NAVAL AIR TRAINING COMMAND

NAS CORPUS CHRISTI, TEXAS **CNATRA P-561 (06-21)**

FLIGHT TRAINING INSTRUCTION

MULTI-ENGINE FLIGHT TRAINING INSTRUCTION T-44C

2021

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1. CNATRA P-561 (Rev 06-21) PAT, "Multi-Engine Flight Training Instruction," is issued for information, standardization of instruction, and guidance for all flight instructors and students in the Naval Air Training Command.

2. This publication will be used as a guide for completion of Advanced Multi-Engine Flight Training curricula for all student pilots.

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

4. CNATRA P-561 (Rev 08-19) and all other versions are hereby cancelled and superseded.

D. F. WESTPHALL
By direction

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FLIGHT TRAINING INSTRUCTION

FOR

MULTI-ENGINE FLIGHT TRAINING INSTRUCTION

T-44C

P-561

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INTERIM CHANGE SUMMARY

The following Changes have been previously incorporated in this manual:

CHANGE NUMBER	REMARKS/PURPOSE

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

INTERIM CHANGE NUMBER	REMARKS/PURPOSE	ENTERED BY	DATE

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CHAPTER ONE
CONTACT STAGE

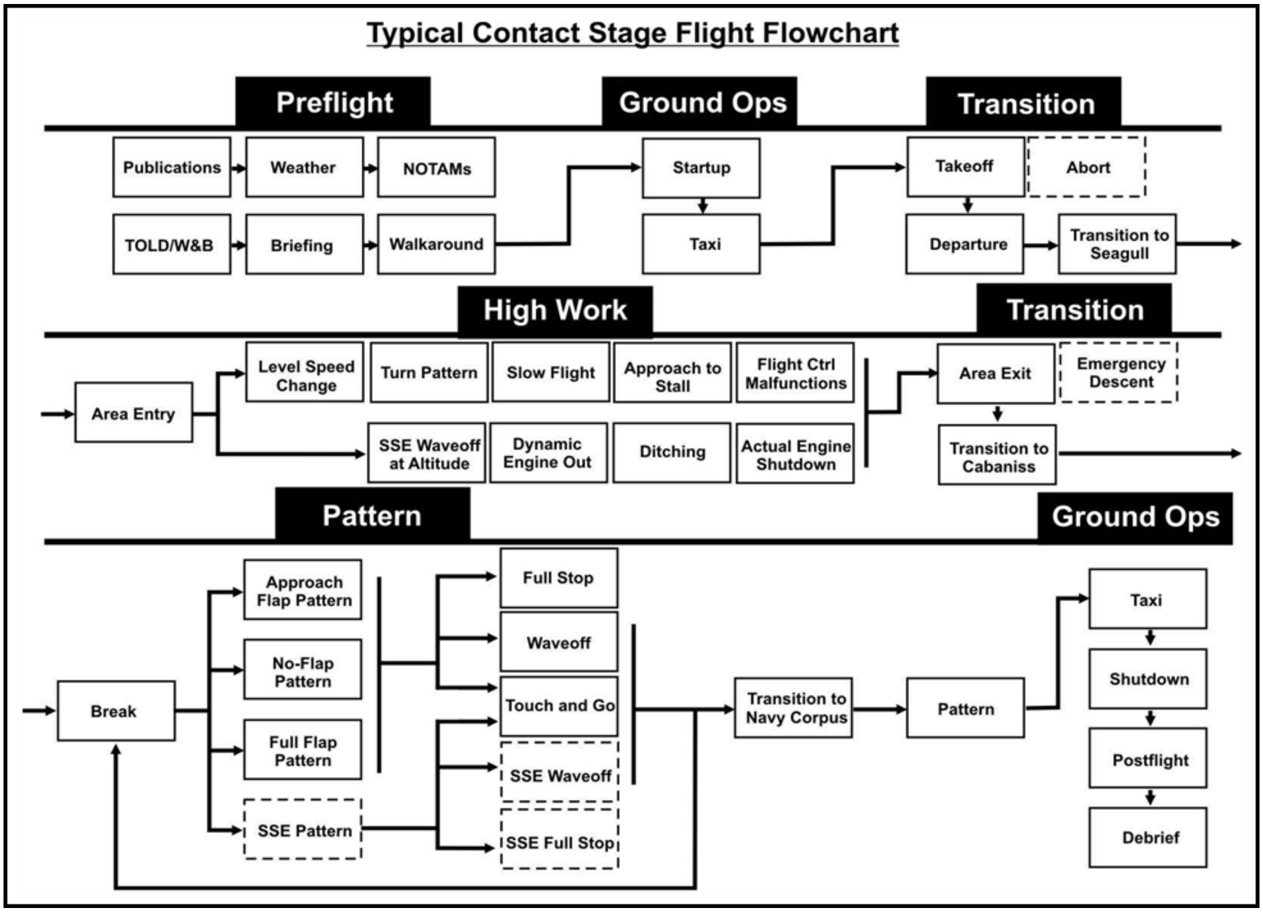

Figure 1-1 Typical Contact Stage Flight Flowchart

100. INTRODUCTION

The objective of the Contact Stage is to introduce you to multi-engine flight in Visual Meteorological Conditions (VMC). You will become familiar with aircraft systems and flight characteristics under normal and emergency operations. This phase of training instills basic mental and physical skills necessary to operate a multi-engine military aircraft. The multi-piloted cockpit introduces you to pilot-in-command decision making and crew resource management skills. Successful completion will result in designation as "safe for solo." Hard work and dedication now will build the foundation for success as a multi-engine aviator.

If possible, you will be scheduled with the same Instructor Pilot (IP) through C4302. These first seven flights (referred to as the "on-wing" stage) are crucial for establishing standardization and will provide a basis upon which all of your subsequent training will be based. For the remainder of your training, you will be scheduled with any qualified IP. It is advantageous to fly with a number of instructors in order to be exposed to different techniques.

FTI Methodology. This FTI is intended as a reference and is designed to explain MPTS-specific procedures and to amplify existing publications. It is imperative, both for your success in this course and your future success as a military aviator, that you have a working knowledge of all the publications covered in this training course. Just as the NATOPS is a guide to the aircraft, this FTI is a guide to the Maritime MPTS curriculum. Each section is organized first to teach the "what," by explaining in flowchart form how a typical flight will run for that stage. Next, we will explain the "how," teaching how to properly execute the procedures for each "building block" of these flights. Finally, we will teach the "why," explaining in depth the reasons for these procedures, covering topics not previously taught in Primary or in ground school. This document will refer you to reference publications, amplify their guidance, and provide procedures that cannot be found elsewhere.

One technique for using this publication is to chair-fly a flight by tracing the flight's sequence of events through the provided flowchart. When you come to a "building block" that you feel you have not yet mastered, review the procedures for that flight segment in the FTI or the NATOPS. Doing so, you should be able to chair-fly a typical flight for that stage before your first event of that stage. This will allow you to learn faster, having familiarity with the book knowledge while gaining the practical knowledge in the aircraft. The flowchart can also allow you to more effectively learn from your flights. Following a flight, you can trace the sequence of the flight through the flowchart. Identify "building blocks" where you performed well and ones where you still need practice, then focus your studies on the latter. Use this publication as a tool and you will be able to study "smarter, not harder."

1. **Crew Resource Management.** The IP usually sits in the right seat and will act as PM (pilot monitoring), but on some training flights, a student will fill this position. Traditionally, the PM is tasked with checklist management, radio communications, and navigational duties as well as continuously backing up the PF (pilot flying). For training purposes, certain duties normally delegated to the PF or PM may be restricted at the discretion of the IP (e.g., the student is responsible for radio communications while flying). The PF's level of SA is limited by the information received from all crewmembers, not necessarily the sum of each crewmember's individual SA. Therefore, as a PM, you must do everything feasible to support the PF and maximize this level of SA. This includes radio communication, checklist management, execute PM callouts, automation management, and cockpit setup (tune radios, set FGP, set altitude selector, dim lights, etc.). When conducting PF duties, students shall ensure all appropriate comms are completed; however, in an effort to reduce comm workload, PM may initiate standard comms without direction. PF should verbalize all clearances with PM as soon as practicable following PM read back.

2. **Observer Duties.** The student not in the cockpit is designated the OBS, and shall take an active role in executing crew duties. The OBS's responsibilities are vital to the safety of the aircraft and crew. At a minimum, the OBS shall monitor radios, clear the aircraft before and during turns, maintain traffic lookout and separation/interval, verify the gear is down and locked prior to the 90 for each landing, touch, and go, or low approach, check flaps upon touch-and-go landings, and count the number of passes. Additionally, the OBS is responsible to make the IP aware of any potential safety issues. The IP may delegate

additional duties to the OBS as the flight profile dictates. The OBS is not a backup for the student in the seat who may be forgetting something; however, the OBS should *always* notify the crew of anything that may affect flight safety.

3. **See And Avoid.** You must never forget you are responsible for looking outside and scanning for traffic. The majority of Contact training is conducted in VMC. Operating on an instrument clearance still requires you to scan for other traffic. The only separation normally provided by Air Traffic Control (ATC) is between other Instrument Flight Rules (IFR) traffic. Even at or above Flight Level 180 (FL180), where all aircraft are required to be IFR, near misses have occurred with other IFR aircraft and with illegal Visual Flight Rules (VFR) aircraft. Even though other aircraft may be operating legally, never assume you are protected in any airspace. Become intimately familiar with airspace and operating procedures listed in this manual and keep your head out of the cockpit.

Clearing procedures described in this section must be adhered to at all times. When making turns on the ground or in the air, clear your flight path left and right. The OBS is also very valuable in searching for traffic.

NOTE

Whenever reporting other aircraft, utilize the following terminology: *"Traffic in sight"* or *"Negative contact."* Do not utilize *"Talley ho"* and other such phrases not found in the pilot/controller glossary. Utilize *"Roger"* to indicate reception of a transmission, not an *"Affirmative"* or *"Negative"* response. Utilize *"WILCO"* to indicate reception and compliance.

4. **Inadvertent IMC.** IMC must be avoided while flying VFR. Occasionally, IMC may be flown into inadvertently even with the best intentions to avoid it. Early maneuvering is the best measure to avoid inadvertent IMC. Flying VFR on dark nights is one time to be particularly careful.

No set procedures will cover inadvertent IMC in all situations. Good headwork and situational awareness must be used to meet the objectives. Fly out of IMC, rely on your instrument scan until VMC, fly safe altitudes for terrain and obstacle avoidance, and get ATC assistance.

101. PREFLIGHT PLANNING

The preflight is one of the most critical phases of flight. Knowing the most current local information and weather is essential for a successful flight. Additionally, it is always easier to deal with a maintenance problem on the ground rather than trying to handle an in-flight emergency. Problems can often be found and diagnosed during the preflight. Note the runway in use. A complete preflight requires: Publications, Weather Briefing, Notices to Airmen (NOTAMs), Temporary Flight Restrictions (TFRs), Bird Aircraft Strike Hazard (BASH) conditions, TOLD/Weight and Balance Calculations, Aircraft Issue Actions, Flight Briefing, and

Walkaround. Come to the brief with items 1-5 completed. Complete items 6 and 7 if aircraft has been issued prior to brief.

1. **Publications.** Prior to each brief, SMAs shall pick up a navigation bag with current FLIP publications. Required Pubs during local flights: NATOPS manual, VT-31 Standard Operating Procedure (SOP), TW-4 SOP, In-flight Guide, Flight Training Instruction, Course Rules (Air Operations Manual) and the following FLIP documents:

    a. IFR Enroute Supplement. Contains the Airport/Facility Directory (1).

    b. Flight Information Handbook. Has the table of contents on the front cover (1).

    c. Enroute Low Altitude/Enroute High Altitude Charts (1x Low 19/20, 1x Low 21/22, 1x High 7/8).

    d. Terminal Low Altitude/Terminal High Altitude IAPs (1 x North TX (Vol 9), 2 x Central TX (Vol 10), 2 x South TX (Vol 11), 2 x SW High).

    e. Terminal Change Notice (TCN). Updates the FLIP Terminal IAPs (2).

    f. STARs. Standard Terminal Arrivals (1).

Students must also carry: Flashlight, dog-tags, flight gloves, and fuel packet (at IP discretion), including any additional equipment required by NATOPS and CNAF M-3710.7 series.

2. **Weather Briefing.** You must check current and forecast weather before your briefing, and print out a DD-175-1 flight weather briefing form. Ensure that the weather is at or above VFR minima for the flight. Refer to SOP for VFR minima.

A DD-175-1 flight weather briefing form shall be completed for each flight. Also bring current METARs and TAFs for your planned area and duration of flight. Refer to the SOP for other weather policies, including student solo requirements. When flights are to be conducted in the local area a DD-175-1 Canned Weather Brief should be used. These canned weather briefs may be found on the Internet.

NOTE

> If a ground delay is experienced, recheck ATIS and the weather void time on your DD-175-1. Request an update with Metro if required and note the extension time on your DD-175-1. Be prepared to give your briefing number.

3. **NOTAMs.** At a minimum, you must check and print local area NOTAMs for Navy Corpus Christi (KNGP), Corpus Christi International (KCRP), Cabaniss Field (KNGW), Jeppesen NavData Alerts/NOTAMs and GPS NOTAMs. Use the DoD NOTAMs Web site. If you cannot access NOTAMs online, call 1-800-WX-BRIEF and a preflight briefer will be able

to provide them. Ensure that you are familiar with the NOTAMs prior to the brief. For more information on NOTAMs see Section 404 (4).

4. **TFRs.** Ensure there are no TFRs in effect for your complete route/duration of flight.

5. **BASH.** Check BASH for complete route of flight. Be prepared to discuss this model, including ways to mitigate/avoid bird hazards, with your IP during the brief. Information may be found on www.usahas.com.

6. **TOLD/Weight and Balance.** Takeoff and Landing Data encompasses all performance data for a flight. The performance charts in NATOPS are based on operating procedures and conditions explained either in the text or on the chart itself. The takeoff and climb performance is the most important operational consideration because payload and/or range may be reduced due to limiting takeoff conditions. In fact, we easily have the performance to land at many fields that we then cannot take off from. Reducing our takeoff gross weight is the easiest way to improve our takeoff and climb performance. Another option is to wait for better takeoff conditions - lower temperatures, stronger headwinds, or dry runways.

Takeoff Gross Weight Limitations. All takeoff and initial climb performance is planned with one situation in mind: safe continued operation after an engine failure. Here are some basic considerations to establish a safe takeoff gross weight:

a. We are required to be able to accelerate to rotation speed, lose an engine, and stop on the remaining runway. In other words, our accelerate-stop distance must be equal to or less than runway length. The limiting factor, here at NGP, is most often our accelerate-stop distance on days with wet runways.

b. We are required to be able to climb at a gradient steep enough to clear obstacles if an engine fails. In other words, our one-engine inoperative climb gradient must be 200 feet/nautical mile or the published obstacle clearance climb gradient for the departure procedure. In many cases, this is the most restrictive of all aircraft performance factors, especially at high-density altitudes and in mountainous terrain.

c. Accelerate-Go Distance. This may need to be considered if departing in bad weather conditions from an airport with a runway end crossing height.

Weight and Balance Computations. A Weight and Balance Clearance Form F is required for every flight with more than three passengers or any cargo aboard the aircraft. Normally, the pre-computed Form F found in the binder at maintenance issue is sufficient for standard student sorties. Compute takeoff weight to ensure below the maximum allowed. Subtract basic weight, baggage, and additional crewmembers/passengers from maximum landing weight to compute maximum total fuel weight required before the first landing. Calculate accelerate-stop distance, one-engine-inoperative maximum climb rate for the first takeoff, and compute stall speeds for flaps up, flaps full down, and flaps approach at 30º Angle of Bank (AOB).

NOTES

1. Maximum landing weight should not be exceeded; however, emergency conditions may dictate landing above maximum. A Maintenance Action Form (MAF) is required if normal limits are exceeded.

2. Accelerate-stop distance can be calculated using NATOPS. One-engine-inoperative maximum climb rate can be determined by using NATOPS Figures. Particular attention must be paid to these calculations when density altitude (DA) is high, as aircraft performance may be impaired. Stall speeds can be calculated using NATOPS as applicable.

7. **Aircraft Issue.** Read the aircraft logbook and print crewmembers' names/squadron on the back of the "A" sheet. If a passenger is embarked, list their name/rank/SSN last four/duty station/activity and debarkation point (if not final destination of the aircraft). The PIC will review all outstanding discrepancies and corrective action for all gripes for the last 10 flights. Pay particular attention to pink (outstanding) gripes and verify none are downing discrepancies. Additionally, note the Daily/Turnaround Inspection Record. Unless the PIC remains the same or the aircraft is "hot seated," a turnaround must be signed-off after every flight. The turnaround remains good for 24 hours if the aircraft is not flown. The daily must be completed at the end of each flying day and remains good for 72 hours if the aircraft is not flown, 24 hours if flown. The PIC will have final authority to determine if outstanding "up" gripes are acceptable for the assigned mission. The PIC (or designated student if solo) shall sign block 11 of the Aircraft Inspection and Acceptance Record (OPNAV 4790/141) assuming full responsibility for the safe operation of the aircraft and the safety of the other individuals aboard.

NOTE

If embarking passengers at an intermediate stop, the PIC is responsible for leaving a passenger manifest with competent authority. The pilots are responsible for daily/post-flight inspection while off-station.

The CNAF 4790/141 "A" sheet provides for:

a. The pilot's acceptance of the aircraft in its present condition.

b. Identification of aircraft by BUNO, T/M/S, and reporting custodian.

c. Certification of an aircraft's readiness for flight by maintenance personnel, and a record of fuel, oil, oxygen, expendable ordnance aboard, special equipment, and limitations.

8. **Briefing.** Arrive prepared to the briefing. You should know the briefing items to a level that you can teach them. Students are responsible for arriving to the brief with a flight profile tailored to their individual training requirements and continuity in accordance with the MCG. You should also be familiar with your flight profile and prepared to execute any maneuvers for which you are opted. Chair-flying is a good technique to prepare for a flight profile. Bring your weather briefing, NOTAMs, and required publications, to every briefing. You must be familiar with the weather and NOTAMs for the brief (i.e., don't simply print them out without reviewing them).

NATOPS Brief. A NATOPS brief is required for every flight, including hot seat and mid-period pickup evolutions. Your Instructor may choose to do the NATOPS brief, but be prepared to brief it yourself.

Aviation Training Jacket. It is the student's responsibility to review the ATJ frequently, ensuring the calendar card is updated and Aviation Training Forms (ATFs) are not missing. If a problem is suspected, notify Student Control. Do not wait until the week of your scheduled winging to attempt to correct administrative errors.

9. **Aircraft Inspection (Walkaround).** The PIC will ensure a complete aircraft inspection is performed prior to each flight. Normally the student scheduled to start will preflight the aircraft interior. After the brakes have been pumped firm, remove the chocks during preflight. Unless specifically instructed by the IP, do not leave any panels open. Never leave fuel or oil caps off, as foreign material may enter the system.

NOTES

1. The AUX Battery in the forward avionics compartment shall be tested to ensure a charge for 5 seconds during preflight.

2. Always ensure you are preflighting the correct aircraft on the correct parking spot; it is easy to confuse the aircraft side numbers with the bureau numbers.

3. The control lock shall be left in place until a pilot is in either seat and is guarding the controls. If off station and the ground-handling agency anticipates the need to tow the aircraft, the rudder lock shall be removed for the duration of the tow.

4. Ensure the brakes are firmly pumped before chock removal. Remove chocks before engine start. Always chock the aircraft if it is to be left unattended for any duration.

5. When "hot seating," review the logbook then take an "A" sheet to the aircraft (with crewmembers' names on the back). Get a discrepancy brief and sign for the aircraft after the original PIC releases it to you with his/her signature. The relieving PIC will return the new "A" sheet to Maintenance Control. Engines must remain running to contact a "hot-seat" evolution.

6. Hearing protection is required when on the aircraft line. Ensure all of your flight suit pockets are zipped to prevent Foreign Object Damage (FOD).

7. During (dry) warm weather operations, open both cockpit side windows and leave the cabin door open.

8. While performing preflight cockpit checks, it is recommended you set the audio panel as required in the Before Start Checklist.

9. If no OBS is assigned, the last crewmember entering the aircraft is responsible for locking the cabin door.

102. GROUND OPERATIONS

Ground operations involve as many challenges as flight operations. Even though the aircraft is moving far slower than during flight, you are in much closer proximity to hazards such as taxiway lights and other taxiing aircraft. Vigilance and attention is as important in ground ops as it is in flight.

When deplaning crewmembers from an aircraft with both engines running, the left engine shall be feathered and weather radar placed in “STBY.” Upon exiting the aircraft, ensure the door is closed and locked. Proceed at least 10 feet around the front of the aircraft. The safe zone shall be an arc from one wingtip drawn to the other wingtip. A visual “thumbs up” signal will be given to the remaining crewmember in the aircraft confirming all clear and allowing the prop to be brought out of feather. Upon returning to the aircraft, proceed around the front of the aircraft and do not approach the cabin door until a visual signal is received from the crewmember inside (thumbs up – outside of the side window), confirming the left prop is feathered, the aircraft is depressurized and you are cleared to enter. At night, crewmembers will use a flashlight to ensure that visual signals are seen and understood from outside the cockpit.

Startup.

1. **Before Start Checklist.** Accomplish the Before Start Checklist in accordance with the appropriate NATOPS and FTI Appendix.

NOTE

Ensure a lineman is present for all engine starts at KNGP regardless of location IAW current VFR course rules instruction. If a lineman is not standing by when ready to start, turn on the avionics master and contact “Peg Base” 138.775.

2. **Start Procedures.** Start engines in accordance with the appropriate NATOPS and FTI Appendix. Perform start procedures from memory. If starting during darkness, the PM

should use a flashlight to provide extra illumination of the gauges (especially Interstage Turbine Temperature (ITT). Panel lights may dim significantly when the starter is energized.

NOTE

Should a Ground Power Unit (GPU) start be required, see NATOPS. Students are not authorized to motor starters unsupervised, unless they have signed for the aircraft.

3. **After Start Checklist.** Accomplish the After Start Checklist in accordance with the appropriate NATOPS and FTI Appendix.

4. **Taxi.** Before commencing taxi operations, signal lineman for a brake check. Roll the plane forward, complete the brake check, and give the lineman a thumbs-up. This procedure releases the lineman for other duties.

Accomplish taxiing in accordance with NATOPS. From a slow taxi, close the power levers and smoothly apply brakes to obtain a brake check. Further taxi without a radio call may be commenced in the immediate line area as dictated by course rules. Do not proceed out onto any active taxiway until you have called for taxi clearance from Ground. Whenever possible, commence turns after moving forward. It is extremely difficult to begin an immediate turn from a dead stop. When rolling out of a turn, use opposite rudder, power, and brakes as necessary; anticipate the need to neutralize all inputs**.** ***When coming to a stop, do not leave the power levers behind the detent.*** Set the parking brake whenever stopping for longer than a few seconds; however, do not set the parking brake at line up and wait on the runway.

NOTES

1. When under the direction of a taxi director, follow signals as directed; however, if you feel that compliance with the director's signals will jeopardize the aircraft, adjacent equipment, etc., stop and investigate. Utilize "wing walkers," have the aircraft towed, or take other appropriate action prior to continuing. ***The PIC has primary responsibility for safety of the aircraft at all times.***

2. Do not utilize Beta/Reverse in the line area.

3. After C4105, at the IP's discretion, the PM may continue taxi to the runup area while the PF begins checking RADIO/NAVAIDS (Navigational Aids). If possible, note specified radial/Distance Measuring Equipment (DME) at a marked checkpoint on the field.

4. The PF should not tune RADIO/NAVAIDS while taxiing.

5. At the intersection of all taxiways/runways the PF will call *"Clear left"* or *"Clear right"* as appropriate. Upon hearing the call, the PM will clear his/her side and respond without request.

6. Whenever transferring controls utilize the following terminology: *"You have the controls." "I have the controls." "Roger, you have the controls."* This positive three-way transfer is always required when exchanging control of the aircraft. The PF giving up control may also give some guidance, such as, *"keep us on this heading and altitude."*

7. When conducting PF duties, students shall ensure all appropriate comms are completed; however, in an effort to reduce comm workload, PM may initiate standard comms without direction. PF should verbalize all clearances with PM as soon as practicable following PM read back.

5. **Engine Runup.** The Engine Runup Checklist shall be accomplished in accordance with NATOPS and the appropriate Appendix. Taxi into the runup area and stop with approximately 15 feet wingtip distance between aircraft. Ensure the aircraft is aligned in accordance with course rules, the nosewheel is not cocked, and the aircraft is well clear of the taxiway.

CAUTION

Do not taxi between or over raised runway edge lighting or taxiway lighting.

103. DEPARTURE/ARRIVAL TRANSITIONS

A good portion of a contact flight is spent transitioning to and from the working areas and to and from airfields. Familiarity with takeoff procedures and course rules is essential.

1. **Takeoff.** Accomplish the Before Takeoff Checklist in accordance with the NATOPS and appropriate FTI Appendix.

NOTES

1. Block assignments/instrument departure requests to Seagull should be made from the runup area for all applicable flights. If takeoff is not commenced within 30 minutes, cancel your block reservation with Seagull so the airspace may be utilized by other aircraft. You should receive your clearance before setting the FMS.

2. If a return to the field in ***VMC*** is not possible, ensure an approach above minimums is available in the local area, and IAPs are readily accessible

3. At the “Crew” prompt on the Before Takeoff Checklist complete the takeoff, touch and go, and/or IFR briefing as required. Give a full briefing before the first takeoff of the event.

Once cleared for “takeoff,” or “line up and wait,” clear the downwind, base, final, and the runway for traffic. Then direct the PM to “continue” the Before Takeoff Checklist while crossing the hold short line and taxiing into position for takeoff on the runway centerline with minimal usable runway behind the aircraft. The pilot should turn on the lights, anti-ice, and advance the condition levers to high idle and the co-pilot should set the transponder while taxiing onto the runway before the PF calls for the checklist. The *“high idle”* response must not be made during the Before Takeoff Checklist until N1 reads between 70-73%. Set 70-80% N1 when aligned with the centerline, unless you anticipate a long delay for your takeoff clearance. Check the wing/nacelle for fuel caps in place, panels secure, and no fluid leaks. Check engine instruments/props stabilized and note heading aligned with the runway. Excessive time on the runway checking instruments, fuel, and nacelles prior to takeoff should be avoided. The left seat shall report *“checked left”* and the right seat shall report *“checked right.”* Release the brakes, drop your heels to the deck and smoothly apply maximum allowable power. ***Do not use brakes*** to maintain centerline during the takeoff roll. Anticipate the need to add right rudder with power application. Monitor torque and ITT limits and auto feather armed lights illuminated (passing 90% N1 power lever position). The PM shall back up the power levers with his hand to keep them from creeping aft (and fine tune the levers if required to prevent exceeding limits), monitor aircraft and engine instruments, and call out any malfunctions. Normally the power levers are matched evenly and maximum allowable power is utilized throughout the takeoff roll. Look down the runway for lineup and track centerline. If off centerline, make smooth, slow corrections.

Scan airspeed throughout the takeoff roll. Smoothly pitch up 7-10 degrees and relieve control pressure with electric trim once airborne. Do not depend exclusively on the PM to call *“rotate.”* At V_R, the PM will call *“rotate.”* The only communication on the runway during takeoff should be *“rotate,” “abort,”* or *“[state a malfunction].”* Crosswind takeoffs shall be accomplished in accordance with NATOPS.

WARNING

During critical phases of flight, (e.g., takeoff, landing, initial climbout, waveoff, VFR landing pattern), the PF shall keep one hand on the power levers to facilitate immediate response of thrust Praise the gear when airborne with two positive indications of climb; increasing altitude and positive Vertical Speed Indicator (VSI). Use the verbal phrase “gear up.” If the PM agrees with the decision to raise the gear, PM should also use the verbal phrase “gear up.” Once both pilots vocalize “gear up,” the right seat pilot will select the landing gear handle to the up position.

CAUTION

During runway operation, insufficient weight on the right main landing gear squat switch may cause the landing gear handle downlock J-hook to unlatch and allow the landing gear handle to be inadvertently raised while the aircraft is on the ground.

Aborted Takeoff (Both Engines Operating). Any member of the crew may call an abort. Maintain directional control with smooth rudder application. The PF executes the abort procedures IAW NATOPS. Practicing aborted takeoffs familiarizes the student with procedures required to discontinue takeoff and safely stop the aircraft. The maneuver may be initiated by activation of the Master Caution/Warning lights, verbal calls of *"abort,"* or *"simulated low oil pressure,"* etc. Crew coordination is a necessity in emergencies and all crewmembers must know exactly what the PF intentions are. The IP is responsible for determining if sufficient runway remains before inducing an abort situation and informing Tower of the intention to abort. Initiate the abort prior to rotate utilizing the memory items in NATOPS. Use caution when using reverse if aborting for a power loss as you will not have symmetrical reverse thrust.

NOTES

1. Reverse is more effective at higher speeds, while brakes are more effective at lower speeds; however, this does not preclude the use of both simultaneously if required.

2. Solos shall not practice aborted takeoffs.

3. If power has been advanced and you are past the two thousand feet remaining marker on a touch and go, you should continue the takeoff and handle any malfunctions once airborne.

2. **Departure.** After the gear indicates up, props will be reduced to 1900 RPM. Adjust climb power, accelerate to the appropriate speed, and comply with course rules. Anticipate level off. Fine-tune the props as soon as possible to reduce cabin noise and airframe vibration. Accomplish the Climb Checklist in accordance with NATOPS and FTI Appendix.

Climb Checklist. The Climb Checklist ***should*** be called for above 1000' AGL except for low-level flights planned for extended periods below 1000'. Utilize the Abbreviated Climb Checklist when appropriate (between instrument approaches). Otherwise, execute the full Climb Checklist. The Climb Checklist is neither required nor desired if staying in the touch-and-go pattern or when utilizing the Nueces and Sunrise transitions to transit between KNGP, KNGW, and KCRP.
The following minimum AGL altitudes apply for training:

a. 8000 feet – Full Stalls

b. 5000 feet – Dynamic Engine Cut, Approach to Stalls (VMC to deck or 5000 feet above cloud deck)

c. 4000 feet – Ditching recovery, slow flight, actual engine shutdown/feather. (Weather conditions must allow a VMC return to the nearest suitable airport prior to actual engine shutdowns.)

d. 2000 feet – Initiate recovery from emergency descent

e. 1000 feet – Recovered from emergency descent/overwater seat changes

f. 800 feet – Overland seat changes

g. 300 feet – Simulated Single-Engine (SSE) after takeoff (IP initiated)

h. 200 feet – SSE waveoff (IP directed)

i. 100 feet – Normal waveoff (IP directed)

3. **Climb, Cruise and Descent.** A table of standard parameters is provided below. Torque settings are approximate and will differ widely due to differences in aircraft weight, in engine efficiency and variations in power output at different altitudes. Utilize these parameters when conducting curriculum maneuvers; however, they are not meant to restrict the full range of operating limits permitted by NATOPS. Advanced training often requires use of various settings in an operational environment.

Power Settings:

Maneuver	KIAS	Prop RPM	Torque
Normal Cruise	150	1900	650-700
Fast Cruise	170	1900	900-1000
Slow Cruise	130	1900	450-550
Cruise Climb			
SL-10K	150	1900	Max Allowable
10K-20K	130	1900	Max Allowable
20K-25K	120	1900	Max Allowable
above 25K	110	1900	Max Allowable
V_X	102	1900	Max Allowable
V_Y	108	1900	Max Allowable
V_{XSE}	102	1900	Max Allowable
V_{YSE}	110	1900	Max Allowable
Emergency Descent	227	2200	Idle

Figure 1-2 Power Settings

*Cruise descent may be made at any airspeed and power combination within the aircraft operating envelope. Observe V_{mo} limit.

**Nearly identical maximum rates of descent may be obtained in either the clean or dirty configuration. The dirty descent gradient is considerably steeper. Much greater distance over the ground will be obtained in the clean configuration.

Climb From Cruise. To enter climb from cruise:

a. Raise the nose to the climb attitude and transition to the appropriate climb airspeed, while simultaneously adjusting power as required.

b. Adjust pitch and power as required to maintain climb airspeed.

Cruise From Climb. To enter cruise from climb:

a. 50-75 feet prior to the desired altitude, smoothly decrease pitch to the cruise attitude.

b. Adjust power as necessary. Maximum climb power may be maintained until the desired cruise airspeed is attained.

Cruise From Descent. To enter cruise from descent:

a. 50-75 feet prior to the desired altitude, smoothly increase pitch to the cruise attitude.

b. Simultaneously apply cruise power.

Descent From Cruise. To enter a descent from cruise:

a. Reduce power as required.

b. Reduce pitch to obtain the airspeed/rate of descent combination desired.

NOTE

If desired descent airspeed is lower than cruise airspeed (e.g., Basic Instrument (BI) patterns, emergency descent), reduce power, and allow airspeed to bleed off prior to lowering the nose. Readjust power and pitch to maintain desired performance.

104. HIGH WORK

High work is a general category of any maneuver performed at altitude designed to build basic skills. Emphasis is placed on smooth power manipulation, aircraft control, and trim.

Normally, the student starting the aircraft will practice high work first and then swap seats at altitude. The second student will normally practice at altitude and then fly the aircraft to a selected field for pattern work. Place your seat full aft and full down and assist the relieving student with strapping-in to expedite changes. The new student flying should place his/her headset on as soon as possible. Do not use the controls or instrument panel as a handhold. An overhead strap is provided for that purpose.

During all high work, leave the landing/taxi lights off. Reply *"set"* to the challenge "*lights*" on the Landing Checklist. Utilize the heading bug as a reference while performing maneuvers. Only the PF will direct the cancellation of the gear warning horn when required. ***The gear horn circuit breaker shall not be pulled in flight.***

1. **Level Speed Change.** Level speed changes focus on aircraft control throughout changing airspeed and power configurations. Primary emphasis is on trim, heading, and altitude control. Conduct transitions in the following order:

   a. Normal cruise – 150 KIAS.

   b. Fast cruise – 170 KIAS.

   c. Slow cruise – 130 KIAS.

   d. Normal cruise – 150 KIAS.

Use power as required to expedite airspeed changes. Stabilize momentarily at each new airspeed before transitioning to the next.

2. **Turn Pattern.** The turn pattern is a coordination maneuver designed to build basic piloting skills. Emphasis is on trim, scan, altitude control, and smoothness. Enter on an assigned heading and maintain 150 KIAS with props at 1900 RPM. The pattern consists of turns and reversals and commenced in either direction. Lead all turns by about 1/3 the Angle of Bank (AOB) when rolling out or commencing a reversal. The 30° AOB turns may be omitted at the IP's discretion after initial introduction and initial practice of the entire maneuver. Procedures are as follows:

   a. 30° bank, 180° turn.

   b. 30° bank, 180° reversal.

   c. 45° bank, 360° turn.

   d. 45° bank, 360° reversal.

3. **Slow Flight.** Slow flight familiarizes pilots with low speed trim requirements and flight characteristics in the landing configuration.

Begin on an assigned altitude and heading with props at 1900 RPM and 150 KIAS. Maintain a constant altitude throughout the maneuver. Procedures are as follows:

a. Power – 400 ft-lbs (initially, then as required).

b. Flaps – Approach, anticipate the ballooning effect when lowering flaps by pushing forward on the yoke and trimming accordingly.

c. Gear – Down, Landing Checklist complete.

d. Airspeed – Stabilized at 100 KIAS. Power must be added as the aircraft nears its target airspeed.

e. Turn – In either direction for 90° at 30° AOB. Lead rollout by 1/3 the AOB. Stabilize momentarily, then turn back to the original heading. At slow airspeeds, the aircraft will reach 90° of turn very quickly.

f. Flaps – Down (IAW flap limiting speeds). Anticipate ballooning and counter with trim.

g. Airspeed – Slow to 90 KIAS. Power must be added as the aircraft nears its target airspeed.

h. Turn – Complete another 90° turn and reversal as before. Rate of turn will be faster at slower airspeeds.

i. Recover – Make a level recovery as follows:

    i. Power – Maximum allowable.

    ii. Flaps – Approach.

    iii. Gear – Up.

    iv. Flaps – Up.

    v. Airspeed – 150 KIAS. Adjust power as the aircraft nears 150 KIAS.

NOTES

1. Retracting flaps at low airspeed causes the aircraft to initially settle unless you make a substantial attitude change (pitch up approximately 7-10 degrees). After acceleration, the nose will pitch up and require forward yoke pressure until the elevator can be re-trimmed. Use of manual trim may be helpful and faster. At lower airspeeds, increasing power requires right rudder. As

airspeed increases, less rudder will be necessary to sustain balanced flight.

2. If any indication of stall is evident during the maneuver (e.g., stall warning horn), add power, decrease Angle of Attack (AOA), and commence stall recovery procedures. Continuation of the maneuver is at the IP's discretion.

3. On all maneuvers, gear and flaps may be cycled simultaneously, electrical loads permitting. Do not select flaps full down or full up without stopping at approach flaps first. Do not reverse the travel of the gear or flaps while in transit.

4. **Approaches to Stalls.** Approaches to stalls are practiced in order to recognize an approaching stall and to quickly execute a recovery with minimal altitude loss. Start approaches to stall on assigned altitude and heading at 150 KIAS.

a. **Pre-Stall Checks**. Complete the following pre-stall checks from memory prior to the first stall entry. Have the PM review it complete for subsequent approaches to stalls.

i. Spin Recovery Procedures – Briefed IAW NATOPS.

ii. Loose gear – Stowed.

iii. Altitude – 5000 feet AGL minimum (VMC to the deck, 5000 feet above cloud deck).

iv. Yaw damp – Off.

v. Props – 1900 RPM.

vi. Stall Speeds – Reviewed.

b. **Clean, Power Off**

i. Ensure Stall Checklist completed.

ii. ii. Roll into 30º AOB (clearing turn).

iii. Power – 400 ft-lbs.

iv. Roll wing level after 90° of turn.

v. Reduce power to idle. Maintain wings level and current altitude. Stop trim at 100 KIAS.

vi. Immediately recover at the first indication of stall as outlined in the stall recovery procedure.

c. **Dirty, Power Off**

i. Ensure Stall Checklist completed.

ii. Roll into 30º AOB (clearing turn).

iii. Power – 400 ft-lbs.

iv. Select flaps approach. Maintain altitude.

v. Select gear down and complete the Landing Checklist.

vi. Roll wings level after 90º of turn.

vii. Select flaps full down. Reduce power to idle. Maintain wings level and current altitude. Stop trim at 100 KIAS.

viii. Immediately recover at the first indication of stall as outlined in the stall recovery procedure.

d. **Dirty, Power On**

i. Ensure Stall Checklist completed.

ii. Roll into 30º AOB (clearing turn).

iii. Power – 400 ft-lbs.

iv. Select flaps approach. Maintain altitude.

v. Select gear down and complete the Landing Checklist.

vi. Roll wings level after 90º of turn.

vii. Select flaps full down. Maintain wings level and current altitude. Stop trim at 100 KIAS.

viii. Immediately recover at the first indication of stall as outlined in the stall recovery procedure.

e. **Approach Turn**

i. Ensure Stall Checklist completed.

ii. Roll into 30º AOB (clearing turn).

iii. Power – 400 ft-lbs.

iv. Select flaps approach. Maintain altitude.

v. Select gear down and complete the Landing Checklist.

vi. After 90º of turn maintain 30º AOB.

vii. Reduce power to 300 ft-lbs. Maintain 30º AOB and current altitude. Stop trim at 100 KIAS.

viii. Immediately recover at the first indication of stall as outlined in the stall recovery procedure.

f. **Stall Indications**

Initiate recovery at the first indication of any of the following:

i. Stall warning horn.

ii. Calculated stall speed.

iii. Airframe buffet.

iv. Uncontrollable loss of altitude.

v. Inability to maintain wings level/selected roll attitude.

NOTES

Solos shall not practice stalls.

g. **Stall Recovery.** Immediately regain flying speed with minimal altitude loss when recovering from a stalled condition. The T-44 climb performance will provide zero altitude loss under most conditions. Avoid large attitude and rapid configuration changes. Utilize the following procedures when recovering from a stalled condition:

i. Simultaneously:

(a). Power – Maximum allowable.

(b). Nose attitude – Adjust to break stall (relax back pressure to slightly lower the nose).

(c). Level wings.

(d). Center the ball.

ii. Flaps – Approach (unless already up). Ensure the aircraft is level or climbing with 85 KIAS or greater prior to raising the flaps to approach.

iii. Gear – Up (once a positive rate of climb is established).

iv. Flaps – Up.

v. Airspeed – V_Y.

NOTES

1. The maneuver is complete when established in a climb on assigned heading and trimmed for V_Y.

2. There is no assigned heading for approach turn stall recovery.

3. When performing this maneuver at high altitudes (above 8000' MSL), a secondary stall warning may sound if the pitch attitude is too high.

5. **Emergency Procedure Training.** Simulated emergency training is conducted during all phases of instruction. Practicing emergencies is required to develop fully qualified and confident flight crews. Accuracy is much more important than speed. Maintaining scan and control is imperative during an EP. During night or instrument conditions, direct the PM to activate switches (generator, etc.) outside your normal scan pattern. During any emergency, you should maintain aircraft control, analyze the situation, take the proper action, and land as soon as conditions permit. All emergencies shall be conducted in accordance with NATOPS and the FTI.

Emergency checklists are challenge-response-response. Instructors shall ensure the student verbalizes the correct responses to all checklist items. (To facilitate good CRM, students may add “left/right” to the response but this is not required and does not detract from standardization). Students will be held responsible for knowledge of all emergency procedures. NATOPS should be referred to in all emergencies and referenced at the completion of all memory item checklists.

a. **Single Engine Training.** Any number of simulated emergencies will require a SSE shutdown at altitude. Point to the appropriate prop lever/condition lever to identify the desired control. Do not move any prop/condition lever in flight unless an actual shutdown is intended. Emergency situations shall be handled IAW NATOPS. When an engine fails, more power may be required to maintain the established flight regime than is available with the operative engine. At least twice as much power will be required in most training circumstances on the operating engine to maintain the same flight regime. The use of rudder trim during SSE at altitude is highly encouraged.

If unable to maintain directional control, it may be regained by:

i. Increasing airspeed (may require trading altitude).

ii. Reducing power – This reduces the amount of asymmetric thrust.

When an engine fails, add the maximum power available until continued flight is assured. Only reduce when the desired altitude and airspeed are attained.

Proper management of the operating engine will increase the ability to safely reach a suitable landing area. Greater than normal cruise power will be required to maintain altitude and airspeed. Fuel must be carefully managed and crossfeed considered. Some situations, such as a windmilling prop, may demand very high power and place undesired mechanical stress on the operating engine. If maximum power is required to stay airborne, use it; however, if possible, use minimum power required to meet operational requirements.

Do not descend prematurely. Single-engine performance in the T-44 is not inspiring; however, turns can be made into or away from the failed engine. Evaluate crosswind and check runway length/width. Single-engine landings should be made on the most favorable runway preferably with the wind from the dead engine side to assist controllability in reverse conditions (reverse should only be used if landing distance is a critical). If the crosswind component on available runways is too demanding, consider utilizing another field.

WARNING

NATOPS recommends an approach flap landing, but if field length or conditions require full flaps, single-engine waveoff may not be possible.

b. **Simulating Feather.** When simulating feather, the IP should adjust torque on the "feathered" engine in accordance with NATOPS. This action results in achieving zero thrust.

c. **Return To Dual Engine Flight Following Single-Engine Training.** At the completion of SSE training returning to dual-engine flight is simple, but must be performed smoothly, especially if an engine has actually been secured or prop actually feathered. The objective is to allow the engine and prop to smoothly come up to speed. If power is added abruptly, prop or engine acceleration limits may be exceeded, and yaw may be excessive. Maximum torque should not be exceeded. Never add power to a feathered prop without placing the prop out of feather and allowing it to come up to idle RPM first. Slowly add power, allowing time for engine spool-up, and smooth prop acceleration, then continue to advance power to match the other engine. Smoothly adjust both power levers as required, adjust props as appropriate and fine tune to reduce cabin noise.

d. **Actual Engine Shutdown/Feather.** Engine shutdown, feathering, and restarts shall be conducted in accordance with NATOPS and only when required by the curriculum for the specific flight. Complete the Emergency Engine Shutdown Checklist, Windmilling Airstart Checklist, and/or Starter Assisted Airstart Checklist as required. The full Emergency Shutdown Checklist should be accomplished prior to accomplishing the Starter-Assisted Airstart Checklist.

During training, actual engine shutdown will only be induced by placing a condition lever to fuel cutoff. The condition lever shall not be moved from fuel cutoff after a shutdown until required by the appropriate restart checklist. Syllabus flights requiring actual prop feathering or engine shutdown shall be performed only in VMC during daylight. Weather must be in accordance with wing and squadron standard operating procedures. No engine may be secured or prop feathered below 4000 feet AGL, except during an actual emergency IAW CNAF M-3710.7 series.

For malfunctions that allow a restart after shutdown (e.g., chip light with no secondary indications), complete the Emergency Engine Shutdown Checklist, then execute the Starter Assisted Airstart Checklist down through Step 12. This will facilitate a quick restart should the operating engine malfunction. This is referred to as "pre-loading" the engine.

CAUTION

Do not touch a firewall valve or fire extinguisher button in flight unless an actual emergency necessitates a shutdown. Point to the applicable item during simulated training.

The emergency report should include as much of the following information as applicable, time permitting:

i. Declaration of emergency or MAYDAY.

ii. Identification.

iii. Souls on board.

iv. Nature of distress or urgency.

v. Weather.

vi. Intentions.

vii. Present position and heading, or if lost, last known position, time, and heading since that position.

viii. Altitude.

ix. Fuel remaining in hours and minutes for ATC and total quantity for firefighting preparation.

x. Any other useful information.

Do not sacrifice aircraft control to give the emergency report. If time is critical, accomplish the first three items as a minimum.

6. **SSE Waveoff at Altitude.** SSE waveoffs allow safe transition from SSE descending flight to maximum power, SSE climbing flight. The maneuver is designed to stop altitude loss as soon as possible while transitioning to a climb at a desired climb speed. Practice at altitude prepares the student for SSE waveoffs in the traffic pattern. The SSE waveoff is a demanding maneuver requiring precise aircraft control and expedient execution of procedures. Climb performance is directly proportional to how well the maneuver is executed. Limited power margins (especially at altitude) dictate exact execution.

Level off on a 1000 feet altitude plus 800 (e.g., 4800, 5800, etc.), 120 KIAS, on a numbered heading. This simulates 800 feet on the downwind leg of the traffic pattern. The IP will simulate a single-engine scenario by reducing one power lever to idle or simulating a situation requiring an engine to be secured. *"Power up, rudder up, clean up"* and complete the Emergency Shutdown Checklist without delay. The IP will call *"Approaching the 180."* Lower the flaps and gear and complete the Landing Checklist. Immediately start a descending left turn to arrive at the "90" at 500 feet and a minimum of 110 KIAS. Continue the turn to "final," rolling out at 250 feet with a minimum of 110 KIAS and maximum of 120 KIAS.

Smoothly place the props full forward. When IP calls *"Waveoff,"* execute the memory items for the Single-Engine Waveoff Procedure IAW ***NATOPS Chapter 16.***

Transition to a climb attitude while adding power to the operative engine. Anticipate the need for simultaneous application of rudder. Keep the ball nearly centered (¼ to ½ out towards the operating engine) while using up to 5º AOB into the operating engine. Maintain a minimum of V_{XSE} and a maximum of V_{YSE}. Level off or descend if required to maintain flying speed. Under no circumstances allow speed to approach V_{SSE}.

The maneuver is complete when established in a clean climb, minimum of V_{XSE} (preferably V_{YSE}), with the aircraft trimmed, and in balanced flight.

7. **Dynamic Engine Cut.** The dynamic engine cut simulates an engine failure immediately after takeoff with a windmilling prop. It allows practice of critical single-engine skills at a safe altitude. Emphasis is on heading and airspeed control, minimum loss of altitude, and completion of emergency checklist items.

Maneuver Setup. Begin on a numbered heading at 150 KIAS. Maintain level flight prior to setting a takeoff attitude. Utilize the following steps:

a. Prop Sync – Off.

b. Trim – 2° up and do not re-trim until after rotation. Utilize pitch to maintain altitude as airspeed bleeds off.

c. Power – 300 ft-lbs.

d. Props – Full forward.

e. Altitude – Minimum 5000 feet AGL, or with 5000 feet above a cloud deck.

f. Flaps – Up (normal takeoff configuration).

g. Gear – Down. Landing Checklist complete.

NOTE

A handy memory aid for setting up the Dynamic Engine Cut is the "5, 4, 3, 2, 1, Gear Down/Landing Checklist" technique, as follows:

FIVE – 5000 ft minimum

FOUR – Propellers full forward

THREE – 300 ft/lbs torque

TWO – 2 degrees nose up trim

ONE – Prop Sync Switch-Off

GEAR DOWN, LANDING CHECKLIST

Approaching 95 KIAS, smoothly apply takeoff power and rotate to the takeoff attitude (7-10 degrees up). Maintain heading. Anticipate the need for right rudder with power application.

NOTE

IP will not call *"Go"* as airspeed approaches 95 KIAS. Once takeoff power is set, the IP will call *"Rotate."*

At a speed above V_{SSE} the IP will pull one power lever to idle, simulating an engine failure. Raise your hand slightly when you feel the IP pull a power lever back. Do not grip the power levers so tightly that the IP cannot move the control. Do not attempt to anticipate which engine will be failed. An actual engine failure will be a surprise and require prompt recognition and action.

Primary scan should be outside on the horizon. Pick a point (e.g., a cloud) to assist in controlling yaw. Immediately stop the yaw utilizing rudder and aileron and adjust the nose attitude to maintain a positive rate of climb and appropriate airspeed (minimum of 91 KIAS (Vsse), accelerating to 102 KIAS (Vxse)/110 KIAS (Vyse). Substantial rudder pressure will be required. Use a maximum of 5º AOB into the operating engine to help maintain heading. Once aircraft control is fully regained, execute the Engine Failure After Takeoff Procedure IAW ***NATOPS Chapter 14.***

Identify the failed engine utilizing engine instruments (torque, ITT, N1, fuel flow) and rudder pressure. Your foot working hard to maintain heading is on the same side as the operating engine. Your non-working foot (dead foot) is on the same side as the dead engine. Do not look at the power levers to initially determine which engine has failed. During an actual engine failure, they would both be matched.

Hold the checklist momentarily after executing the first three memory items of the Emergency Shutdown Checklist and pull the props back to 1900 RPM. Reset maximum power and check to see if the prop feathered. If it did not, call for the Alternate Feathering Checklist. If it did feather, and the malfunction was a fire or fuel leak, continue the Emergency Shutdown Checklist with steps 4-6. Otherwise declare an emergency, and continue the Emergency Shutdown Checklist as times permits.

The maneuver is complete when the aircraft is climbing trimmed at V_{YSE} (minimum V_{XSE}), on takeoff heading, comms passed to the PM, and the Emergency Shutdown Checklist has been executed.

8. **Ditching.** Simulated ditching allows practice of procedures required to successfully complete a water landing. Waveoffs following a simulated ditch shall be initiated no lower than 4000 feet AGL utilizing both engines. The instructor shall fly all ditch recoveries. The maneuver is complete upon simulated water impact. “Sea Level” will be designated by the instructor (usually the bottom of the block). NATOPS discusses how to select an appropriate ditch heading. The weather information packet for operational flights usually contains recommended ditch headings for use when the crew cannot see the water surface. You should use all information available to select a ditch heading, but due to the limitations imposed by Seagull blocks, the IP may have to give you a ditch heading that will allow sufficient airspace to complete the maneuver. Ditching is most likely to be caused by an uncontrollable fire, fuel starvation, or dual engine failure. If ditching due to a low fuel state, complete the maneuver while power is still available on both engines. The following must be carefully managed for a successful ditch:

Wings Level/Heading. It does not do any good to fly a perfect ditch if the airplane hits a wave head-on. Ensure wings are level prior to impact. A couple of degrees off heading will not make much difference, but cart wheeling on impact could prove fatal.

Rate of descent. The airframe will absorb much of the impact, but not all of it. Excessive rates of descent greatly reduce the survivability of the ditch. The vertical deceleration will be almost instant on water impact. The greater the rate of descent, the higher the instantaneous G-load experienced by the crew.

Airspeed. Do not get slow. The recommended airspeed provides a safety margin to ensure controllability of the aircraft. Since the aircraft decelerates in the horizontal over a longer period of time, slightly higher airspeeds are still survivable.

NOTE

NATOPS provides an excellent discussion of ditching technique. The Ditching Checklist does not need to be memorized. General quizzing by instructors about checklist items is encouraged, but students are not expected to memorize these items.

a. **Power Available (Both Engines).** This situation would most likely be caused by a fuel problem (leak, poor planning, getting lost). Descend at a comfortable rate as you turn to the ditch heading. Complete the Ditching Checklist and follow NATOPS ditching techniques. Remember, nose attitude controls airspeed and power controls rate of descent. The Vertical Speed Indicator (VSI) lags, so concentrate on airspeed, allow the VSI to settle out and make required power adjustments. Utilize trim so the aircraft does the work.

b. **Power Available (Single-Engine).** This situation may be caused by an uncontrollable fire or other catastrophic engine failure. Time may be more critical since the fire may damage flight controls and/or structural integrity. Make an emergency descent as appropriate (if you are already close to the water a full blown emergency descent might increase your workload unnecessarily, but do make an effort to get down quickly). Select a ditch heading and complete the Ditching Checklist. Follow the NATOPS ditching technique. The single-engine ditch is essentially the same as the two-engine ditch. Power still controls rate of descent and nose attitude still controls airspeed. Keep the ball centered throughout the maneuver.

NOTE

If power is available, there is no reason to hit the water out of the parameters. If your ditch is not looking good, add power, climb up a couple hundred feet, and start over.

c. **Power Off.** The first priority after a dual engine failure is to attempt to regain the use of one or both engines. The altitude and airspeed at the time of the power loss will determine if this is an option. Use pitch attitude to slow to Maximum Range Glide Speed 130 KIAS, while maintaining your present altitude as long as possible.

NOTE

At low altitude consideration should be given for using max endurance glide speed 102 KIAS in order to minimize altitude loss during attempted restart.

Attempt a restart with the appropriate checklist. If light-off does not occur within 10 seconds, call for the Emergency Engine Shutdown Checklist. Continue to use pitch attitude to maintain Maximum Range Glide Speed as you complete the Emergency Engine Shutdown (minimum first three items as altitude permits) and Ditching Checklists. The idea is to trade airspeed for rate of descent.

d. **Dual Engine Failure.** A simulated dual engine failure allows practice of restart procedures and may be followed by a simulated ditch. Simulated ditches shall not be practiced with an engine actually secured or a prop feathered.

The maneuver may be initiated in any configuration above SSE by the IP reducing both power levers to idle. It may be commenced following a simulated engine shutdown by reducing the remaining power lever to idle. You will select an appropriate ditch heading unless instructed otherwise.

The size of the working blocks (e.g., 2000 feet) generally do not allow sufficient time to complete a successful Starter-Assisted Airstart. Unless NATOPS recommends not attempting a restart (fire, etc.), or insufficient battery voltage exists, a simulated restart attempt should be made on both engines simultaneously. The following procedures should be utilized:

i. Clean up if required and commence a turn toward the coastline, a desired heading, or IP assigned heading while transitioning to max range airspeed. Max endurance airspeed will allow you more time for restart if altitude is minimal.

ii. Simultaneously commence the Windmilling Airstart Checklist. Simulate both condition levers at fuel cutoff by pointing at both levers. The autoignition may be armed, or the starters may be simulated on, at the student's discretion. The IP will state *"no lightoff"* or *"lightoff on the left/right/both."* If a restart is successful, add power and complete the checklist. If the restart fails, complete the Emergency Engine Shutdown Checklist (appropriate items as time permits) and follow ditching procedures.

iii. Stop engine restart attempts at some point during the engine out ditch. The engines should be secured by doing at least the first three items of the Emergency Shutdown Checklist. Place emphasis on flying a proper ditch. Attempting engine relights all the way to the water is likely to deplete all battery power if using the starters. This would eliminate the possibility of a successful IFR ditch.

105. AREA DEPARTURE

Complete the Approach Checklist in accordance with NATOPS and course rules. Obtain ATIS information for your intended destination. A common technique to remember is to do the "A-B-Cs" or "A-C-A-S-A" to depart the Seagull working area.

ATIS – Obtain ATIS.
Brief – Give the Touch-and-Go Brief, and discuss your plan to get to the airfield.
Checklist – Call for the Approach Checklist.

ATIS – Obtain ATIS
Cabaniss – Contact Cabaniss Field on Ch. 15 to find out the landing runway

Approach Checklist – Call for the Approach Checklist
Seagull – Terminate with Seagull on Ch. 19
Approach – Check in with Corpus Approach on Ch. 8

Terminate with the appropriate agency/agencies and proceed according to course rules. If a VFR return cannot be made, contact Approach and request an appropriate IFR routing. Emergency descents will usually be practiced on the descent radials after departing the working area.

NOTE

Aircraft utilizing Cabaniss Field should contact Cabaniss Tower prior to area departure.

Emergency Descent. The emergency descent shall be accomplished IAW NATOPS (clean or dirty configuration) with the student verbalizing each step. The emergency descent enables maximum altitude loss in minimum time. It may be utilized under normal or emergency conditions when rapid loss of altitude is desired. Consider desired altitude loss, angle of descent, and status of aircraft power source when choosing configuration. During low altitude operations, recoveries must be commenced no lower than 2000 feet AGL and completed no lower than 1000 feet AGL. Do not exceed gear, flap, or structural limiting airspeeds. Windshield heat is utilized to prevent condensation when descending from high altitude into a warm moist environment. It generally is not required during low altitude operations. The emergency descent is complete when the aircraft is level with power set and props at 1900. It is recommended that you place the props to 1900 as you arrest the rate of descent while beginning to recover from the emergency descent.

106. PATTERN WORK

Pattern work is the focus of the Contact stage. Takeoff and landing will always be part of your flight profile, regardless of mission or aircraft type. Obviously, if you cannot land the aircraft, little else matters. Pattern work will teach you to safely recover the aircraft in both normal and emergency situations.

1. **Break Entry.** Enter the break IAW course rules with wings level at 200 KIAS. Report the numbers, or as directed. When cleared, smoothly roll into a level bank, not to exceed 45º, while simultaneously reducing power to idle. Select approach flaps (174 KIAS maximum) and anticipate ballooning. Utilize the horizon in conjunction with the attitude gyro to maintain a smooth, level turn.

Select gear down (155 KIAS maximum) and complete the Landing Checklist. Landing, taxi, and strobe lights are left on in the traffic pattern.

Adjust AOB to roll out on downwind with the runway on the lift detector (left pattern). This will place the aircraft approximately 1 mile abeam. Slow to 120 KIAS on downwind and then descend to pattern altitude.

NOTES

1. Field elevation at NGW is 30 feet. For traffic pattern training, field elevation is considered to be 0 feet. Additionally, a maximum of 4 aircraft are permitted in the pattern at Cabaniss.

2. Due to increased airfield elevation, the pattern altitude at Orange Grove is 800' AGL/1000' MSL instead of the 800' AGL/MSL pattern at Navy Corpus/Cabaniss.

3. Pattern altitude at Goliad is 800' AGL/1100' MSL.

4. Harlingen Tower often directs a 1000' AGL/MSL pattern (Field elevation is 36').

5. At Orange Grove, place the transponder in standby when entering the pattern.

6. Terrain Warnings should be inhibited while conducting landing pattern work at Cabaniss or any other authorized field that does not appear in the T-44C Integrated Hazard Avoidance System (IHAS) database. To inhibit the terrain warnings, select TERR and hold MODE until the message Terrain Inhibit appears. Reverse the procedure to reactivate the terrain warnings.

a. **Downwind Entry.** A downwind entry is made at 1000' (AGL), preferably on a 45º angle. Transition to 130 KIAS, intercept midfield approximately 1 mile abeam, and turn downwind. Transition to the landing configuration and descend to pattern altitude once established downwind.

b. **Base Entry.** A base entry is performed by arriving at the 90º position with 110-120 KIAS, 500 feet AGL, and Landing Checklist complete.

2. **Normal Landing Pattern.** Leave the gear down for the normal landing pattern. The landing pattern consists of upwind, crosswind, downwind, 180º position (abeam), approach turn (base), 90º position, and final. All altitudes listed below are AGL. Use of rudder trim is not recommended in the landing pattern. In all cases, rudder trim shall be centered by the 180 position.

Observer (OBS) responsibilities include maintaining a lookout for traffic, monitoring the radios, counting landings, checking three green lights/props full forward on final, and checking flaps up on touch and go. The landing pattern is a geographic pattern, meaning the aircraft should be flown over the same points each time and adjustments for wind be made with bank angle.

a. **Upwind.** The upwind leg is flown along the extended runway centerline at an altitude of 300-500 ft and 120 KIAS (not to exceed 130 KIAS). Crab into the wind to maintain centerline. After receiving Tower clearance for downwind, report clear left and right, and as soon as possible after reaching 300 ft, with the required interval. An immediate turn is desired to prevent an extended pattern. If only one aircraft is in the pattern, the Tower will normally authorize *"All turns downwind at Pilot's discretion"* or *"you have left closed traffic, report the 180 with the gear on each pass"* and a radio call is not required. Always check for traffic prior to turning. Near-misses and midair collisions have occurred in the pattern with other aircraft.

Per course rules, normal interval following a T-44/T-6 touch and go aircraft is 15 degrees ahead of the wing, or abeam if the aircraft is still in a crosswind turn. If the T-44/T-6 is known to be a full stop aircraft, interval is 30 degrees behind your wingtip.

b. **Crosswind.** Scan the horizon and attitude gyro in the crosswind turn. Maximum AOB is 30º in the pattern. Maintain balanced flight and 120 KIAS. Passing 600 ft, direct approach flaps and adjust power as required to level off on downwind at 800 ft (or published pattern altitude) and 120 KIAS. If a no-flap landing is desired, leave flaps up. Complete the landing checklist as soon as practicable. Remember that all non-memory item checklists will be referenced during performance to include the landing checklist.

c. **Downwind.** Scan the horizon, attitude gyro, and IVSI to maintain pattern altitude and 120 KIAS with the aircraft trimmed. Fly approximately one mile abeam by keeping the lift detector on the runway edge (left pattern). In right traffic utilize a similar position on the wing to maintain desired position. Crab into the crosswind as required in order to obtain a desired track over the ground. Maintain balanced flight.

The distance abeam may be adjusted slightly to compensate for strong crosswinds when bank angle in the final turn is not enough to keep the aircraft from overshooting. Attempt to maintain as tight a pattern as possible. If not already completed, complete the landing checklist while adding power as required to maintain 120 KIAS. Do not respond, *"Down and Locked"* until all three gear indicate green. The objective is to maintain a consistent ground track, while compensating for winds with bank angle during the crosswind and final turns.

d. **180º Position (Abeam).** Visually check for three green lights indicating gear down and locked, then make a report to Tower IAW the Typical Briefs and Voice Procedures Appendix. If the gear is up for any reason, ensure the PM has been briefed on your intentions and report *"Gear is up"* to the Tower. Complete the Landing Checklist and report the gear down to the Tower no later than the 90. During contact training, the gear shall never be held past the 90.

No-wind turns are made abeam the intended point of landing. Adjust this position for known headwind on final (begin turn early) and tailwind (begin turn late) components. Adjust AOB for overshooting (greater AOB than normal) and undershooting (lesser AOB than normal) crosswinds.

e. **Approach Turn (Base).** The approach turn is normally commenced abeam the intended point of landing. The turn point may be adjusted slightly to compensate for strong winds. Maintain as tight a pattern as possible. Reduce power and bank the aircraft as required to make a continuous descending/decelerating turn to final (maximum of 30 degrees AOB). AOB and power required may vary significantly depending on wind direction and aircraft weight. For overshooting crosswinds, use less AOB from the 180 turn to the 90° position and more AOB after the 90. For undershooting crosswinds, use more AOB from the 180 turn to the 90 and less AOB after the 90° position. Avoid angling in or overshooting on final.

f. **Final.** Continue the final turn, maintaining balanced flight and a maximum of 30º AOB. Arrive on extended runway centerline, 1000-1200 ft from the threshold, at 250 ft. After rolling out on final, maintain aircraft centerline parallel to runway centerline with rudder. Use aileron to keep the aircraft from drifting off centerline ("wing down, top rudder" is a good technique). Avoid angling to final. Look down the entire length of the runway to get a good perspective on alignment. The correct sight picture will put the runway centerline between your legs. A constant angle of descent to the touchdown point is desired. The runway numbers should be your aim point while in the contact pattern, thus the descent angle is slightly steeper than a standard 3° instrument approach glideslope. On final place the props full forward, verify three green lights, gear handle down with no red light, then respond *"Props full forward, three down and locked, review me complete."* The PM will verify the props full forward, three green lights, and gear handle down with no red light and then respond *"Reviewed complete, cleared (option, full stop, low approach)."* The landing should be made in the first 1000 feet of the runway. Maximum crosswind component is 20 knots. During Contact training, place the props full forward at the same point in the pattern on each approach. They shall not be utilized as "speed brakes" to compensate for sloppy airwork.

In gusty wind conditions, consideration should be given to maintaining 5 to 10 knots above normal speeds.

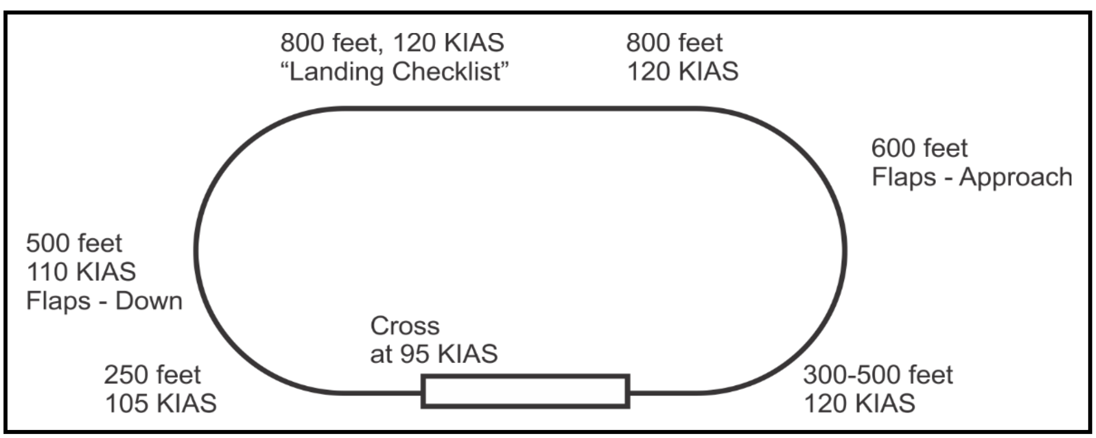

Figure 1-3 Normal Landing Pattern (Approach and Full Flap)

NOTES

1. All altitudes are given in AGL.

2. It is assumed that the landing gear is already down during the entire pattern.

g. **Approach Flap Landing.** Approach flap landings are the standard landing profile for the T-44. Approach flaps allow comfortable landing airspeeds without requiring high power settings by providing additional lift without dramatically increasing drag. Roll onto final at 105 KIAS. Cross the threshold at 95 KIAS. Slowly close the power levers while bringing the nose up (flare).

h. **No-Flap Landing.** A no-flap landing may be required following a flap malfunction. For this reason, we practice no-flap landings and flap malfunction scenarios. The same airspeeds and altitudes apply through the 90, then roll onto final at 110 KIAS. Reduce power and adjust nose attitude as required to control airspeed. There is less drag in the no flap configuration and the tendency is to arrive fast over the numbers. Cross the threshold at 105 KIAS. Slowly close the power levers while gradually bringing the nose up (flare). Avoid making an abrupt pitch-up correction. The aircraft will tend to balloon and then sink rapidly as airspeed nears the stall.

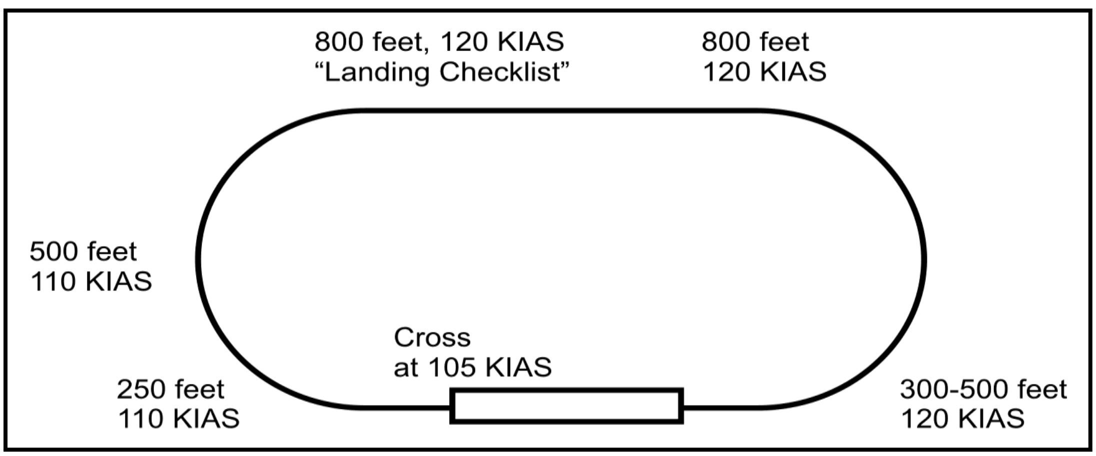

Figure 1-4 No Flap Landing Pattern

NOTES

1. All altitudes are given in AGL.

2. It is assumed that the landing gear is already down during the entire pattern.

i. **Full Flap Landing.** Full flap landings can dramatically decrease landing roll distance, but require higher power settings due to increased drag. Select flaps down after the 90, but before rolling onto final at 105 KIAS and selecting props full forward. Additional power is normally required to compensate for increased drag. Cross the threshold at 95 KIAS. Slowly close the power levers while bringing the nose up (flare). Beware of porpoised and/or flat landings.

j. **Touchdown.** It is critical to maintain proper alignment on touchdown. Scan down the entire length of the runway and keep the centerline between your legs. ***Do not fixate on a spot near the aircraft.*** Utilize rudders to keep the nose parallel and aileron to maintain position. If a crosswind correction is required, the upwind mainmount should touchdown before the downwind one. The nosewheel must touchdown last. Maintain corrections throughout the landing and rollout. No large control inputs are required or desired. Ideally, power levers will be at idle when the aircraft touches down on all normal landings.

WARNING

A porpoised landing may occur if the nosewheel touches down before the mainmounts. The nose will generally bounce back up and induce an uncontrollable oscillation until airspeed decreases below 40-50 KIAS. If a porpoised landing is encountered, immediately reduce power levers to idle and apply back pressure to maintain a “flare attitude” until the oscillation stops, and then accomplish a full-stop landing. A waveoff is not recommended due to proximity to V_{SSE} and V_{SO}. It is better to accept a hard or rough landing rather than attempt a waveoff.

NOTE

The transfer of controls from the instructor to the student on the deck during the touch-and-go sequence is not recommended. There must be no question as to who has the controls during this critical phase of flight.

k. **Full Stop.** Dual-engine full-stop landings may be made in any flap configuration. Crosswind corrections must be maintained throughout the landing rollout. Once the nosewheel is on the runway, lift the power levers over the detent and ***smoothly*** pull into reverse. Use of reverse will depend upon circumstances. Prolonged full reversing with resultant airframe vibration, engine noise, and possible prop erosion should be avoided. Augment with smooth, even braking as required. Prop reverse is more effective at higher airspeeds and brakes more effective at lower airspeeds. Scan the length of the runway to maintain centerline. Come to a slow taxi prior to making any abrupt turns to avoid stressing the gear. The After Landing Checklist shall not be commenced until clear of the runway.

If a landing is made with props inadvertently left at 1900 RPM, ***slowly*** advance the props full forward prior to utilizing reverse, or stop using brakes only.

l. **Touch and Go.** Touch-and-go landings are an integral part of the curriculum. They require concentration, quick scan, and thorough briefing. Maintain crosswind corrections throughout the landing and rollout. Maintain centerline and alignment. Do not fixate inside the cockpit. Prior to executing a touch and go, complete the Touch-and-Go Briefing as per the Typical Briefs and Voice Procedures Appendix. Additionally, touch and goes, full stop landings, and waveoffs, completed with the SMA as PM, do not count against the landing pattern limits, as set forth in the CTW4 SOP (COMTRAWINGFOURINST 3710.11 series).

Once safely on the runway (with nose wheel contact) the PF will:

i. State *"Reset Flaps and Trim,"* then advance the power levers to the 12 o'clock position to obtain engine spool-up.

ii. When the PM calls *"Go,"* further advance the power levers to maximum allowable torque (a minimum of 1000 ft-lbs or greater) to set takeoff power.

iii. With a minimum of 91 KIAS and takeoff power set, execute a normal takeoff when the PM calls *"Rotate."* Keep your hand on the power levers until the aircraft is climbing and well clear of the ground.

After touchdown the PM will:

i. Respond to the PF's direction by stating *"Flaps,"* then reset the flaps for takeoff.

ii. Respond to the PF's direction by stating *"Trim,"* then reset the trim for takeoff.

iii. Confirm flaps set, trim set, and props a minimum of 2000 RPM with engine spool up, by calling *"Go."*

iv. At 91 knots, verify takeoff power set, and call *"Rotate."* Back-up the power levers, monitor engine instruments, and assist the PF as needed in fine-tuning the power levers to prevent exceeding limits.

If a malfunction occurs during the touch and go, consideration should be given to runway remaining prior to aborting. It is recommended with less than 2000 ft remaining (past the two thousand feet remaining marker or the "two board") and power levers advanced beyond the 12 o'clock position that the takeoff be continued. Do not try to abort at this time. This recommendation does not replace pilot judgment during a catastrophic emergency. Immediate action must be taken to determine if the takeoff can be continued.

Once airborne and above 300 ft, verify takeoff power is still set and then pull the props back to 1900 RPM. Maintain 120 KIAS in the climb. Do not allow the aircraft to accelerate past 130 KIAS. A continued nose attitude of 7-10 degrees up greatly assists in maintaining the desired 120 KIAS climb to pattern altitude. Scan over the nose to aid in maintaining the desired climb attitude. Fine-tune the props when able to reduce cabin noise and airframe vibration.

If the crosswind turn is delayed, be prepared to reduce power to prevent climbing through 500 ft. If extended upwind, transition to balanced flight and crab into the wind to maintain departure centerline. Use power as required to maintain 500 ft. Listen carefully for clearance to turn downwind. If not received, do not delay requesting clearance. Keep the pattern as tight as possible.

3. **Waveoff.** Waveoffs shall be accomplished in accordance with NATOPS. Waveoffs allow safe transition from low-powered, descending flight, to high-powered, climbing flight. The maneuver is designed to stop altitude loss as soon as possible while transitioning to a climb at the desired climb speed. Minimum altitude for an IP initiated practice waveoff is 100 feet. The IP may take the controls and execute any waveoff required below 100 feet. A waveoff shall be executed under the following conditions:

a. Excessive overshoot of the runway/greater than 30º AOB required during the approach turn.

b. Landing clearance has not been received by short final.

c. The IP, wheels watch, Tower, or the RDO issues any verbal or visual waveoff signal.

d. Any time three green lights are not visible after rolling onto final.

e. Any time the PF feels an unsafe condition exists.

f. Give consideration to waving off if touchdown cannot be accomplished on the first one-third of the runway.

Be alert to reducing power and leveling at 500 feet, unless cleared downwind. Do not exceed pattern airspeeds or overtake other aircraft. Initiate the waveoff by adding power as required and establishing a positive rate of climb. Then, offset slightly from the runway (on the pattern side) to allow a better view of traffic over or on the runway. When you're cleared for the option, you're cleared for a touch and go, low approach, missed approach, stop-and-go, or a full stop landing. Common errors include beginning the offset too early or communicating with Tower before flying the airplane.

4. **Right Seat Responsibilities.** As a copilot, you must execute checklists when required, following the challenge-response format (or challenge-response-response for EPs.) Do not forget to respond to PM items. You are generally responsible for the avionics, switches, and

gear on your side of the cockpit, although the PIC is ultimately responsible for aircraft operation. You must clear the right side of the aircraft and review the gear is down and props are full forward before landing. During touch and goes, you should reset the trim, call *"go"* when the engines have spooled up, and call rotate at takeoff speed with takeoff power set. The PM is a check on safety of flight and should add to the PF's situational awareness and assist as directed.

5. **Simulated Single-Engine (SSE) Landing Pattern.** The SSE landing pattern acquaints the student with procedures required to land safely following the loss of an engine. The SSE pattern is very similar to a normal pattern except considerations are made for decreased performance and reduced directional control. Maintain higher than normal speeds from the 180 to touchdown to ensure directional control margins are maintained. Rudder trim is not recommended in the SSE landing pattern; however, if rudder trim is used it should be centered by the 180 position and must be centered prior to the final turn. You may use the PM to check the position, but not to center it for you. Never sacrifice control of aircraft to complete a checklist. The PF should appropriately direct the PM to *"hold the checklist"* or *"continue the checklist"* as time permits. The "power up, rudder up, clean up" method is a good technique to remember whenever experiencing power loss.

NOTE

When performing the Emergency Shutdown Checklist, do not configure or call for the landing checklist until the required memory items have been completed. In certain circumstances, temporarily delaying the 180 turn may be prudent in order to ensure the landing checklist will be complete prior to the 90.

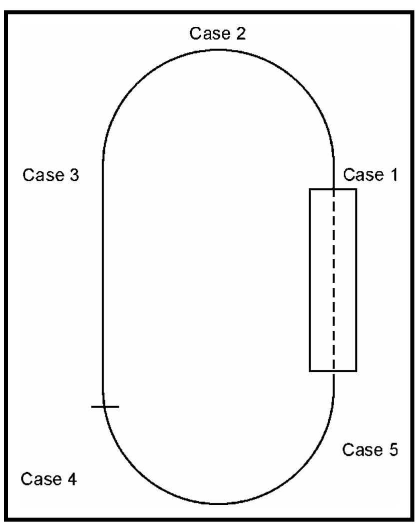

Figure 1-5 SSE Pattern

Case 1. Takeoff to Crosswind. For an engine related malfunction before the turn to crosswind proceed as follows:

a. Determine if the malfunction has caused a power loss:

i. If the malfunction has caused a power loss after takeoff, execute the ENGINE FAILURE AFTER TAKEOFF procedure through the first three steps of the Emergency Shutdown Checklist. Hold the checklist momentarily and pull the props back to 1900 RPM. Reset maximum power and check to see if the prop feathered. If it did not, call for the Alternate Prop Feathering Checklist. Once the prop has feathered, and with proper downwind interval, initiate the crosswind turn at 300’ AGL or above and continue the checklist.

NOTE

The intent of the ENGINE FAILURE AFTER TAKEOFF procedure is for the flying pilot to continue the checklist past step 3 while airspeed is trending towards the target of Vxse or Vyse. Aircraft acceleration to the target airspeed may not be attainable if the propeller fails to feather. Continuing the checklist should lead to the propeller feathering in a timely manner, thus enabling attainment of the intended airspeed.

ii. If the malfunction has not caused a power loss: clean up and given proper downwind interval, initiate the crosswind at 300’ AGL or above. If the malfunction will require an emergency shutdown or a prop to be feathered, clean up the aircraft and continue the turn to downwind and climb to pattern altitude. Execute the Emergency Shutdown Checklist when wings level on downwind, at pattern altitude and 120 KIAS.

b. Perform or continue the applicable procedure/memory items. Determine if there is a confirmed/suspected fire or fuel leak while simultaneously pulling props back to 1900 RPM. Declare an emergency, and continue the checklist as time permits.

c. Climb to pattern altitude, and then accelerate to 120 KIAS. Maximum allowable power may be required initially, but should be reduced once 120 KIAS is established.

NATOPS WARNING

If the autofeather system is activated, retarding either power lever before the feathering sequence is complete will deactivate the autofeather circuit and prevent automatic feathering.

NOTE

Identify the failed engine utilizing engine instruments (torque, ITT, N1, fuel flow) and required rudder. Your foot working hard to maintain heading is on the same side as the operating engine. Once you have reached 102 KIAS, raise the nose to stop any altitude loss, and accelerate to 110 KIAS. Banking 5° into the operating engine, while maintaining the ball nearly centered (¼ to

½ out towards the operating engine), is critical to optimizing single engine climb performance at low airspeed and high AOA.

