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**NAS CORPUS CHRISTI, TEXAS**

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# **FLIGHT TRAINING INSTRUCTION**



## **INSTRUMENT AND NAVIGATION ADVANCED PHASE**

**TH-57**

**2017**



**DEPARTMENT OF THE NAVY**

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1. CNATRA P-458 (Rev. 04-17) PAT, "Flight Training Instruction, Instrument and Navigation, Advanced Phase, TH-57" is issued for information, standardization of instruction, and guidance to all flight instructors and Student Military Aviators within the Naval Air Training Command.
2. This publication is an explanatory aid to the Helicopter curriculum and shall be the authority for the execution of all flight procedures and maneuvers herein contained.
3. Recommendations for changes shall be submitted via the electronic TCR form located on the CNATRA website.
4. CNATRA P-458 (Rev. 09-14) PAT is hereby cancelled and superseded.

A handwritten signature in black ink, appearing to read "M. B. Tatsch", is positioned above the typed name.

M. B. TATSCH  
By direction

Distribution:  
CNATRA Website

**FLIGHT TRAINING INSTRUCTION**  
**FOR**  
**INSTRUMENT AND NAVIGATION ADVANCED PHASE**  
**TH-57**



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### INTERIM CHANGE SUMMARY

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## **INTRODUCTION**

Congratulations! Assuming your familiarization flights are complete, you are now entering a new phase in flight training: advanced navigation. 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, Crew Resource Management (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 and Navigational events for both aircraft and simulator listed in the Advanced Multi-Service Pilot Training System Curriculum (CNATRINST 1542.156 series); however, it does not contain maneuver descriptions previously covered in other FTI publications, such as the Contact FTI. 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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## CHAPTER ONE HELICOPTER LOW LEVEL NAVIGATION

### 100. INTRODUCTION

Helicopter low level navigation is an integral part of the aviator skill set and contributes greatly to mission accomplishment. The maneuvers you will be introduced to in the following sections are the foundation that all military operational tactics are built upon. You will learn more specific tactical maneuvers upon reaching your specific airframe. The following are some definitions that will soon be useful to you in training and in your operational squadron:

**Aim Point:** Any feature that is obvious and provides a steer to the next CP.

**Bingo:** Fuel state needed for recovery IAW NATOPS.

**Dead Reckoning:** A method of calculating one's current position by using a previously determined position, or fix, and advancing that position based upon known or estimated speeds over elapsed time. It is the primary navigation in underdeveloped areas lacking navigation aids, and when the tactical situation dictates or Nap-Of-the-Earth (NOE) flying.

**Funneling Feature:** Any linear feature, manmade (road) or natural (river), that leads to the next checkpoint (CP).

**Joint Operations Graphic (JOG):** The Joint Operations Graphic-Air (JOG-A) is an aeronautical chart for international and joint service air/ground tactical operations that focuses on identifying horizontal control points and low altitude air navigation hazards. The JOG-A is used for tactical air support/assault missions with ground forces and is printed on a Mercator projection. Ground units commonly use the JOG-A as a strategic/operational map to complement the 1:50,000 topographic line map.

**Intermediate CP:** Any feature on your planned route between two checkpoints that provides a good navigational reference.

**Landing Zone (LZ):** Any specified zone used for the landing of aircraft.

**Limiting Feature:** Any manmade or terrain feature that defines a limit to the leg of flight. Linear limiting features are best (river or road), but point features (tower) can also be used.

**Mission Fuel:** The minimum fuel required to complete the mission, [course rules, route, landings at LZ, and RTB] and land within NATOPS minimums.

**Pilotage:** is a method of determining a position over the ground using map-to-ground orientation.

**Rolex:** Timeline adjustment in minutes; always referenced from original preplanned mission execution time. "Plus" means later; "minus" means earlier.

**Time on Target (TOT):** Ordnance impact time on the target; post mission - the actual time of attack.

**Topographic Line MAP (TLM) 1:50,000:** The 1:50,000 TLM is a lithographic map that portrays the greater detail of topographic and cultural information. Relief is shown by contours and spot elevations measured in meters. The map is a true representation of terrain detail. Features are plotted to correct orientation and true location. The map depicts the level of detail required for infantry and reconnaissance units to navigate in various terrain environments including jungle, mountain, arctic, and desert. The 1:50,000 TLM supplements a commander's reconnaissance of his/her zone of action by providing basic terrain analysis information in sufficient detail to support intelligence preparation of the battlefield.

## **101. CONDUCT OF MISSION PROCEDURES**

Any mission may be divided into four phases: Planning, Brief, Execution and De-Brief.

1. Planning - All flight preparation from the receipt of the mission order to the delivery of the mission brief.
2. Brief - Mission Commander's plan to accomplish the mission.
3. Execution - Mission Commander's plan in action.
4. De-Brief - Analysis of the successes/failures of the previous 3 phases.

## **102. MISSION PLANNING PROCEDURES**

The Mission Planning phase includes all the tasks that must be completed for a successful brief and mission. For all operations, Mission Planning always begins with the Mission Analysis, or the mission commander's study of the assigned mission.

Helicopter pilots must be proficient at power management, timing, fuel planning, route selection, and terminal area tactics. These areas are the foundation for both planning and executing an array of missions.

For training purposes, low-level flights shall be conducted only on designated routes. SNAs should check the flight schedule the day before the event for the route assignment.

### **Power Management**

SNAs need to develop a thorough understanding of power calculations and how they pertain to the planned flight profile. While "power required" (Pr) is calculated prior to every flight, SNAs should be able to calculate Pr for LZ operations and also consider Max Endurance and Max Range Pr for their flight profile. Furthermore, SNAs should have an understanding of "power available" (Pa) and how it impacts calculated Pr.

## **1-2 HELICOPTER LOW LEVEL NAVIGATION**

During operational missions the aircraft may not have the power to HIGE or HOGE at certain altitudes and/or weights. Your level flight envelope (the airspeeds at which you are physically capable of flying without drooping Nr or descending) may be truncated given environmental considerations and/or configuration of the aircraft. Imagine attempting to bring more than 2,000 lbs. of food, supplies, and medical equipment up to a mountain village in Haiti while participating in Humanitarian Assistance and Disaster Relief (HADR) efforts following a hurricane. Your calculations may reveal that you have the Pa to exceed power requirements at sea level, but given the temperature and altitude at higher elevations, your Pr will exceed Pa. Perhaps you need to take fewer supplies, less fuel, or land at a different location.

### **Timing**

Missions are typically planned to be event driven or time based. If timing is the critical factor, multiple units or organizations will be counting on your completion of a task on time within a margin of seconds. Every naval aviator should be able to quickly determine time needed to proceed on course in order to make a required event time or TOT.

In the planning phase, you may be assigned a specific time. In this situation, a mission commander will work backwards from the TOT to determine at precisely what time they need to be at each checkpoint enroute given their planned groundspeed. Ultimately, they can then determine at what time they need to walk, brief, pre-flight, and launch.

In the planning phase events may be used to trigger execution actions. In this situation, a mission commander will have a detailed timeline for the sequence of events necessary for mission success. As an event triggers an action, a mission commander commences. In these scenarios, there will be triggers that determine when the aircrew needs to walk, brief, pre-flight, and launch.

It is impossible to make a TOT with inaccurate time information. GPS time is typically used to ensure all units, ground and airborne, are using the same time hack; however, it is *critical* that all crews get an accurate time hack prior to walking, or at least prior to takeoff, in case a loss of GPS occurs. If GPS is available in flight, it should be considered the most accurate source of timing information.

### **Fuel Planning and Fuel Computation**

Successful fuel planning is accomplished by utilizing accurate burn rates: max range, max endurance, ground speed, and full open or flight idle. The preferred method for calculating mission fuel is by using Joint Mission Planning Software (JMPS); however, actual flight conditions may change the fuel burn rate so manual calculations will be necessary. Fuel flow can be calculated for the different flight profiles and ambient conditions using the NATOPS charts. When using JMPS, it is necessary to input accurate data into the software to include temperatures, altitude, aircraft weight, and airspeed.

Determine fuel required to fly from the LZ where TA's will be conducted to the next fuel stop (KNDZ, Site 8, Florala, etc.). If the LZ has RWOP minimum departure fuel restrictions, ensure to take those into consideration when determining the mission fuel.

Determine the amount of time to delay at the LZ for Tactical Approaches (actions at the objective). This time will be put into JMPS as a 'delay' at the LZ checkpoint. Determine the fuel required for the delay using the charts in the NATOPS using 80 KIAS (pattern airspeed) and the appropriate ambient conditions at the field. This calculation will be conservative due to the time spent on the deck between approaches.

Determine fuel required to fly from the point of departure to the terminal area to conduct Tactical Approaches. This will include course rules, the low level route to be flown, and course rules to the NOLF. Depending on mission requirements, this may entail flying a ground speed (to make a TOT) or flying a predetermined airspeed (90 KIAS for the route/100 KIAS for course rules) to finish the route at a calculated time. During execution, winds must be taken into account for all portions of the flight.

### **Route Selection**

When selecting a route for operational missions, the aircrew is either planning the most time and fuel efficient route or planning for detection avoidance. Criteria to consider includes: Enemy location and weapon engagement zone, environment, terrain and time. Routes should be planned to keep higher terrain or thicker vegetation between you and the enemy. Avoid densely populated areas or linear manmade features.

When selecting route CPs, terrain features are preferred over manmade objects because manmade features are subject to change or destruction. Newly constructed features may be confused for intended CPs. Terrain features change less frequently over time.

### **GO/NO-GO Criteria**

Go criteria are the prerequisites that need to be met (equipment, personnel, or conditions) prior to mission commencement and are based on friendly disposition. No-Go criteria are those same prerequisites based on enemy disposition.

### **NOTE**

No-Go criteria will not apply to TW-5 aircraft.

### **Terminal Area/Objective Area**

Ingress (the route into the terminal/objective area) and egress (the route out of the terminal/objective area), will determine success or failure. SWEEP is the acronym that will be used to describe the LZ IAW NATOPS. The discussion of a zone during the brief should include SWEEP and is briefed by exception during real time LZ evaluation as well.

**SWEEP:**

- **S – Size, slope, suitability, and surface.** How big, direction of general slope, how many aircraft can land in the zone, and the makeup of the terrain.
- **W – Wind effect.** A cirque (a bowl-shaped mountain basin that can sometimes have steep walls) may have swirling winds; while a ridge top (a long, narrow elevation of land) may have hazardous mountain top winds. Similarly, a flat zone may have no wind below 50' when obstructed by vegetation.
- **E – Elevation.** When approaching an LZ, terrain may not be level and knowing the elevation of the LZ may be the best way to set up for a normal approach profile to the zone, particularly at night when visual cues are lacking.
- **E – Egress / Obstacles.** Include egress direction and obstacles. Egress may be a descending turn when departing a mountain top pinnacle or may be the same direction as approach. Obstacles and terrain considerations are crucial.
- **P – Power Available / Power Required.** Power available as calculated from the NATOPS manual at the LZ elevation. Power required is HIGE/HOGE requirement at LZ elevation.

Example – “Harold is a 5000’x3000’ T-shaped level grass field. Terrain is marked by 4 gravel diamonds for each LZ and the grassy areas have some relatively deep holes. Anticipated winds are 360 and during landing, a loss of wind effect can be anticipated near the northern boundary due to 75’ tall trees. Elevation is 159’. Egress will be straight ahead with 75’ tall trees. Power available is 100% and Calculated Power required to HIGE/HOGE based on expected arrival time and fuel load is 78%/88%.”

**Maps and Aerial Preparation**

It is very important to perform a detailed map study prior to attempting low-level navigation. A detailed map study includes reviewing details such as: the route itself, surrounding obstacles and hazards, water features, elevations and depressions in terrain, potential airspace conflicts, etc. Go over the route of flight mentally and attempt to visualize the flight path. Certain essential items must be drawn on the map to aid in navigation. Different types of maps may be used depending on the mission or the phase of the mission. The different types of maps include:

- **VFR Sectional** – Sectional Aeronautical Charts include the most current data at a scale of 1:500,000 which is large enough to be read easily by pilots flying by sight under Visual Flight Rules. Sectionals are named after a major city within its area of coverage. They are updated frequently but are not very detailed. The lack of detail due to scale, makes the VFR Sectional less effective in the terrain flight environment.

- **Joint Operations Graphic-Air (JOG-A):** The JOG-A is typically a 1:250,000 scale aeronautical chart for international and joint service air/ground tactical operations that focuses on identifying horizontal control points and low altitude air navigation hazards. The JOG-A is used for tactical air support/assault missions with ground forces and is printed on a Mercator projection. Ground units commonly use the JOG-A as a strategic/operational map to complement the 1:50,000 topographic line map. The JOG-A has more detail than the VFR Sectional, but generally is not used for terrain flight routes.
- **Topographic Line MAP (TLM) 1:50,000 Scale:** The 1:50,000 TLM is a lithographic map that portrays the greater detail of topographic and cultural information. Relief is shown by contours and spot elevations measured in meters. The map is a true representation of terrain detail. Features are plotted to correct orientation and true location. The map depicts the level of detail required for infantry and reconnaissance units to navigate in various terrain environments including jungle, mountain, arctic, and desert. The 1:50,000 TLM supplements a commander's reconnaissance of his/her zone of action by providing basic terrain analysis information in sufficient detail to support intelligence preparation of the battlefield. Helicopters use the 1:50,000 TLM for the terrain flight environment. Typical use will be no less than 5 NM from objective area.

### **Joint Operational Graphic – Air 1:250,000 Scale**

The JOG Air is the primary map for planning and flying the enroute portion of the mission. The map has a scale that provides a wide area of coverage, has latitude/longitude markings, and includes Universal Transverse Mercator (UTM) map features. The JOG map has two versions: JOG Air and JOG Ground. The JOG Air has aviation-related information such as airport elevation, airport beacons, terrain clearance altitudes, and magnetic variation lines. The JOG Air also has the military grid reference system (MGRS) with 10,000-meter grids superimposed in blue on the map. The JOG Ground map is less cluttered (lacking aviation-specific information) and terrain contours are not shaded.

### **Topographic Line Map (TLM) 1:50,000 Scale**

The 1:50,000 TLM is used to accurately locate and confirm unique manmade and natural features. It displays rising and lowering terrain in enough detail to allow for accurate navigation due to a larger scale. The 1:50,000 TLM is the primary map used for low level and terrain flight routes in the terminal area or objective area.

### **Map Data**

The maps available for use during planning and execution may not have the most current aviation hazards, manmade features, and other topography information that may have changed since the map was printed. There are many methods of updating your maps with more current information to help successfully navigate the route.

### **Map Changeover Point (MCP)**

During flight routes it is often necessary to transition between charts/maps. These transitions can occur when the flight route departs the area depicted on the chart/map, or may occur when it is necessary to transition to a larger or smaller scale chart/map that best supports the mission requirements. It is important to identify an MCP, a point easily identifiable on both charts/maps, which facilitates a smooth transition between charts/maps while in flight. The MCP should be selected so as not to be on the edge of the chart/map, leaving some additional route beyond the MCP in order to become oriented. An MCP at the edge of a chart/map may lead to disorientation during the map changeover.

There is no limitation on the transition between charts/maps. On many missions, the transitions will be from small scale chart/map (IE: 1:500,000) to a larger scale chart/map (IE: 1:50,000) while ingressing, then from large scale to smaller scale when egressing. The number of charts/maps needed depends on mission analysis, altitude being flown, and speed along the route. During navigation training the VFR Sectional, JOG-A, and various 1:50,000 TLM maps/charts will be used.

### **Photographic/Satellite Imagery**

Photographs provide up-to-date information on topographic changes. An evaluation of the relative merits of maps and aerial photographs indicates that each has certain advantages. Therefore, whenever possible, they should be used in conjunction with each other to improve overall situational awareness.

#### **Photograph/Satellite advantages as compared to a map:**

- Provide a greater level of detail.
- Are typically more current.
- Show man-made features that do not appear on maps.
- Provide a permanent and objective record of the day-to-day changes within the area.

#### **Photograph/Satellite disadvantages as compared to a map:**

- Some features on aerial photographs may be obscured or hidden by other details, such as a building located in a densely vegetated area.
- Unless geo-referenced grids are calculated, the position, location, scale, and elevations are only approximate.
- Lack of color and contrast in tone make photographs difficult to use in poor light.

Joint Mission Planning System (JMPS) has several tools that can be used to ensure maps/charts have the most current information, and to perform a thorough map study during pre-mission planning.

After you have built your route in JMPS, you may zoom in on the layers until you get to satellite imagery. This satellite imagery is on a scheduled update cycle, and is more current than the JOG-A and 1:50,000 TLM.

The other application within JMPS to take advantage of is Sky View. Sky View will give you a 3D sky view of the route, providing the same perspective that would be seen from a particular altitude. The user can set and adjust the altitude to view the route.

Commercial satellite imagery is another, non-official, source to update your route maps and perform a map study. An important aspect of using satellite imagery is determining how current the information is. Imagery that is several months or years old may show topographical differences that could lead to disorientation during the flight.

### **Map Study**

Once the route of flight has been drawn on the map, a thorough map study can be accomplished. For each leg of flight along the route, the crew should establish both left and right lateral limits, a CP funneling feature, a CP limiting feature and intermediate features if good features present themselves. Each of these should help guide the aircraft toward the desired CP on time and keep the navigator from straying off the intended route. Consider seasonal changes to determine how a piece of terrain will appear. Annotate hazards and plan deviations as necessary. Lastly, note the position of the sun and moon illumination (when visible) throughout the mission timeline.

This map study should include analysis of the assigned area using JMPS and other resources. Imagery available on JMPS can greatly increase aircrew situation awareness of a given area prior to conducting the mission. Additionally, intended routes can be flown using mission planning software to increase SA during the mission. A map study provides the crew with an advance look at the terrain features and other specifics that may be encountered when operating at TERF altitudes. As previously mentioned, a detailed map study will include review of and orientation to the following details:

- Topography such as terrain elevation.
- Hydrography to include lakes, rivers, etc.
- Manmade and natural hazards. This includes towers, powerlines, and tall buildings in addition to mountain peaks and trees.
- Airspace de-confliction such as Class “C” and “D” as well as Restricted Areas and locally imposed noise sensitive areas.

- The route itself, with expected limiting and funneling features, aimpoints, and intermediate checkpoints.

Consider assembling as many different maps of the area of operations as possible. At a minimum, the two different maps we will use are the JOG-A and 1:50,000 TLM. Additionally, satellite imagery, road maps, and VFR sectionals will increase the awareness of the aircrew.

Conducting a good map study will help you reach your terminal area or objective area on time, and alleviate cockpit workload during the high workload portion of the mission. A good map study prior to the flight will alleviate the work load required to navigate and aid in hitting your TOT.

### 103. MISSION PRODUCTS

#### Mission Smart Packs

A mission “smart pack” ensures the entire flight is referencing the same information and material throughout the flight. It may include, but is not limited to, such items as: power calculations specific to each aircraft, a communications card that includes frequencies and frequency assignments for each aircraft, troop and ordinance loadouts for the flight, and an “execution checklist” that represents the entire sequence of events for the mission. The “smart pack” is essentially a gouge packet for the mission that can be crucial for ensuring each “player” in a larger mission understands their role and can execute it. You are encouraged to ask your instructor to elaborate on the use of “smart packs” during operational missions.

Student “smart packs” shall include:

- Cover sheet that includes, at a minimum: aircraft assignments, power calculations, frequencies expected on the route, and a sequence of events with timeline. With respect to timeline, you may need to review the schedule to determine if you are a hot-seat or cold-go. If it is not obvious or you are unsure, either attempt to call your IP (crew rest/crew day dependent) or decide on one course of action and plan it. Similar to operational missions, you may need to adjust your plans according to weather, OPS, or maintenance. The cover sheet format will vary by squadron.
- The JMPS route card for the entire route to be flown (KNDZ, course rules to the route, the route itself, course rules to OLF, 20 minutes of TAs, and finally course rules to KNDZ).
- The JMPS route card for the “bingo” route (the route from the “bingo” CP direct to course rules entry point and then course rules to KNDZ, all flown at max-range airspeed).
- LZ diagram for where you will be conducting TAs.

SNA shall produce two “smart packs.” One will be provided for the IP and the other is for the SNA.

**Landing Zone Diagram**

The LZ diagram is a visual depiction of the landing plan that supports the Mission Commander’s scheme of maneuver. The diagrams should be a single source document that contains all pertinent information relative to the landing and actions at the zone. SNAs shall provide a kneeboard card diagram for the smart pack and should consider including the following details in SWEEP format (“Reasoning” column includes tactical considerations for a metric’s inclusion that may not apply to student events but are provided as amplifying information):

Metric to Consider	Reasoning
Location (Grid or Lat / Long)	Enables quick identification and confirmation in navigation equipment if disoriented.
LZ size in meters	Gives the crew an idea of scale and potentially what type of approach will be made into the zone. Similarly, this will have implications for how many aircraft may land at once.
Magnetic north reference	This standard reference allows the crew to properly orient themselves and others.
Topography	Address whether or not the flight can expect a flat surface, or rolling terrain. Perhaps there are areas in the zone that are more ideal to set the aircraft down given ditches, for example.
Soil composition	Firm packed soil, blowing sand, snow, etc. Has it rained heavily there recently? All of these considerations will frame expectations for what sort of environment the approach will encounter. Can we expect a “degraded visual environment” at the end of the approach? Will we sink into the ground or is it firm enough to support our weight?
Elevation	If an LZ is significantly higher than our departure point, we can expect to have to calculate a separate set of power numbers. Likewise, we will need to confirm these numbers prior to making the approach to ensure we meet the margins set by the mission commander.

Hazards	Brief hazards such as trees, fence lines, walls, powerlines, etc.
Buildings	Similar to hazards, however, buildings may house hidden threats or may otherwise be of interest in our mission. You should orient the flight as to where these buildings are, their numbering/naming convention (if applicable), and point out particular target buildings if they exist.
Winds	Implications for power requirements.
Ingress direction	How will we approach the LZ (i.e., from the north, from the east, etc.) This will impact how the zone will appear to us as we fly inbound to it. The particular ingress direction will also take into consideration many details about the tactical environment.
Landing formation / sites / points	The manner in which the section will conduct themselves with respect to landing in the LZ. Taking into consideration the entirety of the mission requirements and LZ details, the mission commander may prefer certain terminal area tactics. How many aircraft will simultaneously land in the zone, their particular formation into the zone, and their follow-on flight paths out of the zone will all be particular to each mission and each LZ.
Landing direction	Take into account not only the winds but also aforementioned hazards and LZ dimensions.
Egress direction	Same as “Ingress.”
Wave-off direction	Given all the details about the LZ and our mission, a certain wave-off direction will need to be selected. A wave-off direction for the lead aircraft into the zone may be different for the third aircraft in the formation.
Sun / moon position	Tactical implications. You are encouraged to ask your IP for information how these details may be applied to terminal area tactics.

Frequencies	Who will we be talking to in the terminal area and on what primary and alternate frequencies? Are we checking-in with a Joint Terminal Attack Controller (JTAC), an Airborne Mission Commander (AMC), or Rescue Mission Coordinator (RMC)?
-------------	---

**Figure 1-1 LZ Diagram Considerations**

### **Route Cards**

Route cards are to be created using the mission planning software JMPS and should include the departure airfield, course rules to the low level route (if applicable), the low level route, delay at the LZ for Tactical Approaches, and course rules to final destination. Follow instructions from the N0101 Mission Planning Software overview class.

#### **NOTE**

The route card shall be printed utilizing the MAWTS #1/NVG format. Ensure CPs and brief physical descriptions of the CPs are annotated.

### **104. CHART/MAP PREPARATION**

There are two important considerations in chart/map preparation: size and detail. Size is an important consideration because the chart/map should be big enough to include as much of the terrain features and obstacles around the route as possible, yet it must be manageable in the cockpit. Detail is also an important consideration because the route and other important navigational aids need to be drawn on the chart without covering information that could assist in navigation.

Recommended Equipment:

- Charts/Maps
- Straightedge
- Protractor (capable of identifying grid locations)
- Stencil (capable of making doghouses, circles, triangles)
- Transparent Tape
- Scissors

- Ultrafine Tip Marker (red)
- Fine Tip Markers (red, blue and black)

#### NOTE

When writing on the chart/map, the SNA should use a straightedge to ensure the information is professional and legible.

**Step 1.** Tape the charts/maps together using scotch tape.

JOG-A (1:250,000) - Ensure Lat/Long and terrain features are aligned properly.

1:50,000 TLM - Ensure the gridlines and terrain features are aligned to the max extent possible.

#### NOTE

Due to differences in the publish dates of the maps, there can be some slight feature misalignment even when the Lat/Long or gridlines are properly aligned. When this occurs, the priority should be with lat/long or gridline alignment.

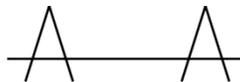
**Step 2.** Chum all the obstacles on the chart using an ultrafine tip red marker.

Towers shall be marked by an ultrafine tip red marker and the elevation in feet AGL at the base.



**Figure 1-2 Tower Elevation**

Power lines shall be marked with an ultrafine tip red marker.



**Figure 1-3 Power Line Marking**

Use the Chart Updating Manual (CHUM), JMPS, VFR Sectional, JOG-A, and local instructions to update obstacles not that are not printed on the charts/maps being used for the route.

The CHUM is a supplementary publication, with bulletins published quarterly, that can be consulted for the most current information on potential low level hazards (towers, power lines, etc.). The CHUM is available on the National Geospatial-Intelligence Agency (NGA) website. It is CAC enabled and requires registration

<https://www.extranet.nga.mil/servlet/RegistrationForm>.

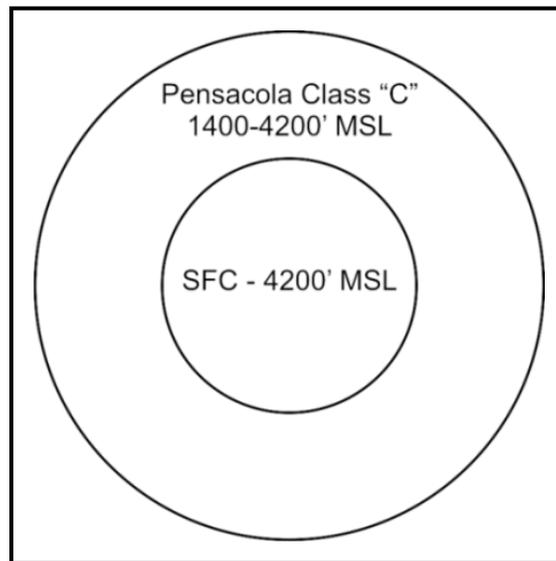
Once you have obtained access, select “Products and Services” on the left side bar, then “AERO Products.” The page will allow you to select a .pdf of the current CHUM publication or select the current monthly ECHUM. The NGA Extranet site enables access to all electronic FLIP, from mission planning documents to approach plates. Access to this site will prove useful throughout your aviation career.

**NOTE**

All elevations on the 1:50,000 TLM are in meters and must be converted to feet.

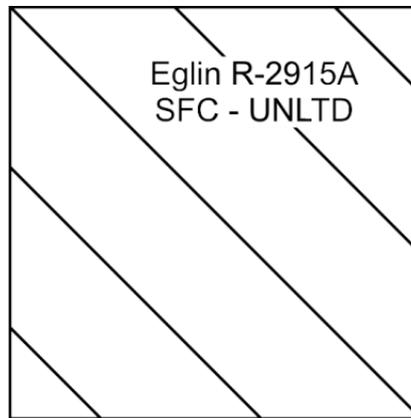
**Step 3.** Plot the airspaces on the chart/map.

Airspaces (Class “C”) shall be chummed using a fine tip blue marker designating the boundaries of the airspace.



**Figure 1-4 5 NM and 10 NM for JOG-A Chart Production**

Prohibited Areas, Restricted Areas and No-Fly Areas shall be chummed using a fine tip red marker designating the boundaries of the airspace with parallel lines through the middle of the airspace.



**Figure 1-5 Boundaries of the Airspace**

All airspaces should include the name of the airspace and altitude limitations to the max extent possible.

**Step 4.** Cut excess areas from charts/maps.

The chart/map should be cut to a manageable size, but not so small that important details are lost. A good rule of thumb for the topographic line maps is to keep six grid squares as a border between the checkpoints and the edge of the map. The six grid squares provide 3.6 miles of important terrain/manmade features that could assist in navigation if disoriented. Also, if the grid numbers are listed within +/- one grid, the grid numbers should be kept to assist with navigation. For JOG-A charts, leave enough map area for navigation and for orientation. Additionally, the chart should be cut in order to leave the grid numbers and lat/long information on the side of the chart. If doing so makes chart/map size untenable, then the margin data should be written in using black marker.

**Step 5.** Place marginal information on the chart.

JOG-A

Front side –Scale shall be on the front of the chart in a location that does not cover other important details. The appropriate Low-Level Navigation Route Checkpoint Table shall be added from local SOP. Back side – All other information shall be added.

1:50,000 TLM

Front side – Scale and Magnetic Deviation shall be on the front of the chart in a location that does not cover other important details. The appropriate Low-Level Navigation Route Checkpoint Table shall be added from local SOP. Back side – All other marginal information shall be added. Only one legend is needed, but coordinate conversion information, adjoining sheets, name, scale and addition (Crestview, Florida 3645 I V747 Edition 6-NIMA) should be placed on the chart for each map used.

**NOTE**

If using more than one 1:50,000 TLM chart and there is a discrepancy between the maps' marginal information, use the most current data.

**Step 6.** Place chart/map type, scale, route (if applicable), name, and date on the chart.

Do not cover up important terrain features. Over water is a good place to write this information, if able. If lamination is available, this information should be under the lamination.

JOG-A, 1:250,000:  
GREEN ROUTE  
PREPARED BY LTJG SMITH  
7 JUL 15

1:50,000 TLM:  
ORANGE ROUTE  
PREPARED BY 1stLT JONES  
7 JUL 15

**Step 7.** Use Joint Mission Planning System (JMPS) to plan entire route of flight. Routes shall be planned using course rules from KNDZ or VFR departures from locations other than KNDZ to the 1st checkpoint on the route, 1st checkpoint to last checkpoint on the route, and from the last checkpoint to the LZ and from the LZ, then course rules back to KNDZ or as directed by the IP. Airspeed for course rules from KNDZ to the first checkpoint on the route, from the last checkpoint on the route to the appropriate LZ, and from the LZ to KNDZ shall be in accordance with (IAW) local course rules. Airspeed from 1st checkpoint to the last checkpoint on the navigation route shall be planned for 90 KTS ground speed. Twenty minutes of TAs shall be planned at the LZ as applicable.

**NOTE**

In order to obtain accurate fuel planning from JMPS, adjustments in airspeed will have to be made in the Combat Flight Planning Software (CFPS). Aircraft configuration will have to be changed to calculated, required fuel at takeoff.

KNDZ→(100 KIAS)→1st Route CP→(90 KTS Ground Speed)→Last Route CP→(100 KIAS)→LZ (20 mins)→(100 KIAS)→KNDZ.

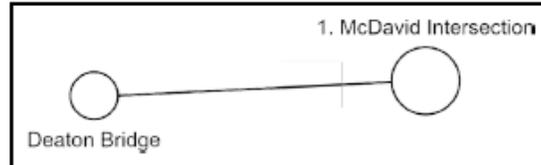
**Step 8.** Use JMPS to plot the specific low-level navigation route using 90 KTS Ground Speed. Route should be planned from the first checkpoint on the route to the last checkpoint on the route.

1st Route Checkpoint→(90 KTS Ground Speed)→Last Route Checkpoint.

Print one copy. This copy is for SNA to calculate route timing.

