *AIM, Chapter 1 Section 1 Navigation Aids*
- *AIM, Chapter 5 Section 4 Arrival Procedures*
- *AIM, Chapter 5 Section 5 Pilot/Controller Roles and Responsibilities*
- *ICW, RNAV Approach Procedures*

407. ILS AND LOCALIZER APPROACH

Description: The ILS provides precision approach information for course and glideslope without the need for radar or ground control. An ILS approach provides a precise flight path for alignment and descent to the runway. The approach ends upon arrival at the DH on glideslope. A localizer approach is a non-precision approach to an MDA that utilizes the course information provided by the ILS system to align with the runway centerline. Although glideslope information may be present on the PFD, it is not utilized for a localizer approach. The pilot must adhere to any step-down altitudes on the approach plate, unlike an ILS approach where the pilot flies the glideslope. The approach terminates at a MAP prior to runway threshold, and the approach minima will be higher than the ILS approach.

Procedures

1. Before reaching the IAF, execute WRNTB (**W**e **R**eally **N**eed **T**o **B**rief).

    a. **W**EATHER: Obtain current weather information to determine **W**eather, **A**ltimeter, and **R**unway in use (**WAR**). Consider listening to one turn in ATIS prior to switching the frequency to the terminal area controller or use secondary VHF/UHF radio to obtain weather information.

    b. **R**EQUEST: Communicate approach request with ATC.

c. **N**AVAIDs: Tune required NAVAIDs using TIN-STM acronym.

d. **T**IMING: Compute timing for the approach if required.

e. **B**RIEF: Communicate the Approach Brief to the crew and delegate copilot duties.

2. At the IAF, execute the 6Ts.

a. **TIME**. Note time.

b. **TURN**. Turn as required to intercept the approach course. The turn will depend on whether the pilot is given a full procedure approach or vectors to final.

c. **TIME**. Start timer outbound when wings level or abeam the station (whichever occurs last) as required for a course reversal procedure.

d. **TRANSITION**. Decelerate to the final approach speed of 90 KIAS, descend if required, and complete the Landing Checklist ("Lower, Slower, Landing Checks").

e. **TWIST**. Set the desired course on the HSI. It is recommended to set the FAC to prevent CDI reverse sensing.

f. **TALK**. Make voice report, as required.

3. Recheck the approach procedure depicted on the approach plate, comply with altitude restrictions, and make voice reports as directed. Proceed to the FAF.

4. At the FAF, execute the 6Ts.

a. **TIME**. Start the timer, as required.

b. **TURN**. Intercept the FAC.

c. **TIME**. Not required.

d. **TRANSITION**. Descend to the DH or MDA. Review that the Landing Checklist is complete.

e. **TWIST**. Set FAC on the HSI.

f. **TALK**. Make voice report, as required.

5. If flying an ILS approach, intercept the glideslope and initiate a descent to stay on the glideslope. If flying a localizer approach, descend to the MDA while adhering to any step-down altitudes. Maintain course alignment with the deviation bar on the CDI/HSI and airspeed at 90 KIAS.

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6. At the DH or MAP, transition to a visual scan with runway environment in sight or execute the Missed Approach.

Amplification and Technique

- Transitions from the en route structure to the IAF may occur in the following ways:

  - *Radar vectors to the FAC*. ATC vectors the helicopter to intercept the FAC, expediting the approach and eliminating the need for a course reversal procedure. Maintain cruise airspeed until cleared for the approach, then execute the 6Ts, emphasizing *TRANSITION* ("Lower, slower, Landing Checks").

  - *ATC clearance direct to the IAF*. In this case, the pilot should expect to execute the published approach, including the course reversal procedure, unless instructed otherwise.

- During an ILS or LOC approach, the CDI will center when the helicopter is on the FAC course, independently of what has been set in the OBS. To improve situational awareness, always set the OBS to the FAC for the approach, even when tracking the procedure outbound. Setting the FAC in the OBS prevents reverse sensing.

- When executing a Back Course (BC) ILS, twist the front course FAC into the course needle to ensure normal sensing.

- During ILS approaches, intercept the glideslope by reducing power as the glideslope indicators begin to center. Maintain 90 KIAS. Adjust power to establish the predetermined rate of descent required to maintain glideslope.

- Due to the extreme sensitivity of the glideslope indicators and the CDI/HSI, ensure all control inputs are small, smooth changes to avoid chasing the glideslope and course. As you approach the airport, the glideslope and glide path become narrower and more sensitive.

- For a localizer approach, utilize non-precision approach procedures while adhering to the required altitudes on the approach plate.

- Glideslope information is not intended to provide guidance below the DH to touchdown. If the runway environment is not in sight at the DH, execute the Missed Approach.

Safety Notes

- If the glideslope indicator disappears during the approach, transition to the localizer approach and descend no lower than the localizer minima, or conduct a missed approach.

- If the course deviation bar is fully deflected or unreliable inside of the FAF and the runway is not in sight, immediately arrest the rate of descent and execute the missed approach using the FMS or contact ATC for missed approach instructions.

CRM

- PNAC reviews the instrument approach and sets up NAVAIDs. (Situational Awareness)
- PNAC gives the Approach Brief to the crew. (Communication)
- PAC/PNAC asks the controller for clarification of instructions as needed. (Assertiveness)
- PAC directs the PNAC to start timing when appropriate (LOC). (Communication)
- PNAC follows the approach on the plate and provides information to the PAC as necessary. (Communication)
- PAC ensures Landing Checklist is complete. (Situational Awareness)
- PNAC looks out for the runway environment and reports “runway in sight.” (Situational Awareness)

References

- *NIFM, Chapter 24 Instrument Landing System*
- *AIM, Chapter 1 Section 1 Navigation Aids*
- *AIM, Chapter 5 Section 4 Arrival Procedures*
- *AIM, Chapter 5 Section 5 Pilot/Controller Roles and Responsibilities*
- *ICW, ILS/Localizer Approach Procedures*

408. GROUND CONTROLLED APPROACHES

Description: Radar approaches, also known as Ground Controlled Approaches (GCA), allow the controller to vector an aircraft to landing by providing course, glideslope, and range information. The controller will constantly monitor aircraft position via radar and communicate flight directions throughout the approach over the radio. GCAs are useful to reduce pilot workload in IMC.

There are two types of GCAs: Precision Approach Radar (PAR) and ASR. The controller will provide heading and altitude vectors for both types of approach prior to the final approach segment. These approaches do not require navigation equipment other than a radio and a heading indicator.

1. **PAR:** The PAR is a precision approach that typically provides a 3-degree glideslope to the published DH. The final controller will provide accurate course and glideslope information throughout the approach to maintain helicopter alignment with the runway centerline. Approach minimums are similar to or lower than ILS approach minimums.

2. **ASR:** The ASR uses a less precise radar than the PAR, so it is a non-precision approach where the controller provides lateral guidance only. The final controller will tell the pilot MDA and any intermediate step-down altitudes along the approach path.

Procedures

1. **W**EATHER: Obtain current weather information to determine **W**eather, **A**ltimeter, and **R**unway in use (**WAR**). Consider listening to one turn in ATIS prior to switching the frequency to the terminal area controller or use secondary VHF/UHF radio to obtain weather information.

2. **R**EQUEST: Communicate approach request with ATC.

3. **N**AVAIDs: There is no navigational aid for a radar approach. Set up a backup NAVAID to increase situational awareness, as desired (use TIN-STM).