Case 2. Crosswind Turn. Loss of an engine in a high AOB turn requires immediate action, especially when turning into the failed engine. Proceed as follows:

a. Determine if the malfunction has caused a power loss:

   i. If the malfunction has caused a power loss: roll wings level to allow proper analysis and better control of the aircraft. Add power on the operating engine (as required), nearly center the ball (¼ to ½ out towards the operating engine) and clean up the aircraft. Maintain a minimum of 102 KIAS (Vxse) or 110 KIAS (Vyse). After establishing coordinated flight, continue the crosswind turn. Continuation of the crosswind turn is desired to prevent extending the pattern.

   ii. If the malfunction has not caused a power loss: continue with the turn to downwind, handle the malfunction, and climb to pattern altitude. If the malfunction will require an emergency shutdown or a prop to be feathered, consideration should be given to cleaning up the aircraft, delaying execution of the Emergency Shutdown Checklist or Primary Governor Failure/Malfunction until wings level on downwind, at pattern altitude and 120 KIAS.

b. Perform the applicable procedure/memory items. Declare an emergency, and continue the checklist as time permits.

c. Climb to pattern altitude, and then accelerate to 120 KIAS. Maximum allowable power may be required initially, but should be reduced once 120 KIAS is established.

Case 3. Downwind.

a. Add power on the remaining engine (as required), nearly center the ball (¼ to ½ out towards the operating engine) and clean up if required to maintain 120 KIAS and pattern altitude.

NOTE

Use good judgment to make your decision whether or not to cleanup. High gross weight, high density altitude, and/or other traffic in the pattern may require that you clean up in order to maintain pattern altitude. If the decision is made to clean up, raise both the gear and the flaps; however, if the emergency (Case 3) occurs nearing the 180 position, it may not be necessary or advisable to cleanup. (Midfield and beyond is a good rule of thumb).

b. Perform the applicable procedure/memory items, declare an emergency, and continue the checklist as time permits.

c. Just prior to the 180, if attitude and airspeed permit, select approach flaps, gear down, and complete the Landing Checklist (if not previously completed). The PM is responsible for making radio calls.

NOTES

1. If altitude and/or airspeed do not permit lowering of the flaps and landing gear, inform the PM and Tower you are holding the gear until reaching the pattern profile.

2. If the Landing Checklist is interrupted, it shall be reinitiated from the beginning.

d. Maintain a minimum of 110 KIAS to the 90. The Landing Checklist shall be complete no later than the 90.

Case 4. Approach Turn. The approach turn is defined as any point after commencing a turn off the 180 until the 90. Power loss in a descent is normally easy to control with only a slight power addition.

a. Add power on the operating engine (as required) while maintaining 110 KIAS minimum, nearly center the ball (¼ to ½ out towards the operating engine) and continue the approach turn. Do not raise the gear unless executing a waveoff.

b. Perform the applicable procedure/memory items, declare an emergency, and continue the checklist as time permits.

NOTES

1. When a fire/fuel leak is discovered past the 180 position, only the first three memory items of the Emergency Shutdown Checklist are required. You may complete the checklist if able, but not at the expense of maintaining solid BAW. Generally, once established on final, focus should be on the landing.

2. After a waveoff is executed the pilot should call for the remainder of the applicable procedure/checklist as appropriate.

3. Once the memory items have been completed, the remainder of the checklist will be completed on deck.

Case 5. After the 90. The steep glideslope maintained in the VFR traffic pattern usually requires little power on final. Therefore, power loss should pose no particular problem. Only slight additional power is normally required. The need for power is usually most noticeable nearing the runway. Maintain directional control and crosswind corrections, ensuring sufficient power to sustain 110 KIAS to the threshold. Accomplish the first three memory items (***optional***); however, do not sacrifice aircraft control to complete the memory items. In the event the memory items cannot be accomplished, indicate that you will land the aircraft and then deal with the emergency on the deck. Concentrate on flying the aircraft to a smooth touchdown on centerline. The aircraft has a tendency to float with one engine feathered. After safely touched down utilize the SSE full stop procedures described below.

NOTES

1. Use of full flaps is left to the discretion of the PIC, but is not recommended due to the reduced waveoff capability. Students shall not practice full flap SSE landings.

2. For actual engine failures, except for a Case 5 failure, the failed engine would have been feathered during the Emergency Shutdown Checklist. If a prop has been feathered, only the operative prop would be placed full forward. In a Case 5 failure, land with both props full forward unless the failed engine has been feathered. It is unlikely the prop would autofeather since the power levers would probably not be above the 90% position. If a waveoff is required under actual single-engine conditions, placing both power levers to maximum allowable should result in an autofeather.

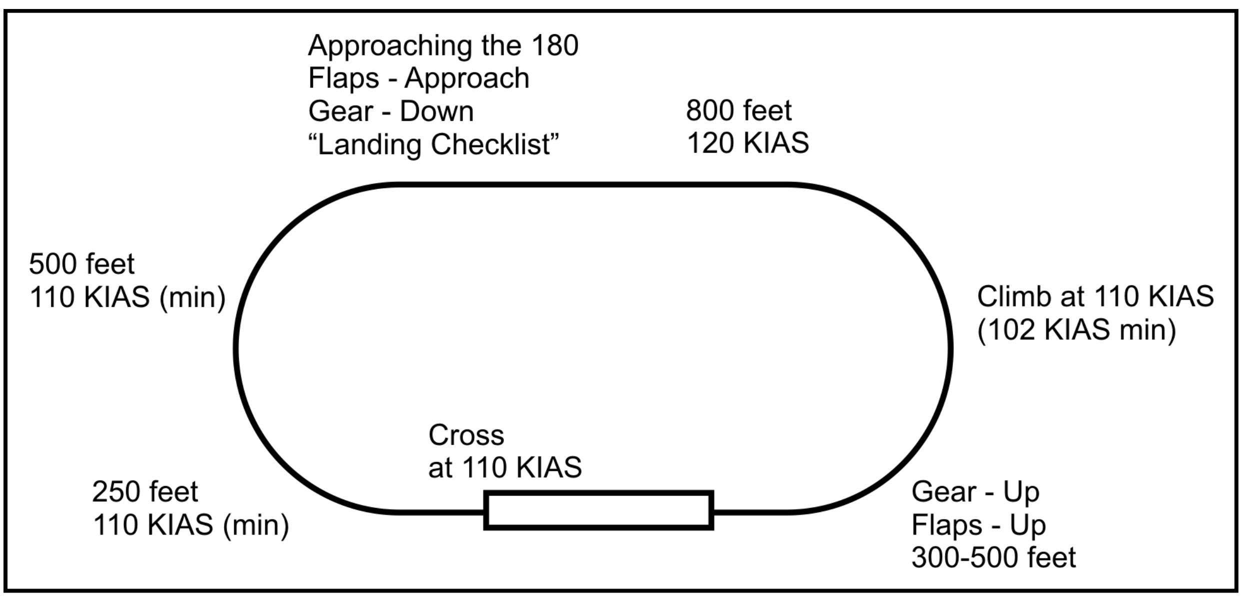

Figure 1-6 SSE **Landing Pattern**
(All altitudes are given in AGL.)

a. SSE Full-stop landing. The SSE full-stop landing presents no particular control difficulties as long as the following procedures are adhered to exactly. After landing, reduce power to idle. Lift both power levers over the detent and slowly ease the operating engine into reverse. Scan toward the end of the runway for alignment. Counteract yaw with rudder and use brakes and power to maintain centerline. Push the yoke full forward and the aileron into the dead engine. If yaw becomes excessive, reduce or discontinue reversing and stop with brakes. Be careful to not lock the brakes. The maneuver is complete when the aircraft has come to a slow taxi on the runway. Following an actual single-engine landing, clear the runway if practicable, then perform shutdown. *Do not attempt to taxi on one engine*. Make single-engine landings on the most favorable runway. Placing the dead engine into the wind may facilitate aircraft control during the landing rollout. Placing the good engine into the wind may help aircraft control and reduce rudder requirements while airborne.

SSE full-stop landings shall only be performed if the SSE full-stop landing Brief has been completed and can be found in the FTI Typical Briefs and Voice Procedures Appendix. SSE full-stop training shall only be performed on a dry runway. Effects of crosswind on rollout shall be discussed. This maneuver is accomplished to demonstrate the coordination required to keep the aircraft on centerline when reversing only one engine. An actual single-engine full stop with reverse would only be used if landing distance were critical. Provided the landing is not excessively long, the runway length minimums utilized on all training flights provide sufficient runway to execute a single-engine full stop without the use of reverse.

b. **SSE Waveoff.** SSE waveoffs allow safe transition from SSE descending flight to maximum power SSE climbing flight. The maneuver is designed to stop altitude loss as soon as possible, while transitioning to a climb at the desired climb speed. Minimum altitude for the IP to initiate a practice SSE waveoff is 200'. The IP shall take the controls, utilize both engines, and execute any waveoff required below 200'.

The SSE waveoff is a demanding maneuver requiring precise aircraft control and expedient procedures. Climb performance is directly proportional to how well the maneuver is executed. Limited power margins dictate exact execution. Utilize T-44C NATOPS Single Engine Waveoff procedures.

If possible, wave off slightly offset to the pattern side of the runway to allow a better view of the traffic.

To standardize all waveoffs, the copilot shall report *"gear up"* before the props are retarded to 1900. The intent of this requirement is to ensure that instructors can maintain proper defensive positioning throughout the waveoff. Students must ensure that they understand the aerodynamic concepts behind getting the gear up, props back, and proper power set for the best performance.

During a single engine waveoff, airspeeds between 102-110 KIAS are acceptable; however, the pilot should strive to climb out at best angle or best rate of climb as needed. Students should be targeting one of these two airspeeds not simply attempting to be between 102-110.

6. **Departing the Visual Flight Rules Pattern.** In the local area, if NGP weather requires IFR, place the appropriate IFR clearance on request. If VFR, depart the airfield via course rules. Tower must coordinate all departures if a Nueces or Sunrise (Tower-to-Tower) transition is required. Clearance for VFR departure normally takes only a few minutes unless an emergency is in progress at NGP. IFR departures require more coordination and may take longer. If the weather is marginal, check ATIS several times during the flight or contact NGP Metro (343.5) to stay on top of the situation. Allow extra fuel if an approach is required. It is always better to "incomplete" rather than press on with inadequate reserves. Landing is required before either fuel gauge indicates within the yellow arc.

If departing IFR, squawk the assigned code and contact Approach when directed.

If departing VFR, do so in accordance with course rules. Carefully note the assigned runway and instructions. Do not confuse left and right runways at NGP. Prevailing winds from the Southeast favor runway 13 throughout most of the year. If instructed to make a base entry, immediate action may be required to arrive at the base (90°) position configured to land.

NOTE

When utilizing KNQI and KNOG for pattern operations, do not land prior to rigged arresting gear cables. For taxi operation exercise caution and taxi slowly across rigged arresting gear cables.

7. **After Landing Checklist.** After the final landing, clear the runway as soon as possible at the first available taxiway once taxi speed is slow (avoid excessive side loads on the gear). Use an off-duty runway only if directed by Tower. Be alert to Tower instructions such as *"Cleared to cross 13 Left"* or *"Hold short of 13 Left."* Read back *"hold short"* or *"cleared to cross"* instructions. Visually check and report clear to the PM.

When clear of the active runway, the Pilot should turn off all non-required lights, turn off all anti-ice switches, and then call for the "After Landing Checklist." This is to avoid multiple "heads down" moments during a time when outside vigilance is important.

NOTE

When taxiing off of RWY 13R/31L and holding short of the inboard parallel, leave strobe lights on as you accomplish the After Landing Checklist to make your aircraft more visible. Secure the strobe lights once clear of all active runways.

8. **Return to Park/Shutdown.** When clear of the duty runway/runways, switch to Ground and report your position and intentions. Do not cross any taxiways or start taxiing until clear of the runway and cleared to taxi by Ground Control. Complete the After Landing Checklist. During early contact flights, it may be prudent to complete the After Landing Checklist while stopped. After the student becomes familiar with checklists and is confident taxiing, the checklist may be completed while slowly taxiing to the line; however, do not call for or attempt to complete checklist items as you are crossing a taxiway or an inactive runway. Give your full attention to clearing left/right/above as applicable. Give way to outbound traffic. The PF should direct the PM to complete items that might divert attention from outside the aircraft, especially at night.

The IP should contact Maintenance Control with tail number and aircraft status. Look for a lineman. If none in sight, stop the aircraft and call Maintenance again.

Exercise extreme caution in the vicinity of other aircraft. If wingtip clearance is doubtful, stop and confirm your position and use wing walkers, if necessary. Taxi slowly, but attempt to maintain forward movement; sharp turns are extremely difficult from a stop. Follow the lineman's directions exactly unless safety would be compromised. It is important to place the aircraft precisely on the spot to facilitate tie-down. Taxi very slowly for the last several feet but do not stop movement prematurely. Smoothly bring the aircraft to a stop and set the parking brake. Once the aircraft has come to a complete stop, complete the Secure Checklist.

107. POST-FLIGHT

Following the Secure Checklist, sweep the interior of the aircraft for FOD prior to disembarking. Perform a post-flight walk around, paying particular attention to fluid leaks, missing panels, and evidence of bird strikes. Ensure the accelerometer is checked, and ensure that the fire bottles have not been discharged. After the post-flight inspection is completed, do not delay in performing administrative duties. If a downing discrepancy was discovered on post-flight, immediately inform Maintenance Control, then initiate paperwork. This ensures the aircraft will not be issued before being repaired.

1. **NAVFLIR (Naval Aircraft Flight Record).** The NAVFLIR computer system provides an electronic record of the flight. Fill in the data as required and print copies as required. The PIC will sign the sheets and turn in the NAVFLIR reports, any MAFs, and the book.
Important items of interest:

a. The PIC will sign the record, certifying it complete and correct.

b. Engine hours/starts may not necessarily be the same, particularly if engines were shut down in-flight.

c. If an actual/simulated approach is logged, actual/simulated instrument time must be logged.

d. In actual instrument conditions, the IP and student will receive credit for an actual instrument approach when a non-designated aviator flies the approach.

e. All times will be in reference to the initial point of departure time zone.

f. If no location identifier exists for the field, use ZZZZ.

2. **Maintenance Action Form (MAF).** The MAF is a single sheet form that is then transferred to a computer driven system. Accurate and timely submission of MAFs is directly related to aircraft availability and safety. They must be 100% correct. If there is any doubt as to whether a gripe is a "downer," discuss it with Maintenance Control or QA. The PIC is the final authority in determining whether the gripe is up or down.

Detailed instructions on completing MAFs can be found in Aircraft Issue. Important points to remember when filling out the form:

a. Print neatly in black ink on a hard, level surface. If the maintenance personnel cannot read it, they cannot fix it. In addition, it is extremely aggravating (and dangerous) if pilots cannot read all entries in the logbook.

b. Use the date and time the MAF is submitted, not when it was discovered.

c. Compose the discrepancy before writing. Be specific. Do not just say "Inop." Give as much detail as possible. Talk to Maintenance Control if you need help. If the gripe is unusual or difficult to explain, also describe it to the work center verbally. A few minutes of your time may save hours of work. Even simple checks sometimes require removing dozens of screws to reach a component. Use NATOPS or maintenance pubs to find the correct component description. Remember, aircraft availability is directly related to the quality of your write-up.

d. Keep a written record of discrepancies as you conduct the flight, to ensure nothing is forgotten. Power settings, amps, etc., may be very important to note.

e. Print the IP's name in the pilot/initiator block, unless solo. This will assist maintenance personnel if further information is required.

f. Circle the appropriate "up" or "down" arrow.

Place the completed NAVFLIR sheet and MAFs inside the aircraft logbook, then return the book to Aircraft Issue.

3. **Debrief.** The debrief can be one of the most important aspects of flight instruction. If you don't understand any element of the flight, it is your responsibility to ask questions. The IP may not be able to answer all of your questions, but may know where you can find the answer. Ask questions about your flight, items you are unsure of or training objectives coming up on your next syllabus event. There are no bad questions.

The flowchart at the beginning of this chapter can be used for flight assessment following the debrief. You can focus your studies by reviewing your flight through the flowchart, identifying the "building blocks" you performed well, and which ones require further work. Use the references included on the flowchart to study those areas.

4. **Aviation Training Jacket (ATJ).** It is the student's responsibility to review the ATJ frequently, ensuring the calendar card is updated and Aviation Training Forms (ATFs) are not missing. If a problem is suspected, notify student control. DO NOT wait until the week of your scheduled winging to attempt to correct administrative errors.

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CHAPTER TWO
BASIC INSTRUMENT STAGE

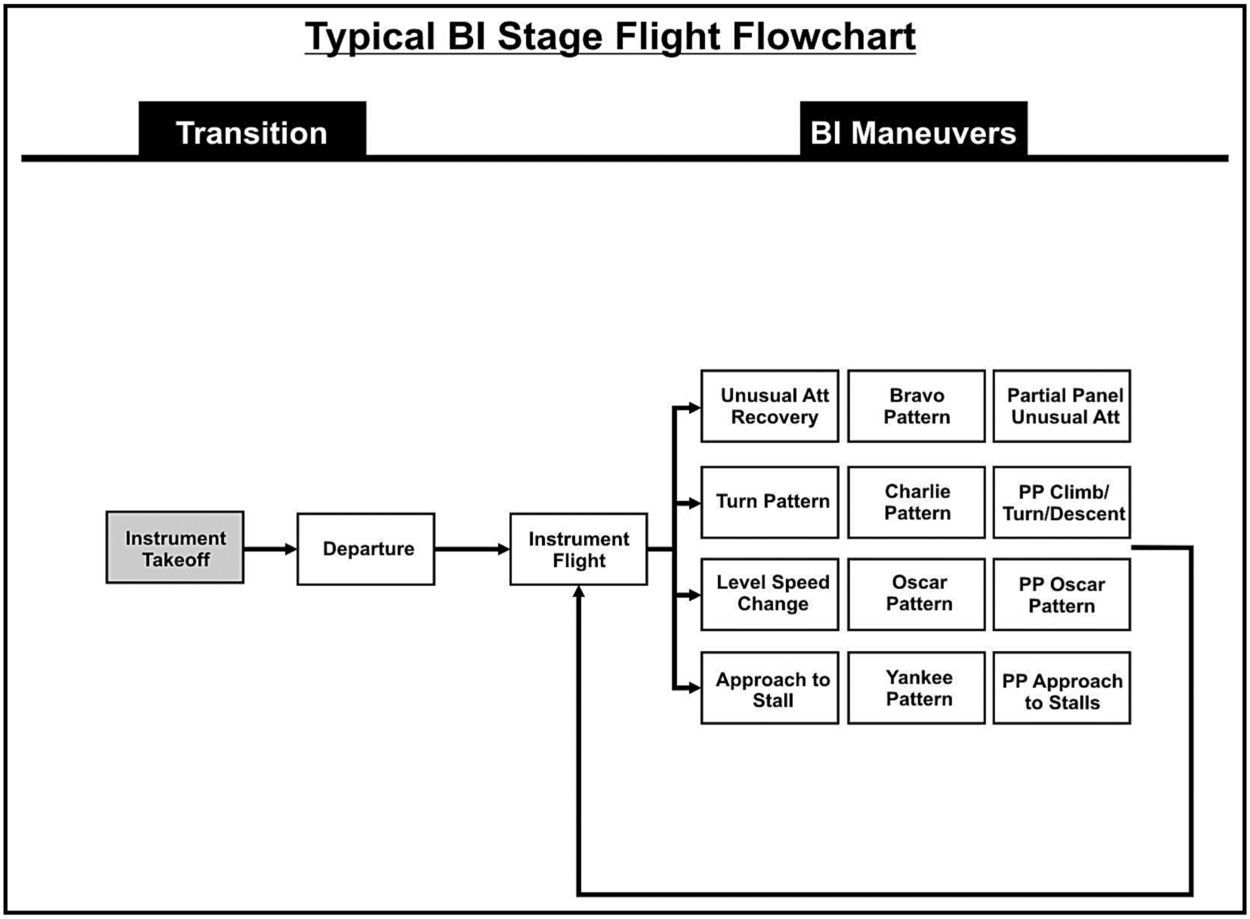

Figure 2-1 Typical BI Stage Flight Flowchart

200. INTRODUCTION

In the Basic Instrument (BI) stage, you will gain proficiency flying a multi-engine aircraft utilizing instruments. Good instrument flight is attained by smooth and precise attitude control. Attain attitude control by:

1. Visualizing and setting a desired power and attitude combination while studying and controlling the aircraft attitude on the attitude indicator.

2. Trimming the new attitude.

3. Confirming this attitude by scanning attitude crosscheck instruments. Once attitude control is mastered, professional instrument flight is attained by setting power and attitude to achieve exact performance. The skills you gain flying full panel and partial panel basic instrument patterns will be utilized extensively in the Radio Instrument Stage.

The BI Stage is designed to refine the fundamental skills required for instrument flight. The performed maneuvers develop precision and smoothness in aircraft control while increasing the speed of a pilot's instrument scan and interpretation using both full and partial panel cross-check techniques. As a professional aviator, you should know the functions and operational procedures for using all of the instruments in your aircraft. You should be familiar with their capabilities, limitations, and characteristics. For a detailed description of equipment, refer to the NATOPS manual. Other materials should be sought and reviewed to become knowledgeable on related subjects such as meteorology and physiology of instrument flight.

NOTE

These events are normally completed in the simulator, but if flown in the aircraft, a visual restriction device (such as goggles) may be used on all BI or radio instrument-training flights when an aft OBS is available. The OBS shall be posted on the same side of the aircraft the device is being utilized and shall assist with clearing responsibilities.

201. INSTRUMENT FLYING

The NATOPS Instrument Flying Manual (IFM) contains detailed information regarding basic instrument flying and should be used to enhance the FTI. It discusses instrument uses, limitations, scan, maneuvers, and physiological aspects of flying. Refer to ***NATOPS IFM Ch. 10*** for a discussion of sensations of instrument flight. There are six basic flight instruments (attitude indicator, directional indicator, airspeed indicator, altimeter, VSI, and turn and slip indicator) which are common to most aircraft. The professional aviator knows not only the functions of these instruments, but their capabilities, limitations, and characteristics. For a detailed description of equipment, refer to ***NATOPS Ch. 20***. For a general discussion of performance instrument characteristics, refer to ***NATOPS IFM Ch. 14***.

1. **Full Panel Scan.** During instrument flight, you must divide your attention between attitude, performance, and navigation instruments. Every instrument pilot must develop proper division of attention (scan) without fixating. When you develop the proper scan, you will be able to quickly note deviations and take corrective action. Refer to ***NATOPS IFM 16.3.4-16.3.7*** for detailed information.

A fundamental principle of flight is attitude plus power equals performance. To obtain desired performance you must maintain the correct attitude and power setting. Another important fundamental is to keep the aircraft trimmed. For every change of power or attitude, you must make small trim adjustments in order to relieve control pressures. In most transitions from level flight, you will have to reset power, attitude, and retrim for the new attitude. The mechanics of transitions will be performed in a specific sequence:

a. ***P***ower.

i. ***A***ttitude.

c. ***T***rim – P.A.T.

Although power and attitude changes are almost simultaneous, you will lead with power lever movement then set the new attitude as you continue the power lever movement to the desired power range. After the power and attitude are set, trim. The generally accepted sequence for trimming the aircraft is:

a. Rudder.

b. Elevator.

c. Aileron.

The rudder trim is usually initiated first because it seems difficult for most pilots to hold the ball centered with rudder for an extended period and secondly, yaw affects both nose and aileron trim. Thus, if rudder were trimmed last, both nose and aileron would have to be retrimmed to some extent. It will be impossible to relax and maintain desired performance for an extended period without trimming.

a. **Attitude.** The primary scan instrument is the attitude indicator. This instrument shows pitch and roll relative to the horizon. Maintain balanced flight by scanning the ball and using rudder pedals/trim to maintain coordinated flight. The altimeter, vertical speed indicator, airspeed indicator, and compass provide additional information to augment the attitude indicator. They also enable you to control the aircraft while flying partial panel.

b. **Heading.** The directional indicator indicates heading. Heading should be corrected primarily by reference to the attitude indicator. First, use the heading indicator to determine the direction and amount of turn required. Then, use the attitude indicator to roll into the angle of bank (AOB) required for the proper rate of turn The AOB for a standard rate turn (SRT) is about 16-18% of TAS. At 5000', this works out to about 26 to 30 degrees AOB. Complete the turn by rolling wings level on the attitude indicator. Recheck the heading and repeat the process if required.

c. **Airspeed and Altitude.** Airspeed and altitude are controlled by a combination of nose attitude and power. If power is held constant, nose attitude will control airspeed and altitude. If attitude is held constant, power will control airspeed and altitude within the limits of power available. An off airspeed or altitude situation can be corrected by nose attitude, power, or a combination of both depending on the desired results.

2. **Instrument Takeoff (ITO).** ITO procedures and techniques are used during takeoff at night, over water or deserted areas, and during periods of reduced visibility. Takeoff is accomplished by a combined use of outside visual reference and flight instruments. The amount of attention given each instrument varies with experience, type of aircraft and existing conditions. The possibility of an abort must be considered before attempting an ITO. Pitot heat

and other anti-icing equipment should be used as appropriate. Align the aircraft with runway centerline and complete the Takeoff Checklist. Recheck all heading indicators against runway heading and attitude indicators for any errors. Pay special attention to the heading and attitude indicators for any errors. Release the brakes simultaneously and use visual reference on initial roll. Smoothly apply maximum available power. As the takeoff roll continues, transition from outside references to the heading, airspeed, and attitude indicators. The rate of transition is directly proportional to the rate at which outside references deteriorate. It is essential to establish an instrument scan before losing outside references. At rotation, set the takeoff attitude (7-10 degrees up) using the attitude indicator as the primary reference. The takeoff attitude should be maintained as the aircraft leaves the ground. Raise the gear when airborne with two positive indications of climb; increasing altitude and positive Vertical Speed Indicator (VSI). Use the verbal phrase “gear up.” If the PM agrees with the decision to raise the gear, PM should also use the verbal phrase “gear up’. Once both pilots vocalize “gear up,” the right seat pilot will select the landing gear handle to the up position.

CAUTION

During runway operation, insufficient weight on the right main landing gear squat switch may cause the landing gear handle downlock J-hook to unlatch and allow the landing gear handle to be inadvertently raised while the aircraft is on the ground.

While the gear is retracting, attitude should be adjusted to provide an increase in airspeed while climbing, until the normal climb schedule airspeed is reached. Maintain or adjust the pitch attitude as required to ensure the desired climb while accelerating to normal climb schedule airspeed of 150 KIAS.

During BI Flights, you may be required to fly a Departure. Refer to the Departure Section, chapter 4 section 405 in the FTI, for information on IFR Departures.

3. **Constant Rate Climbs, Descents, and Standard Rate Turns.** Climbs, descents and turns are accomplished essentially the same as in the Contact stage except as delineated below. These maneuvers are practiced in order to refine the skills required for instrument flight. In the BI stage all climbs and descents are made at a rate determined by the pattern being flown; however, the AOB and radius of turn required for a standard rate turn will vary with TAS. As airspeed decreases, the AOB required for a standard rate turn decreases. AOB is more critical than rate of climb due to the time it takes to make corrections. Corrections to altitude can be done quickly. The pitch change required for a 500 FPM climb rate at 150 KIAS is approximately 2º. Power required is approximately 900 ft-lbs.

a. Constant rate climbs/descents are accomplished by varying power as required to maintain a constant vertical speed. Nose attitude is varied to maintain constant airspeed.

i. It is important to adjust pitch slowly and smoothly to transition to a climb/descent from normal cruise.

ii. Once the climb/descent is established, cross-check the altimeter against the clock and make power corrections as necessary to correct the rate of climb/descent. Remember to adjust pitch with each power change in order to maintain constant airspeed.

b. Standard rate turns (SRT) are accomplished by smoothly rolling to the AOB required to put the turn needle at the standard rate position. Full panel standard rate turns are started with the clock's second hand on the 6 or 12 position of the clock, using a three second lead to compensate for attitude change.

i. Slight pitch up adjustment is required to compensate for loss of lift. Prolonged turns require power addition to maintain constant airspeed.

ii. Smoothly roll out of the turn anticipating the roll out heading by 1/3 the AOB; e.g., for 30° AOB, start rolling out 10° prior to roll out heading.

iii. As wings roll toward level, anticipate a tendency for the aircraft to gain altitude.

iv. Adjust AOB as necessary to a maximum of 30° to catch up in a turn.

v. The frequency with which progress checks are made in a timed pattern is a matter of technique. If 30 second checks are made, a 90º heading change should have occurred and an altitude change equal to half the desired rate per minute should also have occurred. More frequent checks can be made but caution should be taken not to attempt them so often that attitude and airspeed maintenance suffers.

202. BASIC INSTRUMENT MANEUVERS

1. **Unusual Attitude Recovery.** During IMC flight, there is the possibility that scan breakdown, vertigo, or attitude indicator failure may result in an unusual attitude. In an unusual attitude, the attitude indicator may be of little assistance if it tumbles or becomes difficult to interpret. Knowing the factors contributing to vertigo can help us avoid it (refer to ***NATOPS IFM Ch.7***). Practical problems simulate these conditions and are practiced to acquire the correct recovery techniques. The first step in the recovery is to recognize the unusual attitude, confirm an unusual attitude exists by comparing other control and performance instruments, and recover using the techniques below.

a. Recovery: Nose Low.

i. Level the wings by referencing the attitude indicator.

ii. Raise the nose to the level flight attitude on the attitude indicator and maintain level flight by referencing the altimeter, vertical speed, and airspeed.

iii. Regain 150 KIAS while maintaining straight and level flight by setting normal cruise power 600-700 ft-lbs, referencing attitude and altitude.

iv. When the aircraft is stabilized in straight and level flight, return first to base altitude, and then base heading.

b. Recovery: Nose High.

i. Leaving bank angle in (within reason) aids in recovery. As the nose approaches the horizon, level the wings and ensure a level flight attitude.

ii. Remainder of recovery same as nose low.

NOTE

Use power as necessary throughout the recovery, however, if at any time the airspeed exceeds 200 KIAS, reduce power. If at any time airspeed drops below 100 KIAS, smoothly advance power to 800-900 ft-lbs.

2. **Level Speed Change.** Identical to Contact Stage Level Speed Change

3. **Turn Pattern.** Identical to Contact Stage Turn Pattern

4. **Approach to Stalls.** Identical to Contact Stage Approach to Stalls

203. BASIC INSTRUMENT PATTERNS

Basic instrument patterns incorporate fundamental airwork into a sequence of continually changing altitudes, headings, and airspeeds. Practicing these patterns develops timing, precision, and smoothness in control, and develops both full and partial panel scan techniques. Refer to ***NATOPS IFM 18.2*** for more information on BI patterns. In addition to the Contact Stage standard airspeeds and approximate power settings, use the following for BI maneuvers:

CONSTANT RATE CLIMB	AIRSPEED	PROP RPM	TORQUE (approx.)
500 FPM	150 KIAS	1900	850 FT-LBS*
667 FPM	150 KIAS	1900	1000 FT-LBS
CONSTANT RATE DESCENTS	AIRSPEED	PROP RPM	TORQUE (approx.)
500 FPM	150 KIAS	1900	450 FT-LBS
800 FPM	150 KIAS	1900	350 FT-LBS

* 900 ft-lbs if turning.

Figure 2-2 Table of Airspeeds and Power Settings

NOTE

These power settings are a place to start in finding the correct power for given conditions. Required power will vary with altitude, aircraft weight, and engine efficiency.

1. Begin all patterns on a cardinal heading.

2. The elapsed time may be reset and started for each pattern.

3. During full panel patterns, AOB will vary if behind or ahead in the turn, but do not exceed a maximum of 30° AOB. AOB required for SRT is about 16-18% of TAS.

4. In full panel patterns roll out on desired heading using the one-third AOB rule. In Partial panel patterns roll out on timing and do not use any lead when rolling out of the turn.

5. Pattern diagrams may be utilized for reference if desired, but memorization is recommended.

6. Pitch change required for 500 FPM rate of climb is about 2 degrees.

Purpose. The BI patterns are proficiency maneuvers designed to improve a pilot's cross-check and aircraft control. They incorporate fundamental airwork into a sequence wherein the pilot is faced with continuous changes of attitude and speed. Practicing these maneuvers will develop smooth and precise aircraft control while strengthening instrument scan and interpretation during both full and partial panel scenarios. The skills gained flying the BI patterns will be utilized extensively in the Radio Instrument Stage of training.

Constant-Rate Climbs, Descents, and Standard Rate Turns. All climbs and descents are made at a rate determined by the pattern being flown.

Pattern Descriptions.

1. **Turn Pattern.** Refer to the Contact Stage section of this FTI and Figure 2-3 for a description of the turn pattern. Begin the turn pattern straight and level at 150 KIAS and 1900 RPM.

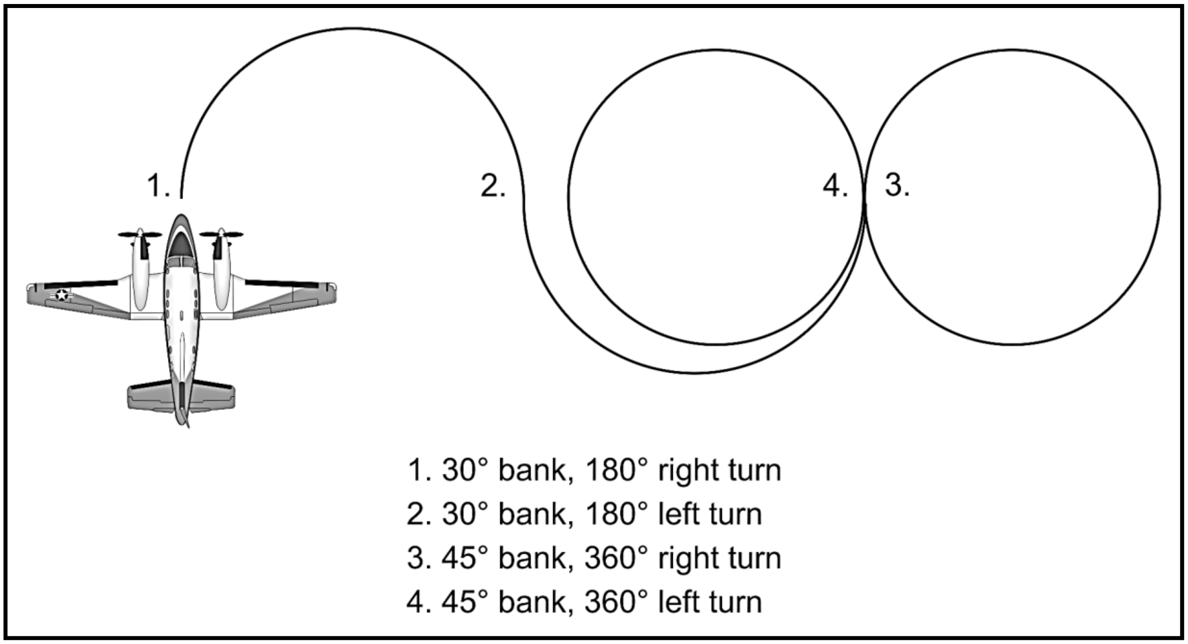

Figure 2-3 Turn Pattern

2. **Level Speed Change.** Refer to the Contact Stage section of this FTI for a description of level speed changes. Begin the level speed change maneuver straight and level at 150 KIAS and 1900 RPM.

3. **Oscar Pattern.** Begin the Oscar pattern at 1900 RPM and 150 KIAS for one minute. Make a standard rate 360° turn to the left while climbing 1000' and maintaining 150 KIAS. At the completion of the turn, fly straight and level for one minute at 150 KIAS, then make a 360° standard rate turn to the right while descending 1000' and maintaining 150 KIAS. Constant airspeed, trim, small attitude adjustments, and altimeter, heading, and clock cross checks are essential. Attempt to maintain a constant 500 FPM rate and constant SRT once established.

Refer to Figure 2-4.

a. Straight and level (1 min.).

i. 650 ft-lbs torque (approx.).

ii. 150 KIAS.

b. Climb 1000 feet at 500 FPM while executing a left SRT for 360° (2 min.).

i. 900 ft-lbs torque (approx.).

ii. 150 KIAS.

c. Transition to straight and level (1 min.).

i. 650 ft-lbs torque (approx.).

ii. 150 KIAS.

d. Descend 1000' at 500 FPM while executing a right SRT for 360° (2 min.).

i. 450 ft-lbs torque (approx.).

ii. 150 KIAS.

e. Transition to straight and level (1 min.).

i. 650 ft-lbs torque (approx.).

ii. 150 KIAS.

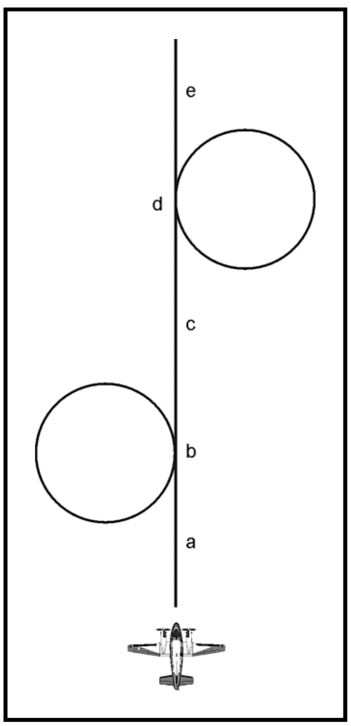

Figure 2-4 Oscar Pattern

4. **Bravo Pattern.** The Bravo pattern is a level Charlie pattern with 1 minute legs, constant airspeed of 150 KIAS. Refer to Figure 2-5.

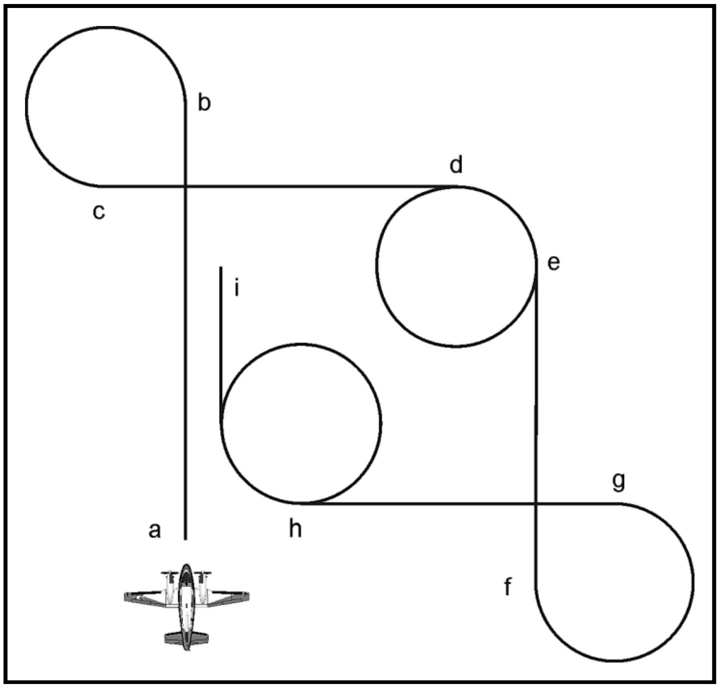

Figure 2-5 Bravo/Charlie Pattern

5. **Charlie Pattern.** The purpose of the Charlie pattern is to develop fundamental instrument skills in a challenging maneuver. The importance of scanning the attitude indicator, maintaining constant airspeeds while attaining altitude and heading checkpoints against the clock, making proper corrections and smoothness should be emphasized.

Refer to Figure 2-5.

a. Straight and level (1 min.).

i. 650 ft-lbs torque (approx.).

ii. 150 KIAS.

b. Climb 1000' at 667 FPM while executing a left SRT for 270° (1.5 min).

i. 1000 ft-lbs torque (approx.).

ii. 150 KIAS.

c. Transition to straight and level (2 min.).

i. 1000 ft-lbs torque.

ii. Airspeed will vary with altitude.

d. Maintain altitude and reduce airspeed to 150 KIAS while executing a right SRT for 90° (30 secs). Descend 1000' at 500 FPM continuing a right SRT for 360° (2 min.).

   i. 450 ft-lbs torque (approx.).

   ii. 150 KIAS.

e. Climb 1000' at 500 FPM (2 min.).

   i. 900 ft-lbs torque (approx.).

   ii. 150 KIAS.

f. Transition to a level left SRT for 270° (1.5 min.).

   i. 700 ft-lbs torque (approx.).

   ii. 150 KIAS.

g. Climb 1000 feet at 500 FPM (2 min.).

   i. 900 ft-lbs torque (approx.).

   ii. 150 KIAS.

h. Descend 2000 feet at 800 FPM while executing a right SRT for 450° (2.5 min.).

   i. 350 ft-lbs torque (approx.).

   ii. 150 KIAS.

i. Transition to straight and level (maneuver complete).

   i. 650 ft-lbs torque (approx.).

   ii. 150 KIAS.

6. **Yankee Pattern.** The Yankee pattern is a departure from traditional BI patterns in that it is flown under SSE conditions and at 120 KIAS. The maneuver is flown in order to build skills required to fly single engine approaches under instrument conditions. It teaches both scan and the effect of power changes upon rudder. All legs are one minute long and all turns are standard rate. All descents are 500 FPM.

Refer to Figure 2-6.

a. Straight and level, single engine procedures complete (1 min.).

   i. 900 ft-lbs torque (approx.).

   ii. 120 KIAS.

b. Level left SRT for 180° (1 min.).

   i. 1000 ft-lbs torque (approx.).

   ii. 120 KIAS.

c. Descend 500 feet at 500 FPM (1 min.).

   i. 500 ft-lbs torque (approx.).

   ii. 120 KIAS.

d. Continue 500 FPM descent while executing a left SRT for 45° (15 sec.).

   i. 600 ft-lbs torque (approx.).

   ii. 120 KIAS.

e. Continue 500 FPM descent (45 sec.).

   i. 500 ft-lbs torque (approx.).

   ii. 120 KIAS.

f. Continue 500 FPM descent while executing a right SRT for 180° (1 min.).

   i. 600 ft-lbs torque (approx.).

   ii. 120 KIAS.

g. Transition to straight and level and for (1 min.).

   i. 900 ft-lbs torque (approx.).

   ii. 120 KIAS.

h. Lower approach flaps and landing gear 10 seconds prior, complete the Landing Checklist, and descend 500 feet at 500 FPM (1 min.).

i. 1000 ft-lbs torque (approx.).

ii. 120 KIAS.

i. Wave off straight ahead (SSE) at 110 KIAS; when safely climbing use right SRT to return to base heading. The maneuver is complete when climbing on base heading at or above 110 KIAS or at the discretion of the instructor.

j. Remember, AOB required for a SRT will be less in this pattern as the TAS is lower.

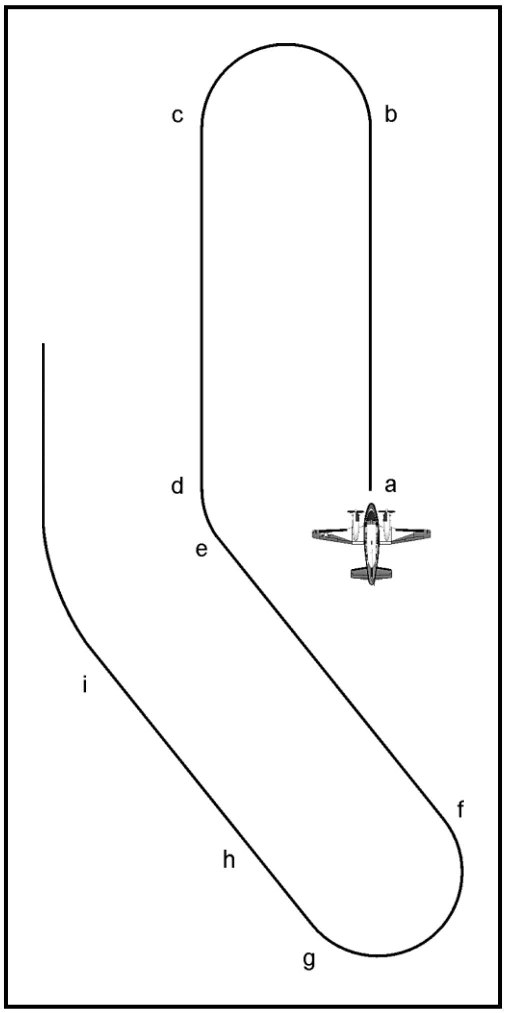

Figure 2-6 Yankee Pattern

204. PARTIAL PANEL MANEUVERS

Partial panel flight is the loss of primary attitude indication and/or heading. This may occur through individual component failure or loss of aircraft electrical power. You are expected to be familiar with the situations under which this circumstance might occur and how to troubleshoot it. It is standard BI practice to fail both attitude and heading indicators. Some electrical malfunctions will cause the loss of both heading and attitude indicators. Under partial panel conditions, the pilot must obtain pitch and roll information from sources other than the primary attitude indicator. Heading, pitch, roll, airspeed, and VSI are obtained from the ESIS. If ESIS heading information is unreliable, use the standby compass. A standard no-heading transition brief can be found in the Typical Briefs and Voice Procedures Appendix. Refer to ***NATOPS IFM 17.6*** for a detailed discussion of partial panel flight, and ***NATOPS IFM 14.1*** for a detailed discussion of wet compass characteristics.

NOTES

1. In an actual situation, if any of the pilot’s indicators fail and the PM instruments are still functioning properly, the controls should be transferred to the pilot monitoring. Partial panel flight in IMC conditions is an emergency.

2. The magnetic compass is NOT reliable with the air conditioner, vent blower, windshield heat, electric heat or windshield wipers (“big five”) on.

1. **Timed Turns Using the Magnetic Compass.**

Failure of both PFDs or both AHRS would require the use of the ESIS. The ESIS heading tape can still be used (a DG warning will appear above the tape) but will be subject to precession errors and will have to be updated periodically. About every 15 to 20 minutes, roll wings level, ensure the “big five” are off and get a heading check from the magnetic compass. Use the ESIS menu to update the ESIS heading. Repeat periodically. Of the ESIS heading tape has failed completely as well as both PFDs or both AHRS, the following procedures can be followed to establish the aircraft on desired headings using the magnetic compass:

a. Complete heading failure requires use of the magnetic compass for heading information. Remember that this instrument provides reliable information only during straight and level unaccelerated flight. Due to this limitation, timed turns are required when making heading changes. Use the wet compass as a cross check before commencing the turn and after rolling out wings level.

b. Note the magnetic compass heading while straight and level and compute the number of degrees between the present heading and the desired heading. If the number is 30° or greater, divide the number of degrees to be turned by the standard turn rate of 3° per second to find the duration of the turn; e.g., a 120° turn will take 40 seconds. For turns of less than 30°, turn at a 2/3 needle width (1/3 SRT), for the number of seconds equal to the degrees of turn; e.g., a 20° turn takes 20 seconds. Once timing has been computed, roll into the turn smoothly. Do not use any lead when rolling in or rolling out of a turn. Begin the roll into the turn when you commence timing and start your rollout at the completion of your timing. Attempt to roll in and out of the turn at a constant rate. If, after rolling out, a correction is required, follow the steps previously discussed. Do not exceed a SRT when partial panel.

NOTE

Crosscheck the turn needle width in order to fine tune the bank angle used on the ESIS in a standard rate or half standard rate turn.

c. When making turns of greater than 90°, it is possible to use the magnetic compass as a rough crosscheck, taking into account the inherent lead and lag. As previously discussed, the “big five” electrical items must be secured if the magnetic compass is to be utilized for a cross check. Roll out on east or west headings as there is little lead or lag error on these headings. If roll out on north is desired, lead the roll out by the flight latitude, e.g., 030 (left turn) or 330 (right turn) if at 30° latitude. If roll out on south is desired, lag the roll out by the flight latitude, e.g., 210 (right turn) or 150 (left turn) if at 30° latitude. Correct as necessary after wings level with the wet compass stabilized using the steps discussed above. Environmental requirements normally preclude securing the air conditioner for training purposes. When requested, cardinal-heading calls shall be made by the IP in a turn, except the rollout heading. Students should time the entire turn and update the turn progress as cardinal headings are called. Level heading calls will be made by the IP using his PFD with the air conditioner simulated off. Calls will be rounded to the nearest 5° mark. Remember, the magnetic compass tends to oscillate. Maintaining headings within ± 5° may be very difficult in an actual emergency.

2. **Partial Panel Approach to Stalls.**

The ESIS is used and procedures are as for full panel stall approaches; however, partial panel approach turn stalls shall not be performed.

3. **Partial Panel Unusual Attitudes.**

Use the ESIS, procedures remain the same as for full panel.

4. **Partial Panel Oscar Pattern.**

The partial panel Oscar pattern is the same as full panel except for scan. Use the ESIS as described earlier for the partial panel Oscar pattern; however, if heading information is not available (AHRS-1 failure and ESIS heading tape failure) the turns will have to be timed and standby compass used. Request PM assistance to provide turn progress updates at each cardinal heading (ensure the PM is briefed on lead/lag characteristics).

Refer to Figure 2-4.

a. Straight and level (1 min.).

   i. 650 ft-lbs torque (approx.).

   ii. 150 KIAS.

b. Climb 1000 feet at 500 FPM while executing a left SRT for 360° (2 min.).

   i. 900 ft-lbs (approx.).

   ii. 150 KIAS.

c. Transition to straight and level (1 min.).

   i. 650 ft-lbs torque (approx.).

   ii. 150 KIAS.

NOTE

If turns are executed by timing, once wings level, request heading and correct to base heading utilizing a timed turn.

d. Descend 1000 feet at 500 FPM while executing a right SRT for 360° (2 min.).

   i. 450 ft-lbs (approx.).

   ii. 150 KIAS.

e. Transition to straight and level (1 min.).

   i. 650 ft-lbs torque (approx.).

   ii. 150 KIAS.

NOTE

Turns are executed by timing. Once wings level, request heading and correct to base heading utilizing a timed turn.

CHAPTER THREE
NIGHT CONTACT STAGE

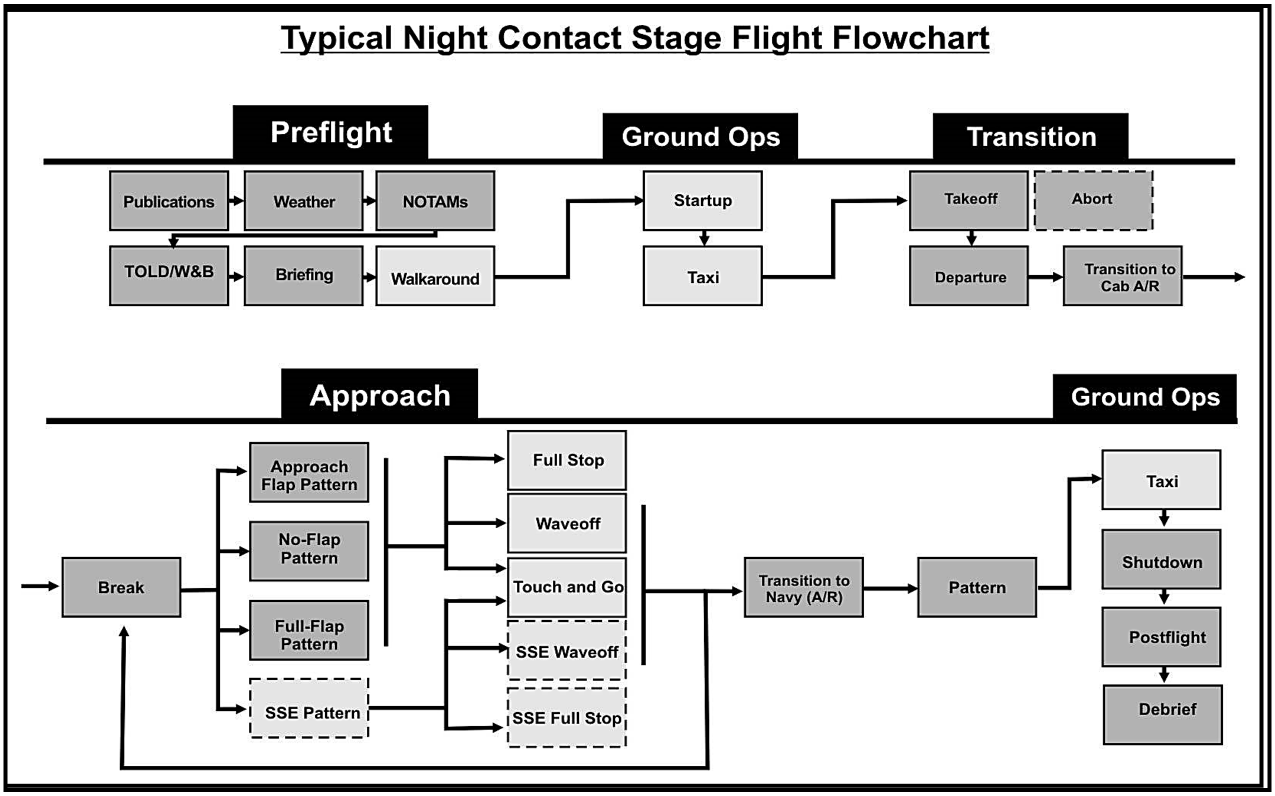

Figure 3-1 Typical Night Contact Stage Flight Flowchart

300. INTRODUCTION

Night contact introduces the student to multi-engine flight at night. Emphasis is placed on lighting techniques, operations in the touch-and-go pattern, and scan. VFR flying at night is similar to daylight operations with the exception of reduced visual references and depth perception. Increased reliance must be placed on the gauges and a combination visual/instrument scan utilized.

The aircraft must be equipped for night operations. Ensure you have a flashlight prior to the brief. Utilize a clear lens when conducting preflight inspections. Pay particular attention to frost or ice accumulations, which are difficult to detect at night.

If possible, allow your eyes to become night-adapted prior to flight. Avoid bright sunlight (e.g., the beach), eat well, and get plenty of rest.

Most of the flight procedures for the night contact stage are the same as day contact procedures. There are a few differences and additions listed below.

301. NIGHT FLYING ENVIRONMENT

With the exception of lighting, virtually all airborne procedures are identical to daytime operations. You must be constantly vigilant of your position, instruments, and other traffic. Maintain a continuous scan. Never fixate on one particular light or stare at dark areas for an extended period. Bring your scan back into the cockpit systematically. Avoid large rates of descent near the surface, particularly when descending over water or in mountainous terrain. Recommend the RADALT (Radio Altimeter) be set at 1000' (or 200' below altitude if operating below 1200') for operations outside of a traffic/instrument pattern. This will provide an indication of inadvertent descent. It may be helpful to set the RADALT bug at 50 or 100 in the pattern.

1. **Aircraft Lighting.** Aircraft and cockpit lighting must be set correctly to achieve optimum efficiency and decrease inherent hazards associated with night flying. Consider the following:

a. During start, the PM or OBS uses a flashlight to provide extra illumination of the gauges (especially ITT), as panel lights may dim significantly when the starter is energized.

b. Display position lights (NAV lights) during the period from 30 minutes before official sunset until 30 minutes after official sunrise, or at any time when prevailing visibility, as seen from the cockpit, is less than three statute miles.

c. Utilize taxi lights for all ground movements during hours of darkness, unless under control of a taxi director. All lights will remain on during taxi, with the exception of the strobe and landing lights. Secure the taxi light once under the direction of a lineman.

d. During transition from dusk to full darkness, dim cockpit lighting gradually in order to enhance outside visibility. Attempt to maintain both sides of the instrument panel at nearly the same intensity.

e. Bright lights tend to reflect off cockpit side windows, creating false impressions of other aircraft or lights on the ground. Maintain cockpit lights at minimum intensity required for illumination.

f. Rotating beacon, strobe, and landing/taxi lights may be distracting and also induce vertigo during adverse weather conditions. Selected lighting may be secured temporarily if required for safe operation.

g. Use ice lights on the ground when additional wing illumination is desired, and in-flight to check the wing/nacelles. Turn the ice lights on when taking the runway for takeoff and secure them during the Climb Checklist/abbreviated Climb Checklist, or after turning downwind if the checklist is not required.

h. When encountering lightning or bright lights, turn cockpit lights to full bright.

i. When the gear is down, taxi/landing lights on at all times, except in adverse weather when the PF has the option to secure them. Practice night landings without the use of landing/taxi lights are not authorized. If external lighting is lost, you are solely responsible for traffic separation.

NOTE

TRAWING FOUR aircraft may be differentiated at night as follows: T-44s have a red beacon, T-6s do not have a beacon and their landing lights are on the mainmounts instead of the nose gear assembly.

2. **Field Lighting.** Taxiway lights are blue. Runway edge lights are white, except on instrument runways, where amber replaces white on the last 2000 feet, or half the runway length, whichever is less (to form a caution zone for landings). Green end lights are located on the approach end and red end lights on the departure end. Runway lights are uniformly spaced at intervals of approximately 200 feet. Runway edge lights are classified according to the brightness they are capable of producing: High Intensity Runway Lights (HIRL), Medium (MIRL), or Low (LIRL). Runways may be equipped with touchdown zone lighting, centerline lights, runway remaining lighting, high-speed taxiway turnoff lights, runway end identifier lights, etc. Most lights at controlled fields can be adjusted by the Tower upon request. At some fields, the PF must turn the lights on and often can also adjust the intensity. When using pilot-controlled lighting, a good technique to utilize is to quickly key the mike seven times then adjust intensity as required. The lights will stay on for a period of 15 minutes. Check the airfield diagram/Enroute Supplement to determine if pilot-controlled lighting is available. When inbound on an instrument approach, you may want to activate pilot-controlled lighting at the FAF inbound. Military fields utilize a white-white/green (split) beacon while civil fields use a white/green beacon.

Naval air stations also have runway waveoff lights. They are red lights controlled by the Tower. ***A waveoff is required when flashed the waveoff lights.***

NOTE

At Cabaniss Field not all taxiways are lighted. Taxiing at night on an unlighted taxiway is prohibited.

Many fields, such as CRP, utilize Visual Approach Slope Indicator (VASI) lights as an aid in maintaining a defined G/S. VASIs may be visible from 3-5 miles during daylight and up to 20 miles at night. The most common system is a 2-bar installation set at 3º, often aligned with an ILS (Instrument Landing System) G/S. An “on-glideslope” presentation would be: red over white (“pilot’s delight”), low: red over red (“pilot is dead”), and high: white over white (“out of sight”). Some military fields such as NGP utilize an optical landing system (OLS/Fresnel lens). Visual landing aids are part of the runway environment and may be used as the basis for continuing an instrument approach and landing, after reaching Decision Altitude/Height (DA/DH) or Minimum Descent Altitude (MDA).

Detailed information on lighting can be found in the Aeronautical Information Manual (AIM), FIH, Enroute Supplement, IAPs, commonly called “approach plates,” enroute chart, VFR sectional chart, etc. Preflight planning is required to determine if lighting is available and what type system is installed.

302. NIGHT GROUND OPERATIONS

1. **Engine Start.** Start procedures are the same as daytime with the exception of lighting. Set cockpit lights as desired. Turn position lights and rotating beacon on at “lights.” Direct the PM to shine his/her flashlight on the PF’s fingers extended to indicate the engine to be started. During the start sequence, have the PM or OBS put the flashlight beam on the engine instruments and pedestal. Keep in mind all lights will dim when the starter is energized. Be alert for a hot start due to the increased electrical demand from the lights. During winter be especially cautious as the coldest temperatures are normally encountered at night. Utilize a GPU if required.

2. **Taxiing.** When ready to taxi, turn the ice lights on or flash the taxi light momentarily. This will indicate to the lineman you are ready to taxi, and help illuminate the wings. It also alerts other traffic that you are pulling forward. Once forward of the parking spot, secure the ice lights. Taxi forward only the minimum distance required to check the brakes and release the lineman. Stay well clear of the taxiway at night. Upon reaching the engine run up area, secure the taxi light. When ready for further taxi, turn on the taxi light and once again secure the taxi light when you are at the hold short.

Taxi procedures are the same as daylight except greater caution must be exercised. The tendency is to taxi fast during night conditions. This can be minimized by scanning out the side window for a better perception of taxi speed. Do not hesitate to state your problem and ask for assistance if you become disoriented. Mishaps have occurred when aircraft mistakenly taxied onto the wrong runway/taxiway during night or low visibility situations.

NOTE

> Be especially cautious of runway edge lighting and taxiway lighting. There are times when some lights will not be on and they pose a serious hazard to potential propeller strikes.

If the aircraft must be shut down on a taxiway, notify Ground and leave the position lights on if possible. Do not attempt to taxi on one engine. Have the aircraft towed to parking. A situation requiring a shutdown would be an engine chip light, low oil pressure, etc.

Be extremely cautious when operating near other aircraft or obstructions. Watch for unmarked hazards such as fire bottles and chocks. Avoid being "heads down" when running a checklist at night. It is advisable to stop the aircraft until the applicable checklist is complete.

303. NIGHT TRAFFIC PATTERN OPERATIONS

Night Traffic Pattern. The night traffic pattern is flown the same as the day contact pattern. Crosswind corrections are not as easy to anticipate due to a lack of visual cues. Fly a normal pattern. Concentrate on looking down the entire length of the runway to avoid angling. It is extremely important to hit pattern checkpoints to prevent having to make gross corrections. The most common night landing error is failing to flare sufficiently. Altitude cues are not readily apparent and the flare must be anticipated. Do not fixate on a spot in front of the nose. Sight toward the end of the runway and land with a visual picture of the centerline between your legs. Do not fixate inside the aircraft on rollout, especially during touch and goes. Keep your scan outside and maintain centerline. The OBS may shine a flashlight on the trim panel (at IP's discretion) to assist in resetting trim during touch-and-go operations.

304. NIGHT LANDING AND RETURN TO PARK

Landing and Return to Park. After landing, turn off strobes and landing lights as soon as practicable. Comply with standard daytime procedures and return to the line. The PF should direct the PM to complete items that might divert attention from outside the aircraft. Energize ice lights prior to turning into the parking spot. Immediately after initiating the turn, secure landing/taxi lights to prevent blinding the taxi director.

305. NIGHT EMERGENCIES

Handle night emergencies the same manner as daytime with several exceptions.

1. Scan is paramount. You must maintain control of the aircraft while executing procedures. During night or instrument conditions, direct the PM to activate switches (generator, etc.) outside your normal scan pattern. Altitude loss/airspeed deviations may be more difficult to detect at night. On landing, be sure to scan well down the runway in order to detect yaw.

2. Darkness in the cockpit may make it more difficult to read the checklist and verify switch positions. A more deliberate approach to emergency procedures is required.

3. It is easy to become disoriented at night. If you think you are not sure of your position, confess and take immediate action. Climb if appropriate to clear terrain or get better reception. Conserve fuel; consult bingo/max range charts when time allows. Verify NAVAIDs and then check DME and tail of the needle. If still unsure, call ATC and ask for help, squawking 7700 or as assigned. Comply with advice and instructions received.

306. NIGHT VISUAL ILLUSIONS

To be a safe pilot at night, you need to understand the dangers of night visual illusions. False horizons, autokinesis, and the "black hole" illusion have claimed the lives of unprepared pilots. Fortunately, the dangers from these illusions can be mitigated by understanding them and knowing how to prevent them. Refer to ***NATOPS IFG 7.1.2*** for information on night visual illusions and prevention.

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CHAPTER FOUR
INSTRUMENT STAGE

400. INTRODUCTION

Welcome to instrument flying! The purpose of this chapter is to provide procedural information for operating in the instrument environment during advanced multi-engine flight training. Additionally, it provides an introduction of information about instrument flight, which students use as a starting point for study. Students are expected to know the procedures and information included; however, personal preference will dictate the choice of technique. This is not an all-inclusive source document and study should not be limited to the FTI alone. There are many excellent reference sources of instrument flying knowledge available, some of which are listed below. This stage of training requires a high degree of motivation and professional dedication. You will acquire the confidence and precision necessary to fly military aircraft in a dynamic instrument environment. Emphasis will be placed on Crew Resource Management (CRM), Situational Awareness (SA), and Pilot in Command (PIC) decision-making. Successful completion will result in certification as a standard instrument rated pilot.

NOTES

1. Students are expected to be thoroughly familiar with all brief and discuss items for events, and will be held responsible for anything in the FAR part 91/AIM, FTI, IFM, AIGT Study Guides, and NATOPS pertaining to the brief/discuss items.

2. Many instrument flights are flown at night and require students to be thoroughly familiar with night engine starting, aircraft lighting, and night taxi procedures. Refer to Chapter 3, Night Contact Stage, for night procedures.

3. Pay attention to the Student Tendencies. They are included for a reason!

401. REFERENCES AND SUGGESTED READING

T-44C NATOPS
https://airworthiness.navair.navy.mil/

CNAF M-3710.7 series, NATOPS General Flight and Operating Instructions:
Located on the CNATRA Website, e-Book Bag via pipeline.
https://adss.navy.mil/ebookbag/home.aspx

VT-31 Standard Operating Procedures (SOP)
https://adss.navy.mil/ebookbag/home.aspx

VT-35 Standard Operating Procedures (SOP)
https://adss.navy.mil/ebookbag/home.aspx

CTW-4 Standard Operating Procedures (SOP)
https://adss.navy.mil/ebookbag/home.aspx

NATOPS Instrument Flight Manual (IFM): NAVAIR 00-80T-112: most recent version available at https://airworthiness.navair.navy.mil/

AIGT Study Guides

Flight Information Publications (FLIPs) (General Planning (GP), Area Planning (AP), IFR Enroute Supplement, Flight Information Handbook (FIH):
https://aerodata.nga.mil/AeroBrowser/ (*Requires CAC/PKI credentials to access).

FTIs: https://www.cnatra.navy.mil/pubs-pat-pubs.asp

Master Curriculum Guides (MCGs): https://www.cnatra.navy.mil/pubs-instructions.asp

AIM: https://www.faa.gov/air_traffic/publications/

FAA Instrument Procedures Handbook: http://www.faa.gov/library/manuals/aviation/

FAA Instrument Flying Handbook: http://www.faa.gov/library/manuals/aviation/

FAA Pilot's Handbook of Aeronautical Knowledge:
http://www.faa.gov/library/manuals/aviation/

FAA Airplane Flying Handbook: http://www.faa.gov/library/manuals/aviation/

Joint Order 7110.65 Air Traffic Control:
https://www.faa.gov/regulations_policies/orders_notices/

Sources for International Civil Aviation Organization (ICAO) Procedures/Information:
FLIPs and Foreign Clearance Guide (FCG)

TERPS: FAA Order 8260.3D): http://www.e-publishing.af.mil/ make sure to update with changes 19-20 available on www.faa.gov, click on regulations and policies, click on orders and look for FAA Order 8260.3D

The primary purpose of TERPS is to provide safe terminal procedures for aircraft operating to and from military and civil airports. The main considerations include criteria for obstacle clearance, descent/climb gradients, and landing minimums. TERPS criteria apply to the design of departure procedures (DPs) and instrument approach procedures (IAPs) at any location over which a United States agency exercises jurisdiction. Outside of the United States, IAPs may not have been designed by a U.S. agency; however, if the IAP is published in FLIP, it has been reviewed by an appropriate U.S. agency, meets U.S. TERPS criteria (or its equivalent), and is approved for use. The flight procedures prescribed for instrument approaches are predicated upon the specifications stated in TERPS and, if used, should keep the aircraft within protected airspace.

NOTES

1. Current editions of many FAA publications can be found here: http://www.faa.gov/library/manuals/aviation/. Browse around or simply type the publication name (e.g., ***Instrument Procedures Handbook***) into the search bar.

2. Current editions of many Naval instructions/documents are found at https://www.secnav.navy.mil/doni/default.aspx. Browse around or type an instruction (e.g., CNAF M-3710.7 series) into the search bar.

3. All required documents including the NATOPS Instrument Flight Manual can be found on the CNATRA Website, e-Book Bag via pipeline.

402. CRM

Advanced students have already been introduced to CRM in a multi-engine aircraft, but not to the extent that is needed during instrument flight. Consider this: On an IFR flight, it may be required to tune radios and NAVAIDs, set up avionics, talk to ATC, get ATIS for the next approach, run checklists, and possibly deal with an emergency all at the same time.

CRM allows effective utilization of all your resources in the cockpit to accomplish the mission. In a multi-crew aircraft, there may be another pilot, an engineer, a navigator, and others who will need to work together. In the T-44, the crew typically consists of a Pilot Flying (PF), Pilot Monitoring (PM), and an observer. Utilize these crewmembers to accomplish tasks such as getting ATIS, referencing NATOPS, NOTAMS, Trouble T's and other things that would distract the Pilot Flying (PF) from his primary job of flying the aircraft and managing the cockpit.

In the past, CRM was an abstract idea (DAMCLAS) by which we hoped crew-members would interact well together to make good decisions. While we still use DAMCLAS for guidance, we are starting to introduce standardized call-outs and procedures which optimize task accomplishment.

While these call-outs will not address every possible instance in which CRM will be needed, they provide a framework for good communication and teamwork. Remember, you are a part of a crew. We are not evaluating/training aviators to fly the T-44 by themselves. Utilize the co-pilot (IP) and observer! Reference appropriate CRM appendix and NATOPS for further discussion.

403. GENERAL GUIDANCE

The challenges of instrument flying are compounded by the high traffic density of the local area and the close proximity of its airports. This is a stressful environment and requires thorough preparation and "chair-flying." Unlike a normal "fleet" mission during which there will be plenty of enroute time to prepare for an instrument approach, at times aircrews will be expected to rapidly transition from one airport/approach to another. Sometimes, the Abbreviated Climb Checklist must be followed immediately by the Abbreviated Approach Checklist! The following tips will help you prepare for this:

STUDY the local IFR enroute low altitude chart. Be familiar with the relative positions of the various airports and waypoints in South Texas. Combine this study with the associated approach plates and understand how they relate to one another. Knowing the area in which you will fly builds your SA.

PRACTICE briefing instrument approaches utilizing actual anticipated approaches (VOR 18 CRP, TAC Z NGP, VOR-A ALI, etc.). Develop a method which works for mandatory brief items in FTI/NATOPS. The "sequential method," which starts from the aircraft's present position on the chart and briefs through the expected missed approach, works well. A list of required items is found in the Typical Brief and Voice Procedures Appendix.

LISTEN to the radios. Don't get so caught up in the approach brief or other duties that ATC clearances or directions are missed. Pause conversation every time ATC calls. After hearing your call sign, consider jotting information down on your kneeboard to avoid stumbling during the response. If the call is for another aircraft, then resume what you were doing. It may take weeks to develop, but make an effort to avoid missing your call sign. If unsure of a particular clearance or its meaning, quickly query your IP before responding.

METHODICALLY set up radios and NAVAIDs using the RTU or FMS. Ensure the navigation source and bearing needles are set to properly fly the SID, Airway, STAR, or approach in use. (The "LIDS" technique, which is discussed later in this chapter, is another good NAVAID setup technique used specifically for ILS and LOC approaches.)

Big Picture. Start developing a system and a rhythm that works. Think through procedures and practice them at home by chair-flying. Throughout this syllabus and flying career, you will learn many different techniques used by IPs and others. Determine the techniques that work and add them to your system.

Brief. All students normally show up to every RI brief with a DD-175 and DD-175-1. When the schedule comes out, call the other student on the flight and come up with a plan which will accomplish all of the training objectives for the event. Each SMA will then do their own DD-175 to bring to the brief. One student will submit a request for weather. ***Do not submit 2 requests.***

Positive Course Guidance. Positive course guidance is a continuous display of navigational data that enables the aircraft to be flown along a specific course line. When not on radar vectors, an underlying principle implicit in instrument procedures to ensure vertical and lateral obstacle clearance is that positive course guidance will be used with very limited exceptions and those exceptions will be set forth in the procedure. These exceptions are: limited dead reckoning initial approach segments (with strict criteria limitations for the IAP designer), course-reversals (procedure turns, etc.), and Missed Approach procedures that specify a heading rather than a course. Pilots should always attempt to fly as close to the course centerline as possible. TERPs design criteria will provide maximum obstacle clearance protection when the course centerline is maintained.

Training Standards. This is a challenging program. Students are expected to demonstrate a strong cross-check, exhibit solid flying skills, maneuver the aircraft precisely, maintain radio communications awareness, manage crew coordination and cockpit duties while demonstrating procedural knowledge and good judgment in emergency situations. Use the Course Training Standards (CTS) in the Master Curriculum Guide (MCG) as a guide to instructor expectations of what parameters students should be able to maintain by the end of the instrument phase of training.

Navigation Instruments. Students are expected to refer to the NATOPS manual as appropriate to become familiar with the characteristics of these instruments.

Navigation Aids (NAVAIDs). Students should also familiarize themselves with the characteristics, service volumes, etc., of the following NAVAIDs: VOR, TACAN, VORTAC, DME, ILS/LOC, Marker Beacon, NDB, and GPS. This can be found in the AIM, AFMAN 11-217 and the Navy Instrument Flight Manual (IFM) and AIGT handbook.

Notification of ATC. If a loss of navigation capability or impairment of air/ground communications capability is experienced, a report shall be made including call sign, equipment affected, degree to which IFR capabilities are impaired, and extent of assistance desired. When simulated equipment malfunctions occur during the Instrument Stage, students should make this report to the instructor. Other additional reports can be found in the AIM.

Student Tendencies

1. Not knowing exactly where they are

2. Not knowing exactly where they are cleared to fly (or understanding the entire clearance)

3. Not having instruments set correctly to fly their clearance

4. Not thinking ahead, *"What needs to be accomplished before I get to where I am going? What will I do when I get there?"*

5. Having the tendency to rush themselves and not prioritize, thus allowing air work to suffer; recognize the importance of the axiom "aviate, navigate, communicate"

404. PREFLIGHT PLANNING

Before commencing a flight, be familiar with all available information appropriate to the intended operation. Such information should include, but is not limited to, available weather reports and forecasts, an official DD-175-1 if filing a written flight plan, or a "canned" DD-175-1 for the local area if on a coded flight plan, NOTAMs, TFRs, TOLD card, fuel requirements, alternates available if the flight cannot be completed as planned, and any anticipated traffic delays. In addition, the PIC shall conduct a risk assessment before the flight. Ensure you have a navigation bag with all the necessary pubs, a NATOPS manual, a fuel packet (if required), a flight computer, and a flashlight and other required items listed under preflight planning in the contact chapter of this FTI.

NOTE

For cross-country flights, refer to the In-Flight Guide Checklist.

It is imperative that pilots spend time preflight planning on the ground so they are as prepared as possible once airborne and can maximize mission safety, effectiveness, and training. "FPWANTS" (Figure 4-1) is a memory aid for the typical tasks to be accomplished before an IFR flight. Physically going to Base Ops may not be required considering the capability to accomplish the appropriate tasks via computer, fax, or telephone.

F	Fuel Planning/Packets
P	Publications including NATOPS and TCRs
W	Weather
A	"Activate" flight plan (technically file flight plan)
N	NOTAMs
T	TOLD (takeoff and landing data)
S	SIDs/DPs/STARs/IAPs/Self (Flying gear, earplugs)

Figure 4-1 Base Ops Drill

1. **Fuel Planning/Packets**: Ensure the aircraft has sufficient fuel per CNAF M-3710.7 series/SOPs. Bring appropriate fuel packet if required.

2. **Publications.** Ensure the navigation bag ("nav bag" or "pubs bag") has all the necessary items and they are not expired. The following Flight Information Publications (FLIP) documents are used in preflight planning and/or during the flight. Be familiar with the FLIP system and know where to find flight planning information. Here are some of the most often used FLIP products:

   a. **General Planning (GP).** Published for worldwide use by military aviators contains general information about all FLIP including an index that details the location of information throughout the entire set of FLIP. GP Chapter 4 is one of the most widely referenced chapters. This is where to find information on how to file a DD-175.

b. **Area Planning (AP/1, 2, 3 and 4).** Contain planning and procedure information for a specific region or geographic area, including preferred routing for IFR flights. AP/1 covers North and South America. This is where to find preferred routing for IFR flights.

c. **Area Planning (AP/1A, 2A, 3A, and 4A) (SPECIAL USE AIRSPACE).** Published digitally only, these documents contain all Prohibited, Restricted, Danger, Warning and Alert Areas listed by country and may be referenced if a route of flight approaches these areas. AP/1A covers Special Use Airspace for North and South America, and may be referenced if the FLIP chart indicates Prohibited, Restricted/Warning Areas, or Military Operation Areas (MOA) on or near the route of flight.

d. **Area Planning (AP/1B).** Covers Military Training Routes (MTRs) for North and South America.

e. **IFR Enroute Supplement.** Contains the Airport/Facility Directory

f. **Flight Information Handbook.** Designed for worldwide use in conjunction with DoD FLIP Enroute Supplements. Contains aeronautical information required by DOD crews in flight, but which is not subject to frequent change. Table of Contents on front cover.

g. **Enroute Low Altitude/Enroute High Altitude Charts.**

h. **Terminal Area Charts.**

i. **Terminal Low Altitude/Terminal High Altitude Instrument Approach Procedures (IAPs).**

j. **Terminal Change Notice (TCN).** Published at midpoint of IAP cycle, contains revisions, additions, and deletions to the last complete issue of IAPs.

k. **STARs.** Standard Terminal Arrivals.

Be Informed. Use the FLIP system to plan the route of flight, file flight plans, and learn information about your destinations. Find out if the destination airfield has military contract fuel (civilian fields), requires a PPR number (military fields), hours of operation, runway dimensions, etc. Often a telephone call to the destination Base Ops or civilian FBO is helpful to let them know you are coming and to plan the taxi route after landing.

NOTES

1. Students are not permitted to use highlighted or personalized approach plates. Do not take current approach plates for personal use due to limited availability and operational impact.
2. Government contract fuel locations can be determined by utilizing the "FBO Locator" function on https://aircardsys.com/.

3. Two government agencies produce approach charts: The National Geospatial Intelligence Agency (NGA) (they also produce DoD FLIP) and the National Aeronautical Charting Office (NACO) (FAA agency). NGA instrument approach procedures (IAPs) contain procedures at military airfields and approaches at any other airfield that have been requested by DoD users. NACO Terminal Procedures Publications (TPPs) contain every low altitude procedure certified in the US with the exception of military high altitude procedures. Both agencies have procedures available on their respective Web sites which are authorized per CNAF M-3710.7 series to print and use in flight. Non official Web site links to publications are not authorized (AIRNAV.com, etc.). NGAs Web site is https://www.extranet.nga.mil and is only available from a CAC enabled .mil computer. The NACO Web site is www.naco.faa.gov and is available from any computer with an internet connection.

3. **Weather.** A DD-175-1 Flight Weather Briefing Form, or "Dash One," shall be completed whenever an IFR flight plan is filed. DD-175-1 weather briefs can be obtained online at https://fwb.metoc.navy.mil/. When operating from civil fields where military weather services are not available, an FAA-approved weather briefing from either an FSS (1-800-WX-BRIEF) or Direct User Access Terminal System (DUATS) may be substituted. Refer to squadron SOPs for other weather policies, including student solo requirements. For cross country flight request DD-175-1 the night prior.

Comply with directives (CNAF, SOPs) for takeoff, filing, and weather avoidance criteria.

Non-Precision Approach	Precision Approach
Published Mins ≥ 300-1*	Published Mins ≥ 200-1/2 (24)**
*Note: Published Minimums to the available non-precision approach. **Note: Published Minimums to the landing runway in use. (24) is standard IAP notation for prevailing visibility/RVR in 100s of feet.	

Figure 4-2 Standard Instrument Rating Takeoff Minimums

Destination WX (ETA ±1 Hour)	Alternate WX (ETA ±1 Hour)
0-0 ≤ WX < Published Mins	WX ≥ 3000-3
Published Mins ≤ WX < 3000-3	NP: WX ≥ Published Mins + 300-1 P: WX ≥ Published Mins + 200-1/2
WX ≥ 3000-3	No Alt Required
*Note: Published Minimums to the available non-precision approach. **Note: Published Minimums to the landing runway in use. (24) is standard IAP notation for prevailing visibility/RVR in 100s of feet.	

Figure 4-3 Table IFR Filing Criteria

a. **Alternate Minimums**. Some civil and foreign approaches may have “A”or “A NA” in the remarks.

The “A” tells civilian pilots that the alternate minimums for the approach are nonstandard and that they must look in the front of the IAP book for new alternate minimums. Since military services establish their own alternate minimums, military pilots may ignore the alternate weather minimums listed under the “A.”

The “A” also lists other important information, such as at KHRL (Harlingen, TX), where the ILS/LOC to 17R and the BC LOC to 35L are “NA when the control Tower closed.” Therefore it is important to check the “A” in the front of the IAP regardless of flying military or civilian.

The “A NA” tells civilian and military pilots the specific approach cannot be used in order to qualify the field as an alternate due to an unmonitored facility (NAVAID) or absence of weather reporting service. Without weather reporting facilities at the airport, a pilot will not be able to get a specific forecast for that airport as required by CNAF M-3710.7 series. The lack of monitoring capability of the navigation facilities is a bigger problem. Without monitoring capability, the pilot will not get advanced warning if the NAVAID is not operating. This means if the NAVAID goes off-line or otherwise becomes unreliable, there is no one to issue a NOTAM to inform the pilot of the situation before an attempt is made to identify and use the NAVAID in flight.