**Step 9.** Place the route CPs and LZs on the chart/map. Plot CP's with the protractor and mark them with a circle. Route CPs are marked with a circle about the size of a nickel using a fine tip black marker. Course rules CPs are marked with a smaller circle about the size of a dime using a fine tip black marker. LZs shall be marked with a triangle using a fine tip black marker. The size of the triangle should be approximately the same size of the route CP circles.

**Step 10.** Connect the CPs. Use a single black line along a straight edge drawn from one CP to next CP. Follow the example below.



**Figure 1-6 Route Checkpoints**

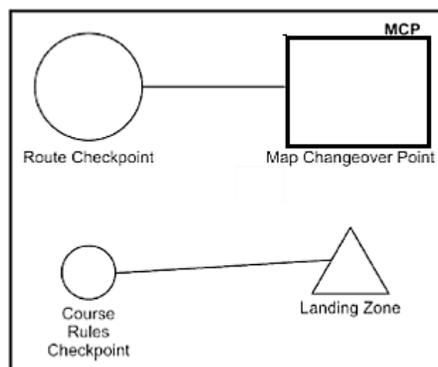
**Step 11.** Label the CPs. Route CPs shall be labeled using the number of the CP and include brief description.

**Step 12.** Laminate (If available, not a requirement).

**Step 13.** Place map changeover points (MCPs) and LZs on the chart/map. MCPs will be required anytime the navigation event uses more than one chart/map. The MCP is a transition point from one chart to the next. If required, study the charts/map and choose a MCP for the route. A MCP should be a natural or manmade feature that is easily identifiable on both charts/maps. Additionally, it should be far enough away from the last CP on the first chart/map and the first CP on the next chart/map to allow for transitioning between charts/maps without loss of orientation.

MCPs are marked with a square about the size of a quarter using a fine tip black marker with the letters "MCP."

LZs should be labeled LZ "name of the OLF or airfield," i.e., "LZ Bay Minette" or "LZ Harold."



**Figure 1-7 MCP & LZ**

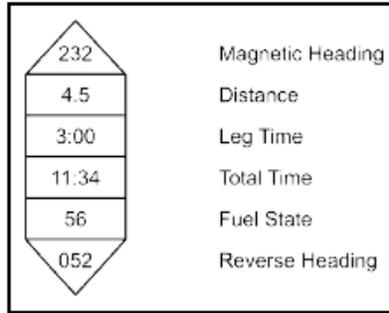
Mileage tic marks may be used to assist in range estimation while traveling along the course. A mark drawn to bisect the course line every one nautical mile works best. One advantage to this technique is that the tic marks will be a constant distance from each other and give you an appreciation for how far certain features are from your next checkpoint. Also, if you find yourself needing to speed up or slow down to make a time on target (TOT), your tic marks are still “valid” in that you will always be a certain distance from your next CP regardless of groundspeed. One disadvantage is that you may cross these tic marks at “uneven” times relative to your leg timing. For example, with a mileage tic mark every mile and flying at 90 KTS ground speed, you will hit your first tic mark in roughly 40 seconds, your second one at time 1+20, and your third at 2 minutes.

Time tic marks may be used to assist in dead-reckoning navigation as well. Use appropriate time intervals as required; the distance between the time tic marks is dependent on groundspeed and CP distance. Advantages to this are the inverse of those associated with mileage tic marks. While your clock and tic marks will be perfectly in sync, you will not necessarily have the SA of knowing how far you are relative to your next checkpoint. Likewise, if you alter your groundspeed, the tic marks become essentially useless until you become reestablished on your route at the appropriate ground speed (beginning at a point you began to calculate them from!)

While not required, it is highly encouraged to use tic marks to increase SA. SNAs may use mileage tic marks or timing tic marks at their discretion.

An intermediate CP is a landmark selected along the flight route and used to verify aircraft position. An intermediate CP should be a unique feature or group of features easily recognizable. A lake, open field, road intersection, and even towers may be used as intermediate checkpoints. They need not be directly on your flight path’s ground track. Confirming you are “on course” by noticing a large lake passing by the aircraft approximately 1 NM to the west, for example, is just as good an intermediate CP as crossing directly over a road intersection. You may mark such points on your chart/map; however, be careful not to clutter the chart up too much, and begin to confuse yourself.

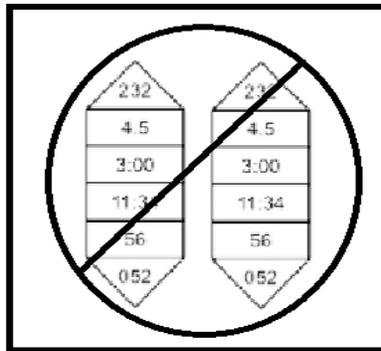
**Step 14.** Place doghouses on the chart. Doghouses should not be used for the checkpoints from NASWF to the route, only on the route itself. Place the doghouses between the appropriate checkpoints and position them as best as possible; not too close to the route or covering important features you may need to see. Doghouses shall contain the following information: Magnetic Heading, Distance between CPs, Leg Time, Total Time, Fuel State and Reverse Magnetic Heading. Grid magnetic angle must be converted to magnetic headings for the course. Use a fine tip black marker.



**Figure 1-8 Doghouse**

**NOTE**

Double dog houses for reverse routes are not authorized. The SNA shall add information for the reverse route in between the magnetic headings, extending the dog house size making sure not to duplicate Leg Time and Distance. The information should be oriented in the direction the route is being flown.



**Figure 1-9 Double Doghouse**

**Additional Chart Preparation Considerations**

1. Each student is responsible for preparing their own chart/map for each route.
2. Neatness is important. Straightedges and stencils shall be used. Charts/maps should be legible and clean. Remember in all missions, good chart/map preparation will enhance situational awareness while poorly prepared charts will detract from your situational awareness.

Charts/maps shall be prepared for the worst possible flight conditions such as low light level on NVGs. Again, a fine balance exists between using pen marks that are too thin to be seen at night and too thick that they cover important navigation features. Fold the chart/map so the navigator may follow the helicopter's position along the route of flight while transferring from one fold of the chart/map to the next.

3. SNA may keep charts/maps that will be used for other syllabus training events; however, SNAs may not use charts/maps created by someone else, and may not give charts/maps to other SNAs for use.

### **105. MISSION BRIEFING PROCEDURES**

1. All operational missions are preceded with a mission brief. The brief can range from a very simple, short discussion to a complex multimedia presentation involving several different aircraft, combat elements and supporting elements.

2. The following is an example of a mission brief for the Low-Level Navigation syllabus. The format of the brief is the OSMEAC Format (Orientation, Situation, Mission, Execution, Administration and Logistics, Command and Signal). The Formation and Night Tactical Stages will use a similar, but more extensive, form of this brief.

3. The briefing card (Figures 1-10 & 1-11) shall be used when preparing the Low-Level Navigation flights. The information does not need to be memorized word for word, but it needs to be presented in the same order and flow as below. The SNA can use the kneeboard sized briefing guide as an aid during the brief. Information encapsulated by arrows (< >) is not covered in the brief, it is amplifying information only and is included for SNA knowledge of operational procedures.

4. Following is the standard briefing template.

### Low-level Navigation Briefing Card

**ORIENTATION**

Time Hack \_\_\_\_\_  
 Aircraft Assignment \_\_\_\_\_ on Spot \_\_\_\_\_  
 Call Sign Eightball/Factory Hand/Lucky \_\_\_\_\_  
 Smartpack Inventory \_\_\_\_\_  
 Maps/Charts \_\_\_\_\_  
 Weather \_\_\_\_\_  
     Current \_\_\_\_\_  
     Destination \_\_\_\_\_  
     Required \_\_\_\_\_ SLAP \_\_\_\_\_

<**SITUATION** - N/A>

**MISSION**

At \_\_\_\_\_ L, HT-8/18/28 will launch a single TH-57C in order to safely complete a \_\_\_\_\_.

**EXECUTION**

**CONCEPT OF OPERATIONS (GENERAL OVERVIEW)**

Route \_\_\_\_\_  
 Control Measures \_\_\_\_\_  
     Boundaries \_\_\_\_\_  
     Airspace \_\_\_\_\_  
     Restricted Areas \_\_\_\_\_  
     LZ's \_\_\_\_\_  
 Obstacles to Flight \_\_\_\_\_  
 Avoidance, Powerlines, Towers, Aircraft, Birds \_\_\_\_\_

**SCHEME OF MANEUVER**

Preflight T-:30 \_\_\_\_\_  
 Taxi T-:05 \_\_\_\_\_  
 Takeoff T = \_\_\_\_\_  
 NASWF → ROUTE \_\_\_\_\_  
 ROUTE \_\_\_\_\_

F = Formation  
 A = Airspeed/Altitude  
 L = Lighting  
 C = Comms/Squawks  
 O = Obstacles/Terrain  
     Powerlines, Towers, Aircraft, Birds

N = Navigation/NVG

ROUTE → LZ \_\_\_\_\_  
     LZ description \_\_\_\_\_  
     SWEEP \_\_\_\_\_  
 LZ → NASWF \_\_\_\_\_

**COORDINATING INSTRUCTIONS**

Emergencies & System Failures \_\_\_\_\_  
 IIMC \_\_\_\_\_  
     Safe Heading \_\_\_\_\_  
     Safe Altitude \_\_\_\_\_  
 Disorientation Procedures \_\_\_\_\_

**Figure 1-10 Low-Level Navigation Briefing Card (Front)**

**ADMINISTRATION & LOGISTICS**  
Flight Duration \_\_\_\_\_  
Fuel  
    Mission \_\_\_\_\_gallons  
    Bingo \_\_\_\_\_gallons

**COMMAND & SIGNAL**  
Communications  
    Preset/Manual Frequencies  
    Nav aids  
    Lost Comms  
ID and Recognition  
    Squawk

**Figure 1-11 Low-Level Navigation Briefing Card (Back)**

**ORIENTATION**

**Time Hack** – Obtain the accurate time prior to the brief from the Naval Observatory Master Clock by calling (202)762-1401 or DSN 762-1401.

Time Hack shall follow the below format:

*“Orientation – Time Hack - In one minute the time will be 1545L.”*

*“Thirty seconds to hack.”*

*“Ten seconds to hack.”*

*“5, 4, 3, 2, 1, hack. At the hack, the time was 1545. If anyone requires an additional time hack, see me after the brief.”*

**NOTE**

Do not continue the brief until your time hack is complete.

*“Attention to brief. I am (Rank & Last Name). Please hold all questions to the end.”*

**Aircraft Assignment**

*“We will be in aircraft \_\_\_\_\_ on spot \_\_\_\_\_.”*

**Call Sign**

*“Our call sign today is Eightball/Factory Hand/Lucky (XXX).”*

**Smart Pack Inventory** – All information provided to assist in the conduct of the flight shall be inventoried. This is to ensure that all aircrew has the same information. Operational missions can require a single ship or a division of aircraft. The Smart Pack is essential to ensure all players have the appropriate call signs, squawks, frequencies, etc....

Inventory shall begin with the first page and continue in order to the last page. For the N43 and N44 Low-Level Navigation syllabus events, the SNA should provide the appropriate kneeboard grade card and completed weight and balance sheet to the instructor. Do not include these 2 pages in the smart pack. Items to be included in the smart pack are cover sheet, route cards, and LZ diagram.

**NOTE**

Page numbers shall be centered on the bottom and labeled, “1 of (X).”

Pen and ink changes should be avoided to the max extent possible but may be necessary. If it is not originally printed on the smart pack then a pen and ink change will be required and shall be briefed.

*“Page one of X is the Cover Sheet. Page two of X is the route card starting at NAS Whiting Field and ending at CP3. Page three etc.”*

*“Pen and ink changes are as follows...”*

**Maps/Charts** – All charts/maps to be used on the route shall be inventoried.

*“Map required for the flight is the Pensacola 1:250,000 JOG-A chart.”*

**Weather** – Obtain current and forecast weather prior to the brief and state required weather for the block of flight. If the flight is an NVG flight, include Solar & Lunar Almanac Planning (SLAP) data.

*“Current weather is \_\_\_\_\_.”*

*“Destination weather is \_\_\_\_\_.”*

*“Weather required for the flight is 600-1, winds less than 35 knots.”*

### **SITUATION**

**Situation** – For an operational mission brief, this section is where the enemy and friendly situation is briefed. Normally, the enemy situation will be briefed by the intelligence department and friendly situation will be briefed by the operations department.

<This section is not applicable and shall not be briefed.>

### **MISSION**

**Mission** – A brief mission statement shall be made.

*“Mission – At (Takeoff time) L, HT-28 will launch a single TH-57C in order to safely complete a (N4301).”*

### **EXECUTION**

**CONCEPT OF OPERATIONS** – Big Picture. Give a general overview of the mission. This is to provide a broad sweep of what the operation is from start to finish.

*“Execution -Concept of Operations - We will launch from NAS South Whiting Field to conduct the flight in the western op area, then conduct TA’s at LZ Site 8. The flight will recover at NAS South Whiting Field.”*

**Route** – Name the route to be flown and altitude.

*“Route - We will fly the Green Route forward at 500’ AGL.”*

**Control Measures** – Features that define the working area for the mission.

**Boundaries** – Natural or manmade features that define the area of operation. Boundary considerations are:

1. Linear features
2. Cardinal in direction (East/West/North/South)
3. Easily recognizable features
4. Should include entire area of operation (consider including NAS South Whiting Field and appropriate NOLF’s if able; additional techniques prescribe defining the Operational Area excluding familiar course rules and home field).

*“Control Measures – Boundaries.”*

*“The northern boundary will be...”* SNAs shall brief boundaries, and when applicable taking into consideration the boundaries found in local SOPs for the operating areas.

**Airspaces** – Describe the airspaces in the local area. Give lateral and altitude limits of the airspaces. Airspaces need to be considered when planning the flight.

#### NOTE

For simplicity and for the purpose of the brief in the training environment, airspaces will be briefed in this section.

Class “C” – Give the feature that defines the center of the Class “C” (NAVAID, Lat/Long, etc.) and the dimensions of the airspace.

*“Airspaces – Class “C.” We have three Class “C” airspaces in our area. The Whiting Class “C” is centered on the Whiting TACAN (NSE). The Pensacola Class “C” is centered on Pensacola International (KPNS) at Lat/Long (30° 28’N - 87° 11’ W). The NAS Pensacola Class “C” is centered on the Pensacola TACAN (NPA). All three have an inner core from the surface to 4200’ MSL out to 5 NM radius and an outer shelf from 5-10 NM radius from 1400’-4200’MSL.”*

**Restricted Areas** – Describe the boundaries and altitude restrictions.

*“Restricted Area – The Eglin Restricted Area R-2915A is located south of I-10 from the surface to unlimited altitude.”*

Prohibited Areas – Describe the boundaries and the altitude restrictions. Also included are No-Fly areas.

*“Prohibited Area – No-fly zone in the...” SNA shall brief IAW local SOPs.*

**LZs** – List the planned LZs for the mission.

*“LZs – We will be using LZ Site 8 for today’s mission.”*

**Obstacles to Flight** – Provide a general overview of the obstacles in the operating area, along with avoidance procedures.

*“Avoidance – Our best defense today is to maintain an active VFR scan and call out all obstacles using the clock code method as we see them and state the action necessary to avoid the obstacle.”*

*“Powerlines – There are multiple powerlines running through the operating area today and should be crossed at the stanchion at the max extend possible.”*

*“Towers – We will offset from any towers, understanding that we have to avoid the guy lines as well as the towers themselves.”*

*“Aircraft – We will make calls at each checkpoint along the route of flight and coordinate as necessary to avoid other aircraft.”*

*“Birds – We will make control inputs as required to avoid a bird strike.”*

**SCHEME OF MANEUVER** – Brief the aircrew on the mission’s entire conduct of flight from brief to landing. The scheme of maneuver should begin with a brief timeline and end when the flight has terminated. Takeoff time is represented by “T.” Any time before Time “T” is “T minus (the time)” and any time after Time “T” is “T plus (the time).”

**Preflight** – Preflight should be conducted 30 minutes prior to the takeoff time. Be flexible, this might be adjusted as necessary by the IP.

**Taxi** – For planning/briefing purposes, taxi 5 minutes prior to takeoff.

**Takeoff** – Takeoff time should be the time set on the flight schedule. Again, be flexible.

*“Scheme of Maneuver – We will preflight at T minus 30. We will call outbound with Base on button X, get ATIS on UHF button #1, and call ground on button #3 to request taxi with the appropriate ATIS information. We will plan to taxi at T minus 5 for a 1500 takeoff. We will taxi single-ship to the appropriate spot as directed by ground. We will remain single-ship throughout the flight. Anti-collision lights – On, 70X in the TACAN, 0100 in standby in the transponder. Approaching the hold short line, we will switch button #4, South Whiting Tower, and inform Tower we are #1 holding short spot (?) for a Baker departure.”*

*“Once cleared for takeoff we will complete the 4Ts and takeoff. We will climb at 70 KIAS to 900’AGL at which time we will accelerate to 100 KIAS and turn outbound to Pt Baker.”*

#### NOTE

Students shall brief the actual aircraft condition for the mission aircraft. If you are a hot seat, brief a timeline for a hot seat. Stating that you will conduct a preflight at T-30 is incorrect.

**NASWF→ROUTE** – Specific course rules to the route shall be briefed in detail starting at the departure from NAS South Whiting Field. It is not acceptable for the SNA to state, *“We will fly course rules to CP1 on the Green Route.”* The course rules shall include, but are not limited to, Time/Distance/Heading, airspeed and altitude.

**ROUTE** – Brief changes in airspeed, altitude, radio frequencies, and transponder codes during this portion of the scheme of maneuver. A good technique for briefing these considerations is using the acronym “FALCON” (Formation, Airspeed/Altitude, Lighting, Communications/Squawk, Obstacles/Terrain, and Navigation/NVGs). When briefing each checkpoint, if any of the FALCON considerations have changed then they need to be mentioned. If the FALCON considerations remain constant, just brief the time, distance and heading to the next checkpoint. If some considerations change, brief only those considerations that did change and omit the others. For example, at the beginning of the brief we state, *“We will remain single-ship throughout the flight.”* Therefore, the brief may omit the “F” from the remainder of the brief and must only consider ALCON.

**Formation** – As mentioned above, if single-ship, a statement should be made that the aircraft will remain “single-ship throughout the flight.” For formation navigation syllabus events, however, brief the type of formation flight, such as cruise, parade, or combat cruise.

**Airspeeds/Altitudes** – If the airspeed/altitude changes, brief how/when they change.

**Lighting** – Brief the lighting scheme to be used during the flight IAW local SOPs.

**Communications/Squawk** – Multiple radio frequencies and squawks will be used during the conduct of the flight.

**Obstacles** – Any physical feature that might provide a hazard to flight. In this section, brief only the obstacle’s location relative to the portion of the route being briefed. The immediate actions necessary to avoid the obstacle will be briefed in the Coordinating Instructions section of the brief. Brief the obstacles from big too small.

#### Powerlines

*“Powerlines - Between CP1 and CP2 there is a northwest-southeast running powerline. In the vicinity of CP5 and the town of Bay Minette, there is a north-south running powerline. All powerlines are 150’ AGL or lower.”*

**Towers** – Briefly describe the towers in the working area. Describe the towers using the height in AGL. If there are multiple towers in a specific area, state the highest of the group in AGL. If there are specific towers important to your conduct of flight, make sure to mention them (even if they are in a group of towers).

*“Towers - There are multiple towers in the working area. Towers of specific note are as follows: the 1414’ AGL tower just east of the town of Barrineau Park, multiple towers south of I-10 in the vicinity of CP7 the tallest of which is 1953’ AGL ...”*

**Aircraft** – Briefly describe potential aircraft hazards in the area including other training aircraft as well as potential transient aircraft.

*“Aircraft – There will be other aircraft in the area. Both military and civilian fixed wing traffic will be operating in the area in addition to other helicopters.”*

**Birds** – Describe the potential bird hazard in the area. Bring attention to areas with increased hazardous potential such as rivers, lakes, marshes, and trash dumps. SNAs should consult with their respective Safety Department for further BASH information.

**Navigation** – SNA shall brief each leg of the route to include the following:

When briefing the route, ensure clock codes are given first and follow-up with a backup heading.

*“CP 4 is the intersection of a north-south running road and an east-west running railroad track. At CP 4, we will come left to 10 O’clock, back up heading 320 for 5 miles and time of 3 minutes and 20 seconds.”*

Use limiting features, funneling features, aim points, and intermediate points to highlight key aids to navigation along the route so all aircrew are aware of them.

When describing roads, use the physical feature of the road instead of the legend term. In the legend on the chart, roads are usually described as “Primary” or “Secondary” roads. This description stems from the volume of traffic on the roads and not necessarily the type of road.

As aviators, it is more useful to use the physical description of the road itself. Roads fall into one of four categories: all-weather or hardball, improved surface, unimproved surface, and jeep trails.

1. All-Weather or Hardball - Concrete or asphalt.
2. Improved Surface – Leveled and packed down with improvements such as culverts and bridges. Not paved.
3. Unimproved Surface – Loose surface.
4. Jeep Trails – Tracks going through the woods.

**NOTE**

There is a difference in the depiction of roads on the JOG-A and the roads on the 1:50,000 TLM. Jeep trails will not be shown on the JOG-A. The smallest roads depicted on a JOG-A will be unimproved surface roads.

**NVG** considerations for each segment of flight shall be briefed for NVG syllabus events. These considerations shall include, but are not limited to, cultural lighting, environmental conditions, relative sun/moon position, shadowing, etc.

**ROUTE→LZ** – The specific route of flight from the last checkpoint to the LZ shall be briefed in detail ending with the LZs arrival point. It is not acceptable for the SNA to simply state, “*We will fly from CP10 to Site 8.*” The course rules shall include, but are not limited to, Time/Distance/Heading, airspeed and altitude.

**LZ** - Brief the terminal procedures on how to enter the landing pattern at the LZ.

*“At Pt. Racetrack, we will call LZ Harold on button #12 and report inbound. We will follow course rules by flying over the power lines and split the field for the appropriate course in use.”*

In addition, brief the LZ utilizing the “SWEEP” format.

*“LZ Site 8 is roughly a thousand foot by thousand foot grass field. There is slope on the southeast corner and we will avoid conducting TA’s in that area. The LZ is suitable for a single TH-57. Winds are expected from the NE at 15KIAS. The LZ is 159MSL. Our egress on a waveoff is straight ahead, with departure egress in the SE corner. Our power required at the LZ is calculated as HIGE of XX% and HOGE of XX%.”*

During some syllabus events, specifically NVG events, the LZ might be an airfield. In this case, the SNA shall brief the plan to enter the field for the planned runway in use.

*“At checkpoint 2, we will turn to the 2 O’clock position for a heading of 348, distance of 10.5 NM and timing of 6 minutes, 48 seconds for Atmore Municipal. We will make a call on button #19, Western Area Common, that we are off the route inbound for Atmore, then make a 10 mile call inbound to Atmore on VHF frequency 122.8. We will then make a five mile call to Atmore traffic. With winds out of the south, we will plan to enter a left downwind for runway 18 at Atmore. Atmore is (Brief SWEEP).”*

**LZ→NASWF** -- Specific course rules from the route shall be briefed in detail starting at the departure corner and ending at the NAS South Whiting Field VFR entry point. It is not acceptable for the SNA to state, “*We will fly course rules from Site 8 to South Whiting.*” The course rules shall include, but are not limited to, Time/Distance/Heading, airspeed and altitude.

## NOTE

SNA should plan for de-confliction measures between other training areas and course rules traffic while transiting to and from the route. SNA should determine how many other aircraft are expected to be in the area and at the LZs. This enables the members of the flight to have higher SA about the expected working area and LZ traffic.

**COORDINATING INSTRUCTIONS** – Coordinating Instructions are the immediate actions or considerations in the event the conduct of flight deviates from the Scheme of Maneuver. Brief these considerations in view of the flight profile. Low-level navigation considerations may be different from other phases of flight. This is a mission brief, not a NATOPS brief. The NATOPS brief (by exception) is briefed after the mission brief and will include how to handle the cockpit in the case of emergencies.

### Emergencies/System Failures

*“Coordinating Instructions – Emergencies/System Failures – If we have an emergency/system failure during the flight, we will handle in accordance with NATOPS. We will always endeavor to turn a flying emergency into a ground emergency.”*

**Inadvertent Instrument Meteorological Conditions (IIMC)** – Brief a plan on how to handle this emergency. Once in IIMC is not the time to “discuss how to regain VMC.” In order to build a plan, the SNA should study the chart/map to find the highest obstacle in the area taking into account the Maximum Elevation Figure (MEF). Add a minimum of 200’ to the height of the obstacle in MSL and designate a Minimum Safe Altitude (MSA) for the route. Then study the chart/map for a cardinal direction that leads away from the majority of obstacles and clear of all airspaces. Designate this as the Safe Heading (SH). It is possible that more than one SH is necessary at different phases of the flight; however, assigning too many will render the safety measure ineffective. The SNA needs to understand that de-confliction on the route might dictate a different heading and the primary job of the crew is to execute a turn in the safest direction given the variables at that time. Additionally, SNA should study the chart/map to determine the proper controlling agency to contact if IIMC is encountered.

*“IIMC – IIMC is an emergency. If we go IIMC, the PAC will switch to an instrument scan, level the wings, level the nose, center the ball, and start a 500 FPM rate climb to the established MSA and execute a standard rate turn the shortest direction to the SH. PNAC will squawk 7700, dial up 124.05 Eglin Approach in the VHF, request handling, and a discrete squawk for an approach back to (KNDZ or appropriate airfield). If we regain VMC, we will remain VMC.”*

### Disorientation Procedures

*“Disorientation Procedures – If we become disoriented on the route of flight, we will attempt to identify a known reference point. Options include; climbing, orbit or hold until reoriented, or return to the last known checkpoint and continue the flight.”*

## ADMINISTRATION & LOGISTICS

**Administration & Logistics** – Any considerations concerning the basic logistical requirements for the flight.

**Flight Duration** – The total flight time shall be calculated using JMPS and will be briefed appropriately.

*“Administration & Logistics – Flight Duration will be 1 hour and 33 mins.”*

**Fuel** – Two fuels are calculated.

### **Mission Fuel**

*“Fuel – Mission Fuel is XX gallons.”*

### **Bingo Fuel**

Bingo fuel is calculated using the appropriate NATOPS charts. The SNA is required to do a detailed chart/map study and calculate a bingo to an appropriate fuel source.

*“Bingo fuel is XX gallons for a VFR arrival at (applicable fuel source) within NATOPS mins.”*

*“We will depart the LZ with \_\_\_\_ gallons or a steady low fuel light.”*

## COMMAND & SIGNAL

### **COMMUNICATIONS**

**Preset/Manual Frequencies** – Brief any frequencies and associated controlling agencies in addition to those listed in local SOPs. Examples of additional frequencies/controlling agencies might be an uncontrolled field or ATC.

*“Command & Signal – Communications – Preset/Manual frequencies will be in used as required. Additional VHF frequencies for today’s flight will be 124.85 Pensacola Approach, 124.05 Eglin Approach when on the Purple Route and 121.95 Instructor Common.”*

**NAVAIDS** – Brief all NAVAIDs to be used throughout the flight and ensure they are plotted on charts/maps.

*“NAVAIDs – Today on the Purple Route we will be primarily using visual navigation. We can use Crestview VORTAC 106X/115.9 for reference. Also, the Purple Route will be loaded in the GPS for backup as required.”*

**Lost Communications** – As a crew, determine the appropriate course of action for the route flown and the appropriate landing area. If returning to NAS South Whiting Field, comply with the local lost communications SOPs.

*“Lost Communications – If we experience a total radio failure, we will climb to a safe altitude to gain altitude separation for other route traffic and troubleshoot. If unable to regain radio communications, we will maintain VMC, squawk 7600, make all calls in the blind. We will intercept course rules to NAS South Whiting Field. Once at NAS South Whiting Field, we will overfly the field with navigation lights in flashing bright, determine the course for the runway in use and look for an ALDIS lamp signal from the tower.”*

## **ID AND RECOGNITION**

**Squawk** – Review all squawks to be used during the conduct of flight.

*“ID and Recognition – Squawk – We will squawk 0100 outbound to Pt Pond. At Pt Pond, we will squawk the Western Operating Area code of 4777. At the Welcome Station, we will squawk 1200 inbound to Site 8. We will squawk 0400 inbound on course rules to NAS South Whiting Field.”*

## **Additional Mission Brief Considerations**

1. Face and address the audience, not the chart/map.
2. Practice pointer use for the brief, and put the pointer down when it’s not in use.
3. Rehearse, rehearse, and rehearse. Be prepared and practice with other SNAs.

## **106. NATOPS BY EXCEPTION BRIEF**

The NATOPS By Exception Brief covers internal cockpit procedures between aircrew members and expands items that require additional explanation. Items such as aircraft emergencies/system failures, cockpit crew coordination, and items not specifically addressed in the mission brief shall be briefed in the By Exception brief. For example, specific procedures concerning PAC and PNAC responsibilities shall be covered. There are two different sets of responsibilities: on the route and in the pattern. On the route, PAC responsibilities are to Aviate, Navigate, and Communicate, while avoiding obstacles and controlling the aircraft. PNAC responsibilities on the route are navigating and monitoring performance instruments. In the pattern, PAC continues to Aviate, Navigate, Communicate, and PNAC responsibilities are backing up the PAC in Aviating, Navigating, and Communicating with a verbal response or thumbs up.

## **107. LOW-LEVEL NAVIGATION EXECUTION**

The use of the 6Ts is a recommended technique for low-level navigation. SNAs should endeavor to develop a systematic approach to navigation and the 6Ts is a good system to ensure that all necessary items are accomplished. At each checkpoint, the PNAC verbalizes each step. This

method takes into account that the PAC is responsible for avoiding obstacles and controlling the aircraft and is primarily on an outside scan.

### **Execution – 6 Ts**

#### **1. T = Time**

When the PNAC has the checkpoint in sight, he should reset the 8-day clock. Inform the PAC the checkpoint is in sight and the next direction of turn.

*“McDavid intersection is off the nose. McDavid is the intersection of Hwy 29 running north-south and the hardball road coming in from the West. There is a tower on the northwest side. At McDavid, we’ll be coming right to 2 O’clock.”*

#### **2. T = Turn**

Advise the PAC the direction to turn. The aircrew shall confirm the aircraft is cleared in the direction of the turn prior to executing the turn.

*“Come right to 2 O’clock. Clear right”*

Once the PAC rolls out on the clock code, refine the heading based on winds and ground track. Remember that the backup heading is for the PNAC reference only, the PAC is 100% on an outside scan. PNAC gives the PAC a natural/manmade feature for an aimpoint.

*“Rollout. Aim down the right side of the catfish ponds.”*

#### **3. T = Time**

Once rolled out on heading, start the 8-day clock for leg time. Note the actual total time on the ADF and compare to the planned total time.

#### **4. T = Transition**

Confirm airspeed, altitude, NAVAIDs, squawks and adjust as required. PNAC informs the PAC of adjustments in altitude and airspeed as well as changes to the NAVAIDs and transponder code if necessary. Note fuel state and compare with planned fuel.

#### **5. T = Twist**

Twist the backup heading in the HSI.

#### **6. T = Talk**

PNAC give gas/gauges check.

PAC makes proper external traffic call.

*“Gauges checked normal. We have 45 gallons.”*

*“Lucky 066, CP 1 to 2”*

SNA needs to consider fuel status and determine if the aircraft is on track with mission fuel or if the aircraft is getting close to BINGO fuel and then determine how to proceed.

### **Use of Global Positioning System**

The Global Positioning System (GPS) is an excellent tool for navigation. In some areas of the world where terrain features are limited or over water, it may be your best/only source of information; however, it has limitations. If satellite reception is inadequate, control points are programmed incorrectly, or the GPS receiver fails etc., the aircrew must rely on navigation skills.