4. **T**IMING: Not required.

5. **B**RIEF: Communicate the Approach Brief to the crew and delegate copilot duties. Using the Rate of Climb/Descent Table in the back of the approach plate, determine the approximate descent rate required and the DH or MDA.

6. Maintain cruise airspeed until given the instructions “contact final controller.” At that time, transition to 90 KIAS final approach speed and complete the Landing Checklist.

7. When directed by the controller to turn or descend, execute as soon as the instructions are received. The controller assumes that the pilot maintains the last assigned heading, so that subsequent instructions will be based on that heading.

   a. **PAR**: The PAR begins when the final controller informs the pilots they are on final. When advised that the helicopter is “on glideslope,” adjust power to establish the predetermined rate of descent while maintaining airspeed and assigned heading.

   b. **ASR**: When cleared to descend to the MDA, adjust the rate of descent to ensure reaching the MDA before reaching the MAP, which is usually 1 mile from the runway threshold.

8. Expect landing clearance to be relayed at three NM.

9. At the DH or MAP, transition to a visual scan with the runway environment in sight or execute the Missed Approach.

Amplification and Technique

- Make standard rate turns while being vectored in the instrument pattern and half standard rate turns on the final.

- Balanced flight is essential to facilitate small, expeditious control corrections.

- Read back all assigned headings, altitudes, altimeter settings, and traffic until told by the controller, "Do not acknowledge further transmissions." A "roger" radio call may acknowledge lost communication and missed approach procedures if the instructions are fully understood. However, if any doubt exists, read the instructions back or ask for clarification. Always read back landing clearances.

- No-Gyro PAR or ASR Approach. If directional gyro information fails or appears to be giving false information, pilots may request a no-gyro PAR or ASR approach. Instead of assigned headings, the controller will use "turn left," "turn right," and "stop turn" to provide course information. Make standard rate turns in the pattern, and half the standard rate turns on the final. Start and stop turns immediately upon receipt of the controller's instructions.

Safety Notes

- Final controllers alert pilots to deviations using the phrases "slightly right/left of course" or "slightly above/below glideslope" and "well right/left of course" or "well above/below glideslope." If the helicopter exceeds the deviation limit of the PAR, the controller will inform the pilot that the helicopter is outside of the safety envelope of the system and direct the pilot to execute a missed approach. If this occurs, execute the missed approach; do not attempt to regain the course or glideslope.

- Some PARs, such as the PAR 32 at KNDZ, have DHs that result in a Height Above Touchdown (HAT) that is less than 200 feet. As per CNAF M-3710.7, single piloted aircraft are limited to a 200 foot HAT. If the published DH results in a HAT that is less than 200 feet, the pilot must adjust the DH so that the HAT is a minimum of 200 feet.

- When on a GCA, lost communication procedures should be initiated if no transmissions are received for approximately one minute while being vectored to final, 15 seconds while on an ASR final approach, or five seconds while on a PAR final approach. Attempt to contact ATC on a secondary frequency, the previous frequency, tower, or guard. If unable to re-establish communication or maintain

VMC, proceed with a published instrument approach procedure or previously coordinated instructions, such as the lost communication procedures delineated for Whiting Field in the RWOP.

CRM

- PNAC reviews the instrument approach and sets up NAVAIDs. (Situational Awareness)
- PNAC gives the Approach Brief to the crew. (Communication)
- PAC/PNAC asks the controller for clarification of instructions as needed. (Assertiveness)
- PNAC provides information to the PAC as necessary. (Communication)
- PAC ensures Landing Checklist is complete. (Situational Awareness)
- PNAC looks out for the runway environment and reports "runway in sight." (Situational Awareness)

References

- *NIFM, Chapter 25 Ground Controlled Approaches*
- *AIM, Chapter 5 Section 4 Arrival Procedures*
- *AIM, Chapter 5 Section 5 Pilot/Controller Roles and Responsibilities*
- *ICW, GCA Procedures*

409. DEPARTURE PROCEDURES

Description: IFR Departure Procedures enable ATC too quickly and efficiently transition aircraft from the departure airport to the en-route environment. Departures can be predicated on a ground-based NAVAID, such as a VOR or an RNAV (GPS). Many departures include step-up altitudes that provide de-confliction from other departures or arriving traffic. If assigned a departure procedure, it is imperative to adhere to altitude restrictions and course/heading restrictions as depicted on the departure procedure visual and written information or as assigned by ATC.

Procedures

1. Set up for the departure prior to taxiing for takeoff. Use the same WRNTB acronym to ensure that no portion of the setup is omitted.

a. **W**EATHER: Obtain current weather information to determine **W**eather, **A**ltimeter, and **R**unway in use (**WAR**) at the departure airfield.

b. **R**EQUEST: The flight plan, including the desired departure, should be filed prior to walking to the helicopter. After listening to ATIS, contact Clearance Delivery to obtain the clearance, which will include the assigned departure procedure.

c. **N**AVAIDs: Tune required NAVAIDs using TIN-STM acronym or load the RNAV (GPS) procedure in the FMS.

d. **T**IMING: Timing is never required for an instrument departure.

e. **B**RIEF: Communicate the Departure Brief to the crew and delegate PNAC responsibilities.

2. Contact ground and taxi to the active spot or runway as directed.

3. After takeoff, comply with the Departure Procedures as depicted on the Departure Plate or as directed by ATC.

4. Many departures include turning climbs, arcs, and point-to-points. Utilizing the 6Ts at major transition points, such as entering or leaving an arc or beginning a point-to-point, will help maintain orientation on the procedure and prevent mistakes of omission.

a. **TIME:** Note time.

b. **TURN:** As required to join the arc, start the point-to-point, or intercept the next radial.

c. **TIME:** Not required.

d. **TRANSITION:** Slow to the climb airspeed and climb to the next step-up altitude.

e. **TWIST:** Set the next desired radial or course as required.

f. **TALK:** Make a voice report, as required.

Amplification and Technique

- Flying an instrument departure is much like flying an instrument approach in reverse. Think of it in terms of headings, arcs, and courses with step-ups instead of step- downs.

- When taking off for an instrument departure, maintain runway heading until 400 feet (or the altitude depicted on the departure before making the first turn). At Whiting Field, the instructor may direct the PAC to turn early or roll out on an intermediate heading in order to maintain course rules and avoid flying through the maintenance pattern.

CRM

- PNAC reviews departure procedures and sets up NAVAIDs. (Situational Awareness)
- PNAC gives the Departure Brief to the crew. (Communication)
- PAC/PNAC asks the controller for clarification of instructions as needed. (Assertiveness)
- PNAC follows the departure on the plate and provides information to the PAC as necessary. (Communication)
- During departures from KNDZ, the PNAC directs the PAC to ensure that the helicopter remains on course rules and clear of the maintenance pattern. (Situational Awareness/Communication)

References

- *NIFM, Chapter 28 Flight Clearance*
- *AIM, Chapter 5 Section 2 Departure Procedures*

410. MODIFIED NORMAL APPROACH

Description: The modified normal approach enables the pilot to transition from the instrument approach MDA or DH to a hover over a specific point. The modified normal approach is a transition maneuver which allows the helicopter to intercept the normal approach profile from the instrument approach at 90 KIAS and arrive simultaneously at zero groundspeed and hover altitude over a preselected spot with a maximum margin of safety.