NOTE

Any time “NA” is used on publications, it means “not authorized.” For example, circling may not be authorized in a certain direction because the designer couldn’t provide obstacle clearance. A visual climbout over the airport (VOCA) might not be authorized at night since pilots can’t visually identify obstacles.

b. **Enroute Weather Facilities.** Ensure the weather forecast is updated at least once while enroute on all cross-country flights. If weather is deteriorating, it is often better to divert to your alternate early in the flight rather than pressing on with decreasing fuel reserves. Utilize HIWAS, military Pilot to Metro Services (PMSV), Flight Service Station (FSS) (255.4), or Enroute Flight Advisory Service (EFAS or "Flight Watch") as appropriate. Reference FIH and AIM for more information on Enroute Weather Facilities.

4. **Flight Plans.** Questions regarding the proper filing of a DD Form 175 or DD Form 1801 flight plan can be answered by referencing ***GP Chapter 4***. Detailed instructions and examples are given for each block.

Preferred routing between NGP and many local destinations is posted in Base Ops and should be used whenever possible. For traveling to and from locations outside of the South Texas area, preferred IFR routes have also been established between busier airports to facilitate traffic flow. These routes are listed in the AP/1 for North and South America and should be referenced before filing the flight plan. IFR clearances are generally issued based on these preferred routes unless severe weather or other circumstances dictate otherwise.

a. **Enroute Planning.** Proper preflight planning of the enroute portion should ensure a safe and efficient flight. When filing IFR routes, plan the route to avoid prohibited areas, restricted areas and MOAs by a minimum of 3 nautical miles (NM), unless permission has been obtained to operate in that airspace and the appropriate ATC facilities have been advised. Whenever a MOA is active, (usually daylight hours on weekdays) an IFR clearance through the area will not normally be issued. Numerous MOAs exist in Texas and are not depicted on high charts. Be prepared to accept IFR routing around active areas. In the past, Houston Center has vectored CNATRA IFR traffic through active T-45 MOAs; be leery of accepting such a clearance without radio contact with participating aircraft.

b. **Change of Flight Plan Enroute.** Simple enroute changes to a flight plan, including deviations for weather, can usually be accomplished directly with Air Route Traffic Control Center (ARTCC). If a change in the flight plan is complicated, involves airspace covered by multiple ARTCC facilities, or the ARTCC workload is heavy, the change may have to be filed with FSS.

i. **ARTCC.** Refer to the back cover of the IFR Enroute Supplement for the correct format. Call ARTCC with *"request change of route/destination."* If ARTCC can handle it, read the request. If they are too busy to take your request, attempt to get clearance to an intermediate point on the new route. This will allow you to continue towards the new destination while contacting FSS.

ii. **FSS.** Before contacting FSS, write the change down in correct sequence as specified on the back cover of the IFR Enroute Supplement. Ideally, maintain contact with ARTCC and utilize a second radio to contact FSS. The FSS specialist has a copy of the flight plan form to be filled in and will expect you to read your request in the proper order without pause. Do not read the block headings, only the information required. After filing the flight plan, request a weather update if required. Allow reasonable time for FSS to input the flight plan and then call ARTCC for the new clearance. Pilots may need to state the FSS with which you filed. Be ready to copy clearances.

c. **Canceling/Closing IFR Flight Plans.** As described for civilians in the Aeronautical Information Manual (AIM), and as far as FSSs are concerned, “canceling” and “closing” an IFR flight plan are synonymous and interchangeable; however, CNAF M-3710.7 series differentiates between canceling and closing an IFR flight plan for Naval aircraft Because the military provides additional flight following through Base Ops; merely cancelling a flight plan with FSS will not close out the flight plan at Base Ops. The AIM and CNAF M-3710.7 series establish guidance on canceling/closing flight plans.

NOTES

1. Cancellation in the air is always an option while in VMC outside Class A airspace by stating, *“Cancel my IFR flight plan”* to the controller. Immediately after canceling an IFR flight plan, the pilot should change to the appropriate radio frequency, VFR beacon code (1200), and appropriate VFR altitude. In this case, flight following may not be provided by ATC for the remainder of the flight unless requested; however, if enroute to a military field the aircraft will still receive flight following through the destination Base Ops facility provided a departure message was properly sent from your departure location – either from your military departure field Base Ops facility or from the civilian field’s servicing FSS after calling them directly and passing along the departure message. (See Section 413 (3), Departure Message, for more information.)

2. If on a VFR flight plan, upon canceling or completing the flight, the PIC shall close the flight plan with a FSS or ATC facility.

5. **NOTAMs.** A Notice to Airmen (NOTAM) is time-critical aeronautical information that is of a temporary nature or not known sufficiently in advance to permit publication on aeronautical charts or in other operational publications. NOTAMs are disseminated by the U.S. NOTAM System (USNS) via the Defense Internet NOTAM System (DINS) and could include such information as airport or primary runway closures, changes in NAVAID status, RADAR service availability, and other information essential to planned enroute, terminal, or landing operations. Before every flight, check NOTAMs for the departure field, destinations, possible alternates, ARTCCs, and the airspace in between. Check the GPS NOTAMS. You can access DINS Web site (https://www.notams.faa.gov/) from any computer.

a. **Definition.** A NOTAM is defined as an unclassified notice containing information concerning the establishment of, condition of, or change in an aeronautical facility, service, procedures, or hazards; the timely knowledge of which is essential for safe flight operations. NOTAM abbreviations are explained in the FIH and the Notices to Airmen Publication (NTAP).

b. **Types.** Listed are six different types of NOTAMs. ***All must be checked prior to flight.***

i. **Military Flight Safety NOTAMs.** These NOTAMs contain information about individual military aerodromes; runway closures, NAVAID outages, frequency changes, runway lighting, etc.

ii. **Flight Data Center (FDC) NOTAMs.** The most important thing to know about FDC NOTAMs is they are regulatory (read: you must follow them). FDC NOTAMs contain important information such as amendments to published approaches, chart changes, and TFRs. FDC NOTAMs are broken down into the following categories: General FDC NOTAMs, ARTCC FDC NOTAMs, and Airports, Facilities and Procedural FDC NOTAMs.

iii. **Attention Notices.** Attention Notices are general notices that apply to military pilots. They are broken down into the following groups with the associated abbreviation: All (ATTA), Europe (ATTE), North America (ATTN), Caribbean and South America (ATTC) and Pacific (ATTP)

iv. **Civilian "D" (Distant) Series NOTAMs.** These NOTAMs are the civilian equivalent of a Military Flight Safety NOTAM. They contain information about individual civilian aerodromes, runway closures, NAVAID outages, frequency changes, runway lighting, etc. When typing a field's four letter identifier (e.g., KCRP), these NOTAMs are shown.

v. **Notices to Airman Publication.** This book consists of four parts and is available on the DINS Web site under "Flight Related Links," on the right side of the page.

vi. **GPS NOTAMs.** There are four types of GPS NOTAMs.

(a). **Satellite Vehicle (SV) Outage NOTAMs.** These NOTAMs are accessed through the DINS Web page by entering the four-letter identifier "KGPS" in the main NOTAM Retrieval area. When entered, this identifier will provide information on SV outages. SVs will be identified by a number (e.g., 15) and listed as "unreliable" or "unusable." These SVs should be deleted from your FMS using the RAIM page. Any mention of "Pseudo Random Noise (PRN)" is a reference to the SV type only and should not be interpreted as a degraded SV.

(b). **RAIM availability NOTAMs.** These NOTAMs may be obtained by entering any four-letter ICAO identifier in the main NOTAM Retrieval area on the DINS page.

(c). **Jeppesen NavData Alerts/NOTAMs.** These NOTAMs highlight significant changes affecting the database in the T-44 FMS and can be found on the Jeppesen Web site. There is a link to the Jeppesen Web site on the right side of the DINS page under “Flight Related Links.” These NOTAMs do not detail any problems with RNAV/GPS procedures, just errors in the Jeppesen database.

(d). **GPS jamming NOTAMs.** Information on planned GPS jamming operations for the US National Airspace System (NAS) is listed in the appropriate center NOTAMs. In areas of predicted jamming, aircraft may not plan to use GPS to fly instrument procedures.

NOTE

The FMS 3000 database is populated by Jeppesen and alerts may also be found at: http://www.rockwellcollins.com/fms/navalerts.asp.

c. **DoD Internet NOTAM Distribution System (DINS).** DINS is a large central data management system, which derives its information from the U.S. Consolidated NOTAM Office at the FAA Air Traffic Control Command Center located at Herndon, VA. Real-time NOTAM information is maintained and made available through the internet. Coverage includes all military airfields and virtually all domestic, international, and Flight Data Center (FDC) NOTAMs. If not covered by DINS, the airfield does not transmit NOTAM data to the USNS. In such a case, contact the desired location directly for NOTAM information.

The DINS main Web page is https://www.notams.faa.gov/ with a backup address of https://www.notams.faa.gov. DINS provides real time NOTAM data validated by the USNS, which includes domestic, international, military and FDC NOTAMs. The following three areas of the DINS Web site provide the information we need here in the United States:

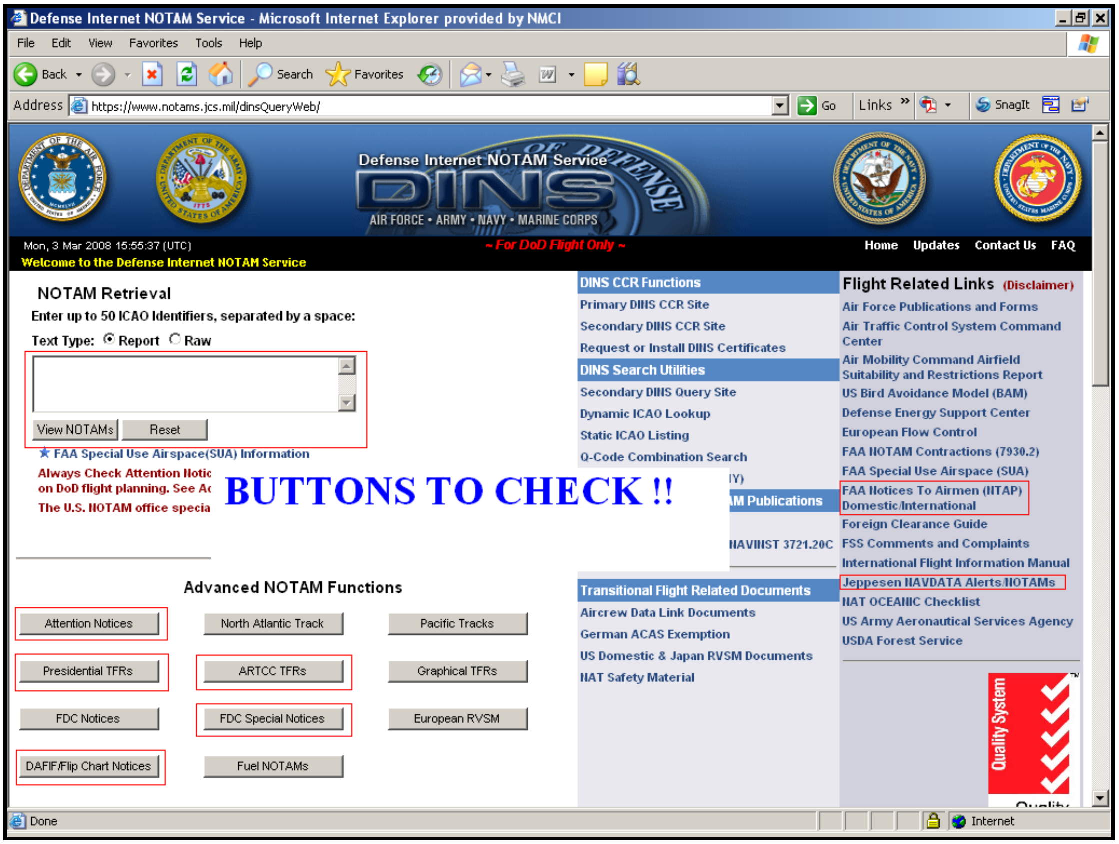


Figure 4-4 DINS Web Page

d. **DINS Web page limitations.** It is important to understand that the DINS Web page, while updating on a real-time basis, does not auto-refresh any information currently displayed. This means that while the information is up-to-the-minute current when it is originally accessed, no further updates are received unless the page is refreshed by clicking "View-Refresh" or by reentering the selected ICAO identifiers and clicking on "View Notices." The NOTAM Web site should be rechecked before all flights to ensure you have the latest NOTAMs.

e. **The FAA NOTAM Distribution System.** Unlike DINS, which allows pilots to check their own NOTAMs, the FAA NOTAM Distribution System is based on a verbal briefing system. To obtain a verbal briefing, contact an FSS. The easiest way to accomplish this is to call 1-800-WX-BRIEF. The FSS Briefer will provide you with D NOTAM information for any requested field. FSSs maintain a file of FDC NOTAMs affecting conditions within 400 miles of their facility. FDC information concerning conditions more than 400 miles away from the FSS, or already published in the NTAP, is given only on request. The FSS Briefer assumes pilots have looked at the appropriate sections of the NOTAM Publication. They will not brief the information contained in the NTAP unless specifically requested.

6. **Aircraft Performance/Takeoff and Landing Data (TOLD).** TOLD encompasses all performance data for a flight. Operations without this knowledge is dangerous. The performance charts in the NATOPS manual are based on operating procedures and conditions explained either in text or chart form. The takeoff and climb performance is the most important operational consideration because payload and/or range may be reduced due to limiting takeoff conditions. In fact, we easily have the performance to land at many fields from which we cannot takeoff (disregarding SOP minimum runway length requirements to make a point). Reducing our takeoff gross weight is the easiest way to improve our takeoff and climb performance (another option is to wait for better takeoff conditions such as lower temperatures, stronger headwinds, dry runways, etc.). If on cross-country and anticipating a need to limit takeoff weight to preserve performance, aircrews should wait to fill the fuel tanks until determining the gross weight limitation.

a. **Takeoff Gross Weight Limitations.** All takeoff and initial climb performance is planned with one situation in mind: safe continued operation after an engine failure. Here are some basic considerations to establish a safe takeoff gross weight:

i. We are required to be able to accelerate to rotation speed, lose an engine, and stop on the runway. In other words, our accelerate-stop distance must be equal to or less than runway length. Here at NGP our limiting factor is most often the accelerate-stop distance with wet runways. If accelerate-stop distance exceeds the active runway length, possible solutions are to request the long runway, reduce your fuel load, or wait for more favorable conditions.

ii. Plan to climb at a gradient steep enough to clear obstacles if an engine fails. In other words, our one-engine inoperative climb gradient should be 200 feet per nautical mile (FPNM) for a diverse departure or the published obstacle clearance climb gradient for the departure procedure. In many cases this is the most restrictive of all aircraft performance factors, especially at high density altitudes (e.g., mountainous terrain).

b. **Accelerate-Go Distance.** This will need to be considered if departing in bad weather conditions from an airport with a runway end crossing height.

c. **Enroute Limitations.** Another limiting factor to consider in preflight planning is our one-engine-inoperative service ceiling. Minimum Enroute Altitudes (MEAs) over mountainous areas are sometimes higher than the one-engine service ceiling.

d. **Weight and Balance Computations.** A Weight and Balance Clearance Form F is required for every flight. Normally, the pre-computed Form F found in the back of the Aircraft Discrepancy Book (ADB) is sufficient. If carrying three or more passengers or cargo, a Form F must be computed and on file to ensure the aircraft is under the structural weight limitation (check both the maximum takeoff weight and the maximum zero fuel weight) and has its center of gravity within limits for both takeoff and landing.

7. **Standard Instrument Departures (SIDS), Obstacle Departure Procedures (ODPs), Standard Terminal Arrivals (STARs), and Instrument Approach Procedures (IAPs)**

a. **Methods of IFR Departure**. The following methods may be used to depart an airport under IFR:

i. Specific ATC Departure Instructions

ii. Obstacle Departure Procedure (ODP) (A subcategory of DPs)

iii. Standard Instrument Departure (SID) (A subcategory of DPs)

iv. Diverse Departure

v. Visual Climb Over the Airport (VCOA)

b. **How an Airport Becomes an Instrument Airport.** Simply put, when an airport is first created, it is a VFR airport until it is determined that IFR operations are necessary. The first instrument procedure at an airport, which the procedure designer will use TERPS to construct, is usually an Instrument Approach Procedure (IAP). When an IAP is initially developed for an airport, the need for Departure Procedures (DPs) are also assessed. A DP will not exist if there is not an IAP for that airport. DPs come in many forms, but they are all based on the design criteria outlined in TERPS and other FAA orders.

c. **Planning the Departure.** Before departing an airport on an IFR flight, consider the type of terrain and other obstacles on or in the vicinity of the departure airport. Determine whether or not the departure airport has a Standard Instrument Departure (SID), an Obstacle Departure Procedure (ODP), or neither. (Both SIDs and ODPs fall under the general category of "Departure Procedures" (DPs). An ODP may drastically affect the initial part of the flight plan. Considering the forecast weather, departure runway and existing DP, plan the flight route and climb performance accordingly to compensate for the departure procedure.

d. **The Trouble T** ( ), on the approach plate at your departure airport indicates an obstacle has penetrated the 40:1 obstacle clearance surface (OCS). When this happens the Departure Designer has multiple options:

i. Typically, if the obstacle is within 1 mile of the Departure End of the Runway (DER) and requires a higher climb gradient only until 200' above DER, the designer will publish the obstacle as a note. This is known as a low close in obstacle. Typically, pilots would be able to see these obstacles unless the weather is less than 200-1. As a technique, if able to arrive at the DER at or above the highest MSL altitude associated with any of the low close in obstacles, the aircraft will clear them all. Departure planning should be for one engine inoperative.

NOTE

The OCS begins at DER and 0 feet for Air Force and Navy designed departures and 35 feet above the DER for FAA/Army designed departures.

ii. Publish a higher required climb gradient (200'/NM is the minimum for any instrument departure). Refer to additional instrument information appendix to convert climb gradients to VSI climb rates.

iii. Publish avoidance routing. This may be in textual form in the front of the IAP or graphically on its own page.

iv. Publish non-standard weather minimums. By publishing higher weather minimums (in lieu of a higher climb gradient) that allow a pilot to see the obstacle, departure designers can expect that pilots will not fly into obstacles they are able to visually identify. Refer to appropriate service directives concerning departures. For instance, USAF aircraft are prohibited from using these non-standard weather criteria. Often these notes will be accompanied by an asterisk (*) that gives the option to use your standard departure weather minimums (CNAF/SOPs) and comply with the published Trouble T climb gradient.

SHEPPARD AFB/WICHITA FALLS MUNI (KSPS), WICHITA FALLS, TX . . . . Amdt 1, 11293
DEPARTURE PROCEDURE: Rwy 15R/15C/15L, Climb on track 153° to 2500' before turning Westbound. **Rwy 17,** Climb heading 160° to 2500', intercept SPS VORTAC R-120 outbound. Cross SPS R-120/8 DME (HUNEP) at or below 2500', then climb and maintain 5000' or higher as assigned. Turn on course after reaching 3100'. **Rwy 35,** Climb heading 355° to 1500' then proceed on course.
TAKE-OFF OBSTACLES: Rwy 17, Light pole 31' AGL/1040' MSL, 837' from DER, 726' left of centerline. **Rwy 35,** Large frame aircraft parking, 56' AGL/1053' MSL, 337' from DER, 542' left of centerline. Large frame aircraft parking, 56' AGL/1053' MSL, 451' from DER, 573' left of centerline.

TULSA INTL (KTUL), OK . . . . . Amdt 1, 10266
DEPARTURE PROCEDURE: Rwy 26, climb on a hdg between 289 CW to 083 from DER, or minimum climb of 222 ft/NM to 2900 for headings 084 through 288.
TAKE-OFF OBSTACLES: Rwy 18R, vehicle on road 200' from DER, 419' right of centerline, 15' AGL/687' MSL. Antenna on bldg 549' from DER, 447' left of centerline, 22' AGL/692' MSL. Bldg 411' from DER, 574' right of centerline, 39' AGL/699' MSL. Sign 1151' from DER, 757' right of centerline, 46' AGL/720' MSL. Bldg 2847' from DER, 690' right of centerline, 118' AGL/788' MSL. **Rwy 26,** antenna and bldg 1031' from DER, 745' left of centerline, up to 53' AGL/708' MSL. Tree 1544' from DER, 425' left of centerline, 53' AGL/713' MSL. **Rwy 36L,** trees 726' from DER, 608' right of centerline, 69' AGL/659' MSL. Trees 822' from DER, 596' left of

Figure 4-5 IFR Take-Off Minimums and Obstacle Departure Procedures

iv. Create standards for a Visual Climbout over the Airport (VCOA). The designer will typically create weather minimums well above VMC conditions to allow the pilot to circle within a specified distance of the airport and climb to a specified altitude and then depart. As a technique, put VCOA in the remarks of your flight plan if you intend to fly one and advise tower/ATC of your intentions.

vi. Use a combination of all of the above methods.

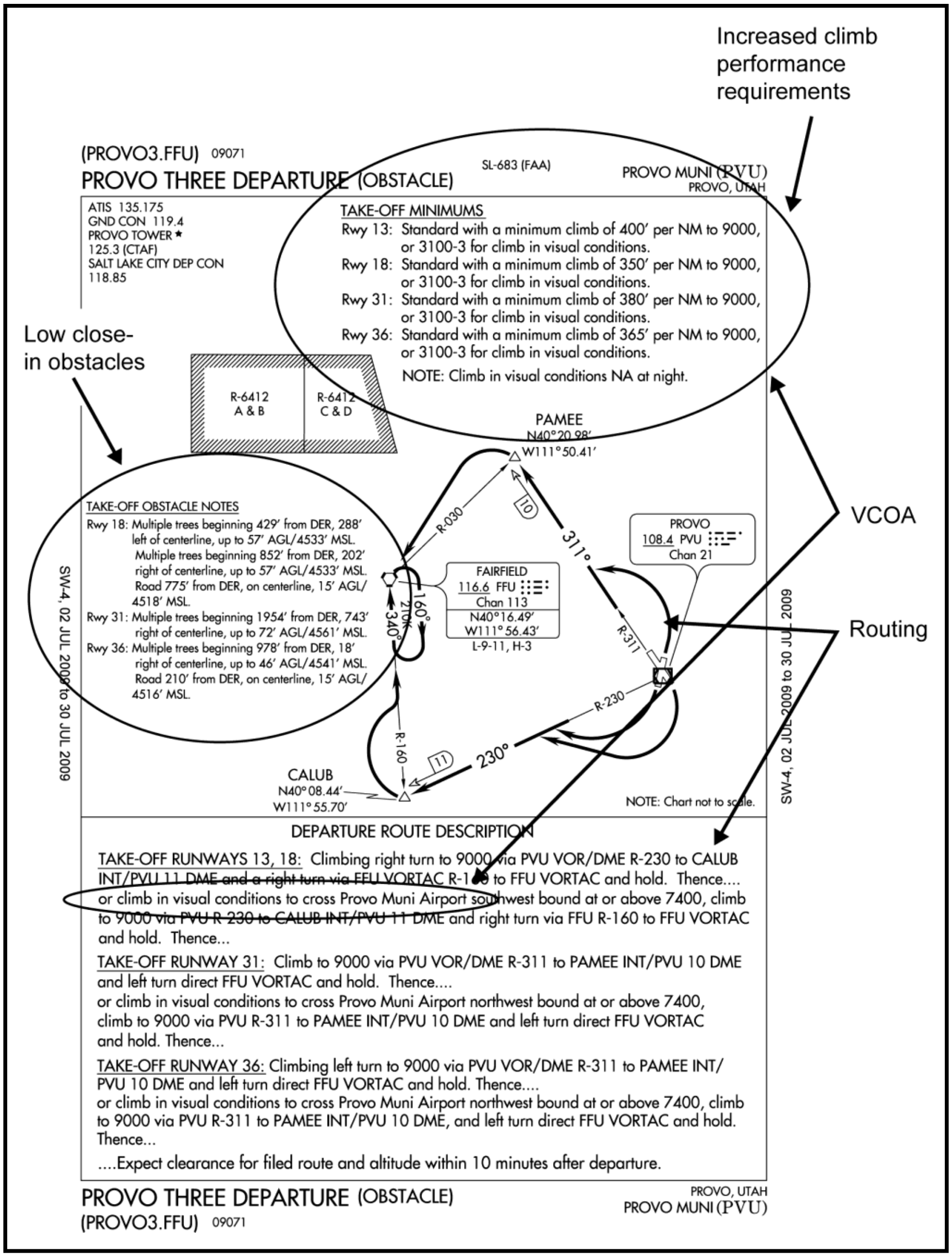


Figure 4-6 TERPS Design Options

e. ***If no ODP is published***, pilots are authorized to execute a diverse departure. Climb straight ahead to 400 feet AGL before turning on course while maintaining a 200 ft/NM climb gradient or greater. ***If an ODP is published***, pilots are not authorized a diverse departure.

f. ***SIDS*** take obstacle clearance into account, but are typically used for ATC convenience. SIDS are usually Radar Departures or Pilot Nav Departures and should be carefully evaluated before taking off. If there is any doubt of the departure clearance, query ATC. ATC will specifically clear pilots to fly the SID. SIDS are always published graphically. A high potential for confusion exists when ATC modifies the SID and/or tells pilots to resume the SID. If in doubt, query.

– **Civil SIDs vs. Military SIDs.** Although civil SIDs (FAA and CONUS Army procedures) in the United States are constructed using the same TERPs criteria as military SIDs, the information presented is significantly different. It is important to be aware of the differences:

(a). **No Obstacles are Identified or Depicted.** Although many obstacles may be present, civil SIDs do not provide any obstacle information to the pilot.

(b). **ATC Climb Gradients.** Civil SIDs also do not normally identify ATC climb gradients in any way; it is up to the pilot to recognize and compute any ATC climb gradients.

(c). **Obstacle Climb Gradients.** On civil SIDs, minimum climb gradients required for obstacle clearance will be depicted on the SID, or included in the ODP (Trouble T section).

(d). **Climb gradient depicted on the SID**. At some airports, the minimum climb gradient will be published on the SID. In such cases, although a Trouble T is depicted on the SID, the climb gradient published on the SID itself takes precedence over the climb gradient contained in the ODP.

(e). **Climb gradient included in the ODP.** In other situations, there will be no climb gradient published on the SID; however, the SID chart will depict a Trouble T. In these cases, refer to the ODPs in the front of the approach book to determine the minimum climb gradient for the runway used. When no climb gradient is specified on the SID, comply with the gradient published with the ODP for that runway.

g. **If taking off in the RADAR environment** and no clearance is given to fly a SID, ATC departure instructions are normally issued in the form of a heading to fly on departure followed by radar vectors. Exercise caution with this type of departure instruction if IMC will be encountered. Comply with ODP climb gradients for the appropriate runway. If IMC and there is a “climb to (altitude) before turning (direction)” for the runway, climb to the appropriate altitude before turning to the ATC issued heading. Realize ATC does not share obstacle clearance responsibility until they state “radar contact” and issues an assigned heading. If any doubt exists to whether the instruction will provide obstacle clearance, pilots should fly the ODP instructions for the runway/airport and advise ATC of their intentions.

If departure instructions aren’t received prior to takeoff, pilots are expected to comply with the ODP or fly a diverse departure if no ODP exists.

CAUTION

All ATC systems are not created equal. While you may trust an FAA controller nearly 100%, the pilot is always ultimately responsible for terrain/obstacle clearance; be careful who you trust to help you with that responsibility.

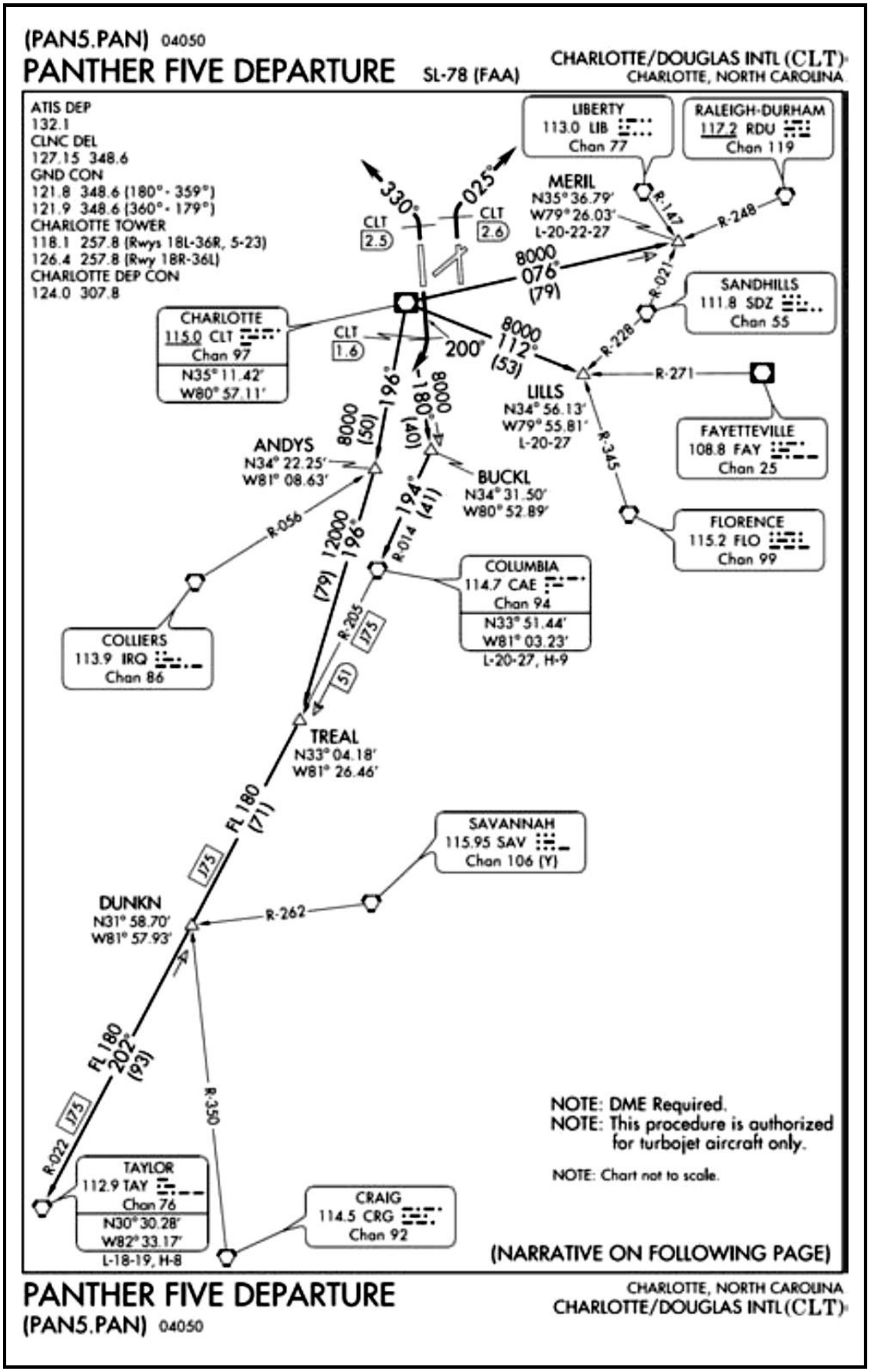


Figure 4-7 Pilot NAV SID

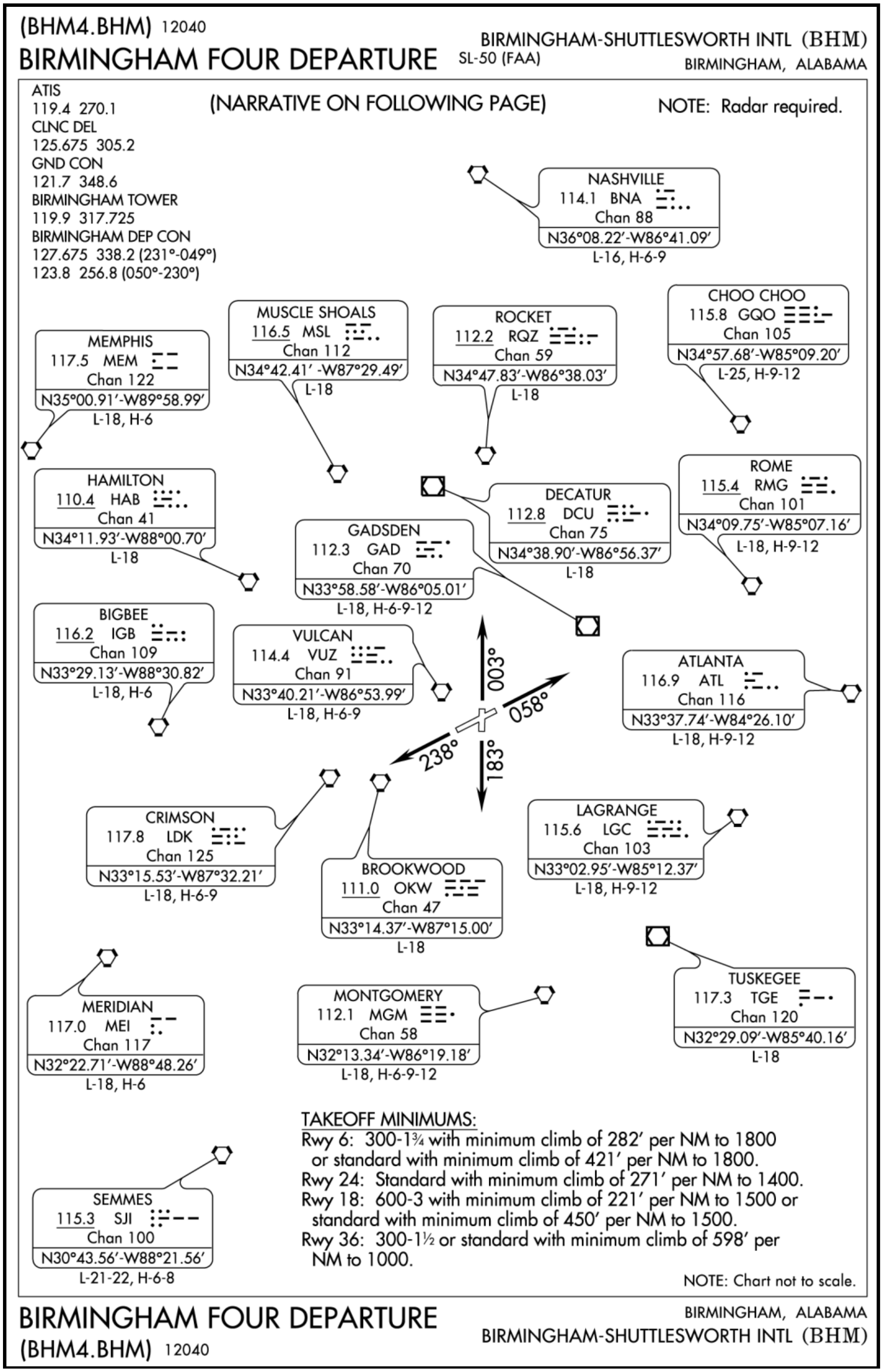


Figure 4-8 Vector SID

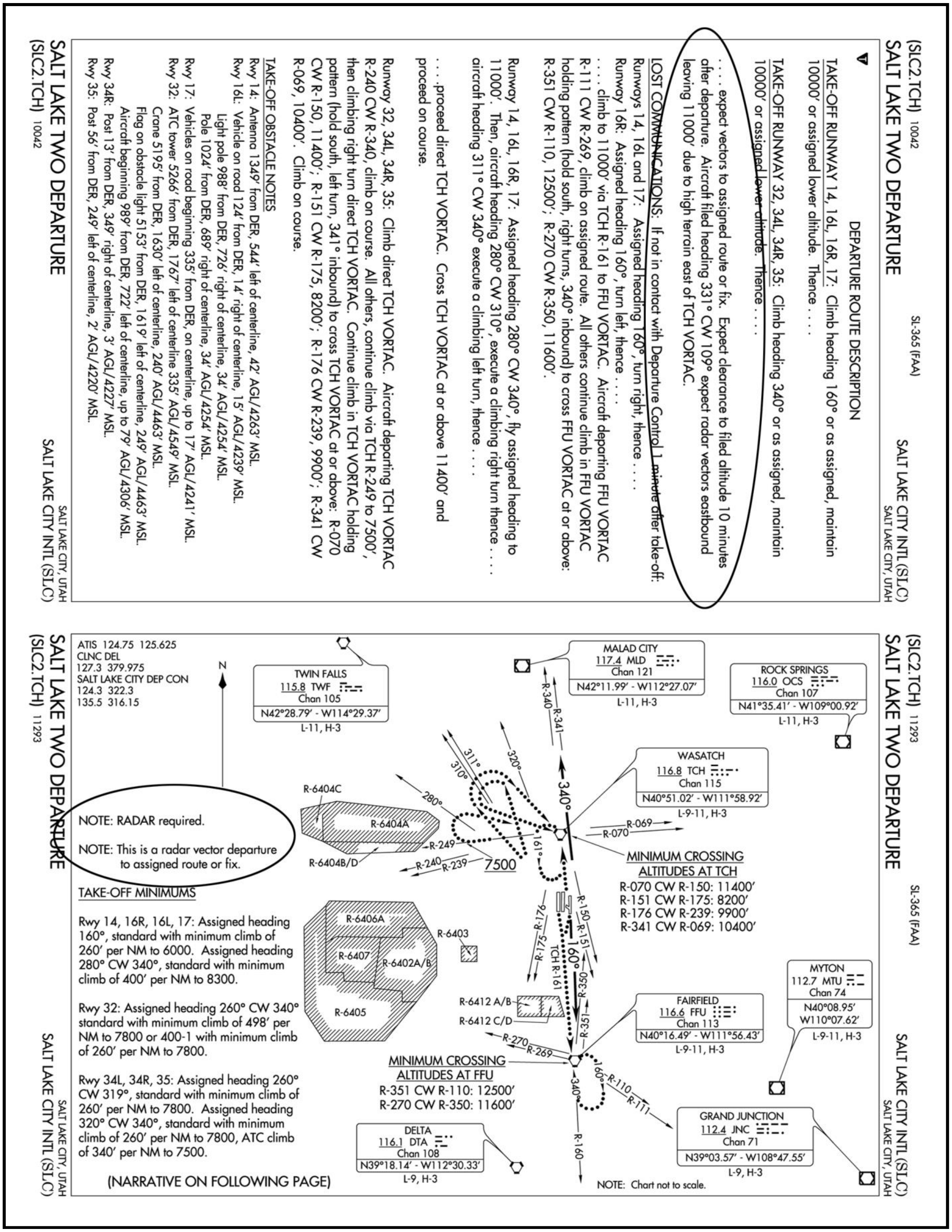


Figure 4-9 Vector SID with Pilot NAV

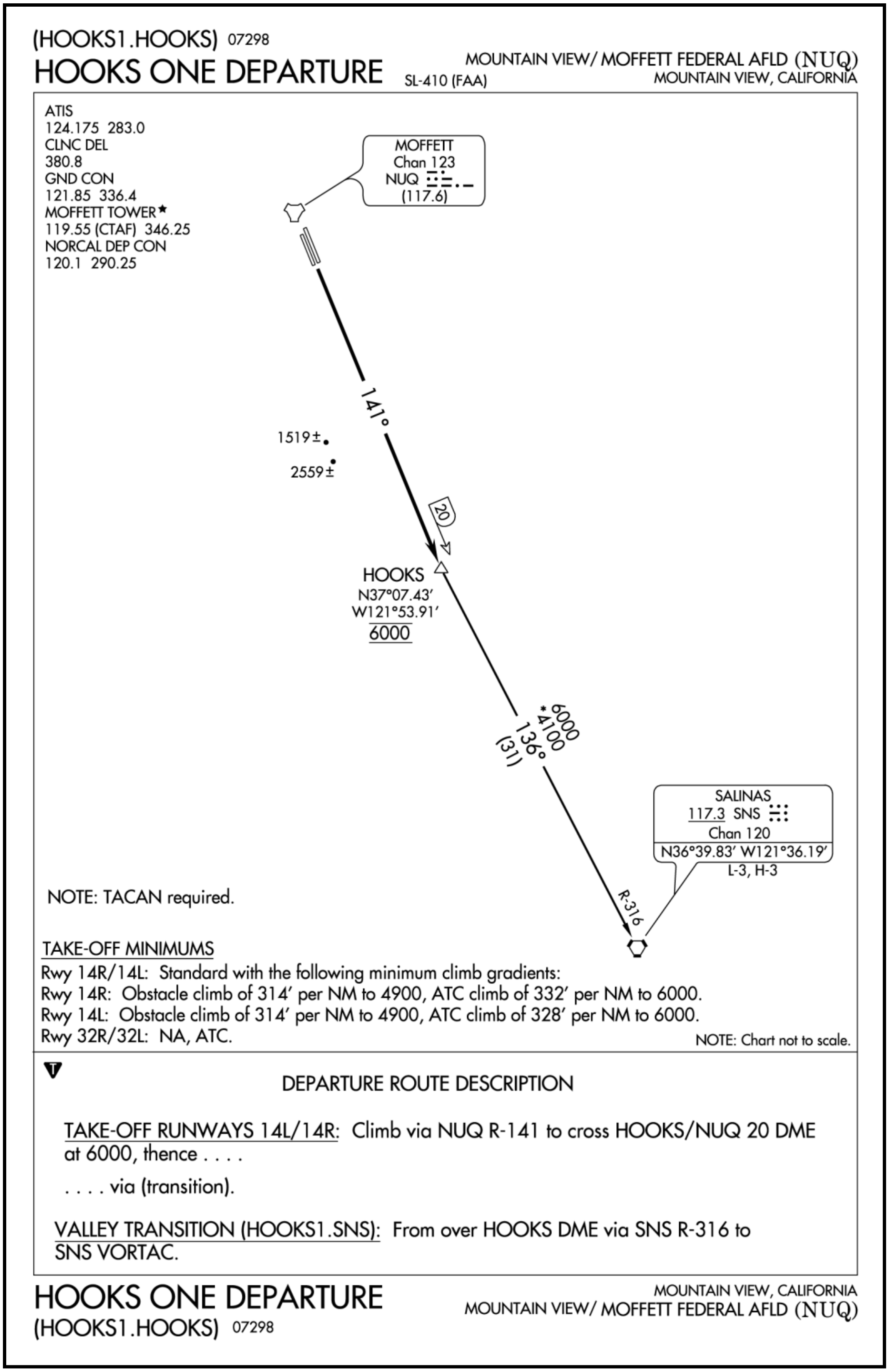


Figure 4-10 Military SID

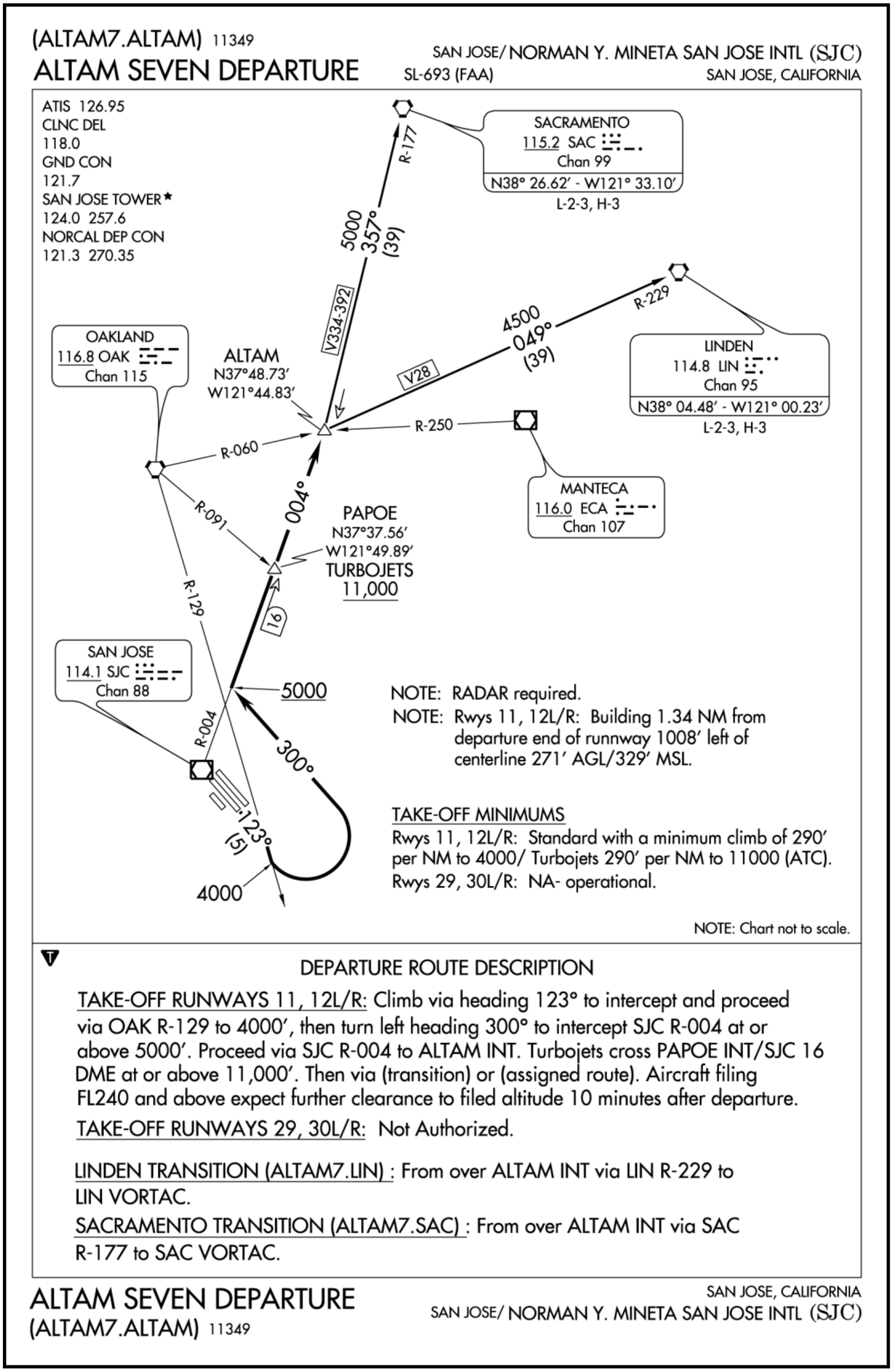


Figure 4-11 Civil SID

h. **Planning the arrival.** If STARs have been published for the destination, file the STAR that is appropriate for the arrival direction. There may be different STARs for aircraft arriving from the North, East, etc. Look at the index in the front of the STARs book to determine which one is appropriate for the flight. If choosing not to file a STAR, at least review and be familiar with them in the event that ATC issues a STAR in the clearance.

i. **Planning the approach.** Preparation for flying an instrument approach begins with a study of the IAP during preflight planning. The end result of an approach – either a landing or a missed approach – can be directly dependent upon the pilot's familiarity with the IAP.

8. **Student Tendencies**

a. Not including the alternate destination on the DD-175-1 weather brief

b. Not bringing the DD-175-1 weather to the flight brief

c. Not checking the valid times on the weather brief

d. Not checking all the appropriate destination, alternate, ARTCC, or GPS NOTAMs

e. Not ensuring that the flight plan is closed out (when applicable)

405. IFR DEPARTURES

NOTE

The AIM is an excellent resource for IFR departure information.

1. **Instrument Takeoff (ITO).** The ITO is a composite visual and instrument takeoff flown when conditions permit. The ITO procedures and techniques are invaluable aids for takeoffs at night, toward and over water or deserted areas, and during periods of reduced visibility. It is important to immediately transition to instrument references when disoriented or when outside visual references become unreliable. Students should simulate an ITO on all instrument training events (e.g., simulate loss of visual references during climb-out, not while on the runway).

a. **Preparing for the ITO.** Before performing an ITO, perform an adequate before-takeoff check of all flight and navigation instruments to include publications.

i. Have your NATOPS manual and the appropriate enroute and Instrument Approach Procedure (IAP) charts within reach. Fold the enroute charts so that your route is visible.

ii. Select the appropriate navigational aids to be used for the departure, and set the navigation instruments and switches as required. This includes setting the CDI and the heading marker to logical positions for departure. The ATC clearance and departure procedures (DPs) must be thoroughly understood before takeoff. The appropriate IAP chart for the departure field shall be readily available in the event an instrument approach becomes necessary immediately after takeoff. Use the anti-ice/deice equipment as appropriate for the weather.

NOTE

NAVAIDs should be set up for a logical departure. In any case, an emergency return to the field should be planned and the IAP/NAVAIDs should be immediately available. Pre-loading these NAVAIDs is sufficient.

b. **Performing the ITO.** Refer to the Basic Instruments chapter for instrument takeoff.

406. NAVIGATION PROCEDURES

1. **Introduction.** An instrument flight, regardless of its length or complexity, is a series of connected BI flight maneuvers. The information received from the navigation instruments or ATC determines what maneuver to perform, when to perform it, or what adjustments, if any, are required. DPs, enroute charts, STARs, IAPs, and similar publications should be considered as textual or pictorial presentations of a series of connected instrument flight maneuvers. Radio instrument procedures are flown using a combination of the techniques described in this section (proceeding direct, radial-to-arc, course intercepts, etc.).

NOTE

Where procedures depict a ground track, the pilot is expected to correct for known wind conditions. In general, the only time wind correction should not be applied is during radar vectors or when told to fly or maintain runway heading.

2. **Setup of Navigation Instruments.** Using the acronym “TIMSS” can be an effective technique.

NOTE

Use CRM! The PF shall ensure the proper NAVAID is tuned and identified. Use the PM and Observer to assist.

a. **Tune.** Tune to or select the desired frequency or channel.

b. **Identify.** Positively identify the selected station.

NOTE

VOR NAVAIDs may be identified on the PFD by the three-letter identifier (e.g., NGP for Navy Corpus). Absence of the three-letter identifier means the aircraft is not receiving the appropriate signal. There is no need to listen to the Morse code group. TACAN will need to be identified (not monitored) by the Morse code ID; however, ADF, Marker Beacons will need to be monitored.

i. **VOR.** The station identification may be a repeated three-letter Morse code group, or a three-letter Morse code group alternating with a recorded voice identifier.

ii. **TACAN.** The TACAN station transmits an aural three-letter Morse code identifier approximately every 35 seconds.

iii. **NDB/ADF.** The non-directional radio beacon transmits a repeated two- or three-letter Morse code group depending on power output.

NOTE

The ground station portion of the non-directional radio beacon is known as the Non-Directional Beacon (NDB). The airborne receiver is known as the Automatic Direction Finder (ADF).

iv. **ILS/LOC.** The ILS localizer transmitter puts out a repeated four-letter Morse code group. The first letter of the identifier is always “I” to denote the facility as an ILS.

NOTE

Voice communication is possible on VOR, ILS, and ADF frequencies. Listening to voice transmissions by a Flight Service Station or other facility (e.g., Transcribed Weather Broadcast (TWEB) is not a reliable method of station identification and shall not be used. Consult FLIP documents to determine the availability of specific stations.

c. **Monitor.** Monitor station identification while using it for navigation. Removal of identification serves as a warning to pilots that the facility is officially off the air for tune-up or repairs and may be unreliable even though intermittent or constant signals are received. The navigation signal is considered to be unreliable when the station identifier is not being received. Monitor the appearance of the identifier on the PFD or the aural Morse code identifier (NDB) continuously to ensure adequate signal reception strength.

d. **Select.** Select the proper NAV source and bearing needles. (What NAVAID should the needles display?)

e. **Set.** Set the selector switches to display the desired information on the navigation instruments.

3. **Proceeding Direct**

a. **Tune and Identify the Station**

b. **Turn.** Turn the aircraft in the shorter direction to place the head of the bearing pointer under the top index or upper lubber line.

c. **Center the Course Deviation Indicator (CDI).** Center the CDI with a TO indication (does not apply if using needle only, such as proceeding direct to a NDB).

NOTE

Homing to a station is an incorrect method of navigating direct to a NAVAID and should be avoided. The correct method for navigating direct to a NAVAID would be to utilize the CDI, or setting the wind corrected course on the NAVAID needle.

4. **Homing to a Station**

a. **Tune and Identify the Station**

b. **Turn.** Turn the aircraft in the shorter direction to place the head of the bearing pointer under the top index of the HSI (VOR, TACAN, NDB). Adjust aircraft heading, as necessary, to keep the bearing pointer under the top index of the HSI. Since homing does not incorporate wind drift correction, the aircraft follows a curved path to the station. Therefore, homing should be used only when maintaining a direct course is not required. It is not procedurally correct to home when cleared direct to a fix. If the wind is known, use a correction.

NOTE

Make sure to look at the bearing pointer. Using the CDI, it may appear there is an intercept to the course, but if you look at the bearing pointer, you may not! Remember to push the head to the course, or conversely, pull the tail to the course.

c. **Maintain Course.** Maintain the selected course to the station while correcting for winds and keeping the CDI centered.

5. **Inoperative Procedures.** If either the compass or the bearing pointer is inoperative, the HSI may be used to determine the bearing to the station by rotating the course set knob until the CDI centers with a TO indication in the TO-FROM indicator. The magnetic bearing from the aircraft to the station then appears in the course selector window. Until verified by radar or other navigation equipment, consider this bearing information unreliable.

6. **Maintaining Course.** To maintain course, fly a heading estimated to keep the aircraft on the selected course. If the CDI or bearing pointer indicates a deviation from the desired course, return to course avoiding excessive intercept angles. After returning to course, re-estimate the drift correction required to keep the CDI centered or the bearing needle pointing to the desired course. The CDI and bearing needle may show a rapid movement from the on-course indication when close to the station. In this situation, avoid making large heading changes ("chasing the needles") because actual lateral deviation is probably small due to proximity to the station.

7. **Station Passage**

a. **VOR and VOR/DME.** Station passage occurs when the TO-FROM indicator makes the first positive change to FROM. If RMI only, station passage is determined when the bearing pointer passes 90° to the inbound course.

b. **TACAN.** Station passage is determined when the range indicator stops decreasing (minimum DME).

c. **ADF.** Station passage is determined when the bearing pointer passes 90° to the inbound course.

NOTE

When established in an NDB holding pattern, subsequent station passage may be determined by using the first definite move by the bearing pointer through the 45° index on the RMI.

8. **Arc Intercepts.** TACAN and VOR/DME arcs are often used during an instrument flight. An arc may be intercepted at any angle but is normally intercepted from a radial. An arc may be intercepted when proceeding inbound or outbound on a radial. A radial may be intercepted either inbound or outbound from an arc. The angles of intercept (arc-to-radial or radial-to-arc) are approximately 90°. Because of the large intercept angles, the use of accurate lead points during the interception will aid in preventing excessive under or overshoots.

a. **Arc Interception from a Radial**

i. **Tune and Identify.** Tune the TACAN or VOR/DME equipment.

ii. **Lead Point.** Determine the direction of turn and a lead point that will result in positioning the aircraft on or near the arc at the completion of the initial turn.

About 0.8 NM works well as a no-wind lead point for a 90° turn at 150 KIAS low altitude.

iii. **Turn.** When the lead point is reached, turn to intercept the arc.

iv. **Monitor.** Monitor the bearing needle and range indicator during the turn, and roll out with the bearing needle on or near the 90° index (wing-tip position).

v. **Reference 90° Index.** If the aircraft is positioned outside the arc, roll out with the bearing needle above the 90° index to correct toward the NAVAID; if inside the arc, roll out with the bearing pointer below the 90° index to correct away from the NAVAID.

b. **Radial Interception from an Arc**

i. **Set.** Set the desired course in the Course Selector window.

ii. **Lead Point.** Determine the direction of turn and the lead required in degrees. The interception of a radial from an arc is similar to any course interception except the angle of interception will usually be approximately 90°. The lead point for starting the turn to intercept the course will depend upon several variables. These are the rate of turn to be used, the angle of interception, and the rate of movement of the bearing needle. The rate of movement of the bearing pointer is governed by the size of the arc being flown, aircraft TAS, wind direction and velocity. Five radials work well as a no-wind lead point for a 90° turn at 150 KIAS on a 10 DME arc.

NOTE

The primary reference for leading a turn to intercept the radial (usually final approach) should be a bearing needle, not just the CDI. Relying solely on the CDI for lead radial information and turn anticipation often leads to late turns to intercept course. Watch the bearing needle tail rise/fall to meet your CDI course.

iii. **Turn.** When the lead point is reached, turn to intercept the selected course. Monitor the CDI or bearing needle during the turn and roll out on course or with a suitable correction to course.

c. **Maintaining an Arc.** Control aircraft heading to keep the bearing needle on or near the 90° index (reference point) and the desired range in the range indicator. A reference point other than the 90° index must be used when operating in a crosswind. If the aircraft drifts toward the station, select a reference point below the 90° index. If the drift is away from the station, select a reference point above the 90° index. The elected reference point should be displaced from the 90° index an amount equal to the required drift correction.

Techniques for maintaining and correcting to the arc are:

i. **Bank Angle.** Establish a small bank angle that results in a rate of turn keeping the bearing needle on the selected reference point and the desired range in the range indicator.

ii. **Short Legs.** Fly a series of short, straight legs to maintain the arc. To fly an arc in this manner, adjust the aircraft heading to place the bearing needle 5 to 10 degrees above the selected reference point. Maintain heading until the bearing needle moves 5 to 10 degrees below the reference point. The range should decrease slightly while the bearing needle is above the reference point, and increase slightly when below the reference point.

iii. **Corrections.** A technique to correct back to the arc: change aircraft heading to displace the bearing needle 5° below the reference point for each one-half mile deviation to the inside of the arc, and 10° above the reference point for each one-half mile outside the arc.

9. **Point-to-Point.** Bearing and range information from a VOR/DME or TACAN facility is sufficient for navigating direct to any point within reception range. The following are some techniques to accomplish a point-to-point:

a. **Tune.** Tune the TACAN and/or VOR/DME equipment as required. Use the enroute chart, IAP chart, etc., to determine the NAVAID that defines the new point.

b. Select the desired primary navigation source and bearing pointer on the PFD.

c. Twist the head of the CDI to the point-to-point radial.

d. **Turn.** Make an initial turn in the general direction of the desired fix. This step is optional, but the objective is to turn in the general direction of the desired point rather than fly away from the point while attempting to determine a precise heading. There are a couple of techniques to help you determine the general direction:

i. **Charts.** Grab the chart (you should have it out already to determine which NAVAIDs to tune) and determine the current aircraft position relative to the assigned fix and imagine a line drawn between the two. Turn in that direction.

ii. **The "Pinch" Method.** Turn to a heading approximately halfway between the head of the bearing needle and the head of the CDI.

iii. **HSI. The "Pencil" Method.** When using the HSI, the desired radial (e.g., R-038 for RYNOL) should be dialed into the CDI and the aircraft turned to a heading between the head of the bearing needle (TACAN needle) and the head of the CDI.

e. **Adjustments for DME.** The initial turn may be adjusted to roll out on a heading other than halfway between the bearing needle and the desired radial (though it will still be between the two). If the range must be decreased, roll out on a heading closer to the bearing needle (this will get you closer to the NAVAID). To increase the range, roll out on a heading closer to the desired radial (gets you farther from the NAVAID).

NOTE

If the desired radial and bearing needle are in the upper half of the compass card after rolling out on the point-to-point heading, the aircraft will cut the arc.

f. **Visualize.** Visualize the aircraft position and the desired point on the compass rose of the HSI. The following factors must be understood when visually establishing the aircraft position and the desired point on the compass rose:

i. S**tation Location.** The station is located at the center of the compass rose, and the compass rose simulates the radials around the station.

ii. A**ircraft Position.** The aircraft position is visualized along the tail of the bearing needle.

iii. T**he Fix.** The desired fix is visualized along the desired radial from the station. The point with the greater range (either the aircraft position on the bearing needle or the new fix) is established at the outer edge of the compass rose. The point with the lesser range is visualized at a place on its radial that is proportional to the distance represented by the outer edge of the compass rose.

g. **Determine Heading.** Determine a precise heading from the aircraft position to the desired point. Determine the heading to the point by connecting the aircraft position to the desired point with an imaginary line. Establish another line in the same direction and parallel to the original line that runs through the center of the compass rose. This will establish a no-wind heading to the desired point and is referred to as the "pencil method" because pilots often hold their pencil (or pen) up to the HSI as the imaginary line between the two points.

h. **Adjust Heading.** Adjust aircraft heading as necessary and proceed to the point.

Drift. Apply any known wind drift correction. The effect of wind drift and any inaccuracy of the initial solution may be compensated for by repeating the previous steps while enroute.

Distance. The distance to the desired point can be estimated since the distance between the aircraft position and the desired point is proportionate to the distance established from the center to outer edge of the compass rose.

i. **Update.** Update heading enroute to refine your solution and correct for winds.

NOTES

1. The same problem can be easily and accurately solved on the CPU/26A computer (preflight planning, etc.). This is done on the wind face by imagining the center grommet is the station and applying the same basic techniques as above.

2. If the desired radial and bearing pointer are in the upper half of the compass card after rolling out on the point-to-point heading, the aircraft will cut the arc.

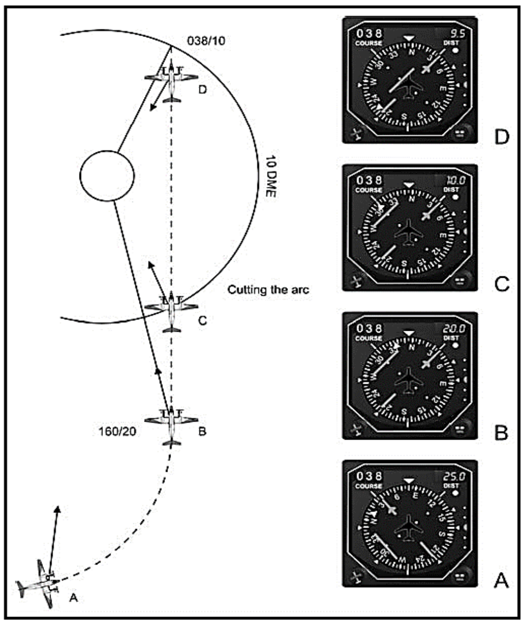


Figure 4-12 Cutting the Arc

10. **Student Tendencies**

a. Attempting to comply with a clearance with the NAVAIDs set incorrectly

b. Not identifying the selected station or directing the PM to do so

c. Not monitoring the NDB during use or directing the PM to do so

d. ***Not correcting for wind and drifting off course***

e. Not selecting the proper NAV source (e.g., attempting to fly a TACAN approach in NAV1 mode, attempting to fly a LOC course in TAC mode, etc.)

f. Not centering the CDI for course guidance when proceeding direct to a VOR or TACAN

g. Not turning at an appropriate lead point when intercepting an arc or radial and consequently overshooting the desired course

h. Not tuning the TACAN or VOR/DME before attempting a point-to-point

i. Not updating heading during a point-to-point

j. Not referring to the bearing needle when intercepting a course; only relying on the CDI

407. HOLDING

Holding is maneuvering an aircraft in relation to a navigation fix while awaiting further clearance. Normal holding airspeed is 150 KIAS. If extended holding is anticipated, consult NATOPS for maximum endurance speed. Consideration should be given to requesting extended leg lengths if the delay exceeds 20 minutes. This will result in fewer turns, which allows decreased fuel consumption and pilot workload.

Use of TACAN station passage as a fix is not acceptable for holding fixes. Therefore, do not hold directly over a TACAN. Refer to ***AIM 5-3-7, NATOPS IFM 21.3.12***, and ***AIGT Study Guide Ch. 6*** for more information on holding.

1. **Airspeeds.** Start speed reduction when 3 minutes or less from the holding fix. Cross the holding fix, initially, at or below the maximum holding airspeed.

a. All aircraft may hold at the following altitudes and maximum holding airspeeds:

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

Figure 4-13 Holding Airspeeds

b. The following are exceptions to the maximum holding airspeeds:

i. Holding patterns from 6,001' to 14,000' may be restricted to a maximum airspeed of 210 KIAS. This non-standard pattern will be depicted by an icon.

ii. Holding patterns may be restricted to a maximum airspeed of 175 KIAS. An icon will depict this nonstandard pattern. Pilots of aircraft unable to comply with the maximum airspeed restriction should notify ATC.

iii. Holding patterns at USAF airfields only – 310 KIAS maximum, unless otherwise depicted.

iv. Holding patterns at Navy fields only – 230 KIAS maximum, unless otherwise depicted.

2. **Techniques for Copying Holding Instructions (Figure 4-15)**

a. Draw an arrow from the specified direction of holding.

b. The head of the arrow is the fix; fly the inbound course to the head.

c. Draw or visualize the remainder of the pattern by the instructions given.

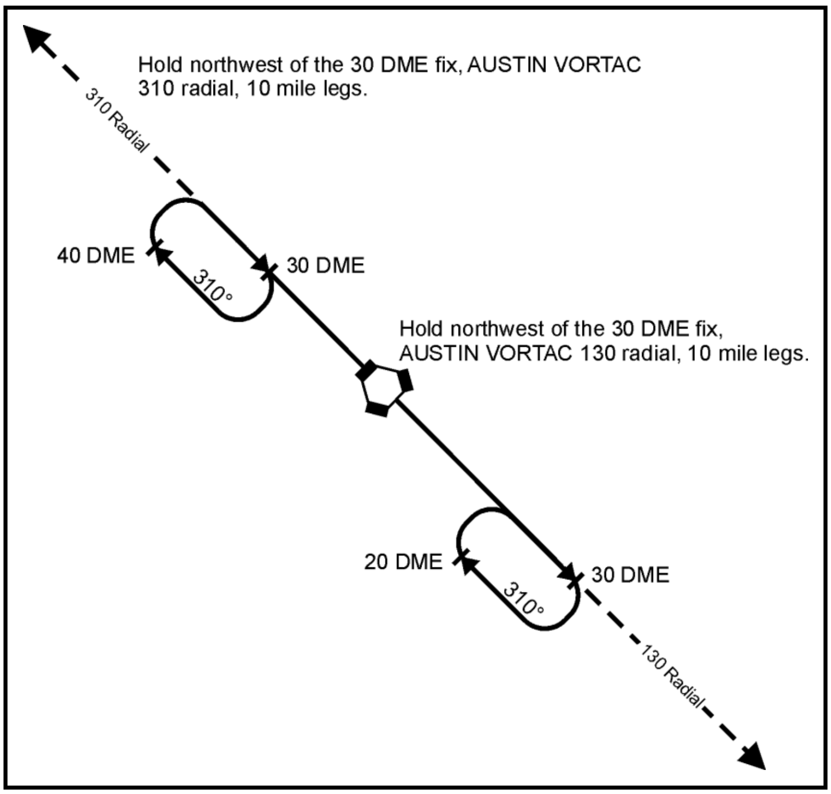


Figure 4-14 Copying Holding Instructions

3. **Holding Pattern Entry.** Holding pattern entry is as simple as crossing the holding fix, turning outbound, and remaining within the holding airspace. The following is a typical sequence of events:

Receive the ATC holding clearance and copy the instructions.

Proceed direct to the holding fix (or as cleared) at the assigned altitude.

Determine the direction of the entry turn and adjust speed to cross the fix at 150 KIAS.

Cross the holding fix and execute the "Six T's." (Technique: although this is a good technique, do not delay required actions in order to work your way through the "Six T's.")

TIME. Note the time and compare it to the EFC.

TURN. Turn to the appropriate outbound heading using the parallel, teardrop, or direct entry as described below. Apply a correction if compensating for known wind.

TIME. ***Begin outbound timing when outbound and abeam the fix, whichever occurs last. If you cannot determine the abeam position, start timing when wings level outbound.***

If holding over a VOR, abeam can be determined in the turn, but if holding over an NDB, abeam cannot be easily determined since NDBs are not accurate in the turn.

Calculating Abeam. A common mistake is to assume that because the NAVAID needle is at the 3 or 9 o'clock, the aircraft is abeam. This is only true if your aircraft heading is parallel to the inbound course of the holding pattern.

See what the holding course is, then either add or subtract 90 degrees. When the head or tail passes this value, the aircraft is abeam. Another technique is to have the CDI set to the inbound course, then when the needle is perpendicular to the CDI, the aircraft is abeam.

(Technique: take the course and use (+1 and -1) or (-1 and +1); e.g., if the holding course is 208, abeam would be 90 degrees off, (-1 and +1 would be 118).)

Another common mistake is not timing when over the holding fix/outbound. If the current heading sets the aircraft up for a teardrop, then time when over the holding fix, not once wings level outbound.

TRANSITION. Confirm airspeed is 150 KIAS and altitude is as assigned.

TWIST. Twist the CDI to the inbound holding course.

TALK. Report established in holding if required. (Report the time and altitude upon reaching a holding fix and when leaving any assigned holding fix; however, these reports may be omitted if involved in instrument training at military terminal area facilities when radar service is being provided; e.g., in the local area, holding reports are not required.)

If ever confused about whether a call is required, go ahead and make one.

a. **Holding Pattern Entry Techniques.** Use appropriate hand for direction of holding pattern (Figure 4-15). Index finger aligns with aircraft heading on the HSI. The no-wind outbound heading of the holding pattern will be in one of three entry sectors. The lower portion of your hand is directly attached to your wrist, signifying a direct entry. The split between your index and middle fingers roughly form the shape of a teardrop, signifying a teardrop entry.

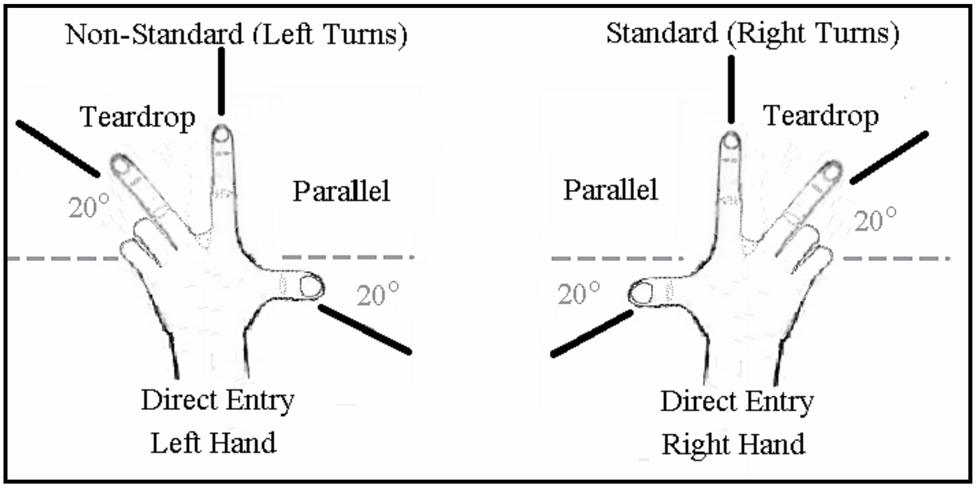


Figure 4-15 Holding Pattern Entry Technique

NOTE

An alternate technique is to use your thumb on your opposing hand to form the same angles.

b. **Entry Turns.** The angular difference between the outbound holding course and the heading at initial holding fix passage determines the direction of turn to enter the holding pattern. Enter the holding pattern based on your heading (±5°) relative to the three entry sectors depicted in Figure 4-16. Students will be expected to understand these holding entry techniques. The AF technique will not be taught.

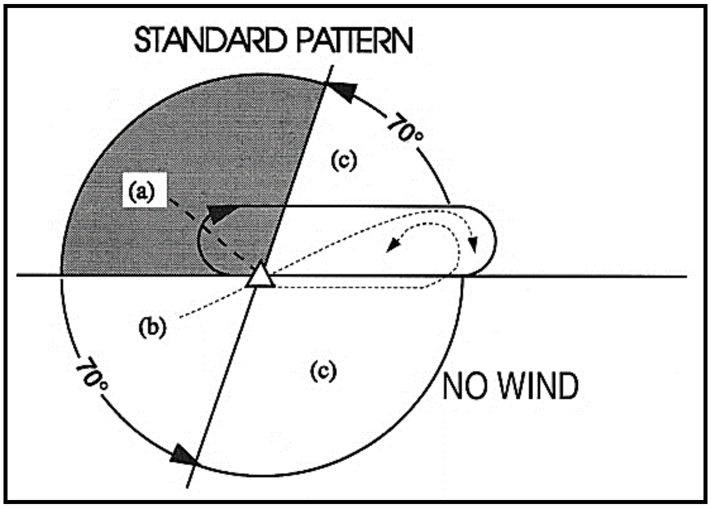


Figure 4-16 Holding Pattern Entry Procedures

Parallel Procedure. When approaching the holding fix from anywhere in sector (a), the parallel entry procedure would be to turn to a heading to parallel the holding course outbound on the non-holding side for one minute, turn in the direction of the holding pattern through more than 180 degrees, and return to the holding fix or intercept the holding course inbound.

Failure to plan for winds may place the aircraft on the holding course or cause the aircraft to cross the holding course. If on the holding course, maintain the holding course outbound. Upon completion of the outbound leg, turn towards the holding side. This turn may result in the aircraft being greatly displaced from the inbound course. Pilots may either proceed direct to the fix or intercept the course inbound.

If blown across the holding course, upon completion of your outbound leg, turn towards the radial (Tail-Radial-Turn). This eliminates a turn farther away from the holding course for which the holding procedure was evaluated.

Teardrop Procedure. When approaching the holding fix from anywhere in sector (b), the teardrop entry procedure would be to fly to the fix, turn outbound to a heading for a 30 degree teardrop entry within the pattern (on the holding side) for a period of one minute, then turn in the direction of the holding pattern to intercept the inbound holding course.

If utilizing a teardrop entry for DME or GPS holding, once 1 minute is reached on the teardrop heading, turn back to parallel the inbound course for the remaining distance.

Direct Entry Procedure. When approaching the holding fix from anywhere in sector (c), the direct entry procedure would be to fly directly to the fix and turn to follow the holding pattern.

While other entry procedures may enable the aircraft to enter the holding pattern and remain within protected airspace, the parallel, teardrop, and direct entries are the procedures for entry and holding recommended by the FAA.

4. **Timing Adjustments.** The standard no-wind length of the inbound legs of the holding pattern is one minute when holding at or below 14,000' MSL and 1½ minutes when holding above 14,000' MSL. ATC expects pilots to fly the complete holding pattern as published. Therefore, do not shorten the holding pattern without clearance from ATC. If receiving a clearance specifying the time to depart a holding pattern, adjust the pattern within the limits of the established holding procedure to depart at the time specified.

a. **Timing Outbound.** Begin outbound timing when outbound and abeam the fix. If unable to determine the abeam position, start timing when wings level outbound. (For teardrops, start timing when crossing the fix, not once rolling wings level.)

On the initial outbound leg, do not exceed the appropriate time for the altitude unless compensating for a known wind. Adjust subsequent outbound legs as necessary to meet the required inbound time.

b. **Inbound Timing.** Begin inbound timing when wings level inbound. This means when rolling out from the first turn inbound. If the aircraft is off the inbound course and a heading adjustment is needed, don't wait until after making a correction turn to begin timing.

5. **Drift Corrections.** Compensate for wind effect primarily by drift correction on the inbound and outbound legs. This is called the triple drift technique **(**Figure 4-18). When inbound, use course guidance and note the drift correction required to track the holding course. It is important to get established inbound early, so there is sufficient time to determine the drift correction. Use the track indicator for wind corrections.

NOTES

1. Wind corrections should be applied upon entry into holding because the direction and strength of the wind is known.

2. Outbound drift corrected headings are to be held for 1 minute, whether utilizing timing or DME. Once the initial 1 minute is up, turn back to parallel the inbound course.

When outbound, triple the inbound drift correction; e.g., if correcting left by 8° when inbound, correct right by 24° when outbound. We triple the drift correction during the first minute of the outbound leg because no drift correction is made during either of the one-minute turns (use "single" drift for the remaining time or distance outbound if necessary). A helpful technique is to set the heading bug to your outbound drift-kill heading while flying the inbound leg. Make adjustments as necessary on each subsequent pattern.

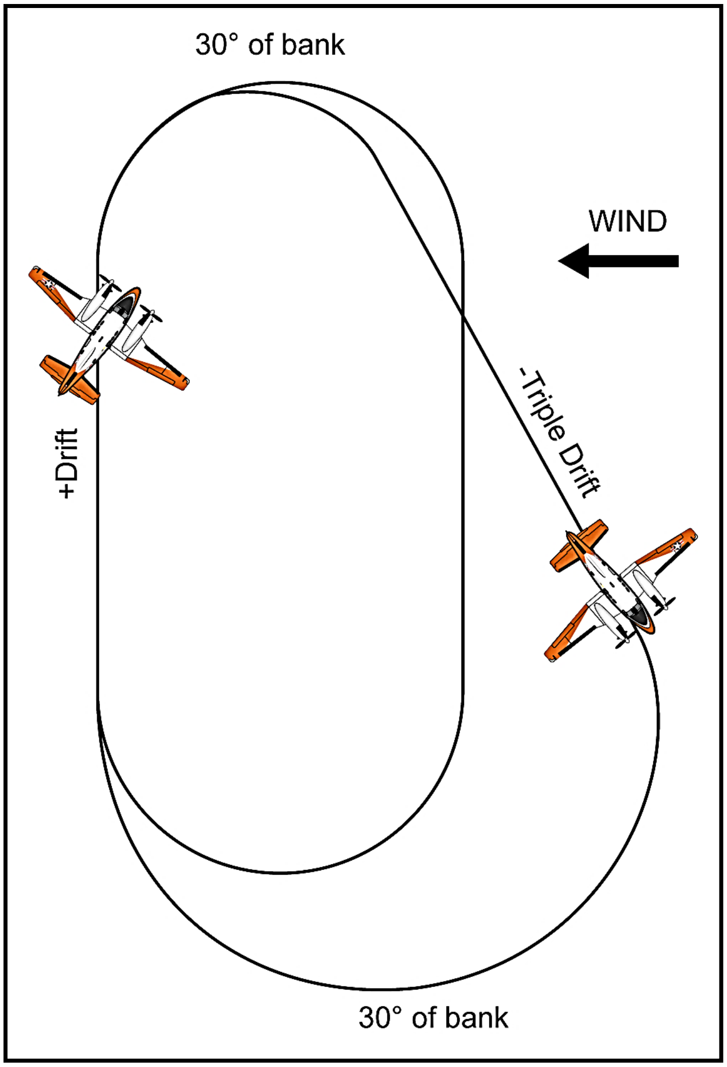


Figure 4-17 Triple Drift

6. **Distance Measuring Equipment (DME)/GPS Along-Track Distance (ATD).** DME/GPS holding is subject to the same entry and holding procedures except that distances (nautical miles) are used in lieu of time values. The outbound course of the DME/GPS holding pattern is called the outbound leg of the pattern. The controller or the instrument approach procedure chart will specify the length of the outbound leg. The end of the outbound leg is determined by the DME or ATD readout. The holding fix on conventional procedures, or controller defined holding based on a conventional navigation aid with DME, is a specified course or radial and distances are from the DME station for both the inbound and outbound ends of the holding pattern. When flying published GPS overlay or stand-alone procedures with distance specified, the holding fix will be a waypoint in the database and the end of the outbound leg will be determined by the ATD.

NOTE

Not all GPS holding is based on ATD. If the IAP specifies timing, use timing.

7. **Descending in Holding.** If an aircraft is established in a published holding pattern at an assigned altitude above the published minimum holding altitude and subsequently cleared for the approach, the pilot may descend to the published minimum holding altitude. The holding pattern would only be a segment of the IAP if it is published on the instrument approach procedure and is used in lieu of a Procedure Turn (PT).

For those holding patterns where there are no published minimum holding altitudes, the pilot, upon receiving an approach clearance, must maintain the last assigned altitude until leaving the holding pattern and established on the inbound course. Thereafter, the published minimum altitude of the route segment being flown will apply. It is expected that the pilot will be assigned a holding altitude that will permit a normal descent on the inbound course.

If established in holding on a published holding-in-lieu-of PT (bold) or in a properly aligned holding pattern, and then subsequently cleared for the approach prior to returning to the holding fix, and the aircraft is at the prescribed altitude, additional circuits of the holding pattern are neither necessary nor expected by ATC. If additional circuits are desired to lose excessive altitude or become better established on course, it is the pilot’s responsibility to advise ATC upon receipt of their approach clearance. For example, if you’re holding at a HILO approach and cleared for the approach, when you turn inbound proceed to the FAF and runway. Approach Control doesn’t expect you to make another turn in the HILO holding pattern.

8. **Arrival at Initial Approach Fix (IAF).** If arriving at your clearance limit IAF without clearance for the approach or specific holding instructions, hold as depicted on the approach plate at the assigned altitude and obtain an EFC time. If a specific holding pattern is not depicted, hold on the PT side of the approach course.

9. **Radio Failure.** In the event of loss of two-way communications enroute, upon arrival at the IAF without clearance for the approach, hold as previously instructed, as depicted, or on the PT side of the approach course. Commence the approach at the EFC time (if received) or ETA as calculated from the filed or amended (with ATC) ETE. Choice of approach is at pilot’s discretion. In the event of loss of two-way communications while in holding, commence the approach at the EFC time. For two-way radio failure holding procedures, refer to FIH A.5.a.1.e.3.