- A good PAC is constantly honing his/her navigation skills using pilotage, dead reckoning, and navigation aids such as the GPS.

### **Navigation Parameters**

- The low-level navigation flights are designed to introduce the aviator to the problems associated with navigation at 500 feet AGL and below on large-scale maps.
- The SNA shall maintain orientation along the route and with each CP. Airspeed should be adjusted accordingly to maintain orientation and timing as required. In the event the aircrew becomes disoriented, a climb to a minimum of 500 feet AGL is required until established back on the route.

### **NOTE**

During operational missions, disorientation procedures will change based on a variety of factors including threats in the AOR.

The SNA shall be +/- 2 minutes of timing starting from the first CP and ending with the last CP. Adjusting airspeed, delaying time to CP, and holding are permitted to meet timing. With sufficient time and CPs remaining, adjusting airspeed is the preferred method to get back within the 2-minute time constraint. If the SNA recognizes that adjusting airspeed alone will not allow sufficient time to get within parameters, the SNA can request a ROLEX and the IP can elect to extend the overall route time.

*“Sir, request ROLEX, PLUS 1 min.”*

### **Fuel Checks and Calculations**

There are two ways of presenting the fuel on board at any given time in the flight. You can give it in gallons or time. Both have useful applications and both are important to the overall fuel management.

When conducting fuel checks in flight, use the fuel quantity in gallons to compare with the fuel required to continue the mission from your route card. If you have less fuel on board than is required from your detailed mission planning, adjustments to the route or the time in the terminal area must be made. We also use fuel in gallons to monitor our Bingo Fuel. Fuel measured in gallons is primarily used for internal planning.

IPs should introduce converting fuel in gallons to time, and demonstrate how to properly utilize the information effectively.

*“Sir, fuel quantity is 41 Gallons, BINGO fuel is 15 Gallons, we have 1+00 remaining until BINGO.”*

### **Fuel Management**

As discussed earlier, part of fuel management is monitoring your fuel on board during the route and comparing it to the calculated fuel from the route cards, also known as a fuel ladder. At each checkpoint, you should ensure you have enough fuel to meet the fuel requirements as calculated in your pre-mission planning. Incorporate this into the 6 Ts to ensure proper fuel monitoring throughout the route.

### **Route Timing**

Total route time will be calculated in JMPS during pre-mission planning. Based on the route time calculated, we can plan backwards to determine our takeoff time known as Time “T.” From Time “T” do the backward timeline planning to determine taxi time, preflight time, brief time, etc. This will set the tone for the flight and provide a foundation for fuel planning.

#### **NOTE**

TOT timing starts at the first CP on the route and ends at the last CP.

If you are behind timeline and cannot arrive at the TOT, SNAs must coordinate with the IP for permission to ROLEX to a new time. If you are ahead of timing along the route, a technique to arrive at the TOT is to adjust Knots of Indicated Air Speed (KIAS) as necessary to increase or reduce groundspeed or to hold at a checkpoint prior to the objective area.

In order to determine the necessary correction to apply to groundspeed, a general rule is the 10% per minute rule. A 10% change in speed held for 1 min will correct for 6 seconds. In order to determine the length of time to hold a correction divide the timing deviation by 6 sec. In order to use this method, first determine how far ahead or behind you are on timing in seconds. Then take the time and divide it by 6. This is the amount of time, in minutes, that you will need to hold a 10% change in planned ground speed to get back on timeline.

Equations:

$$\text{Ground Speed Adjustment} = \text{Planned Ground Speed} * 10\%$$

$$\text{Length of Time to Hold A Correction} = \frac{\text{Time Deviation (in seconds)}}{6 \text{ sec}} * 1 \text{ minute}$$

**NOTE**

If a 10% increase/decrease is not possible, due to aircraft limitations or safety considerations, the equation can be adjusted by using 5% or half of the calculated value for the adjustment. When using 5%, divide the time deviation by 3 seconds, which will increase the length of time to hold the correction.

**Example:** Arrival at a checkpoint occurs 20 seconds later than planned. This indicates the need to increase speed to get back on timeline.

Using the general rule:

1. Divide 20 sec by 6 sec, which equals 3 minutes and 20 seconds. Therefore an increase of speed by 10% is required for 3 minutes and 20 seconds to get back on timeline.
2. If planned groundspeed is 90 knots, then a 10% increase is 90 knots + 9 knots = 99 knots ground speed.
3. SNA then determines what the desired KIAS is for the flying pilot to fly, and directs the flying pilot to hold that airspeed for the next 3 minutes and 20 seconds.

If using 5%, then (20 sec / 3sec)\* 1 Minute = 6 minutes and 40 seconds. 5% of 90 Knots is 4.5 Knots. An increase to 94.5 or 95 Knots groundspeed should be held for 6 minutes and 40 seconds to get back on timing.

If a ROLEX becomes necessary, the SNA must calculate a new TOT and request a ROLEX for the new TOT from the IP. ROLEX is a contingency that can usually be avoided through proper planning and detailed, and a request for ROLEX will be at the discretion of the IP.

Overall route timing should be monitored using the ADF. Leg time should be kept on the 8-day clock with the sweep hand timer.

SNAs must monitor route time and leg time at each checkpoint to ensure proper groundspeed is being flown. Head winds and tail winds can have a big effect on groundspeed and must be identified by the aircrew early in the route. Expected wind effects should be included in the weather portion of the mission brief.

ROLEX should not be used to correct for wind effects. Proper weather planning and execution is required.

### **Additional Execution Phase Considerations**

SNA shall notify IP when actual fuel differs from the planned mission fuel or when reaching the bingo fuel with instructions for proceeding, VFR, to a fuel source.

*“Sir, we only have 45 gal, I calculated required mission fuel as 55 gal, we need to cutout TA’s to complete the route.”*

*“Bingo fuel is 35 gallons. Current fuel is 40 gallons, I recommend we turn left to 165 and proceed to LZ Site 8.”*

## **108. TERRAIN FLIGHT**

### **Application**

1. Terrain Flight (TERF) entails those tactical flights in which the intent is to fly at or below 200 feet AGL. TERF is the employment of aircraft in a manner to utilize terrain, vegetation, and manmade objects to enhance survivability by degrading the enemy’s ability to visually, optically, and/or electronically detect or locate the aircraft.

2. TERF is flying close to the earth's surface using low-level, contour, or Nap Of the Earth (NOE) flight techniques to prevent or counter an enemy's capability or efforts to acquire, track, and engage the aircraft. Three types of terrain flight are:

- a. **Low-level** flight is flown at a selected altitude at which detection along the route is avoided or minimized. The flight route is pre-selected and flown at a constant airspeed and indicated altitude.
- b. **Contour** flight is flown at low altitude conforming to the contour of the earth's surface. It is characterized by varying airspeed and altitude as terrain and obstacles dictate. Minimum recommended altitude for contour flight is 50 feet AGL.
- c. **NOE** flight is flown as close to the earth's surface as terrain and obstacles permit. It is characterized by varying airspeed and altitude as influenced by terrain, weather, ambient light, and enemy situation. Typically airspeed varies from 0 - 40 knots and altitude varies from 10 - 50 feet above terrain.

### **Procedures and Maneuver Descriptions**

#### **1. Crew Resource Management (CRM)**

CRM is a prerequisite for safe and effective TERF. It is used to establish individual pilot responsibilities and to organize cockpit duties.

- a. The Pilot At the Controls (PAC) has two primary responsibilities: controlling the helicopter and avoiding obstacles. The PAC must keep their vision outside the helicopter and avoid distractions, particularly cockpit related duties. They should report terrain and landmark information to the Pilot Not At the Controls (PNAC) to assist with navigation. PAC retains control of the helicopter during aircraft or system emergencies and completes the critical memory items requiring flight control input in accordance with the NATOPS brief.
- b. PNAC is primarily responsible for accurate navigation. He/she must remain oriented at all times, monitor cockpit instruments and perform assigned cockpit duties as briefed. During an aircraft or system emergency, PNAC executes the critical memory items not requiring flight control input in accordance with the NATOPS brief.

## **2. Low-level Navigation**

- a. Of the three modes of terrain flight, low-level flight is the least crew intensive. The terrain contours depicted on the chart are more readily identifiable from the altitudes flown. Contour and NOE provide certain threat avoidance advantages over low-level but are significantly more challenging and will not be flown in the advanced rotary syllabus.
- b. Proficient navigation during low-level flight requires training and practice. CP identification is critical. The PNAC must be proficient in chart/map reading, terrain interpretation, and correlating terrain features with map symbols. PNAC must continuously integrate cockpit instrumentation (heading, airspeed, and timing information) with map and geographic information to maintain SA and orientation.
- c. Visual scanning is the ability to promptly and effectively recognize reference points in the field of vision. To scan visually, the pilots must first have an understanding of what they will see. That is why CP and intermediate CPs must be thoroughly analyzed and briefed before the flight; however, both pilots must be prepared for the terrain to look differently than depicted and adjust as necessary. It is also important that both pilots not focus only on close features, but scan from the bigger, broader terrain features to the smaller, more precise terrain features. Keep your scan out far for easily identifiable features and work your way closer to the aircraft.

### **NOTE**

Maps and charts may not always depict features accurately. For example, routes that are flown after periods of drought or heavy rains may have water features, or lack thereof, that are drastically different from the depiction.

- d. The PNAC should relay information to the PAC to enable the PAC to maintain an outside scan. Providing information to the PAC is not just a running commentary about what you are “looking for.” It is finding recognizable terrain features in order

to determine if you are on course and time, then using that information to give direction to the PAC. The PNAC should employ the following techniques:

- i. Provide the PAC with incremental guidance. Information need not be provided beyond the next turning point. When available, provide multiple references, natural and/or manmade, to help identify a CP.
- ii. Provide heading information in such a manner that the PAC does not have to continually reference the instruments. The PAC should be told to turn to a “clock” position or to a recognizable terrain feature or aim point. Use instructions such as “turn left, stop turn” to tell the PAC what to do to stay on course. Provide a backup heading. The PNAC should include headings for all types of low level routes to alleviate procedure changes when transitioning from day to night.

*“Turn left to your three o’clock, I’ll call your roll out... Roll out, backup heading 286.”*
- iii. If airspeeds need to be changed or adjusted, the PNAC should tell the PAC to increase or decrease, as applicable.
- e. The PAC shall assist the PNAC in navigation by calling out prominent terrain features and maintaining pre-briefed parameters including direction (not necessarily heading), altitude, and airspeed. Upon identifying a landmark called out by the PNAC, the PAC will promptly identify it by direction and distance.

### 3. Flight Safety

During low level flight, aircraft control is more critical due to terrain and hazards associated with the low altitude. Aircraft handling involves the ability to judge rate of closure to obstacles and/or change in bearing and altitude. The timely and accurate determination of rate of bearing change and distance enables the PAC to determine the best route for obstacle avoidance.

Thorough chart/map preparation and chart/map study is of paramount importance during low-level flight to aid in identifying possible hazards along the route. Hazards must be accurately drawn on the chart/map prior to the mission brief. The following flight safety factors must be considered:

- a. Birds. A momentary climb or gradual turn is often enough to avoid a bird strike. PAC will utilize VFR see and avoid procedures.
- b. Wires. Wire hazards include power lines, communication wires, and cables used in transportation such as gondolas. To prevent wire strikes, both pilots shall conduct a detailed chart/map study of the operating area to identify and mark wire hazards. The safest place to cross is *at the stanchion*, particularly when unable to visually acquire the wires or when crossing wires strung across a valley or saddle. Visual clues to wire locations during flight are:

- i. A swath through vegetation.
  - ii. Poles/Stanchions.
  - iii. Wires along roads, near towers and in the vicinity of buildings.
- c. Vertical Obstacles. This includes poles, stanchions, trees, and towers. These are often very difficult to see until extremely close but they can generally be identified during a thorough map study. Towers and associated guy-wires are especially hazardous and can be avoided by maintaining an outside scan during all flight profiles.
- d. Certain emergencies, such as an engine failure or tail rotor drive/control failure, are far more critical during terrain flight. The crew must constantly keep a lookout for landing sites in the event an emergency arises.

#### **4. Environmental Conditions**

- a. Ceilings will restrict the ability to climb along the route and flight into the sun is very hazardous when it is low on the horizon.
- b. Visibility is the primary limiting factor that will determine whether the flight can be conducted. Adequate visibility is required on takeoff, enroute, and in the terminal area. During the course of the flight, the most important considerations are maintaining both visual references with the ground and maintaining an appropriate airspeed to avoid obstacles. Anytime visibility is reduced, airspeed may be decreased to provide the added response time required to avoid obstacles.
- c. Adverse effects of current and forecasted weather shall be considered and briefed.

#### **109. DEBRIEF**

A thorough debrief shall be conducted at the completion of every flight. All participating aircrew should meet at a designated location and time to discuss the successes/failures of the flight. The discussion is led by the mission commander and should be debriefed by phase (Planning, Brief, Execution). The debrief should be held as close as possible to the completion of the mission in order to preserve as much information as possible. The critiques of the mission should start with something positive and then move into the mission failures. All aspects of the flight should be covered.

In the training environment, the IP will debrief the SNA's event planning and event brief prior to the flight. This debrief should cover chart/map preparation as well as delivery and content of the brief. The execution of the flight shall be debriefed at the completion of the flight IAW local SOPs. This will facilitate the SNA receiving an honest critique of the entire flight and guide the IP in conducting a standardized debrief.

## **CHAPTER TWO**

### **INTRODUCTION TO BASIC AND RADIO INSTRUMENTS**

#### **200. INTRODUCTION**

Up to this stage in your training, most of your flying has been done using visual references external to the aircraft. The next step to becoming a professional naval aviator requires you to be well versed in the proper techniques to perform maneuvers requiring reference to the aircraft instruments and gauges. The following section will introduce you to the fundamental building blocks of instrument flight.

#### **201. SNA RESPONSIBILITIES**

##### **General**

Every SNA should remember these four guidelines when managing their training program:

1. The flight instructor wants the SNA to learn to be a professional naval aviator. Ask questions and use your flight instructor to help you through problem areas.
  
2. The Advanced Helicopter Training Phase has a requirement for a more complex method of preparation than encountered previously. The system covers local course rules, all previously introduced NATOPS units, and FAA/DOD FLIP publications including the Federal Aviation Regulations (FAR) and the Aeronautical Information Manual (AIM). This system is used to ensure thorough preparation and introduce the SNA to the sources available to the fleet naval aviator. The following is a recommended sequence for referencing the applicable publications:
  - a. Refer to the Advanced Helicopter MPTS TH-57 Master Curriculum Guide.
  - b. Refer to Table of Contents in FTI.
  - c. Read appropriate portions of FTI.
  - d. Read appropriate references listed in FTI.
  - e. Read appropriate FAA/DOD FLIP publications, including the AIM.
  - f. Refer to applicable sections of the NATOPS manual.
  - g. Refer to applicable sections of CNAF M-3710.7.
  - h. Refer to the local course rules.
  - i. Read the applicable SOPs.

3. Preparation is the key to professionalism. Do not be satisfied with only knowing enough to complete the hop. What is being taught in the advanced helicopter phase has a direct transference to all fleet operations.

Remember one important concept for as long as you fly an aircraft: You *must* be your own most aggressive critic. This does not mean you become a mental case in the cockpit, but it *does* mean as an aviator nearing the end of the flight training syllabus you must demonstrate one of the most critical qualities a professional aviator has: self-discipline. This means you prepare for every hop as if your professional reputation is at stake. Realize that you are at the stage where your instructor might not mention your deviations as they occur; he will likely wait to analyze your scan and discipline to see if you make the input yourself. Your flights are not contests where someone is keeping score and counting your mistakes. Your flight grades should not be as important as your own honest appraisal of your flight performance. You are expected to come well-prepared, but you will make mistakes. Most of these mistakes, with a few exceptions, are forgiven as long as you deal with them professionally on the spot and learn from them. This is why they call it flight school.

4. Use your time wisely. The volume of knowledge that must be assimilated during your training is about the same as would be required in a graduate college degree program; remember, however, you cannot afford to “dump” the things you learn once you have completed a check flight. The skills and knowledge you develop now must stay with you for the remainder of your flying career.

## **202. FLIGHT SIMULATOR TRAINING**

Simulator periods are of tremendous value for learning the procedures and flight techniques used in Basic Instrument, Radio Instrument, and Airways Navigation. In order to maximize learning, the SNA shall prepare for the periods in the same manner as for a flight. The simulator periods will be conducted as though they were actual flights. SNAs shall ensure all ground preparation is complete prior to simulator periods or flights and the objectives contained in the required unit are fully understood.

## **203. LEARNING EMERGENCY PROCEDURES**

The thought process for handling critical emergencies in instrument flight begins the same as it does in VFR flight. As always, in Naval Aviation, the priority for handling emergencies is to AVIATE, NAVIGATE, then COMMUNICATE using the necessary procedures/actions appropriate for the situation. The PAC must take the initial steps and the PNAC will perform as directed or previously briefed by the Pilot in Command (PIC). The level of cockpit tasking during emergencies under IFR is greater than that during VFR because aircraft control will require more effort in IMC. Some systems not required in Visual Meteorological Conditions (VMC) become essential for IMC flight and communication with controlling agencies may be required to prevent further aggravation of an unsafe situation. In addition to system knowledge and aviation skill, proper CRM will be required to safely resolve an emergency.

When the crew conducts the NATOPS brief, they should carefully brief the division of tasks during simulated emergencies, and the flight shall be conducted as briefed. Consider the following conditions in your planning:

1. **Ambient Conditions.** Most importantly, if in VMC, remain VMC. If in IMC, the PIC may want to direct the PAC to fly the aircraft while the PNAC diagnoses the problem. At night, even in VMC, cockpit tasks will proceed more slowly than in daytime, and a VMC/IMC scan will be required to control the aircraft. Delegate tasks accordingly.
2. **Nature of Emergency.** When encountering an emergency, the priorities are AVIATE, NAVIGATE, then COMMUNICATE. In order to know what to communicate to ATC you must diagnose the malfunction, and then decide what action and assistance you require. “Are you declaring an emergency?” should never need to be asked by ATC. If you require preferential handling in order to safely address your situation then declaring an emergency is the appropriate way to get that priority. If you are not in need of immediate assistance, or do not require preferential handling then it is likely that you are not dealing with an emergency. It is important to clearly communicate your situation and desires/intentions. Doing so ensures that ATC understands the nature of your emergency and the urgency of your situation. If there is ambiguity, ATC may not be able to provide you the necessary assistance.
3. **Area of operation.** If you can determine your location on a VFR sectional, you can use the Maximum Elevation Figures (MEF) to determine a minimum operating altitude. Approach plates show MSAs and IFR charts show MEAs/MOCAs. Approach controllers use Minimum Vectoring Altitudes (MVA) not accessible to pilots. The PIC may desire a descent below a known ceiling (from the DD 175-1 or another source) to one of the minimum altitudes listed above. The ATC controller cannot determine the location of clouds directly. ATC will use PIREPS, and weather reports to assist you in your desired actions, but you should never ask for “vectors to VMC.” It is the pilot’s job to ask for altitudes, headings, or clearances that will provide the best opportunity to return to a safe condition. Pilots should carefully compare the benefits of “searching for VMC” against the benefits of getting vectors to the nearest instrument approach option.

Your flight planning should have revealed the nearest divert fields to your position. In a “land as soon as possible” situation, an airport with an instrument approach may be the “first site at which a safe landing can be made.” Keep known traffic in mind but tell ATC what you want to do. Put yourself in the driver's seat and get ATC's attention and appreciation for your condition.

4. **Crew experience and “comfort level.”** Aircrews of different experience levels may handle the same situation differently. For example, an experienced pilot experiencing a hydraulic failure may be very proficient at boost-off landings to a touchdown. On the other hand, for a less experienced pilot, the likelihood of an aircraft rollover during a boost-off landing might be significant. In another example, two experienced pilots in a mechanically-perfect aircraft may suffer from extreme vertigo, food poisoning, or hypoxia, creating a very real emergency. No set of rules can cover all situations. Trust your instruments, and trust your judgment.

In the Instrument stage, just as in the Contact stage, emergency procedures will be discussed in the brief and practiced in flight. When briefing or in flight, unless otherwise specified by the IP, assume you are on an IFR flight plan on a daytime flight in radar contact with ATC. Then:

- a. Name the malfunction, given a set of indications.
- b. State the immediate response required of the PAC first if in VMC, then if in IMC.
- c. Recite critical memory items from NATOPS specifying which steps will the PAC, PNAC performed.
- d. Simulate a call to ATC specifying the situation, request, and whether or not you are declaring an emergency.
- e. Using the Pocket Checklist, execute the cockpit cleanup.

#### **204. DISCUSSION ITEMS**

During your preparation for your flights you will note a number of discussion items you will need to research prior to your flight. As mentioned before, you will need to refer to publications other than this FTI and your NATOPS manual in order to become conversant on these subjects. Do not limit your research to a quick review of the glossary or information handed down from previously completed SNAs; many of these items relate to other areas of concern and lengthier discussions of them will shed better light. When you discuss an item with your instructor, it is a good idea, particularly since you are in the advanced stage of your training, to discuss the item in question as thoroughly as you can. Do not force your instructor to attempt to draw it out of you. If your discussion is too complete for the purposes of that flight, the instructor will tell you.

#### **205. APPROACH MATRIX**

Many SNAs have had success with a matrix they draw on their kneeboard once they find out what approaches they will shoot during the hop. The matrix can contain whatever you want, but often times they include: approach name & page number, frequency in NAV 1, HSI course, GPS waypoints, CDI course, ADF frequency, and timing. This helps organize and expedite programming of NAVAIDS during the COMM/NAV Checklist, but should not and is not meant to tie the SNA's hands from remaining flexible and changing plans as ATC or the crew sees fit.

#### **206. COMM/NAV CHECKLIST**

The COMM/NAV Checklist is designed to help you test and tune your NAVAIDS and radios before departure. As you complete the test for each item, consider the required setting for your departure. For example, if you are planning a Baldy One departure, you should leave 70X in NAV 1 and have 135° twisted in the HSI. If you are not departing via a Standard Instrument Departure (SID), you should set up your NAVAIDS for an approach at your departure point in case of emergency. Have the Morse Codes available for the station you will be identifying. The numbers in this example apply to South Whiting Field (KNDZ). Adjust as necessary at other locations.

<b>CHALLENGE</b>	<b>ACTION</b>	<b>RESPONSE</b>
a. CLOCK	Wind (only if necessary), set time, reset, and start second hand.	SET AND WOUND.
b. DME	Ensure both pilots have selected NAV1. Press DME test button. Check that indicator reads 0.0 or 0.1.	TEST.
c. ATTITUDE GYRO	Cage only if needed.	CAGED.
d. BAR ALT(S)	Set the barometric altimeter to field elevation.	SET TO FIELD ELEVATION.
e. HSI/RMIs	Compare HSI heading with the corrected wet compass heading (use deviation card). If excessive difference is noted secure ECS, fan, defog blower, landing light, searchlight, position lights and pitot heat. Ensure headings match. Ensure slaving adapter switch is in "SLAVE" and that the compass deviation indicator is "ALIGNED."	SLAVED AND ALIGNED.
f. MARKER BEACON	Hold switch in test position. Ensure all lights work.	TEST.
g. RAD ALT	Set DH bug at 25 feet. Press the TEST button. Check for indicated altitude of 50 + 5 feet and a visible off flag. Release the TEST button. Check for DH light and tone. Depress light button to disable tone. Reset DH bug to zero or as required. Copilot repeats.	TEST AND SET.

h. VHF	Push in COMM 2 button on audio control panel. Select 2 with the MIC selector. Set 121.95 (instructor common) in the USE position and 124.85 (Pensacola Approach) in STANDBY. Pull out the volume control knob (squelch off), set the volume, and push knob back in. Squeeze trigger switch and check for a "T." Repeat for copilot. Push out the COMM 2 button and select 1 on the MIC selector.	TEST AND SET.
(B) i. VOR	Check that frequencies can flip flop and that the standby frequency can be changed using both the inner and outer knob.	TUNED AND SET.
(C) j. NAV1 and HSI (CDI)	Set channel to 70X and push the USE button in. Push in the DME button on the audio control panel and listen/verify the Morse code. Twist in the course indicated by the double RMI needle. Fine tune until the course indicator centers. Check twisting 10° on either side causes full deflection of course indicator. Twist in reciprocal course and check that TO-FROM flag swaps. Check DME 1.4 + 0.5. Execute procedures for both the HSI & CDI.	TUNED AND SET.
(C) k. GPS/NAV 2	Set both sides of cockpit to NAV 2. Check DME at 34.5 miles, TO/FROM flag indicating FROM, HSI/CDI deviation at ½ scale deviation right, glideslope ½ scale up, OBS out 315°, OBS in reflect the course set in the HSI, RMI 130°, and single needle pointing 130°. Check for	TEST AND SET.

	current date and time. Update altimeter setting from current barometric altimeter setting and hit APPROVE. Ensure database current and acknowledge.	
l. TRANSPONDER	Turn function selector to TEST. Check all lights illuminated. Turn function selector to STBY. Press the EMERG button. Check for 7700. Set the required squawk.	TEST AND SET.
m. ADF	Select the ANT mode with ADF button. Tune 326 in USE position. Push in ADF button on audio control panel and listen/verify the Morse code. Adjust volume as necessary. Push out ADF button on audio control panel. Push in buttons on RMI to place both needles in ADF mode. Needles should lock at the 90/270 position. Watch the needles home on signal while selecting ADF mode. Place both needles in VOR mode.	TUNE AND SET.
n. UHF	(B) Turn off squelch, adjust volume, and turn squelch on. Select GUARD mode and check for 243.0. Select MANUAL mode and ensure frequency selectors will change the frequency. Select PRESET mode and set to base channel (5 or 6). Toggle read switch and check frequency. Turn TEST knob full clockwise and read all "8's." Set to desired brightness.  (C) KTR 909 UHF radio. Turn off squelch and adjust volume. Tune in preset	TEST AND SET.

	button 5. Switch to manual and verify appropriate frequency. Check guard frequency set to 243.0. Ensure guard is set active. Once complete contact base outbound.	
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**207. FLIGHT SEQUENCE**

**Planning, Brief, Preflight, Start, Taxi, Takeoff, and Departure Sequence**

For ATC-controlled SIDs you will need to contact South Whiting Clearance Delivery once you have received ATIS information. Consult local SOPs for the format for the radio call. Once you have contacted South Whiting Ground, your instructor will take the controls and taxi the aircraft for takeoff. Enroute to the hold short line, you will complete the Instrument Takeoff (ITO) Checklist and you will execute an ITO. Once airborne, you will be instructed to contact your departure controller with your “off report.” If you have not been instructed to switch frequencies, request the switch. Remember, if you used a NAVAID for your SID that you could not ID on the ground, you will need to ask your instructor to ID it once you are airborne. When the initial level off is complete you will execute the Level off Checklist.

**208. PASSING THE CONTROLS**

When you pass the controls to your instructor, remember to let him know the parameters you would like him to maintain. (e.g., “Fly the 24 mile arc at 1700 ft and 100 KIAS until you intercept the 223 radial inbound.”) Keep an eye on what is going on when you are not flying so you can be oriented when you get the controls again.

**209. USEFUL ACRONYMS**

Naval aviators are no different than other military people in their penchant for acronyms. Acronyms help us organize our thoughts and actions when the pace of events threatens to force them out of our field of view. Generally speaking, the tasks listed in the acronyms are meant to be performed in order because that is how they are ranked in terms of criticality.

**6 Ts**

The 6Ts can be used at navigation checkpoints, IAFs, FAFs, and any other significant point/change during a flight. Verbally acknowledging each item even if it is not applicable will ensure no steps are missed.

**TIME.** Note the time.

**TURN.** Turn to intercept course or heading.

**TIME.** Begin timing when wings level inbound, abeam the fix outbound or when FAF inbound.

**TRANSITION.** Decelerate as required (approach speed 90 KIAS, holding 80 KIAS) descend as required, complete landing checklist/gas and gauges check as required.

**TWIST.** Set desired course in CDI/HIS and/or confirm GPS mode.

**TALK.** Make voice report, gas and gauges check as required.

***PASTT* Gas and Gauges:**

Apply this acronym when you execute a missed approach. Be methodical in the completion of these items but avoid unnecessary delays in making your missed approach call.

*Power* (set climb/cruise power),

*Attitude* (adjust the nose for the climb as required),

*Searchlight* (turn it off),

*Turn* (to comply with missed approach/climb-out instructions),

*Talk* (make the appropriate missed approach call, reason for missed approach, and your intentions), and

*Gas* (note quantity).

*Gauges* (check all engine and flight instruments).

***WAR: Weather, Altimeter, Duty Runway***

This is what you request from ATC or your instructor prior to each approach where ATIS is not available. When ATIS is available, get this information prior to contacting the terminal approach controller in order to determine what approach you will use.

*Weather*

*Altimeter*

*Duty Runway*

***TINTS: Tune, Identify, Needles, Twist, Select***

The TINTS acronym will assist with cockpit set up in preparation for an approach, and is also useful when preparing for departure from and airfield, or the switching of nav aids.

*Tune* – the NAVAID frequency.

*Identify* – the NAVAID Morse code.

*Needles* – VOR or ADF mode.

*Twist* – set proper course in HSI/CDI.

*Select* – select NAV1 or NAV2.

**WRNTB:**

This acronym should be referenced when preparing to do an instrument approach. As a way to remember, use “**We Really Need To Brief.**”

*Weather* (get WAR),

*Request* (request the approach from ATC)

*NAVAIDs* (tune and ID as required using **TINTS** acronym.

*Tune* – the NAVAID frequency. *Identify* – the NAVAID Morse code. *Needles* – VOR or ADF mode. *Twist* – set proper course in HSI/CDI. *Select* – select NAV1 or NAV2.)

*Timing* (compute)

*Brief* (the approach).

**210. CREW RESOURCE MANAGEMENT (CRM)**

[Reference: P-457, Contact FTI regarding CRM] You will be challenged by your instructor to demonstrate sound and effective CRM skills in flight. By the time you reach the RI stage you will have completed integrated CRM classroom training. You will need to be well versed in CRM concepts during your BI and RI training. CRM is the teamwork that rises from effective cockpit communication. It is a strategy and a tool by which aviators work cooperatively to accomplish the mission safely and effectively. It is not simply the apportionment of cockpit chores.

**211. APPROACH BRIEF**

The purpose of the approach brief is to discuss the approach as a crew in order to build a shared mental model and to serve as a final check on the approach plan and setup.

## **Procedures**

The following six items shall be briefed prior to commencing an instrument approach:

1. Approach Name
2. Weather Minimums/Compare to current weather conditions
3. FAF and Timing
4. MDA/DH
5. Missed Approach Point and Approach Lighting System (if applicable)
6. Terminal Procedures

Example approach brief for the COPTER TAC 004 at KNDZ:

“Attention to brief. This will be the COPTER TACAN 004 to KNDZ. The weather required for the approach is 400 and 1/2. The current weather is 800 and 1. The final approach fix is NELOE and there is no published timing. The MDA is 540 and the missed approach point, WUBLA is at .2 DME off of the NSE TACAN. At MDA, runway 14 will be off of our right side and there is no approach lighting system. We can anticipate entering a right downwind, for runway 14 landing spot 3 for the fuel pits. Are there any questions?”

### **NOTE**

At airports with control towers it is common for ATC to assign alternate missed approach instructions. When issued, alternate missed approach instructions supersede published missed approach instructions.