Procedures

1. Determine landing point and decelerate as necessary.

2. Intercept the normal approach profile and execute normal approach procedures.

Amplification and Technique

1. The helicopter is transitioning from IMC to 90 KIAS when the airport environment is reported “in sight.” The modified normal approach could be a straight-in or circling approach to the runway or helicopter landing areas. Therefore, the transition altitude can vary from 200ft AGL to greater than 500 ft AGL. The initial decision about how to maneuver the helicopter is critical to position the helicopter for the normal approach profile for landing.

2. Determine where the helicopter will intersect normal approach profile and adjust airspeed and altitude to continue the normal approach parameters for landing.

CHAPTER FIVE
EMERGENCIES IN IMC

500. INTRODUCTION

During any emergency, regardless of whether it occurs in VMC or IMC, the following steps must be performed:

- Maintain control of the helicopter.
- Alert the crew.
- Determine the precise nature of the problem.
- Complete the applicable emergency procedure or take action appropriate for the problem.
- Determine the landing criteria and land as required.

An emergency in IMC presents some additional complications that are not present during an emergency in VMC. While IMC, the pilot will be unable to visually acquire the closest available landing area, even if the perfect one exists right below the helicopter. A particular emergency procedure may require the pilot to secure the required equipment or avionics for an IMC flight. These IMC-specific considerations change the decision-making process and require the pilot to take greater amounts of information into account when determining a course of action.

501. "AVIATE, NAVIGATE, AND COMMUNICATE" IN IMC

All basic piloting skills, regardless of whether in IMC or VMC, can be broken down into one basic mantra: Aviate, Navigate, and Communicate. This mantra also applies to emergencies, particularly those that occur in IMC, because the pilot must be able to deal with the issue while continuing to fly and then communicate effectively with ATC to land the helicopter safely. Many tasks will require a clear delineation of the PAC, who keeps their primary focus on flying the helicopter, and the PNAC, who is able to support the flying pilot while focusing on items that may distract the flying pilot.

Aviate

Regardless of the emergency, the PAC must focus on flying the helicopter safely at all times. In addition to executing all critical memory items requiring flight control inputs, the PAC is still responsible for maintaining ATC assigned parameters. If the emergency requires the pilot to deviate from assigned ATC parameters, the pilots must declare an emergency and inform ATC of the deviation immediately to avoid potential traffic conflicts.

Navigate

During an IMC emergency, the pilots must remain oriented in time and space. The PAC must maintain assigned parameters and remain oriented along the assigned route of flight. The PNAC should aid the PAC in remaining oriented. The best way to ensure accurate orientation during an emergency is to maintain good situational awareness throughout the flight, including periodically looking for appropriate divert airfields, and available instrument approaches. Good situational awareness allows pilots to make better decisions quickly in the event of an emergency instead of scrambling to gather the information that they should already have.

Communicate

Not only should the pilots alert the crew to an emergency, but they should also alert ATC to the situation by declaring an emergency and squawking 7700. When a pilot declares an emergency, ATC will want to know the nature of the emergency, the amount of fuel onboard (in hours and minutes), the number of souls on board, and the crew's intentions. If the pilot does not provide this information initially, ATC will ask for it. When describing the nature of the emergency, ATC does not need details, just enough information so the controller has an idea of what the problem is and the severity of the emergency.

The most important aspect of communication during an IMC emergency is conveying the crew's intentions to ATC. When stating intentions to ATC, the pilot should be as specific as possible. For example, if you need an approach, tell ATC which airfield you want to go to and what approach you want. Being as directive as possible allows ATC to help you land the helicopter safely in the most expeditious manner possible. Requesting vectors for an approach to the nearest airfield will work if you do not know what airfields are nearby or what approaches they offer. However, the ATC controller is not in the helicopter with you and may not understand the full scope of the emergency or the capabilities or limitations of your helicopter.

Consequently, the controller may offer suggestions that are not feasible with a particular emergency. The resulting back and forth between ATC and the pilots may waste valuable time and be distracting to the crew. To avoid a long conversation, the pilot should maintain good situational awareness throughout the flight. Just as a good VMC pilot continuously looks out for emergency landing sites during VMC, a good IMC pilot takes note of nearby airfields with instrument approaches.

When communicating intentions to ATC, pilots should consider requesting a lower altitude. A lower altitude may allow the pilot to regain VMC and execute an emergency landing at a suitable site rather than transiting to an airfield and shooting an instrument approach. The lowest altitude at which ATC can vector an aircraft is called the Minimum Vectoring Altitude (MVA). MVAs are not published, but pilots may request a descent to the MVA to potentially regain VMC. In addition to providing vectors and descents, ATC can also provide useful information to help pilots make informed decisions. For example, ATC may read ATIS to an emergency aircraft or provide the latest ceiling and visibility at nearby airports. ATC may also be able to provide relevant NOTAM information.

Aviators should never request vectors to VMC. ATC cannot provide that information. The weather radar available to ATC is designed to show precipitation so it may detect heavy, wet clouds, but it cannot be counted on to determine areas of IMC or VMC. ATC will know the ceilings and visibility at airfields, but they do not have that information for areas not covered by an airfield weather reporting system.

502. CREW RESPONSIBILITIES DURING EMERGENCIES IN IMC

The most important thing to remember about CRM during an emergency in IMC is that one pilot must always focus on flying the helicopter. The most likely way to become lost or spatially disoriented is for both pilots to put their heads down to troubleshoot a system or read an emergency procedure. By looking away from the instruments or focusing on other tasks, pilots run the risk of becoming spatially disoriented and potentially unable to effectively control the helicopter or mistaking air work deviations for emergency indications.

During an emergency, the PAC should execute the memory items that require flight control inputs and continue to fly the helicopter. The PNAC should execute those memory items not requiring flight control inputs, break out the pocket checklist to read the emergency procedure, and conduct any necessary troubleshooting.

Aircrew and observers are great assets during an emergency. They can read and manage checklists, allowing the PNAC to back the PAC up on the flight instruments or troubleshoot. Aircrew and observers can also back the flying pilot up by monitoring flight instruments.

During an emergency, it may be necessary to divide up cockpit tasks further. Depending on the nature of the emergency, it may be prudent for the PNAC to make the radio calls and coordinate with ATC. This allows the PAC to focus on flying safely while the PNAC manages the cockpit.

503. USE OF FLIGHT DIRECTOR MODES DURING AN IMC EMERGENCY

Pilots may use Flight Director (FD) modes during some emergencies, but must be aware of the autopilot limitations in order to use it safely and effectively. In addition, engaging a FD Mode does not alleviate the PAC’s responsibility to closely monitor flight instruments and maintain control of the helicopter. Even if a mode is engaged, the PAC’s focus must be on flying the helicopter.

The autopilot does not know when the helicopter is experiencing an emergency situation and will continue to attempt to maintain the assigned parameters, regardless of the state of the emergency. For example, with Altitude Mode engaged, the autopilot will still attempt to maintain altitude in the event of an engine failure. If the pilot is not closely monitoring the instruments and controls, the autopilot could put the helicopter in an undesirable or unrecoverable state before the pilot has a chance to make a control input.

During an emergency, it is acceptable and often necessary to turn off the modes and manually fly the helicopter. Hand flying requires that the PAC devote more thought and energy to flying, but it will prevent any distractions or confusion caused by the FD modes. Manually flying will also prevent unwanted autopilot inputs over the course of the emergency procedure.