10. **Holding Using the Flight Management System**

a. **Introduction.** The FMS-3000 Flight Management System (FMS) allows the pilot to better determine exact wind corrections for holding patterns, providing both numerical and graphical depictions on the Primary Flight Display (PFD). This section outlines the capabilities of the system from entering to exiting holding.

b. **Entry.** As the aircraft approaches a holding fix, the FMS calculates the initial size of the holding pattern based on the current wind conditions, the airplane's true airspeed or the MAX HOLD speed, whichever is lower, and either the leg time or the leg distance of the holding pattern. In addition, it determines the best entry method based on aircraft position. For parallel entries into a hold, the FMS steers the outbound entry leg to an extended fixed distance. This is done to ensure the protected airspace of the holding pattern is not violated when flying in excessive wind conditions.

c. **Executing the Holding Pattern.** The FMS provides optional steering data presented on the PFD (bank steering bars) and is calculated to steer the airplane in the smallest symmetrical racetrack pattern. If desired, raw data on the PFD or directly from the FMS screen is also available to fly the FMS-aided holding pattern.

Just before crossing the holding fix, the FMS calculates the size of the holding pattern based on existing conditions. The size of the holding pattern is set (unless edited on the CDU HOLD page) until the next passage of the fix. Just before each subsequent pass of the fix, the FMS recalculates the holding pattern.

When flying a hold, approximately five seconds before reaching the holding fix on each circuit around the holding pattern, the waypoint alert features flashes the holding fix waypoint to alert you of the crossing.

d. **Changes.** Changing the hold direction, leg time, leg length, or inbound course on the FMS HOLD page, causes the FMS to immediately recalculate the holding pattern. If a change to a holding pattern results in the airplane being off the holding track, the FMS provides steering guidance onto the new holding pattern track using the smallest course change required.

e. **Exit.** In order to sequence the aircraft to exit the holding pattern, select EXIT HOLD from the FMS HOLD page. At that point, the FMS sequences to the next point on the flight plan. If the airplane is on the outbound turn or leg of the holding pattern when EXIT HOLD is selected, the FMS immediately begins to steer back to the inbound leg to the fix. If the holding pattern is part of the approach, the EXIT HOLD will be automatically selected once turning inbound. If given clearance to continue holding, select CANCEL EXIT (LEGS Page) and continue holding as depicted on the approach.

11. **Student Tendencies**

a. Allowing the aircraft to drift across holding course while outbound on parallel entry

b. Not correcting for drift during outbound legs

c. Correcting the wrong direction for drift during outbound legs

d. Not keeping a standard rate throughout both turns

e. Forgetting to hack the clock at the proper time inbound and outbound

f. Forgetting the EFC given by controller

g. Adjusting outbound timing incorrectly

h. Holding triple drift correction too long in DME holding

i. Determining the abeam position by "the needle off the wingtip"

408. ARRIVAL

1. **Arrival Weather.** Before arrival at the destination it is important to make preparations for arrival. It is important to know what runway aircraft are landing on and what weather conditions exist. Once this information is gathered, brief the approach and plan the descent. It is never "too early" to get the weather. Once receiving ATIS, copy it and start briefing. Often you can use the forecast winds at your destination to plan the arrival runway in the absence of ATIS.

2. **Communications**. A high level of professionalism on the radio is typically the only interaction other pilots and ATC controllers will have to judge pilots. When making the initial call with the (approach/center) agency listed on the approach plate be sure to provide the ATIS identifier for the airfield you intend to shoot your first approach at and say *"request"* if you have a lengthy request. (This allows the controller to be ready and helps avoid clogging up the radios twice with a complicated request). When the controller says to go ahead with the request, state what approach you would like, how you intend to fly it (vectors/procedure turn/track), where it will begin from (which IAF), and how it will terminate (full stop, vectors ILS, pilots own navigation to another IAF…. etc.). These procedures will help minimize the lengthy extraction of information the controller needs to issue you a clearance and climb out instructions. See the Typical Briefs and Voice Procedures Appendix for more information.

Approach/Landing Minimums. Before commencing an approach using any approach procedures, pilots must meet the approach criteria established in CNAF M-3710.7, SOPs, and other service directives. For straight-in approaches pilots should use RVR, if available, to determine if visibility meets the weather criteria for approaches. Prevailing visibility shall be used for circling approach criteria.

The T-44 is a multi-piloted aircraft; however, single-pilot minimums shall be observed unless both pilots are winged aviators.

Multi-Piloted Approach Criteria. When reported weather is at or below published landing minimums for the approach to be conducted, an approach shall not be commenced unless the aircraft has the capability to proceed to a suitable alternate in the event of a missed approach.

Single-Piloted Approach Criteria. An instrument approach shall not be commenced if the reported weather is below published minimums for the type of approach being conducted; however, once an approach has commenced, pilots may, at their discretion, continue the approach to the approved published landing minimums as shown in the IAP even if the reported weather goes below published minimums.

Absolute minimums for a single-piloted aircraft executing a precision approach are 200-1/2 (2400 RVR) or published minimums, whichever is higher.

These provisions are not intended to preclude a single-piloted aircraft from executing practice approaches (no landing intended) at a facility where weather is reported below published minimums when operating with an appropriate ATC clearance. The facility in question must not be the filed destination or alternate, and the weather at the filed destination and alternate must meet the filing criteria for an instrument clearance (specified in CNAF M-3710.7 series).

Do not hesitate to get weather or brief the expected approach prior to arrival.

3. **Approach Brief.** Review of the IAP for an approach (non-precision and precision) should include, but is not limited to the following. The items required for an approach brief can be found in the Typical Briefs and Voice Procedures Appendix.

NOTES

1. A common student mistake on cross-country or even review stage is to wait until close to the field (10-20 miles) before briefing the approach and performing the Approach Checklist. It is a good idea to do this as soon as ATIS (or equivalent) is received in order to concentrate on the flying the approach.

2. As discussed before, good CRM would dictate requesting the PM to tune and copy ATIS.

A good technique is to use the Approach Plate page as a guide. Start with the page number and then work your way from left to right starting at the top. With practice pilots are able to brief the necessary information quickly and concisely.

NOTES

1. Students ***shall*** reference the Trouble T during all approaches that contain one. The Trouble T applies specifically to departures, not arrivals. The advantage of briefing a Trouble T on approach is for reference in case determination is made to continue beyond the MAP (the only place obstacle clearance is assured by performing the MA procedure). This may include a touch and go or any rejected landing beyond the MAP.

2. The approach brief may be accomplished prior to “crew” on the Approach Checklist. The PF should transfer controls in order to accomplish the approach brief provided that a thorough brief of

heading, altitude, and airspeed are relayed prior to the transfer. (The purpose of transferring controls during the brief is to promote good CRM, but this shall not be used as a crutch for improper time management or orientation.)

4. **Descent.** An enroute descent, STAR, or a high altitude instrument approach enables an aircraft to transition from the high altitude structure to a position to commence the approach. (High Altitude Approaches will be covered later). ATC will usually issue a clearance for a specific type of approach. The omission of a specific type in the approach clearance indicates that any published instrument approach to the aerodrome may be used. Unless receiving an appropriate ATC clearance to deviate, fly the entire IAP starting at the IAF. Before starting descent, recheck the weather (if appropriate).

NOTE

FAA controllers are not required to respond to clearance read-backs; however, if your read-back is incorrect, distorted, or incomplete, the controller is obligated to make corrections. If unsure of the clearance and/or instructions, query the controller.

a. **Enroute Descent.** The enroute descent is the most frequently used transition from an enroute altitude for the approach. It may be flown either via radar vectors or non-radar routings, using approved navigation aids. The type of final approach to be flown must be understood by the aircrew and the approach controller (ILS, PAR, visual pattern, etc.). Request the specific final approach or low altitude IAP you desire, as well as the following approach if doing multiple approaches for training. Be careful to not reduce power too much in the descent; pressurization cannot be maintained within limits if N1 is low. Maintain 75% N1 (2 engines) or 85% N1 (1 engine).

b. **When to Descend.** ATC requirements probably have more influence over when to begin the descent than any other single factor. Other items to consider before starting an enroute descent are range, desired descent rate, weather, terrain, and low altitude fuel consumption. For planning purposes, various techniques are acceptable to determine the point at which descent is desired. For both of these techniques, about 1000-1500 FPM is usually sufficient, but can't always be counted on.

A good technique to evaluate how your descent is going is to divide the altitude to lose by 2; by the time you are halfway to your calculated descent point (DME), you should be halfway to your final altitude. Here are three commonly used techniques to figure out when to descend:

i. A simple technique is to use three times the altitude to lose in thousands of feet as the distance from destination in nautical miles to begin descent which represents a 333′/NM glidepath. (3 x altitude to lose = miles). (e.g., you are at 20,000' and the FAF altitude is at 1500'. Round the 1500' to 2000' – you now have 18,000' to lose. 3 x 18 = 54. The latest you want to start down is 54 miles from the point at which you want to be down to 1500'. In this case, you would want to be down at least 3 miles prior to the FAF.)

ii. Another rule of thumb is [2 x (altitude to lose)] +10=miles.

NOTE

When deciding how far out to descend, think about at what point it is desired to be down by. It isn’t always a DME distance from the field. Usually, it is a good idea to be down to your final altitude by the FAF or configuration point. Also, if having to pass the airfield to land the opposite direction, the aircraft has more miles to lose the required altitude.

iii. Other techniques compare a desired rate of descent to altitude to lose to determine the time; time and groundspeed then gives distance. Ensure you use a descent gradient/descent rate appropriate to the technique you are using (reference 60-to-1 rules in ***FTI Additional Instrument Information Appendix***). In other words, know what pitch to use and VSI to hold during the descent in order to arrive at the target altitude at the desired point over the ground.

The big picture is, the closer the aircraft is to the destination before descent, the larger the descent gradient/rate required. Any technique that is used to plan the enroute descent will improve SA.

c. **Standard Terminal Arrivals (STARs).** Standard Terminal Arrivals (STARs) and Flight Management System Procedures (FMSPs) [used only by aircraft with FMS] are arrival routes established to simplify clearance delivery procedures and facilitate transition between enroute and instrument approach procedures. The term STAR used in the following paragraphs refers to both STARs and FMSPs. Expect to fly a STAR if one exists for the destination. Make sure to have at least a textual description. The only time you are cleared to descend according to the STAR published altitudes is if ATC uses the term “descend via,” otherwise the clearance for the STAR is only for the lateral routing. To fly a RNAV STAR, verify the aircraft has the proper RNAV equipment, a current database, proper RAIM, and verify the FMS data against the published STAR data. RNAV STARS and RNAV instrument approach procedures must be recovered in their entirety from the database.

5. **Unicom Voice Reports.** We often operate at uncontrolled fields in the local south Texas area. At such fields, we must be even more vigilant about de-conflicting our flight path both visually and on the radios. For this reason, when operating at uncontrolled fields, the student should make the VHF (UNICOM/CTAF) reports and direct the instructor to handle the UHF (Approach/Center) communications.

6. **CTAF Voice Reports.** When operating at uncontrolled fields, the student shall monitor ATC and the advisory frequency (CTAF/UNICOM). UNICOM calls may be delegated to the IP while still on Center or Approach frequency when required traffic calls need to be made. It is imperative that initial traffic advisories be made no later than ten miles from an uncontrolled field. When switched over to UNICOM by Approach or Center, students shall assume the UNICOM calls. It is strongly recommended that you continue to monitor ATC, and advise them you are doing so; this will allow them to continue to advise you of potential traffic conflicts, workload permitting.

Be familiar with the UNICOM/CTAF communication procedures in ***AIM 4-1-9***. For UNICOM/CTAF position reports, use *"Montana/Stingray XX."* Remember, aircraft operating at these airports are not required to have radios. Also remember that many of the civilian pilots operating at uncontrolled fields will be unfamiliar with instrument flight; accordingly, when making traffic advisories over UNICOM, call out your position in reference to the field, not in reference to a fix (e.g., *"10 miles to the north"* not *"approaching CONOR"*).

If ever confused about what to say, just speak in plain English. The important information to get out is where you are and what you plan to do. (e.g., "*Victoria traffic, Navy King Air 424 is 10 miles to the NW, inbound straight-in 12L; we're going to low-approach and climb out to the SE at 3000 feet, Victoria.")*

Make, at a minimum, a 10 mile call, downwind, base, final, and departing.

NOTE

At airfields with a separate CTAF and UNICOM frequency, monitor and use the CTAF frequency to make your voice reports.

7. **Student Tendencies**

a. Not planning the enroute descent, starting descent too close to the field and being rushed or descending far earlier than necessary when given a pilot's discretion descent

b. Not updating descent rate during the descent

c. Not repeating all headings, altitudes (departing and assigned), and altimeter settings to ATC

d. Missing radio calls

e. Not getting weather and/or ATIS information soon enough

f. Forgetting about the Approach Checklist

g. Not being prepared when ATC issues a clearance for a STAR

h. Attempting to exceed VMO in the descent

i. Uncertain use of fuel log

409. APPROACH TRANSITIONS

Low altitude approaches are used to transition aircraft from the low altitude environment to final approach for landing. Low altitude instrument approach procedures exist for one purpose – to assist you in guiding your aircraft to the final approach fix (FAF), on course, on altitude, and in the final approach configuration. It has become normal to expect ATC to provide radar vectors to final; however, always be prepared to execute the "full procedure" when appropriate.

1. **Instrument Stage Basics.** The primary focus in the I4100 block is basic instrument, CRM, and cockpit procedures. On these initial flights, emphasis should be placed on introducing the SMA to instrument flight and the IFR environment. IPs should consider student proficiency and performance prior to simulating emergencies and malfunctions during the I4100 block. The focus should be on the instrument basics, but ***should not neglect NATOPS EP'S*** or operating limits.

NOTE

The I4100-4200 blocks should include approach transitions that give students time in between approaches. There is a place for quick transitions between approaches, but the idea of these blocks is basic instrument and CRM skill.

2. **Radar Vectors.** The use of radar vectors is the simplest and most convenient way to position an aircraft for an approach. Using radar, ATC can position an aircraft at almost any desired point, provide obstacle clearance by the use of minimum vectoring altitudes, and ensure traffic separation. This flexibility allows an aircraft to be vectored to any segment of a published routing shown on the IAP or to radar final. Radar Controllers use Minimum Vectoring Altitude (MVA) charts providing minimum altitudes of 1000 or 2000 feet in designated mountainous areas; MVAs may be lower than non-radar MEAs/Minimum Obstruction Clearance Altitude (MOCAs). They may also be below emergency safe or minimum sector altitudes; however, while being radar vectored, IFR altitude assignments will be at or above MVA. While being radar vectored, repeat all headings, altitudes (departing and assigned), altimeter settings, and comply with controller instructions.

Once cleared for the approach, maintain the last assigned altitude, and heading until established on a segment of a published route or IAP. Use normal lead points to roll out on course. Do not climb above last assigned altitude to comply with published altitude restrictions unless instructed to do so.

Descent. If at any time there is doubt as to whether adequate obstacle clearance is provided or controller instructions are unclear, query the controller. The controller should inform you if radar contact is lost and provide you with a new clearance or additional instructions. If advised that radar contact is lost while in IMC and there is a delay in receiving new instructions, ask the controller for a new clearance or advise the controller of your intentions. This is particularly important if below minimum safe, sector, or emergency safe altitude.

Vectors for Approach. The controller may vector the aircraft to any segment of an IAP before the FAF and clear an aircraft for an approach from that point. Normally maintain 150 KIAS while being radar vectored, although 170 KIAS or other airspeeds may be flown at the pilot's discretion or as directed by ATC. The controller will issue an approach clearance only after established on a segment of the IAP; or you will be assigned an altitude to maintain until you are established on a segment of the IAP. Operationally, vectors to final are a very common means of expediting traffic flow and reducing controller workload.

Orientation. Remain oriented in relation to the FAF by using all available NAVAIDs. Complete the Approach Checklist and be prepared to fly the approach when cleared by the controller. From that point, comply with all course and altitude restrictions as depicted on the approach procedure except do not climb above the last assigned altitude to comply with published altitude restrictions unless so instructed by the controlling agency. Configure, slow, and complete the Landing Checklist before the FAF.

A good technique is to watch the head of an available NAVAID as it "falls" to your course. Do not rely solely on the CDI for SA. The CDI gives you no information until it comes off the wall, and even then, verify it with some other information.

If ATC has issued a heading that won't intercept the inbound course prior to the FAF, or they are about to vector you across the centerline, call them.

3. **High Altitude Approaches.** The high altitude approach (or penetration) allows the aircraft to maintain an efficient fuel consumption/true airspeed profile and/or to delay descent into low altitude weather (such as an icing layer). High altitude approaches are most common at military fields and are used primarily by fighter type aircraft. ATC will generally assign an alternate procedure for transport category aircraft. High altitude approaches are generally flown the same as low altitude approaches, with a few exceptions. Refer to the ***AIGT Study Guide Chapter 8*** and ***NATOPS IFM 22.2.4.2*** for a more detailed discussion of the different types of high altitude procedures. As with any approach, before reaching the IAF, recheck the weather, review the IAP, obtain clearance for the approach, and complete the Approach Checklist.

Reviewing the IAP. The entire approach must be flown as depicted to comply with all course and altitude restrictions. Usually radial approaches or radial and arc combination approaches are associated with TACAN or VORTAC facilities and teardrop approaches are associated with VOR or NDB facilities. Reviewing the IAP should include calculating descent rates and/or gradients required in order to comply with altitude restrictions. The approach normally requires a higher rate of descent and correspondingly higher Indicated Airspeed (IAS) than a low altitude IAP. Carefully observe NATOPS speed limitations and appropriate airspace speed restrictions. (Maximum speed in class C or D within 4 NM from primary airport, less than 2500 feet AGL is 200 KIAS, and maximum speed in class B is 250 KIAS.) Flaps may be utilized to provide a steeper approach angle. If required, props may be placed full forward for as long as necessary.

The gear and/or full flaps may be extended in unusual circumstances but should generally be avoided.

Descent. High altitude penetration descent may be initiated when outbound/abeam the IAF with a parallel or intercept heading to the course. The controller should assign you the depicted IAF altitude. If you are not assigned the IAF altitude and cannot make the descent gradient by starting the penetration from your last assigned altitude, request a lower altitude. Remember, you must be able to comply with subsequent mandatory and maximum altitudes.

4. **Low Altitude Approaches**

Terminal routings. Terminal routings from enroute or feeder facilities are considered segments of the IAP and normally provide a course, range in nautical miles (not DME), and minimum altitude to the IAF. The altitudes published on terminal routings are minimum altitudes and provide the same protection as an airway MEA. Terminal routings may take the aircraft to a point other than the IAF if it is operationally advantageous to do so.

When cleared for the approach, the published off airway (feeder) routes that lead from the enroute structure to the IAF are part of the approach clearance.

NOTES

1. Pilots can easily tell if a feeder is a feeder and not simply a way to identify a fix by where the arrow points and the information included.

2. If the arrow passes through the point and doesn't have an altitude and distance with it, it is solely a means to ID a fix.

3. If the arrow points to a fix and has altitude and distance, it is a feeder fix. (At times, the IAP may combine both. Reference the KBRO LOC BC RWY 31L.)

Before the IAF. A low altitude IAF is any fix labeled as an IAF or any PT/HILO PT fix. Before reaching the IAF, recheck the weather (if appropriate), review/brief the IAP, obtain clearance for the approach, and complete the Approach Checklist. Normally cross the IAF at 150 KIAS and maintain this for the initial and intermediate segments of the approach, although 170 KIAS or other airspeeds may be flown for extended arcs/segments at the pilot's discretion or as directed by ATC.

Enroute Approach Clearance. If cleared for an approach while enroute to a holding fix which is not collocated with the IAF, either proceed via the holding fix or request clearance direct to the IAF. If the IAF is located along the route of flight to the holding fix, begin the approach at the IAF. If you over-fly a transition fix (feeder route fix), fly the approach via the terminal routing. If in doubt as to the clearance, query the controller.

Altitude. When cleared for the approach, maintain the last assigned altitude until established on a segment of a published route or instrument approach procedure. At that time, the pilot may descend to the minimum altitude associated with that segment of the published routing or instrument approach procedure.

NOTE

Refer to Low Altitude IAPs (Section 410) for specifics on when aircraft are considered established on a segment of an approach.

Approach Clearance. Clearance for the approach does not include clearance for the holding airspace; however, if established in holding and cleared for the approach, complete the holding pattern to the IAF unless an early turn is approved by ATC. When clearance for the approach is issued, proceed to the IAF. For further guidance, see Low Altitude Instrument Approach Procedures below.

Final Approach Segment. Some approaches depict only a final approach segment, starting at the FAF. In these cases, radar is required to ensure you are properly aligned with the final approach course at the appropriate altitude. When cleared for the approach, maintain the last assigned altitude until established on a segment of the published instrument approach procedure (IAP). An example is the "VOR/DME RWY 30L" at Houston/William P. Hobby Airport (HOU).

Dead Reckoning (DR) Courses. Many IAPs utilize DR courses. Although course guidance may not be available, the DR course should be flown as closely as possible to the depicted ground track. Use lead points for turns to and from the DR legs to roll out on the depicted ground track. Fly the depicted ground track by correcting for wind. A good example is the DR course from the RAYMO IAF on the "ILS RWY 17R" at Harlingen/Valley International Airport (HRL).

5. **Student Tendencies**

a. Not planning the enroute descent, starting descent too close to the field and being rushed or descending far earlier than necessary when given a pilot's discretion descent

b. Not repeating all headings, altitudes (departing and assigned), and altimeter settings to ATC

c. Not getting weather and/or ATIS information soon enough

d. Concentrating on flying and forgetting about the Approach Checklist

e. Not being prepared when ATC issues a clearance for a STAR

f. Attempting to exceed VMO in the descent

g. Uncertain use of fuel log

410. LOW ALTITUDE INSTRUMENT APPROACH PROCEDURES (IAPS)

Refer to ***AIM Section 5-4-7*** for information on IAPs. There are two broad categories of low altitude approaches: course reversals and procedure tracks. Course reversals are further broken down into PTs and holding-in-lieu-of PTs (HILO PT). Procedural tracks are commonly found using arc/radial combinations or specified teardrop tracks. Before we look at each type in detail, here are some guidelines that apply to all low altitude approaches:

Six T's. You may use the following "Six T's" technique to help accomplish the tasks required upon passage of the IAF and FAF.

Time. As required

Turn. Turn to intercept course

Time. As required

Transition. Reduce power to initiate descent

Twist. Set the inbound, teardrop, or front course

Talk. Refer to NATOPS callouts. At FAF, only contact if non-radar, requested to do so, or haven't contacted Tower yet.

NOTE

A common mistake, at the FAF, is taking too long getting through the "Six T's" and not descending on the approach.

CDI. Here are a few CDI guidelines:

a. Direct – Use the CDI when proceeding direct.

b. LOC BC – Always set the front course (to prevent reverse sensing).

c. CDI Only – Never rely on the CDI alone to decide whether your intercept to a course is correct. ALWAYS look at your NAVAID needle to see if you are "pushing" or "pulling" it correctly.

1. **Initial Approach Fix (IAF).** Most approaches will begin at an IAF. ATC will normally issue clearance to the appropriate IAF for the approach. Unless ATC specifically clears you otherwise, you are expected to fly to the IAF and execute the full instrument approach procedure as published.

Entry Turn. Upon reaching the IAF, you have two choices, whether it is a PT or a procedure track:

If your heading is ***within 90°*** of the procedural course, use normal lead points to intercept the course. This applies to both IAFs on PTs ***and*** procedure tracks.

NOTE

Leading the turn to the outbound course helps you get established more smoothly and quickly.

If, approaching an IAF for a PT without DME, it is difficult to calculate a lead point. In this case, you may want to cross the fix and turn in the shortest direction (e.g., NDB or VOR without DME).

If your heading is ***not within 90°*** of the procedural course, over-fly the IAF and turn in the shortest direction to intercept the procedural course.

NOTE

If, upon arrival at the IAF, you are not conveniently aligned to the outbound course/arc (e.g., not w/in 90), do not ask for "maneuvering airspace." This term is not found in the AIM and maneuvering for better alignment is not necessary.

Descent. Assuming you are cleared for the approach, do not descend until outbound/abeam and on a parallel or intercept heading to the PT course.

The same mistake can be made in calculating your "abeam" position as could be made in holding. Remember to use 90 degrees off of the PT course to determine abeam, not the needle off the wingtip. (See holding entry for further discussion.)

NOTE

When flying PTs designed in FAA airspace, there is no requirement to wait until on a parallel or intercept heading to begin descent from the PT fix altitude; however, when flying these types of course reversals in ICAO airspace, this procedure is mandatory due to different TERPs criteria. In the interest of forming good habit patterns, the USN and USAF have adopted the ICAO method as procedural.

2. **Course Reversals.** The two common types of course reversals are: the PT and the HILO PT. Before discussing each type of course reversal in detail, these guidelines apply to all course reversals:

a. **Restrictions.** Do not execute a PT or HILO PT in the following situations (many people use the memory aid "SNERT").

i. When ATC issues clearance for a "Straight-in" approach.

ii. If flying the approach via No PT routing (depicted by a solid black line from an outlying feeder-fix).

iii. When Established in holding, subsequently cleared the approach, and the holding course and PT course are the same.

iv. When ATC provides Radar vectors to the final approach course.

iv. When ATC issues clearance for a Timed approach. Timed approaches are in progress when you are established in a holding pattern and given a time to depart the FAF inbound.

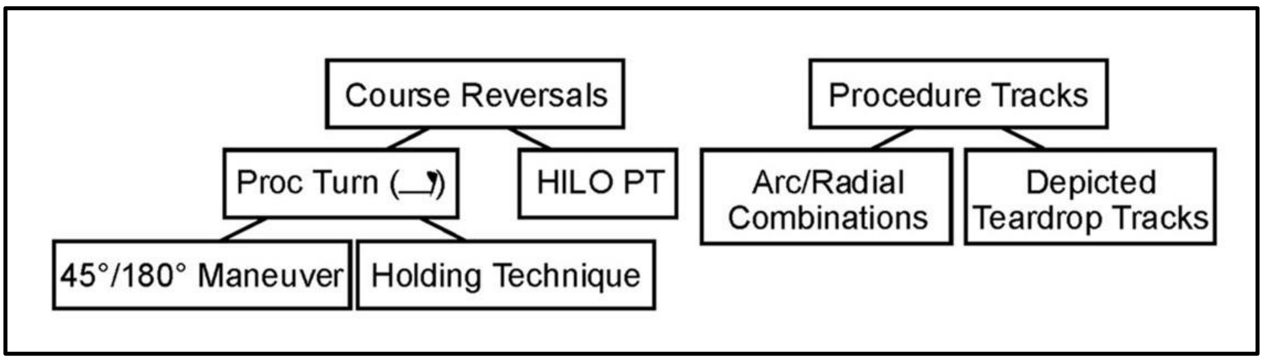


Figure 4-18 Breakdown of Low Altitude Approach Categories

NOTE

The "holding technique" discussed here encompasses both the "racetrack pattern" and "teardrop PT" referred to in ***AIM Section 5-4-8***.

In any of the situations described above, proceed to the FAF at the published FAF altitude and continue inbound on the final approach course without making a PT, holding pattern, or any other aligning maneuver before the FAF unless otherwise cleared by ATC. If needing to make additional circuits in a published holding pattern to lose altitude or to become better established on course, or wish to execute a PT for training before departing the FAF inbound, pilots are responsible to request such maneuvering from ATC.

NOTE

Historically, these restrictions have created a lot of confusion between pilots and controllers. If ever in doubt about what ATC expects, query the controller or advise him of your intentions.

b. **Procedure Turns.** One of the most common types of low altitude course reversals is the PT. PTs are depicted in the plan view of U.S. Government charts with a barb symbol (↗) indicating the direction or side of the outbound course on which the PT or maneuvering is to be accomplished. The PT fix is identified on the profile view of the approach at the point where the IAP begins.

Techniques for Flying PTs. The two common techniques for executing a PT course reversal are: the 45/180 degrees maneuver and the holding technique. How to accomplish a PT is actually a technique left to the discretion of the pilot, but for our purposes, we concentrate on the 45/180.

For standardization purposes, the 45/180 degrees course reversal is the primary method of PT used throughout the maritime syllabus. Be familiar with and prepared to fly PTs using other techniques and they will be utilized in other syllabus events.

Regardless of the method chosen to fly the PT, consider the following paragraphs when planning the approach:

Plan the outbound leg to allow enough time for configuration and any descent required before the FAF. Be sure to adjust the outbound leg length in order to stay inside the "remain within" distance noted on the profile view of the approach plate. The "remain within" distance is measured from the PT fix unless the IAP specifies otherwise.

When the NAVAID is on the field and no FAF is depicted, plan the outbound leg so the descent to MDA can be completed with sufficient time to acquire the runway and position the aircraft for a normal landing. When flying this type of approach, consider the point of interception of the final approach course as the final approach point (FAP). This is the point when established inbound and beginning your descent from the PT completion altitude. Since it is considered equivalent to the FAF, establish approach configuration and airspeed and complete the Landing Checklist before the FAP.

If given a clearance for the approach from ATC that contains a restriction such as ***"maintain altitude until further advised,"*** pilots are expected to fly the PT ground track at the last assigned altitude. After the ***"altitude restriction is deleted,"*** the published minimum altitude of the route segment being flown will apply.

If given a clearance for the approach from ATC that contains a restriction such as, ***"I will call your PT,"*** pilots are expected to proceed outbound on the radial using course guidance as appropriate until advised by ATC. In this case, the pilot is no longer obligated to stay inside the "remain within" distance. The pilot must request permission from ATC before making any turns or performing a non-depicted teardrop. When in doubt, verify intentions with the controller.

A second option is when Approach directs the aircraft to ***"proceed outbound on the PT; I (Approach) will call your inbound."*** In this case the aircraft should begin the outbound portion of the 45/180 but should not execute the turn reversal portion of the maneuver until directed. When in doubt, verify intentions with the controller.

Consider established inbound IAW Fig 4-19. Do not descend unless continued tracking within these parameters is assured. PT inbound is the point where course reversal has been completed and an aircraft is ESTABLISHED inbound on the intermediate approach segment or final approach course.

TYPE OF APPROACH	ESTABLISHED INBOUND WHEN:
VOR, TACAN, or GPS	HALF SCALE DEFLECTION OR WITHIN 5 RADIALS
LOCALIZER	CDI DEFLECTION
NDB	WITHIN 5 BEARINGS

Figure 4-19 Established Inbound Table

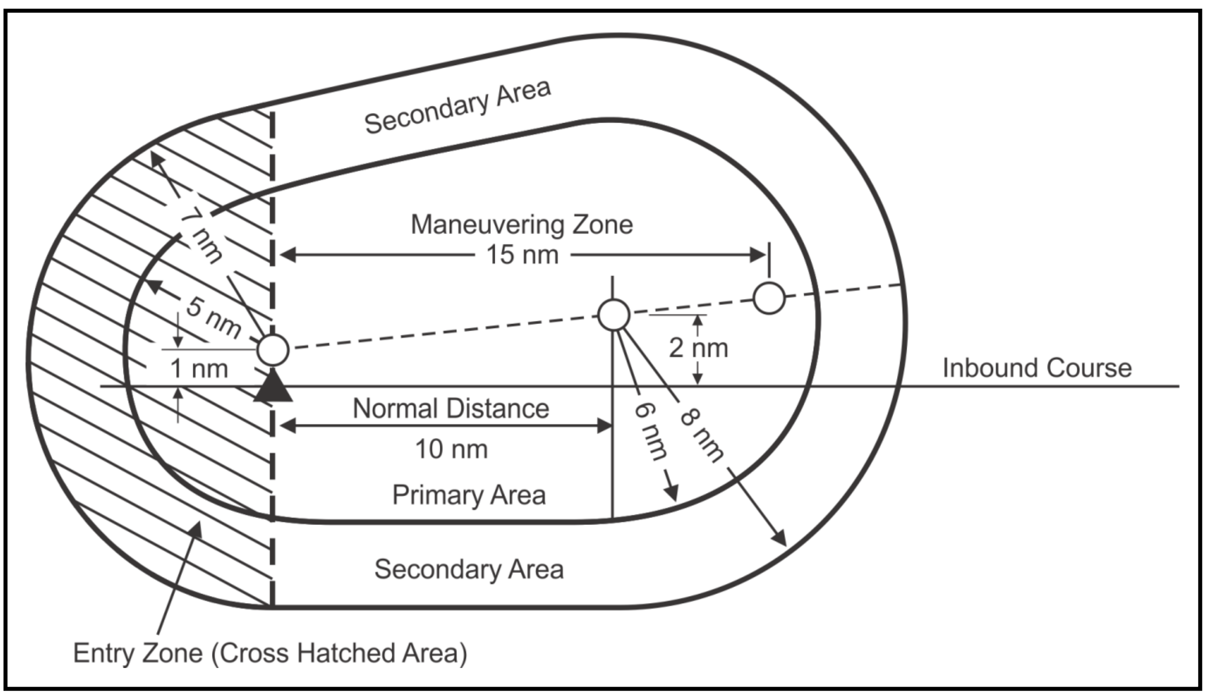


Figure 4-20 TERPS PT Protected Airspace

i. **The 45/180 degrees maneuver.** One method which may be used to accomplish a PT approach is the 45/180 degrees course reversal maneuver.

Entry. As described above in Low Altitude Instrument Approach Procedures.

Proceeding Outbound. Intercept and maintain the PT course outbound as soon as possible after passing the PT fix. Timing outbound is a technique; however, the important aspect of proceeding outbound is to remain within the “remain within” distance. (***Monitor your DME.***)

Begin timing outbound and abeam the fix. If you cannot determine the abeam position, start timing when wings level outbound.

One minute timing outbound is used for standardization, unless timing adjustments are needed for winds, but reference should be made to DME, if available, to remain within the “remain within” distance. Comply with the published “remain within” distance.

If using timing and there is a strong tailwind outbound, consider timing for 30-45 seconds, instead of 1 minute. If a headwind is present time longer.

Descent Outbound. Outbound/Abeam and a parallel or intercept heading.

Executing the Course Reversal maneuver. At the appropriate time on the outbound leg, begin the course reversal maneuver. To begin the reversal maneuver, turn 45° away from the outbound track toward the maneuvering side. Begin timing upon completion of the 45° turn, time for one minute (for standardization). Timing out on the 45° is technique! If within 2 NM of the “remain within” distance, turn no matter what your timing is. (***Monitor your DME!***)

Next, begin a 180° turn in the opposite direction from the initial turn to intercept the PT course inbound.

NOTE

ICAO and USAF use 1 minute timing from the start of the 45° turn for categories A and B, and 1 minute 15 seconds from the start of the 45° turn for categories C, D, and E aircraft.

Descent Inbound. Do not descend from the PT completion altitude until you are established on the inbound segment of the approach (***Figure 4-21***).

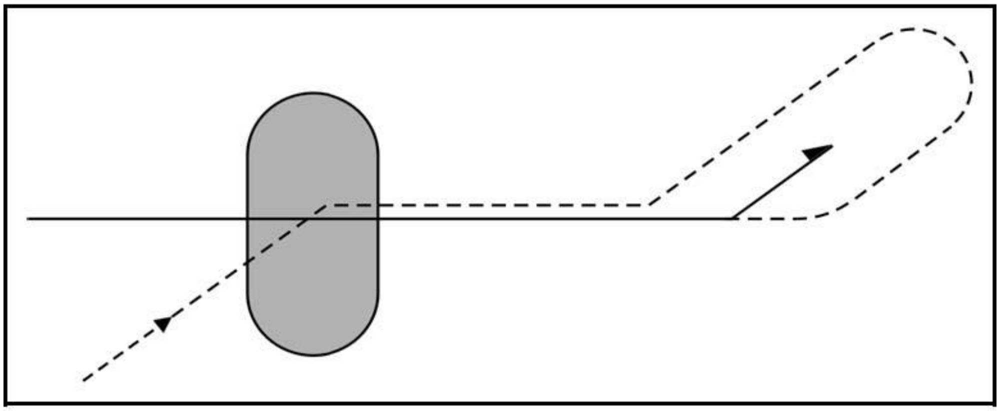


Figure 4-21 45˚/180˚ Maneuver

ii. **The 80/260 degrees Course Reversal maneuver.** An option to the 45/180 degrees course reversal is the 80/260 degrees maneuver. The procedures for flying each maneuver are identical with the exception of the actual course reversal.

To begin the reversal maneuver, make an 80° turn away from the outbound track toward the maneuvering side followed by an immediate 260° turn in the opposite direction to intercept the inbound course.

In most ICAO countries, if the 45/180 degrees or the 80/260 degrees is depicted, the PT must be flown using the specified course reversal.

iii**.** **Holding Technique.** The holding technique is another method used to accomplish a PT course reversal on any approach designed using U.S. TERPs.

Entry. Enter the PT according to the holding entry procedures described in the holding section with the following exceptions:

(a). **Parallel Entry.** If the entry turn places the aircraft on the non-maneuvering side of the PT course (parallel entry) and you are flying in excess of 180 KTAS, you must correct toward the PT course using an intercept angle of at least 20°. This may apply to the T-44 at some high altitude airports.

(b). **Teardrop Entry.** The advantage of the teardrop is that pilots can (and should) proceed outbound using course guidance (if available) to achieve the proper offset from the PT course so that one continuous turn will establish you inbound. The offset required will depend on TAS, rate of turn, and winds.

(c). A rule of thumb to achieve the proper offset from the PT course is that a 30° teardrop course works well for a 1 minute outbound leg, a 20° teardrop course works well for a 2 minute outbound leg, and a 10° teardrop course works well for a 3 minute outbound leg. Another technique, and perhaps the most common, is to use the standard 30° teardrop course for one minute, then turn to parallel.

NOTE

When performing a teardrop course reversal, use any available course guidance for your "teardrop" course. For example, if you are flying a 30-degree teardrop, fly the associated radial which aligns to the chosen course. Set the CDI to your teardrop course until turning inbound.

Timing. Begin timing outbound and abeam the fix. If unable to determine the abeam position, start timing when wings level outbound. Adjust the outbound leg length to stay inside the "remain within" distance and at the completion of the outbound leg, turn to intercept the PT course inbound.

NOTES

1. A common mistake while performing a Holding technique PT is to assume that you must only go outbound for 1 minute. This is not the case, since you are not flying a holding pattern. Again, timing is a technique. You must simply remain within the "remain within" distance. A 1½ minute outbound leg is normally sufficient, although 2 minutes or even more may be desired in some instances, such as an approach with no FAF or an approach requiring a large descent on the inbound course.

2. If DME is available, use it to ensure the aircraft doesn't depart the cleared "remain within" airspace. If DME is not available and timing is all that you have, make sure to take into account headwinds or tailwinds (e.g., 20 knot tailwind, time for 1:00 or 1:15 instead of 1:30 outbound).

Descent. As described above in Low Altitude Instrument Approach Procedures. Do not descend from the PT completion altitude until established on the inbound segment of the approach.

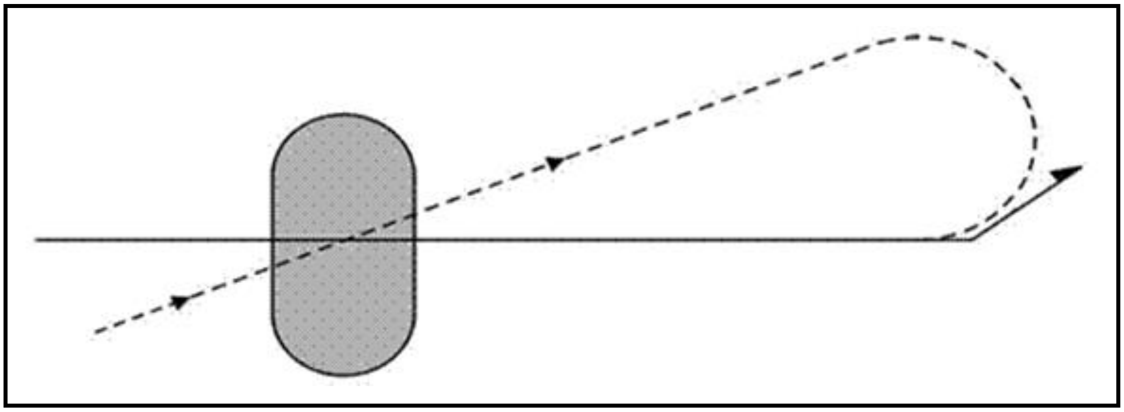


Figure 4-22 Teardrop Entry

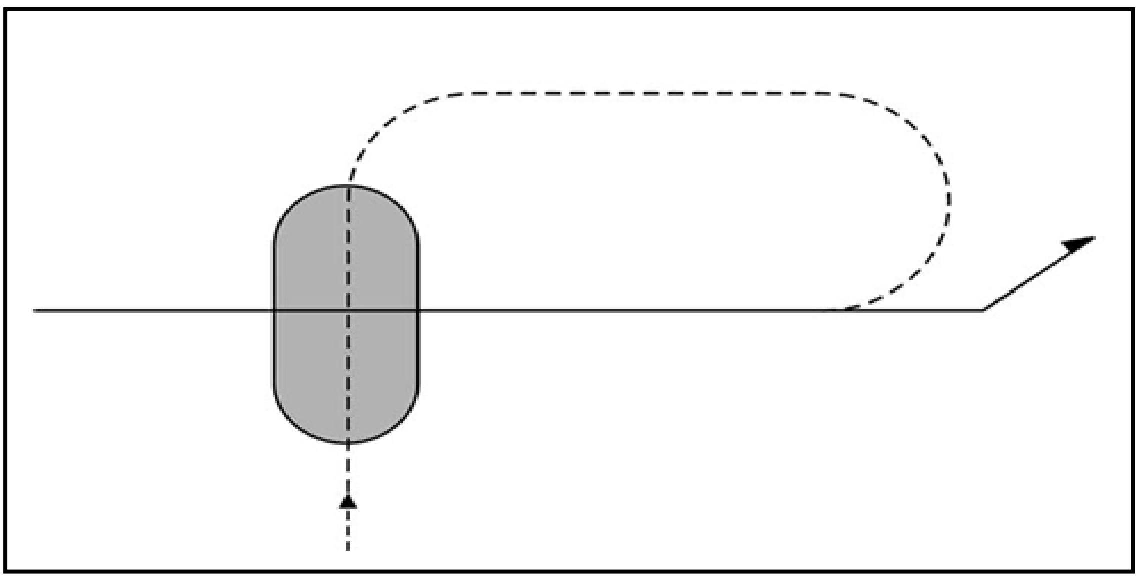


Figure 4-23 Direct Entry

c. **Holding Pattern in Lieu of PT.** The HILO PT is another common way to execute a low-altitude course reversal. The HILO PT is depicted like any other holding pattern except the holding pattern track is printed with a heavy black line (bold) in the plan view. The depiction of the approach in the profile view varies depending on where the descent from the minimum holding altitude should begin.

Flying the Holding Pattern. Enter and fly the HILO PT holding pattern according to the holding procedures described in Section 407.

Descent. If cleared for the approach, descent may be made to the minimum holding altitude when established in holding (initial passage of the holding fix). Descent from the minimum holding altitude may be depicted in two ways: descent at the holding fix or descent on the inbound leg. When a descent is depicted on the inbound leg, you must be established on the inbound segment of the approach before beginning the descent.

Additional Guidance for HILO PTs. If cleared for the approach while holding in a published HILO PT, complete the holding pattern and commence the approach without making additional turns in the holding pattern (altitude permitting). If an additional turn is needed to lose excessive altitude, request clearance from ATC since additional circuits of the holding pattern are not expected by ATC. If the aircraft is at an altitude from which the approach can be safely executed and you are ready to turn inbound immediately, you may request approval for an early turn.

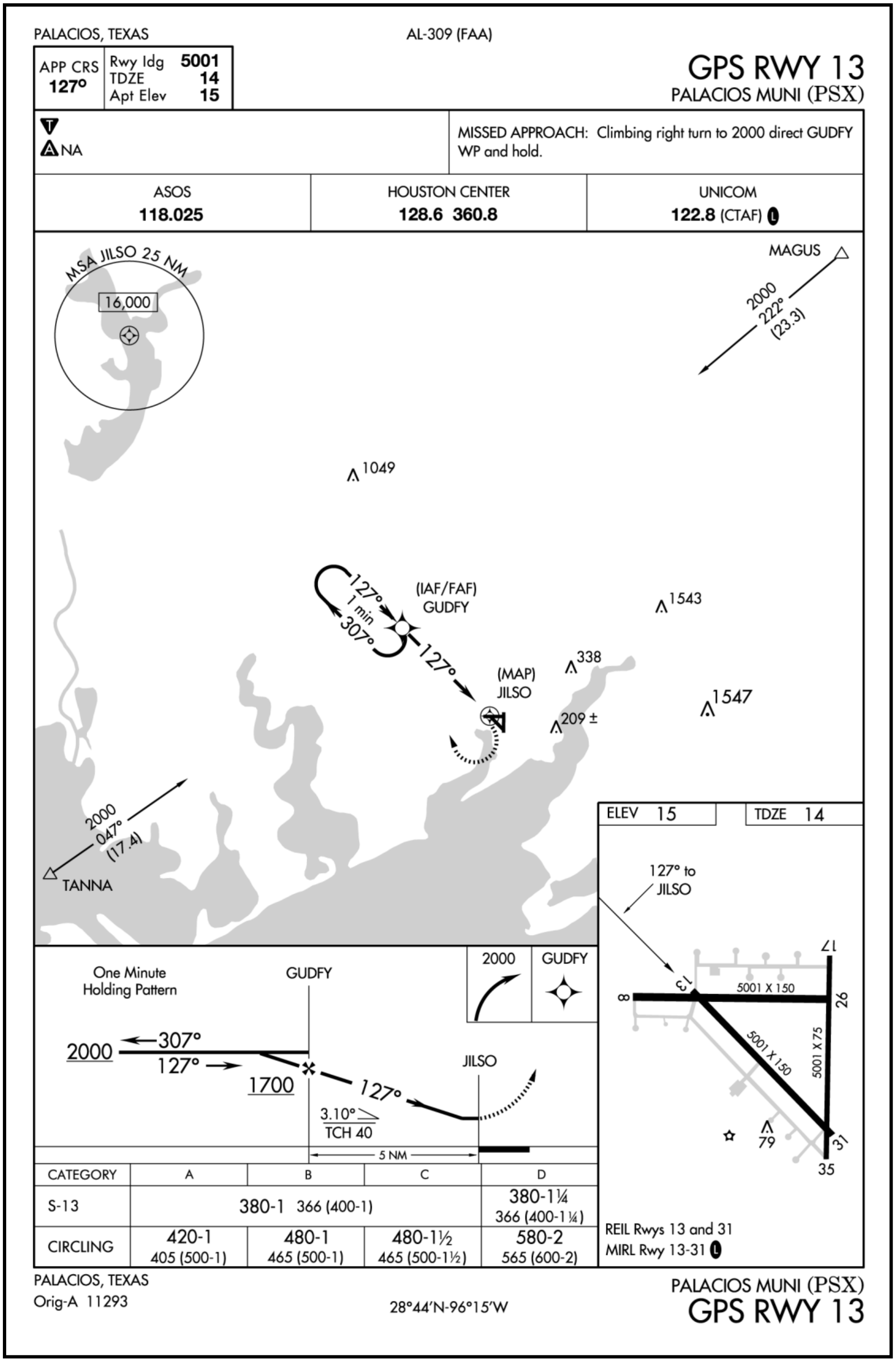


Figure 4-24 HILO Approach

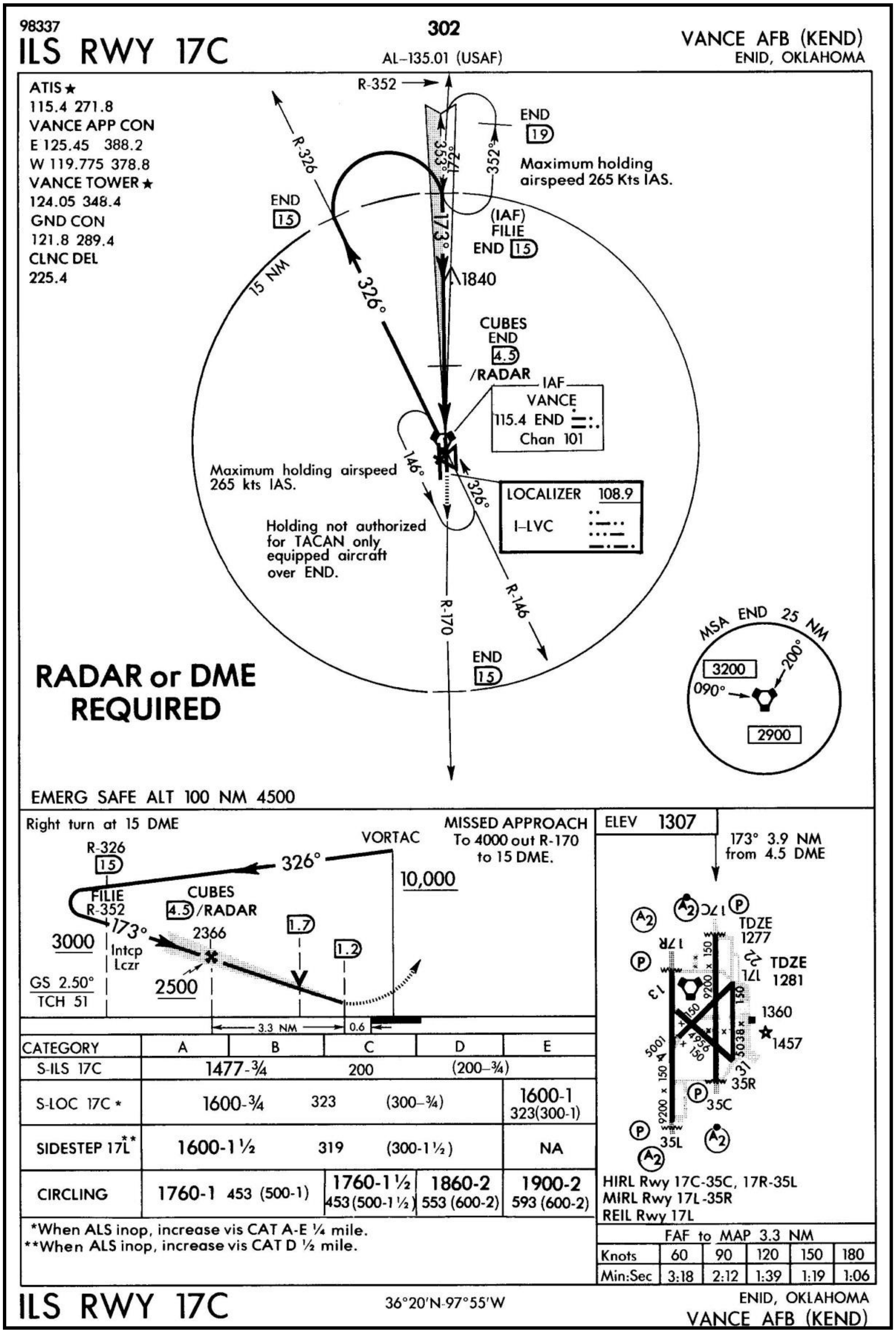


Figure 4-25 Depicted Teardrop

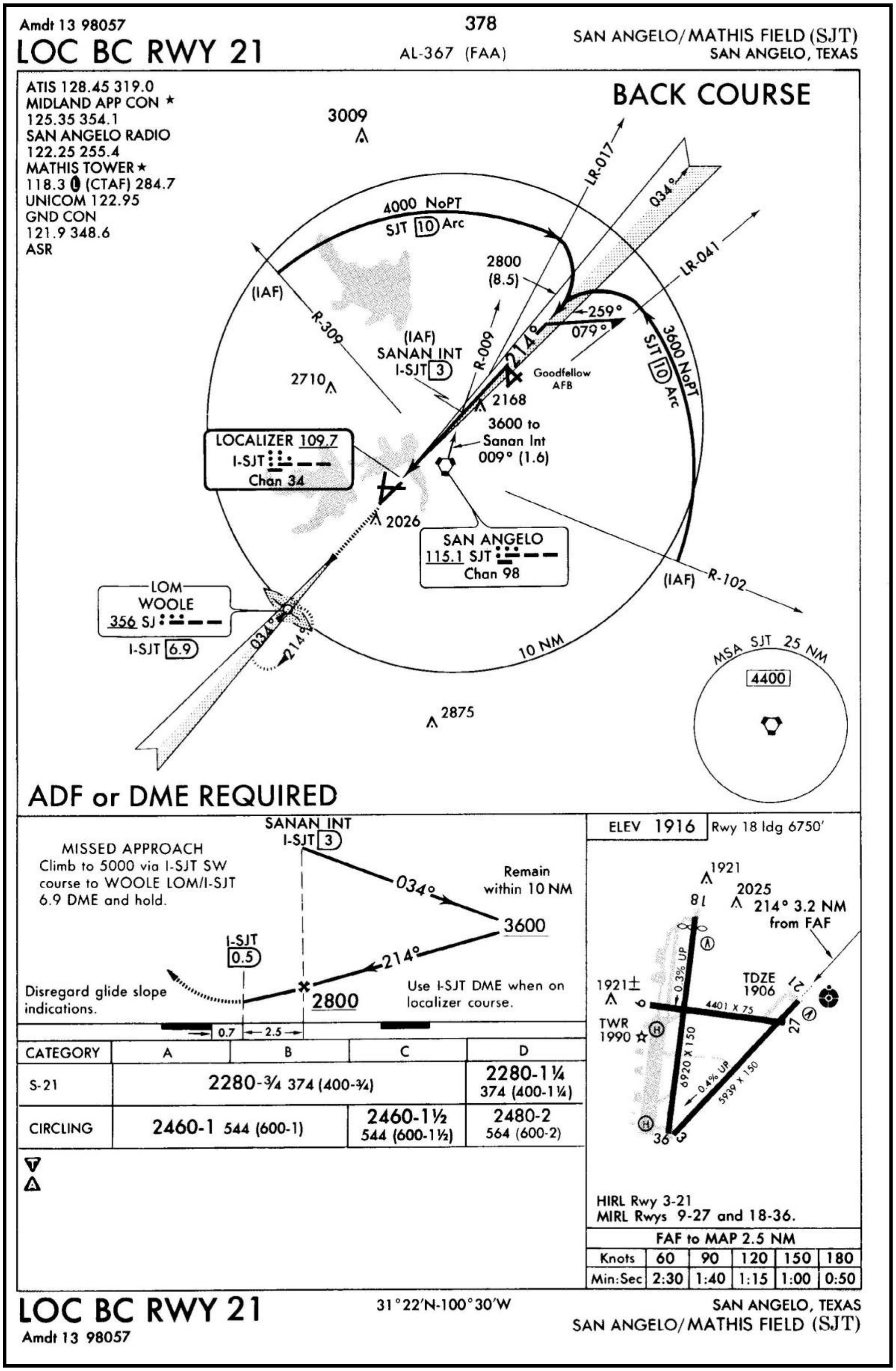


Figure 4-26 Arc/PT Approach

3. **Procedural Tracks.** When a specific flight path is required, procedural track symbology is used to depict the flight path between the IAF and FAF. There is no one specific depiction for a procedural track. The depiction used is a heavy black line showing intended aircraft ground track. It may employ arcs, radials, courses, turns, etc.

Entry. As described above in Low Altitude Instrument Approach Procedures.

Descent. As described above in Low Altitude Instrument Approach Procedures. Except for initial descents at an IAF, be established on the appropriate segment of the procedural track before descending to the next altitude shown on the IAP.

Descent Inbound. Do not descend from the PT completion altitude until established on the inbound segment of the approach (***Figure 4-21***).

Maneuvering. Conform to the specific ground track shown on the IAP. Where a teardrop turn is depicted, turn to the inbound course at any time unless otherwise restricted by the approach plate. Determine when to turn by using the aircraft turn performance, winds, and the amount of descent required on the inbound course; however, do not exceed the published “remain within” distance.

Published Lead Radials. Lead radials are required to be published when the course change from the initial to intermediate segment exceeds 90°.

a. A lead radial or bearing is published to help you identify a lead point to turn onto the intermediate course, but this lead point is based on the highest speed category listed on the approach plate, which is 2 miles and will usually be greater than required for the T-44.

b. Where to lead the turn is the pilot’s discretion; it will vary with groundspeed. Again, about 0.8 NM works well as a no-wind lead point for a 90° turn at 150 KIAS. Using the 60-1 rule at 10 DME, 5 radials is about .8 NM.

CAUTION

Maximum designed obstacle clearance is based on the ability to maintain the course centerline. Use position orientation and judgment to determine when to descend while attempting to intercept the procedural track.

4. **Configuration on IAPs.** The aircraft is slowed to 120 KIAS, when configuring, and this airspeed is maintained until making the transition to land.

When to configure is technique and up to the PF; however, the Landing Checklist must be complete prior to the FAF/FAP/glideslope intercept point, unless “holding the gear” in the up position when single engine. The following are some guidelines for configuring:

	PRECISION	NON-PRECISION	RADAR APPROACH PAR	RADAR APPROACH ASR	LNAV/VNAV APPROACH
NORMAL	1 ½ dots below glideslope at glideslope intercept altitude or 3 NM prior to FAF	3 NM prior to FAF	Base or Dog-leg to final	Base or Dog-leg to final	1 ½ dots below glidepath at appropriate intercept altitude or 3 NM prior to FAF

Figure 4-27 Normal Configuration Procedures

NOTES

1. If you don't have DME or there isn't an FAF, a good technique is to configure after the 45/180 turn prior to course intercept. (NDB, approach with no FAF (final approach point (FAP), or VOR w/out DME.)

2. LNAV/VNAV approaches – although technically a non-precision approach, procedures should be the same as a precision approach flown to a decision altitude (DA). Configuration can be made either three miles prior to the FAF or at a dot and a half below glidepath.

3. Radar Vectors to final for a ground based NAVAID may use the suggested techniques from Figure 4-28; however, ATC can vector the aircraft to final up to 1 NM from the FAF without informing the pilot. In this case, configuration per Figure 4-28 may occur prior to being established on final.

4. No Flap Approaches. The no flap approach presents no unusual handling characteristics and is flown the same as any other approach. The props are placed full forward at the normal point on the approach.

If receiving unusually short vectors, or if considerable altitude loss is necessary, the aircraft may be configured prior to intercepting final.

5. **Final Segment.** The final segment begins at the FAF and is the most important part of the approach. There are key aspects to the Final Segment, which we will discuss here. They include, but are not limited to, Timing, Turns, and Descents.

Timing. Timing is required when the final approach does not terminate at a published fix, as is usually the case with VOR, NDB, and localizer. If timing is required to identify the MAP, begin timing when passing the FAF or the starting point designated in the timing block of the approach plate. This point is usually the FAF, but it may be a fix not co-located with the FAF such as a LOM, NDB, crossing radial, DME fix, or outer marker. Time and distance tables on the approach chart are based on groundspeed; therefore, the existing wind and TAS must be considered to accurately time the final approach. Use timing (when required or as a backup) on all approaches with published timing.

NOTES

1. If timing is not specifically depicted on the IAP, timing is not authorized as a means of identifying the MAP.

2. Unless situational requirements dictate flying an approach off-speed i.e. ATC direction, aircrew should fly a proper approach speed-profile from FAF to MAP in order to ensure proper timing. An additional point of note is to be cognizant of winds, as that will also impact timing.

3. Timing is the least precise method of identifying the MAP; therefore, when the use of timing is not authorized for a particular approach because of TERPs considerations, timing information will not be published.

4. If other means of identifying the MAP are published (e.g., DME), they should be used as the primary means to determine the MAP. In these situations, timing is a good backup, but it is not the primary means of identifying the MAP. For example, upon reaching the published DME depicting the MAP, do not delay executing the missed approach just because you have not reached your timing.

5. The Middle Marker (MM) may never be used as the sole means of identifying the MAP. The MM may assist you in identifying the MAP on certain localizer approaches provided it is coincident with the published localizer MAP. To determine the location of the MAP, compare the distance from the FAF to MAP adjacent to the timing block. It may not be the same point as depicted in the profile view. If the MM is received while executing such an approach and your primary indications (DME and/or timing) agree, you may consider yourself at the MAP and take appropriate action. If the MM is the only way to identify the MAP (e.g., timing is not published), the approach is not authorized.

6. On a LOC approach, if you haven't reached your timing, but you have reached the MM and the procedure depicts starting the missed approach at the MM, you should start it. Missed approaches are based upon a designated point on the ground, so if you don't have DME, go missed when you hit timing or the MM, whichever occurs first. If you don't, you could depart TERPs airspace.

Turns. When a turn is required over the FAF, turn immediately and intercept the final approach course to ensure obstruction clearance airspace is not exceeded. Turns at the FAF are rare, but there are still a few of these approaches out there, so be vigilant when briefing the approach.

Descent. The whole point of doing an approach is to place the aircraft in a safe position to land. If you don't get down to MDA prior to the MAP (or VDP) and break out of the weather, the entire approach was poorly flown and an opportunity to land the aircraft was missed.

You must arrive at MDA prior to the MAP on each approach.

NOTE

Aircrew should brief expectations when approaching MDA or DA/DH. Students shall execute a missed approach if arriving at the MAP or DA/DH and the IP hasn't called the "field in sight." It is fine to ask the IP if the field is in sight when approaching MDA or DA/DH.

Arrive at MDA at or before the published, or derived, VDP on each approach, in order to have a normal descent angle to land. A common student mistake is to ignore how long the final approach segment is. There are some that are 2 miles long and some that are 9 miles long. Take a look at the length and then decide what rate of descent you may need to get down prior to the VDP. Some will require greater than 1000 FPM and some less than 500 FPM.

NOTE

If there isn't a VDP published, obstacle clearance is not guaranteed from a VDP to the runway; however, it is still a good idea to calculate one to make sure you get down to the MDA in a good position to descend and land.

Avoid rapid descent requirements on final by crossing the FAF at the published altitude. Note that you can descend from the FAF once on the appropriate heading outbound from the station or the appropriate radial inbound. Do not wait to descend until the needle settles out of the cone of confusion.

Determine the approximate initial descent rate required on final by referring to the "Rate of Climb/Descent Table" in the IAP books or by using one of the techniques in the Cockpit Procedures Appendix. The maximum descent gradient from the FAF to the threshold required for a straight-in approach is 400 ft/NM (800 ft/min with a GS of 120 knots); however, plan to arrive at the MDA with enough time and distance remaining to identify the runway environment and depart the MDA from a normal Visual Descent Point (VDP).

E.g., FAF is at 1500' and 5 DME. Calculated VDP is at 400' MDA and 1.2 DME. Quick math tells us we have 3.8 miles to lose 1100'. At approximately 2 miles/minute (3.8 miles is just under 2 min), that's about 550 FPM. Increase slightly to 600 FPM and you'll get down just prior to the VDP. (These numbers are approximate for quick, no calculator; in-the-plane math comps.)

There are 2 Descent techniques we will use for non-precision approaches. ***Both of these techniques should be flown in RIs***. The first is the "Dive and Drive techniques," which gets us down to MDA relatively quickly. The second technique is one which the FAA has developed to provide a more stabilized approach using a calculated Vertical Descent Angle (VDA).

Method A (Dive and Drive). One technique is to start with an indicated 800-1000 ft/min VSI, but it should be determined from the IAP whether a different descent rate is required. You should brief your planned descent rate in the briefing, particularly if you exceed 1000 ft/min.

Method B (Vertical Descent Angle – VDA). A second technique is to fly a stabilized approach from the FAF to the Threshold Crossing Height (TCH). The FAA is developing Vertical Descent Angle (VDA) on non-precision approaches that will give a constant rate descent from the FAF to the TCH. The purpose of a constant rate descent is to have a stabilized approach and prevent getting low early. This was developed by the FAA to reduce the occurrences of CFIT.

a. A VDA is an aid in making a stabilized descent to the MDA on non-precision approaches.

b. The published angle is for information only – it is strictly advisory in nature. This angle will be published on many non-precision, straight-in approaches. It is important to remember, though, that this angle is to a TCH, not a VDP or MAP. It is still your responsibility to get down to the MDA prior to the VDP or MAP.

c. May be published from a step down rather than FAF, if the step down would penetrate the path from the FAF.

d. Does not change any rules for non-precision approach, or MDA.

e. Does not provide additional obstacle protection below the MDA over an approach without the angle.

f. No special equipment is required.

g. Utilize the table on the inside back cover of the IAP for descent angle, groundspeed, and VVI combinations.

  i. Another technique is to halve your groundspeed and add a zero.

  ii. E.g., 140 groundspeed = 700 VSI (140/2 = 70 + 0 = 700 VSI)

  iii. Computed VVI can be backed up by altitude/DME checkpoints (should lose 300 feet per mile assuming a VDA of 3.0) or visual presentation. (T-44C VNAV mode during LNAV only or overlay approaches.)

h. VDA does have limitations associated with computations based on groundspeed and VVI.

  i. Groundspeed varies based on wind gusts variations and TAS (altitude/temperature dependent) causing any groundspeed calculated manually to likely be inaccurate.

  ii. Calculations would be dependent on precise pilot control of IAS and VVI which will be more difficult to control if in turbulence often associated with flight in IMC.

  iii. Although calculations can be backed up with DME checkpoints, not all non-precision approaches use DME.

i. If VDA is not properly flown, arrival at the MDA beyond the VDP could negate any value gained by using VDA and possibly lead to missed approach.

j. Single Engine using VDA. Using a stabilized VDA approach while single engine offers many advantages. Single engine method using VDA should not require as aggressive power changes as the dive and drive method. By using the VDA, the T-44 can more easily maintain proper airspeed in the landing configuration while descending and would not require last minute configuration/checklists on short final (configuration techniques other than those recommended in the FTI/NATOPS require sound judgment, communication between crewmembers, and thorough understanding of procedures).

Step-down Fix. A step-down fix between the FAF and the missed approach point is sometimes used. You may not descend below the step-down fix altitude unless you can identify the step-down fix (you must be capable of simultaneous reception of final approach course guidance and the step-down fix).

Visual Descent Point. Depending on the location of the MAP, the descent from the MDA often will have to be initiated prior to reaching the MAP in order to execute a normal (approximately 3°) descent to landing. The VDP will often be published on the approach chart; if not depicted, it may be computed using techniques described in ***FTI Appendix E.***

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. Therefore, 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.

Calculating a Visual Descent Point (VDP). The first step to computing a VDP is to divide the Height Above Touchdown (HAT) from the IAP by your desired descent gradient. Most pilots use a 3° (300 ft/NM) glidepath for landing. Here is the formula to use:

HAT/Gradient (normally 300) = VDP in NM from end of runway

Now that you know how far the VDP is from the end of the runway, you may add this distance to the DME at the end of the runway to get a DME for your VDP. Armed with this information, it is easy to compute the distance from the FAF to the VDP. This distance is important in computing the descent gradient necessary for final approach. Using the FAF altitude, the MDA, and the distance from the FAF to the VDP, you can compute a descent gradient from the FAF to the VDP along with a target VSI to ensure you are meeting the desired descent gradient.

Example: HAT = 420 FT, MDA = 840 FT MSL, DME at the end of the runway = 0.5 DME, FAF = 6 DME

FAF altitude = 2500 FT MSL, desired landing gradient = 300 FT/NM, Approach airspeed = 150 KIAS GS

VDP = HAT/Gradient = 420/300 = 1.4 NM from end of runway

VDP DME = DME at end of runway + VDP distance = 0.5 DME + 1.4 DME = 1.9 DME

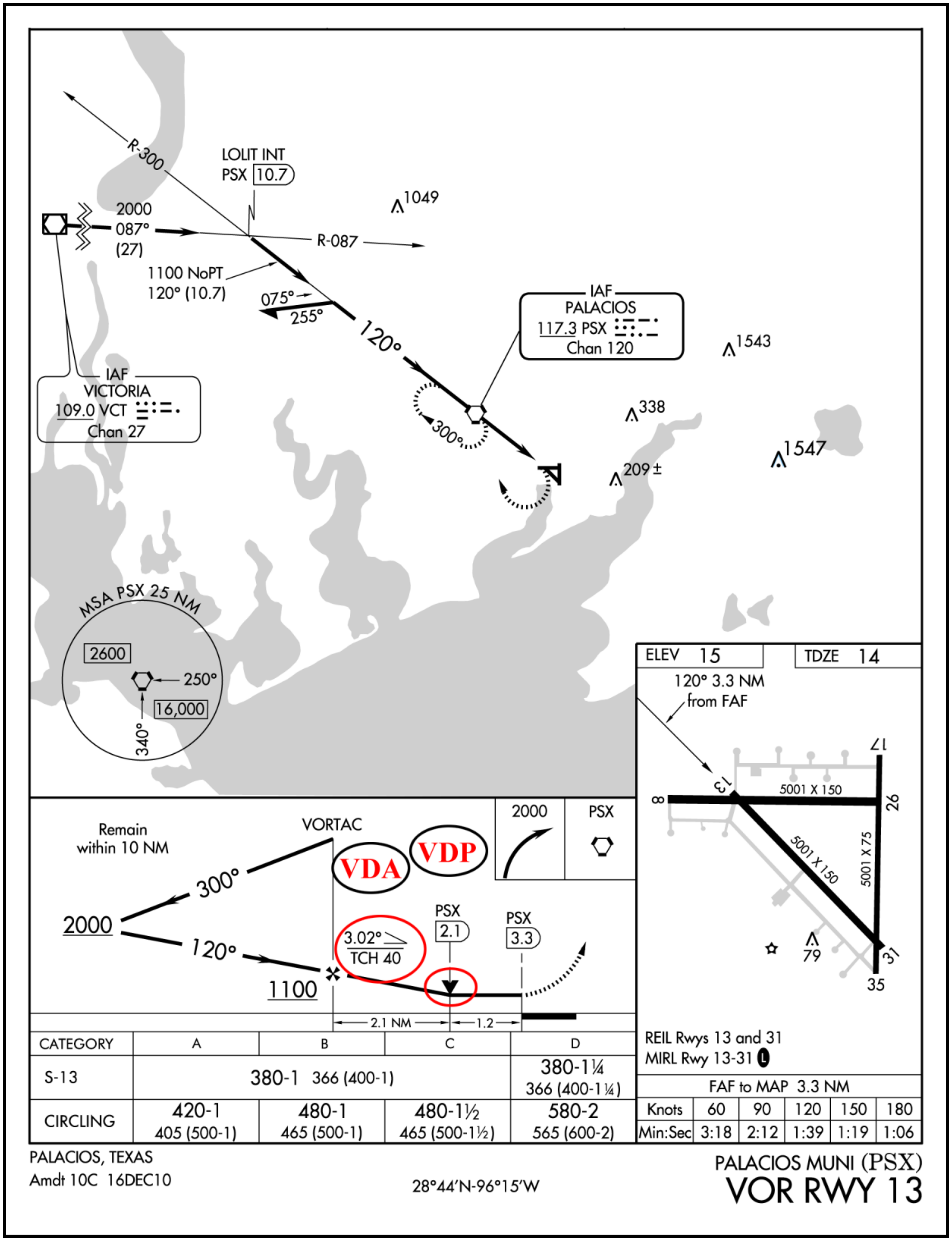


Figure 4-28 Vertical Descent Angle/Visual Descent Point

6. Decent Below MDA or DA/DH. Descent below MDA or DA/DH is not authorized unless:

   a. The aircraft is continuously in a position from which a decent to landing on the intended runway can be made at a normal rate of decent using normal maneuvers;

   b. The flight visibility is not less than the visibility prescribed in the standard instrument approach being used; and

   c. At least one of the runway environment visual references is distinctly visible and identifiable to the pilot.

The runway environment is commonly defined as:

   a. The approach light system (except that the pilot may not descend below 100 ft. above the Touch Down Zone Elevation using the approach lights as a reference unless the red termination bars or the red side row bars are also visible and identifiable)

   b. The threshold

   c. The threshold markings

   d. The threshold lights

   e. The runway end identifier lights

   f. The visual approach slope indicator

   g. The touchdown zone or touchdown zone markings

   h. The touchdown zone lights

   i. The runway or runway markings

   j. The runway lights

NOTE

In many cases, the minimum visibility required for the approach will not allow you to see the runway environment until beyond the VDP. This emphasizes the need to compute a VDP and determine a point along the approach when you will no longer attempt to continue for a landing. A common error is to establish a high descent rate once the runway environment is in sight. This can go unnoticed during an approach without visual glidepath guidance and may lead to a short and/or hard landing. Caution should also be used to avoid accepting a long touchdown and landing roll.

NOTE

TERPS criterion does provide obstacle clearance to allow a momentary descent below DA/DH when executing a missed approach.

Alignment. Be aware that the final approach course on a non-radar final may vary from the runway heading as much as 30° (except localizer) and still be published as a straight-in approach. If the final approach course isn't exactly coincident to the runway, a smooth turn to intercept extended centerline should be executed as soon as the runway is in sight. Keep in mind that a longer final will give you more time and distance to correct for crosswinds if applicable.

Runway in Sight (Non-Precision). Once the decision to land has been made, you have two options on a non-precision approach, depending on conditions (weather, runway length, etc.) Fly a normal glidepath (VASI or PAPI assisted if available) to the 1000' runway aiming point markings. You may want to do this if the weather is down to mins and you don't have good visibility.

Take over visually and aim for the first 500'. You may want to do this if runway length is a consideration.

Runway in Sight (Precision). Once the decision to land has been made, continue on the ILS glideslope path while bringing in outside references (VASI or PAPI) to assist you. Going below glideslope to land earlier than 1000 feet down the runway is typically not necessary for runways served by a precision approach (often relatively long runways); however, pilot discretion dictates whether you abandon the ILS glideslope and likely the visual glideslope to land early.

Slow to Final Speed. Always attempt to be stabilized, trimmed for 120 KIAS, in the proper configuration and at the proper altitude, before crossing the FAF. At approach minimums, with the airport environment in sight and in a safe position to land, review the Landing Checklist complete and slow to normal pattern airspeeds. (105 KIAS on final and 95 KIAS over the threshold.)

NOTE

The gear horn shall not be silenced after the FAF/glideslope intercept.

7. **Student Tendencies**

a. Allowing instrument crosscheck to break down while implementing emergency/malfunction procedures

b. Not having the Landing Checklist complete by the FAF/glideslope intercept

c. Overshooting intercept of final – underestimating CDI rate of movement, especially during LOC or LOC BC

d. Twisting the inbound course under the course arrow instead of the front course on a localizer back course approach

e. Not accomplishing the tasks contained in the "Six T's" at the IAF or FAF (Remember that the "Six T's" are only a technique and if you get everything accomplished without using them that, is all that is required.)

f. Not intercepting the outbound course within 1 minute

411. TYPES OF INSTRUMENT APPROACHES

Now let's discuss the different types of approaches you will be flying while in the Instrument Stage.

Radar Approaches

Non-Precision Approaches

Precision Approaches

1. **Radar Approaches.** Refer to ***NATOPS IFM 25.3, 30.10*** and ***AIM 5-4-11*** for information on Radar Approaches.

NOTES

1. Although you aren't flying an approach with a diagram depicted on an approach plate, you should have an approach to the same runway (if available) up and not only brief the approach minimums, but all other applicable information for that field.

2. When shooting a PAR approach, students shall brief that they will use the most precise approach available for the runway in use as a backup (e.g., ILS RWY 13R at NGP when shooting PAR to NGP). For training purposes only, it is the IP's discretion as to what NAVAID will be tuned on the student's side.

Dogleg. The transition to final segment of the approach includes all maneuvering up to a point where the aircraft is inbound and approximately 8 NM from touchdown. A dogleg to final is considered a part of the "transition to final" segment. The configuration point is technique, but if you didn't configure on base, consider establishing the aircraft configuration and airspeed and complete the Landing Checklist while on dogleg.

Complying with ATC. During the transition to final, the radar controller directs heading and altitude changes as required to position the aircraft on final approach. Turns and descents should be initiated immediately after instructed. Perform turns by establishing an AOB which will approximate a SRT for the TAS flown but not to exceed 30° of bank.

Orientation. Use available NAVAIDs to remain position-oriented in relation to the landing runway and glideslope intercept point. The controller will advise you of the aircraft position at least once before starting final approach.

Airport Surveillance Radar (ASR) and Precision Approach Radar (PAR)

a. **Non-Precision – Airport Surveillance Radar, Descent:**

C**ontroller.** The controller will inform the pilot of the runway to which the approach will be made, the MDA, and the Missed Approach Point (MAP) location, and will issue advance notice of where the descent to MDA will begin. Upon request, the controller will provide recommended altitudes on final.

NOTE

During ASR approaches, the PF may elect to set appropriate radar minimums once checked-in with the final controller and established on the final approach course, but no later than the "begin descent to minimum descent altitude" call. This is intended to prevent any delays in initiating the final descent at the appropriate location, particularly when executing radar approaches while coupled to the autopilot.

D**escent.** When the aircraft reaches the descent point, the controller will advise you to *"begin descent to minimum descent altitude."* If a descent restriction exists, the controller will specify the prescribed restriction altitude. When the aircraft is past the altitude limiting point, you will be advised to continue descent to MDA. Pilots may elect to set appropriate radar minimums once checked-in with final controller and established on final approach course, but no later than the begin descent to minimum descent altitude call for ASR approaches. The preceding is intended to prevent any delays to initiating descent at the appropriate location, particularly when executing radar approaches while coupled to the autopilot.

C**ourse guidance.** The controller will issue course guidance when required and will give range information each mile while on final approach. You may be instructed to report the runway in sight. Approach guidance will be provided until aircraft is over the MAP unless you request discontinuation of guidance. The controller will inform you when you are at the MAP.

MDA. Fly the aircraft at or above MDA until arrival at the MAP or until establishing visual contact with the runway environment. If you do not report the runway environment in sight, missed approach instructions will be given. For a more detailed discussion, see above in the Low Altitude Approach section.

Runway environment. Arrive at the MDA with enough time and distance remaining to identify the runway environment and descend from MDA to touchdown at a rate normally used for a visual approach. At the MAP, the straight-in surveillance system approach error may be as much as 500 feet from the runway edges. For a more detailed discussion, reference Low Altitude Instrument Approach Procedures.

Single-engine ASR. If using recommended altitudes on final, for configuration purposes, continue as described in “Single-Engine Precision Approach”; however, if well below the recommended altitudes during the approach, revert to non-precision configuration procedures.

If electing not to use the recommended altitudes on final, for configuration purposes, continue as described in “Single-Engine Non-Precision Approach.”

NOTE

If not sure whether you need to clean up because of getting low or slow, err on the side of caution. Use your discretion.

b. **Precision Approach Radar (PAR), Descent:**

Controller. A PAR is a precision approach, where the final controller has radars both for azimuth and elevation, allowing him or her to provide corrections to both course and glideslope. The precision final approach starts when the aircraft is within range of the precision radar and contact is established with the final controller. Normally this occurs at approximately 8 miles from touchdown. Students brief the most precise approach available as a backup to the PAR.

NOTE

During PAR approaches, the PF may elect to set appropriate radar minimums once checked-in with the final controller and established on the final approach course, but no later than the “on glide path” call. This is intended to prevent any delays in initiating the final descent at the appropriate location, particularly when executing radar approaches while coupled to the autopilot.

Descent. Approximately 10 to 30 seconds before final descent, the controller will advise the aircraft is approaching the glidepath. When the aircraft reaches the point where final descent is to start, the controller will state, "*Begin descent*." Wait to descend until the controller says "*On glidepath*." At that point, establish the predetermined rate of descent. When the airspeed and glidepath are stabilized, note the power, attitude, and vertical speed. Use these values as guides during the remainder of the approach. Vertical speed is a great instrument to use flying a precision approach. If you keep your VSI needle within 100' of where you want it and make small corrections, it will be a more stable approach. Pilots may elect to set appropriate radar minimums once checked-in with final controller and established on final approach course, but no later than the on glide path call for PAR approaches. The preceding is intended to prevent any delays to initiating descent at the appropriate location, particularly when executing radar approaches while coupled to the autopilot.

NOTE

The "begin descent" call is a standard instruction GCA final controllers issue for all types of aircraft. If descent is commenced at that point, you will be below glidepath for the approach requiring power and pitch corrections to get back on glidepath.

C**ourse and Glidepath guidance.** The controller issues course and glidepath guidance, and frequently informs you of any deviation from course or glidepath. The controller's terminology will be: *"on course, on glidepath, slightly/well above/below glidepath,"* or *"slightly/well left/right of course."* Controllers may also issue trend information to assist you in conducting a PAR approach. Examples of trend information phraseologies used are: *"going above/below glidepath, holding above/below glidepath, holding left/right of course,"* etc. Modify trend information by using the terms *"rapidly"* or *"slowly"* as appropriate. Use the terms *"slightly"* or *"well"* in conjunction with the trend information.

C**orrections.** Corrections should be made ***immediately*** after instructions are given or when deviation from established attitude or desired performance is noted. Avoid excessive power, pitch, or bank changes. Normally pitch changes of 1° will be sufficient to correct back to glidepath.