## **Amplification and Technique**

1. In the event of aircraft degradation, poor weather, unfamiliar airport or other atypical situation, additional briefing may be required in order to guarantee the safe and orderly conduct of the flight.
2. The approach brief should be conducted as part of a complete WRNTB approach setup in order to minimize errors. In the event that holding is conducted prior to an approach and the holding shares the same radial and NAVAID, it is allowable to brief the approach prior to entering holding.
3. In the event that the IAP must be changed due to an aircraft system malfunction or ATC request, the 6Ts and an updated approach brief should be given prior to commencing the new

approach. If it is impossible to do so prior to approach clearance then a missed approach or holding should be requested in order to allow more time.

4. Depending on radio congestion, it may be impractical to complete the approach brief without talking over other ATC conversation. In such instances, the pilot briefing the approach should cease briefing whenever there is a conversation between ATC and another aircraft that has a similar call sign, destination, altitude, or is communicating weather information of interest.

5. There are two elements of the terminal procedure description: the runway position relative to the aircraft at MDA/DH and the pattern segments that will be flown while maneuvering to land. The pattern segments should be described with standard terminology such as downwind, base, final, etc.

## **212. APPROACH PLATES**

A few years ago, a helicopter with a full load of passengers aboard took off from a ship shortly before sunrise. Once airborne, the pilots were to switch frequencies and rendezvous with other aircraft. The aircraft struck the water within a minute of takeoff; many of those aboard were killed. The mishap board determined the PAC had become involved with checking his kneeboard for the next frequency, making frequency changes and failed to notice the fatal shallow descent that killed him and several others.

The flying pilot flies; he does not interrupt his instrument scan and induce vertigo by burying his head in his approach plate on his knee. The non-flying pilot gives him read-backs and updates on requests. During the approach, the flying pilot limits himself to quick glances to spot important approach information (i.e., MDA, MAP, etc.). The flying pilot's use of his approach plate is not a substitute for solid CRM.

## **213. THE APPROACH**

This is an example of how the approach sequence might proceed: The SNA is still at the controls having just completed the VOR 9L approach. He has just finished going through the PASTTGas acronym and he is executing the missed approach/climb out instructions. As he initiates the WRNTB sequence, he gets his WAR information and asks the instructor to tune and identify the NAVAIDs, compute timing, and brief the next approach. The instructor notes the SNA's effort to make good use of his crew, but in order to evaluate the SNA's ability to perform these tasks, the instructor takes the controls, and lets the SNA do them. You can anticipate the instructor will abbreviate this process by taking the controls once you are established in your missed approach procedure so you can set up for your next approach. The instructor might brief the approach to the SNA as he approaches the terminal environment. Remember to request the approach. The SNA might find he needs reminders and updates as he goes along in the approach, information he cannot get in just a quick glance: "Sir, what is my outbound heading?" "Sir, was that final approach fix at five miles?" and so on until he senses he is approaching the MDA/DH when he might ask, "Sir, what was that MDA?" The SNA who asks these questions and double checks his own progress proves he is not voice activated. Crossing the IAF and FAF, the SNA completes the 6 Ts. Somewhere during the approach he will be given his airport clearance (report field in sight

or missed approach, for instance). Pay attention to and comply with your clearance.

#### **214. MANEUVER COMPLETE REPORT**

The maneuver complete report will be performed at the completion of each maneuver during the BI phase of instruction.

1. Report “maneuver complete.”
2. Check gauges.
3. Scan the caution panel lights to include the clear chip light.
4. Check the fuel quantity.
5. Note the time.

#### **Example**

“Maneuver complete, gauges in the green, no caution lights, fuel 45 gallons, time 1345.”

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## **CHAPTER THREE BASIC INSTRUMENTS**

### **300. INTRODUCTION**

The Basic Instrument procedures and patterns are intended to provide the student with a sound basis for progressing to Radio Instrument navigation. The ability of the naval aviator to perform proper instrument flight will transform periods of bad weather and low visibility from a liability to an asset for the successful completion of military missions, especially when used in combination with radio, radar, and target recognition devices. To become an efficient instrument pilot, considerable time and effort must be placed on learning proper procedures and developing effective scan and trim techniques.

### **301. ATTITUDE INSTRUMENT FLIGHT**

#### **Maneuver Description and Application**

[Reference: NATOPS Instrument Flight Manual (NIFM) Chapter 17 (ATTITUDE INSTRUMENT FLYING), SFENA TH-57 Advanced IFR Training Manual MINISTAB]

Attitude instrument flight is that condition wherein the pilot controls the aircraft with reference only to the aircraft instruments.

The pilot must be able to rapidly adjust to a basic instrument scan and fly his aircraft by reference to the aircraft instruments in the event he encounters IMC and is unable to maintain suitable visual references.

#### **Amplification and Technique**

While the techniques used for attitude instrument flight in helicopters are essentially the same as those used in airplanes, the helicopter pilot who has previous experience in airplanes should bear in mind these important differences:

1. In helicopters, with either semi-rigid or fully articulated rotor systems, the fuselage is permitted to move independently of the rotor disc. While gravitational, centrifugal, and aerodynamic forces tend to align the fuselage in an attitude corresponding to a given rotor attitude, these two attitudes are not in a fixed, corresponding relationship as are wing attitude and fuselage attitude in an airplane. For this reason, the pilot is unlikely to achieve desired results by merely selecting a fuselage attitude and power setting.
2. There is no instrument available directly measuring rotor attitude. Therefore, the pilot must depend more on instruments, such as the airspeed indicator, turn and slip indicator, and vertical speed indicator, which measure rotor attitude indirectly.
3. The Vertical Gyro Indicator (VGI), better known as the attitude indicator, is used for “ball park” estimates of rotor attitude. All transitions from one attitude to another should normally be

made by the combined use of the attitude indicator, turn needle, and ball to ensure a “ball park” attitude in balanced flight - then resume an efficient instrument scan.

4. Power changes result in changes in rotor attitude, fuselage attitude, and the relationship between the two. Increasing collective causes the nose to pitch up, yaw right, and roll right. Decreasing collective pitch has the opposite effect; hence, immediately following power changes, the airspeed indicator takes on added importance. Because of the design characteristics of the TH-57, these attitude changes are relatively small when compared with other helicopters.

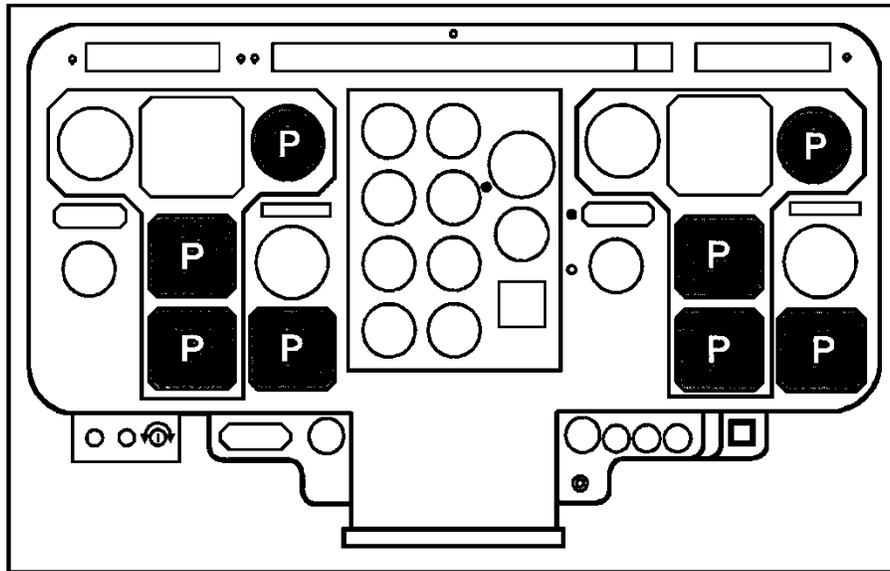
5. Throughout this manual, when the term “attitude” is specified in terms of directly measurable quantities (i.e., 5° to 10° nose down, 15° AOB, wings level, etc.), then the term applies to fuselage attitude; however, when attitudes are specified in terms of airspeed or rate of turn (i.e., 80 KIAS climbing attitude, standard rate turn wing attitude, etc.) the rotor attitude is of primary concern.

### **Trim and Scan**

The TH-57C is equipped with both a force trim system and a 3 axis stability system, “MINISTAB.” For large attitude changes (i.e., 5 knot airspeed corrections), depress the force trim/maneuver button, set the desired attitude, release the button, and then hold the attitude steady for one second. The MINISTAB will now maintain the new attitude; however, in instrument flying, many corrections are very small. For small corrections working against the trim may be desirable. Depressing the force trim/maneuver button first defeats the purpose of the force gradient springs (“artificial feel”) to provide stability for small corrections. By working against the trim, there will be some resistance to work against to reduce the tendency to over control. This is called the “fly through feature” of the MINISTAB system. Also, by working against the trim, you only change the MINISTAB attitude retention in the axis of movement while retaining the attitude retention of the unaffected axis. For example, during an approach, moving the cyclic against the trim in the pitch axis and then holding the new attitude steady for one second can make an airspeed correction while retaining the attitude retention for roll and yaw. Depressing the force trim/maneuver button will cancel the attitude retention in all three axes, pitch, roll and yaw, until the button is released and all three axes are steady for one second. Exerting light pressure on both pedals at the same time, moving the pedals, then releasing the pressure trims the pedals. When checking if the aircraft is trimmed, relax on the controls. If the attitude remains steady the aircraft is trimmed, if it does not, it is not trimmed.”

Scanning is the ability to view and interpret all cockpit instruments to achieve a desired effect. The instrument pilot uses performance gauges to keep the aircraft under control, and navigation instruments to keep the aircraft over a known geographic position. By organizing the scan, eliminating unnecessary instruments from the scan, and trimming the aircraft, scan becomes more efficient and quicker.

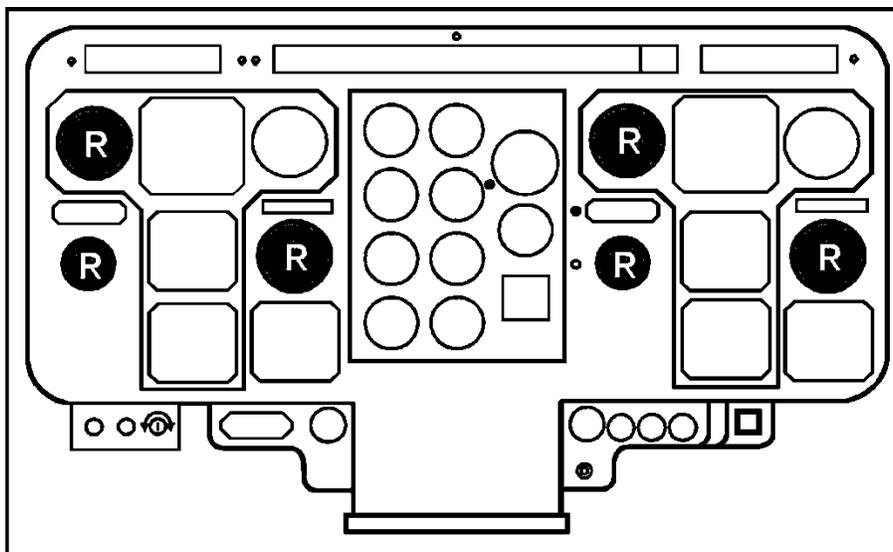
Group the instruments by categories to narrow your scan down to essentials. The shaded instruments in Figure 3-1 are position indicators.



**Figure 3-1 Positional Gauges**

Time and altitude are read from the clock and altimeters respectively, leaving the rate gauges.

The rate gauges, Figure 3-2, are the airspeed (rate of motion), IVSI (rate of climb or descent), and turn & slip (rate of turn) indicators. They enable the pilot to keep the aircraft under control. In order to best maintain a desired set of parameters (altitude, heading), you should not dwell on where you are (altimeter, RMI), but rather you should more frequently scan the gauges that tell you where you are going (IVSI, turn needle). By developing a very rapid scan of the three rate instruments and using good trim technique, the pilot will develop good basic instrument skills.



**Figure 3-2 Rate Gauges**

### **Safety Notes and Common Errors**

The most common error in attitude instrument flying is over-controlling the aircraft and not developing a thorough understanding of the performance information displayed by the instruments.

1. Instrument scan breakdown (fixation).
2. Poor trim.

### **302. INSTRUMENT TAKEOFF (ITO)**

#### **Maneuver Description and Application**

[(Reference: NATOPS Flight Manual (Instrument Takeoff), NIFM Paragraph 18.2.1.2 (Rotary-Wing ITO)).]

The purpose of the instrument takeoff is to safely transition to forward flight in instrument meteorological conditions. It is important to emphasize that CNAF M-3710.7 defines IMC as lack of a visible horizon rather than entry into the clouds. The following is a list of situations in which the ITO is commonly utilized by fleet helicopters:

1. Night shipboard takeoffs.
2. Brownout and whiteout takeoffs.
3. Transition to forward flight from a hover after conducting an overwater rescue.
4. Recovery from an unusual attitude in a hover.

#### **Procedures**

1. With clearance for takeoff and a five-foot hover check completed, the instructor will position the aircraft on the runway aligned with runway heading and transfer the controls.
2. Trim the controls in the neutral position. Smoothly and slowly raise the collective until light on the skids. Adjust the controls to prevent drift. As the aircraft leaves the runway surface, smoothly and slowly lower the nose to no more than 3° below the horizon. Simultaneously raise the collective until 5% above hover torque is attained.
3. Maintain takeoff power, confirm you are in a climb, remain wings level, and maintain runway heading with pedals.
4. Upon reaching translational lift, smoothly lower the nose to no more than 5° below the horizon and recheck torque.
5. Maintain runway heading with pedals with wings level until reaching 65 KIAS.

### **3-4 BASIC INSTRUMENTS**

6. Upon reaching 65 KIAS, center the ball and maintain runway heading with wing attitude. Climb to 400 feet above the departure end of runway elevation before making an initial turn.

**NOTE**

For training syllabus instrument departures from NAS South Whiting under VMC conditions only, departure turns will normally be initiated at 200 feet AGL in order to prevent conflicting with VMC course rules traffic.

7. Maintain power and attitude until reaching 70 KIAS. Upon reaching 70 KIAS maintain 70 KTS climb attitude with takeoff power until reaching the level-off point, the level-off point will be computed by subtracting 10% of the climb rate from level off altitude.

**Amplification and Technique**

1. After clearance for takeoff is received, the instructor will perform a five-foot hover check on the runway to determine hover torque. The aircraft will then be positioned on the runway and aligned with the runway heading. He will transfer the flight controls to the SNA.
2. Your instructor will provide torque advisories. As the aircraft leaves the runway surface, the miniature aircraft in the attitude indicator is slowly lowered to no more than 3° below the horizon bar and the collective simultaneously raised until 5% above hover torque is attained.

Although your instructor is giving you power advisories, you must continue to scan and control torque yourself.

3. Passing through effective translational lift, some nose attitude adjustment will be necessary to prevent the nose from pitching up and slowing the aircraft acceleration (pendulum effect). Reposition the nose attitude to no more than 5° below the horizon.
4. Maintain runway heading *with pedals* and a wings level attitude until reaching 65 KIAS.

**Common Errors and Safety Notes**

1. Over-controlling nose attitude. In the event of a power loss on takeoff, a nose low attitude in excess of 5° near the ground can gravely complicate the ensuing autorotation.
2. Failing to effectively control the nose during the transition through translational lift.
3. Failing to maintain runway heading with rudder pedals during the initial portion of the takeoff. If obstacle clearance is to be maintained, it is vital to maintain the runway heading with the pedals until a safe climb rate is reached.
4. Failure to maintain takeoff power until 70 KIAS, particularly passing through translational lift and beyond.

5. Ensure a positive rate of climb is maintained at all times. Turns will not normally be initiated until at least 400 feet AGL.

### **Crew Resource Management**

1. ITO
  - a. PNAC ensures completion of ITO Checklist. (Situational Awareness)
  - b. PNAC briefs Instrument Departure. (Communication)
  - c. PNAC provides torque advisories to PAC. (Communication)
  - d. PNAC monitors engine and flight instruments and confirms aircraft is climbing. (Situational Awareness)
  - e. PAC assigns instrument flight responsibilities for PNAC. (Leadership)
2. Instrument Departure
  - a. PAC directs PNAC to update NAVAIDs and radio frequencies. (Leadership)
  - b. PNAC ensures PAC complies with departure instructions. (Situational Awareness)

### **303. STRAIGHT AND LEVEL FLIGHT**

#### **Maneuver Description and Application**

[(Reference: NIFM Paragraph 18.3 (STRAIGHT AND LEVEL FLIGHT)).] A flight maneuver where altitude, heading and airspeed are held constant.

#### **Common Errors and Safety Notes**

1. Failure to trim the aircraft properly.
2. Failure to keep the ball centered.
3. Fixation on an instrument or group of instruments at the exclusion of others, contributing to a breakdown in the scan necessary to maintain straight and level flight.

### **304. LEVEL SPEED CHANGE**

#### **Maneuver Description and Application**

The level speed change is taught so the pilot may learn the proper control coordination and instrument interpretation as the aircraft varies airspeed. A pilot will apply level speed change

skills when transitioning from cruise flight conditions to a holding pattern, slowing the aircraft when requested by the controlling agency in order to provide proper spacing of aircraft, or accelerating to cruise airspeed upon reaching cruising altitude. The constants are heading and altitude.

### **Procedures**

1. **Trim** the aircraft at **80 KIAS** on assigned heading and altitude.
2. **Reduce** collective and adjust wing attitude and pedals to maintain heading and ball centered. Apply aft cyclic to slow the aircraft to **70 KIAS** and stabilize momentarily.
3. **Increase** collective and adjust wing attitude and pedals to maintain heading and ball centered. Apply forward cyclic to accelerate the aircraft to **100 KIAS** and stabilize momentarily.
4. **Reduce** collective and adjust wing attitude and pedals to maintain heading and ball centered. Apply aft cyclic to slow the aircraft to **80 KIAS**. Stabilize.

### **Amplification and Technique**

Scan wing attitude, ball, and heading to ensure they remain constant. Scan IVSI and maintain altitude with aft cyclic application. This will give an immediate indication of tendency to climb or descend. Apply enough cyclic to prevent a descent but not so much that the aircraft balloons. Approaching the new airspeed, it will probably be necessary to adjust collective and cyclic slightly to maintain each new airspeed while holding altitude.

### **Common Errors and Safety Notes**

1. Failure to stabilize prior to each speed change.
2. Rushing the maneuver, causing scan to lag behind the pace of the maneuver.
3. Failure to anticipate the new airspeed that results in decelerating or accelerating beyond the desired airspeed.
4. Allowing the aircraft to drift off heading due to the wings not being level or the ball not being centered. Remember from the earlier discussion on attitude instrument flight, increasing collective pitch causes the nose to pitch up, yaw right and roll right and decreasing collective pitch has the opposite effect. Effective anticipation of these nuances will improve performance of this maneuver.
5. Fixating on the airspeed indicator. An effective scan will result in rapid glances at the airspeed indicator to check progress with the great bulk of the scan being devoted to maintaining basic airwork, altitude, heading, and trim.
6. Failure to scan the IVSI and climbing or descending off altitude.

### **305. STANDARD RATE TURNS TO HEADING**

#### **Maneuver Description and Application**

[(Reference: NIFM Glossary, Paragraph 15.4 (TURN AND SLIP INDICATOR)).]

Standard rate turns are taught so the pilot will learn the proper attitudes and AOB required at different airspeeds to maintain the standard turning rate of 3° per second. A pilot will apply the standard rate turn in many instrument maneuvers to include: procedure turns, holding patterns, and turn-in precision approaches. The constants are altitude and airspeed.

#### **Procedures**

1. Once assigned a new heading, compute time to turn at a standard rate of 3° per second (i.e.,  $90^\circ \text{ turn} \div 3^\circ/\text{sec} = 30 \text{ sec}$ ).
2. Smoothly roll into standard rate turn three seconds prior to the time the turn should commence. Check turn needle with ball centered to confirm rate of turn.
3. Check the progress of the turn at least every 15 seconds for 45° and 10 sec for 30°. Increase or decrease AOB as required to complete turn on time.
4. Lead rollout sufficiently to finish on assigned heading.

#### **Amplification and Technique**

1. The AOB for a standard rate turn will vary with different airspeeds; as airspeed increases, AOB necessary for a standard rate turn will also increase. Confirm you are turning at a standard rate by checking the turn needle, then, return your scan to the attitude indicator.
2. Rollouts from standard rate turns should be commenced at a point prior to the rollout heading equal to 1/2 the number of degrees of the AOB used for the standard rate turn (i.e., 20° AOB requires a 10° lead).

#### **Common Errors and Safety Notes**

1. Failure to initially roll into a good standard rate turn and maintain the required AOB due to a breakdown in scan.
2. Failure to lead the rollout heading properly, resulting in overshooting or undershooting the desired rollout heading.
3. Failure to keep the ball centered. An aircraft flown out of balance will not bank as anticipated and will be more difficult to maintain on assigned altitude.

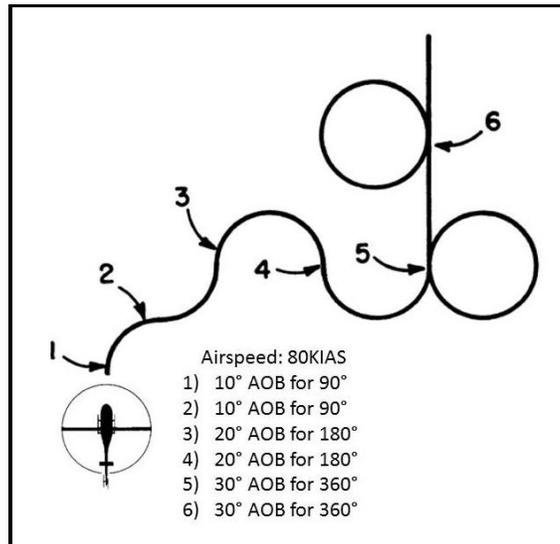
4. Failure to maintain airspeed/altitude. Remember, if you have not changed your power setting and you observe a change in IVSI, you have probably inadvertently over-controlled the nose pitch. Failure to take advantage of the instantaneous indication provided by the IVSI in this instance will result in a change in altitude and airspeed.

### **306. TURN PATTERN**

#### **Maneuver Description and Application**

[(Reference: NIFM Paragraph 18.5 (ROTARY-WING INSTRUMENT FLYING), Paragraph 18.2.2 (Steep Turns)).]

This maneuver will help the pilot learn the proper corrections necessary to maintain altitude and airspeed while making extended turns with varying AOB. The turn pattern consists of level, constant airspeed, constant altitude turns and reversals using 10°, 20°, and 30° AOB for 90°, 180°, and 360° turns, respectively.



**Figure 3-3 Turn Pattern**

#### **Procedures**

1. Trim the aircraft at 80 KIAS on assigned altitude and cardinal heading.
2. Initiate a turn in either direction utilizing 10° AOB for 90° of heading change. After 90° of turn, reverse the turn at 10° AOB for 90° of heading change. Maintain airspeed and altitude.
3. After the second 90° of turn, reverse the turn and roll into a 20° AOB for 180° of heading change. After 180°, reverse the turn and use 20° AOB for 180° in the opposite direction. Maintain airspeed and altitude.

4. After the second 180° of turn, reverse the turn at 30° AOB for 360° of heading change. After the 360° of turn, reverse the turn at 30° AOB for 360° of heading change. Maintain airspeed and altitude.
5. After the second 360° of turn, roll wings level on heading, altitude, and airspeed.

### **Amplification and Technique**

1. The reversals will begin at a point prior to the reversal heading which is 1/2 the number of degree AOB. For instance, 10° AOB turn should be reversed 5° prior to the reversal heading.
2. Little or no power change is required for the 10° AOB turn, but some additional power may be required for the 20° AOB turn, and usually a definite power increase will be required to maintain altitude for the 30° AOB turn.

### **Common Errors and Safety Notes**

1. Failure to maintain the proper AOB due to a breakdown in scan and trim techniques.
2. Failure to maintain altitude and airspeed because of a need for additional power in the steeper AOB turns.
3. Ballooning during reversal due to poor power management/scan breakdown.
4. Failure to scan IVSI for climb/descent trends. Watch tendency to pull the nose up or allow it to fall during reversals.
5. Failure to begin reversals on the appropriate heading.
6. Failure to keep ball centered during reversals.
7. Failure to roll out of a turn at the same rate at which SNA rolled into the turn.

## **307. VERTICAL S-1 PATTERN**

### **Maneuver Description and Application**

[(Reference: NIFM Paragraph 18.4 (CLIMBS AND DESCENTS), Paragraph 19.2.1 (Vertical S-1, S-2, S-3, S-4)).]

The vertical S-1 pattern is a proficiency maneuver that develops control coordination while climbing and descending at 500 FPM. The vertical S-1 will be performed with airspeed and heading as constants.

**Procedures**

1. Trim the aircraft at 80 KIAS on a cardinal heading and assigned altitude.
2. Three seconds prior to a cardinal time, smoothly adjust power to establish a 500 feet per minute rate climb or descent. Continue maneuver for one minute (500 feet of altitude change). Check progress of maneuver at least every 15 seconds. Adjust power as required to complete maneuver on time. Maintain heading and airspeed.
3. At an altitude of 10% of the Vertical Speed Indicator (VSI) reading prior to level off altitude, adjust power and attitude to level-off on altitude, heading, and airspeed.
4. Trim the aircraft at 80 KIAS on assigned heading and new altitude for one minute.
5. Three seconds prior to the cardinal time, smoothly adjust power to establish a standard rate descent or climb in the opposite direction of the first half of the maneuver. Continue maneuver for one minute (500 feet of altitude change). Check progress of maneuver at least every 15 seconds. Adjust power as required to complete maneuver on time. Maintain heading and airspeed.
6. At an altitude of 10% of the VSI reading prior to level off altitude, adjust power and attitude to level-off on altitude, heading, and airspeed.
7. Trim the aircraft at 80 KIAS on assigned heading and altitude.

**Amplification and Technique**

1. The maneuver commences on any cardinal heading and assigned altitude (five hundreds or even thousands of feet such as 1500 or 2000 feet) and three seconds prior to the second hand of the clock reaching a cardinal time (3, 6, 9, 12). Transitions to climbs or descents are made by adding or decreasing sufficient power to attain a 500 feet per minute rate climb or descent while maintaining 80 KIAS. Performance should be checked periodically to ensure 125 feet altitude change for every 15 seconds of elapsed time. Corrections must be made immediately in order to maintain the desired performance.
2. If other than 500 fpm climb or descent is being held, lead the level off by 10% of rate of climb/descent (i.e., 10% of 600 fpm is 60 feet) prior to level off altitude or as required.

**Common Errors and Safety Notes**

1. Failure to maintain 80 KIAS in the climb or descent. Avoid the tendency to allow the nose to pitch up when adding power for the climb and pitch down when reducing power for the descent. Scan must be rapid and thorough in order to maintain the constants and detect and correct any developing errors while they are still small.
2. Failure to maintain ball in the center.

3. Failure to scan the IVSI for climb/descent trends.

### **308. OSCAR PATTERN**

#### **Maneuver description and application.**

[(Reference: NIFM Paragraph 18.5 (ROTARY-WING INSTRUMENT FLYING), Paragraph 19.2.3 (OSCAR Pattern)).]

The Oscar pattern is a maneuver combining the use of standard rate turns and standard rate climbs and descents, which are designed to develop the pilot's scan proficiency. The Oscar pattern will be performed with airspeed as the constant.

#### **Procedures**

1. Trim the aircraft at 80 KIAS on a cardinal heading and assigned altitude.
2. Three seconds prior to a cardinal time, smoothly adjust power to establish a 500 feet per minute rate of climb or descent while simultaneously rolling the aircraft into a standard rate turn to the left or right. Continue maneuver for two minutes (1000 feet of altitude change, 360° of turn). Check progress of maneuver at least every 15 seconds. Adjust power and AOB as required to complete maneuver on time. Maintain airspeed.
3. At an altitude of 10% of the VSI reading prior to level off altitude, adjust power, AOB, and attitude to level off on altitude, heading, and airspeed.
4. Trim the aircraft at 80 KIAS. Maintain heading and altitude for one minute.
5. Three seconds prior to the cardinal time smoothly adjust power to establish a 500 feet per minute rate of climb or descent while simultaneously rolling the aircraft into a standard rate turn. Descend/climb and turn in the opposite direction of the first half of the maneuver. Continue maneuver for two minutes (1000 feet of altitude change, 360° of turn). Check progress of maneuver at least every 15 seconds. Adjust power and AOB as required to complete maneuver on time. Maintain airspeed.
6. At an altitude of 10% of the VSI reading prior to level off altitude, adjust power, AOB, and attitude to level-off on altitude, heading, and airspeed.
7. Trim the aircraft at 80 KIAS on new heading and altitude.

#### **Amplification and Technique**

1. The clock, altimeter, directional gyro, and ball should be checked to ensure a standard rate turn and a 500 fpm climb or descent, have been established in balanced flight. Adjustments to attain proper altitude should stay within 500+200 fpm as required. There should be a heading change of 45° every 15 seconds with a simultaneous climb/descent of 125 feet.

2. If for any reason the rollout heading or level off altitude is not reached as the second hand of the clock reaches the cardinal time, the turn and climb/descent will be completed on the desired heading and altitude rather than on time.
3. The rollout heading should be led by 1/2 the number of degree of the AOB used for the standard rate turn.
4. The important thing is to get off to a *standard rate START*. If you miss the first 15 seconds of timing, do not worry; pick it up after 30 seconds. Get a good rate of climb/descent and turn right at the start.

### **Common Errors and Safety Notes**

1. Failure to stabilize prior to climb/descent.
2. Failure to maintain a standard rate turn and climb/descent. Scan VGI and IVSI for AOB and climb/descent trends.
3. Letting airspeed vary. This can result in an unwanted rate of climb/descent and turn.
4. Fixating on one parameter of the maneuver (e.g., standard rate turn) allowing the other (e.g., climb) to deteriorate.
5. Failure to keep ball in the center. An aircraft flown out of balance will exhibit characteristics varying from those normally expected at a given AOB and power setting.
6. Allowing the aircraft to pitch up or down during power adjustments, hence causing loss of airspeed control.

### **309. INSTRUMENT AUTOROTATION (SIMULATOR ONLY)**

#### **Maneuver Description and Application**

Instrument autorotations are practiced to develop the confidence and ability to execute a safe autorotative descent in the event of an engine failure under IMC.

#### **Procedures**

1. The instructor will initiate the maneuver by inducing an engine failure or simulating an emergency that ultimately leads to an engine failure.
2. Establish a stable autorotative descent. Adjust nose attitude to 60 KIAS and collective to maintain rotor RPM between 90 and 107% (94 – 95% optimum).
3. Turn to the direction of the last known wind.

4. Ensure harness is locked, give a MAYDAY report, and set the transponder to emergency (7700).

5. Time and altitude permitting, consider executing Engine Restart in Flight Procedures.

If VMC is encountered above 200 feet AGL:

6. Continue flight in VMC and transition to Full Autorotation procedures.

If still IMC when passing through 200 feet AGL:

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

8. At 150 feet AGL, ensure collective is full down.

9. At 75 to 100 feet AGL, smoothly establish an 8 to 10 degree nose up attitude (flare) on the attitude indicator (depending on gross weight and wind conditions) to reduce groundspeed and rate of descent.

10. At 10 to 15 feet AGL, coordinate up collective and forward cyclic to slow the rate of descent and lower the nose to level attitude. Maintain heading with the pedals.

11. Level the skids prior to touchdown. Use collective as necessary to cushion the landing and touchdown with 0 to 10 knots of groundspeed.