504. LANDING CRITERIA DURING EMERGENCIES IN IMC

For most emergency procedures, the NATOPS landing criteria do not change depending on whether the helicopter is in IMC or VMC. However, instrument conditions complicate landing criteria for the simple reason that the pilots cannot see the ground to select a suitable landing site in the event of an emergency. This forces the pilots to make sometimes difficult decisions based on the nature of the emergency, the proximity of an acceptable instrument approach, and the terrain or obstacles surrounding the helicopter.

Land as Soon as Practicable

Land as Soon as Practicable is defined as, "extended flight is not recommended. The landing site and duration of the flight are at the discretion of the pilot in command." Depending on the nature of the emergency, the pilot may continue the flight after a Land as Soon as Practicable emergency so long as the flight remains VMC. If that same emergency occurred in IMC, the pilot may elect to terminate the flight and return to the home field or execute a full stop approach at a nearby airfield. For example, in the case of a dual inverter failure, NATOPS directs the pilot to land as soon as practicable. Under VMC, the pilot may elect to continue the flight to the original destination. However, if a dual inverter failure occurs in IMC, the pilot might elect to divert to a nearby airfield to avoid extensive flight without AC power while in IMC. In this case, the definition of land as soon as practicable remains the same, but how the pilot responds varies based on the current weather conditions.

Land as Soon as Possible

Land as Soon as Possible is defined as, "land at the first site at which a safe landing can be made." In VMC, Land as Soon as Possible is often taken to mean a nearby farmer's field or any other open area that can accommodate a helicopter. However, in IMC, none of these options are available. As a result, the "first site at which a safe landing can be made" may be a nearby airfield with a suitable instrument approach. Many factors must be taken into account when determining where to land.

If a pilot faces a Land as Soon as Possible emergency while IMC, the pilot should first attempt to regain VMC. ATC cannot give vectors to VMC, but they can allow an emergency aircraft to descend to the MVA in the hopes that the aircraft can gain VMC. If the helicopter does not gain VMC after descending to the MVA, the pilot should request short vectors to an instrument approach at a nearby airfield. When requesting an approach during an emergency, be as specific as possible so ATC can help you more quickly.

Choosing an approach during a Land as Soon as Possible emergency depends on the weather at the airfield. If ceilings are low and there is some concern about breaking out at the bottom, select the approach with the lowest minimums so that you have the best chance of successfully breaking out on the approach and landing. This is usually a precision approach, either an ILS or a PAR. If the ceilings are higher, such as near 1,000 feet, consider executing a non-precision approach. The minimums will be higher, so the helicopter will not be allowed to descend as far, but a non-precision approach does not require the pilot to follow a glideslope. Consequently, after the FAF, the pilot can make a descent to the MDA in the hope of gaining VMC as soon as possible and finding a safe place to land prior to reaching the airfield.

When deciding which approach to request, the pilots should also take the current airport winds into account. Even during an emergency, a pilot should attempt to conduct the approach and landing into the wind. However, the nature of a Land as Soon as Possible emergency may preclude flying all the way around an airfield to achieve more favorable winds. During some emergencies, it may be necessary to accept a tailwind approach and to expedite landing the helicopter.

Lastly, the pilot must consider airspeed when executing an approach during a land as soon as possible emergency. Normally helicopters execute instrument approaches at 90 KIAS to use Category A approach minima. However, during some emergencies, the pilots may elect to fly the approach at a faster airspeed to get the helicopter safely on the ground as soon as possible. Keep in mind; if the pilots elect to fly faster than 90 KIAS, the approach minimums may change because they are now subject to Category B approach minima. Higher airspeeds also require larger control inputs to slow the helicopter, arrest the rate of descent, and land safely. Depending on the emergency, flying faster may not be the best solution. Some emergencies, such as Tail Rotor Gearbox Malfunction, may require that the pilots minimize the power requirements to avoid placing additional stress on failing components. In those cases, the pilots may elect to fly the normal approach speed or perhaps a little slower to prevent any further damage to components prior to landing.

Land Immediately

In the TH-73A NATOPS, Land Immediately is defined as, “execute a landing without delay.” Land Immediately procedures are concerned with the crew’s survival because the impending failure will be catastrophic, such as an engine fire or transmission seizure. All the remaining time airborne must be dedicated to safely landing the helicopter.

A Land Immediately emergency in IMC puts the pilot in a difficult dilemma. Depending on the weather, the pilot may be forced to immediately descend through the clouds to execute a landing with no idea what is under the helicopter until the very last second.

Much like a Land as Soon as Possible emergency, the pilot should request lower from ATC and descend rapidly in an attempt to gain VMC. If the pilot is unable to gain VMC and the helicopter is very close to the FAF of an instrument approach, the pilot may request short vectors to that approach. The pilot should consider this option carefully because most instrument approaches take four to five minutes to execute. Depending on the nature of the emergency, the pilot may not have that long before the helicopter becomes uncontrollable.

If the pilot is unable to gain VMC, the other option is to request vectors away from any known obstacles and begin a controlled but expeditious descent to gain VMC and find a place to land. Pilots should be aware that once the helicopter is below the MVA, ATC is unable to provide obstacle clearance. The helicopter may encounter towers, power lines, trees, or terrain that remains unseen due to low ceilings and visibility. If pilots elect this option during an emergency, they should still alert ATC to their intentions. Depending on the location, ATC may still be able to provide some obstacle advisories during the descent.

The TH-73A is equipped with a Helicopter Terrain Awareness and Warning System (HTAWS) that includes an obstacle warning database. If the database is current, this system can provide pilots a warning of terrain and obstacle conflicts but should not be used as a primary means of navigation. It can alert pilots to potential hazards during an IMC descent, but it is by no means comprehensive. For example, the database does not contain every single tree, building, and power line, so it cannot be relied upon to provide the pilot with an obstacle-free descent path.

505. DECISION MAKING IN IMC

When dealing with an IMC emergency, pilots must first take care of the basics associated with any emergency procedure. Not only must pilots "aviate, navigate, and communicate," but also every pilot must know the critical memory items of NATOPS emergency procedures. The added stress and required decision-making brought on by an IMC emergency must be handled by remaining calm and making the best decision possible with the information available. No pilot is alone in the decision-making process. Every helicopter in Naval Aviation requires two pilots, and most have aircrew who can provide information and aid in decision-making. ATC can also provide information to aid in good decision-making, such as current weather and available approaches.

Pilots are sometimes uncertain whether to declare an emergency with ATC or not. Different circumstances call for different courses of action, but a good rule of thumb is ***if you need preferential handling, declare an*** **emergency**. Declaring an emergency ensures that you will get priority for any descents, routing, and approach or landing clearances you might need. When declaring an emergency, communicate your desires and intentions clearly, so that ATC can provide you the necessary assistance as quickly as possible.

Regardless of how you reach a decision, the Pilot in Command (PIC) is ultimately responsible for the crew and the helicopter. Therefore, they must make informed decisions and choose a course of action in a timely manner to prevent the situation from getting worse.

CHAPTER SIX
AUTOMATION AND CRM IN THE IFR ENVIRONMENT

600. INTRODUCTION

Autopilots and Flight Directors (FD) are tools to aid pilots in controlling the helicopter. They increase a pilot's situational awareness by displaying pertinent information that is easy to decipher. They also reduce the pilot's workload by performing the mundane tasks of flying and allow them to concentrate on higher-order tasks and decision-making.