H**eading control.** Accurate heading control is important for runway alignment during the final approach phase. When instructed to make heading changes, make them ***immediately***. Heading instructions are preceded by the phrases *"turn right"* or *"turn left."* To prevent overshooting, the AOB should approximate the number of degrees to be turned, not to exceed a ½ SRT. After a new heading is directed, the controller assumes it is being maintained. Additional heading corrections will be based on the last assigned.

Decision height. DA is the MSL altitude and DH is the AGL height at which a decision must be made during a precision approach to either continue the approach or to execute a missed approach. The crew will use DA from their barometric altimeter as their primary reference, but expect radar controllers to refer to DH. Descent below DA/DH is not authorized until sufficient visual reference with the runway environment has been established. The controller will advise the pilot when the aircraft reaches the published DH. DA/DH is determined in the cockpit either as read on the altimeter or when advised by the controller, whichever occurs first. The controller will continue to provide advisory course and glidepath information until the aircraft passes over the landing threshold at which time the controller will advise *"Over landing threshold."* To provide a smooth transition from instrument to visual conditions, a systematic scan for runway environment should be integrated into the cross-check before reaching DA/DH. Two NATOPS qualified aviators must be at the controls to utilize minimums lower than 200 feet (refer to the Squadron SOP and CNAF M-3710.7 series).

S**ingle-engine PAR**. If flying a single-engine or SSE PAR, request a "ten second gear warning" (before descent) from the GCA final controller to aid in configuring the aircraft. Continue as described in "Single-Engine Precision Approach."

2. **Non-Precision Approaches (VOR, TACAN, NDB, VOR/DME, GPS/RNAV, LOC, LOC BC).**

Non-Precision Approach

Overview. All non-precision approaches are flown using similar procedures, although NAVAID characteristics differ. In general, non-precision approaches have no precision glideslope and have "less precise" course guidance than the localizer; however, one thing should be abundantly clear: once on any approach, minimum terrain clearance has to diminish (you are descending to land). As it does, the importance of precise altitude management becomes increasingly crucial. On non-precision approaches inside the FAF, minimum obstruction clearance at the MDA can vary from 200 feet on LOC, VOR, and TACAN approaches to 300 feet on NDB approaches. Couple this with an altimeter error of up to 75 feet and it should be easy to see the need for precise altitude control.

CAUTION

The rate of CFIT (controlled flight into terrain) accidents during non-precision approaches is five times that of precision approaches. Another interesting note is most major airlines do not even allow their pilots to fly non-precision approaches without approval. Of course, in the military we routinely fly to many locations where a non-precision approach is the only option; it is not dangerous if flown properly.

WARNING

Flight director or autopilot approaches to an MDA should be flown in NAV mode to ensure that the aircraft levels off at the preselected altitude. Approaches flown to DH/DA, (ILS or LNAV/VNAV) should be flown in approach mode (APPR). Be careful when using APPR mode because the aircraft will not honor the preselected altitude and will continue to the runway.

Transition to the Final Approach Course. Again, this is performed by using either radar vectors or a published approach procedure.

Final Approach. The final approach starts at the FAF and ends at the MAP. The optimum length of the final approach is 5 miles; the maximum length is 10 miles. For a more detailed discussion, reference the Low Altitude Instrument Approach Procedures.

Navigation Receiver. Once the aircraft is inside the FAF, at least one navigation receiver must remain tuned to and display the facility providing final approach course guidance. For example, if only one VOR receiver is operable, that receiver cannot be re-tuned inside the FAF to another VOR station that identifies subsequent step-down fixes and/or the MAP.

Identifying the FAF. The FAF is indicated on the IAP with a Maltese Cross. Looking for multiple ways to identify the FAF provides for backup in case the primary method fails. An OM (or other NAVAID such as a compass Locator Outer Marker (LOM), VOR, or NDB) or a DME fix may define the FAF. Radar may be substituted for an outer or middle marker if it is published on the IAP. Crossing radials may also be used if published on the IAP; however, this method should be used with discretion unless it is the only method available because it precludes the PM from backing up primary course guidance until reaching the fix.

VOR, VOR/DME, TACAN. Follow the guidance in Section 410 Non-Precision Approaches for these approaches, and keep in mind the importance of properly setting up your NAVAIDs. For any VOR-based approach, ensure that VOR mode is selected, and likewise for TACAN-based approaches. Also ensure that you are no longer in RNAV or Linear Deviation mode. If you are using a VOR without DME, you may want to consider holding the DME of a NAVAID that will increase your Situational Awareness. Refer to ***NATOPS IFM 21.3.12.2 – 21.3.12.7.1 and 22.2.4*** for information on VOR and TACAN approaches **NDB.** NDB approaches are generally similar to VOR-based approaches, but keep in mind that you only know direction to the station, and do not have CDI-precise indications. Many NDB approaches use the radio beacon as the IAF or FAF, as DME is not available for NDBs. Ensure that you select ADF on your instruments for an NDB approach. As your VOR receivers will be free for most NDB approaches, you should set them to something logical to increase your Situational Awareness. Refer to ***NATOPS IFM 23.1 and 23.1.2.3*** for information on NDB approaches.

Many NDB approach plates include radial and distance (in NM) information from another NAVAID (often a feeder route) that may aid in SA, since NDB’s do not have distance information themselves (refer to the NDB at Wharton, KARM).

LOC. Localizer approaches are non-precision approaches that use the localizer from the ILS for azimuth guidance, without using the ILS glideslope. Procedures for using the localizer on a LOC approach are similar to the localizer part of an ILS approach, but pilots must also comply with published altitude restrictions, as on a non-precision approach. Localizer approaches are generally published on the same plates as ILS approaches. If glideslope information is lost on an

ILS approach and are above localizer mins, consider yourself transitioned to a localizer approach and proceed accordingly (e.g., to the LOC MDA).

NOTE

See ILS for LIDS Check technique.

a. **Signal.** The localizer signal typically has a usable range of at least 18 miles within 10° of the course centerline unless otherwise stated on the IAP. ATC may clear you to intercept the localizer course beyond 18 miles or the published limit; however, this practice is only acceptable when your aircraft is in radar contact and ATC is sharing responsibility for course guidance. ATC may clear you to any NAVAID beyond the published service volumes if in radar contact and able to share navigation responsibility.

b. **Sensitivity.** As with other types of NAVAIDs, a LOC gets more sensitive the closer you are to the antenna. With a LOC, this is even more so. If you use large corrections to get back on course, you are more likely to fly through the CDI course. Try to keep corrections to ±5 degrees.

c. **Back-up NAVAIDs.** When flying a localizer approach, it is always wise to tune up another NAVAID, if one is available, to help increase SA. For example, if there is a NDB/OM, select the ADF needle and keep watch as the head "falls" to your CDI course. When it is within 10 bearings, you know you are getting close. This will prevent you from missing the CDI course becoming "alive" and blowing through final.

Localizer Back Course. In order to fly a LOC BC approach, set the published front course in the course selector window. The term "front course" refers to the inbound course depicted on the ILS/localizer approach for the opposite runway. On the back course approach plate, the published front course is depicted in the feather as an outbound localizer course.

NOTE

See ILS for LIDS Check technique.

a. **Reverse Sensing Explained.** The LOC BC is exactly what it sounds like – the extension of the localizer in the opposite direction. The approach utilizes the same localizer antenna and frequency as the ILS/localizer front course. Because the localizer antenna gives no bearing information, the CDI displays only directional deflection from centerline, regardless of course selected in the course select window. For this reason, if you twist in the final approach course when flying a LOC BC, the CDI will appear to be commanding you the wrong direction.

For example, if on a LOC BC with the inbound course dialed into your CDI, this is what will happen: If your CDI is commanding a right turn to correct and you turn right, the CDI will continue to get farther away. This is called reverse sensing and is avoided by always twisting in the front course as stated above.

b. **Sensitivity.** Because a localizer antenna is usually located beyond the departure end of the runway; it is therefore, before the approach end of the BC runway. The antenna's close proximity when flying a LOC BC makes the CDI much more sensitive than when flying a normal localizer approach.

If large corrections are used to get back on course, the aircraft will be more likely to fly through the CDI course. Try to keep corrections to ±5 degrees.

c. **False Glideslope.** False glideslope (G/S) signals may exist in the area of a LOC BC that may cause the G/S warning flag to disappear. Disregard all G/S indications when executing a BC approach unless a G/S is specified on the IAP.

d. **Back-up NAVAIDs.** When flying a BC localizer approach, it is always wise to tune up another NAVAID, if one is available, to help increase SA. For example, if there is a NDB/OM on the ILS front-course side; select the ADF needle and keep watch as the head "falls" to your CDI course. When it is within 10 bearings, you know you are getting close. This will prevent you from missing the CDI course becoming "alive" and blowing through final.

Student Tendencies

a. Improper configuration procedures (e.g., not retracting the gear with an engine loss inside the FAF on a non-precision approach)

b. Forgetting to request a "10 second gear warning" on SSE PAR; unnecessarily requesting a gear warning on a no-gyro radar approach

c. Chasing a calculated VSI, not using the control instruments to establish a rate of descent

d. Over controlling course and/or glidepath on final

e. Slow to initiate descent to MDA and/or not getting down to the MDA prior to the VDP

f. Descending below MDA or through step-down altitudes

g. Not being prepared to revert to a LOC approach should glideslope fail on ILS (not timing or not briefing MDA)

h. Not going missed approach with full scale CDI deflection

i. Turning the wrong way on an approach, especially on no-heading approaches or with CDI inoperative

3. **Precision Approaches.** Precision Approaches take the azimuth guidance of a non-precision approach, and add vertical guidance. This allows approaches to be constructed to lower minima. Civilian precision approaches can have minima as low as zero ceiling-zero visibility. Military approaches generally have minima of 200' AGL or more. ILS, MLS, and GLS (GNSS Landing System) are all precision approach systems, but the T-44 is only equipped for the ILS. Localizer approaches are based on ILS systems, but are non-precision approaches, as they do not provide vertical guidance. Refer to ***AIM 1-1-9*** and ***NATOPS IFM Ch. 24*** for information on ILS, LOC, and BC LOC approaches.

NOTE

PARs are also precision approaches. See the Radar Approach section.

ILS Precision Approach (ILS). In the United States, the glideslope, the localizer, and the Outer Marker (OM) are required components for an ILS. If the OM is inoperative or not installed, it may be replaced by DME, another NAVAID, a crossing radial, or radar provided these substitutes are depicted on the approach plate or identified by NOTAM. If VOR2 is used to identify intermediate fixes and/or the FAF, it should be tuned to the LOC frequency not later than immediately passing the FAF (unless it is required to identify subsequent step-down fixes and/or the MAP). If the glideslope fails or is unavailable, the approach reverts to a non-precision approach system (if SSE, raise the gear and continue the approach if possible using non-precision procedures). If the localizer fails, the procedure is not authorized. Reference the ***AIGT Study Guide Chapter 2*** and ***NATOPS Ch. 20*** for complete and detailed discussions on the navigation/communication equipment procedures.

Transition to the ILS Localizer Course. This is performed by using either radar vectors or a published approach procedure.

a. **Localizer signal.** The localizer signal typically has a usable range of at least 18 miles within 10° of the course centerline unless otherwise stated on the IAP. ATC may clear you to intercept the localizer course beyond 18 miles or the published limit; however, this practice is only acceptable when your aircraft is in radar contact and ATC is sharing responsibility for course guidance.

b. **Back-up NAVAIDs.** When flying a localizer approach, it is always wise to tune up another NAVAID, if one is available, to help increase SA. For example, if there is a NDB/OM, select the ADF needle and keep watch as the head “falls” to your CDI course. When it is within 10 bearings, you know you are getting close. This will prevent you from missing the CDI course becoming “alive” and blowing through final.

c. **"LIDS" Check.** The CDI, TACAN, and/or VOR may still be necessary for navigation or position orientation (ILS, LOC, LDA, or LOC BC approaches) at the time the navigation instruments are setup during the Approach Checklist. For this reason, a good technique is to use the "LIDS" check before intercepting the localizer (for example: on base, on the arc, etc.) to ensure instruments are setup properly. **L**ocalizer. Tune the ILS localizer frequency and select the appropriate HSI select/annunciator switch as soon as practicable during the transition and monitor the identifier.

Inbound Course. Set the published localizer front course in the course selector window.

DME. Select DME-hold, as required.

Select PFD mode and select needles.

Accomplish the Approach

i. **Intercepting the Localizer.** Once the localizer course is intercepted, reduce heading corrections as the aircraft continues inbound. Heading changes made in increments of 5° or less will usually result in more precise course control. The approach must be discontinued if the localizer course becomes unreliable, or any time full-scale deflection of the CDI occurs on final approach.

ii. **Descent.** When on the localizer course, maintain glideslope intercept altitude (published or assigned) until intercepting the glideslope. Published glideslope intercept altitudes may be minimum, maximum, mandatory, or recommended altitudes and are identified by a lightning bolt (↯).

When on glideslope, cross-check the aircraft altitude with the published "Glideslope Altitude at OM/FAF" to ensure you are established on the correct glideslope. Do not descend below a descent restrictive altitude (minimum or mandatory) if the CDI indicates full-scale.

iii. **Glideslope Indicator (GSI).** Prepare to intercept the glideslope as the GSI moves downward from its upper limits. Configure the aircraft for landing, and call for the "Landing Checklist" when the GSI reaches a dot-and-a-half above center, or a half-dot when performing a single-engine ILS. Adjust pitch and power as required after configuration. Determine the approximate rate of descent to maintain the glideslope. The vertical speed required will be dependent upon the aircraft's groundspeed and the ILS glideslope angle, but will normally be 500-700 FPM. Slightly before the GSI reaches the center position, coordinate pitch, and power control adjustments to establish the desired rate of descent.

iv. **Pitch Adjustments.** Pitch adjustments made in increments of 2° or less will usually result in more precise glidepath control. As the approach progresses, smaller pitch and bank corrections are required for a given CDI/GSI deviation.

v. **Over Controlling.** During the latter part of the approach, pitch changes of 1° and heading corrections of 5° or less will prevent over controlling.

vi. **Steering Commands.** If using pitch and bank steering commands supplied by the flight director system, monitor flight path (CDI and GSI) and aircraft performance instruments to ensure the desired flight-path is being flown and aircraft performance is within acceptable limits. A common and dangerous error when flying an ILS on the flight director is to concentrate on the steering bars and ignore flight-path and aircraft performance instruments.

vii. **Cross-Check.** Maintain a complete instrument cross-check throughout the approach, with increased emphasis on the altimeter during the latter part (DA is determined by the barometric altimeter). An increased use of VSI is useful especially when flying precision approaches. If you keep the VSI where you want it, you will stay on/near the GS.

A good use of CRM would be to ask the PM to keep their eyes outside looking for approach lights/runway. The PF should keep their eyes inside on the instruments. See the Transition to Land section for more information.

viii. **Decision Height.** Do not descend below localizer minimums if the aircraft is more than one dot (half-scale) below or two dots (full-scale) above the glideslope. If the glideslope is recaptured to within the above tolerance, continue descent to DA/DH. At DA/DH, the decision must be made to either continue the approach or to execute a missed approach. If executing a missed approach, the aircraft will dip slightly below DA/DH while transitioning to a climb. If continuing for a landing, review the Landing Checklist complete before touchdown. See the Transition to Land section for more information.

NOTE

Use DA from the barometric altimeter as the primary decision reference. The DH light and the RADALT are useful crosscheck instruments and a valuable backup, but are secondary to the DA from the barometric altimeter.

WARNING

Flight director/ autopilot ILS approaches are flown in approach mode. The preselected altitude (DA) will not be honored when (GS) or (GP) is displayed in the vertical mode field.

IFR-in-VMC Approaches. Military flights are generally conducted under IFR, yet we often fly in VMC. IFR-in-VMC approaches allow us to take advantage of this and proceed visually, thereby reducing pilot/controller workload. A visual approach is conducted on an IFR flight plan and authorizes the pilot to proceed to the airport visually. Operationally, visual approaches are often the most common approaches, especially in good weather. Contact approaches initially seem similar to visual approaches, but are subject to much different requirements, and are far more rare.

a. **Visual Approach.** Visual approaches reduce pilot/controller workload and expedite traffic by shortening flight paths to the airport. A visual approach is conducted on an IFR flight plan and authorizes the pilot to proceed visually and clear of clouds to the airport. The pilot must have either the airport or the preceding identified aircraft in sight, and the approach must be authorized and controlled by the appropriate ATC facility. Always backup a visual approach with available NAVAIDs. There have been numerous cases of aircraft, including major airlines, landing at the wrong airfield on a visual approach, especially at night. Refer to ***AIM 5-4-22*** for information on visual approaches.

i. **Conditions Required to Conduct Visual Approaches.** To fly a visual approach, several conditions must be met:

(a). The reported weather at the airport: ceiling at or above 1000 feet and visibility three miles or greater.

(b). ATC will authorize visual approaches when it will be operationally beneficial.

(c). Visual approaches are IFR procedures conducted under IFR in VMC with one exception – normal VMC cloud clearance requirements are not applicable. Pilots must be able to proceed visually while remaining clear of clouds.

(d). ATC will not issue clearance for a visual approach until the pilot has the airport or the preceding aircraft in sight. If the pilot has the airport in sight but cannot see the preceding aircraft, ATC may still clear the aircraft for a visual approach; however, ATC retains both aircraft separation and wake separation responsibility. When visually following a preceding aircraft, acceptance of the visual approach clearance constitutes acceptance of pilot responsibility for maintaining a safe approach interval and adequate wake turbulence separation. Notify the controller if you do not see the preceding aircraft or are unable to maintain visual contact with it.

ii. **A Visual Approach is an IFR Approach.** Although you are cleared for a “visual” approach, you are still operating under IFR. Do not cancel your IFR clearance when cleared for a visual approach. Be aware radar service is automatically terminated (without advising the pilot) when the pilot is instructed to change to advisory frequency.

iii. **What ATC Expects You to Do When Cleared for a Visual Approach.** After being cleared for a visual approach, ATC expects you to proceed visually and clear of clouds to the airport in the most direct and safe manner to establish the aircraft on a normal straight-in final approach. Airspeed and configuration point is at pilot's discretion. Complete the Landing Checklist no later than one mile from the runway. Clearance for a visual approach does not authorize you to do an overhead/VFR traffic pattern.

iv. **Visual Approaches Have No Missed Approach Segment.** A visual approach is not an instrument approach procedure and therefore does not have a missed approach segment. If a go-around is necessary for any reason, aircraft operating at controlled airports will be issued an appropriate advisory, clearance, or instruction by the Tower. At uncontrolled airports, aircraft are expected to remain clear of clouds and complete a landing as soon as possible. If a landing cannot be accomplished, the aircraft is expected to remain clear of clouds and contact ATC as soon as possible for further clearance (separation from other IFR aircraft will be maintained under these circumstances).

b. **Contact Approach.** Refer to ***AIM 5-4-24*** for information on contact approaches. A contact approach is one where an aircraft on an IFR fight plan, operating clear of clouds with at least one mile flight visibility and having an ATC authorization, may deviate from the instrument approach procedure and proceed to the airport of destination by visual reference to the ground. This approach will only be authorized when requested by the pilot and the reported ground visibility at the destination is at least 1 SM.

NOTE

Being cleared for a visual or contact approach does not authorize the pilot to fly a 360° overhead traffic pattern. An aircraft conducting an overhead maneuver is VFR and the IFR flight plan is canceled when the aircraft reaches the "initial point." Aircraft operating at an airport without a functioning control Tower must initiate cancellation of the IFR flight plan before executing the overhead maneuver or after landing.

IAP with Published Visual Segment. In isolated cases (due to procedure design peculiarities) an IAP procedure may contain a published visual segment. The words "fly visual to airport" will appear in the profile view of the IAP. The depicted ground track associated with the visual segment should be flown as "DR" course. When executing the visual segment, remain clear of clouds and proceed to the airport maintaining visual contact with the ground. An example of this type of approach is the "VOR/DME" or "GPS-A" at South Lake Tahoe, California.

Missed Approach Point. Since missed approach obstacle clearance is assured only if the missed approach is commenced at the published MAP at or above the MDA, the pilot should have preplanned climb-out options based on aircraft performance and terrain features.

CAUTION

Obstacle clearance becomes the aircrew's sole responsibility when the approach is continued beyond the MAP.

Charted Visual Flight Procedures (CVFPs). A published visual approach where an aircraft on an IFR flight plan, operating in VMC when authorized by ATC, may proceed to the destination airport under VFR via the route depicted on the Charted Visual Flight Procedure (CVFP). When informed CVFPs are in use, the pilot must advise the arrival controller on initial contact if unable to accept the CVFP. An example of a CVFP is the "HOTEL VISUAL RWY 29" at North Island NAS in San Diego.

a. **Characteristics.** CVFPs are established for noise abatement purposes to a specific runway equipped with a visual or electronic vertical guidance system. These procedures are used only in a radar environment at airports with an operating control Tower. The CVFPs depict prominent landmarks, courses, and altitudes, and most depict some NAVAID information for supplemental navigational guidance only.

b. **Altitudes.** Unless indicating a Class B airspace floor, all depicted altitudes are for noise abatement purposes and are recommended only. Pilots are not prohibited from flying other than recommended altitudes if operational requirements dictate. Weather minimums for CVFPs provide VFR cloud clearance at minimum vectoring altitudes. Therefore, clearance for a CVFP is possible at MVA, which may be below the depicted altitudes.

c. **Clearance.** CVFPs usually begin within 20 miles from the airport. When landmarks used for navigation are not visible at night, the approach will be annotated "PROCEDURE NOT AUTHORIZED AT NIGHT." ATC will clear aircraft for a CVFP after the pilot reports sighting a charted landmark or a preceding aircraft. If instructed to follow a preceding aircraft, pilots are responsible for maintaining a safe approach interval and wake turbulence separation. Pilots should advise ATC if at any point they are unable to continue an approach or lose sight of a preceding aircraft.

d. **Climb-Outs.** CVFPs are not instrument approaches and do not have missed approach segments. Missed approaches are handled as a go-around (IAW FLIP and GP). The pilot should have preplanned climbout options based on aircraft performance and terrain features.

Student Tendencies

Improper configuration procedures (e.g., not retracting the gear with an engine loss inside the FAF on a non-precision approach).

a. Forgetting to request a "10 second gear warning" on SSE PAR or unnecessarily requesting a gear warning on a no-gyro radar approach

b. Chasing a calculated VSI and not using the control instruments to establish a rate of descent

c. Over-controlling course and/or glidepath on final

d. Slow to initiate descent to MDA and/or not getting down to the MDA before the VDP, making a safe landing transition impossible. This usually results from not reviewing the IAP to determine the descent rate required on a non-precision approach

e. Descending below MDA or through step-down altitudes

Transition to Land. The transition from instrument to visual flight conditions varies with each approach. Pilots seldom experience a distinct transition from instrument to visual conditions during an approach in obscured weather. Obscured conditions present you with a number of problems not encountered during an approach that is either hooded or has a cloud-base ceiling. At the point where the hood is pulled or the aircraft breaks out below the ceiling, the visual cues used to control the aircraft are usually clear and distinct and there is instantaneous recognition of the position of the aircraft in relation to the runway. With obscured ceilings or partially obscured conditions, the reverse is usually true; visual cues are indistinct and easily lost and it is difficult to discern aircraft position laterally and vertically in relation to the runway. The keys to making the transition smooth and precise are preparation and understanding.

a. **Approach Lighting Systems.** The approach lighting systems now in use, along with their standard lengths, appear in the FIH. Each IAP chart indicates the type of approach lighting system by a circled letter on the airport sketch. Actual length is shown on the airport diagram for any system, or portion thereof that is not of standard length. The IFR Supplement indicates availability of airfield, runway, approach, sequenced flashing, runway end identification lights, runway centerline lights, and visual glideslope indicators such as VASI, PAPI or OLS. Be familiar with the types of lighting installed on the landing runway. This means knowing more than just the type of lighting system installed. A picture of what the lighting system looks like should be firmly implanted in your mind. When viewing only a part of the lighting system, you should be able to determine aircraft position relative to the runway.

b. **No Vertical Guidance.** Instrument approach lights do not provide the pilot adequate vertical guidance during low visibility instrument approaches. Studies have shown the sudden appearance of runway lights when the aircraft is at or near minimums in conditions of limited visibility often give the pilot the illusion of being high. They have also shown that when the approach lights become visible, pilots tend to abandon the established glidepath, ignore their flight instruments, and instead rely on the poor visual cues.

c. **Cross-Check.** A recommended method to ensure against a dangerously high rate of descent and a short or hard landing is to maintain a continuous cross-check of the GSI or flight director and pay continuous attention to PAR controller instructions as well as VSI and ADI indications. A stabilized rate of descent is key to a successful approach and final approach segment after the runway and/or approach lights have come into view. Once the approach becomes unstable inside of the FAF or during the transition to land, consideration should be given to performing a waveoff and missed approach in the interest of aircraft and aircrew safety.

d. **CRM.** CRM in the final phase of the approach is extremely important. (See CRM callouts.) It is key that the PF keep their eyes on the instruments and not worry about looking outside for the airport. Let the PM worry about that. Once the PM sees the Approach Lights, Airport, or Runway, they will let you know.

With the Airport/Runway in Sight – The PF is free to start transitioning to a combined visual/instrument cross-check and proceed to the runway and land.

e. **Visual Transition.** Knowing visual cues can be extremely erroneous; the pilot must continue to cross-check instruments and listen to the PAR controller's advisories even after runway and/or approach lights have come into view. Most pilots find it extremely difficult to continue to crosscheck their flight instruments once the transition to the visual segment has been made, as their natural tendency is to believe the accuracy of what they are seeing, or they continue to look outside in an effort to gain more visual cues.

To successfully continue reference to VSI and/or GSI when approach lights come into view, a scan for outside references should be incorporated into the cross-check at an early stage of the approach, even though restrictions to visibility may preclude the pilot from seeing any visual cues. If such a scan is developed into the cross-check, it will facilitate the recheck of flight instruments for reassurances of glidepath.

NOTES

1. Once the decision to land has been made, you have a few options, depending on conditions such as weather, runway length, etc.

2. (Non-Precision) Fly a normal glidepath (VASI or PAPI assisted, if available) to the 1000' runway aim-point markings. This is the favored method of proceeding to land. A Constant Descent Final Approach (CDFA) from the FAF to landing is the safest manner to execute a transition from instrument flight to landing. The use of a VDP and calculating a descent rate from the FAF to the VDP is recommended.

3. (Non-Precision) Take over visually and aim for the first 500'. This should only be done if the ability to stop the aircraft on the runway's available length is questionable (i.e. for a runway of minimum length, 4,000 ft). Keep in mind that aiming for the first 500 feet will likely require a lower pitch angle, thus increasing descent rate close to the ground.

4. (Precision) Continue on the ILS glideslope while bringing in outside references (use VASI or PAPI to assist you). Keep your aim down the runway to the 1000' runway aim-point markings.

Straight-in Minimums: Are shown in the IAP when the final approach course is within 30 degrees of the runway alignment (15 degrees for GPS IAP's) and a normal descent can be made from the IFR altitude shown on the IAP to the runway surface. When either the normal rate of descent or the runway alignment factor of 30 degrees (15 degrees for GPS IAP's) is exceeded, a straight-in minimum is not published and a circling minimum applies. The fact that a straight-in minimum is not published does not preclude pilots from landing straight-in if they have the active runway in sight and have sufficient time to make a normal approach for landing. Under such conditions and when ATC has cleared them for landing on that runway, pilots are not expected to circle even though only circling minimums are published. If they desire to circle, they should advise ATC.

Side-step Maneuver Procedures: ***Where a side-step procedure is published***, aircraft may make an instrument approach to a runway or airport and then visually maneuver to land on an alternate runway specified in the procedure. Landing minimums to the adjacent runway will be higher than the minimums to the primary runway, but will normally be lower than the published circling minimums. Examples of ATC phraseology used to clear aircraft for these procedures are: *"Cleared for ILS runway seven left approach. Side-step to runway seven right."*

a. **Begin Side-step.** Pilots will not begin the side-step maneuver until past the FAF with the side-step runway or side-step runway environment in sight. The side-step MDA will be maintained until reaching the point at which a normal descent to land on the side-step runway can be started.

b. **Lose Visual.** As in a circling approach, if you lose visual reference during the maneuver, follow the missed approach specified for the approach procedure just flown, unless otherwise directed. An initial climbing turn toward the landing runway will ensure the aircraft remains within the obstruction clearance area.

Circling. General Procedures. Circling to land is a visual flight maneuver. When the instrument approach is completed, it is used to align the aircraft with the landing runway. Circle at: 120 KIAS during normal and single engine situations. Circling may require maneuvers at low altitude, at low airspeed, and in marginal weather conditions. Pilots must use sound judgment, have an in-depth knowledge of their capabilities, and fully understand the aircraft performance to determine the exact circling maneuver. Each landing situation is different because of the following variables:

a. Ceiling

b. Visibility

c. Wind direction and velocity

d. Obstructions

e. Final approach course alignment

f. Aircraft performance

g. Cockpit visibility

h. Controller instructions

The circling MDA and weather minima used are those for the runway to which the instrument approach is flown. The circling minima listed on IAPs apply to non-radar non-precision approaches (LOC, VOR, TACAN, etc.). Circling procedures and techniques are not compatible with precision approach criteria, and under normal circumstances should not be attempted.

a. **Instructions.** If the controller has a requirement to specify the direction of the circling maneuver in relation to the airport or runway, the controller will issue instructions in the following manner: *"Circle (direction given as one of eight cardinal compass points) of the airport/runway for a right/left base/downwind to runway (number)."* For example, *"Circle west of the airport for a right base to runway one eight."* The pilot should report *"commencing circle"* when initiating any circling maneuver.

NOTE

Circling obstruction clearance areas (which provide required obstacle clearance of 300 feet) are determined by aircraft category; the T-44 is a Category B aircraft. Maneuver the aircraft to remain within the circling area (Figure 4-30). If it is necessary to maneuver at speeds in excess of the upper limit of the speed range authorized for your Category (B = 91-120), use the next higher landing category. When you request circling MDA from the controller for a circling ASR approach, state your aircraft category.

Additional consideration is required when operating at high altitudes or with strong tail winds. Effects of TAS on radius of turn must be considered. Protected airspace for circling is based only on ground-speed; therefore, at higher altitudes or with strong tailwinds, your aircraft could be outside protected airspace. The next approach category should be considered.

b. **Descent.** After descending to circling MDA and when the airport environment is in sight, determine if the ceiling and visibility are sufficient for performing the circling maneuver. The airport environment is considered the runways, its lights and markings, taxiways, hangars, and other buildings associated with the airport. Since the MDA is a minimum altitude, a higher altitude may be maintained throughout the maneuver, should you break out of the clouds early.

c. **Pattern.** Choose the best pattern for the situation. Consider VFR or other flying may be in progress at the airport. Maneuver the shortest path to the base or downwind leg, as appropriate, considering existing weather conditions. There is no restriction from passing over the airport or other runways. Maneuver the aircraft to a position allowing you to keep as much of the airport environment in sight as possible. Consider making your turn to final into the wind if this maneuvering allows you to also keep the airport environment in sight. You may make either left or right turns to final unless:

i. Directed by the controlling agency to do otherwise.

ii. Required to do otherwise by restrictions on the approach chart or IFR/VFR Supplement.

iii. Other aircraft are already in the pattern. Do what they do.

d. **Weather – High Ceiling/Good Visibility.** If weather permits, fly the circling approach at an altitude higher than the circling MDA, up to normal VFR traffic pattern altitude. This allows the maneuver to be flown with a more familiar perspective and better visual cues. Do not descend below circling MDA or reduce airspeed below 120 KIAS until in a position to place the aircraft on a normal glidepath to the landing runway. (In order to prepare students for the worst situation, fly practice circling approaches at the circling MDA if feasible and conditions permit.)

e. **Weather – Low Ceiling/Restricted Visibility.** If weather does not permit circling above the MDA, do not descend below circling MDA or reduce airspeed below 120 KIAS until in a position to place the aircraft on a normal glidepath to the landing runway (sometimes called the "VFR pattern checkpoint").

f. **Missed Approach.** If you lose visual reference while circling to land or there is any doubt whether the aircraft can be safely maneuvered to touchdown, execute the missed approach.

CAUTION

Be aware of the common tendency to maneuver too close to the runway at altitudes lower than your normal VFR pattern altitude. This is caused by using the same visual cues you use from normal

VFR pattern altitudes. Select a pattern that displaces you far enough from the runway allowing you to turn to final without over-banking or over-shooting final.

Student Tendencies

a. Flying a "duck-under" maneuver when transitioning to land, not maintaining a normal glidepath to the Runway Point of Intersection (RPI) by using visual glideslope indicators

b. Weak cross-check of airspeed and altitude while concentrating on visual cues outside aircraft during a circling maneuver

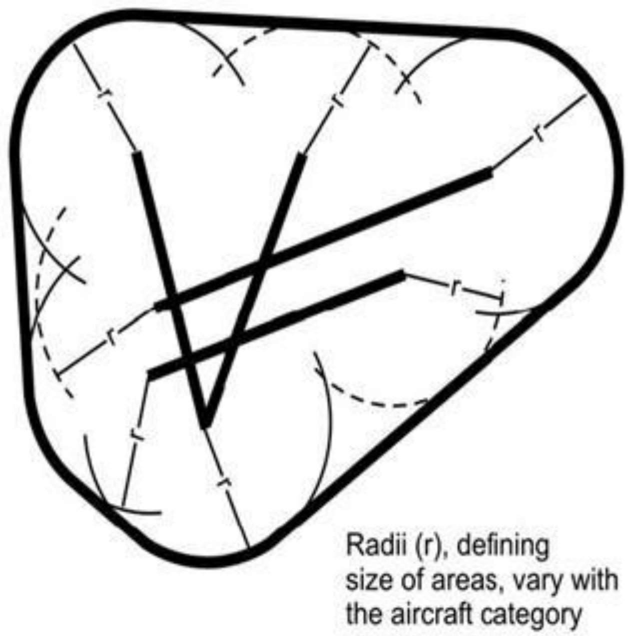
c. Starting circling maneuver early, turning from final approach course before inside the circling obstacle clearance area

d. After leveling off at circling MDA, allowing the aircraft to climb back into the "simulated weather" while maneuvering to land, resulting in an instructor directed missed approach

e. Overshooting turn to final during a circling maneuver

f. Not utilizing the PM

AIRCRAFT CATEGORY	OBSTRUCTION CLEARANCE RADIUS
A	1.3 NM
B	1.5 NM
C	1.7 NM
D	2.3 NM
E	4.5 NM



STANDARD CIRCLING APPROACH MANEUVERING RADIUS

Circling approach protected areas developed prior to late 2012 used the radius distances shown in the following table, expressed in nautical miles (NM), dependent on aircraft approach category. The approaches using standard circling approach areas can be identified by the absence of the C symbol on the circling line of minima.

Circling MDA in feet MSL	Approach Category and Circling Radius (NM)				
	CAT A	CAT B	CAT C	CAT D	CAT E
All Altitudes	1.3	1.5	1.7	2.3	4.5

C EXPANDED CIRCLING APPROACH MANEUVERING AIRSPACE RADIUS

Circling approach protected areas developed after late 2012 use the radius distance shown in the following table, expresse in nautical miles (NM), dependent on aircraft approach category, and the altitude of the circling MDA, which accounts for true airspeed increase with altitude. The approaches using expanded circling approach areas can be identified by the presence of the C symbol on the circling line of minima.

Circling MDA in feet MSL	Approach Category and Circling Radius (NM)				
	CAT A	CAT B	CAT C	CAT D	CAT E
1000 or less	1.3	1.7	2.7	3.6	4.5
1001-3000	1.3	1.8	2.8	3.7	4.6
3001-5000	1.3	1.8	2.9	3.8	4.8
5001-7000	1.3	1.9	3.0	4.0	5.0
7001-9000	1.4	2.0	3.2	4.2	5.3
9001 and above	1.4	2.1	3.3	4.4	5.5

Figure 4-29 Circling Obstruction Clearance Area

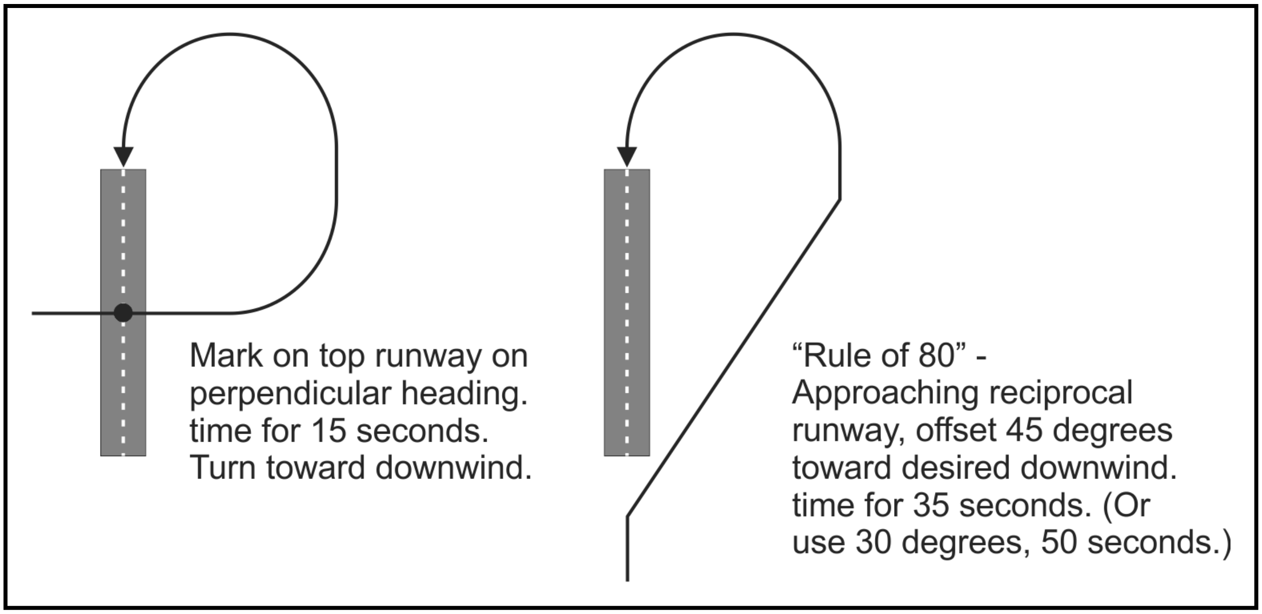


Figure 4-30 Example Circling Techniques

Missed Approach. Performing a missed approach successfully is the result of thorough planning. You should familiarize yourself with the missed approach instructions during preflight planning. The missed approach instruction is designed to return the aircraft to an altitude providing enroute obstruction clearance. In some cases, the aircraft may be returned to the initial segment of the approach. The pilot should tell the controller how the approach will terminate prior to beginning the approach. A clearance for an approach includes clearance for the missed approach published on the IAP, unless ATC issues verbal missed approach instructions.

a. **Non-Precision.** The MAP for a non-precision straight-in approach is located along the final approach course and no farther from the FAF than the runway threshold (or over an on-airport navigation facility for a no-FAF procedure and some selected FAF procedures). To determine the location of the MAP, compare the distance from the FAF to the MAP adjacent to the timing block. It may not be the same point as depicted in the profile view. If there is not a timing block, the MAP should be clearly portrayed on the IAP.

NOTES

1. The MAP depicted on the IAP is for the non-radar approach with the lowest Height Above Touchdown (HAT). For example, on an ILS approach designed by the FAA, the MAP printed will be for the ILS DA/DH. The MAP for the localizer will probably be at the approach end of the runway and the only way to determine this is by the distance listed on the timing block.

2. The middle marker may never be used as the sole means of identifying the MAP, so if the MM is the only way to identify the

MAP, (timing not published), then the approach is not authorized. The MM may assist you in identifying the MAP on certain localizer approaches provided it is coincident with the published localizer MAP. To determine the location of the MAP, compare the distance from the FAF to MAP adjacent to the timing block. It may not be the same point as depicted in the profile view.

3. If DME is available, you should use DME to identify the MAP. If; however, timing and the MM are the only means available, you should use both. Whichever you reach first, (end of timing or MM) should be where you start your Missed Approach Procedure. The point is to go missed approach at the physical spot on the earth where the MAP is. If you have reached the MM but not your timing yet, you should go missed.

b. **Precision.** The MAP for any precision approach is the point at which the decision altitude/height is reached. This is normally the point depicted on the IAP as the start of a climbing dashed line.

NOTES

1. ILS missed approaches are intended to be executed at the decision altitude/height (DA/DH) with the assumption that the aircraft will descend slightly below the DA/DH. It is procedurally incorrect and unnecessary to execute a missed approach prior to the DA/DH to avoid dropping below it.

2. Stabilized non-precision approaches simulate a constant glideslope down to MDA. Pilots should not confuse these with precision approaches as no additional tolerance is given to “dip below” the MDA.

c. **Obstacle Clearance.** The obstacle clearance area provided for the missed approach is predicated upon the missed approach being started at the MAP. A standard climb gradient of 200 ft/NM is required unless a higher climb gradient is published on the IAP. Keep in mind that beginning the missed approach instruction from other than the MAP will not guarantee obstacle clearance.

d. **Initiation.** When the missed approach is initiated prior to the MAP, proceed along the final approach course to the MAP at or above the MDA or DA/DH before executing a turning maneuver and then proceed via the route and altitudes specified in the published missed approach.

e. **Important Guidelines.** If you have been cleared to land (full stop), it is important to remember ATC expects you to land; therefore, if you have been cleared to land and must subsequently execute a missed approach, notify ATC as soon as possible and execute the published missed approach unless you have been issued verbal missed approach/departure instructions.

f. **ATC Radar Vectors.** ATC radar vectors (heading and altitude) issued during the initiation of the missed approach take precedence over the published or verbally issued missed approach instructions.

Missed Approach Instructions

a. **Multiple Approaches.** The controller is required to issue, before the FAF, appropriate departure instructions to be followed upon completion of approaches that are not to full-stop landings. The pilot should tell the controller how the approach will terminate before beginning the approach. If you plan to shoot multiple approaches, ATC may give you instructions in lieu of the published missed approach procedure.

b. **Climb-out Instructions.** The controller will state, *"After completion of your low approach/touch-and-go/stop-and-go/option, climb and maintain (altitude), turn left/right heading (degrees)."* These instructions are verbally issued missed approach/departure instructions (often referred to as "climb-out instructions"). They supersede published missed approach/departure instructions and constitute an ATC clearance. Delay any turns until past the departure end of the runway if it is visible, and at least 400 feet above field elevation. If the departure end is not visible, climb on runway heading until 400 feet above field elevation before beginning your turn. ATC may direct a turn at another point.

NOTE

During a practice missed approach in VMC or low approach at NGP, follow the warning in the IFR departure section of course rules that states: "If departing and upwind traffic is staying in the pattern and has not been cleared downwind, a dangerous overtaking situation can develop. Maintain appropriate airspeed to avoid overtaking the traffic ahead. Accelerate to 150 KIAS once traffic ahead has cleared. Overfly the runway no higher than 500 feet, until over the departure end. At the departure end commence a climb to assigned altitude and switch to departure frequency.

c. **In-Flight Guide.** In the local area, Corpus approach will normally issue coded climb-out instructions, which can be found in the FAA/CTW-4 LOA printed in the "Blue Brains." Students may have the instructor or observer read aloud the specifics of the clearance. Students should develop a reliable system (notes, heading bug/PSA, etc.) for remembering the climb-out instructions, since they are expected to be able to fly all clearances without instructor intervention.

d. **Published missed approach instructions**. You may be given guidance from ATC upon completion of the approach to fly the published missed approach procedure. This happens at many of the uncontrolled fields you will fly into in the local training area. When given this and you descend out of the MDA or do a touch and go the procedure has now become a departure and should be flown as such. Unless a Trouble T restriction for that runway states otherwise a plan to perform a diverse departure turn at 400’ AGL in the shortest direction to meet the intent the published MAP.

e. **Circling Approaches.** Executing the verbally issued climb-out instructions in conjunction with a circling approach is more complicated. If upon reaching the MAP the airport environment is not in sight, execute the verbally issued climb-out instructions from the MAP. If the circling maneuver has begun and the airport environment is visually lost, begin an initial climbing turn toward the landing runway to ensure the aircraft remains within the circling obstruction clearance area. Continue the turn until established on the verbally issued climb-out instructions. See “Circling Missed Approach” below.

f**.** **When to do the Missed Approach.** Perform the missed approach when the MAP or DA/DH is reached and any of the three following conditions exists:

i. The runway environment is not in sight.

ii. You are unable to make a safe landing.

iii. You are directed by the controlling agency.

NOTE

Simulated weather is at the discretion of the instructor; students shall execute a missed approach if arriving at the MAP or DA/DH and the instructor has not called the *“field in sight.”*

g. **Fly the Aircraft.** When you decide to execute the missed approach, transition from the approach to the missed approach in a positive manner using precise attitude and power control changes. Wave off using the appropriate NATOPS procedures. Advance power as required and establish a climb with the missed approach attitude of 7 to 10 degree pitch. Accelerate to normal climb airspeed. When assured you will not touch down, retract the gear; and raise the flaps. Complete the Climb Checklist. Since aircraft control may require almost total attention, you should have the first heading, course, and altitude in mind before reaching the MAP.

h. **Climb Gradient.** Ensure your aircraft can achieve the published climb gradient. When the gradient is not published, a climb of at least 200 ft/NM is required.

i. **Request clearance.** As soon as practical after initiating the missed approach, advise ATC (include the reason for missed approach) and request clearance for specific action, that is, to an alternate airport, another approach, or holding. Do not sacrifice aircraft control for the sake of a voice transmission.

j. **Obstacle Clearance.** Terrain clearance is provided within established boundaries of the approach course and the missed approach path. It is essential you follow the procedure depicted on the IAP chart or the instructions issued by the controller. Be aware of the minimum safe altitudes found on the IAP charts. Remember, the missed approach climb gradient begins at the published MAP.

k. **Circling Missed Approach.** Refer to ***AIM 5-4-21(c)*** for circling missed approach instructions. If you lose visual reference while circling to land, follow the missed approach specified for the approach procedure just flown, unless otherwise directed.

i. **Initial Climb.** Make an initial climbing turn toward the landing runway to ensure the aircraft remains within the circling obstruction clearance area.

ii. **Comply With Instructions.** Continue to turn until established on the missed approach course. Again, an immediate climb must be initiated to ensure climb gradient requirements are met. (Another way to say it is after the initial turn toward the landing runway, get on the dotted missed approach line.)

NOTE

In as much as the circling maneuver may be accomplished in more than one direction, different patterns will be required to become established on the prescribed missed approach course, depending on the aircraft position at the time visual reference is lost. Situational awareness of the position of the aircraft in relation to the runway environment and the missed approach course should be maintained throughout the circling maneuver.

iii. **Obstacle Clearance.** Adherence to the above procedure will assure the aircraft remains within the circling obstruction clearance area until established on the missed approach course and within the established missed approach obstruction clearance area. Remember, the climb gradient, which ensures obstacle clearance on the missed approach path, begins at the published MAP.

iv. **Missed Approach Course.** The missed approach course is always the dotted line on the IAP. If, for example, the dotted line shows a turn to the South, before proceeding to the MAP North of the field, you must get "established" on that course first (e.g., make your initial turn towards the landing runway, then a turn to the South to get on the dotted line).

Wherever practical, the IAP designer constructs the missed approach course as a continuation of the final approach course. Often; however, a turning missed approach course is required, or if a straight climb to a specific altitude followed by a turn is necessary to avoid obstacles, a combination straight and turning missed approach area may be constructed. Read the missed approach instructions carefully and observe the dashed line depiction ("worm tracks") of the missed approach course in the plan view on the IAP.

A good technique is to put your heading bug on the general direction of the dotted line (in this case, East). Once you make the initial climbing turn towards the landing runway, all you then need to do is turn to your "bug."

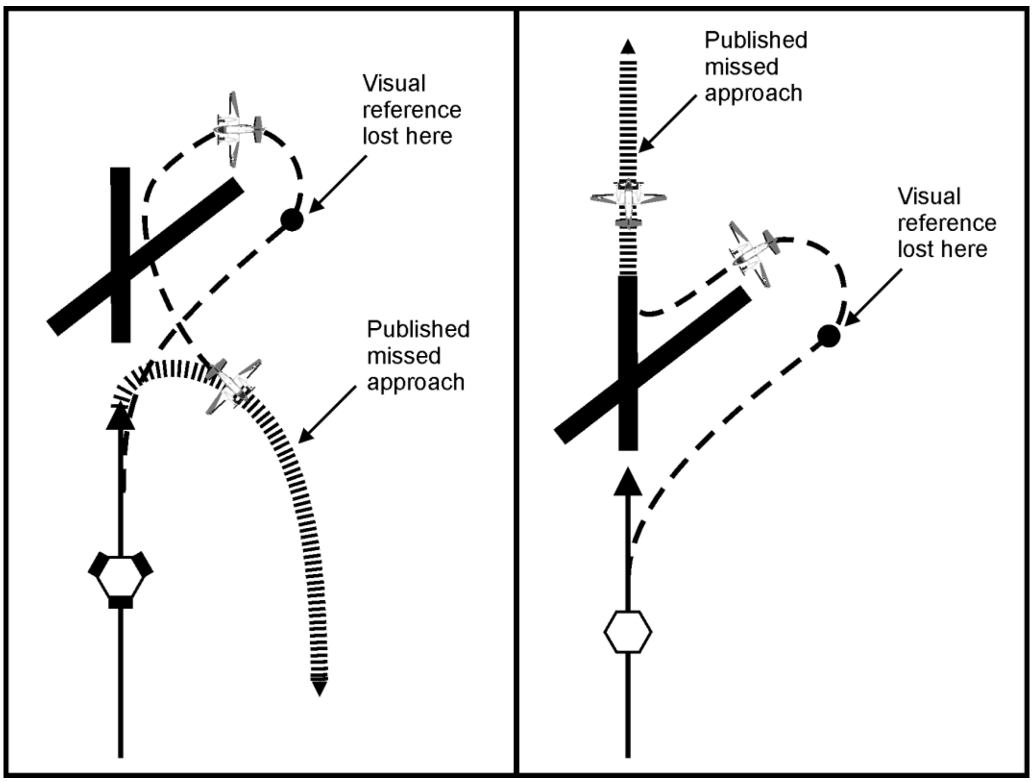


Figure 4-31 Missed Approach from the Circling Approach

Student Tendencies

a. Not executing missed approach at DA/DH or MAP when the instructor has not called the *"field in sight."*

b. Not writing down or remembering climb-out instructions and having to ask instructor for them.

c. When executing climb-out instructions, not delaying initial turn until past the departure end of the runway and at least 400 feet (you may; however, turn early if directed by ATC).

d. On a circling missed approach, after making an initial climbing turn toward the landing runway, rolling out on runway heading instead of continuing to turn until established on the missed approach course.

412. EMERGENCY PROCEDURES

Throughout the Instrument Stage, you will frequently have the opportunity to demonstrate your knowledge of emergency procedures. Malfunctions encountered in IMC conditions require strict compliance with NATOPS and efficient crew coordination. You must devote your attention primarily to flying the aircraft while simultaneously executing and directing corrective action. The SSE scenarios have a more realistic timeline than most Contact Stage scenarios (which are normally compressed into a pattern circuit to maximize training). When the instructor gives any simulated malfunction: maintain aircraft control, analyze the situation, and take the appropriate actions. After executing any memory items, call for the appropriate checklist as soon as practicable. Make decisions about how the planned course of action may have to change in response to the situation. Prioritize and delegate tasks as necessary.

As in the Contact Stage, power, rudder, and configuration consideration must be given during all simulated single engine scenarios. After shutdown of an engine, determine if an airstart should be attempted or if the engine should be “pre-loaded” for a Starter Assisted Airstart should a greater emergency present itself.

1. **Single Engine Approaches.** After engine failure, determine if an airstart should be attempted or if the engine should be shut down and then “pre-loaded” for a starter-assisted airstart. The MOVEOFF acronym from contact should provide guidance for when to “pre-load” the airstart. When simulating an emergency requiring engine shutdown, it is good technique to check for secondary indications before and after memory item execution.

a. **Engine Failure on Climb-out.** Add power as required, clean up, and perform the Emergency Engine Shutdown Checklist. Maintain V_{XSE}/V_{YSE} in the climb, or airspeed and power combination that allows the aircraft to climb at the minimum climb gradient until desired altitude is attained. Remain VMC if possible, declare an emergency, and state your intentions. If IMC, request a suitable approach for existing weather. Recommend a PAR or ILS due to the precision glideslope. Provide souls on board, fuel remaining (time), and the nature of the emergency, when time permits.

b. **Engine Failure Enroute.** Perform the Emergency Engine Shutdown Checklist, declare an emergency, and land as soon as possible. Be alert to increases in cabin altitude and MEA requirements. Use charts and the IFR Supplement to help determine suitable divert fields. Use the DRAFT technique from the AIGT study guide to quickly give your intentions to ATC.

2. **SSE Approach Configuration Procedures.** When executing a single engine or SSE approach, maintain a clean configuration and 150 KIAS if possible, 130-150 KIAS allowable for the initial and intermediate segments of the approach until the normal configuration point. Configuration procedures depend on the type of approach being flown. Any approach to a circle or sidestep will use non-precision approach configuration procedures.

a. **Single-Engine VDA or Precision or Precision Approach.**

Once established on final and approaching the configuration point, lower the flaps and gear and complete the Landing Checklist; there should not be difficulty in maintaining 120 KIAS with gear down and flaps at approach, when in the descent. Begin descent with sufficient power on the available engine to maintain glidepath and airspeed; a strong crosscheck and appropriate controls will ensure that the aircraft doesn't get low or slow.

NOTE

If at any time you are unable to maintain glidepath or airspeed, or MDA on VDP if arriving early you should retract the gear or clean up completely to eliminate drag. After re-establishing glidepath and airspeed, reconfigure and complete the Landing Checklist again.

b. **Single-Engine Non-Precision Approach.** If flying a single-engine or SSE non-precision approach (not utilizing the VDA method):

NOTE

IAW with **Figure 4-32 SSE Configuration Procedures** the PF may utilize flaps to approach once inside the non-precision normal configuration point. Utilizing flaps at approach at or inside the FAF will allow the PF to better maintain 120 KIAS while increasing their descent rate/VSI to aid in descending to MDA at or prior to the VDP/MAP. With flaps at approach and the gear up the aircrew will have enough power to execute momentary level offs and execute circling maneuvers, however the aircrew may bring the flaps back up anytime better performance is needed to execute a procedure or maneuver. Utilization of full flaps should not normally be used and are only to be used if gear is down and locked. If full flaps are used during a single engine approach, the waveoff procedure will result in a loss of approximately 200 feet before a positive rate of climb can be established.

Slow to 120 KIAS any time after the normal configuration point, but before the FAF. The gear should be left in the "up" position, and flaps may be brought to approach or left up as required IAW figure 4-33. During warmer months it may be impossible to maintain level flight and 120 KIAS with the gear down. Keep sufficient power on the available engine to maintain airspeed and the desired descent rate inbound from the FAF.

Because less power is available when single engine, it may be desirable to use a slightly higher lead than normal when leveling off at the MDA. Maintain 120 KIAS upon reaching the MDA; a strong crosscheck and appropriate control inputs will ensure the aircraft does not get low or slow. Do not lower the gear and complete the Landing Checklist until the runway environment is in sight and you are in a safe position to descend from the MDA for the landing. Maintain a minimum of 110 KIAS until over the threshold. If an engine failure is experienced in the dirty configuration, retract the gear up immediately, retraction of flaps is at discretion of aircrew, and comply with the above procedures unless landing is assured.

NOTES

1. During SSE training, ensure the gear is down no later than the 90° position or one mile from the threshold.

2. For actual single-engine approaches in good visibility, utilizing VASI or other optical system is desirable to maintain a "normal" 3° glideslope. In this situation, the approach may be considered to be precision for configuration purposes.

3. A common student mistake on SE approaches is to rush the procedure and devote total attention to shutting down the engine. If you do this, you will most likely lose track of where you are on the approach. You aren't in Contacts anymore! You now usually have ***much*** more time to handle the EP than you did on downwind. ***Slow down*** and keep your SA on the approach.

4. During a SSE approach, use of rudder trim is not recommended. In all SSE cases, rudder trim shall be centered by FAF on an instrument approach.

	ILS	NON-PRECISION	RADAR APPROACH PAR	RADAR APPROACH ASR	LNAV/VNAV, VDA APPROACH
SSE (also see Emergency Procedures)	½ dot below glideslope at glideslope intercept altitude	Flaps as required at or inside normal configuration point. Gear down when in safe position to land	10 Sec gear warning	(1) 10 sec gear warning, when using recommended altitudes. (2) Flaps as required on Base or Dog-leg to final, Gear down when in safe position to land, when using Dive and Drive.	(1) ½ dot below GP at appropriate intercept altitude or approaching FAF (2) Safe position to land

Figure 4-32 SSE Configuration Procedures

NOTES

1. On a SE non-precision approach using the Dive and Drive method, lower the gear with field in sight and intercepting a normal landing glidepath.

2. For a SE circling approach, lower the gear when the aircraft is on a normal glidepath to the landing runway. This is not always the “180.” Generally, at MDA, you will be lower than the VFR pattern altitude of 800' AGL, so you must wait until you are at the proper position. 650’ AGL circling altitude would correlate to the “135” position. In all cases the landing checklist must be complete by the “90.”

3. On a SE ASR, you may configure with a 10 sec gear warning if you are going to use recommended altitudes and descend on a stable glidepath. If you get well below those altitudes; however, you must clean up the gear until in a safe position to land. When utilizing the 10 sec method a good technique is to maintain 150 KIAS until you hear the 10 sec gear warning and the simultaneously configure and slow to 120 KIAS.

4. LNAV/VNAV approaches – Configuration point for SSE approaches should be a half dot below glidepath. Circling is not authorized when flying an approach to LNAV/VNAV minimums. If at any time you are unable to maintain glidepath or airspeed, you should retract the gear to eliminate drag, and consideration given to retracting the flaps. After re-establishing glidepath and airspeed, reconfigure and complete the Landing Checklist.

5. No Flap Approaches. The no flap approach presents no unusual handling characteristics and is flown the same as any other approach.

c. **Single-Engine after Configuration Point.** If an engine fails or must be shut down after the aircraft has already been fully configured, the configuration should be matched with the above guidelines. On a precision approach, additional power on the available engine will be required, but changing the configuration should not be necessary.

On a non-precision approach, unless ready to descend from the MDA for transition to land, it is normally necessary to raise the gear immediately and adjust power on the available engine to maintain airspeed.

NOTE

In the event that you are configured on a SSE approach with vertical guidance and the vertical guidance is lost (e.g., ILS to LOC transition) or switching from LNAV/VNAV to LNAV you must clean up per above guidance unless you can determine that you are on or above the VDA, and or the field is in sight and you are in a position to land, as you are now on a non-precision approach. A good acronym to remember for this scenario is CRAT: Configuration – Clean up, RADALT – Reset to LOC AGL, Altitude – Re-brief LOC MDA, Timing – Re-brief LOC timing.

3. **SSE Circling Procedures.** The approach should be flown as described in “SSE Non-Precision Procedures.”

When circling during SSE operations, lower the flaps if not already at approach, and gear when intercepting the appropriate VFR pattern checkpoint. The Landing Checklist must be complete no later than the 90° position. Place the operating prop full forward (both props on SSE approach) and review the Landing Checklist. Airspeed may be reduced from 120 KIAS only when intercepting a segment of the VFR pattern.

The circling maneuver, especially single engine, can be one of the most demanding requirements of a pilot (depending on daylight, weather conditions, etc.); it is critical to maintain precise control of airspeed and altitude while visually aligning the aircraft to the landing runway.

NOTE

Most circling approaches are below the normal VFR altitude of 800' AGL. Therefore, a safe position to descend and land will be after the normal 180 position. For instance, if the circling altitude is at 500' AGL, you should configure approaching the 90 position, not at the 180. If configuring early while SE, you may not have enough power to maintain altitude to landing. In all cases, the Landing Checklist shall be complete by the 90 or 1 mile on final.

4. **SSE Missed Approach Procedures.** A single engine or SSE missed approach is a critical maneuver requiring precise aircraft control. Comply with the appropriate NATOPS procedures for single engine waveoff. Use maximum available power on the good engine and establish a positive rate of climb with 7 to 10 degree nose-up pitch.

Maintain 110 (V_{YSE}) in the climb [102 KIAS minimum (V_{XSE}) may be used if necessary to clear close in obstacles]. When assured you will not touch down, retract the gear and raise the flaps. Substantial rudder and 5° dead engine up will be required with power application on the SSE missed approach.

NOTE

SSE training shall not be continued or initiated while flying the Club-1 coded departure from CRP's runway 13. The shallow climb poses a threat to aircraft flying the two-mile wagon wheel at Cabaniss Field.

5. **CDI Failure (Needle Only).** If the CDI fails, or is found to be out of tolerance during an instrument check, the following procedures are available:

a. **VOR/TACAN.** Can be flown using the needles on the HSI. Remember, the needle will always point to the station, the head of the needle will always "fall," and the tail of the needle will always "rise." Put another way, you always "push" the head of the needle to the desired course or "pull" the tail to the desired course.

b. Under these circumstances, the following techniques may be helpful:

i. **Inbound Course Intercept.** A common technique to use when intercepting a course inbound is to put the heading bug on the inbound course; the pointer will "fall" to the heading bug when on an intercept heading. The intercept is completed by turning to put the pointer under the upper lubber line. Maintain course by keeping the pointer centered on the heading bug.

ii. **Outbound Course Intercept.** When intercepting a course outbound, the heading bug is put on the outbound course; this time, the "tail" will "rise" to the heading bug when on an intercept heading. Turning to put the heading bug and the "tail" under the upper lubber line completes the intercept. Maintain course by keeping the "tail" centered on the heading bug.

6. **DME Failure.** In the event that you lose DME on an approach inside the FAF, switch immediately to timing. Rely on your wind calculations from the approach brief, unless the wind has shifted dramatically. If you are on an approach that requires DME, you are no longer authorized to shoot the approach. If the approach is "DME or RADAR required," then you should contact ATC and request position information in order to continue the approach. In the training environment, inform your instructor before contacting ATC.

7. **Lost Communications.** Ensure you check all switches, volume controls, and plugs. Attempt contact on VHF and UHF, including Guard frequency. Monitor any available voice NAVAID. Make all radio calls *"in the blind"* and comply with the detailed instructions in ***FIH A.5*** or locally in the ***FAA/CTW-4 LOA.***

a. **Radar Approaches.** In preparation for the radar approach, select a backup approach compatible with the existing weather. If you experience lost communications, you are automatically cleared to fly any published approach unless the controller previously issued a specific lost communications approach.

b. **Contact.** Attempt contact with the controlling agency if no transmissions are received for approximately: one minute while being vectored to final, fifteen seconds while on final for an ASR approach, or five seconds while on final for a PAR approach.

NOTE

A common misconception is that if you are flying under IFR, you must comply with the AVE-FAME acronym from the FIH. This is true only if you are IMC! If it is VMC, it doesn't matter that you are flying under IFR, you still proceed VMC and land.

8. **ESIS Approach.**

Initial Considerations. First, troubleshoot and transfer the controls to the co-pilot if the system failure affects only the pilot's instrument panel. Remain VMC and land as soon as practical if weather is not a problem and this is an option. Secure all electrical equipment ("big five") that may influence the wet compass if the malfunction is a heading problem. See the Typical Briefs and Voice Procedures Appendix for a typical brief for partial panel malfunctions. An approach on the Emergency Standby Instrument System is considered a partial panel approach because it does not utilize the primary flight instruments. Failure of the primary flight instruments may occur in various ways including the failure of the primary flight displays (PFD), attitude heading reference systems (AHRS), or electrical failure.

Simulated Display System Failures.

a. **Partial Panel (PP) Flight:** Any flight conducted without the use of the primary attitude instrument: the Attitude Gyro. This may occur in various ways including a failed primary flight display (PFD), attitude heading reference system (AHRS), or electrical failure, and will be simulated by dimming the pilot and copilot PFDs.

b. **Dual AHRS Failure:** An actual failure of this nature in the aircraft will result in a red ATT and HDG warning flag where the attitude gyro and compass were located; however, the only way to simulate this malfunction in the aircraft is to dim the pilot PFD. Therefore, the instructor pilot should indicate to the student whether he/she has had a “display/PFD” or “AHRS” failure when dimming the pilot PFD. The procedures for a dual AHRS failure are located in Chapter 15 of the NATOPS manual. It should be noted that the reversionary panel should be checked to both the AHRS #1 and AHRS #2 positions to see if attitude and heading are restored. It should also be noted that the ESIS will no longer receive accurate heading input and will be prone to drift over time with a failure of AHRS #1. This will be noted by the “DG” (Direct Guidance) indication located directly over the heading tape on the ESIS. Therefore, the pilot should brief the capabilities of the wet compass and turn off the “big five” (electric heat, air conditioning, vent blower, windshield heat, and windshield wipers) electronics to back up each rollout heading if receiving vectors. An example brief is included in the Typical Briefs and Voice Procedures Appendix.

c. **Dual Primary Flight Display Failure:** An actual malfunction in the aircraft will result in the complete loss of pilot and copilot PFDs. If the ESIS does not indicate it is operating in “DG” mode then AHRS#1 input to heading is still functioning. At this point, an emergency may still be declared due to the loss of the primary attitude indicator, but it is not necessary to update ESIS heading from the wet compass. An example brief during a dual display failure is included in the Typical Briefs and Voice Procedures Appendix.

d. **Direct Guidance:** Direct Guidance refers to compass operation which is not slaved to the flux detectors located in each wingtip. Instead, the compass is slaved to the slew switches located on either side of the reversionary panel in order to update headings from the wet compass. The ESIS will operate under direct guidance when AHRS #1 has failed and the heading will still track in turns and appear to operate normally. Heading drift error is directly proportional to the amount of time past and maneuvers conducted.

e. **ESIS Approach:** An approach on the Emergency Standby Instrument System is considered a partial panel approach because it does not utilize the primary flight instruments. Whenever flight must be conducted solely by using the ESIS, the pilot in command (PIC) should consider declaring an emergency with ATC. The PIC must also consider what kind of approach the aircraft is now capable of flying. Although it is possible to fly a procedure turn, HILO, or tear drop approach utilizing the heading, course, and course auto-center functions of the ESIS, radar vectors to final are highly recommended in an actual emergency. The easiest to execute, and most precise approach choices would be a PAR, ASR, or ILS. The final option would require a VOR approach. If flying a procedure turn, have the outbound course dialed in when proceeding outbound to avoid reverse sensing. Dial in the inbound course after the 45 degree procedure turn outbound. Use station passage (TO/FR swap on ESIS) or a radar cut to identify the final approach fix. Because DME is not available on the ESIS, the pilot should understand approach selection limitations when practicing ESIS approaches. The use of DME through the FMS or MFD is good headwork and can be requested by the pilot flying for situational awareness. The PIC should consider requesting No-Gyro vectors for the approach.

f. **ESIS Back Course:** When a localizer is in NAV 1 another menu option is available in the ESIS; “LOC BC.” In order to not have reverse sensing the pilot must select this during the PFD/FGP portion of the approach check list. For standardization purposes and better situational awareness, set the front course in the ESIS as the inbound course and select “LOC BC” from the menu option. Not selecting “LOC BC” and putting in the front course will result in reverse sensing.

Glideslope Failure During an ILS, LNAV/VNAV GPS, or FMS Overlay Approach

Student should:

1. Clean up if SSE

2. Transition to backup Non-Precision Approach Profile (800-1000 fpm descent to step-down fix or MDA)

3. Brief backup Non-Precision Approach Minimums and Missed Approach Point. (LOC or LNAV MDA)

4. Ensure Timing was started for LOC DME backup. (No timing required for GPS approaches)

5. Advise ATC of degradation to navigation equipment and transition to non-precision minimums.

DME Failure

Remember the ESIS has no DME. The FMS or MFD can be utilized for situational awareness.

Student should:

1. Advise ATC

If on approach, transition to timing backup if applicable.

2. Brief the new minimums if applicable.

Or

3. Request vectors for a radar approach, or other approach not requiring DME for final approach fix identification.

GPS - No Approach Available/FMS Caution Alert Message (2 DME from FAF)

Student should:

1. Advise ATC

2. Maintain FAC, and FAF altitude and proceed along FAC to MAP.

3. Execute missed approach or comply with ATC instructions.

Or

4. Request vectors/clearance for another approach not requiring GPS. (Visual approach, radar approach etc.)

SSE LNAV/VNAV Approach or FMS Overlay Approach.

Student should:

1. Remain configured if able to maintain glideslope.

2. Follow GS information to Decision Altitude (DA) or MDA

3. Execute missed approach at DA or MAP if runway environment not in sight.

Or

1. Clean up if unable to maintain glideslope or airspeed.

2. Configure when established on glideslope with sufficient airspeed or field in sight and in safe position to land, but no later than 1 DME or 90 position from landing runway.

NOTE

If planning a circling approach, clean up and descend to circling MDA then reconfigure at the appropriate visual checkpoint.

413. CROSS-COUNTRY PROCEDURES

Cross-country will immerse you in the complexities of the real-world ATC environment. Outside the South Texas training environment, you will find that flying in unfamiliar airspace poses its own unique challenges. A cross-country flight is simply an instrument phase flight with a more involved planning period and a longer enroute transition. Cross-country flights have a few intricacies not involved in local instrument flights, including cross-country pubs bags, the fuel packet and unfamiliar field operations.

Optimum Path Aircraft Routing System (OPARS). An OPARS is an in-depth weather briefing that includes fuel calculations. Refer to ***NATOPS IFM 27.2.2.1***.

Publications. A pubs kit for a cross-country is in principle the same as a normal instrument flight pubs bag. Make sure that you have charts (high and low) and IAP books covering the vicinity of the entire route of flight. Pubs can be found in the duty office or in Base Ops. You should have two copies of each relevant IAP book and one copy of each chart, and your pubs kit should be in order before the morning of the cross-country.

Fuel Packet. Any off-station flight involves the fuel packet. The fuel packet contains a card for military field refueling ops, and a card for civilian fuel purchases, if the field has a military contract for gas. Refer to the IFR Supplement to see if they do. You should hold on to the fuel packet and ensure that all fuel receipts are stored in the packet. Also make sure that civilian fields print the fuel receipt in gallons of fuel, not dollars. You need to sign out the fuel packet in Aircraft Issue and return it there following the flight.

NOTE

> In conjunction with fuel log entries required every 30 minutes on cross-country flights, pilots shall also perform an instruments/nacelles check. This allows a check for any possible engine/fuel malfunctions, and will instill good habit patterns.

1. **Enroute Weather.** Ensure your weather forecast is updated at least once enroute on all cross-country flights. The weather radar is a useful tool for assessing enroute weather. Refer to NATOPS for weather radar operation procedures. It is often better to divert to your alternate early in the flight, rather than pressing on with decreasing reserves. Utilize military PMSV (pilot-to metro), FSS, or EFAS (Enroute Flight Advisory Service, “Flight Watch”) as appropriate.

2. **Civilian Airfield Operations.** The same preflight planning must be accomplished at civilian fields as at military fields. Most Fixed Base Operators (FBOs) will have a pilot lounge or flight planning room with limited resources; you will have to plan ahead and ensure you already have all the required pubs, etc. Most of the time you will receive your weather brief, NOTAMs, and file your flight plan all with one phone call to the FSS at 1-800-WX-BRIEF (1-800-992-7433). Ask about local noise abatement procedures. Be sure the linemen are familiar with fueling a King Air 90 (fill nacelle tanks first). If the aircraft is to be towed, ensure

the rudder lock is removed, the parking brake is off, and that they will be using a proper tow bar or other device. A lineman is often not available to monitor engine starts at civil fields. If no lineman is posted, loudly call, *"CLEAR PROP!"* out of the appropriate window before starting the first engine.

NOTES

1. Though ATC usually has UHF backup frequencies, most military pilots find it useful to use VHF frequencies while enroute or operating at civil fields. Since most other traffic utilizes VHF, you will hear their calls, they will hear yours, and the result will be fewer "blocked" transmissions. At military fields; however, it is preferable to transmit on UHF so military aircraft without VHF capability will hear your transmissions. Regardless, monitor UHF Guard at all times.

2. When filing with an FSS, ***NEVER*** give them the names of the crewmembers. The names are "on file" at your home base (KNGP).

3. **Departure Message.** While flying IFR, military aircraft have two distinct methods of flight following. The first and primary method of flight following is provided by ATC, with whom you will be in continuous radio contact. If flying to a military installation, additional flight following is provided by the military destination Base Operations dispatcher, who will initiate a search if pre-announced aircraft do not arrive. Base Ops knows which aircraft are supposed to arrive based on departure messages.

How Departure Messages Work. Per the GP, a flight plan (DD-175) filed with a military Base Operations is passed to the local FSS immediately after the flight's departure from a Tower-controlled military field. Flight service then notifies the destination base of each aircraft's ETA. This is the departure message. The base, if necessary, can then take action to divert aircraft to an alternate, or initiate advisory action on NOTAMs, weather, or other hazards. If your destination is a military base, this message goes to Base Operations at your destination airfield, thus pre-announcing your arrival and providing for flight following by the destination dispatcher. If your destination is a civilian field, the message goes to that airfield's servicing FSS and remains with them.

"How Does This Affect Me?" Departure messages will be sent from military bases automatically. When departing civilian fields per GP chapter 6, the pilot must ensure the actual departure time is passed to the FSS serving that departure field. Utilize the second radio to accomplish this when cockpit duties allow. After initial contact is established, a typical call might be *"Albuquerque Radio, Navy 1G404, IFR off Santa Fe Muni at 2215 Zulu, enroute Hill AFB, request departure message be sent*." This ensures a departure message is sent and you will not arrive unannounced at your next destination. This is especially important when arriving at military fields, even when returning to home station (e.g., returning to Navy Corpus after an out/in or cross-country flight). Because our mission in the training command allows more common use of civilian fields, we must pay special attention to this requirement. It is Base Operations' job to monitor and track the arrival of incoming aircraft and provide flight following. Due to disregard of this rule in the past, many aircraft have arrived each week unannounced.

4. **Flight Director/Autopilot Usage.** The flight director may be used independently or may be coupled to the autopilot. If the flight director alone is utilized, the aircraft is flown manually using command bars as guidance. The autopilot similarly may be used with or without the flight director. When coupled, the autopilot controls the aircraft using commands generated by the flight director. The pilot must continually monitor autopilot performance and be alert to deviations. Never rely exclusively on the autopilot. Disengage the autopilot by depressing the AP/YD disconnect switch on the yoke to the first detent and take over manually if required. Use the NATOPS manual procedures for operation of the flight director and autopilot. Observe the following:

a. Confirm all appropriate annunciator lights are illuminated during use of AP/FD.

b. The autopilot will roll to bank angles up to 27°.

c. When the autopilot is coupled, select HDG (with the bug on the nose) before changing NAVAID frequencies. This will prevent sudden turns as the aircraft attempts to intercept a new navigation course.

NOTE

The autopilot may be utilized as desired after initial introduction, at the instructor's discretion.

5. **Coupled Approach.** Follow procedures in the NATOPS manual. If autopilot coupled operations are to be conducted, advise the instructor to inform ATC approach controller as soon as practical, but not later than the FAF (ATC only needs to be called if wx is < 800-2). This will allow time for the appropriate ILS critical area to be cleared or an advisory issued. The advisory used by controllers will be: *"localizer/glideslope signal not protected."* In this case be alert for unstable or fluctuating ILS indications that may prevent an autopilot coupled approach. Continually monitor autopilot performance and remember you must configure the aircraft manually and control the airspeed with the power levers.

NOTE

The boundary of the ILS critical area is identified by the "double-runged ladder" marking (see chapter 2 in the AIM) painted on the taxiway; also, a sign with an inscription "ILS" in white on a red background will be installed adjacent to the taxiway. This should be used as the runway holding position when the ceiling is less than 800 feet and/or visibility is less than 2 miles or when directed by ATC.

6. **Right Seat Orientation.** The purpose of right seat events is to better prepare students for follow-on assignments as a copilot or 2P. During these flights, students will build on the skills learned during the radio instrument stage of training. Emphasis is placed on physically flying the aircraft from the right seat as well as accomplishing all normal duties. During ground operations and whenever the instructor is flying, the student will accomplish standard pilot monitoring responsibilities. While the student is at the controls, the instructor will accomplish pilot monitoring responsibilities and will normally handle all radio communications and assist as required or requested.

Differences. One of the differences between the left and right seat is the relative position of the power levers. You will control the aircraft with your right hand on the yoke and your left hand on the power levers. Since the power levers are on the left side of the center console, it will require a greater reach to move the power levers. There is a tendency to set lower power; crosscheck the engine instruments to ensure desired power setting. Be careful you do not mistake the propeller levers for the power levers. Another difference is the visual sight picture when landing the aircraft; when new to the right seat, pilots tend to land right of centerline.

NOTE

When in the right seat and not at the controls, make sure you are shadowing the controls of the PF. This is especially important while in a landing pattern or on final. You must be ready to take the controls in an emergency or should the PF become incapacitated.

414. FLIGHT MANAGEMENT SYSTEM (FMS) & GLOBAL POSITIONING SYSTEM (GPS)

Flying a GPS approach is much like flying any other non-precision approach. For GPS procedures reference ***NATOPS Ch. 20*** and the ***FMS Operator's Manual***. Incorrect inputs into the GPS receiver are especially critical during approaches. In some cases, an incorrect entry can cause the receiver to leave the approach mode. Refer to ***NATOPS IFM Ch. 26 and AIM 1-1-19*** for general information on GPS approaches.

GPS is just one form of RNAV approach. RNAV (Area Navigation) could consist of GPS, DME/DME, VOR/DME, INS, DOPPLER, and LORAN systems. The FAA is currently renaming many "GPS" approaches to "RNAV (GPS)." This means the Final Approach Course requires you to navigate by RNAV equipment, and GPS is required for the RNAV solution. "RNAV or RNAV (RNP)" refer to other types of RNAV. Many FAA Advisory Circulars (ACs) contain more detailed information.

Study Other Sources. This section is a brief overview of FMS/GPS procedures and cannot provide by itself the knowledge required to use GPS for enroute navigation or terminal approach procedures. It is therefore your responsibility to study and be familiar with the appropriate manuals and regulations concerning the use of the FMS installed in the T-44 aircraft. The following sources provide additional information: the FMS/GPS computer courseware, FMS

Operator's Manual, Rockwell-Collins Manual, NATOPS Flight Manual, AIM, IFM, and AFMAN 11-217 V2.

1. **RAIM Prediction.** The operational status of GNSS operations depends upon the type of equipment being used. For ***GPS***-only equipment TSO-C 129(a), the operational status of non-precision approach capability for flight planning purposes is provided through a prediction program that is embedded in the receiver or provided separately.

a. **Receiver Autonomous Integrity Monitoring (RAIM).** When GNSS equipment is not using integrity information from WAAS or LAAS, the GPS navigation receiver using ***RAIM*** provides ***GPS*** signal integrity monitoring. ***RAIM*** is necessary since delays of up to two hours can occur before an erroneous satellite transmission can be detected and corrected by the satellite control segment. The ***RAIM*** function is also referred to as fault detection. Another capability, fault exclusion, refers to the ability of the receiver to exclude a failed satellite from the position solution and is provided by some GPS receivers and by WAAS receivers.

b. **Satellites Vehicles (SV).** The ***GPS*** receiver verifies the integrity (usability) of the signals received from the ***GPS*** constellation through ***RAIM*** to determine if a satellite is providing corrupted information. At least one satellite, in addition to those required for navigation, must be in view for the receiver to perform the ***RAIM*** function; thus, ***RAIM*** needs a minimum of 5 satellites in view, or 4 satellites and a barometric altimeter (baro-aiding) to detect an integrity anomaly. For receivers capable of doing so, ***RAIM*** needs 6 satellites in view (or 5 satellites with baro-aiding) to isolate the corrupt satellite signal and remove it from the navigation solution. Baro-aiding is a method of augmenting the GPS integrity solution by using a nonsatellite input source. GPS derived altitude should not be relied upon to determine aircraft altitude since the vertical error can be quite large and no integrity is provided. To ensure that baro-aiding is available, the current altimeter setting must be entered into the receiver as described in the operating manual. The T-44C has baro-aiding capability.

c. **GPS "NAV-OFF" Flag.** ***RAIM*** messages vary somewhat between receivers; however, generally there are two types. One type indicates that there are not enough satellites available to provide ***RAIM*** integrity monitoring and another type indicates that the ***RAIM*** integrity monitor has detected a potential error that exceeds the limit for the current phase of flight. Without ***RAIM*** capability, the pilot has no assurance of the accuracy of the ***GPS*** position.

i. When a problem occurs, a yellow ***MSG*** (Message) annunciation will appear on the ***PFDs*** (Primary Flight Displays). This indicates the ***FMS*** has a new message and the aircrew needs to view it. If there is a problem with the number of satellites the ***FMS*** is tracking, a ***"RAIM NOT AVAILABLE"*** or ***"APPROACH RAIM NOT AVAILABLE"*** message will also be displayed.

ii. **Integrated Systems.** Although GPS is designed to replace some navigation equipment, the way it is integrated into the navigation system will depend on the mission of the aircraft. GPS can greatly enhance the performance of an INS. The INS in turn increases the usefulness of GPS equipment. INS has the ability to accurately measure changes in position and velocity over short periods of time using no external signal; however, errors are cumulative and increase with time. GPS can provide a continual position update that allows the INS to calculate error trends and improve its accuracy as time increases. The INS aids the GPS receiver by improving GPS anti-jam performance. When GPS is not available (due to mountain shadowing of satellites, jamming, or high dynamic maneuvers), this improved INS will provide the integrated navigation system with accurate position information until the satellites are in view or the jamming is over. An added advantage is that GPS provides an in-flight alignment capability for the INS.

iii. **WAAS.** (Not currently available in T-44)

2. **GPS Requirements**

a. **Navigation Database.** Navigation databases supporting GPS equipment certified for enroute and terminal operations contain, as a minimum, all of the airports, VORs, VORTACs, NDBs, and all named waypoints and intersections shown on enroute and terminal area charts, SIDs, and STARs. In the terminal area, the database includes waypoints for SIDs and STARs as well as other flight operations from the beginning of a departure to the enroute structure or from an enroute fix to the beginning of an approach procedure. All named waypoints are identified with a five-letter alpha character name provided by the National Flight Data Center (NFDC). Waypoints unnamed by the NFDC, such as a DME fix, are assigned a five-letter alphanumeric coded name in the database (as an example, D234T – This coded waypoint represents a point located on the 234 radial of XYZ VORTAC at 20 NM. The letter T is the twentieth letter of the alphabet and is used to indicate a distance of 20 NM.) The navigation database in use in the T-44C FMS is the Jeppesen NavData Database. Most military aircraft use a different database, called the DAFIF database.

b. **Retrievable.** All approach procedures to be flown must be retrievable from the current airborne navigation database. Aircrew cannot create their own approach procedures.