### **Crew Resource Management**

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

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

PNAC backups flying pilot on the gauges, reporting critical altitudes (i.e., “200 feet”). (Situational Awareness, Communication)

PAC provides feedback to PNAC (i.e., Roger, 200 feet, leveling the wings”). (Situational Awareness, Communication)

PNAC verifies correct control input (i.e., “Collective is full down”). (Situational Awareness, Communication)

PNAC reports incorrect control inputs and proper action to take (i.e., if PAC reports “150 feet, flare,” PNAC reports “Negative, collective full down”). (Leadership, Situational Awareness, Assertiveness)

### **Amplification and Technique**

1. Since time may be short, the format of the MAYDAY report should place the higher priority items first. For example, “MAYDAY, MAYDAY, MAYDAY, Navy 8E050, Crestview VORTAC, 225 radial, 15 miles, (simulated) engine failure.”
2. This is a high workload maneuver for the PAC – PAC may direct PNAC to “lock, talk, and squawk.”
3. At some time during the maneuver, you will enter VMC, though the break out altitude may vary. During the first block of training, you will have sufficient time to transition to Engine Failure at altitude procedures and set up for a suitable landing site. As you become more experienced with the maneuver, you will have less time/altitude for visual procedures. Toward the end of your instrument simulator training, you may be challenged to execute the entire maneuver – including touchdown – under IMC.

### **Common Errors and Safety Notes**

1. Failure to maintain 60 KIAS in the descent.
2. Slow, insufficient or incorrect control inputs.
3. Failure to maintain heading with pedals.
4. Using the attitude indicator, turn needle, and ball to ensure a coordinated turn in balanced flight of not more than 30° AOB for the turn into the wind. This will prevent the nose from falling through or ballooning during the turn.

## **310. INSTRUMENT AUTOROTATION**

### **Maneuver Description and Application**

Instruments autorotations are practiced to ensure IPs remain proficient at executing autorotative descents in the event of an engine failure under actual IMC.

#### **NOTE**

*Instrument Autorotations in the aircraft will only be executed by IP/IUTs flying with IP/IUTs.*

### **Procedures**

1. The instructor will initiate the maneuver by announcing “simulated” and rolling the twist grip to flight idle.
2. Establish a stable autorotative descent. Adjust nose attitude to 60 KIAS and collective to maintain rotor RPM between 90 and 107% (94 – 95% optimum).

3. Turn to the direction of the last known wind.
4. Check  $N_g$  at flight idle RPM. Report  $N_g$  and  $N_r$ .
5. Ensure harness is locked, give a simulated MAYDAY report, and simulate setting the transponder to emergency (7700).
6. Time and altitude permitting, consider executing Engine Restart Flight Procedures.
7. Upon reaching 1000 feet MSL, or higher at the discretion of the Stan IP, transition to Engine Failure at Altitude procedures and set up for an appropriate landing site.
8. No lower than 400 feet AGL, initiate a waveoff to be completed no lower than 300 feet AGL.
9. Return to original altitude and airspeed unless otherwise directed.

### **311. PARTIAL PANEL**

#### **Maneuver Description and Application**

[(Reference: NIFM Paragraph 18.6 (PARTIAL PANEL FLIGHT)).]

1. A partial panel situation exists anytime there is a failure in one of the primary flight instruments necessary for flying or navigating in instrument conditions, and the pilot's scan must shift to the secondary and standby instruments. Partial panel work is practiced to increase the pilot's ability to control and maneuver the aircraft in IMC when such a degraded instrument condition exists.
2. Generally, partial panel situations are divided into two categories: (1) attitude indicator/attitude gyro failures and (2) heading indicator/directional gyro failures. Paragraphs 312 through 315 discuss these emergencies in detail.

### **312. PARTIAL PANEL, ATTITUDE GYRO FAILURE**

#### **Maneuver Description and Application**

[(Reference: NIFM Paragraph 18.6.2 (ATTITUDE INDICATOR FAILURE); NATOPS paragraph 14.28.7).]

1. The attitude indicator is important for instrument flight; it provides an indication of the aircraft's general pitch and roll attitudes. Failure of the attitude gyro requires the pilot to combine the indications from the other instruments to determine overall aircraft attitude. Should a failure occur while in IMC, the pilot must be proficient in controlling the aircraft without the use of the attitude gyro/indicator. Therefore, all pilots must be proficient at controlling the aircraft under instrument conditions without the use of this instrument should it fail.

2. As discussed previously, there is no instrument that measures rotor attitude, and no direct relationship between a helicopter's nose and rotor attitude. As a result, a helicopter pilot must always incorporate into his instrument scan those secondary instruments that measure rotor attitude indirectly: the airspeed indicator, turn and slip indicator, and VSI. During a partial panel condition (failed attitude gyro), those secondary instruments – already in the helicopter pilot's scan – become the primary means of controlling and adjusting the aircraft's attitude.
3. When flying under partial panel condition (failed attitude gyro) the pilot should anticipate a slight lag in these secondary instruments, especially when power adjustments produce changes in rotor/fuselage attitude and in the amount of "ball" required for balanced flight. Failure to anticipate and react to changes normally results in overcontrol and correction oscillations.
4. Failed attitude indicators, which may degrade rapidly or gradually with gyroscopic precession, are inherently and often severely vertigo-inducing. Refer to paragraph 317 for partial panel spatial disorientation/vertigo recovery procedures.

### **Procedures**

1. The instructor will initiate the maneuver either by covering the SNA's directional gyro or by securing electrical power to it. When simulating partial panel conditions, the SNA's attitude gyro will either be covered or caged in a turning attitude.
2. Stabilize the aircraft straight and level in balanced flight. Execute NATOPS emergency procedures.

### **Amplification and Technique**

1. With the loss of the artificial horizon or attitude indicator, the pilot must use the airspeed indicator, IVSI, or altimeter for pitch axis information (nose attitude). In partial panel flying, the turn and slip indicator (needle and ball) becomes the primary roll axis (wing attitude) scan instrument. This instrument will indicate to the pilot if wings are level or turning and how fast the pilot is turning when augmented with information provided by the heading indicator or wet compass.
2. All corrections for attitude deviations must be small due to the sensitivity of the turn needle and its tendency to oscillate rather than remain stable and with a given attitude or AOB. It is extremely important to have the ball centered or the needle will give information that, while accurate, can easily be misinterpreted.
3. If the aircraft is trimmed with the ball centered, only minor pedal application will be necessary unless the power is changed, regardless of the bank angle.

<b>Maneuver</b>	<b>Attitude</b>	<b>Primary Instrument</b>	<b>Cross Check Instrument</b>	<b>Supporting Instrument(s)</b>
Straight and Level	Pitch (nose)	Altimeter, VSI		Airspeed, Heading, Power
	Roll (wing)	Needle-Ball	Heading	
Level turns	Pitch (nose)	Altimeter, VSI		Airspeed, Heading
	Roll (wing)	Needle-Ball	Clock	
Climbs and descents	Pitch (nose)	Airspeed		Altimeter, VSI, Power, Heading
	Roll (wing)	Needle-Ball	Heading	
Climbing and descending turns	Pitch (nose)	Airspeed	Clock	Altimeter, VSI, Power, Heading
	Roll (wing)	Needle-Ball		

**Figure 3-4 Secondary Instrument Functions, Partial Panel**

**Common Errors and Safety Notes**

1. A pilot should always be aware the possibility of experiencing vertigo is much greater when operating partial panel. Do not be apprehensive about confessing you are experiencing vertigo.
2. Trust the instruments, especially when partial panel.
3. Pilots who “walk the pedals” unconsciously will be unable to maintain a wings level attitude and may encounter dangerous lateral oscillations.
4. Report any aircraft malfunction that, in the pilot’s opinion, seriously affects SNA’s ability to continue in IFR conditions.
5. Take care not to overreact to turn needle movement. Stay smooth.

**313. PARTIAL PANEL, DIRECTIONAL GYRO FAILURE**

**Maneuver Description and Application**

[Reference: NIFM paragraph 15.1 (COMPASSES), paragraph 18.6.1 (Heading Indicator Failure); NATOPS paragraphs 2.18.8, 2.18.9, 14.28.7; FAA Rotorcraft Flying Handbook, 2000].

1. Partial panel situations caused by a directional gyro failure require the use of the standby magnetic compass for heading information. Most standby magnetic compasses (including those in the TH-57) are not gyro-stabilized and are subject to acceleration and oscillation errors, as well as deviation errors caused by local magnetic variation and the influence of nearby electrical loads. As a result, the standby magnetic compass only provides reliable information in during straight and level, balanced and unaccelerated flight.
2. The loss of the directional gyro is an emergency condition, requiring the pilot to execute NATOPS gyro failure emergency procedures, troubleshoot the problem, secure electrical

equipment (searchlight, landing light, ECS, defog blower, and pitot heat), and report the problem with a request for radar service from ATC.

3. Until assigned a discrete frequency, pilots experiencing directional gyro failure should expect to make magnetic compass turns, even while receiving radar vectors from ATC. Magnetic compass turns are executed using either the (1) Timed Turn or (2) Lead Point technique. Due to magnetic compass limitations mentioned previously, timed turns are recommended when making heading changes by reference to the magnetic compass; however, some situations make the lead point technique more practical. Both techniques are discussed below.

### **314. MAGNETIC COMPASS TURNS (TIMED TURN TECHNIQUE)**

#### **Maneuver Description and Application**

[(Reference: NIFM Paragraph 15.1 (COMPASSES), Paragraph 18.6.1 (Heading Indicator Failure); NATOPS paragraphs 2.18.8, 2.18.9, 14.28.7)].

– The loss of the directional gyro is an emergency condition, requiring the pilot to execute NATOPS gyro failure emergency procedures, troubleshoot the problem, secure electrical equipment (searchlight, landing light, ECS, defog blower, and pitot heat), and report the problem with a request for radar service from ATC.

#### **Procedures**

1. The instructor will initiate the maneuver either by covering the SNA's directional gyro or by securing electrical power to it. Securing electrical power is the preferred method, as that is a more realistic representation of actual failure.
2. Stabilize the aircraft straight and level in balanced flight. Execute NATOPS emergency procedures.
3. Troubleshoot. Secure searchlight, landing light, ECS, defog blower, and pitot heat. Report problem and request radar service.
4. When assigned a heading, determine number of degrees of heading change required and the rate of turn (standard or half standard) to use.
5. Determine the time required to complete the turn.
6. Roll into a standard rate turn in balanced flight on a cardinal time (no 3-second lead).
7. Scan instruments to ensure proper altitude and airspeed is maintained. Occasionally, check clock for rollout time.

8. Roll wings level upon reaching rollout time (no 3-second lead). Stabilize the aircraft straight and level in balanced flight.
9. Check magnetic compass for intended heading. Make final corrections utilizing timed half standard rate turns. Maintain assigned heading and balanced flight.

**Amplification and Technique**

1. For turns of 30° or more, a standard rate (3° per second) turn will be utilized. For turns of 29° or less, use half standard rate (1½° per second) turn.
2. To determine the time necessary for turns greater than 30°, divide the number of degrees of turn required by 3, and this is the number of seconds required to turn.
3. For turns less than 30°, multiply the number of degrees required to turn by 2/3, (or 3 seconds per 5° of turn) and this will be the time in seconds required to turn at a half standard rate.
4. All turns should be started and stopped on a cardinal time (3, 6, 9, or 12 on the clock) and not led by 3 seconds as is done for full panel standard rate turns.
5. The rollout is accomplished on time with no lead and at the same rate of roll.

	<b>Degrees of Turn (Standard Rate)</b>	<b>Timing</b>	<b>Degrees of Turn ½ Standard Rate</b>	<b>Timing</b>
	360	2 min	25	15 secs
	180	1 min	15	9 secs
	90	30 secs	10	6 secs
	45	15 secs	5	3 secs

**Figure 3-5 Timed Turns, Partial Panel**

**Common Errors and Safety Notes**

1. Mathematical errors result in incorrect timing figures.
2. Failure to maintain a standard rate turn.
3. Rough cyclic movements cause erratic turn needle indications.
4. Always ensure the ball is centered.
5. A roll-in and roll-out executed too rapidly for the turn needle to respond correctly.

6. Failure to stabilize and maintain level, balanced flight when interpreting magnetic compass heading information.
7. Failure to fine tune with timed turns at the completion of the turn.
8. Searchlight or landing light will slave the magnetic compass off approximately 15°.

### **315. MAGNETIC COMPASS TURNS (LEAD POINT TECHNIQUE)**

#### **Maneuver Description and Application**

[(Reference: NIFM Paragraph 15.1 (COMPASSES), Paragraph 18.6.1 (Heading Indicator Failure); NATOPS, paragraphs 2.18.8, 2.18.9, 14.28.7)].

1. The loss of the directional gyro is an emergency condition, requiring the pilot to execute NATOPS gyro failure emergency procedures, troubleshoot the problem, secure electrical equipment (searchlight, landing light, ECS, defog blower, and pitot heat), and report the problem with a request for radar service from ATC.
2. When radar vectors are not available, magnetic compass turns will be necessary. Magnetic compass turns are executed using either the (1) Timed Turn or (2) Lead Point technique. Although timed turns (see paragraph 314) are preferred when using the magnetic compass, the lead point method can also be used to roll out of a turn when reaching a predetermined lead point on the magnetic compass.
3. Magnetic turns using the lead point technique are susceptible to magnetic dip error. While the compass card is in a banked attitude in the northern hemisphere, the earth's magnetic field causes the north-seeking ends of the compass to dip to the low side of the turn, giving the pilot an erroneous turn indication. This error is most apparent on headings of north and south. In a turn from a heading of north, the compass will briefly indicate a turn in the opposite direction; in a turn from south, it gives an indication of a turn in the proper direction, but at a more rapid rate than is actually occurring. In other words, the magnetic compass lags in turns in the northern half of the compass card and leads during turns in the southern half of the card.
4. The dip error must be considered when computing the lead point at which to begin rolling out of a turn, and is particularly noticeable when turning to a heading of north or south. Turns to the north require a normal lead point, plus a number of degrees equal to the flight latitude. Turns to the south require turning past the desired heading by a number of degrees equal to the flight latitude, minus the normal lead. Therefore, the pilot will compensate for lag during turns toward the north by rolling out before reaching that northerly heading (remember: "stay out of the north"). Likewise, the pilot will compensate for lead during turns toward the south by rolling out past that southerly heading (remember: "go through the south").
5. In the Pensacola area, 30°N latitude is used. The error is greatest in turns to the north and south (in this case, 30°), and least in turns to the east and west (0°). The error is proportionate in the intermediate headings (in this case, an error of 20° at 60° from east and west; 10° at 30° from

east and west); thus, the error is 30° when turning to 360 and 180; the error is 20° when turning to 030, 150, 210, and 330; the error is 10° when turning to 060, 120, 240, and 300.

<b>Heading</b>	N	030	060	E	120	150	S	210	240	W	300	330
<b>Error</b>	-30	-20	-10	0	+10	+20	+30	+20	+10	0	-10	-20

**Figure 3-6 Lead Point Turn Errors, Partial Panel**

**Procedures**

1. The instructor will initiate the maneuver either by covering the SNA's directional gyro or by securing electrical power to it. Securing electrical power is the preferred method, as that is a more realistic representation of actual failure.
2. Stabilize the aircraft straight and level in balanced flight. Execute NATOPS emergency procedures.
3. Troubleshoot. Secure searchlight, landing light, ECS, defog blower, and pitot heat. Report problem and request radar service.
4. When assigned a heading, determine the shortest direction to turn and the proper rollout heading (based on magnetic compass latitude error and rollout lead).
5. Roll into a standard rate turn in balanced flight.
6. Scan instruments to ensure proper altitude and airspeed is maintained. Occasionally check magnetic compass for rollout heading.
7. Roll wings level upon reaching rollout heading. Stabilize the aircraft straight and level in balanced flight.
8. Check magnetic compass for intended heading. Make final corrections utilizing timed half standard rate turns. Maintain assigned heading and balanced flight.

**Amplification and Technique**

1. Magnetic compass heading information is reliable ONLY in straight and level, balanced flight. Computed lead points are most accurate when utilizing 12 to 18 degrees AOB.
2. The proper rollout lead is ½ the AOB. For training purposes, we will use five (5) degrees.
3. The rollout heading is computed by accounting for the magnetic compass latitude error and the rollout lead. For example:
  - a. Turns to North: When turning to 360, lead the rollout (stay out of the north) by the 30° latitude error plus the 5° rollout lead. So, when turning left to 360, start the

- rollout when the compass reads 035 (30° before 360 in a left turn = 030; 5° before that is 035).
- b. Turns to the northern half of the compass: When turning to intermediate northern heading, lead the rollout (stay out of the north) by the appropriate latitude error (10 or 20°), with the 5° rollout lead. For example, when turning right to 330, start the rollout when the compass reads 305 (20° before 330 in a right turn is 310; 5° before that is 305).
  - c. Turns to South: When turning to 180, turn past 180 (go through the south) by the latitude error (30°), with the 5° rollout lead. So, when turning right to 180, start the rollout when the compass reads 205 (30° past 180 in a right turn = 210; 5° before that is 205).
  - d. Turns to the southern half of the compass: When turning to intermediate southern heading, turn past the heading (go through the south) by the appropriate latitude error (10 or 20°), with the 5° rollout lead. For example when turning right to 150°, start the rollout when the compass reads 165° (20° past 150 in a right turn is 170; 5° before that is 165).
  - e. Turns to East or West: When turning to 090 or 270, simply lead the rollout by 5° as you normally would.
4. When given a target heading to fly, the pilot's thought process should follow this line, for instance: "Left to 150 ... that is 20° ... go through the south ... a left turn makes it 130 ... 5° before that makes it 135."
  5. A pilot is expected to complete turns within 10° of the desired heading while maintaining airspeed and altitude. Remember, magnetic compass turns are inexact and corrections will likely be necessary once you roll wings level.
  6. As a pilot develops magnetic compass skills, the pilot will be able to plan the rollout in the turn to the new heading. SNAs are encouraged to develop this skill as soon as possible because it will help in the failed card approach work in the RI stage.

### **Common Errors and Safety Notes**

1. Incorrect calculation of rollout and lead or lag.
2. Failure to lead the rollout by one-half the AOB (5°).
3. Excessive or insufficient AOB.
4. Failure to stabilize and maintain level, balanced flight when interpreting magnetic compass heading information.

5. Failure to promptly fine tune with timed turns at the completion of the lead point technique turn.
6. Searchlight or landing light will slave the magnetic compass off approximately 15°.

### **316. SPATIAL DISORIENTATION/VERTIGO RECOVERY (UNUSUAL ATTITUDES)**

#### **Maneuver Description and Application**

[(References: NIFM Chapter 20 (UNUSUAL ATTITUDES)).]

1. Spatial disorientation/vertigo recovery techniques are practiced in order to enable the pilot to recover from unintentional, undesirable, or unsafe aircraft attitudes that might be encountered in instrument conditions due to a failure of the attitude indicator or internal or external factors leading to a disorienting physiological condition. In most cases, these attitudes are mild enough for the pilot to recover by reestablishing the proper attitude for the desired flight condition and resuming a normal instrument cross-check.
2. It is not likely the PAC will immediately determine whether the problem is physiologically or mechanically induced. Recovery procedures are designed to be accomplished, from habit, in order to regain control of the aircraft. As in any emergency, CRM is essential; therefore, the pilot executing the recovery will recite the corrective actions aloud and facilitate teamwork during the recovery.
3. After assigning the SNA a base recovery heading and altitude, the instructor may initiate the maneuver using one of the three methods:
  - a. Method 1: The IP will fly the aircraft into an unusual attitude while the SNA looks away from the gauges. When the desired attitude has been reached, the instructor will relinquish control of the aircraft to the SNA who will recover from the unusual attitude.
  - b. Method 2: With SNA at the controls, IP tells him to close eyes and directs a series of control inputs which should quickly put the aircraft in out-of-balance flight. When aircraft is sufficiently displaced from normal, IP state: “Open your eyes; recover.”
  - c. Method 3: Unannounced Vertigo Recovery. This method simulates IP succumbing to vertigo while SNA is setting up the cockpit for an instrument approach. While the SNA is setting up cockpit for instrument approach, IP (as PAC) makes incorrect control inputs that go beyond vertigo parameters from NATOPS brief. SNA should note the deviations, make verbal calls to correct, and then come on the controls to recover. In addition to testing the SNA’s Unusual Attitude recovery procedures, this method assesses his CRM assertiveness.

### **Crew Resource Management**

1. PAC alerts PNAC if vertigo or disorientation is encountered. (Situational Awareness)
2. PNAC verbally notifies PAC of deviations from established parameters. (Assertiveness)
3. PNAC provides heading, attitude, altitude, VSI, navigational position and other points of reference to PAC. (Situational Awareness)
4. PNAC provides PAC (when experiencing vertigo) verbal corrective control movements. (Assertiveness)
5. PNAC assumes the controls in a timely manner following exceedance of briefed safety of flight parameters and procedures. (Assertiveness)

### **Procedures**

(Expedite procedures through step 4.)

1. Level the wings.
2. Level the nose.
3. Center the ball.
4. Set power for 80 KIAS. Stop any climb or descent, and achieve 80 KIAS.
5. Recheck the wings, nose, and ball.
6. Execute a 500 FPM climb or descent to base recovery altitude.
7. Execute a level standard rate turn to base heading.

### **Amplification and Technique**

1. Most aircraft are equipped with independently operating attitude gyros. When attitude reference information is suspect, a crosscheck of the other gyro will likely reveal whether the aircraft is full or partial panel. In reality, the controls would normally be transferred to the pilot with the reliable instruments; however, for the purposes of this exercise, you will fly the recovery.
2. Make corrections smoothly and moderately to avoid over-correcting and achieving an opposite unusual attitude, particularly in the case of partial panel recoveries. For instance, over-correcting from a descending left turn could result in a climbing right turn if corrections were made too abruptly or were too great a magnitude. At the discretion of the IP, once the aircraft is in a level flight attitude, recovery altitude and heading can be established simultaneously (i.e., turn to 360 while climbing to 2000 ft).

**Common Errors and Safety Notes**

1. The two dangerous aspects of unusual attitudes are vertigo and rapid loss/gain of altitude.
2. Avoid rapid, random control inputs as they cause over-controlling and severely complicate the recovery.
3. Making corrections for several errors at once may lead to incorrect instrument interpretation.
4. Low “G” situations and large, rapid cyclic movements can lead to mast bumping.
5. At no time shall airspeed be allowed to decrease below 40 KIAS.

**317. PARTIAL PANEL SPATIAL DISORIENTATION/VERTIGO RECOVERY (PARTIAL PANEL UNUSUAL ATTITUDES)**

**Maneuver Description and Application**

[(References: NIFM Chapter 20.3.3 (PARTIAL PANEL UNUSUAL ATTITUDES)).]

1. Failed attitude indicators, which may degrade rapidly or gradually with gyroscopic precession, are inherently vertigo-inducing. With a failed attitude indicator, successful recovery from an unusual attitude depends greatly on pilot proficiency and early recognition of the failure. Attitude indicator failure should immediately be suspected if flight controls were displaced without a corresponding change in the attitude indicator presentation. Additionally, a failed attitude indicator is the likely cause whenever performance instruments (e.g., airspeed, IVSI) begin to contradict the attitude indicator picture.
2. Should an unusual attitude be encountered with (or as a result of) a failed attitude indicator, the pilot must first center the ball to ensure that the secondary gauges are providing accurate information before leveling the wings with the turn needle and stopping any climbs/descents with IVSI.
3. After assigning the SNA a base recovery heading and altitude, the instructor may initiate the maneuver using one of three methods discussed in paragraph 316.

**Procedures**

(Expedite procedures through step 4.)

1. Center the ball.
2. Level the wings and check the turn needle.
3. Level the nose and check the IVSI.

4. Set power for 80 KIAS, stop any climb or descent, and achieve 80 KIAS.
5. Recheck the ball, wings, and nose.
6. Execute a 500 FPM climb or descent to base recovery altitude.
7. Execute a level standard rate turn to base heading.

### **Amplification and Technique**

1. During the initial steps of the maneuver, the pilot should check turn needle and ball as the wings/IVSI/nose are leveled. The pilot does this to determine that the attitude indicator is providing accurate information.
2. In the case of partial panel recoveries (as with all partial panel flight) the pilot makes corrections smoothly and moderately to avoid over-correcting and achieving an opposite unusual attitude. For instance, over-correcting from a descending left turn could result in a climbing right turn if corrections were made too abruptly or were of too great a magnitude.

### **Common Errors and Safety Notes**

1. Avoid rapid, random control inputs as they cause over-controlling and severely complicate the recovery.
2. Making corrections for several errors at once may lead to incorrect instrument interpretation.
3. Low "G" situations and large, rapid cyclic movements can lead to mast bumping.
4. At no time shall airspeed be allowed to decrease below 40 KIAS.
5. A common tendency encountered in these recoveries is a failure to properly interpret the aircraft instruments. For example, the pilot will see the attitude indicator in a wings level position with no climb or descent evident. The pilot believes everything is perfectly normal, but has failed to notice the airspeed is decreasing through 40 KIAS due to a low power setting. Similarly, the pilot has centered the ball, leveled the wings, and leveled the nose, but the pilot's failure to check the turn needle denied an early opportunity to detect a partial panel condition.
6. Attempting to recover the aircraft by sensory feel rather than by proper instrument interpretation.
7. Fixating rather than continuing an efficient instrument scan.

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## **CHAPTER FOUR RADIO INSTRUMENTS**

### **400. INTRODUCTION**

In the Radio Instrument (RI) Stage of your flight training, you will be introduced to the elements of Instrument Navigation. The Contact and Basic Instrument Stages of your training equipped you with basic flying skills. In the RI stage, these skills will be further refined and built upon to enable you to accomplish a specific objective – to navigate from one point to another.

You will learn to depart one airfield, navigate the airways and maneuver the aircraft for a landing at your destination – all on instruments. This will require you to maintain a constant awareness of your geographical position by operating and interpreting the radio instruments in the TH-57.

You will also practice flight planning and the standard procedures for communicating with Air Traffic Control (ATC) agencies.

In order for you to learn what you need about Radio Instruments, it will be necessary to be thoroughly familiar with this FTI. In addition, you should consult other sources of information including but not limited to:

NATOPS Instrument Flight Manual (NIFM)

TH-57 NATOPS

CNAF M-3710.7

Flight Information Publications (FLIP), Departure Procedures, Standard Terminal Arrival (STAR), Approach Plates, IFR Supplement, Flight Information Handbook (FIH)

Aeronautical Information Manual (AIM)

FAA Air Traffic Control manual 7110.65

Federal Aviation Regulations (FAR) Part 91

### **401. NAVIGATIONAL AIDS**

[(Reference: NIFM Part V (NAVIGATIONAL AIDS/FACILITIES AND PROCEDURES), AIM Chapter I (Navigation Aids)).]

#### **Tactical Air Navigation (TACAN)**

TACAN is used by the FAA for airways flight and instrument approaches and by the Navy in its tactical control of aircraft. TACAN is a navigational aid that provides azimuth and Slant Range Distance (DME) information to the pilot, precisely determining geographic position at all times. Combination VOR and VOR/TACAN (VORTAC) stations define most airways in the United States. Also, almost all fleet aircraft, naval air stations, and ships conducting helicopter operations are VOR/TACAN equipped.

VORTAC is considered a unified navigational aid, providing VOR azimuth, TACAN azimuth, and TACAN distance (DME) at one site.

TACAN station passage is determined when the range indicator stops decreasing (minimum DME).

When tuning a TACAN station, utilize TINTS:

1. Tune in the proper TACAN channel, selecting “X” or “Y” as appropriate. Ensure the waypoint indicator (WPT) is not flashing by pressing the “USE” button. Ensure “TACAN” mode is selected and not “TACAN RNAV” or “TAC RNAV APP.”
2. Identify the station. TACAN stations are identified through the DME button on the audio selector panel. The volume cannot be adjusted from the cockpit. Do not select the associated NAV1 button, as this button selects VOR audio only.
3. Choose needle mode. Ensure the “ADF/VOR” selector buttons are in the “VOR” position for TACAN and VOR operation.
4. Twist desired radial information into the CDI and HIS using the Omni-Bearing Selector knob (OBS). Digital radial information may be presented on the DME indicator by selecting the “RAD” button on the NAV receiver panel.
5. Select NAV 1. In the TH-57, you must receive DME in order to receive TACAN azimuth. Since there is only one DME receiver in the TH-57, the pilot can receive only one TACAN station at a time.”

### **VHF Omnidirectional Range (VOR)**

The VOR was developed to replace ADF. Its primary advantage: weather does not affect it like it does ADF.

Most VORs are equipped for voice transmission on their respective frequency. VORs without voice capability are indicated by the letter “W” (without voice) included in the class designator (VORW) On VFR sectionals and IFR Enroute Low Altitude charts, underlined VOR frequencies indicate No Voice transmitted on the frequency.”

Some VOR stations broadcast ATIS or Transcribed Weather Broadcasts (TWEB) on the VHF frequency used for VOR navigation. To hear this information, depress the appropriate NAV button, pull the volume knob out, and adjust volume. Where the frequency 122.1R is listed over a VORTAC frequency box on a Low-Altitude IFR Navigation chart, the pilot may talk to FSS by broadcasting on 122.1 with the VHF radio, then listen for a reply on the VOR frequency through the NAV radio.

The only positive method of identifying a VOR is by its Morse Code identification or by the recorded automatic voice identification which is always indicated by use of the word “VOR” following the station's name.

Station passage occurs when the TO-FROM indicator makes the first positive change to FROM, provided the inbound course to the station is twisted in the HSI.

1. **Tune VOR frequency**, ensuring “VOR” mode is selected. Push “USE.”
2. **Identify the station**. Select the NAV1 button on the audio selector panel. Adjust the volume as necessary by pulling out the volume knob on the NAV receiver panel on the KNS-81, and adjusting the volume.
3. Ensure *needles* are in “VOR” mode.
4. **Twist** in the desired course using the “OBS” knob.
5. **Select NAV 1**.

### Non-Directional Radio Beacon (NDB)

Automatic Direction Finding (ADF) equipment, such as the low-frequency radio compass and UHF/ADF, are normally used as backup navigational aids for more sophisticated navigation equipment such as TACAN, VOR, GPS, or Radar. Frequently, helicopters operating in remote areas do not have this more sophisticated equipment available and LF/ADF or UHF/ADF becomes the primary means of radio navigation. The range of LF/ADF is beyond line of sight, which makes it of special use to low flying helicopters.

**Dip error** in turns causes erroneous bearing indications. Therefore, turns must be made to predetermined headings.

Since ADF receivers do not have a “FLAG” to warn the pilot when erroneous bearing information is being displayed, the pilot must continuously monitor the NDB identification for excessive static and interference to ensure proper reception.

#### NOTE

If receiver fails, needle will remain in the last relative position when failure occurs.

Station passage is indicated when the ADF needle swings through the 90/270 degree position (falls through the wingtip).

## 402. ORIENTATION

### Maneuver Description and Application

[(Reference NIFM Paragraph 21.2 (EQUIPMENT AND OPERATION), Paragraph 22.2 (EQUIPMENT AND TRANSMISSION PRINCIPLES), Paragraph 23.1 (AUTOMATIC DIRECTION FINDING)).] Orientation is the procedure for determining aircraft position with respect to the NAVAID.

### Procedures

1. Tune and identify the station.
2. Ensure the VOR/ADF needle is in the proper position.
3. Determine the radial/course and DME (TACAN/VOR) or bearing/heading (ADF), as applicable.