Autopilots and FD are useful tools, but they are only tools. They cannot eliminate human error; they only change the nature of it. Despite being useful tools, autopilots and FDs are only as good as the pilots operating them. They will not correct pilot mistakes. If a pilot enters the wrong data or engages the incorrect mode, the autopilot and the FD have no way of recognizing the mistake. They will only do what the pilot told them to do, not what the pilot *meant* to tell them to do.

Additionally, autopilot and FD systems are designed and programmed by human beings. These human beings made human decisions such as under what parameters the autopilot and FD can be engaged, how the autopilot and FD modes should operate, and under what circumstances the autopilot and FD modes should uncouple. These decisions may not seem logical to a pilot operating the system and may lead to error as the pilot tries to align their perceptions with what the programmers or engineers thought made sense.

The advent of advanced FD and autopilot systems has drastically changed a pilot's required knowledge base and skill set. In the past, a pilot's training objective revolved around stick-and- rudder skills. Autopilots, FDs, and FMS, have added another dimension to the knowledge set required by pilots. In today's flight operations, pilots are required to not only be able to manually fly the helicopter but also to be system operators. They are required to have a thorough knowledge of the autopilot, FD, and FMS systems and procedures while retaining their hand-flying skills. In some ways, autopilots and FDs have made pilot's lives easier by reducing the fatigue of mundane tasks. In other ways, these systems have made the pilot's work more demanding in that they must now maintain two complete skill sets.

601. AUTOMATION MANAGEMENT

The automation pyramid as shown below in Figure 6-1, often defines the level of automation available in an autopilot system.

- The base of the pyramid has no automation engaged. The pilot flies the helicopter directly using the flight controls.

- The second level of automation is defined as utilizing FD command bars to hand fly the helicopter without the aid of the autopilot. For example, in the TH-73A, this means displaying the FD command bars on the attitude gyro and engaging a FD mode but placing the COUPL/DECOUPL switch to DECOUPL.

- The third level of automation is defined as engaging one or two of the single-axis FD modes and coupling the autopilot to the FD. For example, in the TH-73A, engaging the altitude hold, heading hold, or both are considered the third automation level.

- The highest level of automation occurs when the FD is coupled to the autopilot, and a navigation mode is selected. For example, in the TH-73A, engaging NHDG, NAV, BC, or VOR APR combined with one of the pitch modes places the helicopter in the highest level of automation.

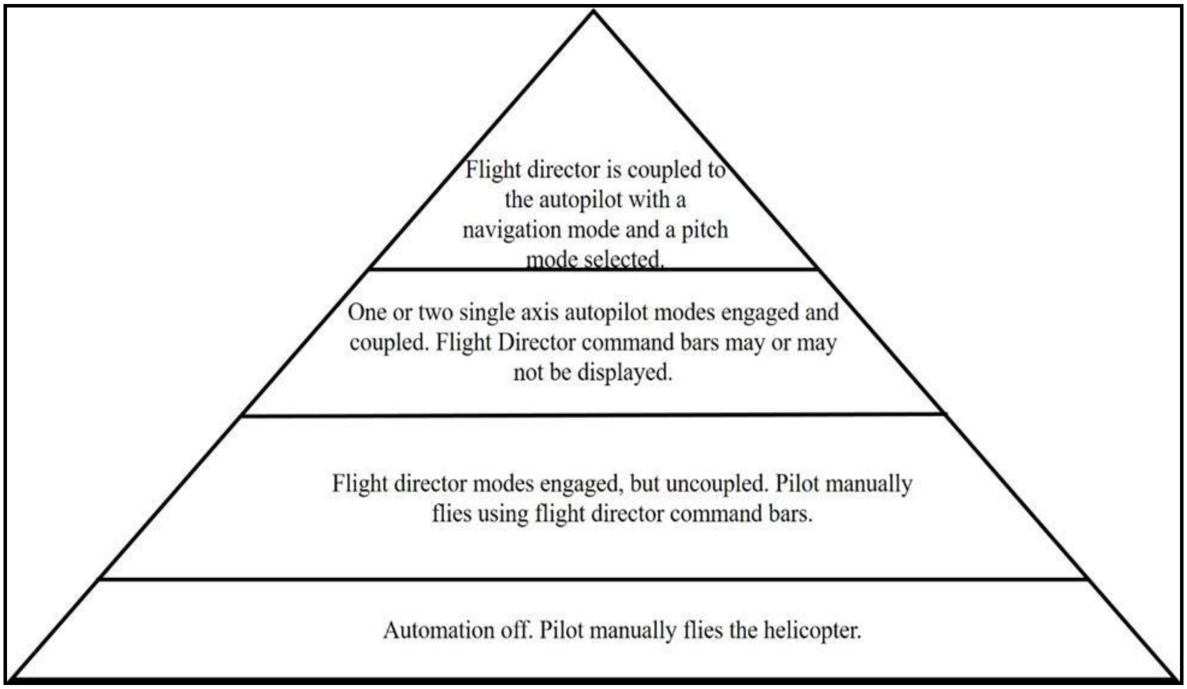

Figure 6-1 The Automation Pyramid

Always select a level of automation that is appropriate for the phase of flight. Autopilots are seldom used for takeoff, so for most departures, the pilot should elect to remain at the base of the automation pyramid. Only after establishing a climb and an initial heading should the pilot consider engaging any of the modes. During en route flight, the pilot may elect to move to the highest level of automation and allow the helicopter to fly the route and maintain altitude. This will give the pilot greater situational awareness because the pilot may focus his or her attention on other cockpit tasks such as coordinating with ATC or setting up an instrument approach.

During the arrival phase, ATC may direct the helicopter to the approach using radar vectors. In this instance, the pilot should choose to decrease the level of automation and manually twist each heading assigned by ATC. When established on the approach, the pilot may elect to return to the top of the pyramid and direct the autopilot to fly the approach.

Training flights are rarely as straightforward as taking off, flying a route, and executing an approach. As a result, students utilizing autopilot will find themselves changing automation levels frequently. At times, the movement up and down the automation pyramid would be so rapid that the autopilot becomes detrimental to flight rather than an aid. For example, attempting to fly around the pattern at an Outlying Field (OLF) using the highest level of automation would be counterproductive.

Although automation frequently reduces task saturation, it can quickly become a source of task fixation in dynamic situations. For example, if ATC changes the runway or approach at the last minute, it will take time and concentration to reprogram the FMS and engage the correct FD modes. Instead of going heads down and trying to sort out the automation, it is frequently easier to manually fly the approach. Turning off the automation in this situation actually increases situation awareness because it keeps the pilot’s attention where it belongs: focused on flying the helicopter.

Aircraft emergencies are another example of when it might be better to secure the autopilot. Some electrical or avionics emergencies may send erroneous inputs to the autopilot, causing it to malfunction. In this case, secure the autopilot. Other emergencies that would warrant securing the autopilot include engine failures or other emergencies that require the pilot to fly a very specific profile.

Any time the pilots are unsure of what the autopilot is doing or why it is doing it, they should decrease the level of automation or secure the automation completely. Never be afraid to move up and down the automation pyramid or turn the automation off completely if that is the safest action at the time.

602. FLIGHT DIRECTOR MODE AWARENESS

The pilot must be aware of what the FD is doing at all times. Mode awareness encompasses three things: what is the current FD-operating mode, what is that mode supposed to do, and how does the mode accomplish its task.