3. **Aircrew Preflight Actions.** In addition to being intimately familiar with operation of their GPS equipment, pilots need to accomplish several additional actions prior to flight using GPS.

a. **GPS NOTAMs.** Review NOTAMs by referring to the installation NOTAMs for your destination and alternates. GPS satellite outages are issued as GPS NOTAMs under the “KGPS” identifier. The NOTAM will list the satellite’s Pseudo Random Noise (PRN) Number followed by a “U/S” indicating that the satellite is unserviceable and cannot be used for navigation. It is important that any affected satellites be deselected to ensure that they are not used for the RAIM calculations.

b. **DATABASE NOTAMs.** Jeppesen NavData NOTAMs highlight significant changes affecting navigation data in our database. These NOTAMs are issued every other database cycle (every two months) and can be found on the Jeppesen Web site (http://ww1.jeppesen.com/company/alerts/alerts.jsp). A link to this Web site is also provided on the DINS page (https://www.notams.faa.gov/). Check these before flight.

c. **File the Appropriate Equipment Suffix.** Aircraft navigating using GPS are considered to be RNAV equipped aircraft and the appropriate equipment suffix should be included on the flight plan. The suffix /G is used for an aircraft with GPS enroute and terminal capability.

d. **Current DATABASE.** In many receivers, including the T-44C, an updatable database is used for navigation fixes, airports, and instrument procedures. These databases must be maintained to the current update for IFR operation. Check for a current database before flight.

e. **Alternate Airport Restrictions.** When an alternate airport is required, it must be served by an approach based on other than GPS navigation, the aircraft must have operational equipment capable of using that navigation aid, and the required navigation aid must be operational.

4. **Flying With GPS.** Flying with GPS isn’t any more difficult than flying with conventional NAVAIDS; however, there are differences. For instance, instead of flying off of a VOR or VORTAC station on an airway or approach, we now fly based on the GPS signal. There is a single performance standard that GPS equipment must meet to conform with the civil and international authorities, which provide for how the equipment gives you information.

Required Navigation Performance (RNP). RNP is intended to provide a single performance standard for aircraft manufacturers, airspace designers, pilots, controllers, and international authorities. When RNP is specified, a combination of systems may be used, provided the aircraft can achieve the required navigation performance.

An RNP “level” or “type” is applicable to a selected airspace, route, or procedure. As defined in the Pilot/Controller Glossary, the RNP Level or Type is a value typically expressed as a distance in nautical miles from the intended centerline of a procedure, route, or path.

SEGMENT	RNP LEVEL	PRIMARY ROUTE WIDTH (NM) – (CENTERLINE TO BOUNDARY)
Enroute	2	2.0 NM
Terminal	1	1.0 NM
Final Approach Segments	0.3	0.3 NM

Figure 4-33 U.S. Standard RNP Levels

Course Sensitivity. Course sensitivity now relates to what phase of flight you are in. With GPS, the sensitivity of the CDI never changes, except when it changes phases of flight.

The Course Deviation Indicator (CDI) sensitivity related to GPS equipment varies with the mode of operation. Unlike traditional ground-based NAVAIDs, GPS course sensitivity is normally linear regardless of the distance from the waypoint. The following modes provide the indicated CDI scaling. Fortunately, when the CDI sensitivity ramps down, it doesn’t do so abruptly. The CDI sensitivity begins to ramp down approximately 2 NM prior to 30 NM (Terminal Mode) and 2 NM prior to the FAF (Approach Mode). This prevents a jump in the CDI should the aircraft be off of the prescribed course.

Enroute Mode. During the enroute transition, prior to the execution of the instrument approach, the display sensitivity is a full-scale deflection of 5 NM either side of centerline.

Terminal Mode. Terminal area operations are operations conducted within 30 NM of the origin or destination airport. CDI full deflection during these operations is ±1 nautical mile. This must take place prior to descending on an approach.

a. When entering the terminal area from the enroute structure and the CDI sensitivity scales down to ±1 nautical mile, a verbal response is required. When the approach mode is armed, (a white TERM light in T-44C), a verbal response of ***“Approach Mode Armed”*** is required.

b. An annunciation of APPR or TERM will not be seen when entering the terminal environment if you do not have an approach selected for your destination; however, the CDI scale will still reduce to ±1 nautical mile.

Approach Mode. At a distance of 2 NM inbound to the FAF waypoint, the display sensitivity begins to transition to a full-scale deflection of 0.3 NM either side of centerline.
Once the CDI ramps down to ±.3, a green “GPS APPR” annunciation will be seen on the PFDs. This means the Approach Mode is active.

Missed Approach Mode. When navigation to the missed approach holding point is activated, the CDI display sensitivity transitions back to terminal area sensitivity (±1 NM).

WARNING

Do not push the go-around button, or cycle the FMS past the MAP prior to going missed approach, unless you are climbing to the missed approach altitude. Doing so will change the FMS mode from Approach Mode to Missed Approach Mode and the CDI from ±.3 to ±1.0. Once this is done, the aircraft is no longer guaranteed obstacle clearance.

5. **Area Operations – Departure.** Load SID/DP. If a SID/DP is to be flown, load the appropriate SID/DP by retrieving the route from the navigation database. If the SID/DP cannot be retrieved from the database, you may not use RNAV procedures to fly prior to the SID/DP termination point.

6. **Enroute Operations**

Use of Predictive RAIM. While you are enroute to your destination, check the expected integrity (RAIM availability) for the planned approach. If your check indicates the appropriate integrity for the planned operation may not be available, develop an alternate plan for landing at the airfield or proceed to your alternate.

On-Deck Flight Plan/Secondary Flight Plan. While enroute, set up second leg of flight plan as necessary.

7. **Prior to Descent**

GPS Approach Briefing. Thoroughly brief the entire GPS instrument approach procedure including the missed approach instructions. Compare the approach retrieved from the GPS navigation database to the instrument approach procedure published on your approach plate. Should differences between the approach chart and database arise, the published approach chart, supplemented by NOTAMs, takes precedence.

Develop a Backup Plan. Develop a backup plan to use in case of GPS or GPS integrity failure (No Available RAIM). Pay particular attention to ground-based NAVAIDs that can be used to help maintain position awareness. Be sure to consider the possibility of equipment failure past the FAF.

Load STAR. If a STAR is to be flown, load the appropriate STAR by retrieving the route from the navigation database. If the STAR cannot be retrieved from the database, then you may not use RNAV to fly the procedure. Additionally, terminal area routing that cannot be retrieved from the navigation database may not be used.

8. **Terminal Area Operations – Arrival**

Maintain Situational Awareness. As you prepare to enter the busy environment of the terminal area, it is important to maintain a high level of situational awareness using all available means.

Monitor all ground-based NAVAIDS available to you (bearing pointers, DME, etc.) since GPS approaches are flown point-to-point. The bearing pointer on your HSI and distance measurement (DME-readout) will be to the next waypoint, not necessarily to the field.

Be Prepared to Use Traditional NAVAIDs. Experience has shown situational awareness can deteriorate when flying GPS approaches if the sequence of events does not go as planned. Be prepared to go to your backup plan if you become disoriented while flying the GPS approach.

Be Wary of "Heads-Down." Operating with GPS in the terminal area tends to be more "heads-down" than normal – especially when things do not go as planned. Being intimately familiar with your GPS equipment and thoroughly preparing for the approach will allow you more time to clear for other traffic.

GPS is a New Form of Flying. Flying GPS approaches involves a new way of flying for most military pilots. Setting up a GPS receiver for an approach usually involves many more operations than are required to configure traditional navigation equipment. The sequence of events is critical to success. Setup routines are not always intuitive, requiring pilots to be thoroughly familiar with their equipment before flying GPS approaches in IMC.

9. **GPS Approaches.** There are two types of GPS approaches: "stand-alone" and "overlay" approaches.

GPS "Stand-Alone" Approaches. GPS "stand-alone" approaches are constructed specifically for use by GPS and do not have a traditional underlying procedure. GPS stand-alone approaches are identified by the absence of other NAVAIDs in the approach title, for example, RNAV (GPS) RWY 35. Current "stand-alone" approaches will be renamed over time as RNAV approaches so that different types of FMS systems can be legally used to fly the approach (not just GPS-based systems), for example, RNAV RWY 35. Straight-in Minimums on current GPS charts correspond to the LNAV Minima on RNAV charts.

Although "stand-alone" approaches are referred to as a single type, there are several different varieties.

a. **T-Shaped GPS Approach (And Varieties)**

b. **Holding In Lieu Of (HILO).** How a GPS HILO is flown is no different than a conventional HILO approach. Refer to section 410, for HILO procedures. The difference lies in the FMS. Aircrew must be familiar with their FMS procedures.

c. **Terminal Arrival Area (TAA)**

GPS Overlays. The GPS Approach Overlay Program is an authorization for pilots to use GPS avionics under IFR for flying designated non-precision instrument approach procedures, except LOC, LDA, and simplified directional facility (SDF) procedures. These procedures are now identified by the name of the procedure and or "GPS" (e.g., VOR/DME or GPS RWY 15). Other previous types of overlays have either been converted to this format or replaced with stand-alone procedures. Only approaches contained in the current onboard navigation database are authorized. The navigation database may contain information about non-overlay approach procedures that is intended to be used to enhance position orientation, generally by providing a map, while flying these approaches using conventional NAVAIDs. This information should not be confused with a GPS overlay approach.

CAUTION

When flying GPS Overlay approaches, the DME readings are based on the underlying NAVAID, not GPS DME. This can cause confusion when flying the procedure as a GPS procedure. Care must be taken to make sure the proper DME fix is being used.

10. **GPS Approach Restrictions.** There are several important operating restrictions when using GPS.

a. Instrument approaches must be accomplished in accordance with approved instrument approach procedures retrieved from the FMS database using the current update cycle.

b. Instrument approaches must be conducted in the FMS Approach mode, and GPS integrity monitoring (RAIM) must be available at the FAF, as indicated to the pilot by the lack of MSG annunciator on PFD.

c. The aircraft must have other approved navigation equipment installed and functioning appropriate for the route to destination airport and any required alternate. GPS overlay and GPS stand-alone approaches may be flown without the need to tune, ident, or monitor any other NAVAID (though this is NOT recommended).

d. Only GPS or GPS overlay approaches (e.g., VOR/DME or GPS) may be flown using solely GPS for guidance. Other approaches in the FMS are provided for reference and may be flown using the FMS as the primary navigation source if the FMS is receiving the required sensor input, there are no FMS caution messages, and the NAVAID required for the approach is used for final course guidance. When using the FMS for course guidance on a VOR, TACAN, or NDB approach, the bearing needle shall be selected in order to insure that FMS derived course and raw data course align.

11. **GPS Approach Rules.** Flying a GPS approach is much like flying any other non-precision approach. For procedures regarding equipment specifics and setup, reference NATOPS and the FMS Operator's Manual. Incorrect inputs into the GPS receiver are especially critical during approaches. In some cases, an incorrect entry can cause the receiver to leave the approach mode.

Descending on the approach. Do not descend on an approach unless:

a. FMS is in proper mode (e.g., Terminal Mode with "Approach Mode Armed").

b. Established on the approach.

Angle of Intercept. Check for large angle of intercept from aircraft heading to initial course on the approach. If angle is >90 degrees, consideration should be given to preventing the FMS from cycling to the next waypoint, since it might do so extremely early. Air Traffic Controllers have multiple restrictions that should prevent them from sending you to an IAF with > 90 degree of intercept.

CDI Course. The CDI automatically sets to the course (assuming FMS is selected).

Inbound Course. The course displayed on the FMS between the FAF and the MAP may be slightly different than that printed on the approach chart, and should not affect approach performance. This is due to the way the FMS connects the approach waypoints.

GPS Integrity Warning Prior to FAF. If a GPS integrity warning occurs prior to the FAF, the pilot should not descend to the MDA, but should proceed to the MAP via the FAF, perform a missed approach, and notify ATC as soon as practical. Alternatively, the pilot may continue provided a backup approach is available using another approved source of navigation.

Step-down Waypoints. Step-down waypoints in the final approach segment of RNAV (GPS) approaches are named in addition to being identified by Along Track Distance (ATD). Most RNAV avionics currently do not accommodate waypoints between the FAF and MAP. Step-down waypoints may not appear in the sequence of waypoints in the navigation database. Aircrew can determine the location of step-down waypoints and visual descent points (if published) by using ATD.

GPS Integrity Warning After the FAF. A GPS integrity warning occurring after the FAF is a serious situation and pilots must be prepared to take immediate action. Transition to your backup approach (if available) or proceed to the MAP along the final approach course and execute the missed approach via the route and altitudes specified in the published missed approach procedure or comply with ATC instructions.

FMS Approaches

FMS Overlay (Visual, GPS, RNAV, VOR/DME, VOR, TACAN, and NDB). The FMS-3000 is designed and authorized to execute non-precision GPS, GPS overlay and multi-sensor RNAV approaches. TACAN and VOR approaches are provided for reference and may be flown in accordance with guidance in the GPS approach restrictions. The lateral and vertical approach guidance is provided, whether using the course deviation, flight director guidance, or coupled autopilot. The database includes missed approach procedures for all approaches, and the procedures are designed to accommodate ATC radar vectors issued before or during an approach. The FMS can track all leg types stored in the approach database.

CAUTION

Use of the visual approach selection in the FMS database does not guarantee obstacle clearance.

FMS VNAV – The intent of the vertical guidance is to fly non-precision FMS-based approaches in a manner similar to that of an ILS. The vertical navigation feature will be used most frequently while conducting an RNAV/GPS approach utilizing VNAV minimums. When the Flight Guidance Panel is properly used, the Flight Director provides steering commands to fly the FMS generated lateral and vertical flight path for the approach.

NATOPS 20.3.2.2 Limitations

The Flight Director will be utilized for all approaches to LNAV/ VNAV DA.

The FMS is not WAAS enabled, therefore the Trouble W and any NOTAM concerning WAAS does not apply to the T-44C.

FMS RNAV/GPS Approaches

1. LNAV/VNAV approaches – although a non-precision approach, procedures should be the same as a precision approach flown to a decision altitude (DA). The aircraft will be configured either three miles prior to the FAF or at a dot and a half below glidepath. Configuration point for SSE approaches should be a half dot below glidepath. Circling is not authorized when flying an approach to LNAV/VNAV minimums.

CAUTION

If unable to maintain glidepath or airspeed, retract the flaps and gear to eliminate drag. After re-establishing glidepath and airspeed, reconfigure and complete the Landing Checklist.

2. LNAV Only approaches – When a glidepath is provided, the glidepath may be used to fly to the MDA. The second option is to use 800′ – 1000′ per minute rate of descent or FLC (120kts) to the MDA.

FMS Missed Approaches. Missed approach procedures are inserted into the flight plan following the MAP or runway threshold when the approach is selected. In order for the FMS to sequence beyond the MAP, AUTO SEQUENCE must be active or the point must be manually sequenced by selecting the GA button or using the FMS CDU. The go around button on the power quadrant or co-pilot’s yoke will cycle the FMS to the missed approach point and command the FD to GA pitch. If continuing usage of the FD, verify FMS is the primary NAV source and select NAV on the FGP.

Technique

When conducting multiple FMS based approaches and missed approach instructions are issued, delete all missed approach points from FMS to prevent clutter and confusion when loading the following approach.

FMS Course Reversal Holds in Approach Transitions (HILO). When an approach includes a course reversal hold and the FMS sequences to that waypoint, the hold is automatically armed for exit. On a parallel entry, the hold will be automatically armed for exit after the entry maneuver has been completed. If an issued clearance requires continued holding, cancel hold exit. When cleared to exit the hold, use the exit hold function.

During course reversal holds, the FMS generates a waypoint labeled (INTC) that is placed where the holding pattern intercepts the final approach course. Altitude constraints that apply until established on the final approach course are applied until the (INTC) waypoint. When an approach is loaded with a holding entry that is based on 1 minute timing, the FMS will place the (INTC) waypoint based on a maximum holding speed of 175 KIAS; however, upon crossing the holding fix, if the airspeed is less than 175 KIAS, the FMS will recalculate the pattern and place the (INTC) waypoint based on the true airspeed of the aircraft at the fix. Hence, it is important to cross the fix on speed (150 KIAS). Should it become necessary to manually change the holding airspeed, enter the LEGS page, type the desired airspeed into the scratchpad, and press the RLSK corresponding to the (INTC) waypoint. In 360 mode, the aircraft is abeam INTC point when the FMS bearing pointer is perpendicular to the CDI.

NOTE

It may be necessary to wait to EXEC (execute) the hold exit until either the inbound turn or established on the inbound leg. Executing EXIT HOLD prior to the inbound turn will cause the FMS to turn and join the inbound leg directly from the present position on the outbound leg, which may not be desired.

If an approach does not have the hold transition in the FMS database, manually build the holding pattern at the desired fix. When using this method, the FMS bearing pointer will point to the hold waypoint throughout the holding entry maneuver and the FMS will not create the (INTC) point present in approach course reversal holds.

FMS Localizer-Based Approaches (ILS, LOC, B/C, LDA, and SDF). The FMS can be used when flying ILS, localizer, localizer back course, Localizer Directional Aid (LDA) and Simplified Directional Facility (SDF) approaches. The FMS uses approach data to preset the EFIS, autopilot, and the localizer receiver before beginning an approach with automatic NAV-to-NAV capture. The FMS does not execute the final approach phase of these approaches; however, it does support the initial approach phase leading to lateral NAVAID capture. Automatic transition to localizer guidance occurs when the aircraft is in a position to capture the localizer beam. Missed approach procedures for these approaches are also included.

FMS Auto-Tuning. When a localizer-based approach is selected, and the airplane reaches 30 NM from the destination airport, the displays, autopilot, and localizer receiver are all automatically preset and tuned by the FMS for a NAV-to-NAV transfer between the FMS and the localizer. It tunes the new LOC frequency, selects LOC as preset NAV source, and sets inbound preset course. If NAV radio is set to manual tuning mode, 30 seconds before FMS attempts to tune the radio, the CDU shows the message "LOC WILL BE TUNED" to alert the crew that it will retune the radio. After the 30 second notice, if the FMS was unable to tune the radio, the message "CHECK LOC TUNING" shows to indicate it was unable to tune the localizer frequency.

CAUTION

If NAV to NAV transfer does not take place by the FAF, select NAV/Bearing Button on left side of PFD to manually select LOC 1 or 2 as appropriate.

When the aircraft is in a position to capture the localizer and cleared for the approach, select APPR on the FGP to arm the flight director and capture the approach. The flight control computer automatically changes the NAV source from FMS to LOC when the aircraft is in a position to receive and capture the localizer signal. Missed approach procedures are flown by re-selecting FMS as the NAV source.

WARNING

Pilots should not completely rely on automation and alerts. It is imperative that the pilot recognize when the airplane reaches the DH or MDA and make a decision whether or not to continue the approach.

Radar Vectors to Final Approach Course (FMS Overlay). Two methods of intercept exist which essentially accomplish the same desired result.

1. Blue Method - When vectors to final are expected, select the VECTORS transition when loading the approach. This transition consists of a course-to-fix leg in the flight plan leading to the FAF. When the aircraft is properly positioned and cleared for the approach, intercept the course-to-fix leg by placing the CTF point in the 1L LSK (blue line) and Execute the flight plan. Continue to intercept course manually or use automation.

2. Green Method - Use heading mode to comply with ATC vectors. Next, change the flight plan in the FMS by placing the FAF in the 2L LSK (green line) and ***before*** pressing the execute key, enter the FMS derived final approach course into the INTC CRS LSK. After execution, an "infinite" final approach course is established. Continue to intercept course manually or use automation.

Secondary Flight Plan. The secondary flight plan is a tool that can be utilized while conducting multiple FMS overlay approaches. When a SEC FPLN is activated and executed, the ACT

FPLN and SEC FPLN exchange places. This prevents losing the previous flight plan when wanting to retrieve it.

CAUTION

While displaying map mode on the PFD, modifying the secondary flight plan will cause the map display to disappear; however, all CDI, autopilot, and flight director inputs are still valid. Be aware of this condition and limit modifying the secondary flight plan while using map mode as the primary PFD display.

Performing the Published Missed Approach Procedure (MAP). The MAP will be labeled on the approach plate by a named waypoint. The designated MAP will vary depending on the type of approach minimums selected. The MAP for LNAV will be the runway threshold or a named waypoint. The MAP for LNAV/VNAV will be at the published DA.

a. **Select Missed Approach Mode.** At the MAP, the equipment will not automatically sequence to the next required waypoint; therefore, the pilot must manually sequence the GPS equipment to the next waypoint using the LEGS screen. Alternatively, the MAP discontinuity may be cleared by pressing the G/A button.

If the G/A button is used, there is no need to press the EXEC key. The legs will automatically cycle past the MAP once it is reached.

WARNING

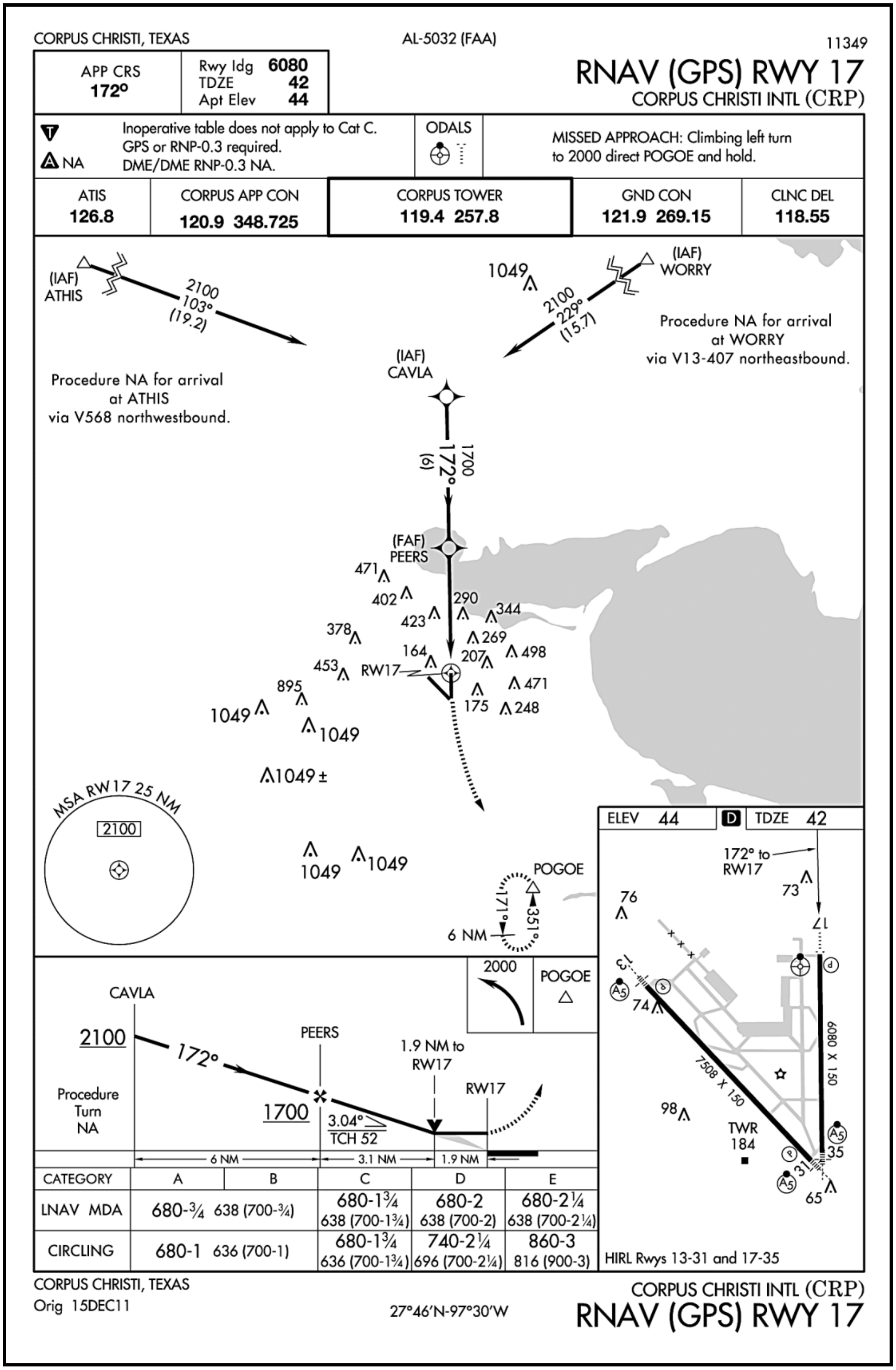
Do not push the go-around button, or cycle the FMS past the MAP prior to going missed approach, unless you are climbing to the missed approach altitude. Doing so will change the FMS mode from Approach Mode to Missed Approach Mode and the CDI from ±.3 to ±1.0. Once this is done, the aircraft is no longer guaranteed obstacle clearance.

The go-around button is NOT a wing leveler, nor does it provide navigation toward the first fix on the missed approach. The go-around button snapshots the aircraft's current heading and provides bank information to maintain that heading until another mode on the Flight Guidance Panel is selected.

c. **Performing the Missed Approach.** If the missed approach is initiated prior to the MAP, proceed to the MAP along the final approach course and then via the route and altitudes specified in the published missed approach procedure or comply with ATC instructions. If the missed approach procedure includes a turn, do not begin the turn prior to the MAP. The obstacle clearance area provided for the missed approach is predicated upon the missed approach being started at the MAP. The FMS/GPS may or may not provide proper guidance along the missed approach path; therefore, it is imperative to review the missed approach procedure fully prior to flying it!

CAUTION

Regardless of the method used to navigate the missed approach procedure, the pilot is still responsible for terrain and obstacle avoidance as well as any ATC-required climb gradients. Pilots must plan to climb at a minimum gradient of 200 ft/NM unless a higher gradient is published.



CATEGORY	A	B	C	D	E
LNAV MDA	680-¾ 638 (700-¾)		680-1¾ 638 (700-1¾)	680-2 638 (700-2)	680-2¼ 638 (700-2¼)
CIRCLING	680-1 636 (700-1)		680-1¾ 636 (700-1¾)	740-2¼ 696 (700-2¼)	860-3 816 (900-3)

Figure 4-34 GPS "Stand-Alone" Approach

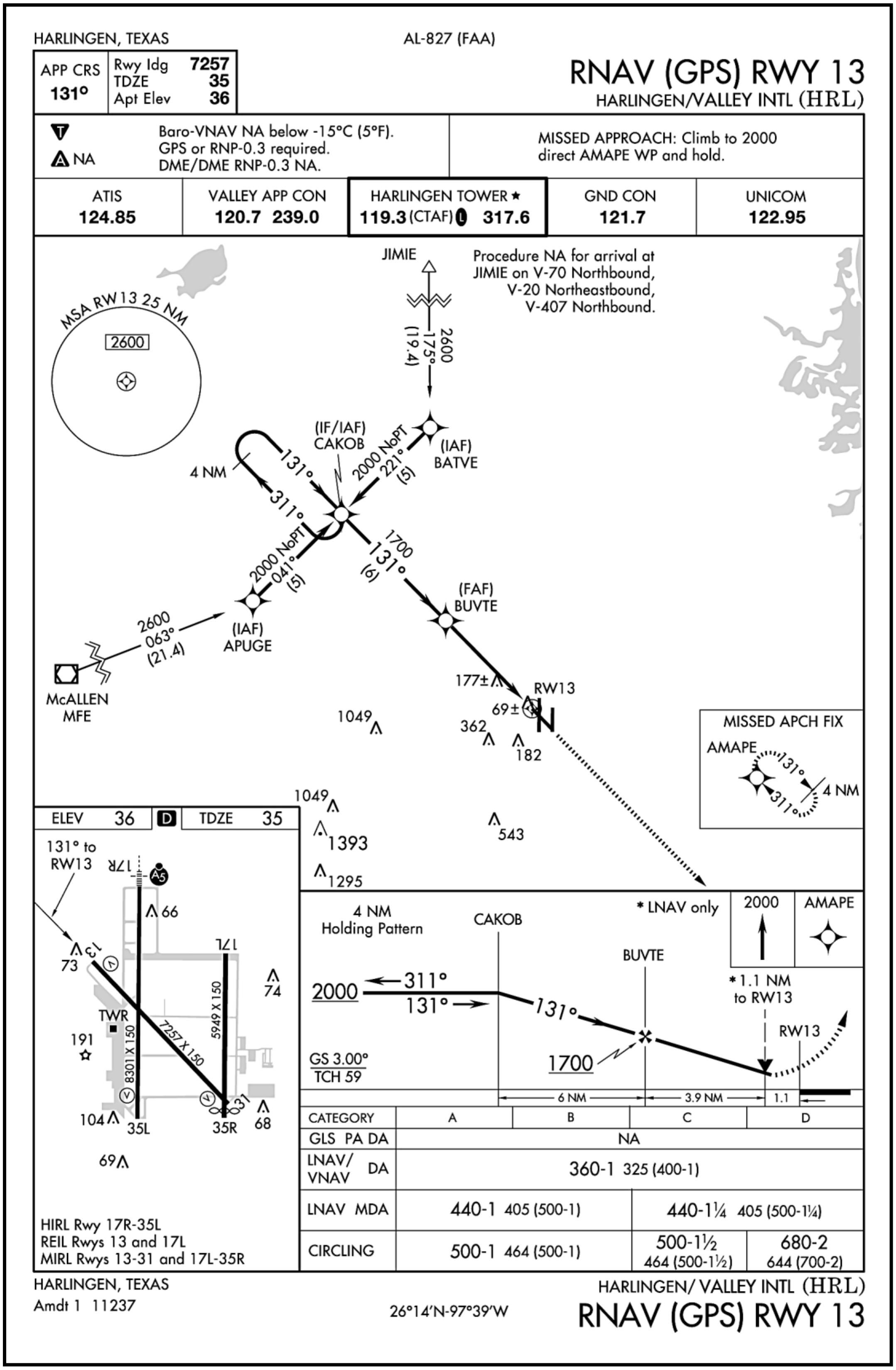
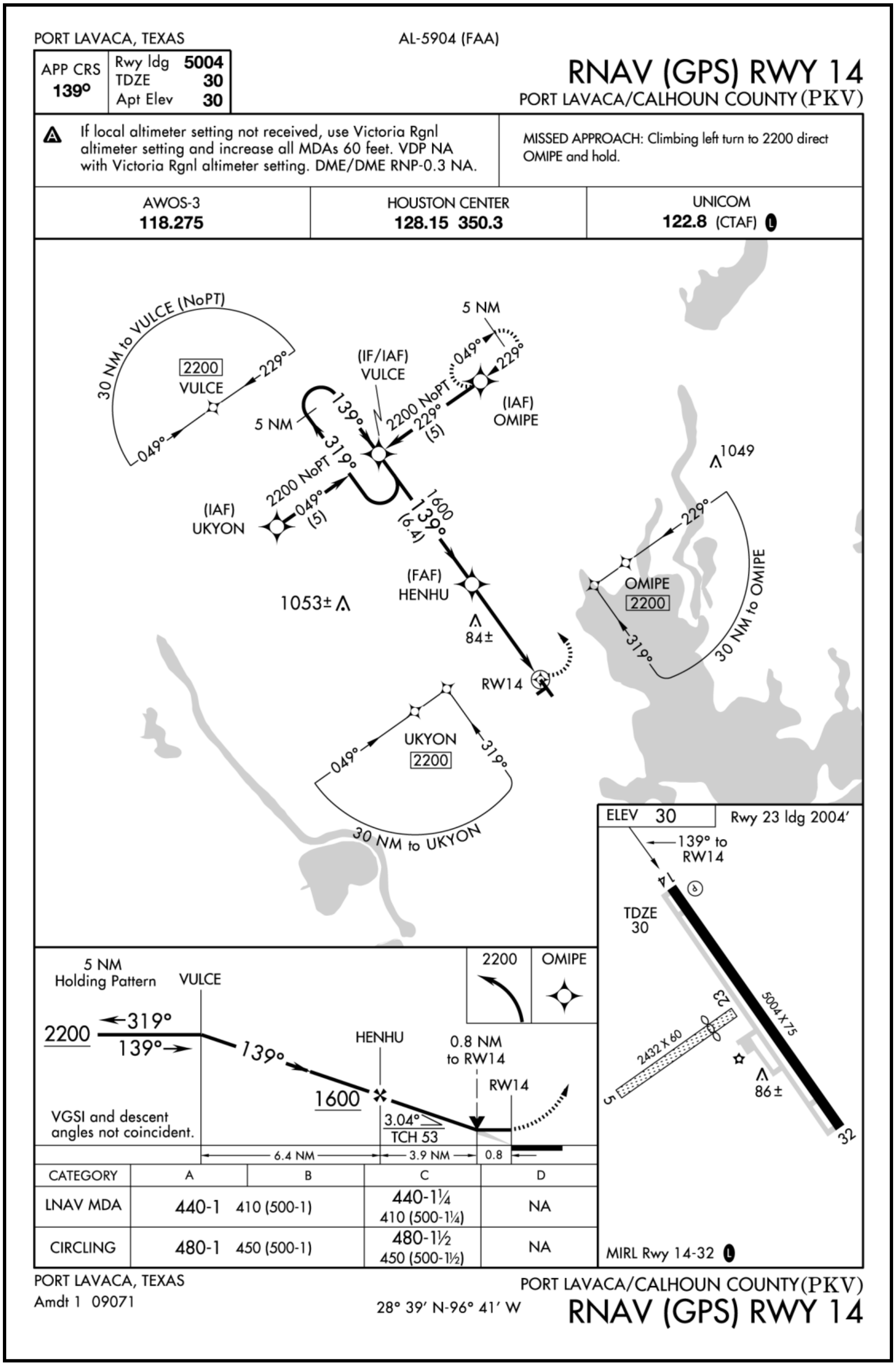


Figure 4-35 GPS "T" Approach



CATEGORY	A	B	C	D
LNAV MDA	440-1 410 (500-1)		440-1¼ 410 (500-1¼)	NA
CIRCLING	480-1 450 (500-1)		480-1½ 450 (500-1½)	NA

Figure 4-36 GPS "TAA" Approach

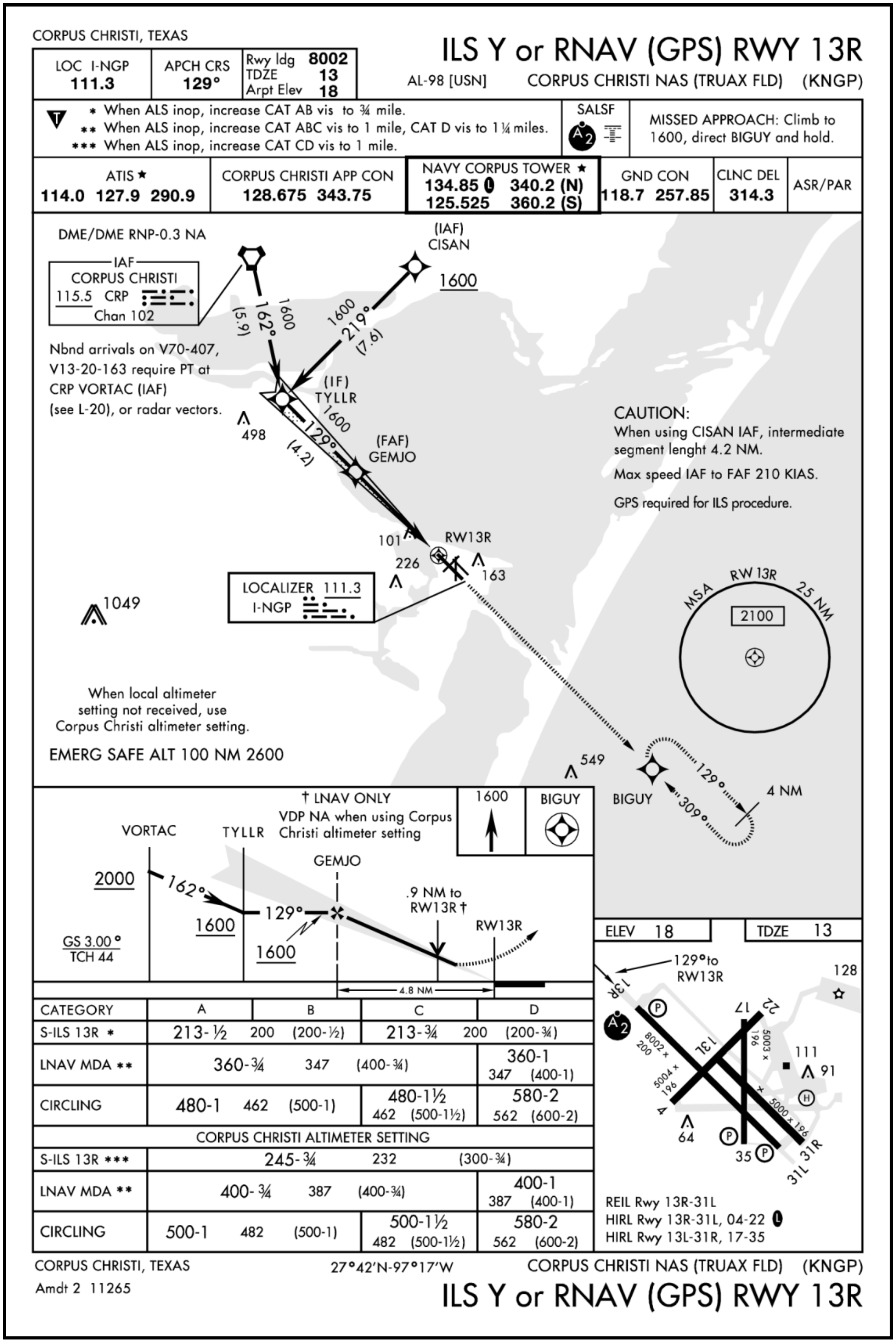


Figure 4-37 GPS “Overlay” Approach

CHAPTER FIVE
FORMATION STAGE

500. INTRODUCTION

The Formation Stage is very brief in comparison to other stages in the Advanced Maritime Curriculum. It reacquaints the student with basic formation flight procedures/principles while introducing formation flight in a multi-engine aircraft with side-by-side seating and limited visibility from the cockpit.

NOTE

> F4300 Block Students: In addition to studying this chapter, read and understand chapter six (Air Refueling Procedures) in preparing for your flight event and brief.

1. **Formation Defined.** A formation consists of two or more aircraft flying at minimum safe separation while performing coordinated maneuvers. The smallest formation unit is the Section, which consists of two aircraft: a Lead (Dash-1) and a Wing (Dash-2). Next in size is a Division, which consists of three or more aircraft.

2. **Prohibited Maneuvers/Flight Conditions**

   a. Intentional Form Flight in IMC.

   b. Night Formation Flight.

   c. Fan Breaks. Breaks wherein both aircraft execute break turns at the same time.

   d. Section Takeoffs and Section Landings.

   e. "Running" Lead Changes. Lead changes executed from other than a stable parade position.

3. **Formation Brief.** The formation brief shall be conducted by the Flight Leader and attended by all members of the flight. Only those maneuvers and flight conditions briefed are authorized. The brief must be complete, thorough, follow the NATOPS briefing format, and shall include at a minimum all items contained in the sample briefing guide detailed at the end of this chapter.

4. **Crew Coordination.** Poor crew coordination is often the cause of formation mishaps. Safe formation flight requires exact crew coordination between the lead aircraft and Wingman and within each cockpit. A thorough brief is the basis for good crew coordination. Each member of the flight must know and precisely execute their responsibilities. Some responsibilities remain constant from brief to debrief, and other responsibilities are based on

position in the flight (which changes). The following is a summary of flight positions and corresponding responsibilities.

a. **Flight Leader.** A Flight Leader shall be assigned (via annotation on the flight schedule) for each formation flight. The Flight Leader is responsible for the safe and orderly conduct of the flight and makes decisions for the flight concerning weather, type departure/recovery, fuel requirements, operating areas, etc. The same pilot holds this responsibility for the duration of the event and does not change with position within the flight e.g., the Flight Leader can be flying in either the Lead or Wing position).

b. **Formation Leader (Lead).** The Formation Leader is the PIC of the lead aircraft. The Formation Leader changes with every lead change. Responsibilities include:

i. Conduct the flight in the briefed sequence.

ii. Keep the flight clear of other aircraft.

iii. Keep the flight in VMC.

iv. Keep the flight in the assigned operating area, in compliance with course rules, and any ATC clearances.

v. Ensure completion of all appropriate checklists (climb, approach, etc.).

vi. Ensure lead aircraft is flown precisely thus providing a stable platform for Wingman.

NOTE

The PF in the lead aircraft must fly using very smooth and slow changes in attitude and power. Remember any sudden or abrupt movements cannot be anticipated or matched, and an unsafe reduction in separation may occur. To avoid confusion, the PF should handle maneuver commands on internal communications.

c. **Wingman (Wing).** The primary duty of the Wingman is to maintain position as briefed, or inform the Lead of any inability to do so. All commands should be acknowledged and frequency changes accomplished as briefed. The PF must be entirely occupied with maintaining safe separation and proper position. To avoid confusion (e.g., the PM acknowledges a maneuver command the PF either missed or misunderstood) the PF should acknowledge all maneuver commands on the internal communication frequency.

d. **Lead Pilot Monitoring Duties.** In addition to performing normal PM functions, the PM will read and perform the appropriate checklist when called for by the PF, keep a scan of engine instruments and fuel state, scan for traffic, and handle external communications for the flight. This prevents distraction of the PF from his primary duties of flying smoothly and precisely.

e. **Wing Pilot Monitoring Duties.** Since it is imperative the PF of the wing aircraft not be distracted, the PM will:

i. Read and perform checklists when called for by the PF.

ii. Keep an instrument scan to maintain awareness of heading, altitude, airspeed, and attitude (you do not want to follow the Lead into an unusual attitude or stall).

iii. Keep a scan of engine instruments.

iv. Back the PF up on the power quadrant and controls. Be ready to take action if an "in extremis" situation develops.

v. Aid the Lead in keeping the flight clear of traffic and weather using internal communications.

vi. Back the Lead up on external communications.

5. **Communications.** Good communication procedures are a prerequisite for maintaining formation integrity and are classified as internal and external. Internal communications involve only Lead and Wing. External communications are between the flight and ATC, other aircraft, etc. Communication procedures will be briefed and can be modified as necessary. The following guidelines apply:

a. **Internal Communications.** Hand signals are impractical for large aircraft and those with limited visibility from the cockpit. Lights and other signals are normally reserved for lost communication and tactical situations. All signals, commands, and matters of importance will be passed on the assigned internal discreet VHF frequency. If only an acknowledgment is required, Wing will respond simply with *"Two,"* vice *"Roger."* This avoids confusion with *"Rogers"* heard over the external frequency. If Wing is unable to comply with maneuver commands, respond with *"Standby"* while Wing maneuvers into position or *"Unable"* followed by reason Wing is unable to perform announced command. If it becomes necessary to make any internal communications over the external communication frequency (button 8, 17, 19, etc.), make only required calls in a professionally brief manner.

b. **External Communications.** A flight is considered to be one aircraft for air traffic control purposes. External communications should be handled by the Lead PM. For external frequency changes use the following sequence:

When directed to another frequency, Lead PF directs Wing on internal frequency *"Montana 431 and flight, switch button ___."*

Wing PM switches frequency and then Wing PF reports *"Two is up button ____"* on internal communications.

c. **Hang With Me.** It is difficult to transmit/receive maneuver commands on the internal frequency when the external frequency is a busy ATC frequency. In these situations, the Lead can pass "*hang with me*" and discontinue maneuver commands.

d. **Communication Conflict Resolution.** In the event of an apparent breakdown in external communication or a missed frequency change, resolve confusion on internal communications if possible. If not, the flight should return to the last good frequency to regain communications.

6. **Pertinent Shared Characteristics of the T-44.** The T-44 has no speed brake or any device designed to slow the airplane rapidly. The following is a brief discussion of various techniques to slow the aircraft, and their applicability to formation training:

a. Pulling the power levers to flight idle does not slow the airplane immediately, because it takes 5 to 20 seconds before a large power reduction will take effect. This is used as a normal procedure to control airspeed and relative motion.

b. Lowering the landing gear is the most immediate way to decelerate the aircraft, but is not practical due to airspeed limitations. The landing gear shall not be used as a speed brake; the correct procedure is to underrun.

c. Placing the prop levers to full forward will slow the aircraft with limited effectiveness. The props shall not be used as a speed brake; the correct procedure is to underrun.

d. Extending wing flaps increases drag and will slow the aircraft; however, the aircraft will balloon, resulting in an unsafe reduction of step-down. Wing flaps shall not be utilized as a speed brake. The correct procedure is to underrun.

e. Visibility forward from and across the cockpit is limited due to the high glare shield, windshield supports, small side windows, and wipers. Compensate for this by moving your head to maintain visual contact with the lead aircraft. It may be helpful to fly with the seat adjusted slightly higher and forward from your normal position. It is recommended that whichever window the PF looks through, he/she should be able to see all appropriate checkpoints in order to maintain proper position on Lead.

Although minimal, the side-by-side seating arrangement results in a difference (parallax) between the left seat and right sight picture. For standardization, fly the checkpoints as seen from your seat.

The vertical stabilizer extends approximately 5 feet (T-44) above the top of the fuselage. During an underrun, or any situation where you end up under the lead aircraft, actual separation will be significantly less than perceived from the cockpit because the tail is above and behind you. Remember, the aircraft is most sensitive in the pitch axis and it rotates about its center of gravity. If you push the nose over to descend, the tail will move slightly higher as a descent is entered. Do not over-control the nose if you end up under the Lead. A combination of nose down and a significant power reduction is the best choice.

Wingtip vortices may induce a strong rolling/climbing tendency toward the Lead's aircraft. Flying with reduced step-down will result in encountering the Lead's vortices and other fuselage induced turbulence. You must exit the vortex/turbulence before you can regain full control of the aircraft.

It is acceptable to leave the Propeller Autofeather Switch in the "ARM" position during these flights due to the relatively low altitudes, high power settings, and increased AOBs at which these flights are flown.

501. GROUND PROCEDURES

Before the brief, students shall attempt to get aircraft assignments/positions from aircraft issue.

Note the location of your Wingman's aircraft on the flight line. This will enable observation of difficulties before/during engine starts.

During the Before Start Checklist, navigation lights shall be turned on to identify the aircraft as a part of a formation flight.

Upon reaching "avionics master," tune squadron common in VHF. Lead will then report "*out of chocks*" on base frequency. When Wing is ready for taxi the Wing PM will report to base their side is "*out of the chocks,*" this will signal Lead that Wing is ready for taxi. The Flight Leader will then direct the formation to switch tactical frequency to formation common. After positive check-in on formation common Lead will then call for taxi: *"Montana 431, flight of two, Wingman 435, across from hanger 57, taxi with information Tango."*

If IMC is expected during transit to working area, aircraft shall coordinate separate IFR clearances, depart individually, and rendezvous VMC in the area.

In the runup area, leave sufficient room for Wing to position his aircraft.

Lead will obtain a block assignment and pass assignment to Wing.

After the takeoff brief has been completed, Wing will report *"Two is ready for takeoff."*

When the flight is prepared for takeoff, Lead will call for further taxi.

Secure navigation lights and switch to Tower frequency approaching the hold short.

The lead aircraft will normally squawk the appropriate code for the entire flight. The wing aircraft will keep his transponder tuned with the lead's squawk, in standby mode and activate it if detached from the flight or if the Lead's transponder malfunctions. If the Flight Leader maintains the squawk throughout the flight, it is important to remember to "ident" when requested by ATC while in the Wing or Dash-2 position.

502. FLIGHT PROCEDURES

1. **Position Keeping.** The lead aircraft is the primary attitude reference for Wing, and Wing maintains proper position by interpreting and controlling his motion relative to Lead. Identify the proper position by using the visual checkpoints on the lead aircraft, and attain/maintain that position by constantly making smooth corrections to step down, fore/aft, and lateral spacing in that order. Any corrections or movement to a new position involves three distinct actions: a control change to produce relative motion in the desired direction at a slow rate, a change to stop that movement, and a change to maintain the desired position. Identify deviations from position as soon as possible and make corrections quickly; this will result in smaller control/power changes and smoother flying.

Common tendencies that hinder good position keeping are:

a. Fixating on the lead aircraft's checkpoints.

b. "Death grip" on the yoke and power levers.

c. Making rapid, abrupt power changes.

d. Failure to trim the aircraft.

e. Getting out of position before making corrections.

2. **Airspeeds, Climb/Descent Rates and Power Requirements.** Unless otherwise specified in the brief or required by an emergency, climb and descent rates should be 1000 FPM. Airspeeds should normally be 150 KIAS or as required on course rules. Lead must leave Wing a power margin when maneuvering. Unless otherwise briefed, Lead will use a maximum of 1200 ft-lbs in climbs and when accelerating, and no less than 400 ft-lbs when descending or decelerating.

3. **Maneuver Commands.** Unless otherwise briefed, Lead will pass maneuver commands for turns, climbs, descents, level offs, changes in airspeed, etc. Wing will acknowledge or, if unable to comply with the command, he/she must transmit *"Standby"* or *"Unable"* and advise the Lead of the preferred course of action (e.g., continue turn/climb, breaking off right/left).

Example

LEAD: *"Standby left turn, standby climb."*

WING: *"Two"* or *"Standby."*

LEAD: *"Cleared to cross under."*

WING: *"Two."*

4. **Takeoff.** If the wind is calm or straight down the runway, Lead takes the center of the outboard half of the runway. For a crosswind, Lead will take the downwind side. The wind will blow his prop wash/vortices off the runway, having no effect on Wing's takeoff roll. Wing takes the center of his half of the runway with his/her wingtip adjacent to Lead's horizontal stabilizer. Set power, perform nacelle and instrument checks, and check the other aircraft for loose panels, leaks etc. If all looks good, exchange a "thumbs-up." With takeoff clearance, Lead begins a normal takeoff roll. Wing begins a takeoff roll 5 seconds after Lead. Wing calls *"Two is airborne"* when the gear is retracted.

5. **Initial Rendezvous / Departure / Climb out**

Running Rendezvous. The running rendezvous is used to join a flight that is proceeding VFR on course. Following takeoff Lead will climb out via course rules, accelerating to 140 KIAS. Wing will accelerate to Lead's airspeed plus 30 KIAS to control rate of closure. The Wing may exploit any turns by cutting inside of Lead's turn radius and converting to a CV rendezvous. The Wing should set an abeam distance from Lead of about 3-5 plane widths. If too wide of a distance is chosen, the Wing will arrive on the 45 degree bearing line with too large of a distance to close, delaying the join up. If too tight, the Wing will not be able to perceive closure. Once established on the 45 degree bearing line, Wing will ride the bearing line into starboard parade. This is a demanding maneuver due to the lack of perceived relative motion in the initial stage. When relative motion first appears, reduce power to control closure rate. If excess closure develops and cannot be controlled safely, Wing shall execute an underrun. When joined, report, "*Two is aboard starboard.*" Lead shall begin transmitting maneuver commands at this time and resume normal course rule speeds. During course rule departures, Lead may transmit, "hang with me" in lieu of separate maneuver commands.

CV Rendezvous. A CV rendezvous is used to join a flight in a turn. When safely airborne, Wing will execute a turn to get inside of Lead's radius of turn and intercept the 60 degree bearing line. Wing will place Lead on the horizon, approaching the bearing line Wing will reduce angle of bank to avoid becoming acute. Lead will maintain 140 KIAS during the rendezvous. Wing shall use a maximum of 150 KIAS until relative motion can be perceived. As the Wing approaches approximately 200 feet from Lead, Wing will transition to 45 degree "Double Step Down." Stabilizing momentarily, Wing will use AOB and power to cross under and up into the starboard parade position outside of Lead's radius of turn.

TACAN Rendezvous. A TACAN Rendezvous is a visual circular maneuver used to join a flight above the weather after takeoff or if the flight is separated. The TACAN rendezvous is normally executed in a left hand turn tangent to the briefed TACAN radial/DME at 150 KIAS, a specified altitude, and direction (inbound/outbound). As shown below, the rendezvous circle is composed of four points, with point one located at the TACAN fix and subsequent points located at 90 degree intervals around the circle.

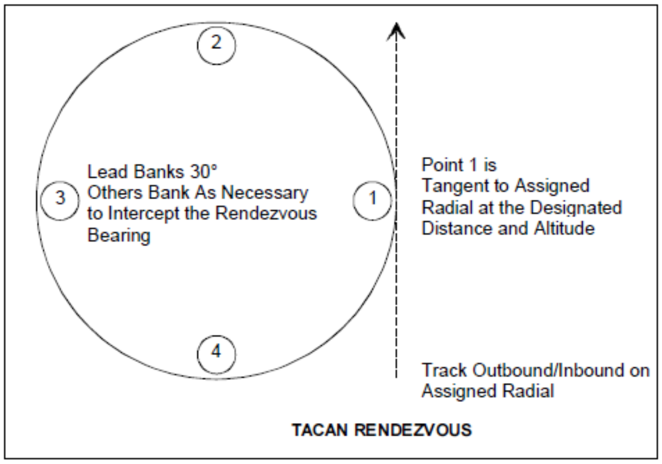


Figure 5-1 TACAN Rendezvous

Upon reaching the TACAN fix, Lead reports his call sign and position ***(e.g., Montana 431 point one)*** and commences a 30 degree AOB turn in the briefed direction. Passing each 90 degree position, Lead transmits his position until Wing acquires a visual. The Lead must adjust the rendezvous turn, to compensate for wind, so that point one is always the briefed radial and DME. The Wingman will fly towards the briefed rendezvous point 1000 feet below the briefed TACAN fix. Wing will remain 1000 feet below Lead until Lead is in sight. The Wing, approaching point one, shall transmit "*Dash-2, point one*" and commence a turn in the direction briefed. Each flight member will report their position, as required, in the rendezvous circle as they pass each respective number. From position reports, Wing will establish an idea of Lead's relative position. When Wing visually acquires Lead, Wing will report "*Visual*" and proceed to 200 feet below the briefed altitude. Wing will maneuver to get on the 60 degree bearing line with fuselages aligned before conducting a standard CV rendezvous.

Initially, if the Lead's aircraft is behind the Wing's wing line when a visual sighting is attained, the Wingman should proceed into the center of the circle (the post) and maneuver the aircraft in the lead/lag manner. The concept of lead/lag should be used to initiate a position from which the bearing line can be attained. If Lead is cross circle from Wing, the Wing should put the Lead just slightly ahead of the nose in order to close the distance. When Lead has moved approximately 30 degrees beyond Wing's nose, Wing should again put Lead just in front of the nose to close the distance. Once Wing has closed to a suitable distance, Wing should attain fuselage alignment and continue with rendezvous as described above.

6. **Underrun.** If Wing fails to recognize or control a rapid closure rate, execute underrun procedures:

a. Increase step-down.

b. Keep Lead in sight.

c. Level the wings (it is okay to allow relative motion to move you outside of Lead's turn; that is preferable to going belly-up to Lead while trying not to go outside Lead's turn).

d. Reduce power to idle to avoid passing ahead of Lead.

e. Transmit *"Underrunning."*

f. When relative motion is under control, join in the assigned position.

7. **Checkpoints.**

To position your aircraft on Lead's 45º bearing (45º aft of Lead's wing); place the tip of Lead's VHF/UHF antenna on the leading edge tip of the horizontal stabilizer. Use of this checkpoint provides step-down. To determine lateral separation, proceed up the bearing line until the vertical stabilizer is directly above a point 1/3 of the way inboard from the wingtip (above the star on the port wing). This sight picture is used for "turns into" Lead as well because Wing turns on Lead's axis. For "turns away" from Lead, Wing turns on his/her own axis, maintaining altitude unless IMC to which all turns are around Lead's axis due to lack of reference with horizon. The "double step-down" checkpoints are used during "turns away."

The "double step-down" position is also used for crossunders, lead changes, and rendezvous. For lateral separation keep half of the outboard nacelle's inboard exhaust opening visible below lead's fuselage. To determine lateral separation, envision a 5' long upper UHF antenna; keep it lined up with the stabilizer leading edge tip.

Identify the 60º bearing (30º aft of lead's wing) by placing Lead's opposite wingtip in line with the trailing portion of the vertical stabilizer. Alternately, when in close, you can place the fuselage star insignia on the tip of the leading edge of the horizontal stabilizer.

During cruise flight Wing may maintain the 20º bearing (70º aft of Lead's wing). This can be identified by lining up the exposed portion of the main landing gear tire with the nose of the lead aircraft. Maintain step-down in cruise by holding Lead slightly above the horizon, or in the top half of the windscreen.

8. **Parade Position.** The parade position is flown with Wing joined on the 45° bearing. Step-down will be approximately 20 feet, nose-to-tail separation approximately 15 feet, with 10 feet lateral separation between Wing's nose and Lead's wingtip. Distance between aircraft down the bearing line is approximately 25-30 feet.

Figure 5-2 Parade Position

9. **Parade Turns.** Parade turns are made at 30° AOB utilizing a reduced roll rate with Wing maintaining parade position throughout. For turns away, Wing must add power. For turns into, Wing must reduce power. Before commencing a parade turn, Lead will:

a. Check Wingman in position.

b. Clear the area.

c. Transmit the turn signal, *"Standby for left/right turn."* When Wing responds, smoothly roll into the turn. Maintain altitude, AOB, and a constant power setting. Roll out of turns using "*Standby roll-out*" or "*Standby reversal*" and the same rate of roll.

Figure 5-3 Parade Turn Away

Common tendencies are to get sucked (aft of bearing) during "turns into" and to let distance between aircraft increase during "turns away" (not adding enough power).

A common tendency for Wing that finds himself acute (ahead of bearing) on the inside of a turn is to increase AOB to move away from the Lead. This is dangerous because the aircraft will move farther ahead and may lose sight of Lead. The correct procedure is to reduce power and/or AOB.

10. **Crossunder.** The crossunder is a maneuver where the Wing moves from parade position to the opposite parade position. In addition to accomplishing the crossunder, the maneuver also provides practice in controlling the rate and direction of relative motion.

Lead will check the Wing in position, clear the area, select a heading giving the Wing ample time to complete the crossunder, and then transmit *"Cleared to cross under."*

Wing will acknowledge the crossunder signal and stabilize in the parade position before commencing the crossunder. Begin by moving into the "double step-down" position. Execute a wing dip to establish a 3-5 degree heading differential, moving (wings level) slowly across and behind Lead. An increase in power is required to maintain constant nose-to-tail separation. Stabilize on the 45° bearing in "double step-down," climb into the parade position then report *"Two's established port."*

11. **Free Cruise.** The cruise position is designed to reduce workload and save fuel when flying formation for extended periods. Wing maintains Lead between the 11 o'clock and 1 o'clock position and 500-1000 feet nose-to-tail distance. When in position, Lead should look approximately three inches wide from wingtip-to-wingtip (about the distance between the index and little finger). Wing maintains a constant power setting of 900 ft-lbs, and maintains position by using radius of turn advantage.

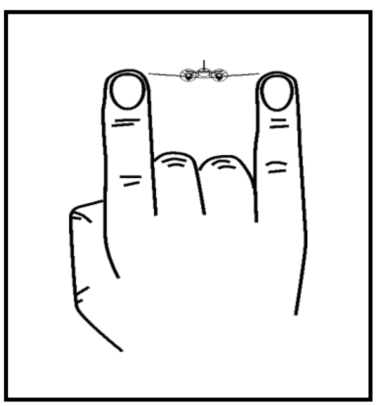


Figure 5-4 Wingtip Distance

The free cruise maneuver is intended to increase proficiency at maintaining a good cruise position. The maneuver is begun from the parade position. Lead transmits *"Standby for free cruise,"* and sets 900 ft-lbs. Wing falls into trail 500-1000 feet behind Lead and approximately 200 feet above Lead's altitude. When in position, Wing reports *"Two's established free cruise."*

Both aircraft will maintain a constant power setting of 900 ft-lbs. Lead will begin unannounced turns, climbs, and descents. Wing maneuvers to maintain cruise position. If Lead climbs/descends, Wing should initiate a climb/descent immediately upon recognition. If Lead turns, Wing should turn at the approximate point in space at which Lead began their turn in order to maintain proper cruise position.

To remain within NATOPS parameters, Lead shall not exceed 45° AOB or 20° nose up/down while Wing shall not exceed 60° AOB or 45° nose up/down. Lead shall not exceed 200 KIAS or get slower than 120 KIAS. Wing will remain within NATOPS airspeed limits. Any unsafe condition will be identified and terminated with a "*Knock it off*" call by either aircraft.

WARNING

Failure to maintain adequate vertical spacing may result in a hazardous rolling tendency due to wingtip vortices and prop wash.

When ready to rejoin the flight, Lead transmits *"Slowing to 150 KIAS, heading 180°, cleared to join starboard."* Wing responds and executes a running rendezvous.

NOTE

If lost sight during free cruise: Wing calls, "*lost sight and altitude*," and Lead calls "*altitude*" and deconflicts the formation.

12. **Breakup and Rendezvous**

The breakup and rendezvous is a practice maneuver during which the Wing joins on the Lead aircraft using AOB/radius of turn while maintaining a constant airspeed. This is a constant power maneuver and the limited visibility from the cockpit requires moving in on the 60º bearing from a significant step down position, thus ending up climbing while joining, requiring power to maintain airspeed.

a. **Lead.** When level at 150 KIAS check the Wing in the starboard parade position and clear the area. Transmit *"Standby breakup and rendezvous."* When Wing responds, sharply roll to left 45º AOB. Maintain altitude and airspeed for 180º of turn, report rollout heading to Wing. Roll out smartly on heading, fine-tuning airspeed, altitude, and trim. Upon receipt of Wing's "*column*" report, roll the aircraft sharply to 45º left AOB initially (flash) and then decrease to 20º AOB. Maintain 20° AOB, airspeed, and altitude until Wing reports in position. The maneuver is considered complete when Wing reports *"Two's aboard starboard."*

b. **Wing.** As the Lead approaches the ten o'clock position, break left at 45º AOB while descending 200 feet. Maintain 150 KIAS throughout the maneuver. ***MAINTAIN VISUAL CONTACT WITH THE LEAD AIRCRAFT***. Vary AOB as necessary to establish interval. The easiest way to do this is to keep Lead at your eleven o'clock position during the breakup turn. Once in trail with Lead positioned slightly above the glare-shield, transmit *"Column."* When you see Lead's wing "flash," turn out of column using 20-30 degrees AOB to get inside lead's radius of turn. Adjust AOB as necessary to move onto the 60º bearing line. Getting on the bearing and staying there may require significant AOB corrections. The ideal 60° bearing line is Lead's outboard wingtip just visible or cresting behind the vertical stabilizer. As Lead's outboard wingtip becomes further aft of the vertical stabilizer, you are too far behind the bearing or sucked. Correct this by increasing AOB. If Lead's outboard wingtip disappears behind his vertical stabilizer, you are too far ahead of the bearing or acute. Correct this by decreasing AOB until the correct position is attained. Throughout the rendezvous, use power as required to maintain 150 KIAS. Radius of turn controls closure rate. With the same airspeed as Lead and on bearing, you should have a comfortable closure rate. As you get closer to Lead, maintain the 60º bearing by keeping the leading tip of the horizontal stabilizer slightly above the star insignia.

c. **Join-up.** The join-up phase of the rendezvous begins when the distance between aircraft is approximately 150 feet. Adjust position to the 45º "double step-down" turns into position. Stabilize momentarily, then use AOB and power to cross under and up into starboard parade position outside of lead's radius of turn. This will require a power increase since you will be moving outside of lead's turn radius and climbing approximately 40' at the same time. Report aboard when stable in the starboard parade position.

Figure 5-5 Rendezvous Join-Up

13. **Lead Change.** Poor coordination during lead changes has been the cause of numerous mishaps; therefore, they must be executed smoothly and exactly. Lead changes shall be initiated from straight-and-level flight with Wing in the port parade or starboard parade position. All lead changes are made with Wing moving into position on the left side of Lead. When Lead is prepared for a lead change, Lead shall signal Wing with *"Cleared to position for lead change."* Wing shall respond *"Two."*

If maneuvering from starboard parade, execute a crossunder but do not stabilize in port parade. Continue moving out to a lateral wingtip-to-wingtip separation of approximately 100 feet or 2-3 plane widths before moving forward of lead's wingtip, simultaneously establishing a slight stepped-up position on Lead. While moving forward of Lead, cross-check heading to ensure the aircraft does not enter a drift into Lead. If maneuvering from a port parade position, take lateral separation while moving abeam Lead and to a slight step-up position. During maneuvering, it is Wing's responsibility to maintain safe separation from Lead.

When Wing is established at Lead's 10 o'clock position, Wing reports *"435 in position for the lead."* Lead shall then transmit *"435 you have the lead on the left."* The new Lead reports *"435 has the lead on the left, you are cleared to join starboard."* At this point, the old Lead (new Wing) acknowledges completion of the lead change by responding *"Two,"* assumes responsibility for maintaining safe separation, and moves aft and down into the starboard parade position. The new Lead shall maintain straight-and-level flight until the new Wing reports *"Two is aboard starboard."*

14. **Recovery.** Wing shall obtain, and pass to Lead, the current ATIS information to determine the runway in use and the type of recovery to be executed.

Since formation IMC recoveries shall not normally be performed, it may be necessary to separate the formation to recover. If the decision is made to recover individually, proceed as briefed. Lead shall detach Wing, letting them recover first.

If weather permits a VMC recovery, proceed via course rules. Transmit *"Hang with me"* to Wing; meaning the flight will continue without further maneuver commands. Lead should concentrate on making slow and deliberate maneuvers. Wing must anticipate the lead aircraft's descent with caution. The tendency is to allow step-down to decrease and begin to underrun the Lead during the initial stages of the descent.

15. **The Break.** While inbound, ensure Wing is positioned on the appropriate side for runway in use. Lead will establish the flight at break altitude and 170 KIAS on extended runway centerline. When cleared to break, Lead will check Wing in proper position, rapidly roll into a 60° AOB level break and maintain power through the first 90° of turn to increase interval. Once on downwind, descend to 800 feet and slow to normal pattern airspeed (120 KIAS).

Wing will make a 45° AOB level break three seconds after Lead. Once established in the turn, reduce power to idle. Maintain visual contact with Lead. If closing on the leader, the Wingman can maintain separation by reducing AOB to move wider abeam. On downwind descend to 800 feet.

Extend gear and flaps when airspeed permits (not in unison). Wing will transmit to Lead *"Two is three down and locked."* Approaching the 180 with the Landing Checklist complete, Lead shall call the Tower, *"Navy Tower, Montana 431 and flight, left 180, three down and locked, full stop, Wingman three down and locked."* Reduced runway separation is approved for formation touch-and-go and full-stop landings.

Both aircraft will make normal landings on centerline. If performing more than one landing, the ideal separation is for Wing to touch down just as the Lead is rotating.

If another break evolution is desired, Lead should advise Approach Control/Tower of intentions during the initial recovery. The flight will make a touch and go, join in a running rendezvous during departure, effect a standard lead change, and reenter for the break via course rules. Coordinate with approach control to remain at 1000 feet for reentry. This will make for a smoother evolution.

16. **Instrument Approach Exposure.** A section instrument approach may be flown in VMC to gain experience in precision formation flight. Instrument procedures and configurations remain the same as for normal approaches with the following exceptions:

a. Flap and landing gear extensions are a delicate maneuver requiring close coordination. Lead may elect to fly a no-flap approach. Before making a configuration change, Lead must advise Wing with *"Standby flaps approach or gear."* Lead transmits, *"Flaps or gear now, now, now"* and extends on the *third "now."* Wing also extends/configures on Lead's third "*now,*" controlling any ballooning effects. With configuration changes complete, Wing reports *"Landing Checklist complete"* to Lead.

b. Fly the final approach course or glideslope to not less than 300 feet AGL or as directed by ATC. At this point, Lead shall begin a low approach and advise the controller of intentions. Wing shall continue the descent to a normal landing.

c. If flying a section instrument approach with a Wingman that is Lost Comm, Lead will execute a touch-and-go landing to indicate that the wing aircraft is cleared to land. Wing will increase separation once field is in sight so as to be in a position for a full stop behind lead's touch and go.

WARNING

The lead aircraft may create significant downwash when going around.

17. **Dissimilar Aircraft Formation.** Dissimilar formation is defined as formation flight consisting of two or more different types of aircraft. Although dissimilar formation in the T-44C is highly discouraged, a thorough understanding of some of the hazards of dissimilar formation is important to your flying career. When aircraft fly in formation, they produce mutual interference of the flow patterns around each aircraft. This change in the aerodynamics can require prompt pilot action to prevent a collision. Most formation flight is practiced with similar aircraft, therefore the aircraft characteristics, limitations, and pilot responses are known in advance. During dissimilar formation, the location, magnitude of wingtip vortices, downwash, or interference patterns may not be known until encountered, often with fatal results. Dissimilar formation flight can be done safely (if authorized by your command) after thorough planning, briefing, and much practice.

NOTE

Most tactical jets are in the "Large Aircraft" wake turbulence category, including such "small" jets as the A-4 and F-16.

18. **Formation Emergency Procedures.** When flying formation, aircraft emergencies or any situation that creates a midair collision threat must be handled quickly and safely. An aircraft with an emergency requiring immediate action will transmit *"Knock it off."* Following is a list of probable unsafe situations/emergencies and appropriate procedures:

a. **Lost Sight, Blind.** Occurs any time Wing loses sight of Lead during VMC operations and plans to rejoin. This must be briefed thoroughly. The obvious danger is a midair collision. Wing must recognize this situation immediately! The following procedures shall be utilized:

i. Wing transmits *"Lost Sight"* or *"Two's blind"* and altitude on internal frequency.

ii. In level flight – Wing increases step-down 500ft.

iii. In a climb – Wing holds altitude; Lead continues climb 500ft.

iv. In a descent – Wing continues descent 500ft, Lead holds altitude.

v. Turns into – Lead rolls out and calls out heading. Wing continues turning for 30° past lead's heading.

vi. Turns away – Wing rolls out and calls out heading. Lead continues turning for 30° past Wing's heading.

vii. Wing cautiously maneuvers to regain visual contact and rejoin ensuring safe altitude separation while maneuvering.

viii. If visual contact is not regained, inform Lead of position (Radial/DME), heading, and altitude. If Lead has Wing in sight, Lead informs Wing of position.

ix. Lead coordinates rendezvous.

x. If lost sight during free cruise: Wing calls, "*lost sight and altitude*," and Lead calls "*altitude*" and deconflicts the formation.

b. **Inadvertent IMC.** If IMC is unavoidable, Wing should maintain a good parade position while Lead maneuvers the flight to exit IMC as soon as possible (180 turn, climb, descend) to exit clouds. In all but the most severe conditions Wing should, if in parade position, be able to maintain sight of lead. If the flight is unable to regain

VMC or Wing loses sight of lead, the following procedure will safely provide adequate vertical, lateral, and nose-to-tail separation.

Wing announces "Lost Sight, IMC breakup." Wing announces his altitude and lateral separation is initiated IAW the existing Lost Sight procedure (p. 5-16), except, if wings level, Wing gains lateral separation by turning away from Lead's last known position. Lead is directive regarding heading assignments (i.e. Reversal, diverge 30 degrees IAW existing Lost Sight, etc.) and altitude assignments, giving consideration to obstacle clearance if needed. Lead will climb 500 feet above Wing's assigned altitude.

If VMC is quickly regained, Lead will coordinate a rendezvous. If VMC is not quickly regained, Lead will coordinate with ATC for IFR handling.

NOTE

Wing squawking active after Lost Sight and/or IMC breakup may increase situational through use of the TAS.

c. **Radio and equipment failures.** Any loss of internal or external communication ability or any equipment necessary to continue the mission shall be reported to the Flight Leader as soon as practicable. If one aircraft loses communications, the other aircraft will normally assume the lead, the squawk, and proceed to home field using the following procedures.

NOTE

The lost comm aircraft should squawk *"Standby"* and the other aircraft should assume all responsibility for squawking and "identing."

d. **Wing – Lost Communications.** Wing will turn his/her rotating beacon off and maintain assigned position. If not joined, watch for lead's "join up" signal (shallow rocking of wings), and join in the starboard parade position. After no response from Wing on either internal or external communications, Lead should note Wing's rotating beacon off, inform ATC of NORDO Wingman, signal Wing to join in starboard parade if not already established, and lead the formation home. Upon entry into the Tower airspace, Lead shall inform Tower of NORDO Wingman and request ALDIS signals. If Wing is cleared to land, Lead shall perform a touch-and-go landing and enter the downwind pattern. Wing will perform a full-stop landing.

NOTE

The NORDO aircraft still maintains responsibility for confirming status of ALDIS lamp signals and/or waveoff lights.

e. **Lead – Lost Communications.** Lead will turn his beacon off and "tail wag" by stepping lightly on the rudders. This will catch the Wing's attention, signal lost communications, and clears the Wing to maneuver for a lead change. Wing acknowledges by securing his beacon. When in position to assume the lead, the Wing turns his beacon back on. The lost communication Lead then turns his beacon back on to signal the actual lead change, and joins in starboard parade upon observing the new lead aircraft rocking the ailerons.

f. **Engine Failure.** Engine loss of the lead aircraft's inboard engine is a serious hazard that Wing must be prepared for at all times. In-flight evaluation has shown the primary hazard to be a rapid loss of airspeed with accompanying yawing into the dead engine. Wing must be prepared for emergency evasive maneuvering. Any sign of impending failure shall be cause for a "*knock it off*" call. If an aircraft in the flight suffers an engine failure, the Flight Leader will choose the most practical means of recovery for the flight. Every effort should be made to maintain flight integrity.

g. **Mid-Air Collision.** In the event of a mid-air collision, regain control and make a "*knock it off*" call. Follow NATOPS procedures to determine aircraft controllability. The Lead will coordinate altitude assignments and separate chase ships as necessary. If feasible, attempt to visually assess the other aircraft's damage while maneuvering away. The aircraft shall not form up on each other again. Both aircraft will recover to nearby suitable fields considering possibly recovering to separate airfields based on available runways.

h. **Aborted Takeoff.** If the lead aircraft aborts a takeoff, the entire flight shall abort. Lead must immediately notify Wing and Tower by making a "*Montana 431 aborting*" call on Tower frequency. Lead remains on his half of the runway avoiding unnecessarily high rates of deceleration. Wing shall avoid overtaking Lead and inform Lead when safely decelerated to allow Lead full use of the entire runway. If Wing aborts, he/she must allow Lead to become safely airborne before notifying the Tower and Lead. Lead shall continue his takeoff and return to land at his/her discretion.

i. **Knock It Off.** This call is used to discontinue the training evolution. Upon hearing this call, aircraft should take safe separation (approximately 500 feet), but maintain section integrity if possible. Discuss the situation on internal communications and standby for further instructions from the Flight Leader.

FORM SEQUENCE

FLIGHT CALL SIGN:____________________

ATIS:____

CLEARANCE:____

TAKEOFF:_________ LAND:_________

OPERATING AREA:_________________

FORM SEQUENCE-DEMO/INTO/PRACTICE:
DEPARTURE (VFR/TACAN RENDEZVOUS)
RUNNING RENDEZVOUS (DEMO)
STARBOARD PARADE (DEMO/INTRO) – LUBE THE LINE
STARBOARD PARADE TURNS (180 DEMO, 360 INTRO)
CROSSUNDER TO PORT (DEMO/INTRO)
PORT PARADE TURNS (180 DEMO, 360 INTRO)
FREE CRUISE (DEMO/INTRO)
RUNNING RENDEZVOUS (INTRO)
BREAKUP AND RENDEZVOUS (DEMO/INTRO)
LEAD CHANGE
REPEAT SEQUENCE FOR NEW WING
LEAD CHANGE (INTRO)
GEAR CHECK (IP UPGRADE)
RECOVERY (VFR, IFR OR SECTION IFR)
BREAK/SECTION APPROACH TO FULL STOP

FORM BRIEF

LEAD SIDE #:_________ BUNO #:_________ PARKING:_________

WING SIDE #:_________ BUNO #:_________ PARKING:_________

WX OBSVR/FORECAST:__________________________________

TYPE OF DEPARTURE (VFR OR TACAN RENDEZVOUS)

ON TOP RENDEZVOUS:

SEAGULL NORTH – CRP 090R/045 DME Left turns Outbound
CENTRAL – CRP 115R/045 DME Left turns Outbound
SOUTH – CRP 140R/045 DME Left turns Outbound
JULIETT ALICE – NOG 090R/012 DME Left turns Inbound

ORBITING RENDEZVOUS ALTITUDE
LEAD HIGH – 500' BELOW TOP BLOCK ALTITUDE
WING LOW – 500' ABOVE BLOCK BASE ALTITUDE

COMM PLAN: TACTICAL:

PRIMARY	140.525
SECONDARY	140.625
GRADESCHOOL	123.45
CHEERLEADER	246.8
WINCHESTER	303.0
MAGNUM	357.0

FLIGHT PROCEDURES:

START POSITION/TAXI PROCEDURES
MANEUVER COMMANDS/TERMINOLOGY
COMM PROC'S (INTERNAL VS. EXTERNAL)
TAKEOFF AND JOINING PROCEDURES
POWER SETTINGS, SPEEDS, CLIMBS, DESCENTS, ETC.
FLIGHT MANEUVERS (TYPE, PROC'S, DEMO/INTRO, LIMITS, ETC)
EXCEPTIONS/MODIFICATIONS (APPROACH, GEAR CHECK, BREAK, ETC)
MAINTENANCE REQUIREMENTS – ONE A/C
NATOPS BRIEF/REMARKS

EMERGENCY PROCEDURES: ENGINE FAILURE, LOST COMM, LOST SIGHT, INADVERTENT IMC, MIDAIR, ABORTED TAKEOFF, UNDERRUN

Figure 5-6 Form Sequence/Brief, Kneeboard

FORM SEQUENCE

FLIGHT CALL SIGN: ______________________

ATIS: ___________________________________

CLEARANCE: __________________________________

TAKEOFF: ____________ LAND: ________________

OPERATING AREA: _____________________________

FORM 1 SEQUENCE: Demo/Intro

Departure (VFR or IFR Rendezvous on Top)
Running Rendezvous
Starboard Parade Demo/Intro (Lube the Line)
Starboard Parade Turns (180 Demo/360 Intro)
Crossunder to Port Demo/Intro
Port Parade turns (180 Demo/360 Intro)
Free Cruise (Demo/Intro)
Running Rendezvous (Intro)
Breakup and Rendezvous (Demo/Intro)
Lead Change (Intro)
Running Rendezvous
Starboard Parade Demo/Intro (Lube the Line)
Starboard Parade Turns (180 Demo/360 Intro)
Crossunder to Port Demo/Intro
Port Parade turns (180 Demo/360 Intro)
Free Cruise (Demo/Intro)
Running Rendezvous (Intro)
Breakup and Rendezvous (Demo/Intro)
Lead Change (Intro)

CHAPTER SIX
AIR REFUELING STAGE

600. INTRODUCTION

1. **Air Refueling Defined.** Air refueling requires exact procedures, precise timing, and multi-airplane Crew Resource Management. It is important for pilots involved in air refueling to know the capabilities of both the tanker and receiver aircraft and be familiar with fundamentals of formation flight. In addition to the FTI, Pilots shall be familiar with:

a. NATO ATP-56B *(*http://www.raf.mod.uk/downloads/atp56usnationalannex.cfm*)*

b. FLIP AP1B (Chapter 4)

c. General Planning (Chapter 4) filing requirements

d. CNAF M-3710.7

The following is a list of some important air refueling definitions:

a. **Rendezvous Control Point (RVCP).** The planned geographic point over which the receiver arrives in the observation position with the assigned tanker. RV (Rendezvous) is sometimes interchanged with AR (Air Refueling).

b. **Rendezvous Control Time (RVCT).** The planned time that the receiver and tanker will arrive over the RVCP. RV (Rendezvous) is sometimes interchanged with AR (Air Refueling).

c. **Rendezvous Initial Point (RVIP).** A point upstream and inbound to the RVCP where the receiver can get a positive fix and confirm or correct the ETA to the RVCP. RV (Rendezvous) is sometimes interchanged with AR (Air Refueling).

d. **Air Refueling Exit Point (A/R EXIT PT).** The designated geographic point at which the refueling track terminates.

e. **Air Refueling Rendezvous.** The procedure employed to enable the receiver to reach the pre-contact position behind the tanker by electronic, radio and/or visual means. The basic types of rendezvous procedures are the RV Delta (point parallel) and RV Golf (enroute).

f. **Air Refueling Track.** A track designated for air refueling.

g. **Air Refueling Altitude/Airspeed.** Altitude/airspeed at which air refueling will take place.

h. **Rendezvous Altitude.** Altitude 1K Below Tanker.

i. **Pre-Contact (ready) Position**. Boom and receptacle- The position approximately 50 feet behind and slightly below the tanker boom nozzle where the receiver stabilizes before being cleared to the contact position.

j. **Contact**. That configuration in which the tankers and receivers are physically engaged and, if applicable, their respective electrical systems indicate a contact made condition.

k. **Clear Contact.** Terminology used by tanker that authorizes the receiver to proceed to the contact position.

l. **Breakaway.** The command used by tanker or receiver flight crewmembers to indicate the need for emergency disconnect and separation of aircraft.

m. **Practice Emergency Separation.** The term to be used by tanker and receiver aircrews when referring to a practice breakaway and prior to accomplishing the maneuver.

n. **RV Delta (Point Parallel Rendezvous Procedures).** The procedure normally used when the tanker arrives in the refueling area ahead of the receiver (a tanker orbit is normally planned).

o. **Emission Control (EMCON) Procedures.** The management of electromagnetic radiation to counter an enemy's capability to detect, identify, or locate friendly emitters for exploitation by hostile action. Refer to NATO ATP-56B PART 2 - ANNEX 5B Communication Procedures.

p. **MARSA.** Military Assumes Responsibility for Separation of Aircraft applies only to participating aircraft and FAA controlled formations. MARSA is declared by tanker or receiver prior to becoming a standard formation during IFR flight. In order to declare MARSA, the tanker and receiver must be in radio contact and have confirmed altitude separation. ATC's sole responsibility concerning the use of MARSA is to provide separation between military aircraft engaged in MARSA operations and other nonparticipating IFR aircraft.