### Amplification and Technique

1. With an operable directional gyro, the head of the ADF needle indicates the magnetic heading to the station from the position of the aircraft. The position of the aircraft relative to the station and magnetic *bearing* is always on the tail of the needle.
2. The TACAN/VOR indicates the *radial* on which the helicopter is located and the course to the station will appear under the head of the needle.
3. With a TACAN or VORTAC, slant range from the station is shown by the DME.

### Common Errors and Safety Notes

1. If the directional gyro is frozen or will not slave, the ADF needle will still indicate relative bearing to the station.
2. Nearly all disturbances affecting the ADF bearing also affect the facility's identification. Noisy identification usually occurs when the ADF needle is erratic. Voice, music, or erroneous identification may be heard when a steady false bearing is being displayed. Since ADF receivers do not have a "FLAG" to warn the pilot when erroneous bearing information is being displayed, the pilot must continuously monitor the NDB identification to alert him when a signal becomes unreliable.
3. A TACAN/VOR station should not be used for navigation unless it can be identified even though it appears a good lock-on is obtained.
4. TACAN/VOR signals are subject to line of sight restrictions and unlock may occur when the aircraft fuselage or other obstructions interfere with the transmitted signal.

5. TACAN is susceptible to azimuth errors of 40° or multiples thereof (i.e., 80°, 120°, etc.). This may be caused by a weak airborne receiver and rectified by merely re-channelizing the unit.
6. The only positive method of identifying a VOR is by its three-letter Morse Code identification or by the recorded automatic voice identification which is always indicated by use of the word “IVOR” following the station's name.
7. Utilize available backup NAVAIDs to prevent in-flight use of erroneous navigation signals.

### **403. HOMING**

#### **Maneuver Description and Application**

[(Reference: NIFM Paragraph 21.3.8 (Homing), Paragraph 22.1.1.7 (Homing)).]

Homing is accomplished when the aircraft is turned to place the head of the needle under the top index, and keeping it there. By keeping the needle under the index, the station will always be directly ahead of the aircraft. Since homing does not incorporate wind drift correction, in a crosswind the aircraft follows a curved path to the station.

#### **Procedures**

Maintain needle under the top index until station passage.

#### **Amplification and Technique**

Homing results in a curved path over the ground unless the aircraft has no crosswind component.

#### **Common Errors and Safety Notes**

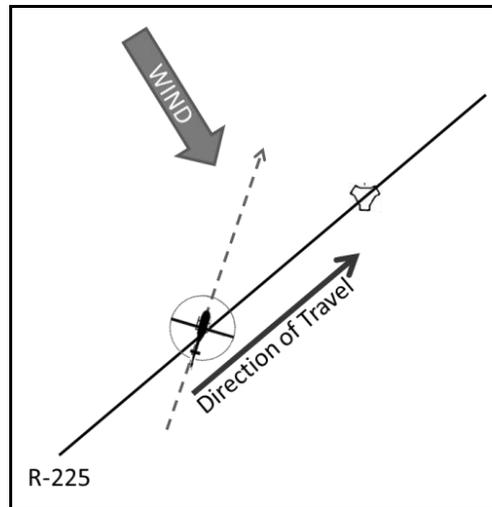
1. When close to the station, the ADF needle will become very sensitive. Avoid large heading changes when this occurs.
2. Homing is not an approved IFR procedure and should be used only when close to the station.

### **404. TRACKING**

#### **Maneuver Description and Application**

[(Reference NIFM Paragraph 21.3.7 (Estimating Drift Correction)).]

Tracking is the procedure for determining a magnetic heading which will correct for wind drift and enable the aircraft to maintain a straight track over the ground which coincides with a desired bearing/radial to or from a station, and is the most direct route from one point to another.



**Figure 4-1 Tracking**

**Procedures**

1. Turn to the inbound or outbound bearing/radial.
2. Apply a wind correction.
3. Correct for drift.
4. Establish a track.
5. Crosscheck for drift.
6. With TACAN/VOR, set CDI/HSI to tracking course.

**Amplification and Technique**

1. Establish the aircraft on the desired bearing/radial while maintaining the corresponding heading. Ensure proper sensing.
2. When tracking inbound, the head of the needle provides magnetic course information. As the aircraft drifts off course, the head of the needle will drift off in the opposite direction (HEAD FALLS). Utilize the tail of the needle to identify your position relative to the station. Inbound, the tail of the needle will identify the bearing/radial which is to be maintained. It is the reciprocal of the inbound magnetic course. Having drifted off course, determine to which side of the bearing/radial the aircraft has drifted and turn in the proper direction toward the desired bearing/radial to correct the drift error (TAIL RISES).
3. When tracking outbound, utilize the tail of the needle to identify the bearing/radial and course from the station. As the aircraft drifts off course, the tail will drift in the same direction. Turn in the proper direction toward the desired bearing/radial to correct the drift error.

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4. Correct towards the new bearing/radial an appropriate amount. The amount of correction required depends on the length of time required to drift off course and the distance from the station. Once established on the desired bearing/radial, turn once again into the wind and establish a crab angle relative to the desired course that will correct for the crosswind component. Cross check the RMI frequently to determine if drift reoccurs. If so, establish a new correction and continue to do so until the correct crab angle is found which accurately compensates for the existing crosswind.

5. When TACAN/VOR tracking utilizing the CDI/HSI, the course deviation bar will drift off center in the same direction as the TACAN/VOR needle for off-course indications. Once drift is detected, select a new heading in the same direction the CDI/HSI has moved. The amount of heading correction will depend on the length of time required to drift off course and distance from the station.

6. Several attempts may be required before the correct amount of drift correction is determined (bracketing).

### **Common Errors and Safety Notes**

1. Do not over-correct when close to the station. Avoid large heading changes close to the station.

2. Allow time for corrections to work.

3. Remember, the CDI/HSI is only a secondary reference. The TACAN/VOR needle is the primary course indicator. If any disparity exists between the CDI/HSI and the TACAN/VOR needle, utilize the needle for navigation.

4. Apply all that has been presented in this FTI (e.g., NAVAIDs, magnetic compass turns, etc.) in forming a complete understanding of the nuances associated with completing this maneuver.

**405. DETERMINING LEAD RADIAL**

**Description**

While conducting intercepts using an arcing method, including “wingtip method” described in paragraph 405, SNAs will need to determine the Lead Radial at which you will begin to intercept the inbound or outbound radial assigned/desired. The lead radial is affected by ground speed, distance from the NAVAID (DME) and rate of turn (Standard versus ½ Standard) for 90° of turn. The following procedures are provided to calculate a lead radial required to intercept a radial off of an arc. There are two methods provided for the SNA to determine the number of Radials to Lead By. See Appendix A for how the Rule of Thumb is calculated and a table comparing Radials to Lead By calculated using the equation method with the Radials To Lead By calculated using the Rule of Thumb. SNAs may use either method, but must be prepared to explain the method used to the instructor when asked. SNAs shall be able to explain both methods and calculate the number of Radials to Lead By using both methods.

Lead Radial Equation:

$$Lead\ Radial = Desired\ Radial \pm \left( (.5\% * Ground\ Speed) * \left( \frac{60}{DME\ of\ the\ Arc} \right) \right)$$

**Procedure**

- Determine the number of Radials to Lead By using one of the following methods:
  - a. Equation Method
    - i. Determine the number of radials per mile using the following equation:

$$60-1\ Rule: \frac{60}{(DME\ of\ the\ Arc)} = Radials\ per\ NM$$

- The 60-1 Rule is based on each radial being 1 NM apart at 60DME which allows the use of the above equation.
- ii. Determine the turn radius of the aircraft for a 90° turn using the following equation:

**Radius of Turn for a 90° Turn:  $(0.5\%) * (Ground\ Speed) = Turn\ Radius$**

- When intercepting a radial from an arc at speeds or situations that preclude the use of a Standard Rate Turn, using 1.0% of the ground speed will allow for a ½ Standard Rate Turn.

- iii. Determine the Radials to Lead by using the following equation:

**$(Turn\ Radius) * (Radials\ Per\ NM) = Radials\ to\ Lead\ By$**

- b. Rule Of Thumb Method
  - i. Based on using a ground speed of 100 Knots, Divide 30 by the DME of the Arc.

$$\frac{30}{DME\ of\ the\ Arc} = Radials\ to\ Lead\ By$$

**NOTE**

The Rule of Thumb Method assumes a ground speed of 100 knots. See Appendix A to compare the differences at varying ground speeds and DMEs between the two methods. In faster fleet rotary wing aircraft or fixed wing aircraft SNAs should use the Equation Method to ensure an accurate calculation of Radials to Lead By.

- ii. Determine the Lead Radial as follows:
  - (a). If arcing counterclockwise:
   
***Lead Radial = Desired Radial + (Radials to Lead By)***
  - (b). If arcing clockwise:
   
***Lead Radial = Desired Radial – (Radials to Lead By)***
- iii. At the Lead Radial, start a Standard Rate Turn to intercept the new radial.

**NOTE**

If Ground Speed cannot be determined in a timely manner, KIAS may be used. This will provide a no-wind lead radial and will require an adjustment for any known winds.

**EXAMPLE**

You are on the 10 DME arc arcing clockwise to intercept the 360 radial outbound. Your current ground speed is 85 Knots according to your GPS. What is your lead radial for the turn?

**Equation Method**

1. Radials per NM = 60/10 = 6 radials/NM
2. Turn Radius = (.5%) (85 knots Ground Speed) = .425 NM
3. Radials to Lead By = (.425 NM) (6 radials/NM) = 2.55 radials rounded to 3 radials

4. Lead Radial = 360 radial - 3 radials = 357 radial

**Rule of Thumb Method**

1. Radials to Lead By =  $30/10 = 3$
2. Lead Radial = 360 radial - 3 radials = 357 radial

**406. INTERCEPTS**

**Maneuver Description and Application**

[(Reference: NIFM Paragraph 21.3 (Procedures)).]

Intercepts are performed in all phases of instrument navigation. Interception is defined as selecting a heading allowing the interception of a desired bearing/radial at a predetermined angle.

Interceptions fall into these categories: inbound, outbound, and over-the-station (a special type of outbound interception).

**Procedures**

1. Tune and identify the station.
2. Determine the bearing/radial you are on.
3. Determine the bearing/radial you want to intercept.
4. Measure the angular difference.
5. Determine the type of intercept procedure required and turn in the shortest direction to commence the intercept.
6. For TACAN/VOR intercepts, set the CDI/HSI to the new course that will be flown after turning to initiate the intercept.

**Amplification and Technique**

**1. Inbound**

- a. **Benchmark method (45° or less of bearing/radial change):**
  - i. Turn in the shortest direction toward the new bearing/radial to place the head of the needle on the appropriate 45° benchmark in the upper half of the RMI (this places the tail in a position to rise to the new bearing/radial). Twist the new course in CDI/HSI.

- ii. Note the aircraft heading.
  - iii. Hold this heading until nearing the new bearing/radial.
  - iv. Turn toward the head of the needle, and apply tracking techniques.
- b. **Wingtip method (greater than 45° of bearing/radial change):**
- i. Turn in the shortest direction toward the new bearing/radial to place the head of the needle on the appropriate 90° benchmark. Twist the new course in CDI/HSI.
  - ii. Throughout the intercept, either turn as necessary to keep the head of the needle on the wingtip, or approximate the arc by placing the head of the needle 5° to 10° above the wingtip and maintain heading until the needle falls 5° to 10° below the wingtip. Repeat the procedure as necessary.
  - iii. Determine the lead radial using procedures listed in paragraph 405, and turn toward the station and apply tracking techniques.

**2. Outbound**

- a. **Benchmark method (45° or less of bearing/radial change):**
- i. Turn in the shortest direction toward the new bearing/radial to place the new bearing/radial under the appropriate 45° benchmark in the upper half of the RMI (this puts the tail of the needle in position to rise to the new bearing/radial). Twist the new course in CDI/HSI.
  - ii. Note the aircraft heading. Hold this heading until nearing the desired bearing/radial.
  - iii. Turn back toward the bearing/radial and utilize tracking techniques away from the station.
- b. **Wingtip method (greater than 45 but less than 120° of bearing/radial change):**
- i. Turn in the shortest direction toward the new bearing/radial to place the head of the needle on the appropriate 90° benchmark. Twist the new course in CDI/HSI.
  - ii. Throughout the intercept, either turn as necessary to keep the head of the needle on the wingtip, or approximate the arc by placing the head of the needle 5° to 10° above the wingtip and maintaining heading until the needle falls 5° to 10° below the wingtip. Repeat the procedure as necessary.

- iii. Determine the lead radial using procedures listed in paragraph 405, and turn away from the station and apply tracking techniques.
- c. **Over-the-station method (greater than 120° of bearing/radial change):**
- i. Turn directly to the station and track inbound.
  - ii. After station passage is indicated, turn to parallel the new bearing/radial until the needle stabilizes.
  - iii. Twist new course in CDI/HSI.
  - iv. Using a 15° to 30° cut, turn to intercept the new bearing/radial and apply tracking techniques.

### **Common Errors and Safety Notes**

1. Pay close attention to the speed at which the tail of the needle is rising in determining the proper amount to “lead” your turn to avoid undershooting/overshooting the desired heading.
2. Always ensure the proper navigational aid is tuned and identified, and bearing/radial selected after having identified or tuned a new NAVAID.
3. With TACAN/VOR intercepts, the course selected in the CDI/HSI is the same as the radial if tracking outbound and the course selected is the reciprocal of the radial if tracking inbound. Remember, the CDI/HSI is only a secondary reference. The TACAN/VOR needle is the primary course indicator. If any disparity exists between the CDI/HSI and TACAN/VOR needle, utilize the needle for navigation.

## **407. ENROUTE NAVIGATION**

### **Maneuver Description and Application**

[NIFM Part VII (Instrument Flight), AIM]

Enroute navigation is the process of locating and directing an aircraft's position with respect to known ground references, visual or electronic. The Radio Instruments (RI) and Airways Navigation (AN) stages are designed to teach navigation using electronic means such as radar, NAVAIDs, and radio communications. With basic instrument skills employed by the flying pilot, coupled with navigation skills employed by the flying pilot or the non-flying pilot, an aircraft is guided through the departure, enroute, and terminal phases of flight.

### **Amplification and Technique**

1. **Aviate, Navigate, Communicate.** This short statement summarizes the proper alignment of priorities for the aviator and provides some guidance for the delegation of cockpit

responsibilities. The first priority is control of the aircraft. Then, if necessary, the SNA may trim the aircraft, pass the controls, and move on to step #2.

2. **A chart and a NAVAID.** At all times, whether under radar control or pilot's navigation, the instrument pilot needs to be receiving some NAVAID, and he needs any chart which depicts that NAVAID on it. Utilize approach plates as well as VFR/IFR charts as required. Move on to step #3.

3. **Where am I? Where am I going?** Utilizing the position indicating instruments (RMI, CDI/HSI, DME/AOM), determine the aircraft's position relative to the selected NAVAID. Narrow the position down to a line, arc, or point on the selected chart. Using the RMI (full card) or standby compass (failed card) determine heading and visualize or draw the aircraft's present vector on the chart.

4. **What is my clearance?** Determine where the aircraft is to be flown, as dictated by a verbal clearance, flight plan, or published route segment. Keeping in mind aviation is movement in three dimensions with the fourth dimension of "time" of importance, the aviator may organize his thoughts by realizing every point on a chart is defined using at least one of three parameters: Positions, Times, and Altitudes. Since the flight plan or published route segment is written down, the pilot need not memorize it, but rather he needs only to identify the next position, time or altitude he must intercept. This is what it takes to "stay ahead of the aircraft."

5. **Fly direct.** Proceed to the next expected position using one of the following methods:

- a. Direct to the station (head of the needle, twist CDI/HSI).
- b. Bearing/radial/localizer intercept.
- c. TACAN point-to-point.
- d. Climb or descent.

While these steps seem like common sense, improperly executing one of them will lead to disorientation, misorientation, or worse. At no time is a pilot relieved of the responsibility for safe and proper navigation, even under radar control or "just an SNA" or copilot.

Consult the AN stage discussion for further amplification of enroute requirements. Remember, your routing from approach to approach during the RI stage simulates enroute time. Therefore, fuel consumption checks, as discussed in the AN portion of this instruction, are necessary.

#### **408. POINT-TO-POINT NAVIGATION**

##### **Maneuver Description and Application**

[(Reference: NIFM Paragraph 22.2.3.8 (Technique of Navigating Point to Point)).]

Point-to-point navigation is a procedure used to fly from one TACAN/VORTAC fix to another using a direct track.

**Procedure**

1. Tune and ID the Station.
2. Set the desired (new) radial in the HSI.
3. Turn to a heading approximately between the *head* of the bearing pointer and the *head* of the course indicator in the HSI. “*Split some heads.*”
  - Adjustments may be made to the rollout heading. If going to a smaller DME, favor the head of the bearing pointer. If going to a larger DME, favor the head of the course pointer (desired radial).
4. Determine which point is farther from the TACAN/VORTAC station, the current fix or the new fix.
5. Using the directional gyro as a plotting board and its center as the station, place the farther fix on its radial at the edge of the card.
6. Determine what fraction the DME of the closer fix is of the farther fix. Place the closer fix on its radial on the directional gyro at a distance from the center of the card equal to that fraction.
7. Connect the two plotted fixes with an imaginary line or a straight edge. Move the line to the center of the directional gyro so that it remains parallel to the original line.
8. Read the no-wind heading where this line crosses the directional gyro.
9. Turn to this heading and apply an estimated wind correction.
10. Repeat the procedure periodically and update the heading as required.

**Amplification and Technique**

1. Steps 2 and 3 are to help the pilot make a timely turn in the general direction of the new fix. After this turn is made, steps 4-10 are used to refine the course to the new fix.
2. Just as your starting position over the ground is the origin of the point-to-point, so it is on the line plotted on the directional gyro. Always read in the direction from the aircraft position to the desired fix.
3. Recompute the point-to-point heading frequently to keep errors, and thus corrections required, very small.

4. As you approach the destination fix note the relationship between the rate of change in DME and radial. Adjust heading to have them change at a rate putting you right on the fix.
5. Use of the HSI/CDI, while not required for this maneuver, may assist in the intercept of the new radial.

### Common Errors and Safety Notes

Failure to adequately account for wind. A pilot can overcome the wind drift with frequent updates of the point-to-point, particularly as he approaches the destination fix.

## 409. HOLDING

### Maneuver Description and Application

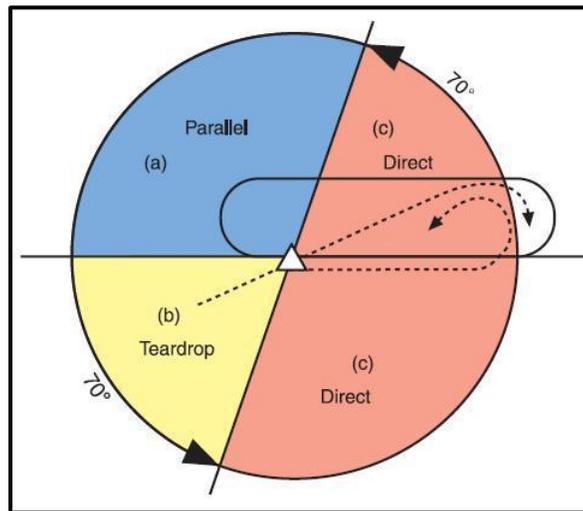
[(Reference: NIFM Paragraph 29.8 (Holding), AIM 5-3-8 (Holding), FAA-H-8083-15A, P. 10-9 (Holding Procedures).]

Holding is the airborne delay of an aircraft at some identifiable fix such as a station, waypoint, intersection, or in the case of TACAN/VORTAC holding, a radial/DME as specified by a controlling agency, enroute chart, or approach plate while awaiting further clearance. 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 having to rely on drawing out the pattern beforehand.

### Procedures

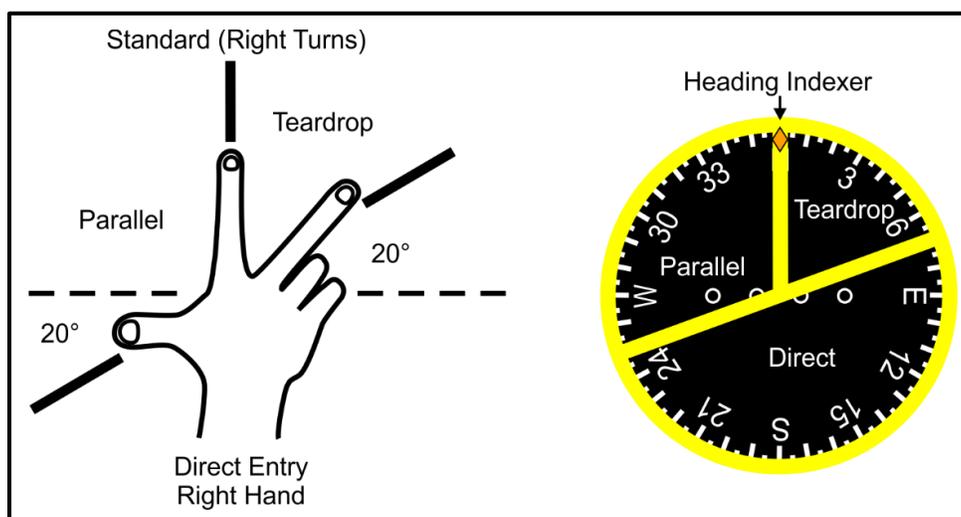
1. **Determine the outbound heading for the assigned holding pattern.** The outbound heading is either the same heading as the holding radial or the reciprocal of the holding radial. This is the heading while flying away from the holding fix. The easiest way to determine the outbound heading is to listen to the holding clearance and visualize the holding pattern on an approach plate, chart, or kneeboard. For example, if instructed to hold northeast 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).
2. **Determine the holding entry.** Approaching the holding fix (on the heading you will cross the fix), superimpose the appropriate holding entry pie diagram over the HSI (see figure 4-1). The region of the diagram where the outbound heading falls determines the entry orbit. If the outbound heading falls within 5° of two entry sectors, either entry may be used. It is preferable to choose a teardrop entry, if it is an option.  
There are three different entry orbits:
  - a. **Parallel Entry:** When approaching the holding fix from sector (a) on Figure 4-1, turn to parallel the holding course on the outbound heading on the non-holding side for one minute or holding DME for TCN or GPS entries.

- b. **Teardrop Entry:** When approaching the holding fix from sector (b) on Figure 4-1, turn outbound on the holding side, 30 degrees away from the holding radial. Time outbound for one minute or proceed outbound for the distance required if DME is being used.
- c. **Direct Entry:** When approaching the holding fix from sector (c) on Figure 4-2, turn to follow the holding pattern.

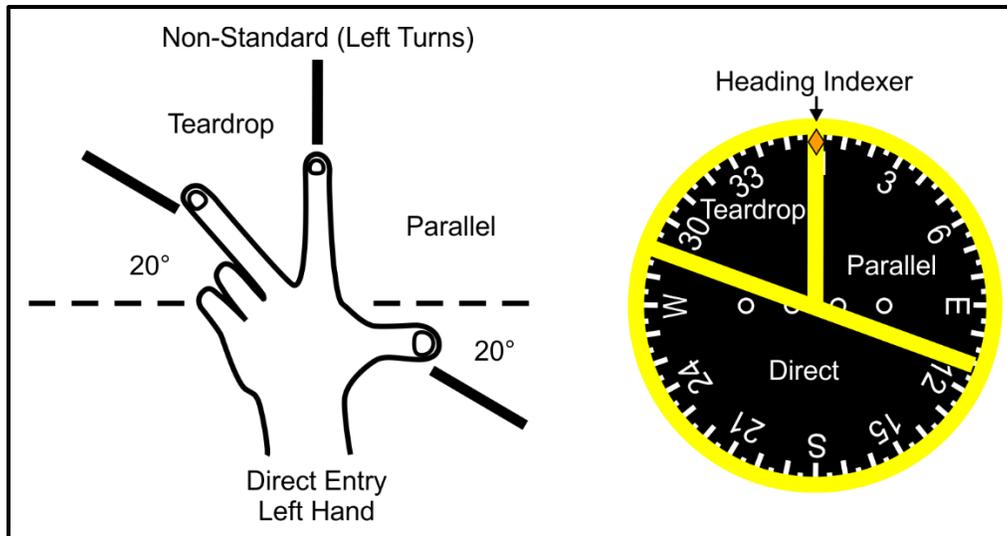


**Figure 4-2 Standard Holding Entry Sector Diagram**

A useful 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 Figures 4-3 and 4-4. Remember that you determine which quadrant the *outbound* heading falls.



**Figure 4-3 Standard Entry Diagram on HSI/CDI Display**



**Figure 4-4 Non-Standard Entry Diagram on HSI/CDI Display**

3. **Fly the holding pattern.** Upon crossing the holding fix, perform the 6 Ts.
  - a. **TIME.** Note time on initial arrival over holding fix (for PTA report).
  - b. **TURN.** Turn to the appropriate outbound heading.
  - c. **TIME (VOR/NDB).** 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.
  - d. **TRANSITION.** Slow to 80 KIAS for a holding delay or 90 knots for a holding pattern approach.
  - e. **TWIST.** Set inbound course in HSI/CDI (VOR, TACAN, LOC, or GPS).
  - f. **TALK.** Make voice report (PTA).

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

- a. **Entry orbit.** Fly the no wind outbound or teardrop heading. Reaching 1 minute or required DME outbound, turn toward and intercept the holding radial/bearing (remember tail-radial-turn and use intercept procedures from section 406). Track inbound to the fix.
- b. **No wind orbit.** The no-wind orbit is flown to determine wind direction and calculate the crab angle required to maintain the desired radial/bearing. Reaching the 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. Set up an intercept

for the holding radial and start timing, if required (VOR/NDB). 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 continue 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 (e.g., ATIS, ASOS, etc.). There are three possible outcomes:

- i. On course with no crosswind component,
  - ii. Undershoot with a crosswind from the non-holding side of the pattern, or
  - iii. 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.
- c. **Wind corrected orbit.** Reaching the fix, note the time needed to fly inbound (VOR/NDB). Use this information to adjust the outbound timing to ensure 1 minute timing inbound. 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

1. Unless otherwise instructed by ATC, pilots are expected to hold as depicted or in a standard pattern.
2. 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 aircraft approaches the fix. Maintain the last assigned altitude unless otherwise directed.
3. The following general information will be given in a holding clearance:
  - a. Direction of the holding pattern from the holding fix.
  - b. Name of the holding fix
  - c. Bearing/radial on which the aircraft is to hold.
  - d. Left turns if a non-standard pattern is to be used.
  - e. Expected further clearance time.

- f. Holding altitude. (Not required if remaining at present altitude).

For published holding patterns ATC may omit all holding instructions except holding direction and the statement “as published.”

4. The aircraft is abeam when it is positioned exactly 90° 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).

5. ***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. (It will be away from the deviation bar when using the CDI in the copilot seat.). If you are already on the radial at the end of the outbound leg, turn toward the protected, holding side of the pattern, e.g., standard pattern turn left).

6. Make all turns during entry and while holding at standard rate (3° per second).
7. Wind compensation will be made on inbound and outbound headings, not when turning.
8. Update expected further clearance (EFC) time at least 5 minutes prior to EFC.
9. Report leaving holding (PTA format not required).

### **Common Errors and Safety Notes**

1. Determine the impact of a delay on fuel state and current aircraft status prior to accepting a holding clearance.
2. Upon receipt of holding instructions, ensure the expected further clearance time has been received.
3. Failing to report entering and leaving holding.
4. Failure to keep airspeed and outbound/inbound headings constant. Failure to make all turns during entry and holding at standard rate (3° per second). Basic airwork is critical to effective wind corrections.
5. Failure to plan ahead for what follows holding such as follow-on navigation or an approach, as appropriate. If an approach is to be made, ensure all preparations have been made prior to commencing that approach (WRNTB, WAR, etc.). As soon as you are talking to the controlling agency that can provide WAR information, request it. Do not wait!

## 410. ARCING

### Maneuver Description and Application

[(Reference: NIFM Paragraph 22.2.3.4 (TACAN Arcs)).]

Arcing provides a means of maintaining a constant DME from a station and is an integral part of TACAN/VORTAC approaches and departures.

### Procedures

1. Proceed to the radial and DME at which the arc begins.
2. Turn in the proper direction perpendicular to the present radial.
3. Set the HSI/CDI to the course to be tracked on at the end of the arc.
4. Maintain the desired arc, correcting for wind as necessary until the CDI/HSI begins to center.
5. Turn inbound or outbound on the new radial.

### Amplification and Technique

1. Lead turns onto the arc as appropriate. If tracking in or out on a radial to intercept the arc lead the turn by approximately 0.5 DME (calculated using 100 knots ground speed) or by multiplying Ground Speed by .5%.

Example: 110 Knots Ground Speed \* .5% = .55 DME, lead the turn by .55 DME.

2. There are two techniques used for maintaining the arc:
  - a. Make frequent but small heading changes to maintain a constant DME. The head and tail of the needle should remain in a fairly constant position close to the 90/270 degree position on the RMI.
  - b. Maintain heading and allow the head of the needle to move 5° to 10° below the wingtip position. Then turn toward the station to place the TACAN/VOR needle 5° to 10° ahead of the wingtip and maintain this heading until the needle is again behind the wingtip.
3. Utilize the Lead Radial Procedures in Paragraph 405.
4. Push “RAD” button in to get LED readout on console for viewing.

**Common Errors and Safety Notes**

1. Failure to adequately account for wind on the arc.
2. Remember, the CDI/HSI is only a secondary reference. The TACAN/VOR needle is the primary course indicator. If any disparity exists between the CDI/HSI and TACAN/VOR needle, utilize the needle for navigation.

**411. INTERSECTIONS****Maneuver Description and Application**

[(Reference: NIFM Chapter 21 (VOR)).]

Intersections are geographic points defined by any combination of radials, or bearings from two or more navigational aids.

**Procedures**

1. Maintain aircraft on radial until approximately 3 miles prior to the intersection.
2. Tune and identify the new station. Maintain heading/course.
3. Set the new radial or course in the CDI/HSI.
4. As the deviation bar approaches center, begin a turn early to arrive on course when the deviation bar arrives at the center, then track on the new radial.

**Amplification and Technique**

These procedures are intended for operation when only one navigational aid and needle is available for navigation and identification of the intersection. In most cases in the TH-57C, intersections will be identified utilizing two NAVAIDs and needles. In this case the flying pilot will be tracking on one needle with the other needle tuned to the intersection-identifying NAVAID. The non-flying pilot will set the flying pilot's CDI/HSI to the radial of this identifying NAVAID. As the deviation bar approaches center, turn to intercept and track on the new radial. Retune the other NAVAID once established.

**Common Errors and Safety Notes**

Remember, the CDI/HSI is only a secondary reference. The TACAN/VOR needle is the primary course indicator. If any disparity exists between the CDI/HSI and the TACAN/VOR needle, utilize the needle for navigation.

## 412. VISUAL DESCENT POINTS

The Visual Descent Point (VDP), identified by the symbol (V), (See Figure 4-2) is a defined point on the final approach course of a nonprecision straight-in approach procedure from which a stabilized visual descent from the MDA to the runway touchdown point may be commenced. The pilot should not descend below the MDA prior to reaching the VDP. The VDP will be identified by DME or RNAV along-track distance to the MAP. The VDP distance is based on the lowest MDA published on the IAP and harmonized with the angle of the visual glide slope indicator (VGSI) (if installed) or the procedure Vertical Descent Angle (VDA), if no VGSI is installed. A VDP may not be published under certain circumstances which may result in a destabilized descent between the MDA and the runway touchdown point. Such circumstances include an obstacle penetrating the visual surface between the MDA and runway threshold, lack of distance measuring capability, or the procedure design prevents a VDP to be identified.