Knowing which mode the FD is in seems easy, but as a flight gets busier and pilots become distracted by other tasks, they may forget the current FD mode. FDs may also drop modes. If a FD receives what it believes to be an erroneous signal or flies outside certain parameters, it may disengage itself or revert to a lower level of automation.

Understanding what each mode is supposed to do is as important as knowing which mode the FD is in. Some modes, like heading or altitude hold, are simple and self-explanatory. Others, such as ILS mode or VOR APR mode, are more complex but must be understood just as thoroughly as any other mode.

Lastly, it is not enough to know what the mode is supposed to do; the pilot must know how it accomplishes its task. For example, in the TH-73A, a pilot knows that the ILS mode will capture and fly a glideslope. However, the pilot must also understand that the TH-73A has a two-axis autopilot, meaning that it does not control the collective or the pedals. It is up to the pilot to adjust the collective to ensure the FD has the correct amount of power to maintain the glideslope at the desired airspeed.

603. HUMAN-MACHINE INTERFACE ERRORS

Human-machine interface errors occur when there is a breakdown between the pilot's expectations and automation actions. There are four major categories of human-machine interface errors:

- Automation Surprise
- Automation Dependency
- Automation Bias
- Automation Complacency

Automation Surprise

Automation surprise occurs when the autopilot does not behave in the manner expected by the pilot. It closely ties with mode awareness. If a pilot has a low degree of mode awareness, they will suffer from automation surprise more frequently. Automation surprise has three major causes:

1. The pilot inadvertently selects the wrong mode or fails to adjust a parameter. This might occur if the pilot selects heading mode without centering the heading bug first. In this case, the helicopter may begin an unexpected turn to an undesired heading.

2. The pilot engages a mode without understanding the mode thoroughly. In this case, the autopilot is operating correctly, but the pilot does not understand what the autopilot is trying to accomplish. An example of this occurs if the pilot selects NAV mode when setting up for the ILS, thinking that this is the correct mode in which to execute an ILS. The autopilot intercepts the localizer correctly, but when the helicopter reaches the glideslope, the autopilot does not intercept it because it needs to be in ILS mode to fly a glideslope. The pilot is left surprised and confused due to low mode awareness.

3. An autopilot failure occurs. Autopilots are reliable systems, but any system is bound to fail from time to time. When autopilots fail, they may act unexpectedly or even dangerously. If you experience an autopilot failure, the best course of action is to turn the autopilot off and hand fly.

Automation Dependency

Automation dependency occurs when a pilot becomes so reliant on the autopilot that they are reluctant or even unable to turn the autopilot off and safely control the helicopter. Even the most reliable system is bound to fail at some point. Pilots must always be ready to take the controls away from the autopilot and fly the helicopter safely.

Some pilots also become dependent on automation to make piloting decisions for them. The automated systems may suggest or recommend a course of action, but the pilot must make the ultimate decision. Automation should never command crew actions. Failing to monitor the autopilot and blindly allowing it to make crew decisions is an insidious form of automation dependency.

There are two basic ways to combat automation dependency. The first way is to practice hand-flying skills often in all phases of flight. Practice keeps a pilot's manual flight skills sharp. Hand flying also gives pilots confidence in their own abilities to turn off the autopilot and manually control the helicopter. The second way to combat automation dependency is to remain mentally involved in the flight. Pilots who allow the autopilot to operate unmonitored may not have the situational awareness necessary to make important decisions when the time comes. As a result, they rely on what the automation says instead of making an informed decision based on their awareness of the situation.

Automation Bias

Automation bias is a tendency for pilots to trust the autopilot and automation more than they trust other instruments, information, or their own decision-making skills. One example of automation bias occurs when the autopilot makes an incorrect turn because the next checkpoint is an error in the flight plan. The pilots might spot the error because they are backing up the autopilot navigation with a sectional but fail to act on it because they believe the automation over their own chart reading skills.

Automation Complacency

Automation complacency occurs when pilots are so confident in the autopilot system that they no longer monitor it as closely as they should. This can lead to errors in which the automation fails or behaves in an unexpected manner, but the pilots do not notice because they are not paying attention.

604. AUTOMATION AND CRM

When flying with automation, the autopilot must be incorporated into cockpit CRM. Autopilots are generally reliable, but they are not infallible. The autopilot must be monitored closely. One way to incorporate the autopilot into CRM is to consider the autopilot a third crewmember. Turning the helicopter over to the autopilot is similar to passing the flight controls to another crewmember. If a crewmember is unable to maintain flight parameters, control of the helicopter must be taken from that crewmember. The same thing applies to the autopilot: if it is not flying as expected, the pilot needs to hand fly the helicopter or correct the flight plan or FD modes. Just as the PNAC backs up the PAC and helps monitor flight instruments, the PAC should continuously monitor the autopilot to ensure it is operating as expected.

The biggest difference between the autopilot and another human crewmember is that the autopilot cannot recognize mistakes; it can only do what it is told to do. For example, if the helicopter commander told the copilot to begin a descent and then became distracted, the copilot would eventually stop the descent or ask the helicopter commander at what altitude to level off.

On the other hand, the autopilot would unquestioningly follow the helicopter commander's guidance and continue the descent until impacting the ground.

When initially engaging autopilot modes, the PAC should direct the PNAC to physically push the buttons. This allows the flying pilot to keep both hands on the flight controls and continue to fly the helicopter. Once the autopilot is engaged, the PAC can reach down to change the modes as required or direct the PNAC to do so, depending on the current workload. Neither pilot should disengage the autopilot until one pilot is ready to take manual control of the helicopter.

When the autopilot behaves unexpectedly, either due to incorrect pilot input or system failure, the most important task is to continue to fly the helicopter. The PAC must maintain control of the helicopter and, in most cases, secure the autopilot. It is the PNAC's responsibility to troubleshoot the autopilot system while the PAC continues to fly. It is tempting for both pilots to go heads down and start messing with the autopilot, but someone must maintain control and fly the helicopter.

CHAPTER SEVEN
FLIGHT DIRECTOR USE

700. INTRODUCTION

FDs and autopilots are useful tools that can make a pilot's job easier by reducing the physical requirement to fly the helicopter. However, just like any other helicopter system, an autopilot has capabilities and limitations that the operator must understand prior to use. They do not allow pilots to relax their attentiveness or abandon their responsibility to fly the helicopter safely. A good pilot possesses a clear understanding of when to use the autopilot, which modes will be most effective for a given situation, and when to disengage the autopilot and hand-fly the helicopter.

This chapter is a guide on how to effectively employ the FD and autopilot in the TH-73A as shown below in Figure 7-1. It is not an in-depth system review of every single mode, nor will it cover every possible scenario a pilot may encounter. Rather, this chapter provides general guidance to broad situations. To become proficient with the FD, the pilot must thoroughly understand the system and how each mode operates. Use systems knowledge and the guidance in this chapter combined to make the autopilot fly the helicopter the way you intend. If the autopilot ever behaves in an undesired manner, do not hesitate to secure the system and manually fly the helicopter.