2. **Air Refueling Overview.** The mission of the Air Refueling Flight is to familiarize pilots with air refueling publications and procedures. Aircrews should act as the tanker for half of the flight then receiver for the other half. Multiple separations and rendezvous may be coordinated. The air refueling familiarization flight shall be flown in day VMC conditions. Rendezvous closure will not be continued inside 1 NM range unless visual contact is established with the tanker. Air refueling will not be continued when in-flight visibility is determined insufficient for safe air refueling operations. In the event that weather conditions do not facilitate a rejoin, each aircraft should maintain at least 1000′ vertical separation and coordinate for individual clearances back to base.

3. **Air Refueling Preflight.** The AP-1B and GP are used extensively during preflight planning. The AP-1B is used to figure out the navigational points, communications plan, A/R block altitudes, and scheduling units, shown in Figure 6-1.

AR ROUTES

NUMBER	ARIP	ARCP	NAVIGATION CHECK POINTS	EXIT	CR PLAN	REFUELING ALTITUDES	SCHEDULING UNIT	ASSIGNED ARTCC
AR111 (East)	ARG VORTAC 274/59 N36°15.00' W92°10.00'	ARG VORTAC 046/56 N36°42.00' W90°04.00'	PXV VORTAC 208/65 N37°00.00' W88°28.00'	BNA VORTAC 017/51 N36°56.00' W86°23.00'	a. 348.900 b. 319.700 c. 1-1-3 d. 2/1 e. 30/93	FL250/FL290	552 OSS/OSOS Tinker AFB, OK DSN 884-1203/1204 C405-734-1203/1204	Memphis ARCP-257.6E/132.37 E EXIT-288.35E/124.27 E
(West)	BNA VORTAC 017/51 N36°56.00' W86°23.00'	PXV VORTAC 208/65 N37°00.00' W88°28.00'	ARG VORTAC 046/56 N36°42.00' W90°04.00'	ARG VORTAC 274/59 N36°15.00' W92°10.00'				Memphis ARCP-354.15W/122.2 75W EXIT-288.35W/124.2 7W

Figure 6-1 AP-1B AR Example

a. Communication/Rendezvous Plan

i. Primary UHF

ii. Backup UHF

iii. APN 69/134/135 Settings (Beacon)

iv. APX 78/Encode/Decode (Transponder)

v. TACAN Channels Receiver/Tanker

NOTE

Tankers use the higher Air to Air TACAN frequency, A/A TACAN channels must be 63 channels apart, and the TACAN is normally set to Y.

The GP is used to help file to the AR route. Figure 6-2 is an example of what an Air Refueling flight plan should look like for the receiver aircraft using the information found in Figure 6-1. For in-flight refueling, receivers enter the AR track at the RVIP and tankers at the RVCP (RVIP if conducting an enroute rendezvous at the IP) using the Navigational Aid identifier and radial DME (if required), the track area and number, and the exit point. This information is inserted in the route of flight at the point to which it applies (e.g., ARG 274059 AR111 BNA). There are a couple of differences that are required to file an air refueling track. The Fuel on Board block has brackets around the amount of fuel that will be gained following the completion of AR. The comments made in the Remarks section lets ATC know who the receiver will be refueling with and the block altitudes requested. The last difference is that the receiver only puts the RVIP, refueling track, and AR Exit Point in the flight plan. In the example listed below the receiver will be flying AR Route 111 east followed by AR Route 111 west.

PRIVACY ACT STATEMENT

AUTHORITY: 10 USC 8012 and EO 9397.
PRINCIPAL PURPOSE: To aid in accurate identification of personnel participating in the filed flight.
ROUTINE USES: To provide data required to process flight plans with appropriate air traffic service authorities. A file is retained by the agency processing the flight plan.
DISCLOSURE: Voluntary; however, failure to provide the SSN could result in denial of flight plan processing.

DATE	AIRCRAFT CALL SIGN	AIRCRAFT DESG AND TD CODE
15 DEC 08	EMPTY 50	BE9L/G

BASE OPERATIONS USE

	TYPE FLT PLAN	TRUE AIRSPEED	POINT OF DEPARTURE	PROPOSED DEPARTURE TIME (Z)	ALTITUDE	ROUTE OF FLIGHT	TO	ETE
	I	180	TIK	2000	250	OKC TUL ARG274059 AR111 BNA017051 AR111 ARG274059		
						TUL OKC TIK	TIK	2+00
					Altitude.			

REMARKS

Request AR with GASSER 55 @ 2230Z FL250B270

RANK AND HONOR CODE

FUEL ON BD	ALTN AIRFIELD	ETE TO ALTN	NOTAMS	WEATHER	WT AND BALANCE	AIRCRAFT SERIAL NUMBER, UNIT, AND HOME STATION
4+30 [1+00]	OKC	0+10	X	-1	15DEC08, TIK	
SIGNATURE OF APPROVAL AUTHORITY	CREW/PASSENGER LIST: ATTACHED / SEE PSGR				ACTUAL DEP TIME (Z)	BASE OPERATIONS USE

Figure 6-2 AR DD-175

4. **Air Refueling Brief.** The following essential items shall be coordinated and briefed with the crew prior to any air refueling training flight. An air refueling kneeboard card example is provided in Figure 6-21.

a. Types of air refueling rendezvous

b. Air refueling area

c. RVIP / RVCP

d. RVCT

e. Air refueling altitude

f. Air refueling track

g. Air refueling speeds

h. Air refueling frequencies (primary and secondary)

i. Tanker and receiver call signs

j. Provisions for emergency, breakaway and rejoin.

601. GROUND PROCEDURES

Ground operations shall be in accordance with Formation Stage Ground Procedures in the FTI. FMS setup for the rendezvous requires the utilization of a discontinuity to display the Seagull boundaries for area orientation while still having the RVIP and RVCP as active waypoints. The best way to insert a discontinuity is to load the Seagull Area then select a departure. Insert the RVIP and RVCP then delete the other departure points. For example, the leg page setup for the receiver might be:

INITIAL POINT (blue)	CRP 115/55
CONTROL POINT (green)	CRP 115/38
-- DISCONTINUITY --	
SEAGULL BOUNDARIES	

1. As Tanker or Receiver set up intercept (Blue Method) between the RVIP to RVCP (PM in Green).

NOTE

With Tanker and Receiver utilizing the same method (PM in Green) the Tanker will be unable to have autopilot coupled via the FMS while PM outbound and instead will have to control autopilot via heading mode. This method is recommended as Tanker and Receiver roles will be switching.

2. USE 2 mile OFFSET to the Left on FLT PLAN page.

3. Inhibit FMS sequence.

4. Verify offset on Progress Page.

These techniques should be discussed at length during the AR procedures brief.

602. FLIGHT PROCEDURES

The simulated tanker and receiver aircraft will depart to the Seagull area using established formation flight procedures with the tanker as the lead aircraft. When the formation is established in the area, the tanker will advise Seagull that they accept MARSA and that multiple rendezvous will be accomplished. Each time a rendezvous is initiated or a role reversal is planned, the tanker aircraft will advise ATC. The tanker aircraft will carry the transponder code for the formation until the aircraft separate. Unless otherwise directed by ATC, when aircraft interval exceeds 3NMs, both the tanker and receiver aircraft will squawk their assigned code. Once established in seagull, the tanker shall clear the receiver aircraft to rendezvous altitude (1000′ below air refueling altitude) and the tanker will climb to air refueling altitude. The Rendezvous Initial Point is the CRP 115/ 55 and the Rendezvous Control Point is the CRP 115/38. The RVIP and RVCP may be changed by the Flight Leader to facilitate airspace requirements. If Alternate Seagull procedures are in effect the flight will coordinate RVIP and RVCP points that allow for a safe and effective rendezvous. The receiver will proceed to the designated Rendezvous Initial Point at 180 KTS and report to the tanker their estimated time to the RVIP. The tanker aircraft will climb to the air refueling altitude, proceed directly to the RVCP, and enter holding at 150 KTS. Once leveled off at the air refueling altitude, the simulated tanker aircraft shall utilize the autopilot in order to ensure a stable platform for the rendezvous.

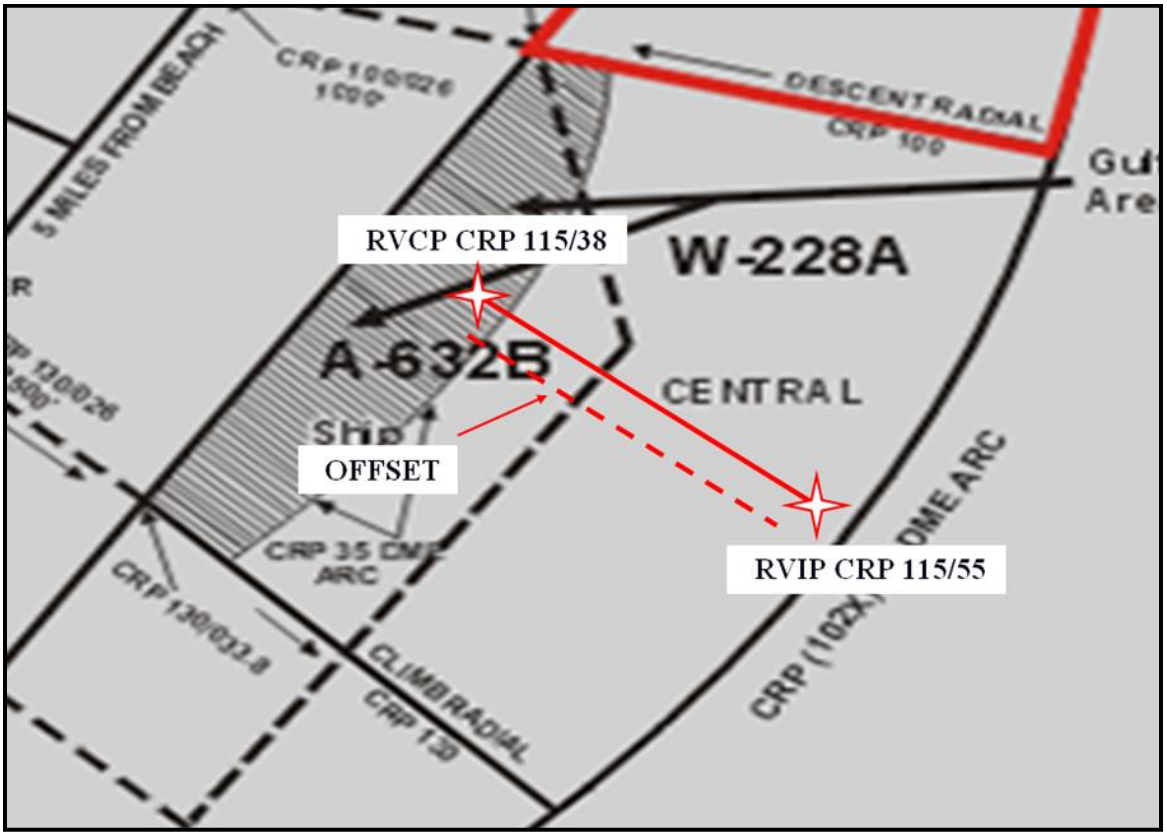


Figure 6-3 Air Refueling Track and Offset in Seagull Central

1. **Crew Coordination.** Safe execution of air refueling operations is dependent on coordination between receiver and tanker aircraft. Both crews must be at the expected altitudes and airspeeds to safely coordinate a rendezvous. A list of required actions and radio calls are listed below. These calls may be simulated if timing does not align.

a. Radio set 30 minutes prior to RVCT

b. 15 minute call (Call-sign, ETA and altitude)

c. A/A TACAN set 15 minutes prior to RVCT

d. ETA to RVIP (receiver)

e. One-half through turn call (tanker)

f. 1 mile closure call (receiver)

g. Simulated boom operator calls

i. Pre-contact call (aircraft confirmation)

ii. Clear receiver to contact

iii. Acknowledge contact/disconnect

iv. Advise receiver to return to pre-contact for checklist or equipment considerations

h. Simulated receiver calls after 15 minute call

i. Visual contact established/loss to include overrun

ii. Pre-contact call

iii. When contact or disconnect is simulated

i. Post air refueling report

2. **Checklists.** The following checklist shall be used by the receiver for completion of the air refueling rendezvous and termination. A pilot kneeboard is provided at end of the air refueling chapter.

Rendezvous /Pre-descent Checklist

1. Radios.……………………………… Set (P,CP)
2. Crew..………………………… Notified (P,CP)
3. Radar (receiver)..……………... Standby (CP)
4. TAS……………….................. As Req (CP)
5. Altimeters..………………….. As Req (P,CP)
6. TACAN A/A………………..... As Req (CP)
7. MARSA (Tanker).……………... Declare (P)

Prep for Contact (Completed By 1/2 mile)

1. Crew……………….Ready for Refueling (P)
2. Exterior Lights………………...As Req (CP)
3. Autopilot…………….............As Req (P,CP)
4. Transponder (receiver)………..…..Off (CP)
5. Seat Height………......Adjust as Req (P,CP)

Simulated Contact
1. Position…………………Monitor (P,CP,OB)

After Air Refueling
1. After Refueling Report………..As Req (CP)
2. External Lights.………………..As Req (CP)
3. Transponder……………………….Set (CP)
4. TAS……………………………As Req (CP)
5. Altimeters………………………..Set (P,CP)
6. Crew.…………………………...Notified (P)

3. **RV Delta (Point Parallel Rendezvous).** A successful point parallel rendezvous requires the receiver to fly the specified rendezvous track and speed from the RVIP to the RVCP. The receiver will call 15 minutes prior to the RVCT and relay call sign, ETA (minutes early or late), and altitude. The receiver will also advise the tanker of their ETA to the RVIP so that the tanker can plan the required offset and modify the holding pattern at the RVCP to proceed down the RVCP/ RVIP line when the receiver calls IP inbound. The tanker will then confirm his call sign, air refueling altitude, and timing (minutes early or late) if it will affect the rendezvous. If either the tanker or the receiver is not on the appropriate rendezvous altitude, an additional radio call will be made when the proper rendezvous altitudes are established. The receiver will proceed from the RVIP to the RVCP using all navigational aids necessary to arrive over the RVCP via the inbound track. Receivers will be 1000′ below air refueling altitude at the RVIP. The receiver will fly down the RVIP/ RVCP track at 180 KTS while the tanker will maintain 150 KTS during the rendezvous.

WARNING

To help ensure safe separation of aircraft, confirm tanker and receiver positions, altitudes, and altimeter settings prior to initiating altitude changes. Additionally, tankers will not initiate final turn to refueling track unless receiver has confirmed level at 1000′ below air refueling altitude.

The tanker FMS will be the primary means of maintaining the offset and the A/A TACAN will be primary for range information. To provide A/A TACAN ranging, the tanker and receiver will set the assigned TACAN channels 15 minutes prior to the RVCT. The receiver will set the numerically lower TACAN channel and the tanker will set the numerically higher channel. The accuracy of the rendezvous equipment should be cross-checked with as many available aids (TAS) as necessary. When it is determined the receiver is at the RVIP, the tanker will turn to or continue on the reciprocal of the receiver's inbound track and will establish the proper offset until reaching the planned turn range. The receiver will not deviate from the RVIP/RVCP centerline unless directed to do so by the tanker. Range will be measured directly from aircraft to aircraft.

NOTE

The turn range and track offset separation will be determined by the tanker using the appropriate chart from Figure 6-16 thru 6-20, which allows approximately 2.0 NM separation at tanker rollout. Air refueling at differing altitudes may be interpolated from these charts.

The tanker will turn inbound to the RVCP at the determined turn range and maintain appropriate air refueling speed when rolled out toward the RVCP. The tanker will note the receiver's distance when halfway through the turn back to the RVCP. This is the best time to determine if an overrun/underrun condition exists and the best time for visual sighting.

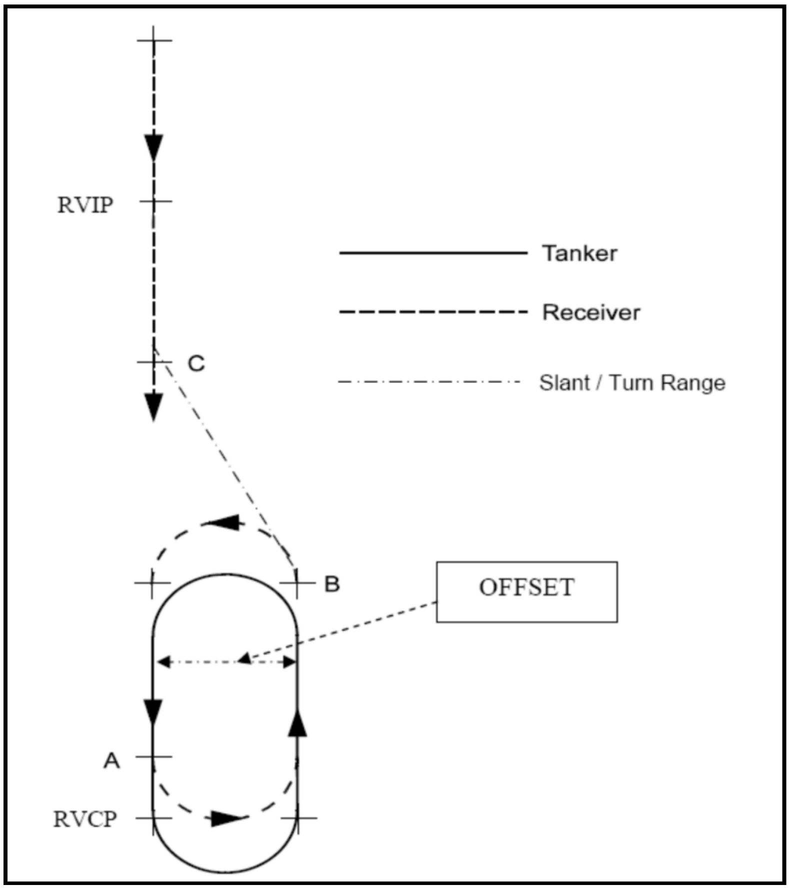


Figure 6-4 RV Delta (Point Parallel) Rendezvous

4. **RV Golf (Enroute Rendezvous).** An enroute rendezvous may be used when tanker(s) and receivers fly individual flight plans to a rendezvous point (RZ) where join-up is accomplished. For training missions, the RVIP or RVCP may be designated as RZ. In this case, air refueling will start as soon as practicable after rendezvous. Tanker(s) and receivers will join up at the RZ by controlling timing to arrive at the RZ at the same time. Timing may be adjusted using differential airspeed, orbit delays, or timing triangles. Assigned altitudes must provide at least 1000 feet separation between tanker and receiver.

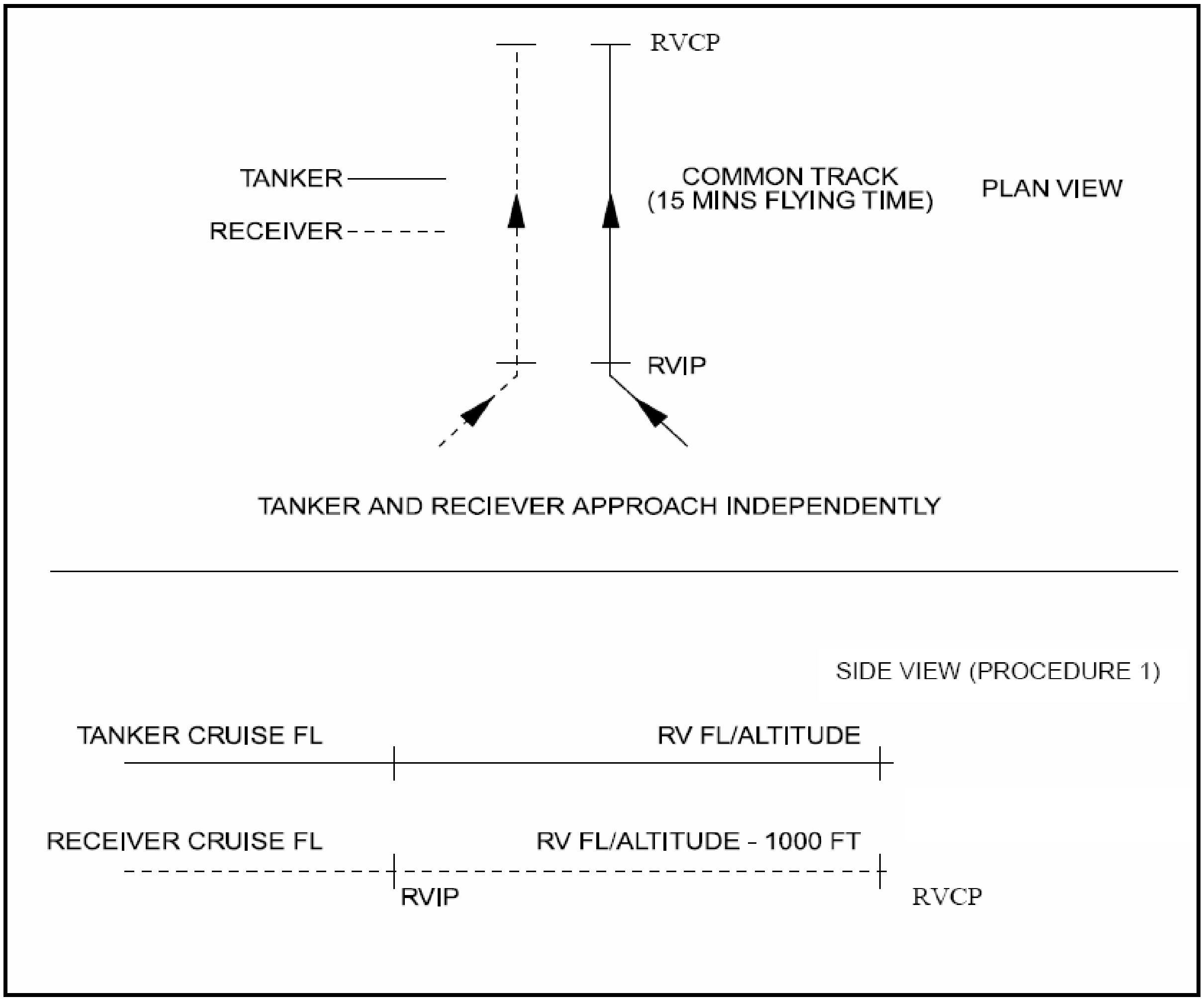


Figure 6-5 Diagram of RV Golf (Enroute)

5. **Overrun/Underrun Procedures.** If an overrun condition exists (receiver overtaking tanker), the tanker aircraft should increase airspeed to 180 KTS while the receiver should slow to 150 KTS. Once within 1 NM, the receiver shall call “terminate overrun procedures” then continue to the 1 NM point 1000’ below the tanker. During an underrun the tanker slows to 140 KTS and the receiver sets max cruise power until approaching 1 NM point. The termination of overrun/underrun procedures, called by the receiver, prompts crews to return to the standard rendezvous airspeeds.

6. **Proceeding to Pre-contact Point.** Once behind the tanker, the receiver is responsible for making course corrections to ensure completion of rendezvous. The 3-, 2-, l-, l/2-NM range calls will be given over interphone to the PF by the PM. The rendezvous altitude separation will be maintained until 1 NM from the tanker and visual contact is established. A gradual climb will then be initiated, with a minimum altitude separation of 500 feet at the l/2-NM trail, to arrive at the pre-contact position. The receiver aircraft should maintain a 10 degree bearing line climb to the pre-contact position using TACAN range information. For each .1 DME closure to the tanker, the receiver should climb 100′. For example, at .9 DME the receiver should be 900′

below the tanker and at .8 DME the receiver should be 800′ below the tanker etc. The 10 degree bearing line can also be maintained by fixing the tanker aircraft in a position in the upper 1/3 of the windscreen (varies with seat position). When the receiver is in a position to clearly see tanker features, the receiver can use the tanker engine exhaust stacks placed on the leading edge to maintain the bearing line and placement of the vertical stab in relation to the top of the wind screen for nose to tail. After rendezvous is completed, tankers will be responsible for all navigation within the designated area, weather avoidance, and position reporting.

7. **Closure.** During rendezvous the receiver will establish 180 KIAS at 1000 feet below AR altitude to a point 1 NM from the tanker. The receiver shall maintain 180 KIAS until the ranges listed in Figure 6-6. Tankers will maintain 150 KIAS air refueling airspeed during closure. If within 1 NM of closure and the tanker is off airspeed by more than 10 knots and required to decelerate or accelerate to obtain contact airspeed; the receiver pilot will be informed prior to tanker airspeed changes.

Receiver Closure Airspeed/ Altitude Schedule		
3 NM	180 KIAS	1000’ below tanker
2 NM	180 KIAS	1000’ below tanker
1 NM	180 KIAS	1000’ below tanker
½ NM	170 KIAS	500’ below tanker
.3 NM	160 KIAS	300’ below tanker
Pre-contact	150 KIAS	35’ below tanker

Figure 6-6 Receiver Closure

WARNING

The receiver will stabilize in the pre-contact position with a zero rate of closure. If the receiver fails to attain stabilized position or it becomes apparent that a closure overrun will occur, a breakaway will be initiated. Failure to initiate a breakaway under a closure overrun condition can result in a midair collision.

8. **Pre-contact Position.** The universal pre-contact position is 50′ behind the tanker on the 10 degree bearing line. For T-44 training, the pre-contact position is attained when the receiver is stabilized 35′ directly behind on the 10 degree bearing line. Visual references include the top of the vertical stabilizer placed on the top edge of the windscreen, the exhaust stacks placed on the leading edges of the wings and the nose gear door aligned with the centerline of the aircraft.

Figure 6-7 Pre-contact Position

9. **Contact.** The contact position in the T-44 is defined as 10′ directly behind the tanker, with +/- 10° lateral and vertical boundaries, and +/- 6′ fore and aft. Once the pre-contact position is attained, the receiver pilot should make the necessary corrections to align the aircraft with the tanker's fuselage centerline and dampen all relative lateral movement of the receiver aircraft. Closure from pre-contact to the contact position should be made very slowly to enable both the tanker pilot/autopilot and the receiver pilot to compensate for the required trim changes. Use established visual references to judge tanker position and scan the entire aircraft to judge relative motion. The visual indications of the contact position include the engine exhaust stacks on the leading edges of the wings, and the tanker tail fixed on the top edge of the receiver windscreen. Lateral checkpoints include the tanker fuselage crease and nose gear door aligned. Anytime lateral movement, pitch oscillations, or rate of closure become excessive, reduce power and drop back into pre-contact position and stabilize the aircraft. As the receiver reaches the contact position, the receiver pilot should hold a steady platform to demonstrate the contact position. Rough usage of controls on the part of either the receiver or tanker pilot will cause a chain reaction with progressively larger corrections required to maintain position. If a change of aircraft control is planned, the receiver should return to the pre-contact position with a slight reduction of aircraft power. An image of the contact position is provided in Figure 6-8. For the purpose of the simulated air refueling flight, the tanker will remain within the seagull area and maximize the airspace for straight and level flight. The tanker shall not exceed 30 degrees AOB while the receiver is in the pre-contact and contact positions. All planned turns should be announced to the receiver aircraft prior to execution.

Figure 6-8 Contact Position

WARNING

Up-wash and downwash effects may occur drawing the aircraft together. Low pressure areas created by an overrunning receiver flying under the tanker will affect static ports, causing possible erroneous airspeed and altitude indications to both aircraft. The tanker autopilot altitude hold function may sense the low pressure as a climbing indication and initiate a descent into the receiver aircraft. The receiver aircraft shall advise the tanker when in the pre-contact and contact positions.

10. **Boom Limits Demonstration.** Boom limits demonstrations entail maneuvering the receiver within the limits of the boom to demonstrate the contact envelope. For limit demonstrations, slowly maneuver into position and stabilize. Do not get too close to the tanker during the upper limits demonstration and be aware of the low pressure between the two aircraft which could pull them together. Lower limit demonstrations are the safest and easiest to perform. Left and right limits are performed to show the aerodynamic effects of the tanker wingtip vortices on the receiver. The tanker vortices tend to push the receiver aircraft to the

center. Inexperienced pilots will overcorrect when trying to return to centerline behind the tanker. Opposite aileron to the direction of drift back to center may be necessary to slow down the rate of return and avoid an overshooting oscillation. A technique for moving from center to the left or right is to ratchet the aircraft slowly to the outer limit then stabilize. All limits demos should align the top of the windscreen with the tail of the receiver. The upper limit is achieved when the exhaust stacks are no longer visible. The lower limit is achieved when the engine stacks are fully visible. The left and right limit is directly behind the engine's inboard exhaust stack. Images are provided in Figures 6-9 thru 6-12.

Figure 6-9 High Boom Limit

Figure 6-10 Low Boom Limit

Figure 6-11 Right Boom Limit

Figure 6-12 Left Boom Limit

11. **Disconnect.** There are two major classifications of disconnects: planned and inadvertent. Planned disconnects may be initiated by either the receiver pilot, copilot, or tanker boom operator activating his disconnect switch. Disconnects may be initiated by the receiver if less than a full load is required, if a malfunction is suspected, or for training purposes. If a prearranged quantity of fuel is to be transferred, disconnect will be initiated by the tanker boom operator after the planned amount of fuel is transferred and the receiver pilot is notified. Inadvertent disconnects may be caused by exceeding the air refueling boom envelope limits. A pressure disconnect switch in the receiver air refueling system will cause a disconnect if excessive pressure surges occur either from transfer pressure or when the selected tanks become full and the high level float switches close. To disconnect in an emergency, the receiver pilot and copilot must be prepared at all times to press the autopilot/air refueling boom release buttons. For the purposes of simulating disconnects in the T-44, receivers shall verbalize the actuation of the autopilot/air refueling release button, advise the tanker and return to the pre-contact position.

603. EMERGENCY AIR REFUELING PROCEDURES

1. **Breakaway Procedures**. When a crewmember aboard either the tanker or the receiver determines that an emergency exists, he will transmit on air-refueling frequency the tanker call sign and the word "*breakaway*" three times. When "*breakaway*" is called, the upper and lower rotating beacons will be turned on (the upper rotating beacon will normally already be on). The "breakaway" call is used to notify the tanker and receiver of any condition that would require an

immediate vertical and horizontal separation of the aircraft. This would include but not be limited to excessive rate of closure overrun and engine failure. The aircraft do not necessarily have to be in contact to call a breakaway.

The following action will be taken simultaneously by the indicated crewmembers and should be treated like boldface for breakaway procedures.

a. **Tanker pilot** – Increase power to obtain forward separation. When notified by the receiver that the receiver is well clear, the breakaway may be terminated. The receiver will be notified and acknowledgment received prior to any power reduction to reestablish refueling speed. If in a turn, maintain the established bank angle until the receiver is well clear. In either case, establish a definite rate of climb and do not decrease airspeed below that indicated at start of climb.

b. **Receiver pilot** – Simulate actuation of the autopilot/boom disconnect switch. Retard throttles, establish a definite rate of descent, transition to instruments, and use props full forward if necessary to assure safe separation. If possible, drop aft of tanker until the tanker is in sight and monitor flight instruments.

c. **Receiver copilot** – Simulate actuation of the autopilot/boom disconnect switch, maintain visual contact with the tanker, and turn on anti-collision lights until clear and standby for instructions to the pilot. The TAS may be utilized after visually confirming that aircraft are well clear.

NOTE

With certain gross weights and aircraft configurations, the receiver rate of acceleration on a breakaway may exceed the rate of acceleration for the tanker aircraft. Receiver aircraft must establish and confirm a positive rate of descent to ensure aircraft separation.

All other emergencies will be handled in accordance with “Formation Emergency Procedures” in the Maritime Formation FTI chapter.

2. **Practice Emergency Separation.** A practice emergency separation is a practice breakaway using the same procedures. To coordinate a “practice breakaway” aircrews shall use the term “*practice emergency separation*” so that the procedure is not confused with an actual breakaway. Aircrews shall brief the maneuver prior to execution. An example of a practice emergency separation brief is “This will be a practice emergency separation called by the tanker/receiver 1 minute after contact.” When ready to execute the procedure, the initiating aircraft calls the tanker formation call-sign and breakaway three times.

604. POST AIR REFUELING

Upon completion of air refueling, the receivers should descend to the bottom of the assigned altitude block while awaiting post air refueling report and further ATC clearance or coordination for role reversal. The tanker is responsible for directing positive vertical separation during refueling formation breakup/separation. All tankers and receivers shall use all means available to monitor the position of aircraft in the formation during all position changes, reforming, or departure from the flight. Receivers will ensure a safe clearance from the tanker as they proceed on their assigned missions. If the receiver is required to accelerate past the tanker and climb on the refueling heading, they will maneuver either left or right (a minimum of 1 NM) of track to preclude climbing directly in front of the tanker.

NOTE

> Any aircraft maneuvers executed prior to the termination of MARSA should be coordinated between the involved refueling aircraft. This may include verbal radio clearance between aircraft depending on emission control procedures and operational constraints. Positive visual clearance is imperative.

605. SEPARATION/TERMINATION PROCEDURES/ROLE REVERSAL

Following completion of air refueling, aircrews should maneuver to the prescribed formation position 1000′ below the tanker. Continue flying behind the tanker, remaining vigilant to keep the tanker in sight. Upon completion of air refueling, the tanker will normally climb to the top of the air refueling block and the receiver will descend to the bottom of the air refueling block. During normal air refueling the tanker coordinates and relays any receiver aircraft ATC clearances. Once the clearance is copied by the receiver, they contact ATC, MARSA is terminated and the aircraft are considered established under normal ATC separation. The receiver will maintain a safe distance from the tanker and proceed on assigned mission. The tanker will give post air refueling information to the receiver as required.

For training command tanker/receiver role reversal, once 1000′ separation is attained by the receiver, the tanker will then turn to the receiver's reciprocal heading. When 3 NM of separation is attained with increasing DME, the tanker will initiate an altitude swap. After both aircraft report level at their respective altitudes, the new tanker proceeds to the RVCP and the new receiver proceeds to the RVIP. The new receiver will then report ETA to the RVIP with a simulated 15 minute call. The procedure for a point parallel rendezvous is then initiated.

Upon the completion of the allotted rendezvous and practice separations the aircraft will rejoin and RTB. VFR recovery to KNGP will be in accordance with formation procedures and course rules. IFR recoveries will be coordinated by the tanker and executed independently in accordance with local procedures. Receivers should maintain 1000′ altitude separation and visual contact with the tanker until receiving their IFR clearance.

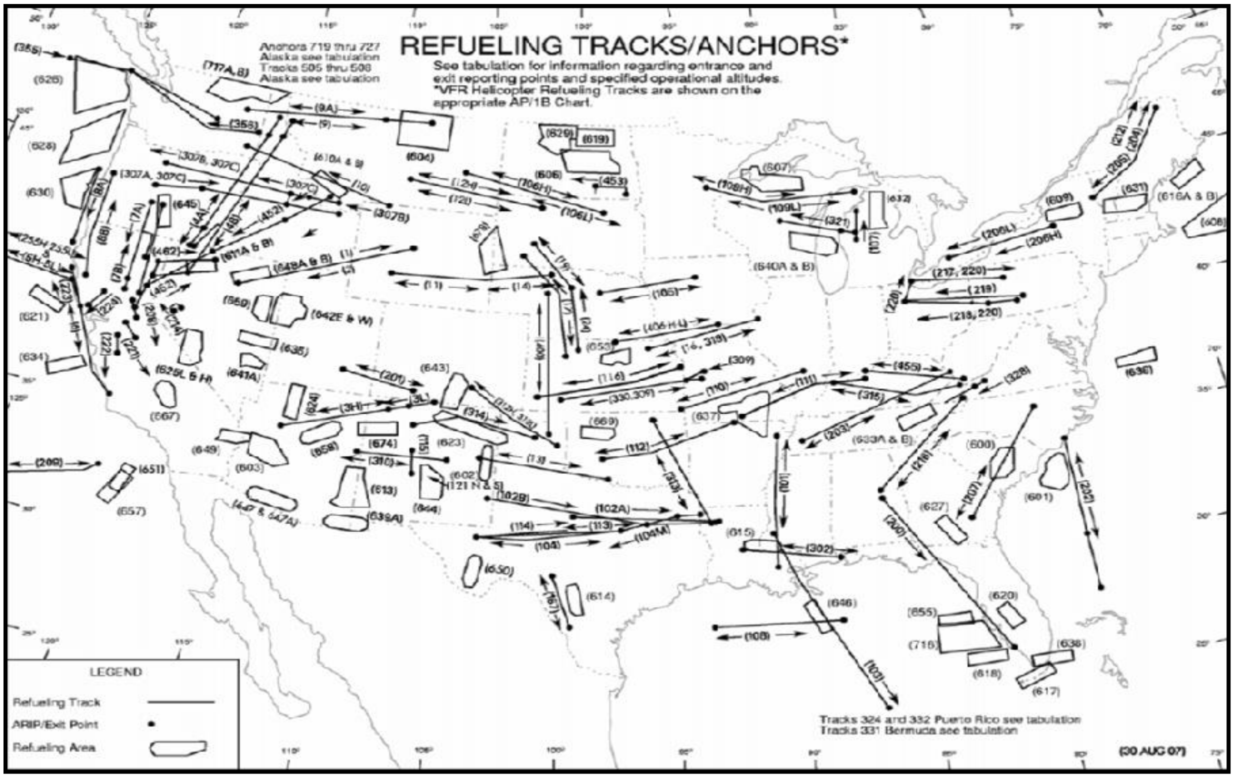


Figure 6-13 U.S. Refueling Tracks

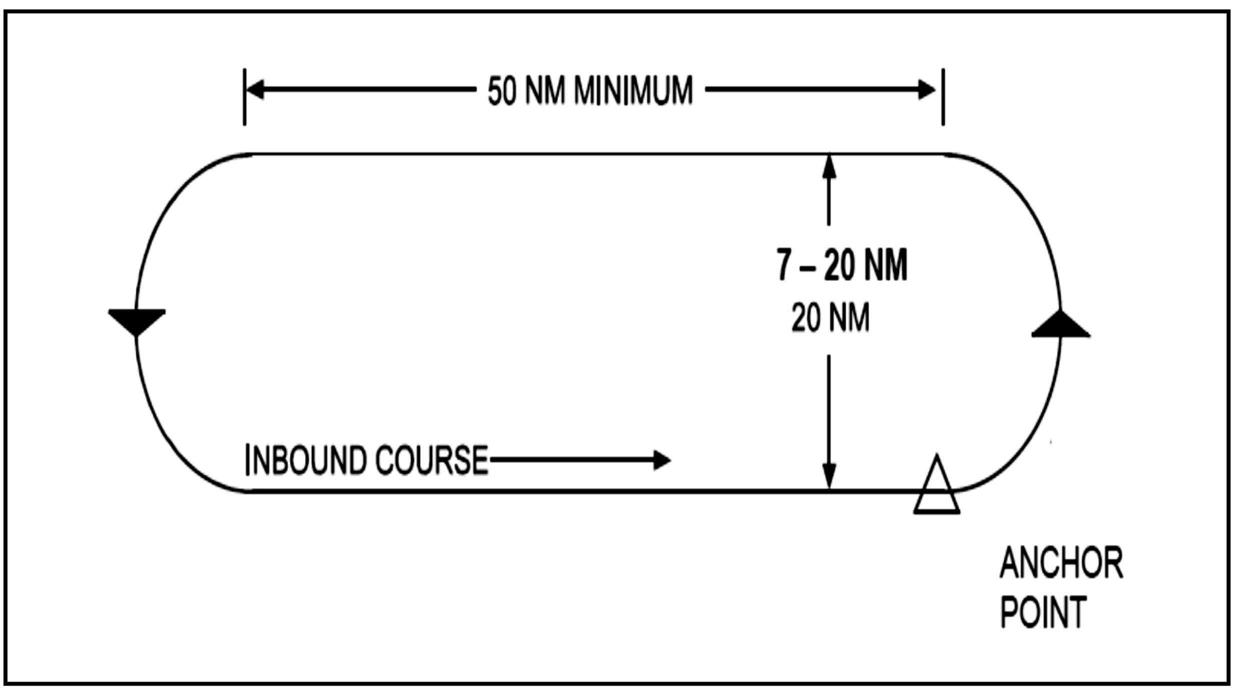


Figure 6-14 Anchor Pattern

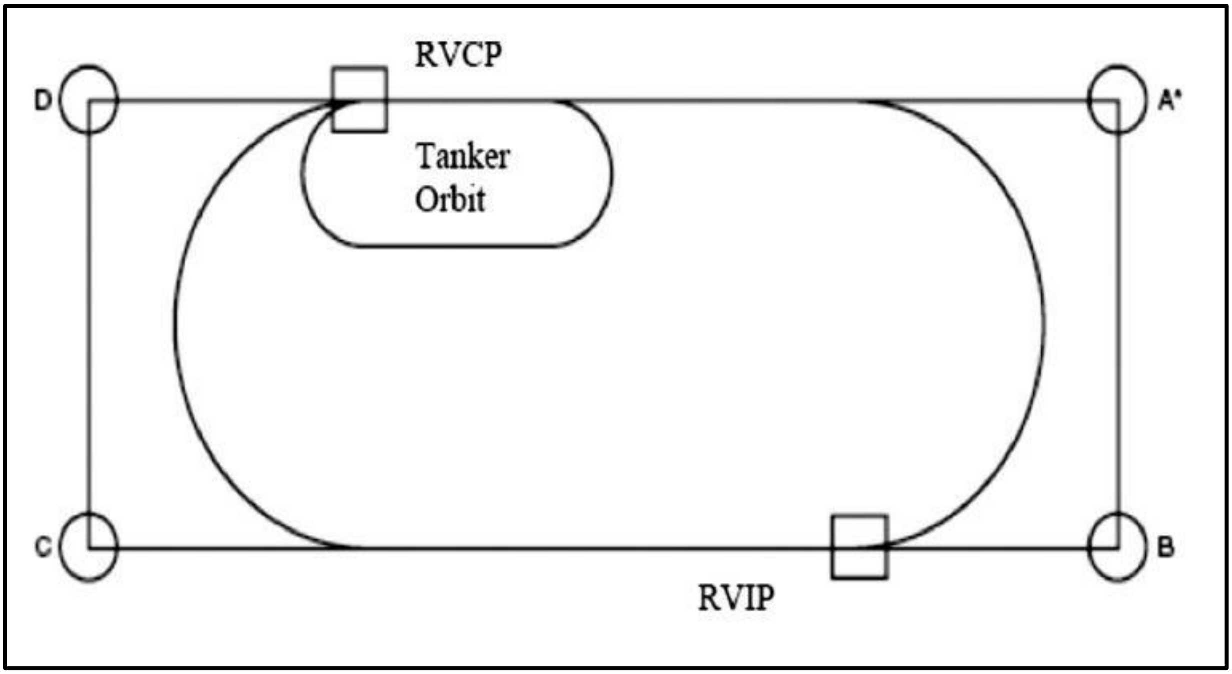


Figure 6-15 Modified RV Delta (Point Parallel)

		Roll Out Distance in NM				**2**		
25 degrees AOB		**Tanker TAS**				**154**		
Tanker IAS	150	**Receiver TAS**				**182**		
Receiver IAS	180							
Closure		**Drift**						
336		**15L**	**10L**	**5L**	**0**	**5R**	**10R**	**15R**
Offset		0.9	.8	1	1.2	1.4	1.7	1.9
Turn Range		4.5	4.7	4.9	5.1	5.2	5.4	5.5

Figure 6-16 Air Refueling Altitude 2K

		Roll Out Distance in NM			2		
25 degrees AOB		Tanker TAS			159		
Tanker IAS	150	Receiver TAS			188		
Receiver IAS	180						
Closure		**Drift**					
347		**15L**	**10L**	**5L**	**0**	**5R**	**10R**	**15R**
Offset		0.7	.9	1.1	1.3	1.5	1.8	2.0
Turn Range		4.7	4.9	5.1	5.3	5.4	5.6	5.8

Figure 6-17 Air Refueling Altitude 5K

		Roll Out Distance in NM			2		
25 degrees AOB		Tanker TAS			170		
Tanker IAS	150	Receiver TAS			200		
Receiver IAS	180						
Closure		**Drift**					
370		**15L**	**10L**	**5L**	**0**	**5R**	**10R**	**15R**
Offset		.8	1.0	2	1.5	1.7	2.0	2.3
Turn Range		5.0	5.2	5.4	5.7	5.9	6.0	6.2

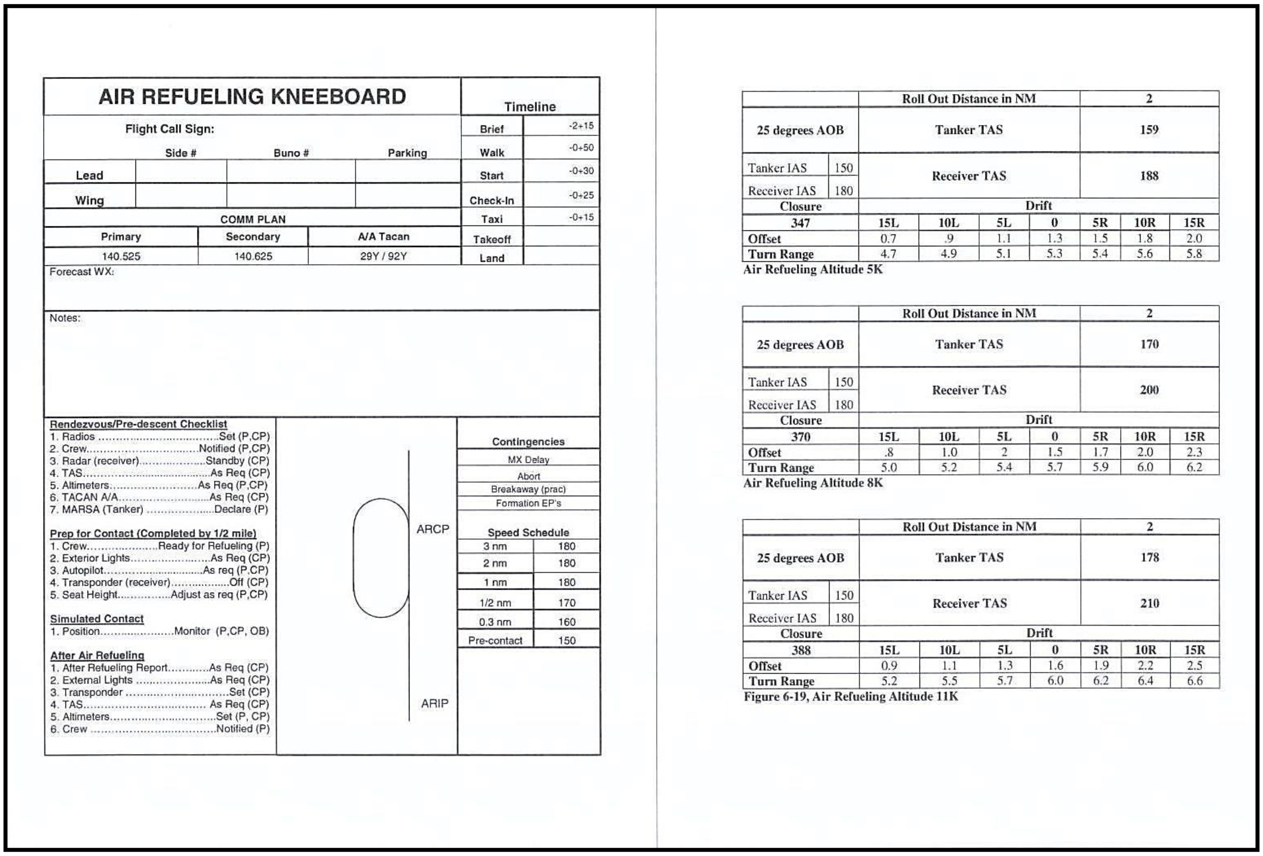
Figure 6-18 Air Refueling Altitude 8K

		Roll Out Distance in NM			2		
25 degrees AOB		Tanker TAS			178		
Tanker IAS	150	Receiver TAS			210		
Receiver IAS	180						
Closure		**Drift**					
388		**15L**	**10L**	**5L**	**0**	**5R**	**10R**	**15R**
Offset		0.9	1.1	1.3	1.6	1.9	2.2	2.5
Turn Range		5.2	5.5	5.7	6.0	6.2	6.4	6.6

Figure 6-19 Air Refueling Altitude 11K

		Roll Out Distance in NM			2		
25 degrees AOB		Tanker TAS			187		
Tanker IAS	150	Receiver TAS			220		
Receiver IAS	180						
Closure		Drift					
407		15L	10L	5L	0	5R	10R	15R
Offset		1.0	1.2	1.5	1.8	2.1	2.4	2.8
Turn Range		5.2	5.5	5.7	6.0	6.2	6.4	6.6

Figure 6-20 Air Refueling Altitude 14K



AIR REFUELING KNEEBOARD

Flight Call Sign:

	Side #	Buno #	Parking
Lead			
Wing			

COMM PLAN

Primary	Secondary	A/A Tacan
140.525	140.625	29Y / 92Y

Timeline	
Brief	-2+15
Walk	-0+50
Start	-0+30
Check-In	-0+25
Taxi	-0+15
Takeoff	
Land	

Forecast WX:

Notes:

Rendezvous/Pre-descent Checklist
1. Radios ....Set (P,CP)
2. Crew....................Notified (P,CP)
3. Radar (receiver)....................Standby (CP)
4. TAS....................As Req (CP)
5. Altimeters....................As Req (P,CP)
6. TACAN A/A....................As Req (CP)
7. MARSA (Tanker) ....Declare (P)

Prep for Contact (Completed by 1/2 mile)
1. Crew....................Ready for Refueling (P)
2. Exterior Lights....................As Req (CP)
3. Autopilot....................As req (P,CP)
4. Transponder (receiver)....................Off (CP)
5. Seat Height....................Adjust as req (P,CP)

Simulated Contact
1. Position....................Monitor (P,CP, OB)

After Air Refueling
1. After Refueling Report....................As Req (CP)
2. External Lights ....As Req (CP)
3. Transponder ....Set (CP)
4. TAS.................... As Req (CP)
5. Altimeters....................Set (P, CP)
6. Crew ....Notified (P)

Contingencies
- MX Delay
- Abort
- Breakaway (prac)
- Formation EP's

Speed Schedule

3 nm	180
2 nm	180
1 nm	180
1/2 nm	170
0.3 nm	160
Pre-contact	150

		Roll Out Distance in NM			2		
25 degrees AOB		Tanker TAS			159		
Tanker IAS	150	Receiver TAS			188		
Receiver IAS	180						
Closure		Drift					
347		15L	10L	5L	0	5R	10R	15R
Offset		0.7	.9	1.1	1.3	1.5	1.8	2.0
Turn Range		4.7	4.9	5.1	5.3	5.4	5.6	5.8

Air Refueling Altitude 5K

		Roll Out Distance in NM			2		
25 degrees AOB		Tanker TAS			170		
Tanker IAS	150	Receiver TAS			200		
Receiver IAS	180						
Closure		Drift					
370		15L	10L	5L	0	5R	10R	15R
Offset		.8	1.0	2	1.5	1.7	2.0	2.3
Turn Range		5.0	5.2	5.4	5.7	5.9	6.0	6.2

Air Refueling Altitude 8K

		Roll Out Distance in NM			2		
25 degrees AOB		Tanker TAS			178		
Tanker IAS	150	Receiver TAS			210		
Receiver IAS	180						
Closure		Drift					
388		15L	10L	5L	0	5R	10R	15R
Offset		0.9	1.1	1.3	1.6	1.9	2.2	2.5
Turn Range		5.2	5.5	5.7	6.0	6.2	6.4	6.6

Figure 6-19, Air Refueling Altitude 11K

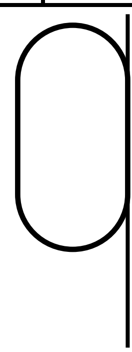
Figure 6-21 Air Refueling Brief

AIR REFUELING KNEEBOARD				Brief	- 2+15
Sequence	**Left**	**Right**	**Observer**	**Step**	- 1+00
				Check-In	- 0+25
Call Sign	**BUNO's**	**Parking Row**	**Base**	**Start**	- 0+20
			140.325	**Taxi**	- 0+10
Interplane (Pri)	**Interplane (Sec)**	**A/A TAC**	**Peg Base**	**Takeoff**	
140.525	140.625	29Y / 92Y	138.775	**ARCT**	0+30
ATIS: Info	**Winds Sky Cond**	**Temp**	**Altimeter**	**Pos Δ**	
				Seat Δ	
				Lnd	
Com Plan / Receiver		**Com Plan / Tanker**		**Sunset**	
Area		Area		**Receiver Speeds**	
Track		Track		3 NM	180
Squawk:		Squawk:		2 NM	180
Air Refueling		**Tanker Rendezvous**		1 NM	180
Track		Tanker TAS		1/2 NM	170
ARCT		Receiver TAS		.3 NM	160
Base Alt		Closure TAS		Pre-contact	150
Block Alt		Drift	5L 0 5R		

Rendezvous/Pre-descent Checklist (15 MIN PRIOR TO ARCT)

1. Radios ………..…...…..Set (P,CP)
2. Crew ..…..…..……Notified (P,CP)
3. Radar (receiver) .. ..Standby (CP)
4. TAS…........................As Req (CP)

Offset			
Turn Range			



ARCP

Contingencies	
MX Delay	
Abort	
Bingo	
Pract Emer Sep	
Formation EP's	

Flight Data	
Temp:	
PA:	
Winds:	

		NOTES
5. Altimeters..…...… .As Req (P,CP) 6. TACAN A/A ……....As Req (CP) 7. MARSA (Tanker)... .Declare (CP) **<u>Prep for Contact (Completed by 1/2 mile)</u>** 1. Crew….Ready for Refueling....(P) 2. Exterior Lights……...As Req (CP) 3. Autopilot....…....... As Req (P,CP) 4. Transponder (receiver) …Off (CP) 5. Seat Height Adjust. As Req (P,CP) **<u>Simulated Contact</u>** 1. Position…..…Monitor (P,CP, OB) **<u>After Air Refueling</u>** 1. After Refueling Report……….....….......As Req (CP) 2. External Lights…..…..As Req (CP) 3. Transponder …...……..….Set (CP) 4. TAS……….…...…… As Req (CP) 5. Altimeters.……..……..Set (P, CP)	ARIP	

6. Crew …..…..………….Notified (P)		

Figure 6-22 Air Refueling Kneeboard

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CHAPTER SEVEN
OVERWATER NAVIGATION STAGE

700. INTRODUCTION

The basic principles of overwater navigation are the same for Navy, Marine, and Coast Guard Maritime platforms. Several types of long-range navigation systems are in use today incorporating Inertial and Global Positioning Systems. Each type aircraft has at least one system; many have several for redundancy.

The Overwater Navigation (ONAV) Stage can be broken down into two basic regimes: Reposition/Transit and Tactical/On-station. Due to the T-44's lack of long-range overwater navigation capabilities, this syllabus will deal with the tactical phase of flight. The purpose of the ONAV Stage is to expose you to composite flight plans, on-station fuel planning, low altitude surface surveillance and rigging, and Air Defense Identification Zone (ADIZ) procedures.

There are many reasons the maritime pilot needs to be proficient and confident flying at low altitudes over water. Locating today's submarines demands precise sonobuoy placement. Magnetic Anomaly Detection (MAD) tracking is another demanding low-level operation. Defensive/offensive mining requires a great deal of finesse for accurate, consistent placement of weapons. With the ever-changing world climate, the Patrol community is seeing a shift in emphasis towards surface surveillance/drug interdiction. Low-level identification and photography of shipping requires precise aircraft placement and airspeed control. For all maritime communities, SAR is a major part of their mission, including visual/electronic search measures and dropping of survival equipment. These and other missions require maritime pilots to be skillful in low-level operations.

701. PREFLIGHT PLANNING

Careful preflight planning, as with all other phases of flight, is essential for a safe, productive overwater mission. Take note of radar altimeter gripes and splits in the barometric altimeters. There are several mission-specific differences in planning discussed in the following text.

1. **Weather.** Due to the obvious lack of weather reporting stations overwater, the National Oceanographic Data Center (NODC) has some extra products for utilization. The majority of the overwater forecast is developed from satellite imagery and computer generation from weather trends. Pilot and ship reports can also be included in the package. Other items of importance include ditch headings, minimum altimeter settings, and winds aloft at various flight levels. All these forecasted products can be found in a HWD packet. These are ordered the night before from the local NODC office.

2. **Fuel Planning.** With the possibility of no divert fields within close flying proximity to the on-station area, careful fuel planning is necessary. Keep an accurate fuel log and update frequently. Some considerations are winds enroute, pressurization capabilities, and single-engine range along with other possible malfunctions. While on-station, minimum fuel

consumption is a priority. Expect fuel flow to average near 500 lbs/hr while on station. Consequently, the aircraft is flown at loiter airspeed, or maximum endurance. For training, fly at 150 KIAS for familiarity as an airspeed buffer and to simulate the higher airspeeds used in your operational platform.

3. **Composite Flight Plan.** A composite flight plan (Figure 7-1) will include a normal IFR airways transit to a VFR Change of Operational Procedure (CHOP) point. From the CHOP point, navigate VFR to the on-station area utilizing radar advisories if desired. Upon completion of the on-station mission, proceed to the ADIZ entry point to pick up the IFR clearance home. Some considerations for VFR route planning are active Alert and Warning Areas, VFR transit corridors, Victor airways, and weather conditions. IFR route planning should include the most expeditious route to and from the CHOP point to maximize the on-station time. Listed below is a sample composite flight plan. Ensure the entry "PADRA" or Pass To Air Defense Radar is in the remarks section to inform the Ground Controlled Intercept (GCI) controllers of your intentions. When filing the flight plan, specifically request Base Operations to transmit your delay and PADRA remarks.

I	200	NGP	1200Z	090	CRP045 PSX218 PSX PSX120030		0+20
V					ⓇD 1+00 PSX120030 NGP		1+00
I	200	PSX120030	1320Z	100	PSX V13 CRP	NGP	0+20
1) REQUEST RADAR VECTORS 2) PADRA							

Figure 7-1 Flight Plan

Contact your instructor the night before to find out if a flight plan should be prepared for the brief. Due to the availability of the Seagull working areas, tactical rigging operations are normally conducted under the control of Seagull RADAR following a normal course rules departure as directed by the squadron's Navigation stage manager.

702. DEPARTURE/ENROUTE/DESCENT

1. **Departure.** Perform a normal IFR or VFR departure as briefed with your instructor.

2. **Enroute.** Operationally, this time is typically spent updating the fuel log and planning your VFR descent to on-station.

3. **Descent.** As always, a good VFR scan is important. Most likely there will be no RADAR service available at low altitude. There is heavy VFR traffic along the coastline, and helicopters transiting to offshore oil rigs. For these reasons extra outside vigilance is required. Another consideration is when to descend. Obviously a transit of 80 miles out to sea at 500' does not save any fuel. Generally, it is best to remain between 1500 and 2500 feet for a good visual search and ease of descent to "rig" altitude.

703. ON-STATION

There are several critical phases on-station, which are discussed, in the following paragraphs.

1. **PIC Responsibilities/Crew Coordination.** It is essential the cockpit team work together. Low altitude, relatively high-speed flight does not leave much room for errors. A plan must be made and briefed prior to descent. At a minimum, a low altitude brief should include standard instrument back-up procedures, low altitude emergency contingencies, and outside/inside lookout doctrine. The brief could sound like:

"Crew we are descending below 1000 ft. During rigging, my scan will be outside, yours should be inside. Call me slow at 140 KIAS, call out my altitude every 100ft, and 'minute to live' when rate of descent is greater than altitude remaining. Call out any unusual attitudes. If I do not respond after two challenges, assume I have vertigo and take the controls. If we have a malfunction or emergency I will first begin a climb before we take the appropriate action."

NOTE

Accomplish seat swaps over water at 1000 feet and above.

2. **Sea State/Winds.** Use the sea state and actual or forecast winds to plan the rigs, and to update your ditching plan. Remember the main swell is best determined while at altitude. Review the ditching procedures in Part V of NATOPS for additional information.

3. **Rules of Engagement.** Rules have been established regarding aircraft/ship encounters to preclude confusion of our intent towards the vessel in question. The following guidelines have been set for TW-4 aircraft:

   a. No "zooming" of vessels (approaching in a threatening manner and then abruptly breaking off).

   b. No crossing the bow by closer than one mile except to get the vessel's attention in an emergency.

   c. No closer than 500 feet abeam when below 1000 feet.

   d. Avoid overflight except when required, and then no lower than 1000 feet.

   e. No purposeful manipulation of propeller RPM.

   f. If possible, limit the number of passes to one full rig or two quick rigs per ship.

4. **Offset/Radar Run-in.** All approaches to vessels and oil rigs shall be offset (e.g., the first pass shall not be an overhead pass). Towers nearing 500 feet and balloons moored to ships by cable above 1000 feet are in existence. There may not be enough time to turn away if a Straight-in approach is used. Remember, always use an offset run-in on your first approach!

The WX RADAR has been used successfully to locate rough positions of targets as small as a shrimp boat in the 10 and 20 NM scales. Experiment if you like. The best results were obtained with the tilt set to (+0) so the sea/ground return has just disappeared.

5. **Rigging Procedures.** There are two basic criteria to be met to accomplish a successful rig run. First, be established comfortably at the run altitude. Second, be set up on profile early. This does not mean be at 500 feet 10 NM out heading inbound on the ship's course. Conversely, do not remain at 1000 feet until 1 mile out and perpendicular to the ship's course. This is where judgment, practice, and the instructor will help to determine a comfortable setup. If targets are a significant distance apart, consider climbing to 1000 feet or more between rigs to increase your search horizon. For training purposes, the minimum on station altitude shall be 500 feet AGL.

For 90% of the rigs you will perform in the fleet, the ship's name, homeport, and a quick photo sequence is the objective. Occasionally you will be required to gather more information, necessitating a full rig. The ship's name can usually be found on the stern, bridge-wing, and bow and the homeport beneath the name on the stern.

6. **Eight-Point Rig.** Also called a full rig or special interest rig. It is used only for intelligence gathering on high priority targets. It consists of photo shots of all angles (8 points) of the target as listed below and in Figure 7-2:

a. Port Bow

b. Port Beam

c. Port Quarter

d. Stern

e. Starboard Quarter

f. Starboard Beam

g. Starboard Bow

h. Overhead

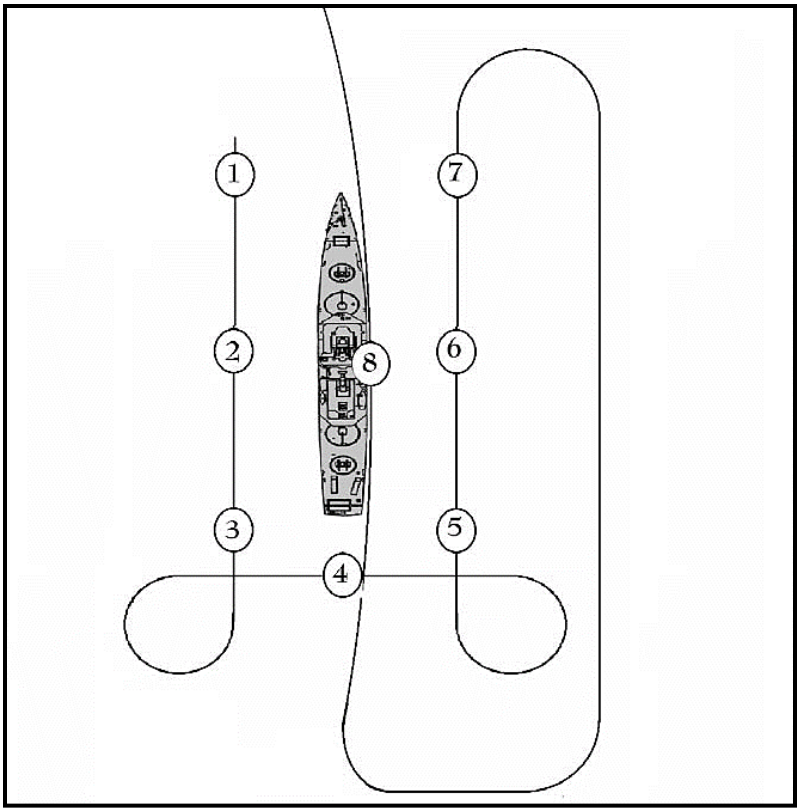

Figure 7-2 Eight-Point Rig

The diagram illustrates the relative positions the in-flight photographer would be taking pictures. In reality, the camera is on auto-wind taking a continuous stream of photos for each pass. Set up for the rig on the reciprocal of the ships heading, bringing the target down the pilot's side of the aircraft. Stabilize at 500 feet with approximately 700 feet of lateral offset. Judging the lateral distance comes with practice. A bit of wing down/top rudder will help lower the nacelle out of the view of the ship. For a large freighter or tanker, 1/2 to 3/4 of the ship should be in view through your window for a proper setup.

Upon completion of the left side pass, continue past the ship for approximately 10-15 seconds, note the ship's course, and turn 270° to the right (use the heading bug for reference). Rolling out for the stern sequence, you will need to take the ship's forward movement into account. A good gauge is roll out perpendicular to the ship's course heading at the stern. By the time you reach position for the photos, the ship will have moved the requisite 500 feet down course for a good offset. Obviously, this will vary with the ship's speed and the winds, but is a good starting point.

Upon completion of the stern shots, continue on heading for approximately 10-15 seconds and execute a right 270° turn. Proceed inbound for the right side shots the same as the left.

Upon completion of the right bow photo, commence a climbing right turn to 1000 feet to set up for the overhead. Turning back inbound, you should actually be on the left side of the ship's course. Approaching the target turn right to just aft of the stern and when crossing, roll into a 45-50 degree left AOB arcing over the top of the ship.

7. **Quick Rig and Banana Rig.** The quick rig (Figure 7-3) and the banana rig (Figure 7-4) are used for routine surface surveillance where target identification and minimal photo intelligence is required. It is preferable to approach from the stern as depicted to allow a picture of the name and homeport. Due to the speed of this operation, a hundred or more of these rigs can be completed during an 8-10 hour on-station period allowing coverage of vast areas.

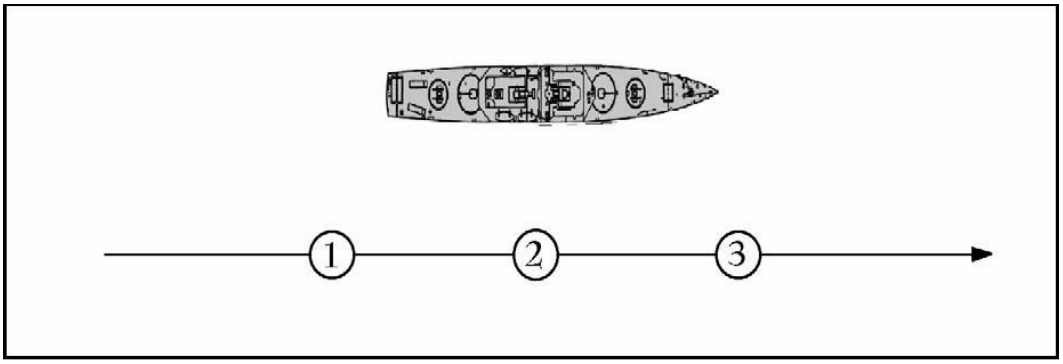

Figure 7-3 Quick Rig

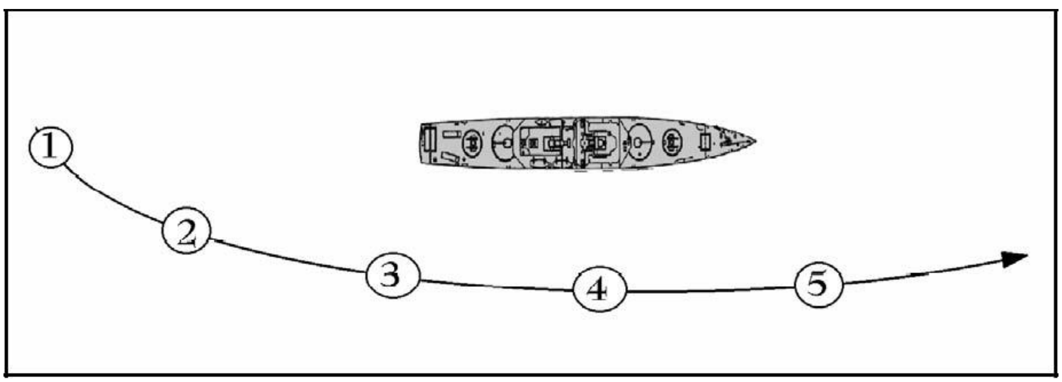

Figure 7-4 Banana Rig

8. **Airspace.** You normally will encounter two types of airspace during overwater flight operations. U.S. airspace within 12 NM of the coastline governed by FAR Part 99, and international airspace governed by International Civil Aviation Organization (ICAO) rules and procedures. While in the training command, flight in international airspace will be regulated by ICAO and CNAF M-3710.7, with 3710 taking precedence. There are several restrictions to VFR flight under ICAO rules preventing the Naval Aviator from completing his/her mission. In these instances, operating under "due regard" means "due regard for the safety of navigation of civil aircraft." Plainly put, you are responsible for your own traffic separation. While in the training command, you will be allowed to operate "due regard" in VMC conditions only. More discussion on ICAO can be found in the FLIP GP (General Planning).

9. **ADIZ Procedures.** The ***U.S. IFR Supplement, FIH,*** and ***AIM 5-6*** cover all the specifics on ADIZ procedures, and should be read for further information. Tolerances for a Coastal ADIZ are ±5 minutes, ±20 NM from centerline of the proposed route, and on altitude. It is easiest to use either a published fix or a radial/DME for an IFR pick-up point. Prior to chopping VFR,

advise center of your proposed operations. While operating in the ADIZ, monitor guard for an "Unknown Rider" call. If a call is heard and is possibly for your aircraft, turn either parallel to or away from the coast and answer on either guard or the GCI frequency to clarify your position and identification. Failure to do so could result in a possible interception and ADIZ violation.

704. RECOVERY

Upon completion of the on-station period, proceed to your pick-up point. Contact the controlling ATC facility to activate your IFR flight plan. The frequency may be the last assigned or the most appropriate from the enroute low altitude chart. Using center or an approach control is preferable, but FSS is also an option. The same voice procedures used for an IFR recovery from Seagull can be utilized (position, altitude, and request). From this point perform a normal IFR transit and approach to home field.

705. EMERGENCIES

It is obvious a malfunction, no matter how small, could lead to catastrophe at low altitude. If the problem is not easily correctable, it would be prudent to begin a climb prior to emergency procedure execution or extensive troubleshooting. Some specific situations are addressed in the following paragraphs:

1. **Engine Fire/Malfunction.** Any situation leading to an engine shutdown requires an immediate climb, while executing the appropriate procedures during the ascent.

2. **Ditching.** If a situation arises requiring a ditch at low altitude, immediate action is required; time will be the most limited asset. Thorough knowledge of your procedures and assigned responsibilities is essential. Review NATOPS Ditching procedures.

3. **Lost Aircraft/Lost Communications.** If at any time your position is unknown, applying the "Five C's" is appropriate (***C***onfess, ***C***limb, ***C***ommunicate, ***C***onserve, and ***C***omply). If overwater, turn west until intercepting the coast then turn to a northerly heading paralleling the coastline. If the heading is greater than 023º, your position is north of the Corpus area; less than 023º, you are south. If lost communications are encountered while on the IFR portion of the flight, utilize the standard procedures in the FIH. If the communications are lost while operating VFR, maintain VMC conditions, squawking the appropriate codes, making calls in the blind, and land as soon as practical. Be sure to contact Base Operations to cancel the flight plan and clear up any questions about your ADIZ penetration.

4. **Survival Equipment Requirements.** CNAF M-3710.7 lists the requirements for survival equipment. Anti-exposure suits are required if air temperature drops below 32 ºF and/or water temperature is below 50 ºF (60 ºF at CO's discretion). For a water temperature of 60 ºF, survival time is two hours or more. LPAs are unusable in the T-44 due to their bulk, which would restrict movement in the cockpit. LPP-1 life preservers have been procured by the Wing and will be available from the Paraloft. Instructions on their use can be found in the brief book. Life preservers shall be worn over the water below 1000 feet. Further information can be found in CNAF M-3710.7 Chapter 8.

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CHAPTER EIGHT
SEARCH AND RESCUE (SAR) FUNDAMENTALS

800. INTRODUCTION

Search and Rescue (SAR) is the deployment of available personnel and resources in rendering aid to persons and property in distress or potential distress. The primary purpose of SAR syllabus flight is to give Coast Guard Student Aviators a brief introduction into the National Search and Rescue System, search planning, execution of Search Action Plan (SAP), and Coast Guard Search and Rescue Operations. This SAR flight should only be viewed as an introduction into SAR fundamentals. Coast Guard Aviators receive extensive SAR training at their respective units. References (a) through (d) were used to develop this syllabus and are listed below. Coast Guard Student Aviators may find the required excerpts from these references in the SAR briefing guides located in the student ready room.

a. National Search and Rescue Manual, Volume 1 and II (U.S. Coast Guard, COMDTINST M16120.5 series)

b. Coast Guard Addendum to the National Search and Rescue Manual, (COMDTINST M16130.2 series)

c. Coast Guard HC-130H Flight Manual

d. NATOPS General Flight and Operating Instructions, (CNAF M-3710.7)

801. SAR ORGANIZATION

SAR Coordinator (SC). The SC for shore SAR operations is the Commandant of the Coast Guard. The Commandant is responsible for the overall coordination of federal, state, and local resources for the conduct of SAR operations.

SAR Mission Coordinator (SMC). Designated by SC to manage SAR missions within a predetermined region. District or Groups commanders are usually assigned as SMC.

Rescue Coordination Center (RCC). RCCs are manned 24 hours a day with a qualified RCC (SAR) Controller who is the direct representative of the SMC. All search planning and tasking (via SAP) for SAR units are generated by the RCC. The RCC controller reports to the District Operations Officer who reports to the SMC.

On Scene Commander (OSC). Manages SAR mission on scene as per the Search Action Plan.

SAR Units (SRU). Individual SAR vessels and aircraft.

OSC Responsibilities. An OSC has operational authority of the SMC, and operational control of all SRUs on scene. The OSC prosecutes the SAR mission using resources made available by the SMC, and should carry out the SAP. SRU parent command retains operational control of

SRUs enroute to and from scene. An OSC is not required for all missions, although one is usually assigned if two or more SRUs are on scene. Large fixed-wing aircraft make excellent OSC platforms because of their extensive communications capabilities, relatively long on scene endurance, and adequate space for planning, plotting, and coordination duties. The OSC responsibilities maybe found in Reference (a), page 1-10 (Volume I). See student SAR briefing guide.

1. Establish and maintain communications with the SMC, assume operational control and coordination of all SRUs assigned, execute the SAP, and modify the SAP to cope with on scene conditions.

2. Establish and maintain communications with all SRUs using assigned on scene frequency, requiring all aircraft to make “operations normal” reports to the OSC every 15 minutes for helicopters and every 30 minutes for multi-engine fixed-wing aircraft.

3. Establish a common altimeter setting for all on scene aircraft.

4. Obtain necessary information from arriving SRUs, provide initial briefing and search instructions, and provide advisory air traffic service to aide SRUs in maintaining separations.

5. Receive and evaluate sighting reports from all SRUs, and divert SRUs to investigate sights. Obtain search results from departing SRUs.

6. If the OSC must depart, shift OSC duty to the SRU remaining on scene which is best able to perform OSC duties. Brief the relief OSC on the current situation and advise the SMC of the change.

7. Submit serially numbered situation reports (SITREPs) to the SMC at regular intervals.

802. SEARCH VARIABLES

The goal of search planning is to cover as much of the search area as possible with a reasonable Probability of Detection (POD). Area coverage is a function of the number, speed, and endurance of SRUs used. POD is the measure of desired search results prior to a search, or the search results actually obtained, and are a function of sweep width and track spacing. The RCC controller balances these variables and on scene weather to develop a SAP to achieve the appropriate coverage factor.

Sweep Width (W). Sweep width is the distance on both sides of a SRU where the probability of detecting a target outside of the sweep width is equal to the probability of missing a target inside that distance. It is a measure of detection capability based on target characteristics, weather, and other factors. A sweep width may be a visual sweep width or an electronic sweep width using the search radar.

Track Spacing (S) (Reference (a), pg. 5-18). Track spacing is the distance between two adjacent parallel search legs. It directly influences the search object’s target detectability.

Coverage Factor (C) (Reference (a), pg. 5-28). Coverage Factor is a measure of search effectiveness or quality. Coverage factor must be calculated to compute the POD of the search object. Coverage factor is calculated by dividing the sweep width by the track spacing (C=W/S). See Figure 8-1 for examples of C=1.0 and C=0.5, respectively.

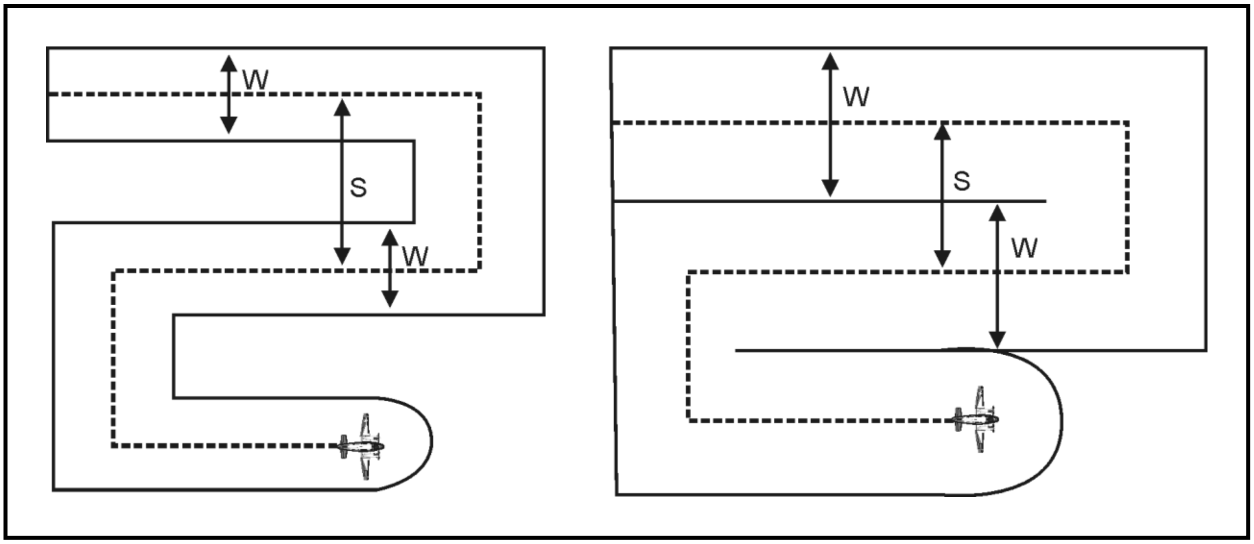


Figure 8-1 Coverage Factor

Probability of Detection (POD) (Reference (a), pg. 5-28). POD is the probability the search object will be detected provided it is in the area searched. It is a function of coverage and the total number of searches in an area and describes the effectiveness of single search or the cumulative effectiveness of multiple searches. Reference Figure 8-2 for Maritime Probability of Detection chart.