- VGSI systems may be used as a visual aid to the pilot to determine if the aircraft is in a position to make a stabilized descent from the MDA. When the visibility is close to minimums, the VGSI may not be visible at the VDP due to its location beyond the MAP.
- Pilots not equipped to receive the VDP should fly the approach procedure as though no VDP had been provided.
- On a straight-in nonprecision IAP, descent below the MDA between the VDP and the MAP may be inadvisable or impossible. Aircraft speed, height above the runway, descent rate, amount of turn, and runway length are some of the factors which must be considered by the pilot to determine if a safe descent and landing can be accomplished.

A visual segment obstruction evaluation is accomplished during procedure design on all IAPs. Obstacles (both lighted and unlighted) are allowed to penetrate the visual segment obstacle identification surfaces. Identified obstacle penetrations may cause restrictions to instrument approach operations which may include an increased approach visibility requirement, not publishing a VDP, and/or prohibiting night instrument operations to the runway. There is no implicit obstacle protection from the MDA/DH to the touchdown point. Accordingly, it is the responsibility of the pilot to visually acquire and avoid obstacles below the MDA/DH during transition to landing.

- Unlighted obstacle penetrations may result in prohibiting night instrument operations to the runway. A chart note will be published in the pilot briefing strip “Procedure NA at Night.”
- Use of a VGSI may be approved in lieu of obstruction lighting to restore night instrument operations to the runway. A chart note will be published in the pilot briefing strip “Straight-in Rwy XX at Night, operational VGSI required, remain on or above VGSI glidepath until threshold.”

The highest obstacle (man-made, terrain, or vegetation) will be charted on the planview of an IAP. Other obstacles may be charted in either the planview or the airport sketch based on distance from the runway and available chart space. The elevation of the charted obstacle will be shown to the nearest foot above mean sea level. Obstacles without a verified accuracy are indicated by a ± symbol following the elevation value.

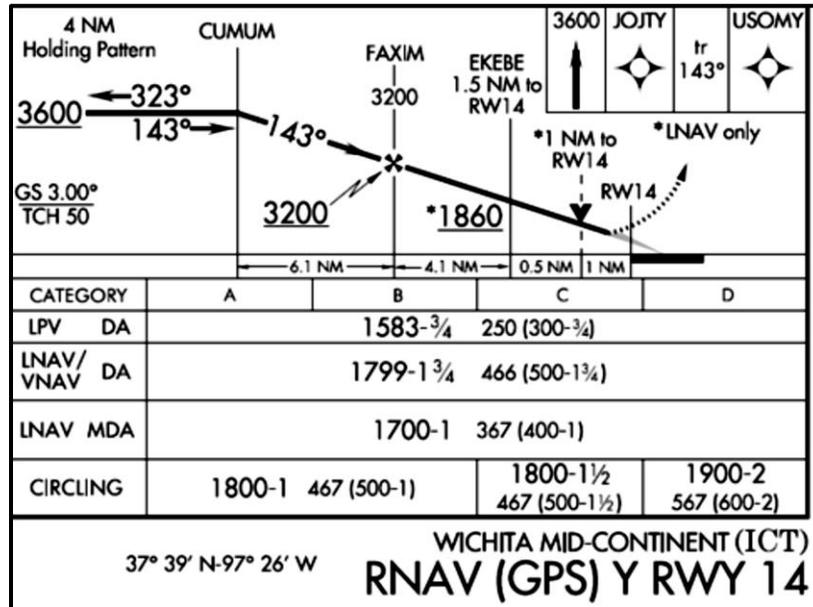


Figure 4-5 Visual Descent Point

Calculating a VDP

WARNING

While the FAA is attempting to place more VDPs on approaches, it should be noted that if there is a penetration of the obstruction clearance surface on final, they will not publish a VDP. If there is no VDP published, it may be for a reason. If choosing to calculate a VDP, it may be used, but be vigilant looking for obstacles from the VDP to landing.

The first step to computing a VDP is to divide the HAT by your desired descent gradient. Most pilots desire approximately a 3° (300 ft/NM) glidepath for landing utilizing the following formula:

$$\text{HAT/Gradient (normally 300)} = \text{VDP in NM from end of runway}$$

This distance can then be added/subtracted to/from the DME at the end of the runway to get a DME for your VDP.

**Example:** HAT = 665 FT, MDA = 700 FT MSL, DME at the end of the runway = 7.4 DME

VDP = HAT/Gradient = 665/300 = 2.2 NM from end of runway

VDP DME = DME at end of runway - VDP distance = 7.4 DME - 2.2 DME = 5.2 DME

### 413. NON-PRECISION APPROACH

#### Maneuver Description and Application

[(NIFM Paragraph 21.3.12.2 (Approaches), Paragraph 22.2.4 (TACAN Approach Procedures), Paragraph 23.1.2.3 (Approach Procedures), AIM Chapter 5 Section (Arrival Procedures), AIM Chapter 5 Section 5 (Pilot/Controller Roles and Responsibilities)).]

An instrument approach is a navigation procedure used to make effect a safe letdown to an airport while in IMC.

#### Procedures

1. **Before** reaching the IAF: (*We Really Need To Brief*)
  - a. Obtain **Weather**, **Altimeter**, and duty **Runway (WAR)** if ATIS is not available.
  - b. **Request** approach from ATC.
  - c. Tune and identify **NAVAIDs** using **TINTS** (See Paragraph 209)
  - d. Compute **timing**, as required.
  - e. **Brief** the approach and copilot duties.
2. **At** the IAF: (6 Ts)
  - a. **TIME**. Note the time at IAF for use in fuel tracking/calculations after the approach.
  - b. **TURN**. Turn to intercept approach course.
  - c. **TIME**. Begin timing outbound when wings level or abeam (VOR/ADF) in accordance with the approach procedure being flown.
  - d. **TRANSITION**. Decelerate to final approach speed of 90 KIAS; descend as required, complete landing checklist.
  - e. **TWIST**. Set desired course in CDI/HSI (VOR/TACAN).
  - f. **TALK**. Make voice report, as required.

Execute approach procedure as depicted on the approach plate, make voice reports as directed, and proceed to FAF.

3. *At* the FAF: (6 Ts again!)
  - a. **TIME.** N/A.
  - b. **TURN.** Turn as required, to intercept the final approach course.
  - c. **TIME.** Begin timing, as required (VOR/ADF). As required (VOR/ADF).
  - d. **TRANSITION.** Descend to MDA (allowing for intermediate restrictions), review landing checklist complete.
  - e. **TWIST.** Set inbound course in CDI/HSI (VOR/TACAN).
  - f. **TALK.** Make voice report, as required.

### Crew Resource Management

1. PNAC reviews and sets up NAVAIDs for IAP. (Situational Awareness)
2. PNAC gives Approach Brief. (Communication)
3. PAC/PNAC asks controller for clarification of instructions (as needed). (Assertiveness)
4. PNAC ensures lookout doctrine is maintained and reports “airport in sight.” (Situational Awareness)
5. PAC ensures landing checklist complete. (Situational Awareness)
6. PAC confirms landing clearance. (Communication)

### Amplification and Technique

1. When the instructor tells you to prepare for your next approach or as you approach the airport at which you intend to execute an approach follow the **WRNTB** (**We Really Need To Brief**) format as delineated in the procedures above.
2. Transitions from the enroute structure to the initial approach fix (IAF) may occur in the following ways:
  - a. Radar vectors to the final approach course. In this case, the pilot is vectored to intercept the final approach course. This saves time and space and eliminates the need for a procedure turn. When being radar vectored to the final approach course

- maintain 100 KIAS until given the instructions, “cleared for the approach,” then transition and complete the landing checks.
- b. Clearance direct to the IAF. When receiving a clearance to the IAF, the pilot should expect to execute the published approach including the procedure turn unless instructed otherwise. The type, degree, and point of turn are at the discretion of the pilot when a barbed type pattern is depicted as long as the turn is executed on the proper side of the outbound course and the “Remain Within” distance is not exceeded. Students should plan to use the headings provided on the plate and time for 2 minutes outbound before turning. After the turn is complete time for another minute and then begin the inbound turn.
  - c. Departing the enroute structure from a “No Pt” fix. In this situation, a pilot should proceed direct to the final approach fix (FAF).
3. Remember, since there is no DME associated with VOR and NDB approaches, the pilot has no idea how close or far from the station the aircraft is located. Therefore, when inbound on an approach, plan a comfortable rate of descent enabling you to reach the MDA before the MAP. The intent is to have sufficient time to acquire the runway environment. Do not descend below the MDA!
4. It is permissible to listen to one turn of ATIS prior to contacting the terminal area controller when the ATIS frequency is located on the same radio you intend to use for primary communications.

### **Common Errors and Safety Notes**

1. Cockpit organization is imperative in completing a successful approach. Utilize backup NAVAIDs to the maximum extent possible. Take best advantage of the acronyms described above to help organize your thoughts and actions.
2. A missed approach shall be executed when runway environment is not in sight at the MAP, when directed by the controlling agency, or when the pilot determines he is unable to continue to a safe landing.
3. In the event of a missed approach (see para 416), it is imperative that a positive rate of climb be established prior to turning, talking, or twisting. Make the appropriate voice report as soon as practicable once established.
4. If an early missed approach is executed, the pilot shall fly the published approach as specified to the MAP at or above the MDA before executing a turn.
5. Remember, the CDI/HSI is only a secondary reference. The TACAN/VOR needle is the primary course indicator. If any disparity exists between the CDI/HSI and the TACAN/VOR needle, utilize the needle for navigation.

6. If a VDP is depicted on the IAP, do not descend below MDA until at the VDP or past it. (See Paragraph 412 for VDP Discussion)

#### **414. TACAN/VOR DIRECTIONAL GYRO FAILURE**

##### **Maneuver Description and Application**

[(Reference: NIFM Paragraph 18.6.1 (Heading Indicator Failure), Directional Gyro Failure Flight Techniques and Procedures (NATC Booklet)).]

Directional gyro failure procedures are practiced in order to enable the pilot to execute a TACAN/VOR approach with a failed directional gyro.

##### **Procedures**

1. The instructor will initiate the maneuver by pulling the HSI circuit breaker. This will secure power to the HSI and the RMI card.
2. Stabilize the aircraft straight and level in balanced flight. Execute NATOPS emergency procedures.
3. Troubleshoot. Secure searchlight, landing light, ECS, defog blower, and pitot heat. Report problem and request radar service.
4. Level the wings and look at the tail of the needle to determine the radial on which the aircraft is located.
5. Check the wet compass for magnetic heading.
6. Set the appropriate course in the CDI/HSI.
7. Utilizing radial intercept techniques, select an intercept heading then make a standard rate turn to that heading using the wet compass.
8. Upon intercepting the bearing, apply tracking procedures.
9. Utilize full panel procedures for other maneuvers.

##### **Crew Resource Management**

1. PNAC reviews and sets up NAVAIDs for IAP. (Situational Awareness)
2. PNAC gives Approach Brief. (Communication)
3. PAC/PNAC asks controller for clarification of instructions (as needed). (Assertiveness)

4. PNAC ensures lookout doctrine is maintained and reports “airport in sight.” (Situational Awareness)
5. PAC ensures Landing Checklist complete. (Situational Awareness)
6. PAC confirms landing clearance. (Communication)

### **Amplification and Technique**

1. With a failed directional gyro, the TACAN/VOR needle tail will be on the correct radial.
2. To avoid confusion and orientation problems, always look at the RMI and NAVAID needles to select an intercept heading. Then, make the turn to that heading utilizing magnetic compass techniques.
3. Depending on the position of the failed directional gyro, you might see the tail of the needle fall and the head rise, contrary to what you are accustomed to seeing.
4. Remember, your heading is on an arc roughly 80° to 100° from the radial you are on at a given time.

### **Common Errors and Safety Notes**

1. Failure to remain oriented, often because the position the directional gyro gives turns the pilot around.
2. Failure to stabilize and maintain level, balanced flight when interpreting magnetic compass heading information.
3. Failure to maintain a solid instrument scan due to fixation, resulting in a breakdown of Basic Airwork (BAW).
4. Failure to utilize magnetic compass turn skills learned in the BI stage.
5. Remember, the CDI/HSI is only a secondary reference. The TACAN/VOR needle is the primary course indicator. If any disparity exists between the CDI/HSI and the TACAN/VOR needle, utilize the needle for navigation.

## **415. ADF DIRECTIONAL GYRO FAILURE**

### **Maneuver Description and Application**

[(Reference: NIFM Paragraph 18.6.1 (Heading Indicator Failure), Directional Gyro Failure Flight Techniques and Procedures (NATC Booklet)).]

Directional gyro failure procedures are practiced in order to enable the pilot to execute an ADF approach with a failed directional gyro.

### Procedures

1. The instructor will initiate the maneuver by pulling the HSI circuit breaker. This will secure power to the HSI and the RMI card.
2. Stabilize the aircraft in straight and level balanced flight. Execute NATOPS emergency procedures.
3. Troubleshoot. Secure searchlight, landing light, ECS, defog blower, and pitot heat. Report problem and request radar service.
4. Turn *directly* inbound or outbound.
5. Level the wings and use the wet compass to determine the bearing on which the aircraft is located.
6. Utilizing bearing/radial intercept techniques, select an intercept reading then make a standard rate wet compass turn to that heading.
7. Upon intercepting the bearing, apply tracking procedures.
8. Utilize full panel procedures for other maneuvers.

### Crew Resource Management

1. PNAC reviews and sets up NAVAIDs for IAP. (Situational Awareness)
2. PNAC gives Approach Brief. (Communication)
3. PAC/PNAC asks controller for clarification of instructions (as needed). (Assertiveness)
4. PNAC ensures lookout doctrine is maintained and reports “airport in sight.” (Situational Awareness)
5. PAC ensures Landing Checklist complete. (Situational Awareness)
6. PAC confirms landing clearance. (Communication)

### Amplification and Technique

1. With a malfunctioning directional gyro, the Automatic Direction Finder (ADF) needle will display relative bearing.
2. Some pilots utilize a technique where they mentally superimpose the heading from the magnetic compass onto the failed directional gyro when determining intercept headings. This visualization prevents turns in the wrong direction and expedites intercepts.

3. Most Non-Directional Radio Beacon (NDB) approaches depict the 45°/180° procedure turn. Keep in mind the inbound half of the turn is intended to give you a 45° intercept with the FAC. When you roll out on that heading, ensure it is the published 45° heading and wait for the needle to fall to the 45° benchmark. If the intercept heading is wrong, you might find yourself on a shallow intercept with no hope of reaching the FAC prior to the airport.

### **Common Errors and Safety Notes**

1. Failure to remain oriented, often because the position the directional gyro gives turns the pilot around.
2. Failure to stabilize and maintain level, balanced flight when interpreting magnetic compass heading information.
3. Failure to maintain a solid instrument scan due to fixation, resulting in a breakdown of BAW.
4. Failure to utilize magnetic compass turn skills learned in the BI stage.

### **416. GROUND CONTROLLED APPROACH (GCA): PRECISION APPROACH (PAR) AND SURVEILLANCE APPROACH (ASR)**

#### **Maneuver Description and Application**

[(Reference: NIFM Chapter 25 (RADAR APPROACHES), AIM Chapter 5 Section 4 (Arrival Procedures) Chapter 5 Section 5 (Pilot/Controller Roles and Responsibilities)).]

Radar control is one of the most precise methods used for accomplishing an instrument approach. A radar-controlled approach provides positive separation, sequencing for landing, and assistance in navigation for the pilot during the approach.

A radar approach is accomplished by a controller providing course, glideslope, and range information. The two types of radar approaches are the PAR (Precision) and the ASR (Non-Precision).

Both the PAR and ASR begin with radar positioning or vectors to the final approach course utilizing surveillance radar. During this “transition to final” segment, the controller directs heading and altitude changes as required to position the aircraft on final approach.

Both types of GCA are ground controlled radar approaches, but the PAR is a precision approach and the ASR is not. The primary difference between the two is that glideslope information is provided to the pilot during a PAR but not during an ASR. Consequently, landing weather minima are higher for an ASR than a PAR. Although no glideslope information is available during an ASR approach, the pilot may request the controller to provide recommended altitudes on final.

### Procedures

1. Obtain **Weather**, **Altimeter**, and duty **Runway (WAR)** if ATIS is not available. (**We Really Need To Brief**)
2. **Request** approach from ATC.
3. Tune and identify **NAVAIDs** using **TINTS** acronym.
4. **Timing** is not required.
5. **Brief** the approach and copilot duties.
6. Maintain 100 KIAS until given the instructions, “contact final controller.” At that time transition to 90 KIAS and complete the landing checklist.
7. When directed to turn or descend by the controller, execute as soon as the instructions are received.
  - a. **PAR:** The PAR starts when the final controller informs the pilot he is on final. When the controller advises the aircraft is “on glideslope,” adjust power to establish the predetermined approximate rate of descent while maintaining both 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 missed approach point (map), which is usually located one mile from the landing threshold.
8. Expect landing clearance to be relayed through GCA controller at 3 NM.

### Crew Resource Management

1. PNAC reviews and sets up **NAVAIDs** for IAP. (Situational Awareness)
2. PNAC gives Approach Brief. (Communication)
3. PAC/PNAC asks controller for clarification of instructions (as needed). (Assertiveness)
4. PNAC ensures lookout doctrine is maintained and reports “airport in sight.” (Situational Awareness)
5. PAC ensures Landing Checklist complete. (Situational Awareness)
6. PAC confirms landing clearance. (Communication)

**Amplification and Technique**

1. Make standard rate turns in the pattern and 1/2 standard rate turns on final.
2. Using information found in the terminal approach charts, determine approximate initial rate of descent and decision height or MDA. Brief this during the approach brief.
3. After a new heading is assigned, the controller assumes it is being maintained and additional heading corrections will be based on the last assigned heading. Fly *the assigned heading*.
4. In order to facilitate small, smooth, expeditious control corrections and have them result in the desired effect on the aircraft, balanced flight is essential.
5. Read back to the controller all headings, altitudes, altimeter settings, start/stop turn indications, landing clearances, and traffic until told, "Do not acknowledge further transmissions." If understood, lost communications, and missed approach may be "rogered." However, if any doubt exists, read the instructions back or ask for clarification.
6. Should the directional gyro fail during flight, comply with the emergency procedures described in the magnetic compass turns paragraphs earlier in this FTI. Remember to advise the controller and request a "no gyro PAR or ASR approach." For training purposes, an attitude gyro failure may also be simulated. In this situation, the pilot will be flying partial panel. The controller will be providing turns to the appropriate directions ("turn left"). He will be advised to make standard rate turns in the pattern and 1/2 standard rate turns on final. Start and stop all turns immediately upon receipt of instructions from the controller.
7. It is permissible to listen to one turn of ATIS prior to contacting the terminal area controller when the ATIS frequency is located on the same radio you intend to use for primary communications.

**Common Errors and Safety Notes**

1. Failure to maintain appropriate rate of turn.
2. Failure to maintain assigned heading.
3. Failure to make appropriate glideslope adjustments.
4. Ensure lost communication and missed approach instructions are obtained from the controller.
5. Avoid excessive power corrections.
6. Never use AOB greater than the number of degrees to be corrected.

7. Resist the temptation to shallow the descent at the end of the approach before continuing visually.
8. If you are unable to comply with instructions alert the controller.

#### 417. VOR/ILS/LOC APPROACH

##### Maneuver Description and Application

[Reference: NIFM Chapter 24 (Instrument Landing System) AIM Chapter 5 Section 4 (Arrival Procedures) Chapter 5 Section 5 (Pilot/Controller Roles and Responsibilities)]

The Instrument Landing System (ILS) is a precision approach system, allowing the pilot to precisely maintain proper glideslope and course, utilizing cockpit instruments, without the need for radar or ground control.

The localizer or back course approach is a non-precision approach that utilizes ILS CDI/HSI information with no glideslope information.

##### Procedures

1. **Before** reaching the IAF: (*We Really Need To Brief*) - usually within 18 NM of the station.
  - a. Obtain *Weather*, *Altimeter*, and duty *Runway (WAR)* if ATIS is not available. (*We Really Need To Brief*)
  - b. *Request* approach from ATC.
  - c. Tune and identify *NAVAIDs* using *TINTS* acronym.
  - d. Compute *timing*, as required.
  - e. *Brief* the approach and copilot duties.
  - f. Intercept the final approach course as the course deviation bar begins to center.
  - g. Intercept the glideslope as the glideslope indicator begins to center (ILS approach). Maintain 90 KIAS.
2. **At** the IAF: (6 Ts)
  - a. *TIME*. Note time, if applicable.
  - b. *TURN*. Turn as required, to intercept approach course.
  - c. *TIME*. Start timing.

- d. **TRANSITION.** Decelerate to final approach speed of 90 KIAS, descend as required, complete landing checklist.
- e. **TWIST.** Set desired course in CDI/HSI (back course approaches, set the front course in the HSI).
- f. **TALK.** Make voice report, as required.

Execute approach procedure as depicted on the approach plate, make voice reports as directed, proceed TO FAF.

- 3. **At** the FAF: (6 Ts again!)
  - a. **TIME.** N/A
  - b. **TURN.** Turn as required, to intercept the final approach course.
  - c. **TIME.** Begin timing inbound (localizer/back course).
  - d. **TRANSITION.** Descend to DH/MDA, review that landing checklist is complete.
  - e. **TWIST.** Set inbound course in CDI/HSI (back course approaches, set the front course in the HSI).
  - f. **TALK.** Make voice report, as required.
  - g. Continue as cleared.

### **Crew Resource Management**

- 1. PNAC reviews and sets up NAVAIDs for IAP. (Situational Awareness)
- 2. PNAC gives Approach Brief. (Communication)
- 3. PAC/PNAC asks controller for clarification of instructions (as needed). (Assertiveness)
- 4. PNAC ensures lookout doctrine is maintained and reports “airport in sight.” (Situational Awareness)
- 5. PAC ensures Landing Checklist complete. (Situational Awareness)
- 6. PAC confirms landing clearance. (Communication)

### **Amplification and Technique**

1. The CDI gives proper sensing on front course localizer/ILS approaches regardless of course set with the course select knob when inbound on front course. FAC should still be set to avoid habit pattern disruption; however, on back course localizer approaches, the CDI will show reverse sensing regardless of the course selected by the course select knob when inbound on back course. On back course localizer approaches, the HSI will show reverse sensing unless the front course FAC is selected by the course select knob.
2. During ILS approaches, intercept the glideslope by reducing power as the glideslope indicators (GSI) begin to center from the top of the CDI/HSI. Maintain 90 KIAS. Once the GSI centers, adjust power to establish the predetermined approximate rate of descent while maintaining both airspeed and heading. Due to the extreme sensitivity of the GSI and CDI/HSI ensure you utilize small, smooth changes in pitch attitude and power setting to remain on glideslope and airspeed.
3. During localizer/backcourse approaches, required altitudes are defined on the approach plate as in any non-precision approach. The approach is non-precision, so apply non-precision procedures.
4. As you approach the airport, the glideslope and glidepath become extremely narrow and, therefore, sensitive.
5. It is permissible to listen to one turn of ATIS prior to contacting the terminal area controller when the ATIS frequency is located on the same radio you intend to use for primary communications.
6. Transitions from the enroute structure to the IAF may occur in the following ways:
  - a. Radar vectors to the final approach course. In this case, the pilot is vectored to intercept the final approach course. This saves time and space and eliminates the need for a procedure turn. When being radar vectored to the final approach course maintain 100 KIAS until given the instructions, "cleared for the approach," then transition and complete the landing checks.
  - b. Clearance direct to the IAF. When receiving a clearance to the IAF, the pilot should expect to execute the published approach including the procedure turn unless instructed otherwise.

### **Common Errors and Safety Notes**

1. Failure to make corrections in the proper direction.
2. Normally a course interception angle of 30° to 45° is sufficient, as CDI/HSI sensitivity in ILS mode is extremely high. Avoid interceptions of greater than 80°.

3. The ILS glideslope facility provides a path, which flares 18 to 27 feet above the runway; therefore, the glide path should not be expected to provide guidance to touchdown.
4. Do not “fly” the GSI and CDI/HSI; utilize a basic instrument scan to effect immediate, smooth corrections.
5. If a glideslope indicator disappears on the CDI/HSI during the approach, descend no lower than published localizer minima, or if not published, no lower than circling minima for your category aircraft. If course deviation bar is fully deflected when inside of FAF and runway is not in sight, execute missed approach.
6. Do not forget reverse sensing techniques.

#### **418. MISSED APPROACH**

##### **Maneuver Description and Application**

[(Reference: NIFM Paragraph 30.18 (Missed Approach) AIM Paragraph 5-4-21).]

A missed approach shall be executed when one of the following conditions exist:

- Arrival at the MAP or the DH and visual reference to the runway environment is insufficient to complete the landing.
- A safe approach is not possible.
- Instructed to execute a Missed Approach by ATC.

During training you will normally be given climb out instructions that will be different than the published missed approach instructions. When under positive control, ATC can also give alternate MAP instructions to follow. ATC issues climb out instructions to facilitate smoother traffic flow when conducting practice approaches. Terminology matters, so it is important to use the phrase “executing climb out” when appropriate. When “missed approach” is stated, it implies one of the above conditions was encountered which may cause unnecessary concern for other pilots flying in the local area. If you are actually executing a “missed approach” for any reason, it is appropriate to state “executing missed approach” and provide the reason for the missed approach. Use the below procedures for a missed approach or to execute climb out instructions.

##### **Procedures**

1. Set required 70 KIAS climb/100 KIAS cruise **POWER**.
2. Set required 70 KIAS climb/100 KIAS cruise **ATTITUDE**. (Check IVSI/altimeter for positive climb indications.)

3. **SEARCHLIGHT** off.
4. **TURN.** Turn to comply with missed approach or climb out instructions and direct copilot to tune navigation aids/GPS as appropriate.
5. **TALK.** Report executing climb out instructions or missed approach, reason for missed approach, and intentions as soon as practicable.
6. **GAS.** Note quantity.
7. **GAUGES.** Check engine and flight instruments.

### **Crew Resource Management**

1. PAC properly performs missed approach when runway environment is not in sight at minimums, unable to make a safe landing, or directed by controlling agency. (Decision Making)
2. PNAC verbally states missed approach instructions to PAC. (Communication)

### **Amplification and Technique**

1. It is imperative a positive rate of climb be established prior to turning, talking, or twisting. Aviate, navigate, and then communicate. Nonetheless, be as prompt as possible in reporting the missed approach to tower.
2. If a missed approach must be executed inside the FAF but prior to the MAP (for loss of GPS integrity, full scale deflection of CDI and unable to correct course, directed by ATC, etc.), do not continue descent down to MDA/DH. Begin an immediate climb to the depicted or assigned missed approach altitude, fly to the MAP and then execute missed approach procedures as required. This is important because obstacle clearance is not guaranteed when off published portions of the approach. Turns in the missed approach are predicated on being executed at the MAP. If full scale deflection of the CDI occurs prior to the MAP in areas of high terrain or obstacles, and the pilot is unable to immediately reestablish the aircraft on course, a climb to Minimum Safe Altitude (MSA) may be required.

### **Common Errors and Safety Notes**

1. Failure to assume a positive rate of climb before doing anything else.
2. Failure to make a complete, timely missed approach call.
3. Failure to make note of the fuel state and plan for further contingencies.

#### 419. KLN 900 GPS APPROACH

##### Maneuver Description and Application

[(Reference: AIM Chapter One, Instrument Navigation Workbook).] A Global Positioning System (GPS) approach via the KLN 900 is a non-precision instrument approach via lateral navigation (LNAV) based on satellite transmitted positioning information received by on-board equipment and not dependent on ground-based navigation aids.

#### 420. GTN-650 GPS APPROACH

##### Maneuver Description and Application

[(Reference: AIM Chapter One, Instrument Navigation Workbook, Garmin GTN-650 Pilot's Guide).] A GPS approach via the Garmin GTN-650 is a non-precision approach that can be flown as an Approach with Vertical Guidance (APV) flown to a Decision Altitude (Localizer Performance with Vertical Guidance [LPV] or Lateral Navigation and Vertical Navigation [LNAV/VNAV]), or without approved vertical guidance (Local Performance [LP] or Lateral Navigation [LNAV]) flown to a Minimum Descent Altitude. An LPV approach uses the Wide Area Augmentation System (WAAS) ground stations in conjunction with GPS satellites to provide improved position accuracy and Decision Altitudes down to a minimum of 200 feet above touchdown. An LNAV/VNAV approach also incorporates approved vertical guidance but at a less accurate sensitivity than LPV. LP approaches take advantage of the improved accuracy of WAAS, but the vertical guidance is advisory only. LNAV approaches are based on satellite position information and are not dependent on ground-based navigation aids and the vertical guidance is advisory only.

##### Procedures (Full Approach)

1. **Before** reaching the IAF: (*We Really Need To Brief*).
  - a. Obtain **Weather**, **Altimeter**, duty **Runway** and winds (**WAR**) or ATIS/ASOS/AWOS.
  - b. **Request** approach from ATC.
  - c. **NAVAIDs**: Load approach into active flight plan.
    - i. Select airport ICAO via the active flight plan or 'PROC' key on the Home page.
    - ii. Select Approach key.
    - iii. On 'PROC-Approach' page, select desired approach.
    - iv. Select transition.
      - (a). Select IAF based on the direction of the Terminal Arrival Area intercept.
      - (b). Select 'Vectors' if Radar Vectors to Final are being utilized.

**NOTE**

When selecting Radar Vectors to Final via the GTN-650, it will extend the final approach course indefinitely to accommodate ATC's vectors. Pilot must ensure the final approach course does not enter prohibited or restricted airspace.

**NOTE**

It is recommended to preview the approach before loading it into the active flight plan to verify that the desired transition is selected. Select 'Preview' prior to loading the approach.

**NOTE**

If Vectors-to-Final is activated while on the "FROM" side of the FAF, automatic waypoint sequencing is suspended and the 'SUSP' annunciation will appear. Automatic waypoint sequencing will resume once the aircraft is on the "TO" side of the FAF and within full-scale deflection.

- v. Select one of the following:
  - (a). "Load Approach" - This will result in the approach loading at the end of the flight plan. The GTN-650 will automatically sequence to the approach waypoints after the enroute waypoints.
  - (b). Load Approach and Activate" - This will result in Direct-to the selected transition waypoint (IAF). If Radar Vectors to Final are selected, it will activate an extended leg to the FAF along the final approach course.
- vi. Ensure NAV 1 is selected and GPS appears on the GTN annunciator panel.
- d. Timing does not apply.
- e. **Brief** approach and copilot duties.

**WARNING**

GTN-650 will default to an LPV approach when a GPS approach is loaded. If the GTN-650 loses precision accuracy, the message key will flash on the screen. Message will say "APPROACH DOWNGRADE" and crew should revert to LNAV approach minima. Vertical guidance will be removed from the HSI/CDI display.

**WARNING**

If the GTN-650 can no longer provide approach level of service, the message key will flash on the screen and on the GPS annunciator panel. Message will say “ABORT APPROACH” and crew shall abort the approach. Subsequent approaches with the message remaining should be a non-GPS based approach.

**WARNING**

If the GTN-650 cannot transition the approach to active mode, the message key will flash on the screen. Message will say “APPROACH NOT ACTIVE” and crew shall abort the approach. Subsequent approaches with the message remaining should be a non-GPS based approach.