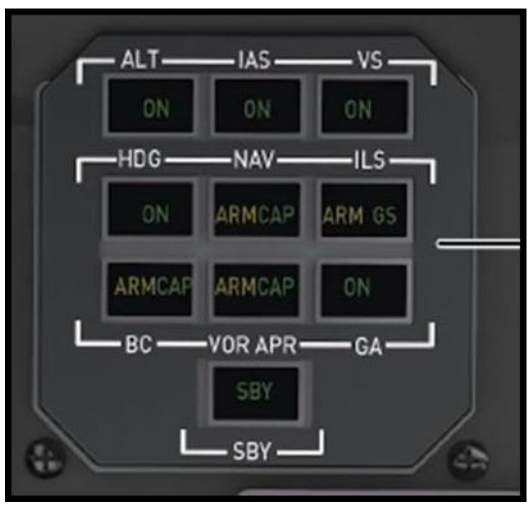

Figure 7-1 Flight Director Mode Selector Panel

701. ENGAGING AND CHANGING FLIGHT DIRECTOR MODES

When engaging or changing autopilot modes, particularly pitch modes such as Vertical Speed (VS) or IAS, utilize the Power, Attitude, Trim (PAT) method for a smooth FD transition. Deliberately using the same steps every time helps the pilot remember to adjust power and avoid drastic FD changes that place the helicopter in an undesired state.

- **Power:** Before engaging or changing a FD mode, set the collective to the approximate power setting. The TH-73A does not control the collective, so the pilot must manually make all power adjustments needed to fly the helicopter using the FD and autopilot effectively.

- **Attitude:** After adjusting the collective, engage the desired FD mode. When engaged, the autopilot will automatically adjust the attitude of the helicopter to achieve the desired parameter.

- **Trim:** After engaging the FD mode, trim the pedals. In the TH-73A, the autopilot will automatically trim the cyclic, but the pilot must trim the pedals. To re-trim the pedals, press the cyclic trim button. Keep in mind that pressing the cyclic trim button not only re-trims the pedals, it also overrides the autopilot cyclic trim controls. To avoid an undesirable response from the autopilot, the pilot must be careful to keep the cyclic in the same position when the trim button is depressed.

The intent is to lead the FD mode change with the PAT technique to avoid passing through the desired altitude, airspeed, or helicopter state. For example, if the FD is set to IAS mode and the helicopter is climbing at 500 fpm, use PAT to set the helicopter power for level off to hold the desired altitude before switching to Altitude (ALT) mode. The goal is to minimize drastic changes in airspeed or altitude via helicopter pitch when transitioning from one mode to another. Anticipate the power setting that is needed to maintain the desired parameter. This reduces the chance of pilot disorientation, especially while using the FD in IMC.

702. RECOMMENDED FLIGHT DIRECTOR MODES

There are many ways to utilize the FD. Experienced pilots will build their own techniques regarding which FD modes to use and when. However, every pilot benefits from starting with basic recommended modes. This section covers the recommended modes for pilots who are first learning to fly with a FD. There are many ways to accomplish the same tasks that are not delineated here. As pilots gain experience and knowledge of systems, they should try techniques outside the scope of this chapter to determine their own preferred modes.

En route Navigation

While navigating using a flight plan loaded in the FMS, use Navigation Heading (NHDG) mode selected from the PFD. The autopilot will adjust the helicopter’s flight path to follow the flight plan exactly. To stop the helicopter from following the loaded flight plan, return to Heading (HDG) mode.

The pilot may want to deviate from the flight plan for a number of reasons, such as radar vectors from ATC or a necessary change to the flight plan that is not loaded. The pilot may elect to fly around a particular checkpoint on a VFR flight plan, like a busy un-towered airfield, instead of flying directly over the top as the programmed FMS flight plan would do. Switching from NHDG to HDG mode allows the pilot to use the heading bug on the HSI to set the desired flight path instead of the programmed flight plan. Be sure the heading bug is in the desired position first before engaging, or else you may turn in another direction!

Before returning to NHDG mode, ensure the desired leg of the flight plan is active, then select NHDG mode on the PFD. The autopilot will turn towards the active flight plan leg and intercept the course.

In cruise flight, use ALT mode in the pitch axis. The autopilot will maintain the set altitude while the pilot controls airspeed via collective setting. To change altitude, the pilot has two options: IAS mode and VS mode.

- **IAS Mode:** **Descents** are usually made in IAS mode. In IAS mode, the autopilot will maintain the selected airspeed. The pilot controls the rate of descent by adjusting the collective. **Climbs** can be done in either IAS or VS mode. If the helicopter is already at the desired climb airspeed, select IAS mode and increase the collective to initiate a climb.

- **VS Mode:** VS mode is useful when the helicopter is faster than the desired climb airspeed. For example, if the helicopter is cruising at 130 KIAS and ATC directs a climb 2,000 feet higher than the current altitude, the pilot will want to slow down while initiating the climb. To accomplish that, dial in a rate of climb and select VS mode without adjusting the collective. The nose will pitch up, and the helicopter will begin to climb while losing airspeed. Upon reaching the desired climb airspeed, select IAS mode. The nose will pitch down to maintain the selected airspeed. Adjust the collective as necessary to achieve the desired climb rate. As the helicopter approaches the assigned altitude, decrease the collective to slow the rate of climb. At the assigned altitude, select ALT mode. If necessary, adjust the collective to achieve cruise airspeed.

NOTE

When engaging HDG mode or VS mode, make sure the desired heading or vertical speed is set before engaging the FD. Otherwise, you may set an undesirable turn or descent/climb rate.

Transition from the En route Environment to the Approach

When conducting a full approach beginning with an IAF, remain in NHDG mode until established on the FAC. After the helicopter establishes on the FAC, switch to the desired mode for the approach, such as Navigation (NAV) or ILS modes.

ATC frequently provides radar vectors to final for instrument approaches for efficient traffic sequencing. When receiving vectors to final, the pilot should use HDG mode and manually twist in the assigned heading as the helicopter approaches the FAC, arm, or switch to the desired approach mode.

The best place to arm or switch modes is when the helicopter heading is within 90 degrees of the FAC, and the helicopter is cleared for the approach. These two conditions usually occur at the same time. ATC makes a similar radio call on every approach. For example, "Navy 8E206, 2 miles from the FAF. Turn left 020, maintain 2,000 until established. Cleared for the approach." The approach clearance call should prompt the pilot to change the mode whenever receiving radar vectors.

703. INSTRUMENT APPROACHES

Each type of instrument approach has two recommended FD modes: a pitch mode and a roll mode. The roll mode controls how the FD will guide the autopilot laterally along the approach course. Roll mode options on an approach include NHDG, NAV, and ILS modes. Pitch modes control how the helicopter will descend on the approach. Since the autopilot does not control the collective, the pilot must work in conjunction with the pitch mode to achieve the desired airspeed and rate of descent. Pitch modes on an approach include IAS, VS, and ILS modes. The most useful modes depend on the type of approach being flown.

RNAV Approach without Vertical Guidance (LNAV, LP)

When conducting an RNAV approach without vertical guidance, such as LNAV or LP RNAV approaches, load the approach into the FMS and navigate using NHDG as the roll mode. To descend on an RNAV approach without vertical guidance, use either IAS mode or VS mode. In IAS mode, the autopilot will maintain the selected airspeed while the pilot uses the collective to control the rate of descent. An advantage of IAS mode is that the pilot can select an airspeed at or below 90 KIAS to ensure that the helicopter remains within Category A approach minimums. Using VS mode ensures that the helicopter will maintain a steady glideslope. If the helicopter needs to level off at an intermediate step down, the pilot can adjust the desired VS to zero. When past the waypoint, the pilot returns the VS to the desired rate of descent without ever changing the mode. VS is convenient for approaches with several step-downs. However, the pilot must adjust the collective every time they adjust the rate of descent. If the pilot uses VS mode to level off prior to the next stepdown altitude, but does not adjust the collective, the helicopter may slow below the minimum IFR airspeed.