2. *At the IAF:* (6 Ts)
  - a. **TIME.** Note time at IAF.
  - b. **TURN.** Turn outbound on procedure turn or towards next waypoint of the approach as appropriate.
  - c. **TIME.** N/R
  - d. **TRANSITION.** Decelerate to final approach speed of 90 KIAS. Descend as required, complete Landing Checklist.
  - e. **TWIST.** Set desired course in HSI/CDI and ensure “GPS” indicated on the GTN-650 annunciator panel. Check that GPS has sequenced to next WPT via the Default NAV page.
  - f. **TALK.** Make voice report as required.
  - g. Execute approach as depicted on the approach plate, make voice reports as directed, and proceed to MAP.
3. *At the FAF:* (6 Ts again!)
  - a. **TIME.** N/A
  - b. **TURN.** Turn as required, to intercept the final approach course.
  - c. **TIME.** N/A
  - d. **TRANSITION.** Descend to next intermediate altitude, decision altitude (DA), or MDA as applicable.

- e. Review landing checklist complete (give consideration to lighting configuration inside FAF).
- f. **TWIST.** Set inbound course in CDI/HSI.
- g. **TALK.** Make voice report as required/directed.

#### NOTE

If approach cannot sequence to active within 2 NM of FAF, Message Key will flash on the screen and GPS Annunciator Panel. Message will say "APPROACH NOT ACTIVE" and crew shall discontinue the approach.

#### NOTE

Distance to next waypoint will always count down to the active waypoint when inbound on approach.

#### Crew Resource Management

1. PNAC reviews and sets up NAVAIDs for IAP. (Situational Awareness)
2. PNAC gives Approach Brief. (Communication)
3. PAC/PNAC asks controller for clarification of instructions (as needed). (Assertiveness)
4. PNAC ensures lookout doctrine is maintained and reports "airport in sight." (Situational Awareness)
5. PAC ensures Landing Checklist complete. (Situational Awareness)
6. PAC confirms landing clearance. (Communication)

#### Amplification and Technique

1. There are multiple ways to load an approach with the GTN-650. Practice loading approaches using the computer-based trainer with the Garmin Pilot's Guide until comfortable manipulating flight plans and loading approaches.
2. At the bottom of the GTN-650 screen, with an approach loaded it should transition from 'ENR' to 'TERM' within 31 NM of the airfield. Within 2 NM of the FAF, it will switch from 'TERM' to 'LPV', or whichever approach is selected.
3. During vectors to final it is imperative the pilot verifies the approach is loaded correctly within their flight plan and stays oriented so the next WPT on the approach is the active WPT after intercepting final.

**NOTE**

If executing a procedure turn, the GTN-650 should sequence it like any other leg. Crew can manually select “Suspend” mode via the OBS/SUSP pushbutton on the GPS annunciator panel, if desired. If a holding pattern is depicted on an approach, the GTN-650 will automatically SUSPEND the approach and the pilot will have to select “Unsuspend” via the GPS annunciator panel or the “Unsusp” button that appears on the lower right corner of the GTN screen.

4. When disabling Suspend mode to enable automatic waypoint sequencing (and vice versa), ensure you are inbound to the desired waypoint.
5. Prior to 2 NM from FAF, check that no messages have appeared on the GTN-650 annunciator panel. Some messages may downgrade the approach or require crew to discontinue approach.
6. Only one approach can be loaded at a time in a flight plan.

**Common Errors and Safety Notes**

1. Receiver Autonomous Integrity Monitoring (RAIM) must be available to commence a GPS approach. A flashing Message indicator may be an indication of RAIM non-availability.
2. Failure to monitor GTN-650 Messages during the approach. There are many messages that can populate, including airspace alerts and issues with the loaded approach. The crew needs to maintain SA of the flashing message annunciator to ensure the active approach is safe to continue.
3. The GPS unit will not automatically sequence to any waypoints required for a missed approach procedure. Automatic sequencing will cease at the MAP. If a missed approach is required, the pilot must UNSUSPEND the missed approach procedures for the GTN to provide guidance to the missed approach WPT. Message will appear on the screen to select “REMAIN SUSPENDED” if the MA is not necessary or “ACTIVATE GPS MISSED APPROACH.”
4. Mistaking CDI/HSI scale change during the approach for actual deviations and subsequently making unneeded or unnecessarily large corrections.
5. Failure to properly load and activate the approach will result in GTN-650 remaining in Terminal rather than Approach mode for course sensitivity. The pilot loading the approach can preview the approach prior to loading/activating to prevent selecting the wrong transition. If confusion exists, check the approach status on the bottom of the screen to determine which mode the GTN-650 is in e.g., ENR, TERM, LPV, LNAV, etc.

**421. GTN-650 VOR, ILS, LOC APPROACHES****Maneuver Description and Application**

[(Reference: AIM Chapter One, Instrument Navigation Workbook, Garmin GTN-650 Pilot’s Guide).] The GTN-650 can be used to set up and execute VOR, ILS, and LOC approaches. These approaches may use the GTN-650 GPS unit for approach set up, but they are *not* “GPS” approaches.

Clearly understanding when the GTN-650 should be in “GPS” versus “VLOC” (ground based radio NAVAID) mode is essential to proper execution of the approach. The KNS-81 can also be used to execute VOR, ILS, and LOC approaches without using the GTN-650.

### Procedures (Full Approach)

1. **Before** reaching the IAF: (**We Really Need To Brief**).
  - a. Obtain **Weather**, **Altimeter**, duty **R**unway and winds (**WAR**) or ATIS/ASOS/AWOS.
  - b. **R**equest approach from ATC.
  - c. Tune and identify NAVAIDs using TINTS acronym: Load approach into active flight plan.
    - i. Select airport ICAO via active flight plan or 'PROC' key on Home page.
    - ii. Select Approach key.
    - iii. On 'PROC-Approach' page, select desired approach.
    - iv. Select transition.
      - (a). Select IAF based on the expected direction of approach intercept.
      - (b). Select 'Vectors' if Radar Vectors to Final are being utilized.
    - v. Select one of the following:
      - (a). "Load Approach" - This will result in the approach loading at the end of the flight plan. The GTN-650 will automatically sequence to the approach waypoints after the enroute waypoints.
      - (b). "Load Approach and Activate" - This will result in Direct-to the selected transition waypoint (FAF). If Radar Vectors to Final are selected, it will activate an extended leg to the FAF along the final approach course. If “Vectors” is selected as the transition, the GTN-650 will immediately change from GPS to VLOC, regardless of distance to the FAF.

#### NOTE

It is recommended to Preview the approach before loading it into the active flight plan to check that the desired transition is selected.

#### NOTE

Ensure NAV 1 is selected when performing ILS/LOC/VOR approaches using the GTN-650.

- d. Compute *timing*, as required.
  - e. *Brief* the approach and copilot duties.
  - f. Intercept the final approach course as the course deviation bar begins to center.
  - g. Intercept the glideslope as the glideslope indicator begins to center (ILS approach).
2. *At* the IAF: (6 Ts)
- a. **TIME.** Note time at IAF.
  - b. **TURN.** Turn outbound on procedure turn or towards next waypoint of the approach as appropriate.
  - c. **TIME.** N/A
  - d. **TRANSITION.** Decelerate to final approach speed of 90 KIAS. Descend as required, complete Landing Checklist.
  - e. **TWIST.** Set desired course in HSI/CDI and ensure “VLOC” indicated on the GTN-650 annunciator panel.
  - f. **TALK.** Make voice report as required.
  - g. Execute approach as depicted on the approach plate, make voice reports as directed, and proceed to MAP.

#### NOTE

For ILS approaches only, the GTN-650 will perform an auto switch from GPS to VLOC when within 1.2 NM left or right of the FAC at a distance of 2-15 NM from the FAF if an IAF or feeder transition is selected. If the “Vectors” transition and “Load Approach and Activate” is selected, the GTN will immediately switch from GPS to VLOC regardless of distance to the FAF. This auto switch function can be deselected on the System CDI Setup page. If the crew elects to let the system auto switch to VLOC *or* elects to manually switch to VLOC (by toggling the GPS/VLOC pushbutton on the GPS annunciator panel), ensure “VLOC” is selected prior to reaching the FAF. For LOC or VOR approaches, the pilot must ensure VLOC is selected prior to reaching the FAF.

#### NOTE

VOR, ILS, and LOC approaches can be flown and/or backed up using the KNS-81 while in NAV 2 source without using the GTN-650.

3. *At* the FAF: (6 Ts again!)
  - a. **TIME.** N/A
  - b. **TURN.** Turn as required, to intercept the final approach course.
  - c. **TIME.** Begin timing inbound (localizer).
  - d. **TRANSITION.** Descend to next intermediate altitude, decision altitude (DA), or MDA as applicable.
  - e. Review landing checklist complete (give consideration to lighting configuration inside FAF).
  - f. **TWIST.** Set inbound course in CDI/HSI.
  - g. **TALK.** Make voice report as required/directed.

### **Crew Resource Management**

1. PNAC reviews and sets up NAVAIDs for IAP. (Situational Awareness)
2. PNAC gives Approach Brief. (Communication)
3. PAC/PNAC asks controller for clarification of instructions (as needed). (Assertiveness)
4. PNAC ensures lookout doctrine is maintained and reports “airport in sight.” (Situational Awareness)
5. PAC ensures Landing Checklist complete. (Situational Awareness)
6. PAC confirms landing clearance. (Communication)

### **Amplification and Technique**

1. Reference Amplification and Technique information in section 415.
2. There are multiple ways to load an approach with the GTN-650 and the crew must ensure the ground-based NAVAID is appropriately configured prior to commencing the approach.
3. Loading a VOR, ILS, or LOC approach using the GTN-650 does not remove the pilot’s responsibility for performing TINTS to verify the proper NAVAIDs are in use. Once the approach is loaded with the GTN-650, ensure the appropriate NAVAID frequency is loaded into the active field (Tune). With the NAVAID frequency selected, momentarily press the volume knob on the GTN-650 and press the NAV 1 button on the communications panel (Identify). Ensure NAV 1 source is selected on both sides (Needles). Set the appropriate course into the HSI and CDI (Twist). Ensure VLOC (not GPS) appears once established on the FAC, or select it using the pushbutton on the GPS annunciator panel (Select).

4. Only one approach can be loaded at a time in a flight plan.

### Common Errors and Safety Notes

1. Failure to ensure a switch from “GPS” to “VLOC” via the GPS annunciator panel or the bottom of the GTN-650 screen will result in flying the approach based off of GPS overlay information instead of the ILS/LOC/VOR frequency. Obstacle clearance is not guaranteed because it is not a certified approach.
2. Failure to make corrections in the proper direction.
3. If a glideslope indicator disappears on the CDI/HSI during the approach, descend no lower than the published localizer minima, or if not published, no lower than circling minima for your category of aircraft. If course deviation bar is fully deflected when inside of FAF and runway is not in sight, execute missed approach.

## 422. TERMINAL PROCEDURES

### Maneuver Description and Application

Reference: Course training standards. Terminal procedures are those tasks that should be accomplished and/or reviewed for preparation for entering the landing environment and continuing on with ground operations.

### Procedures

1. ***IFR: When departing the MDA/DH on a visual glidepath to the landing environment.***
2. ***VFR: At the termination of VFR NAV and commencement of ground operations.***
  - a. Establish proper communication and comply with appropriate ATC instructions in a timely manner.
  - b. Once VMC, maintain a safe visual glidepath to the landing environment and allow for safe visual maneuvering to land.
  - c. Follow visual approach guidance as appropriate, i.e., VASI, PAPI, etc.
  - d. If VASI/PAPI do not apply, maintain helicopter in a safe profile to either the runway threshold or short final for an appropriate helipad.

### Crew Resource Management

PAC calls for the PNAC to review terminal procedures and verbalize those procedures to the PAC. (Situational Awareness, Assertiveness)

**Amplification and Technique**

1. To preclude getting busy in the terminal environment, when enroute within 20 NM of your destination cover terminal procedures as appropriate.
2. The best course of action is to utilize the appropriate approach plate and refer to the diagram of the landing environment, of which include all appropriate ground frequencies.
3. Whatever technique you use come up with a plan that keeps everyone in the cockpit oriented to all aspects of the flight.

**Common Errors and Safety Notes**

1. SNA waits too long to initiate terminal procedures and finds that SNA gets too far behind the power curve to even start the procedures.
2. SNA tries to initiate terminal procedures late in the approach and finds that airwork begins to suffer, due to overtaking.
3. Lack of proper procedure could cause SNA to fly or taxi into an area that may not be authorized due to an unsafe situation etc.

**423. DEPARTURE PROCEDURES**

General: While established in a climb and prior to leveling off at your desired altitude, heading and airspeed, comply with all appropriate departure, SID, or ATC instructions.

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## **CHAPTER FIVE DAY NAVIGATION STAGE**

### **500. INTRODUCTION**

One enjoyable phase of your training will be the opportunity to experience VFR cross-country flights. These flights are conducted to familiarize the pilot with techniques and procedures of helicopter dead reckoning (D/R) navigation and pilotage.

### **501. GENERAL**

D/R navigation is the method for determining position by means of a heading indicator and calculations based on speed, elapsed time, wind effect, and direction flown from a known position. Pilotage is a method of determining a position over the ground using map-to-ground orientation. It is a good crosscheck of D/R navigation.

D/R navigation is used operationally to crosscheck avionics, for primary navigation in underdeveloped areas lacking navigation aids, and when the tactical situation dictates NOE flying.

#### **Crew Resource Management**

1. PAC verbally describes topography and landmarks while on route. (Communication)
2. PNAC performs “Groundspeed/Fuel Checks.” (Situational Awareness)
3. PNAC properly performs navigation and CP procedures. (Mission Analysis)
4. PNAC provides position updates to PAC while on route. (Communication)

### **502. PREPARATION FOR FLIGHT**

**In preparation for the flight the pilot will perform the following tasks:**

1. Attend the appropriate phase lecture.
2. Check out a fuel packet, survival vest, flashlight, emergency radio, navigation charts and publications. A navigation computer should also be taken.
3. The route of flight should be drawn out on the sectional chart. The flight path should be relatively straight, using prominent landmarks as fixes when changing direction and for time distance checks. The pilot should be familiar with all the markings on the sectional chart, minimum enroute altitudes, airspace information, and general VFR procedures.
4. Two complete flight logs should be prepared, allowing for magnetic variance and the winds aloft, after a current weather brief.

5. Two copies of the DD 175 VFR flight plan will be completed.
6. The weather must be forecast to be VFR for the entire route for the duration, plus or minus one hour. The SNA will personally obtain a weather brief and complete two copies of the DD 175-1.
7. Time distance checks should be made at each CP and fuel checks computed at least once on each leg of the flight.
8. The directional gyro compass on the Bravo 161XXX series aircraft does not contain a flux gate and must be reset periodically for accurate indications.

### **503. DAY NAVIGATION SOLO GUIDELINES**

#### **Preflight Preparation**

Plan for cruise airspeed to be between 90 and 100 KIAS.

#### **FDO/ODO Brief and flight plan/Weather Brief approval**

Submit a copy of the DD 175 (Flight Plan, DD 175-1 (Weather Brief)) to the FDO/ODO for their review and approval. Retain a copy of these items and place them in your flight suit. Listen intently to the FDO/ODO's instructions and if you have any questions, *do not hesitate to ask!* If you are confused about the NOTAM abbreviations, ask the FDO/ODO before you file and fly to a closed airport!

#### **Prior to Leaving the Squadron Spaces**

Ensure you have:

1. Fuel Packet
2. Appropriate publications for route of flight (i.e., IFR SUPPLEMENT and VFR SECTIONAL/SECTIONALS.)
3. NATOPS
4. Flight Plan/Weather Brief/Flight Logs
5. Checked NOTAMS (PPR number, if required)
6. Received FDO/ODO Brief
7. FTI
8. Wallet/ID Card

### **5-2 DAY NAVIGATION STAGE**

**Paraloft**

Check out appropriate flight equipment for route of flight.

**Aircraft issue**

Ensure your aircraft has no downing discrepancies against the transponder or numerous repeat gripes against the UHF radio. If so, advise the FDO/ODO, and another aircraft will be issued. These items are important to you in the event an actual emergency occurs. In addition, advise the Maintenance Control representative to place ground handling wheels and a jacking bar in your aircraft's baggage compartment. The SNA pilot will sign for the aircraft. Whoever is functioning as the pilot, will sit in the right seat, start the aircraft, take off, and land.

**Preflight**

Check the baggage compartment to ensure the ground handling wheels (one with green support and one with a red support) and a jacking bar are there and secured properly.

**Prior to Takeoff**

Call out with the FDO/ODO on squadron common and if applicable, call WHITING METRO, and extend your DD 175-1 VOID time if your actual takeoff time will be greater than 30 minutes after your proposed takeoff time. As a matter of courtesy, have your weather brief number readily available.

Turn your position lights STEADY BRIGHT and inform ground of your intention to taxi by saying, "South Whiting Ground, (call sign), solo, taxi, VFR, (destination)."

**Weather Criteria**

DAY NAVIGATION SOLO weather criteria 1500 (ceiling)/3 (visibility). This applies to your home field, enroute, and destination forecast. If the weather forecaster suggests an alternate to you, advise the FDO/ODO *immediately*. If your enroute weather deteriorates below 1500/3 because of an isolated thundershower or smoke, you may circumnavigate that area and continue on course; however, at no time will you lose basic VFR minimums of 1000/3 while circumnavigating these areas. If you are unable to remain 1500/3 continuously or circumnavigate isolated weather, return to the last airport from which you took off. Advise FSS of your intentions so that they may inform your destination of your decision to turn around. ***Under no circumstances will you operate the aircraft below 1000/3 (VFR minimums).*** Special VFR minimums with which you are familiar only pertain to the Whiting Field Control Zone.

**Enroute Procedures**

Monitor squadron common within 40 miles of home field if not already assigned a frequency on UHF. If you are going to TYNDALL via the beach, this will not apply since you will be under radar contact/positive control by Eglin approach. At other times, monitor FSS.

If you are transiting along the beach, do not fly or be vectored more than  $\frac{1}{2}$  *mile* (autorotative glide distance) from the beach. When transiting over open areas of water, always pick the shortest distance from land mass to land mass.

At no time will you descend below 1000 feet (unless under positive control or preparing to land). ***Do not flat hat!*** “Flat Hatting” is flying at low altitude and/or a high rate of speed for thrill purposes. Remember, when dealing with controllers, tell them who you are, where you are, and what your intentions are. If you do not understand something you are told, ASK for clarification.

### **Enroute Emergency Procedures**

During the preflight brief with your co-pilot, clearly delineate the duties each of you will perform in the event of an actual emergency. A vast majority of the actual emergencies encountered by DAY NAVIGATION SOLO SNAs are single instrument indications or caution lights.

### **WARNING**

Do not enter an autorotation for a single instrument indication or caution light. Ensure the twist grip is in the full open position throughout the entire approach.

Listed below are the duties the pilot/copilot perform:

1. Pilot duties:

- a. First and foremost - ***Fly the aircraft.***
- b. Advise copilot of your intentions (degree of urgency in landing and choice of landing site).
- c. ***Communicate!***

Communicate with your copilot. Plan the final approach into the wind whenever practical. If landing near populated areas, be especially vigilant for power lines or telephone lines on final.

2. Copilot Duties:

- a. Switch UHF to GUARD XMIT.
- b. Squawk 7700.
- c. Broadcast appropriate emergency call.
- d. Perform LANDING CHECKLIST.

e. Assist pilot as requested and ensure NATOPS procedures are followed/performed.

3. In the event an actual emergency occurs, regardless of where you are on your route of flight, switch to GUARD XMIT on the UHF, squawk 7700, and broadcast, "PAN, PAN, PAN, (or MAYDAY if applicable), (CALL SIGN), (position), (intentions and nature of emergency), will report safe on deck." For example:

"PAN, PAN, PAN, (CALL SIGN), 2 miles north of Barin Field, landing with an engine chip light, will report safe on deck."

"PAN, PAN, PAN, (CALL SIGN), 4 miles northeast of Evergreen over I-65, landing with fluctuating engine oil pressure, will report safe on deck."

Listen for interrogations by ground stations or other aircraft and answer their questions, time permitting.

Perform a LANDING CHECKLIST and specifically note the position of the TWIST GRIP.

If the emergency is other than a single instrument indication or caution light, utilize the NATOPS CHECKLIST and review the procedures with the pilot. Ensure they are done correctly.

4. After the rotors have come to a complete stop:

Exit the aircraft and turn the blade clockwise for *two* complete revolutions. Tie down the blade and perform a post flight inspection. Disconnect the battery and install the engine inlet/exhaust bags (if in the aircraft). Leave one person with the aircraft, while the other goes to contact the squadron by telephone.

This discussion cannot cover every possible emergency situation, and as such, LOST COMMUNICATIONS or LAND AS SOON AS PRACTICABLE emergencies are left up to the pilot's headwork and common sense. Under no circumstance should you attempt to return to home field if your fuel state is below 45 gallons.

### **At Destination**

Before landing, ensure you know the wind direction. Do not let the transient line personnel land you more than 45° out of the wind line. After shutdown, perform a good postflight, turn the blade two times clockwise, tie down the rotor blade, and secure all your panels, windows, and doors.

## **Refueling**

At the airfields we visit, prompt refueling is usually available. At the most, your aircraft should take 40 gallons. Ensure you get your credit card back and a copy of the receipt marked "CUSTOMER." Note to see if blocks 25 - 29 have been filled in with the "approximate" amount of fuel you expected to receive. Visually check your fuel level and ensure the cap is secure. Complete the summary sheet included in each fuel packet after returning to NAS Whiting Field.

## **Ground Time**

Usual time is about one hour. Refresh yourselves at Base Operations and check to see if your return leg is filed. Check with weather to ensure your return leg is still better than 1500/3. No DD 175-1 is required.

1. In the event the aircraft has to be moved, read Chapter 3 of the NATOPS manual (Service and Handling) prior to attempting to manually move or tow the aircraft. Listed below are further directions to safely install and remove the ground handling wheels:

- a. **Ground Handling Wheels Description.** Hand operated ground handling wheels are mounted on each skid tube near the helicopter center of gravity to facilitate helicopter handling or movement. The wheels are retracted and extended manually and are removable. Two, 6 ply, 3.50 X 6, nylon tires and tubes are used on the wheel assemblies.

### **WARNING**

Maintain a wide stance balance, holding the jacking bar firmly while raising or lowering the handling wheels.

- b. **Removal - Ground Handling Wheels**
  - i. Retract wheels and lock in up position.
  - ii. Remove quick release pin from skid tube.
  - iii. Slide wheel and support assembly forward.
  - iv. Install plugs in release pinhole, if provided.

### **NOTE**

The lock pin must be removed from wheel support assembly before wheels can be retracted or extended. Install lock pin in support to lock wheel in desired position.

- c. **Servicing - Ground Handling Wheels**
  - i. Lubricate axle.
  - ii. Inflate tires to 75 to 80 psi.
- d. **Installation - Ground Handling Wheels**
  - i. Position the support assembly over skid tube with the wheels outboard. Align forward slot of support over the forward mount bolt and slide support aft engaging the aft mount bolt.
  - ii. Insert quick release pin in skid tube forward of the support assembly. Check security of pin.

2. **Maintenance.** If your aircraft requires fluid servicing, ask the transient personnel to provide the fluids IAW the NATOPS. Consult your NATOPS for NATO compatible numbers if required.

- a. ***MIL-L-7808 may not be mixed with MIL-L-23699.*** MIL-H-5606 may be mixed with MIL-H-83282A if it is the only hydraulic fluid available. Be sure to call the FDO/ODO prior to adding an oil/fluid, which is not MIL-L-23699 or MIL-H-83282A.
- b. If any other problems are encountered, call the FDO/ODO from BASE OPERATIONS.

### Preparing for Start

Ensure the grounding wire has been removed from your aircraft. Ensure all your panels are closed and servicing caps secured. ***The transient personnel will not do a walk around inspection of your aircraft!***

### Upon Return

Close out your yellow sheet, dividing the flight time as necessary between first pilot time and copilot time. Return all items you checked out. If you encountered any unusual circumstances during the flight, please debrief them with the CDO/ODO.

### Restrictions

Solo SNAs are specifically prohibited from performing running landings, full autorotation, simulated engine failures, boost-off flight, simulated tail rotor malfunctions, 180° autorotations, no-hover landings, simulated emergencies, maximum load takeoffs, and the carrying of passengers.

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## **CHAPTER SIX AIRWAYS NAVIGATION STAGE**

### **600. INTRODUCTION**

Airways navigation is used extensively in cross-country flying under both IFR and VFR conditions. In airways navigation, the pilot combines and utilizes skills of instrument flying to accomplish a cross-country flight. The safety and efficiency of this flight depends largely on the quality of preflight planning.

### **601. FLIGHT EXECUTION**

#### **Maneuver Description and Application**

[(NIFM Part VII (Instrument Flight), Flight Information Publications (FLIP), IFR Supplement, Terminal Charts (Approach Plates), Enroute Charts, AIM).]

Pilots must develop a thorough knowledge and understanding of flight information documents and radio aids to navigation in order to conduct a cross-country navigational flight safely and accurately. It is extremely important to be prepared to cope with unforeseen situations in flight such as lost communications and emergencies. Flight planning information publications are subject to change. This section reviews flight planning methods and discusses enroute procedures. It is the pilot's responsibility to consult the appropriate FLIP publications and NATOPS manuals for specific performance, flight planning, and enroute information. Review applicable publications frequently to make sure you are familiar with the latest current information available.

#### **Amplification and Technique**

1. Check the FLIP IFR Supplement to determine the suitability of the destination airfield.
2. Make maximum use of all the references and forms to complete your planning.
3. Once the destination airport has been selected and the appropriate preflight planning publications have been obtained, the pilot should accomplish the following:
  - a. Determine the route of flight.
  - b. Complete a fuel planning worksheet and helo logs. It will be necessary to obtain a preliminary weather briefing including winds and temperature to determine fuel consumption values and recommended airspeeds for long-range cruise speed.
  - c. Complete DD 175.
  - d. Obtain formal weather brief (Form DD 175-1) and check the NOTAMS.

- e. Ensure the Pilot-In-Command (PIC) has signed the flight plan and has checked the fuel planning worksheet, helo logs, and DD 175 for corrections.
  - f. File the flight plan with the ODO or with the nearest FSS, whichever is applicable.
  - g. Obtain fuel packet and survival gear.
4. Once the preflight planning is complete and the flight plan filed, the pilot should be ready for takeoff at the time proposed on SNA's flight plan.
5. Prior to takeoff, the pilot must:
- a. Obtain ATIS information.
  - b. Put IFR clearance on request through clearance delivery/ground.
  - c. Copy the clearance.
  - d. Call for taxi clearance.
  - e. Complete the instrument checklist prior to takeoff.
  - f. Obtain release instructions/takeoff clearance.
  - g. Switch to departure control frequency as directed by tower.
  - h. Squawk the correct transponder code assigned by ATC.
  - i. Note takeoff time and fuel on the helo logs.
6. After the climbout is complete and the aircraft is at assigned altitude, the pilot or copilot should:
- a. Accomplish the Level off Checklist.
  - b. Complete the estimated fuel remaining and ETA portion of the helo logs.
  - c. Make fuel consumption checks.
  - d. Make groundspeed checks.
  - e. Recheck destination and alternate weather using Metro or other facilities.
  - f. Conform to appropriate enroute and approach procedures as defined in FLIP General Planning Section, NIFM, AIM, and this FTI.

7. Prior to reaching the terminal area, the pilot should review the appropriate approach and brief the copilot. Controllers normally try to expedite the flow of air traffic in the terminal area and the pilot needs to be prepared.
8. When ATIS is not available, request the terminal weather, altimeter, and duty runway (WAR) as soon as you are talking to the controlling agency that can provide the information. Go through the “*We Really Need To Brief*” sequence as early as possible.

### **Common Errors and Safety Notes**

1. Be thoroughly familiar with NATOPS and FLIP publications.
2. Poorly planned helo logs can lead to an emergency fuel situation even with the planned 20 minute reserve. A properly filled out helo log can save the pilot much time and effort in flight. Helo logs shall be completely filled prior to flight.
3. Utilize all available navigational aids. There are many NAVAID stations along the route of flight that may be used as alternate navigational aids.
4. Be prepared to execute an instrument approach at any airport along your route of flight in the event an emergency may dictate you land as soon as possible.
5. Utilize your copilot. Good CRM saves time and duplicated effort.
6. Always advise ATC of any serious malfunctions in the navigational equipment or aircraft instruments.
7. Always confirm any clearance or amendment to a clearance from ATC if there is any question.
8. Prior to operating in and around civilian airfields, SNAs should review Section 157 in the FAR concerning traffic advisory practices at airports without operating control towers.
9. There is no such thing as too much flight planning.

## **602. GROUND SPEED CHECK**

### **Checks**

Compute groundspeed checks each leg to gain a sense of your actual progress across the ground. This will aid in updating your fuel planning and arrival times.

### **Technique**

1. Establish yourself on a track directly to or from a TACAN/VORTAC.

2. Start the clock and note the DME.
3. After six minutes check DME and multiply by ten. This will be your groundspeed. (Other timing lengths can be used, but six minutes makes computation simple and allows for the groundspeed check to be paired with an initial six minute fuel consumption check).

### **603. FUEL CONSUMPTION CHECK**

#### **Checks**

Fuel consumption checks are made so the actual inflight fuel burn rate can be verified. Also, this check, when paired with information garnered from the groundspeed check, provides a real-time picture of your fuel endurance with reference to your intended destination. Vectors and delays might upset your planned fuel figures. Bear in mind your fuel gauge is not calibrated nor is it marked for easy computation. Therefore, the pilot will need to extrapolate his figures and update his checks regularly for a clearer idea of his fuel burn rate.

#### **Technique**

1. Start the clock and check fuel quantity.
2. Check after six minutes and multiply by ten for initial ballpark check (should be between two and four gallons). This check will only let you know if you have obvious problems with fuel flow.
3. Check after 24 more minutes (30 minutes elapsed) and multiply by two.
4. Recheck every 30 minutes thereafter.

**APPENDIX A  
RADIALS TO LEAD BY RULE OF THUMB**

**A100. RADIALS TO LEAD BY RULE OF THUMB**

This method is for use when determining a Lead Radial for arcing intercepts. SNAs should be familiar with how this equation was arrived at, and do not use it when the ground speed is significantly faster.

Radial to Lead By Equation:

$$\text{Radials to Lead by} = (.5\% * \text{Ground Speed}) * \left( \frac{60}{\text{DME of the Arc}} \right)$$

Solving for 100 Knots Ground Speed:

$$\begin{aligned} \text{Radials to Lead by} &= (.5\% * \text{Ground Speed}) * \left( \frac{60}{\text{DME of the Arc}} \right) \\ &= (.005 * 100) * \left( \frac{60}{\text{DME of the Arc}} \right) = .5 * \left( \frac{60}{\text{DME of the Arc}} \right) \\ &= \left( \frac{30}{\text{DME of the Arc}} \right) \end{aligned}$$

The following chart depicts the comparison of the resulting Radials to Lead By calculated using both the equation method and rule of thumb method.

Ground Speed (knts)	DME	Radials/NM	Turn Radius (NM)	Radials To Lead By (Equation Method)	Radials to Lead By (ROT)
80	5	12	.4	4.8	6
85	5	12	.425	5.1	6
90	5	12	.45	5.4	6
95	5	12	.475	5.7	6
100	5	12	.5	6	6
105	5	12	.525	6.3	6
110	5	12	.55	6.6	6
80	10	6	.4	2.4	3
85	10	6	.425	2.55	3
90	10	6	.45	2.7	3
95	10	6	.475	2.85	3
100	10	6	.5	3	3
105	10	6	.525	3.15	3
110	10	6	.55	3.3	3
80	15	4	.4	1.6	2
85	15	4	.425	1.7	2
90	15	4	.45	1.8	2
95	15	4	.475	1.9	2
100	15	4	.5	2	2
105	15	4	.525	2.1	2
110	15	4	.55	2.2	2

Figure A-1 Radials to Lead By Method Comparison