RNAV Approach with Vertical Guidance (LPV, LNAV/VNAV)

Conduct RNAV approaches with vertical guidance in NHDG mode. To follow the vertical guidance on an RNAV approach, use IAS mode because it most closely mimics how helicopter pilots fly a glideslope when not using an autopilot. In IAS, the autopilot will adjust pitch to maintain the set airspeed. The pilot adjusts the collect as required to maintain the glideslope. Most pilots trim in the approach airspeed when not using an autopilot and follow the glideslope using power, so helicopter pilots tend to be most comfortable following vertical guidance in IAS mode.

Localizer Only Approach

Localizer only approaches should be flown in NAV mode. The autopilot maintains the course dictated by the localizer frequency tuned in the selected navigation source in NAV mode. Descend on a localizer only approach using either IAS or VS mode, the same way those modes are used on an RNAV approach without vertical guidance.

VOR Approach

Pilots have several options when using autopilot to conduct VOR approaches. However, the system will follow the approach most closely in NHDG mode. To use NHDG mode for a VOR approach, load the approach in the FMS, select FMS NAV as the source, and select NHDG when cleared for the approach or when cleared direct to the IAF. Load the VOR frequency into either NAV1 or NAV2 and ensure a bearing pointer associated with the NAVAID is displayed on the HSI as a backup. NAV and VOR APR modes also enable the autopilot to track a VOR approach. However, both modes may struggle to maintain the desired course in close proximity to the NAVAID. For that reason, NHDG is the preferred mode for autopilot VOR approaches.

ILS Approach

ILS approaches can be conducted in either ILS mode or by simultaneously using NAV and IAS modes. For pilots new to FDs, NAV and IAS are the recommended modes because the flight control inputs required of the pilot are more intuitive. NAV mode uses the roll axis to follow the localizer beam. Pilots work together with IAS mode to follow the glideslope the same way they follow the vertical guidance on an RNAV LPV approach.

ILS mode combines the pitch and roll mode into one selection. The roll side of ILS mode follows the localizer the same way it does in NAV mode. The pitch side of ILS mode adjusts the nose attitude to maintain the ILS glideslope. The pilot adjusts the collective to maintain airspeed. However, since the pitch mode adjusts the nose attitude to maintain glideslope, it also changes airspeed. The pilot must then adjust the collective to return to the desired airspeed. There is some lag between the autopilot pitch input, the change in airspeed, and the pilot's collective input. Consequently, ILS mode frequently results in airspeed and glideslope oscillations.

For example, the helicopter descends slightly below glideslope, so the autopilot pitches the nose up. The helicopter slows due to the nose-up attitude, so the pilot increases collective to regain airspeed. By the time the pilot has increased collective, the helicopter is back on glideslope, so the autopilot pitches the nose down to maintain it. With the increased power from the pilot, the helicopter now accelerates above the desired airspeed. As the helicopter accelerates, it climbs slightly above glideslope, causing the autopilot to pitch the nose further down to regain glideslope. As the helicopter accelerates, the pilot takes power out, and oscillations continue. For this reason, ILS mode is not recommended for pilots learning how to conduct actual IMC ILS approaches.

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CHAPTER EIGHT
AIRWAY NAVIGATION FLIGHT

800. INTRODUCTION

Airway navigation is used in cross-country flying under both IFR and VFR conditions. The pilot must utilize the skills and knowledge gained throughout the instrument syllabus to successfully accomplish a cross-country flight. Thorough preflight planning will provide the crew with a safe and efficient route to the destination airport.

During preflight planning, the pilot needs to consult the NATOPS manual, CNAF 3710.7, and the Flight Information Publication (FLIP) or approved mission planning system database for applicable rules and regulations as well as helicopter performance limitations, route, and airport information. The following information is a general guide for IFR flight planning. Make sure planning source documents are current and address all contingencies.

801. FLIGHT PLANNING

The flight planning procedures are as follows:

1. Select the destination airport. After discussing options with the instructor, check the IFR Supplement to verify that the desired destination airport is suitable. Ensure the Fixed Base Operator (FBO) has contract fuel available and a Ground Power Unit (GPU). If the destination is an overnight, verify operating hours, overnight ramp space, and any additional costs, such as ramp fees.

2. Determine the route of flight. Communicate with the instructor regarding the route and intermediate stops to ensure you meet all training requirements along the way.

3. Complete the Navlog. Use ForeFlight to complete the Navlog and detailed fuel planning.

4. Complete the DD-1801 Flight Plan. Use ForeFlight to complete a DD-1801.

5. Create a kneeboard flight packet, as required. Some pilots prefer to compile useful route information on their kneeboard. This may include a cover sheet with route and frequencies, airfield diagrams for each airport, and any other information that would be useful for quick reference in flight. Due to the convenience of approved mission planning applications, some pilots prefer to have everything loaded on their Electronic Kneeboard (EKB) instead. Talk to your instructor about expectations.

6. On the day of departure:

    a. Obtain a weather brief (Form DD 175-1).

    b. Check the NOTAMs for the entire route of flight, including alternate airfields.

c. Ensure the PIC has signed the flight plan and checked the Navlog. Fuel planning, and flight plan.

d. File the flight plan with Base Operations or Flight Service Station (FSS) as applicable.

Pick up the Fuel Packet and ensure the helicopter is equipped with a Cross-Country Kit.

802. FLIGHT EXECUTION

Procedures

Once the flight plan is filed, the crew should be ready for takeoff at the time proposed on the student's flight plan.

1. Prior to takeoff:

   a. Obtain ATIS information.

   b. Contact Clearance Delivery or Ground for IFR Clearance.

   c. Contact Ground for taxi clearance.

   d. Complete the Instrument Flight Checklist.

   e. Obtain IFR release, initial departure instructions, and takeoff clearance from Tower.

   f. Squawk the appropriate transponder code as assigned.

2. After takeoff:

   a. Switch to Departure Control when instructed by Tower.

   b. Note the takeoff time and fuel.

3. After the IFR departure is complete and the helicopter is at the assigned altitude:

   a. Complete the Level-off Checklist.

   b. Conduct a Fuel Consumption Check.

Check groundspeed.

   c. Compare the actual fuel remaining to the estimated fuel remaining and Estimated Time of Arrival (ETA) to the Navlog.

4. Fly the route and approach procedures in accordance with the FLIPs, NATOPS, Instrument Flight Manual, AIM, and this FTI.

Amplification and Safety Notes

- Double-check fuel-planning calculations for accuracy and compliance with CNAF requirements.
- Be familiar with the NAVAIDs along the route of flight, even if the plan is to fly via GPS. VOR airways are defined by VORs. If the GPS fails, ATC expects the helicopter to continue to fly using conventional NAVAIDs.
- Review the FLIPs for the route of flight. Be prepared to execute an instrument approach to an unplanned airfield along the route of flight in the case of an emergency.
- Use good multi-piloted CRM and utilize the PNAC to make flight plan changes, tune NAVAIDs and radio frequencies, and review the route while the PAC flies.
- Know the information and instructions that require a read-back to ATC. If there is any question about flight plan amendments or clearance, ask for clarification.
- Review radio and operating procedures at un-towered airfields before the cross-country flight.

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