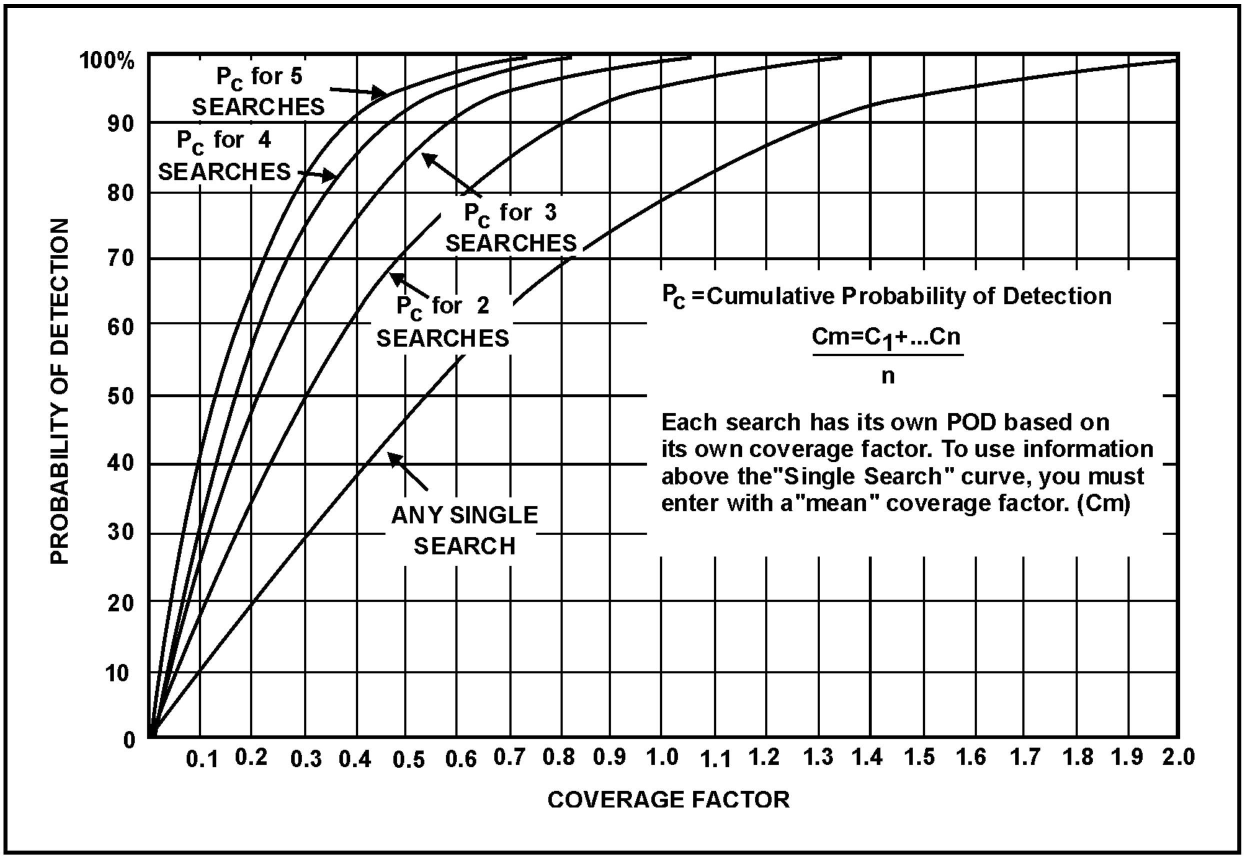


Figure 8-2 Maritime Probability of Detection

1. **Search Pattern Nomenclature. (Reference (a), pg. 5-35)**

   a. **Datum**.

   b. **Commence Search Point (CSP).** Commence Search Point is the location in the search pattern where the SRU begins searching.

   c. **Search Leg.** Search leg is the long leg along the track of any pattern.

   d. **Crossleg.** Crossleg is the connection between two search legs.

   e. **Creep.** Creep is the general direction in which an SRU moves through a rectangular or square area, normally the same direction as the crosslegs.

2. **Search Pattern Designation. (Reference (a), pg. 5-35 and Reference (b), pg. 2-F-1-30)**

A coded system is used to designate search patterns. The major pattern characteristic is designated by the first letter. The second letter denotes either a single (S) or multiple (M) unit search. The third letter designates specialized SRU instructions. Examples: TMR-trackline multiple unit return search, VS-sector search single unit.

a. **Trackline Patterns (T).** Trackline search patterns are used when the intended route of the search object is known. A route search is usually the first search action since it is assumed the target is near track, and either it will be easily seen or the survivors will signal. Reference Figure 8-3 for Trackline Single Unit Return (TRS) search pattern.

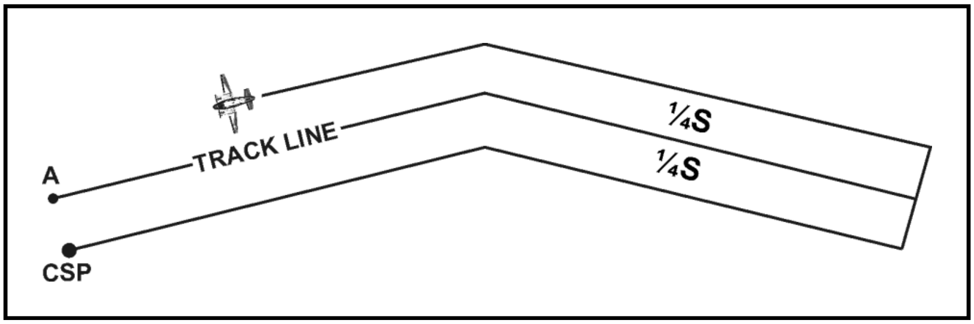


Figure 8-3 Track Line

b. **Parallel Patterns (P).** Parallel search patterns are best adapted to rectangular or square areas and have straight search legs usually aligned parallel to the major axis. Parallel patterns are used for fairly large areas where uniform coverage is desired. Reference Figure 8-3 for single parallel pattern. Reference Figure 8-4 for Parallel Track Single (PS) Unit search pattern (commonly referred to as a PAPA SIERRA search pattern).

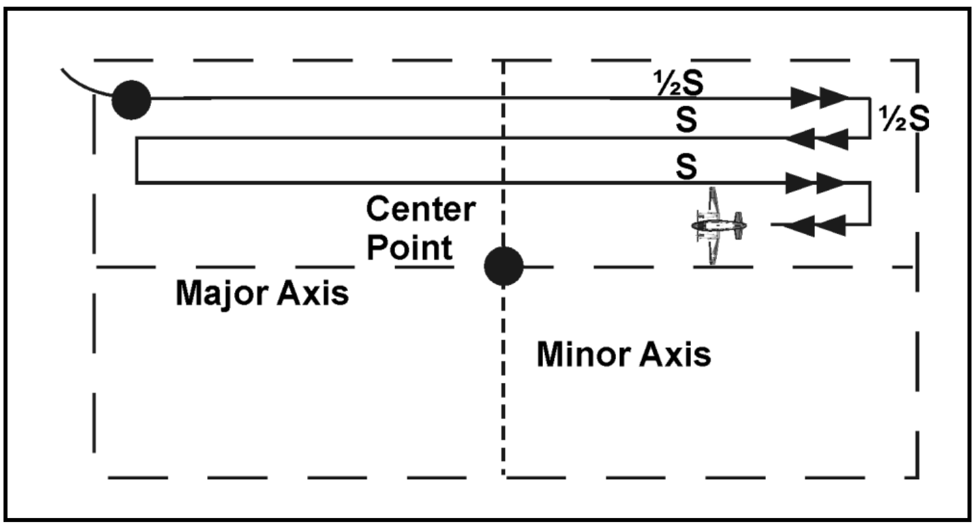


Figure 8-4 Parallel Patterns

c. **Creeping Line Patterns (C).** Creeping line search patterns are a specialized type of parallel pattern where the direction of creep is along the major axis. They are used to cover one end of an area first or to change direction of the search legs where sun glare or swell direction makes this necessary.

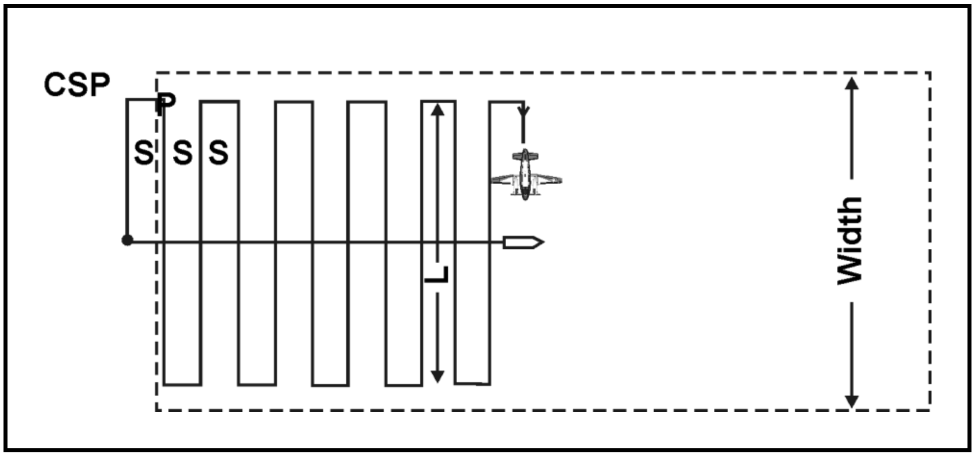


Figure 8-5 Creeping Line Patterns

d. **Sector Patterns (V).** Sector search patterns are used when the distress position is reliable or the area searched is not extensive, and a concentration of effort is desired at datum. The pattern resembles the spokes of a wheel and is used to cover a circular search area. Variables for this pattern are the angle between the successive radii and leg length from datum. Normally, 60° is used as the angle between radii, and the leg length is no longer than 20 NM. Using a 60° radii angle, complete coverage of the search area can be obtained by rotating the pattern 30°, and executing the pattern again (Figure 8-6).

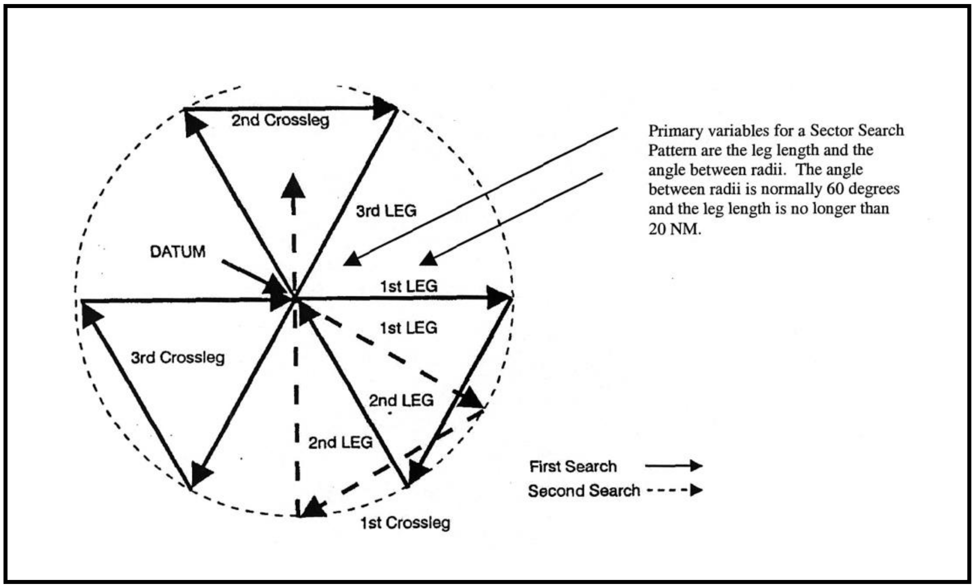


Figure 8-6 Sector Patterns

803. SEARCH ACTION PLAN (SAP)

SAP will normally include the following sections: situation, search area, execution, required coordination, communications, and required reports. The SMC (via the RCC or Sector Operations Center) will develop and provide the SRU the SAP.

Situation Summary. The situation summary is an evaluation of the situation on scene, including the nature of the emergency, last known position of search target, search target description, types of detection aids and survival equipment which the survivors may have, present and forecast weather, and SRUs on scene.

Search Area. Search area details include a listing of the search area and sub-areas that can be searched by SRUs during the allotted time. Search area variables will be listed (CSP, track spacing, required cover factor, etc.), and if required, air-to-air TACAN channel assignments will also be listed.

Communications. To establish effective communications, the SMC will designate primary, secondary, and tertiary control channels/frequencies on scene.

1. **Scanning Techniques. (Reference (a), pg. 6-9 thru 12).** A searching SRU is primarily a platform for scanners. The success of a search may ultimately depend on the number and effectiveness of scanners. The maximum number of scanners should be onboard the SRU during a search; however, all of the scanners do not need to be in the windows at the same time. At the Aircraft Commander's discretion, scanners may be rotated in and out of rest periods to prevent fatigue from seriously degrading the SRUs search capabilities. This is especially true when doing low-level (200 to 300 feet search) PIW (Persons In the Water) searches.

   a. **Lookout positions.** Lookout positions affect scanning. The pilot, copilot, and forward lookouts occupy the best lookout positions on most aircraft. If no forward station is available, the burden of scanning is placed on the pilots. Coast Guard fixed-wing aircraft HC-27J, HC-144, HC-130 H, and HC-130J also have excellent scanner positions on the sides of the aircraft.

   b. **Motivation.** Motivation affects the performance of the entire crew. During the early stages of a search, motivation is high. This decreases as fatigue sets in and hopes of finding the survivor decreases.

   c. **Scanner's Position.** Scanners forced to look into the sun or its path lose visual acuity and can easily fail to detect a search object. The sun's position (azimuth and elevation) relative to the scanner influences the target's detectability. The target appears as a dark silhouette against a bright background, and color is difficult to distinguish. When a target is viewed down range (down sun), haze and glare are less of a problem, colors are more easily distinguished, and target/background contrast are more easily observed.

2. **Sighting and Identification. (Reference (a), pg. 619).** During a large search, many objects other than the actual search target may be sighted. Diverting from search to identify sighted objects diminishes the uniformity of search area coverage regardless of the navigation accuracy. On the other hand, objects sighted other than the actual search object may offer clues if properly interpreted.

a. When a large vessel goes down suddenly, the scene may be littered with considerable debris and a large oil slick, usually traveling downwind of the origin. Boats and rafts will usually be downwind of the debris. Persons in the water may be found clinging to floating objects. Lifeboats from large vessels are normally equipped with emergency radios. If more than one lifeboat was launched, they can be expected to be grouped or tied together to make sighting easier.

b. Aircraft should not change altitude on relocation passes to present the same picture to the scanners. Altitude changes may also conflict with other SRUs. A 90-270 procedure turn or survivor relocation pattern is recommended to over-fly the same position and retain search integrity.

c. If survivors are sighted, SRUs should maintain visual contact with the survivors and inform them they have been sighted using a radio or flying low with landing lights on. If immediate rescue is not possible, SRU should determine the position using several NAVAIDS. A survivor sighting report should be made as soon as possible to the OSC including the following information:

i. Position

ii. Survivor identity

iii. Condition of survivors

iv. Wind, weather, and sea conditions

v. Hours of SRU on scene endurance

vi. Emergency equipment received, used or needed by the survivors

804. ON-SCENE OPERATIONS

On scene operations will begin with execution of the Operational Descent Checklist, followed by either the Pre-search Checklist or Pre-drop Checklist depending on the situation. The Operational Descent Checklist addresses the Aircraft Commander’s operational descent briefing including airspeed, minimum descent altitude, personal floatation device requirements, and aircraft configuration. If a search is required, the Pre-search Checklist will be accomplished which addresses the Aircraft Commander’s search briefing including: thorough description of search target, emergency equipment required (flares and/or SAR equipment), and aircraft configuration. Once the search object has been located, a Pre-Drop Checklist, if required, will be accomplished. There are several critical phases of flight on-scene, which are thoroughly addressed in the following paragraphs.

1. **Crew Coordination/Operations Below 1000 feet AGL.** Because there is no room for error during high-speed low altitude passes, crew coordination/team work in the cockpit is essential. Coast Guard SAR drops and rigs are normally accomplished at 200 feet AGL. The airspeed will depend on which fixed-wing asset (HC-27J, HC-144, HC-130 H, or HC-130J) is being flown. Lower passes may be flown as required at the Aircraft Commander's discretion (e.g., obtain vessel's name and homeport, close look at vessel's condition, etc.); however, in the training command, we are restricted to a minimum altitude of 500 feet AGL. Before any low altitude operations (drops or rigs), the crew must be briefed on minimum altitudes and airspeeds, low altitude emergency contingencies, and outside doctrine. A typical brief sounds as follows: *"Monitor the instruments and call out any unusual attitudes. After the second callout, if I do not respond, assume I have vertigo and take control of the aircraft. Call me 10 knots slow from our target speed. While operating below 1000 feet AGL, we will marry up our barometric altimeters to our radar altimeter, and call out our altitude and rate of descent for every 100 feet. If we have a malfunction while down low, I will begin a climb and then manage the malfunction in accordance with the NATOPS. During rigging I will remain inside on the instruments, your scan will be outside on the target."*

2. **Rules of Engagement.** Rules have been established regarding aircraft/vessel encounters to preclude confusion of intent towards the vessel in question. The following guidelines have been established by TRAWING-4:

a. No "zooming" of vessels (approaching in a threatening manner and then abruptly breaking off the approach).

b. No crossing the bow by closer than one mile except to get the vessel's attention.

c. No closer than 500 feet abeam when below 1000 feet.

d. Avoid over flight except when required, and then no lower than 1000 feet.

e. No purposeful manipulation of the propellers.

f. If possible, limit the number of quick rigs per vessel to three passes.

g. All approaches to vessels and oil rigs shall be offset, e.g., the first pass ***shall not*** be an overhead pass. Towers nearing 500 feet and balloons moored to ships by cables above 1000 feet maybe encountered. There may not be enough time to turn away if a Straight-in approach is used. So, just remember: ***Always use an offset run-in on your first approach.***

3. **Sea State/Winds.** Use the sea state and actual or forecast winds to plan rigs/SAR pattern, and to update your ditching plan. Remember, the main swells are best determined while at altitude. Review the ditching procedures in ***Section V*** of ***NATOPS*** prior to the flight.

4. **Rigging Vessels/Search Object.** Coast Guard rigging procedures are far less rigid than the Navy rigging procedures outlined in Chapter 7 of the FTI. The Coast Guard has no requirement to accomplish eight point rigs and can take photographs from either side of the aircraft. Coast Guard aircraft quick rig vessels from any direction. There is no requirement to rig the vessel from stern to bow on the vessel's starboard side. The vessel can be rigged from bow to stern, stern to bow, or across the vessel's bow or stern. It does not matter from which direction the vessel is rigged as long as the required information and pictures are gathered. Additionally, the vessel or search object is usually taken down the non-flying pilot's side. The flying pilot stays inside on the instruments and positions the aircraft so the non-flying pilot and other crewmembers can clearly observe the vessel. The vessel or search object can be taken down the flying pilot's side at the discretion of the aircraft commander. For law enforcement missions, vessels are rigged to gather information for the Law Enforcement Information System (LEIS). The information required for a LEIS report is the vessel's name, homeport, hull number (if available), position, course, speed, hull color, superstructure color, vessel's activity (fishing, underway, etc.), and type of vessel (long liner, squid jig, high seas drift netter, etc.).

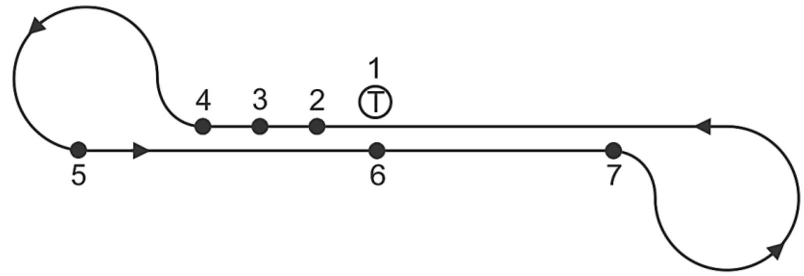
5. **Airspace.** You normally will encounter two types of airspace during overwater flight operations. U.S. airspace within 12 NM of the coastline governed by the FARs, and international airspace governed by International Civil Aviation Organization (ICAO) rules and procedures. While in the training command, flight international airspace will be regulated by ICAO and CNAF M-3710.7, Reference (d). CNAF M-3710.7 always takes precedence. There are several restrictions to VFR flight under ICAO rules preventing Coast Guard Aviators from completing their mission. In these instances, Coast Guard Aviators operate under "due regard," which is "due regard for the safety of navigation of civil aircraft." Simply put, we are responsible for our own traffic separation. While in the training command, you will be allowed to operate due regard in VMC conditions only. More discussion on ICAO can be found in the FLIP GP.

6. **ADIZ Procedures.** The U.S. IFR Supplement and Airman's Information Manual cover all the specifics on ADIZ procedures, and should be read for further information. Tolerances for a Coastal ADIZ are ±5 minutes, ±20 NM from centerline of the proposed route, and on altitude. It is easiest to use either a published fix or a radial/DME for an IFR pick-up point. Prior to chopping VFR, advise center of your proposed operations. While operating in ADIZ, monitor guard for an *"Unknown Rider"* call. If a call is heard and is possibly for your aircraft, turn to either parallel or away from the coast and answer on either guard or the GCI frequency to clarify your position and identification. Failure to do so could result in a possible interception and ADIZ violation.

805. SAR PATTERNS. (REFERENCE (A), PG. 6-21 AND 22 AND REFERENCE (C), PG. 2-94 THROUGH 2-106)

The following three SAR patterns will be introduced to Coast Guard student aviators: survivor relocation pattern, Parachute Air Delivery system (PADS) pattern, and Sea Rescue Kit delivery pattern. Students are not required to have these patterns memorized and are encouraged to sketch the patterns on a kneeboard card for reference during the flight. The Coast Guard uses the following two types of flares/smokes: Mark-25 (burns for 15 minutes) and Mark-58 (burns for 45 minutes).

1. **Survivor Relocation Pattern.** Often a SRU, especially a fixed-wing aircraft, will not be able to identify an object on the first pass, thus requiring maneuvering by the SRU to relocate the object. As it is not unusual for a fixed-wing SRU to lose sight of the target while maneuvering, it is important to have a definite plan for relocating and identifying a sighted object. During the search briefing, the Aircraft Commander should brief the crew on the plan/procedure to relocate an object sighted during the search. The survivor relocation pattern is one procedure that may be used. Upon the initial sighting of an object, a flare (either a Mark 25 or a Mark 58) should be immediately deployed. Fifteen seconds after the first flare is deployed, a second smoke should be deployed. The pilot should make a procedure turn (90-270 either left or right), adjusting the final portion of the turn to roll out on a heading allowing the aircraft to line up with and fly directly over the two smokes. At the Aircraft Commander's discretion, the smokes can be brought down to either the non-flying pilot's side of the aircraft or the flying pilot's side. When abeam the first smoke dropped, a 45-minute smoke (Mark 58) should be deployed. If the object is not sighted, the SRU should continue for 30 seconds and drop another 15-minute smoke. Parallel sweeps on the line of smokes are made until the object is relocated. Additional smokes maybe deployed as required. The survivor relocation pattern will be flown at 120 KIAS, 500′ AWL with approach flaps. Reference Figure 8-7 for survivor relocation pattern.



1) Initial sighting - Drop a smoke (Mark 25 or Mark 58)
2) Maintain heading, altitude, & airspeed for 15 seconds
3) Drop smoke
4) Make procedure turn (90-270) to the left or right
5) Make final turn to fly reciprocal track over markers
6) When over smoke no.1 (initial smoke), drop a 45-minute smoke
7) If target is not relocated, maintain heading for 30 seconds and drop a 15-minute smoke. Continue search using the line of marks.

Figure 8-7 Survivor Relocation Pattern

2. **Parachute Air Delivery System (PADS) pattern.** The PADS pattern is designed to deliver a dewatering pump, which is in a barrel type container (commonly referred to as a pump can), to a vessel taking on water. The container can be filled with other items, such as parts for a repair, as long as the pump can's weight is within parachute limitation. When a vessel is dead in the water, it will align itself perpendicular to the wind (broadside to the wind). Before entering the PADS pattern, a smoke (most likely a Mark 58) will be deployed near the vessel. This smoke will be used to identify wind direction and velocity. The SRU will fly over the target, aligned into the wind/smoke. After passing over the target, the pilot will make a standard rate turn to the left or right to fly downwind. After 30 seconds, pilot will turn back into the wind and advise the Dropmaster *"30 seconds standby."* 15 seconds later, the pilot will advise the Dropmaster *"15 second standby,"* Passing over the drop point, the flying pilot will call *"Drop, Drop, Drop."* If for any reason the drop cannot be made, abort as briefed and re-fly the pattern. Reference Figure 8-8 for PADS pattern. The PADS pattern will be flown at 120 KIAS, 500 feet AWL with approach flaps. Reference Figure 8-9 for a diagram of a deployed pump can.

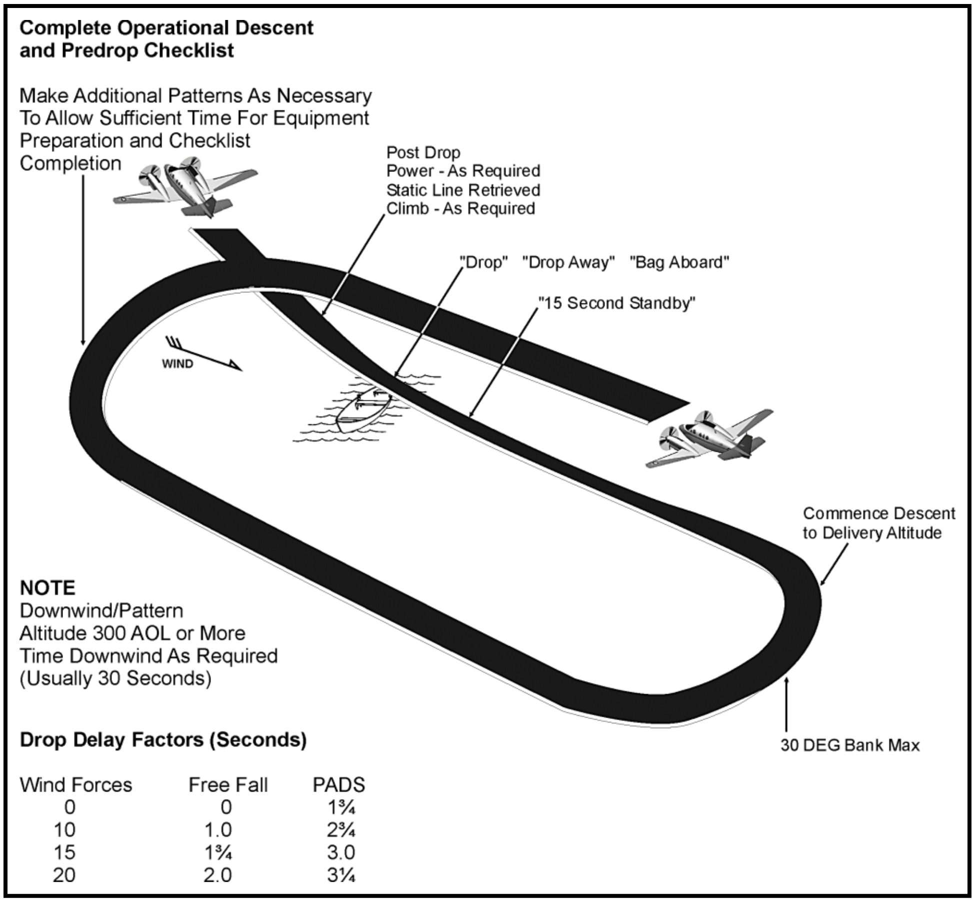


Figure 8-8 Parachute Air Delivery System Pattern

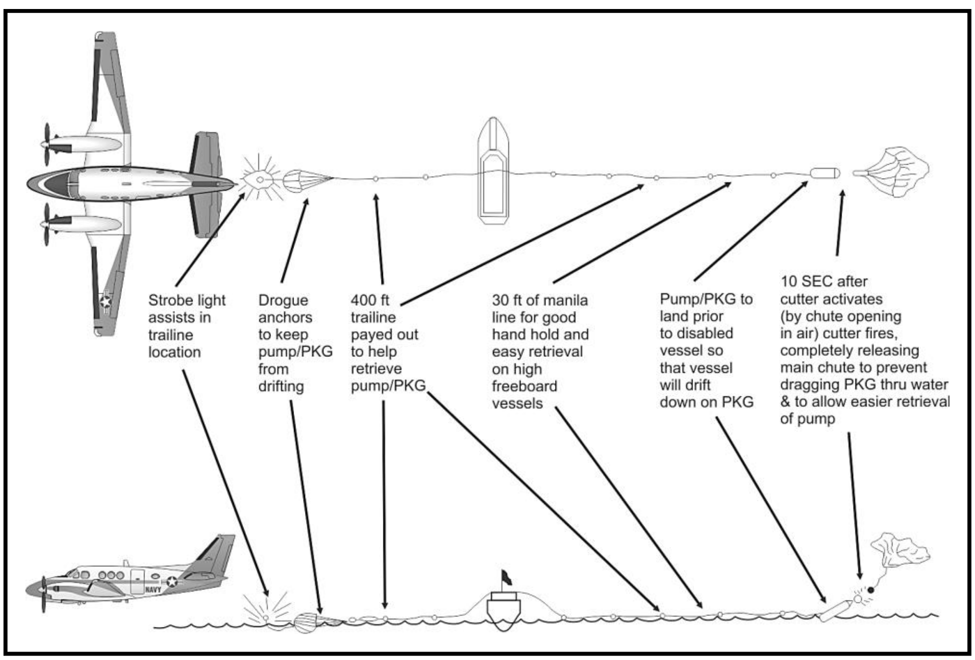


Figure 8-9 Diagram for a Deployed Pump Can

3. **Sea Rescue Kit Delivery Pattern.** This pattern is used to deploy a Sea Rescue Kit (commonly referred to as an ASRK-16 or ASRK-24). An ASRK-16 or ASRK24 can either have 4 or 5 bundles attached to a single line. Bundles 1, 3, and 5 are life rafts; bundles 2 and 4 are filled with survivor equipment. This kit is deployed using either an upwind or downwind delivery pattern. An upwind pattern is used when dropping to people in the water, and a downwind pattern is used when a vessel is sinking and the crew is preparing to abandon ship. After determining whether to drop upwind or downwind of the target, maneuver the aircraft on the reciprocal of the drop run and perpendicular to the wind line to pass approximately 50 feet abeam of the target. Three seconds after passing the target, drop a smoke. This smoke is commonly referred to as the "3 second smoke." Continue on that heading for 15 seconds and drop a second smoke. This smoke is commonly referred to as the "15 second smoke." Make a 15 second procedure turn using at least 40° of turn. Depending on the strength of the wind and the Aircraft Commander's discretion, more than 40° of turn and more than 15 seconds can be used in the procedure turn. After at least 15 seconds, make a standard rate 180° turn to the left and maintain heading until the final turn to the drop run passing 50 feet abeam the target. After rolling out on the drop run, advise the Dropmaster *"30 second standby."* When abeam the 15 second smoke, advise the Dropmaster *"15 second standby."* When directly abeam the 3 second smoke, call *"Drop, Drop, Drop."* If for any reason the drop cannot be made, abort as briefed and re-fly the pattern. The Sea Rescue Kit Delivery pattern will be flown at 120 KIAS, 500 feet AWL with approach flaps. Reference Figure 8-10 for downwind Sea Rescue Kit delivery pattern.

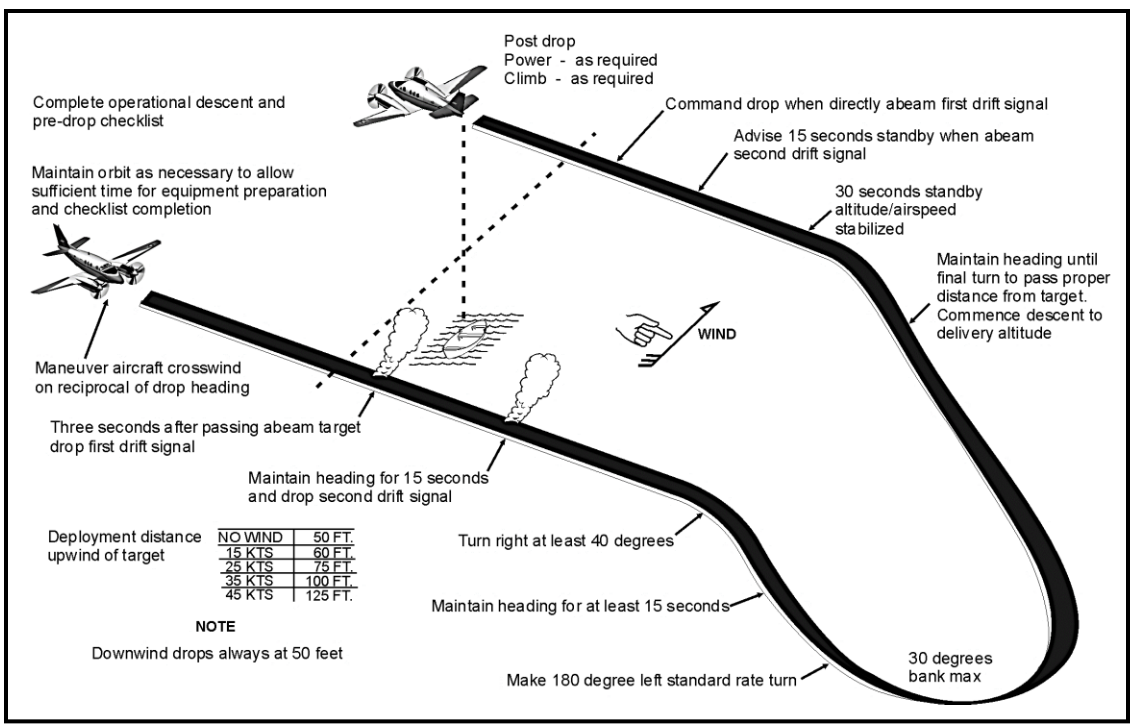


Figure 8-10 Sea Rescue Kit Delivery Pattern

806. EMERGENCIES

It is obvious a malfunction, no matter how small, could lead to catastrophe at low altitude. If the problem is not easily correctable, it would be prudent to begin a climb prior to emergency procedure execution or extensive troubleshooting. Some specific situations are addressed in the following paragraphs:

1. **Engine Fire/Malfunction.** Any situation that may lead to an engine shutdown requires an immediate climb, while executing the appropriate procedures during the ascent.

2. **Ditching.** If a situation arises requiring a ditch at low altitude, immediate action is required and time will be the most limited asset. Thorough knowledge of your procedures and assigned responsibilities is essential. Review NATOPS Ditching procedures prior to the flight.

3. **Lost Aircraft/Lost Communications.** If at any time your position is unknown, applying the "Five C's" is appropriate (confess, climb, communicate, conserve, and comply). If overwater, turn west until intercepting the coast then turn to a northerly heading paralleling the coastline. If communications are lost while operating VFR, maintain VMC conditions, squawking the appropriate code, making calls in the blind, and land as soon as practical.

4. **Survival Equipment Requirements.** Reference (d) outlines the requirements for survival equipment, since the Gulf Waters in our area normally do not drop below 60° F, anti-exposure suits are not required. For a water temperature of 60° F, survival time is two hours or more. If water temperature in the Gulf goes below 60° F, anti-exposure suits will be made available in T-44 aircraft issue. LPAs are unusable in the T-44 due to their bulk which restricts movement in the cockpit. LPP-1 life preservers are used and are available in T-44 aircraft issue. ***Life preservers shall be worn over the water below 1000 feet.*** Further information can be found in Chapter 8 of Reference (d).

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APPENDIX A
GLOSSARY

A100. NOT APPLICABLE

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APPENDIX B
TYPICAL BRIEFS AND VOICE PROCEDURES

B100. RADIO PROCEDURES

The following responses/radio calls are to be used unless it is necessary to adapt them for the situation. These procedures are designed for Navy Corpus Christi operation. While operating off station, the Navy Corpus Christi standard radio calls may be insufficient and detailed communication IAW the FAR/AIM may be required.

T-44 IFR/VFR flights will utilize MNTNA XX/STGRY XX.

Contact Flights

1. Obtain ATIS, then call for taxi:

   "*Navy Corpus Ground*, MNTNA XX/STGRY XX*, taxi from (state location), with information Lima*."

For flights to Seagull:

Once you complete checking "RADIOS/NAVAIDS" on the Takeoff Checklist, request a block from Seagull:

"Seagull, MNTNA XX/STGRY XX*, request blocks available."* or

"Seagull, MNTNA XX/STGRY XX*, request two and three blocks available."*

NOTE

Read back block assignment and set NAVAIDS for departure.

For IFR departures to VFR-ON-TOP conditions in Seagull, obtain ATIS, request a block from Seagull, put your clearance on request, then call for taxi:

"Seagull, MNTNA XX/STGRY XX*, request blocks available."* or

"Seagull, MNTNA XX/STGRY XX*, request three blocks available."*

"Navy Corpus Clearance Delivery, MNTNA XX/STGRY XX*, Quick Two on request."*

"Navy Corpus Ground, MNTNA XX/STGRY XX*, taxi from (state location), with information Delta."*

After FMS is called for on the Before Takeoff Checklist, hold the checklist and copy your clearance:

"Navy Corpus Clearance Delivery, MNTNA XX/STGRY XX*, ready to copy."*

NOTE

Read back clearance and set NAVAIDS for departure.

2. Upon reaching "CREW" on the Before Takeoff Checklist, brief the takeoff IAW the normal briefings of this Appendix.

3. When reaching "Anti-ice/Deice" on the Before Takeoff Checklist, hold the checklist and call for further taxi:

"Navy Corpus Ground, MNTNA XX/STGRY XX*, further taxi."*

4. Approaching the hold short, request takeoff clearance:

"Navy Corpus Tower, MNTNA XX/STGRY XX, number one, holding short, VFR to

Seagull/Homefield Bounce/Sunrise Departure/Portland Departure/Departure Option."

NOTE

To eliminate unnecessary chatter on an already busy frequency, call Tower only if you are number one or two in line (VFR or IFR) for departure.

Responses to Tower clearances:

a. If instructed to hold short:

*"*MNTNA XX/STGRY XX*, hold short."*

b. If instructed to taxi into line up and wait:

*"*MNTNA XX/STGRY XX*, line up and wait."*

c. If cleared for takeoff:

*"*MNTNA XX/STGRY XX*, cleared for takeoff."*

d. Tower may also clear an aircraft to cross a runway and give an instruction as in (a), (b), or (c) above. In this case, read back the entire clearance:

*"*MNTNA XX/STGRY XX*, cross 13L, line up and wait 13R."*

5. Initial contact with Departure:

"Corpus Departure, MNTNA XX/STGRY XX, *off Navy Corpus*, *passing 800 for 2500*, *course rules to Seagull."*

For Departure to Seagull:

a. Approaching the CRP 130 at 26 enroute to Seagull:

"Corpus Departure, MNTNA XX/STGRY XX*, terminate."*

b. Initial contact with Seagull:

"Seagull, MNTNA XX/STGRY XX*, on the 130 climb radial*, *passing three thousand for block 3 central."*

c. Once established in block:

"Seagull, MNTNA XX/STGRY XX*, established block two central."*

Leaving Seagull:

"Seagull, MNTNA XX/STGRY XX, *approaching the 156/100 descent radial at___ DME, vacating block_______, leaving _____ft terminate."*

6. Initial contact with Approach for recovery:

"Corpus Approach, MNTNA XX/STGRY XX*."*

NOTE

Wait for Approach Control to answer you, then go ahead with your request.

"Corpus Approach, MNTNA XX/STGRY XX, _____ ft, on the CRP 156/100 at ___DME, course rules to Shamrock/Southern entry to Cabaniss, with information Zulu."

7. When reaching "CREW" on the Approach Checklist, as applicable, give your touch-and-go brief IAW Normal Briefings in this Appendix.

8. Approaching Point Shamrock or approximately five miles from outlying field:

"Corpus Approach, MNTNA XX/STGRY XX*, terminate."*

"Valley Approach, MNTNA XX/STGRY XX*, Harlingen in sight, terminate."*

9. Initial contact with Tower:

"Navy Corpus Tower, MNTNA XX/STGRY XX, *Point Shamrock, touch and go/full stop."*

"Navy Corpus Tower, MNTNA XX/STGRY XX, Point Shamrock, Sunrise transition on request."

"Navy Corpus Tower, MNTNA XX/STGRY XX*, Point Sunrise, touch and go/full stop."*

"Orange Grove Tower, MNTNA XX/STGRY XX, *five miles south, touch and go."*

"Cabaniss Tower, MNTNA XX/STGRY XX*, Point Sunrise, touch and go."*

10. Report the initial:

"Navy Corpus Tower, MNTNA XX/STGRY XX*, initial runway 17."*

11. When over the approach end of the duty runway:

"Navy Corpus Tower, MNTNA XX/STGRY XX*, numbers for the break."*

12. When abeam intended point of landing:

"Cabaniss Tower, MNTNA XX/STGRY XX, left/right 180, three down and locked, touch and go/full stop."

13. When ready to depart Cabaniss:

"Cabaniss Tower, MNTNA XX/STGRY XX, *Sunrise on request."*

14. If on an extended upwind and feel the Tower has forgotten about you:

"Navy Corpus Tower, MNTNA XX/STGRY XX*, for downwind."*

15. When clear of the duty runway, call for taxi:

"Navy Corpus Ground, MNTNA XX/STGRY XX, clear on Echo, taxi to my line/VT-31 Hotspot."

B101. INSTRUMENT FLIGHTS

Phraseology. Use the proper phraseology as described in the AIM and the Pilot/Controller Glossary. For example, respond *"Traffic in sight"* or *"Negative contact"* to inform the controller whether or not previously issued traffic is in sight.

Departure/Approach. On initial contact with departure/approach control, check in with the airfield departing, altitude passing, and initial altitude assigned. When requesting a particular IAP from approach control, include your intentions (*"full stop"* or *"followed by radar vectors for the ILS RWY 13R at NGP"*); this will let the controller know he/she must issue you climbout instructions (the controller may assume a full stop if no further intentions are communicated).

1. Obtain ATIS, put your clearance on request, and call for taxi:

   "Navy Corpus Clearance Delivery, MNTNA XX/STGRY XX, IFR to (first destination)"

   "Navy Corpus Clearance Delivery, MNTNA XX/STGRY XX, Tango-3 on request, first event, VOR 17 at Corpus International."

   "Navy Corpus Clearance Delivery, MNTNA XX/STGRY XX, GCA-1 on request, eight GCA's."

   "Navy Corpus Ground, MNTNA XX/STGRY XX, taxi from Echo Line, with information Papa."

When you complete checking "RADIOS/NAVAIDS" on the Takeoff Checklist, copy your clearance:

"Navy Corpus Clearance Delivery, MNTNA XX/STGRY XX, ready to copy."

NOTE

Read back clearance and set NAVAIDS for departure.

If practicing approaches (Tango-3, GCA-1) in the Navy Corpus area, then intending to depart on a filed flight plan, put the local departure on request and inform Clearance you have also filed a flight plan. For example, *"Navy 1G411, GCA-1 on request, 2 approaches, followed by filed IFR flight plan to San Antonio International."* The local IFR clearance will be issued on the ground and enroute clearance will normally be issued by Approach while airborne.

2. Upon reaching "CREW" on the Takeoff Checklist, brief the takeoff IAW Normal Briefings in this Appendix.

3. When reaching "Anti-ice/Deice" on the Takeoff Checklist, hold the checklist and call for further taxi:

   "*Navy Corpus Ground, MNTNA XX/STGRY XX, further taxi.*"

4. Approaching the hold short, request takeoff clearance:

   "Navy Corpus Tower, MNTNA XX/STGRY XX, number one, holding short, takeoff."

NOTE

To eliminate unnecessary chatter on an already busy frequency, call Tower only if you are number one in line (VFR or IFR) for departure.

Responses to Tower clearances:

a. If instructed to hold short:

"MNTNA XX/STGRY XX, hold short."

b. If instructed to taxi into line up and wait:

"MNTNA XX/STGRY XX, line up and wait."

c. If cleared for takeoff:

"MNTNA XX/STGRY XX, cleared for takeoff."

d. Tower may also clear an aircraft to cross a runway and give an instruction as in (a), (b), or (c) above. In this case, read back the entire clearance:

*"*MNTNA XX/STGRY XX*, cross 13L, line up and wait 13R."*

5. Initial contact with Departure:

"Corpus Departure, MNTNA XX/STGRY XX, off Navy Corpus, passing 1000 for 1500."

NOTE

If canned departure changed after going to Tower frequency or you suspect some confusion with approach knowing what departure you are flying, it is a good idea to specify departure name, e.g., *"Bay 4."*

6. Initial contact with Approach:

"_____ *approach*, MNTNA XX/STGRY XX, *level* ___, *with (dest airfield) information (ATIS identifier)/ (dest airfield) weather, request.*"

"*Request (name of approach, how it will be done (PT, vectors, HILO), from (desired IAF), and how it will terminate (e.g. "followed by vectors ILS CRP").*"

7. When reaching "CREW" on the Approach Checklist, as applicable, give your touch-and-go brief IAW the Normal Briefings of this Appendix:

8. When clear of the duty runway, call for taxi:

"Navy Corpus Ground, MNTNA XX/STGRY XX, clear on Echo, taxi to my line/VT-31 Hotspot."

B102. NORMAL BRIEFINGS

First Engine Start:

"This will be a battery start of the right engine. The left side is clear." Wait for the PM to respond with "Right side clear."

Second Engine Start:

"This will be a generator assisted start of the left engine. The left side is clear." Wait for the PM to respond with "Right side clear."

VFR Takeoff:

a. On initial takeoff the PF states *"Back me up on the power quadrant and monitor the engine and flight instruments. Call out any malfunctions. All malfunctions will be handled in accordance with NATOPS. Call rotate at 91 knots and note the time of takeoff."* Following each respective pilot's initial takeoff briefing, each subsequent takeoff can be briefed as *"Takeoff procedures are standard, rotate at 91 knots."*

b. Brief the departure:

"This will be a course rules departure to block two south."

c. Brief intentions for an emergency immediately after departure:

"For an emergency after takeoff requiring an immediate return to the airport, we will maintain VFR and request a downwind for runway 13R."

IFR Takeoff:

a. On initial takeoff the PF states *"Back me up on the power quadrant and monitor the engine and flight instruments. Call out any malfunctions. All malfunctions will be handled in accordance with NATOPS. Call rotate at 91 knots and note the time of takeoff."* Following each respective pilot's initial takeoff briefing, each subsequent takeoff can be briefed as *"Takeoff procedures are standard, rotate at 91 knots."*

b. IFR Brief:

The following is a departure briefing guide. No specific verbiage need be memorized. Rather, like an approach brief, a departure brief should cover the following items at a minimum:

Departure

Departure Clearance

Trouble T/ODP/Diverse Departure

Takeoff/Departure NOTAMs

NAVAID setup/FMS setup/Automation

Emergency return

Weather/runway condition

TOLD/V_R/V_{YSE}

MELs/Maintenance factors

Touch and Go:

"*Once safely on the runway, I'll call 'Reset Flaps, Trim' and advance the power levers to 12 o'clock. You reset flaps and trim. Call 'Go' with engines spooled up. Call 'Rotate' at V_R with takeoff power set.*"

Instrument Approach Brief

The following is an approach briefing guide. No specific verbiage need be memorized. Rather, like a departure brief, an approach brief should cover the following items at a minimum.

1. Mandatory Brief Items:

   a. Approach name and page number

   b. NOTAMs/remarks/Trouble T

   c. NAVAID frequency (as applicable)

   d. Initial approach fix

   e. Final approach course

f. Final approach fix/glideslope intercept altitude

g. Step-down altitudes

h. DA/MDA

i. Required vs. actual weather

j. Missed approach point

k. Circling information (as applicable)

l. Runway length/width

m. Missed approach instruction

n. Automation (Flight Director/Autopilot)

2. Time permitting brief items:

a. Field elevation

b. Approach/runway lighting

c. Course arrow to runway threshold

d. Timing (as applicable)

e. Location & elevation of highest obstruction on approach chart

f. Taxi briefing to include anticipated direction of runway exit, intersection for runway exit and expected taxi route.

B103. EMERGENCY BRIEFINGS

The following briefs are suggested techniques for managing CRM in emergencies. They are not intended to be procedural, or a replacement for good judgment. This is not an all-inclusive list of emergencies. Always remember to ***"Aviate, Navigate, Communicate."***

1. **Dual AHRS Failure (T-44C):** In flight, if both AHRS fail.

"I have lost my AHRS. How is yours?"

[IP states his has failed as well]

"Are we able to proceed VMC?"

[IP will respond *"yes"* or *"no."* If *"no,"* continue.]

"Check the circuit breakers and the reversionary panel."

[IP will respond with status of both]

"I am on the ESIS, turn off the 'big five,' are you familiar with the characteristics of the wet compass?

[IP will respond *"yes"* or *"no."* If "*no",*" you must brief the wet compass characteristics.]

"Call out my cardinal headings and update my ESIS heading when I rollout. You have the comms, declare an emergency, and request no-gyro vectors for a PAR/ASR."

2. **Dual Primary Flight Display Failure (T-44C):** In flight, if both PFDs fail.

"I have lost my PFD. How is yours?"

[IP states his has failed as well]

"Are we able to proceed VMC?"

[IP will respond *"yes"* or *"no."* If *"no,"* continue.]

"Check the circuit breakers and the rheostats."

[IP will respond with status of both]

"I am on the ESIS, you have the comms, declare an emergency, and request no-gyro vectors for a PAR/ASR."

3. **SSE Full stop.** *"Once safely on the deck, I will bring both power levers over the detent, reversing with the left/right engine, maintaining centerline with opposite rudder and aileron and forward yoke pressure. If rudder effectiveness is lost, I will bring both power levers toward flight idle."*

APPENDIX C
AIRCRAFT HAND SIGNALS

1. Affirmative (all clear)
2. Negative (not clear)
3. Proceed to next marshaler
4. This way
5. Slow down
6. Turn to left
7. Turn to right
8. Move ahead
9. Stop
10. Brakes (on/off)
11. Move back
12. Turns while backing (tail to left)
13. Turns while backing (tail to right)
14. Clearance for personnel to approach aircraft
15. Personnel approaching the aircraft
16. Insert chocks
17. Remove chocks
18. Connect ground electrical power
19. Disconnect ground electrical power
20. Start engine(s)
21. Cut engines
22. Fire (U.S. Navy use only)

23. Lower wing flaps

24. Raise wing flaps

25. Remove chocks and/or tiedowns

26. Insert chocks and/or install tiedowns

27. Hot brakes

28. Lights (on/off)

29. I have command

30. Pass control

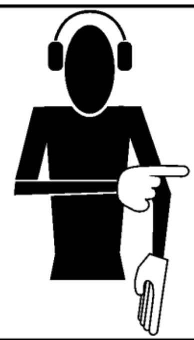
SIGNAL	DAY	NIGHT
(1) 	Hand raised, thumb up.	Same as day signal with addition of wands.
(2) 	Arms held out, hand below waist level, thumb turned downwards.	Same as day signal with addition of wands.
(3) 	Right or left arm down, other arm moved across the body and extended to indicate direction to next marshaler.	Same as day signal with addition of wands.
(4) 	Arms above head in vertical position with palms facing inward.	Same as day signal with addition of wands.

Figure C-1 Hand Signals

SIGNAL	DAY	NIGHT
(5) 	Arms down with palms towards ground, then moved up and down several times.	Same as day signal with addition of wands.
(6) 	Point right arm downward, left hand is repeatedly moved upward - backward. Speed of arm movement indicates rate of turn.	Same as day signal with addition of wands.
(7) 	Point left arm downward, right hand repeatedly moved upward - backward. Speed of arm movement indicates rate of turn.	Same as day signal with addition of wands.
(8) 	Arms extended from body and held horizontal to shoulders with hands up-raised and above eye level, palms facing backwards. Execute beckoning arm motion angled backward. Rapidity indicates speed desired of aircraft.	Same as day signal with addition of wands.

Figure C-2 Hand Signals

SIGNAL	DAY	NIGHT
9 	Arms crossed above the head, palms facing forward.	Same as day signal with addition of wands.
10 	**"ON"** Arms above head, open palms and fingers raised with palms toward aircraft, then fist closed. **"OFF"** Reverse of above.	**"ON"** Arms above head, then wands crossed. **"OFF"** Crossed wands, then uncrossed
11 	Arms by sides, palms facing forward, swept forward and upward repeatedly to shoulder height.	Same as day signal with addition of wands.
12 	Point right arm down and left arm brought from overhead, vertical position to horizontal position repeating left arm movement.	Same as day signal with addition of wands.

Figure C-3 Hand Signals

SIGNAL	DAY	NIGHT
(13) 	Point left arm down and right arm brought from overhead, vertical position to horizontal forward position, repeating right arm movement.	Same as day signal with addition of wands.
(14) 	A beckoning motion with right hand at eye level.	
(15) 	Left hand raised vertically overhead, palm towards aircraft. The other hand indicates to personnel concerned and gestures towards aircraft.	Same as day signal with addition of wands.
(16) 	Arms down, fists closed, thumbs extending inwards, swing arms from extended position inwards.	Same as day signal with addition of wands.

Figure C-4 Hand Signals

SIGNAL	DAY	NIGHT
(17) 	Arms down, fists closed, thumbs extended outwards, swing arms outwards.	Same as day signal with addition of wands.
(18) 	Hands above head, left fist partially clenched, right hand moved in direction of left hand with first two fingers (one finger for SINS) extended and inserted into circle made by fingers of the left hand.	Same as day signal with addition of wands.
(19) 	Hands above head, left fist partially clenched, right hand moved away from left hand, withdrawing first two fingers (one finger for SINS) from circle made by fingers of the left hand. Other arm pointing to appropriate engine(s).	Same as day signal with addition of wands.
(20) 	Left hand overhead with appropriate number of fingers extended, to indicate the number of the engine to be started, and circular motion of right hand at head level.	Similar to day signal except that the wand in the left hand will be flashed to indicate the engine to be started.

Figure C-5 Hand Signals

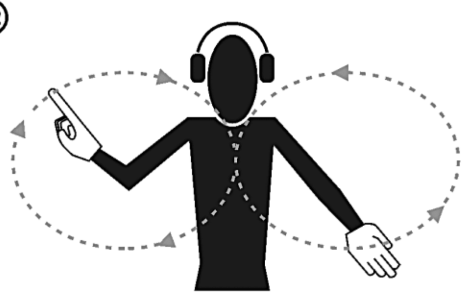
SIGNAL	DAY	NIGHT
21 	Either arm and hand level with shoulder, hand moving across the throat, palm down. Hand is moved sideways, arm remaining bent. Other arm pointing to engine.	Same as day signal with addition of wands.
22 	Describes a large figure eight with one hand and points to the fire area with the other hand.	Same as day signal with addition of wands.
23 	Hands in front, palms together horizontally then opened from the wrist crocodile-mouth fashion.	Same as day signal with addition of wands.
24 	Hands in front horizontally, with palms open from the wrists, then suddenly closed.	Same as day signal with addition of wands.

Figure C-6 Hand Signals

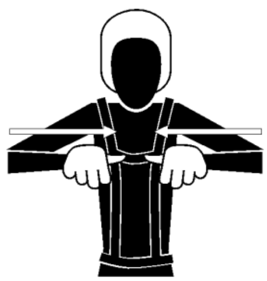
SIGNAL	DAY	NIGHT
25 	Swings arms apart, thumbs extended outwards.	Using hand held light or flashlight, gives on/off signals at one second intervals.
26 	Swings arms together, thumbs extended inwards. In single piloted aircraft, pilot may swing one arm alternately from each side, thumb extended inwards.	Moves hand held light or flashlight at eye level in a horizontal plane alternately inwards from each side.
27 	Makes rapid fanning motion with one hand in front of face and points to wheel with other hand.	Same as day signal with addition of wands.
28 	Points to eyes with two fingers to signal "lights on."	Flashing wands.

Figure C-7 Hand Signals

SIGNAL	DAY	NIGHT
(29) 	Hold one hand open, motionless and high above head, with palm forward.	Same as day except with wand.
(30) 	With both arms shoulder height, point in direction of person receiving control.	Same as day except amber wands.

Figure C-8 Hand Signals

Aircraft handling signals are used as a form of communication between aircrewmen and line personnel when radio communications are not available and to eliminate confusion with multiple adjacent aircraft on one common frequency. The signals in the chapter are standard throughout naval aviation. These signals can be given by line personnel during daylight hours as depicted or with lighted wands at night.

APPENDIX D
FUEL LOG

Fuel logs are required on all cross-country flights. All long range aircraft utilize fuel logs to assess mission endurance and cross check fuel quantity gauges which may be subject to error. The primary purpose of the T-44 fuel log is to expose student aviators to the procedures and considerations involved in proper in-flight fuel management. Entries are required as a part of preflight planning, prior to engine start, prior to takeoff, midway through the climb, and at level-off. Every 30 minutes thereafter, entries are required to update fuel usage and on-top-fuel. Indicated fuel quantity and fuel flow are always read directly from their respective gauges. The fuel log provides a running tally of indicated fuel (the amount shown on the fuel gauges), computed fuel (the known fuel quantity you started with minus fuel flow over a given time as referenced by the fuel flow gauges), and enroute time remaining.

The following example is based on a flight commenced at 0800 with an OAT of 70F/21C, cruising altitude of FL220, departing at sea level, taxiing at maximum ramp weight, and no alternate required.

Step 1. Preflight planning. Determine and record initial computed fuel. Based on an OAT of 70F/21C, ***NATOPS 25-13*** gives a JP-5 fuel density of 6.75 lbs/gal. Take max usable fuel and multiply it by its density (384 gallons x 6.75 lbs/gal.) to obtain an initial total computed fuel quantity of ***2592 lbs or 1296 left/1296 right***. Fuel density is determined by the temperature of the fuel at the time of fueling and assumed to be the current temperature for the first leg of the flight.

Step 2. Before engine start. Record the indicated fuel (off the fuel quantity gauges) and time immediately prior to engine start ***(1250 left/1260 right at time 0745)***.

Step 3. Before takeoff. Normally right before you leave the runup to taxi to the active runway, record the indicated takeoff fuel ***(1220 left/1210 right)***. Then calculate and record the computed fuel quantity. To figure the computed takeoff fuel, assume the nominal 60 lbs fuel burn (30 lbs per side) during the runup and subtract it from the initial computed amount (2592 - 60 = ***2532 lbs or 1266 left/1266 right)***.

Step 4. Record the actual takeoff time ***(0800)***.

Step 5. Midway through the climb. To account for an average fuel burn during the climb, note and record the fuel flow halfway through the climb to cruising altitude (***300 lbs/hr/engine*** at 11,000 feet, in a climb to FL220).

NOTE

Steps 6-11 shall be performed at level-off and then every 30 min thereafter.

Step 6. Record the following information:

a. Time ***(0830)***.

b. Position ***(25 NM south of PSX)***. Note this in the remarks section.

c. Indicated fuel (off the fuel quantity gauges) ***(1050 left/1080 right)***.

d. Once aircraft accelerates and cruise power is set, note and record the fuel flow per engine ***(200 lbs/hr/engine)*** and the groundspeed ***(210 knots)***.

We now have the indicated fuel quantity and have enough information to calculate computed fuel quantity.

Step 7. Calculate and record computed fuel.

a. Level-off: To calculate the fuel burn during the climb, we multiply the time of climb (0830 - 0800 = 30min or .5hr) by the average fuel burn during the climb (300 lbs/hr/engine). This yields a fuel burn of 300 lbs total or 150 lbs per engine. Subtract this amount from the computed takeoff fuel of 2532 lbs (1266 left/1266 right) to obtain a computed fuel quantity of ***2232 lbs or 1116 left/1116 right***.

b. Every 30 min thereafter: Assuming the cruise power setting has been constant, a fuel flow of 200 lbs/hr/engine for .5 hr results in 100 lbs burned per engine. Subtract 100 lbs from the previous entry's computed fuel per side to obtain the computed fuel quantity.

Step 8. Compute and record (in the remarks section) the amount of indicated and computed fuel remaining after one approach (125 lbs) to the on-deck fuel of 530 lbs, e.g., Total Fuel - 655 lbs (530# on deck + 125# for approach).

a. Indicated: 2130 - 655 = ***1475 lbs***

b. Computed: 2232 - 655 = ***1577 lbs***

This is the amount of fuel available to reach the destination, fly one approach and land with the SOP required 265 lbs per side on the deck.

Step 9. Compute and record the estimated fuel time remaining for both the indicated and computed quantities. Divide the total fuel remaining by the total cruise power fuel flow to obtain the fuel time remaining.

a. Indicated: 1475 lbs at 400 lbs/hr ***= 3.69 hrs or 3+41***

b. Computed: 1577 lbs at 400 lbs/hr = ***3.94 hrs or 3+56***

These times represent the time remaining, at the current fuel flow rate, until 265 lbs per side, including 1 approach.

Step 10. Compute and record the time enroute to the destination. Using the required charts, add up the mileage to the destination and divide this by your groundspeed (***725 NM*** at 210 knots = ***3+27***).

Step 11. Compare this estimated time remaining enroute (3+27) to the lower (3+41 assuming worst case) of the two times (indicated or computed) listed under estimated fuel time remaining. This tells us, based on the current fuel flow rate and groundspeed, we have 3+27 to get to the destination and 3+41 until 265 lbs per side. Thus, we have roughly a one quarter hour cushion and should land with approximately 315 lbs per side (worst case).

Step 12. Every 30 minutes, repeat Steps 6 - 11 to continuously monitor flight progress by comparing the enroute time remaining to the fuel time remaining. ***ETA ENROUTE*** must be less than ***EST TIME TO GO FUEL*** or you don't have enough fuel to complete your mission!

Fuel Log											
	Indicated		Computed								
Time	Left	Right	Left	Right	Total Fuel	Fuel Flow	Est Time To Go Fuel	Dist(NM) To Go	Ground-speed	ETA Enroute	Remarks
Preflt (2)	(2)	(2)	(1)	(1)	(1)						
Takeoff (4)	(3)	(3)	(3)	(3)	(3) I (3) C	(5) L (5) R					
Leveloff (6a)	(6c)	(6c)	(7)	(7)	(6d) I (6d) C	(6d) L (6d) R	(9) I (9) C	(10)	(6d)	(10)	(6b/8)
(12)											

Figure D-1 Sample Blank Fuel Log with Legend

Fuel Log											
	Indicated		Computed								
Time	Left	Right	Left	Right	Total Fuel	Fuel Flow	Est Time To Go Fuel	Dist(NM) To Go	Ground-speed	ETA Enroute	Remarks
Preflt 0745	1250	1260	1296	1296	2510 I 2592 C						
Takeoff 0800	1220	1210	1266	1266	2430 I 2542C						
Leveloff 0830	1050	1080	1116	1116	2130 I 2232 C	**300 L** 300 R	3+41 I 3+56 C	725	210	3+27	25 NM S PSX
0900	950	980	1016	1016	**1930 I** 2032 C	**200 L** 200 R	3+11 I 3+26 C	620	210	2+57	75 NM N PSX

Figure D-2 Sample Completed Fuel Log

FMS Fuel Planning

When challenged with "Fuel Log" on the cruise checklist you can use the FMS to determine fuel required to your destination.

1. Press the PERF function key to access the performance menu. Then press the FUEL MGMT LSK to access the fuel management submenu.

2. Go to page 3 of the fuel management section to access the PERF TRIP page

3. Look at the fuel flow gauges and add the two fuel flows together.
   (example: 360L+340R=700lbs/hr)

4. Enter this number in the scratch pad.

5. Press the FUEL FLOW LSK.

6. The fuel required to reach your destination will show under FUEL REQ.
   WARNING.

7. The ETE should be compared to the IDX, PERF page for accuracy.

APPENDIX E
ADDITIONAL INSTRUMENT INFORMATION

E100. AIRSPACE

Airfield Operations. Airfield operations are determined by type of airspace surrounding the field, existing weather, arrival type (IFR or VFR), and whether the field has a Tower in operation. Even when operating under positive control, it is important to know what to expect from uncontrolled traffic.

Class D Airspace. Generally, the airspace from the surface to 2500 feet above the airport elevation (charted in MSL) surrounding airports with an operational control Tower. The configuration of each Class D airspace area is individually tailored. When instrument procedures are published, the airspace will normally be designed to contain the procedures. Two-way radio communication must be established with the ATC facility providing ATC services prior to entry and maintained thereafter while in the Class D airspace. Arriving pilots should contact the control Tower on the publicized frequency and give their position, altitude, destination, and any request(s). Initiate radio contact far enough from the Class D airspace boundary to preclude entering the Class D airspace before two-way radio communications are established.

NOTES

1. If the controller responds to a radio call with, *"[aircraft call sign] STANDBY,"* radio communications have been established and the pilot can enter the Class D airspace.

2. If workload or traffic conditions prevent immediate entry into Class D airspace, the controller will inform the pilot to remain outside the Class D airspace until conditions permit entry.

3. It is important to understand that if the controller responds to the initial radio call without using the aircraft call sign, radio communications have not been established and the PF may not enter the Class D airspace.

4. At airports where the control Tower does not operate 24 hours a day, the operating hours of the Tower will be listed on the appropriate charts and in the airport facility directory (AFD). During the hours the Tower is not in operation, the Class E surface area rules or a combination of Class E rules to 700 feet AGL and Class G rules to the surface will become applicable. Check the AFD for specifics.

Unless otherwise authorized or required by ATC, no person may operate an aircraft at or below 2500 feet above the surface within 4 NM of the primary airport of a Class D airspace area at an indicated airspeed of more than 200 KIAS (230 mph). Class D airspace areas are depicted on Sectional and Terminal charts with blue, segmented lines, and on IFR Enroute Lows with a boxed [D].

Uncontrolled Airport Operations. When approaching an uncontrolled field (no Tower, or Tower not manned) the landing runway is generally at pilot's discretion. Common terminology often heard is *"Winds favor runway 13,"* or *"Runway 24 in use."* No clearance to land will be issued, as there is no controlling authority. Landing on the runway in use by other traffic is recommended, unless operational restrictions dictate otherwise. IFR traffic does not have priority over VFR traffic. Obtain wind/weather and traffic information by calling UNICOM, FSS ("*callsign Radio*"), monitoring AWOS (Automated Weather Observing System), etc. Make traffic advisory calls on the CTAF from a minimum of 10 miles out until landing. If required, the pattern may be over-flown at a higher altitude to visually check the windsock and pattern direction markers. Normal pattern altitude for operations in VMC conditions is 1500 feet AGL for large and turbine-powered aircraft, and 1000 feet AGL for other fixed-wing. The T-44C is considered to be a small turbine-powered aircraft and normal uncontrolled field entry will be made at 1000 feet AGL. Descent to 800 feet AGL is accomplished after entering downwind. Helicopters generally avoid the flow of fixed-wing traffic and operate at 500 feet AGL and below. Entry is accomplished as described in Downwind Entry procedures. Left turns are required unless right is indicated by ground markings or lights, with turns "squared off" rather than the standard military "racetrack." VFR departures are normally made by executing a 45º left turn, or straight ahead. Make all departure turns beyond the departure end of the runway after reaching pattern altitude. See section 408 and the AIM for additional information and voice reporting ("self-announce") procedures.

NOTES

1. IFR enroute chart symbols do not indicate whether the field is controlled or uncontrolled, only whether an IAP is published. On sectional charts, uncontrolled airports are depicted by magenta airport symbols.

2. A number of uncontrolled airports lie inside Class D airspace. If weather is below VFR, ATC clearance must be obtained prior to entry.

3. Taxiing aircraft are not under any control at uncontrolled fields. Advisory calls, in accordance with the AIM, should be made prior to taxi.

Additional Airspace. You will encounter several other types of airspace during Contact flights, or later in the syllabus. As a professional aviator, you must be knowledgeable of all types. It is important to know how to operate your machine and what to expect from other aircraft.

NOTE

Altitudes, operating times, controlling agencies, locations and frequencies for MOAs, prohibited areas, restricted areas, etc., can be found on enroute and sectional chart covers.

Class B Airspace. Class B airspace exists around major airports in the United States. They are depicted on area sectionals and specific Class B sectionals with heavy solid blue bands and on enroute low charts are shaded blue. They are shaped like an "upside-down wedding cake" and are rarely alike. Due to the heavy volume of traffic, special pilot and equipment rules are mandated. IFR operations are virtually identical to any controlled field IFR operations, except the tempo can be hectic. High approach speeds are often mandated until nearing the FAF. Generally, no special requests (practice approaches, etc.) will be approved. If visual approaches are in use, extensive holding delays may be encountered if the "visual" is not accepted. A higher level of expertise is expected and latitude for deviation is small. VFR entry and departure is often via radar vectors or established VFR route. Absolutely no penetration of Class B airspace is allowed without ATC clearance. When cleared to enter Class B airspace, aircraft are expected to follow instructions exactly. Assigned pattern entry speed is often higher than normal. Clearance to depart Class B airspace must be requested on initial call to Clearance Delivery for VFR departures. Instrument flight plans automatically clear IFR aircraft out of Class B airspace.

Class C Airspace. Class C airspace is charted on sectionals with heavy hashed magenta bands and on enroute low charts with blue shading. They are utilized at some busy airports to provide a more orderly flow of traffic. Mode C is required. Airspace contains a 5 NM radius around the airport center, up to 4000 feet AGL. A second ring of airspace extends outward to 10 NM; however, the base is 1200 feet AGL rather than the surface. An additional "outer area" extends to 20 NM and is available for radar advisories. Two-way radio communications must be established with ATC prior to entry within either of the two inner rings. Communication is required prior to departure, except in some situations when operating from satellite airports. In those cases, communication with the departure airport Tower initially suffices. If departing an uncontrolled airport, contact ATC as soon as practicable after departure. Participation while operating in the outer ring is encouraged, but not required. Transponder is required within and above all Class C areas, up to 10,000 feet MSL.

Terminal Radar Service Area (TRSA). TRSAs are utilized around many airports to provide vectoring, sequencing, and separation for all IFR and participating VFR traffic. Altitudes and shapes vary. They are charted on sectionals with heavy solid gray bands and listed in the Enroute Supplement. Clearance to enter a TRSA is not required. VFR participation is not required. If not desired, use the terminology *"negative stage service."* Military aircraft are required to use radar service to the maximum extent possible. Contact approach approximately 25 miles out for service. IFR arrivals will automatically be provided service.

Warning Area. Warning areas are charted on enroute and sectional charts and exist in international airspace beyond the 3-mile territorial limit such as Seagull training area. They often contain hazardous operations such as missile launches, high-speed maneuvers, Air Combat Maneuvering (ACM) training, etc. Transit through a warning area cannot be legally prohibited; however, contact the controlling agency prior to entry (phone or radio) to avoid interrupting exercises or endangering the aircraft.

Alert Area. Alert areas are charted on enroute and sectional charts and depict areas of intensive student training or other high volume activity. Pilots should be particularly attentive to scanning for other traffic when operating in an alert area. No restrictions to IFR or VFR traffic apply.

Prohibited Area. Prohibited areas are charted on enroute and sectional charts and contain extremely sensitive airspace such as the White House. Do not request clearance into a prohibited area unless your mission is tasked by the agency in control of the airspace.

Restricted Area. Restricted areas are charted on enroute and sectional charts and contain areas of unusual hazards such as artillery firing, aerial gunnery, ACM, etc. Hours of operation are often non-continuous, especially at night and on weekends. VFR and IFR aircraft will not penetrate restricted airspace without authorization from the controlling activity. If the area is not active, clearance for VFR and IFR traffic to transit the area will usually be issued. ATC normally will receive IFR routing control when a restricted area is inactive, and pilots on IFR flight plans will not have to obtain their own clearance. VFR pilots must obtain their own clearance from the controlling agency.

Military Operations Area (MOA). MOAs are charted on sectional and low enroute charts and depict areas established to separate military traffic from IFR traffic. Most areas are utilized for acrobatic type maneuvering which might be hazardous to IFR aircraft. VFR traffic should be particularly attentive to scanning for other traffic, and should contact any FSS within 100 miles of the area to obtain accurate real-time advisories. There is no restriction on VFR operations within a MOA. Normally IFR traffic will not be cleared through an active MOA.

Military Training Routes (MTR). MTRs are routes utilized to train military pilots in low level, generally high speed, combat tactics. They consist of VR (VFR) and IR (IFR) routes. The routes above 1500 feet AGL are generally flown IFR, and those below, VFR. They are charted on sectionals with a light gray line labeled with VR/IR and a three or four digit number. Four digits indicate routes generally flown above 1500 feet. Routes above 1500 feet AGL are charted on low enroute charts with brown lines. Detailed information can be found on the DoD Area Planning (AP/1B) chart. Exercise vigilance whenever in the vicinity of a MTR. Contact the nearest FSS within 100 NM of a particular route for route activity information. MTR altitudes are published on the flap of the IFR Enroute Charts (low altitude).

NOTES

1. Maximum speed beneath the lateral limits of Class B airspace is 200 KIAS. Unless authorized, large turbine-powered aircraft will not operate beneath the lateral limits of Class B airspace if transiting to/from a primary airport.

2. Mode C is required when operating within 30 miles of Class B airspace primary airport. The 30 NM ring is depicted by a thin blue circle on sectionals and hashed blue shading on enroute low charts.

E101. 60-TO-ONE RULE AND OTHER FORMULAS

What is the 60-to-1 rule and why should you use it? It is a technique for establishing predictable pitch changes for climbs or descents and lead points for intercepting courses or arcs. The following are three good reasons to use this rule:

1. It allows the pilot to compute the pitch changes necessary when establishing an attitude during the control and performance concept of attitude instrument flying discussed in the BI stage.

2. It reduces the pilot's workload and increases efficiency by requiring fewer changes and less guesswork.

3. It is an alternative to the TLAR (That Looks About Right) method of flying. After gaining experience using the 60-to-1 rule, it will improve your TLAR accuracy.

How to Work With the 60-to-1 Rule. The 60-to-1 rule gives us a mathematical equation to help you figure out all these questions, but it is almost impossible to run these calculations and fly at the same time. You need to use the formulas before you fly. Find out what your turn radius is at cruise airspeed up high and at approach airspeed down lower; find out what a 1° pitch change will do to your VVI and remember those numbers.

The 60-to-1 Rule:

1° = 1 NM at 60 NM (60 NM from the station, there is 1 NM between each radial)
1° = 100 FT at 1 NM (1° climb or descent gradient results in 100 FT/NM)

VSI Versus Pitch Change. We now know how to calculate the altitude gained or lost for each degree of pitch change over a given distance. Throw in a time factor using True Airspeed (TAS) expressed in NM per MIN and we can relate this pitch change to a change in VSI.

First, let's convert speed to NM/MIN, since the 60-to-1 rule is based on TAS expressed in NM/MIN. NM/MIN can be obtained easily from TAS as follows:

NM/MIN = TAS/60

Examples: 120 KTAS = 2 NM/MIN

150 KTAS = 2.5 NM/MIN

Since we don't have a TAS indicator, TAS can be computed from IAS. TAS increases over IAS at the rate of 2% per 1,000 feet altitude increase. So, the following equation could be used:

TAS = IAS + (2% per 1,000 FT) x (IAS)

Example: 3000 FT; 150 KIAS

TAS = 150 + (2% x 3) (150) = 150 + (.06) (150) = 159 KTAS

Another easy but less accurate rule of thumb (best used above 10,000 feet) to determine TAS is:

TAS = IAS + (FL/2) or "Add 5 KIAS per 1000' to IAS"

Example: FL 200; 175 KIAS

TAS = 175 + (200/2) = 275 KTAS

If one degree equals 100 ft/NM, then our VSI can be calculated numerous ways:

VSI for 1° pitch change = NM/MIN x 100 FT

VSI = (Pitch Angle) x (NM/MIN x 100)

VSI = (Gradient) x (NM/MIN) = (FT/NM) x (NM/MIN)

Example: For 150 KTAS and a 2° pitch change

TAS/60 = NM/MIN 150/60 = 2.5 NM/MIN

VSI for 1° pitch change = NM/MIN x 100 = 2.5 x 100 = 250 FT/MIN

VSI for 2° pitch change = 2 x (NM/MIN x 100) = 2 x (2.5 x 100) = 500 FT/MIN

Precision Glidepath. The glidepath published for an approach will be the same for every aircraft. Therefore, a pitch change equal to the published glidepath can be made on the attitude indicator when intercepting the glidepath. Aircraft speed has no effect upon the amount of pitch change required when intercepting the glidepath. Speed only affects the time required to fly the final approach segment and your rate of descent (VSI). Prior to intercepting the glidepath, compute the target VSI for your planned groundspeed. (There's also a chart in the back of the approach plate that does this for you.) When you intercept the glidepath, crosscheck your actual VSI; it should be close to your target VSI. Using the previous formulas, some algebra, and substituting GS (groundspeed – which is TAS corrected for wind) we get the following formulas to compute your target VSI:

VSI for a 3° glideslope = (GS x 10)/2 or "Half the groundspeed and add a zero"

Example: 130 KIAS; 10 KIAS headwind; GS = 120 KIAS

(120 x 10)/2 = 600 FT/MIN VSI

VSI for a 2½° glideslope = [(GS x 10)/2] – 100

Example: 130 KIAS; 10 KIAS headwind; GS = 120 KIAS

[(120 x 10)/2] – 100 = 500 FT/MIN VSI

Descent Gradients for Approaches or Enroute Descents. Now let's look at another real world application. You are flying along fat, dumb, and happy when ATC directs you to cross the ABC VORTAC at 12,000′. A quick glance inside shows you are 25 NM from the ABC VORTAC. You are at FL 270 and you are cruising at 165 KIAS or 255 KTAS (no wind). What descent gradient is required and what VSI should you expect?

First, you need to know what your descent gradient has to be. You can find the descent gradient by applying the 60-to-1 relationship of 100 ft/NM.

Required Gradient = Altitude to Lose/Distance to Travel

Descent Gradient = alt to lose/distance in NM = 15,000/25 = 600 ft/NM

To lose 15,000′ in 25 NM, you'll need a descent gradient of 600 ft/NM or about a 6° pitch change.

NOTE

For practical applications, each 60 KIAS of wind will change pitch 1° (a 60 kt tailwind will require an additional one degree lower pitch, and vice versa).

Now that you know what descent gradient is required, you can compute what your VSI should be if you make a pitch change of 6° (using the formula from above).

VSI = (FT/NM) x (NM/MIN)

VSI = (600 FT/NM) x (4.25 NM/MIN) = 2550 FT/MIN

If you maintain a constant IAS throughout the descent, then your TAS will decrease as you get lower meaning the VSI required to maintain the 6° descent gradient will slowly decrease as you descend. If you hold 2550 ft/min all the way down to 12,000', you will get down early. The most important part of the equation (which remains constant no matter what speed you are flying) is the descent gradient. You must descend at 600 feet/NM (or about 6°) in order to make the altitude restriction at the ABC VORTAC.

Climb Gradients. As you might suspect, computing a climb gradient is really no different than the enroute descent calculations, but let's run an example to see how it's done. Let's say you are getting ready to fly a Departure Procedure requiring a climb gradient of 350 FT/NM to 8000'. So, we need to climb out at a 3.5° angle. Our climb airspeed will be 155 KIAS. The airport is 3000 MSL.

First, we need to calculate our TAS. Because our TAS increases as we climb, we will be conservative and use our TAS at 8000 feet. In this case, 155 KIAS at 8000 MSL works out to 180 KTAS. Dividing this by 60 will give us our speed in NM/MIN.

Now for VSI: VSI = (Pitch Angle) x (NM/MIN x 100) = 3.5° x (3NM/MIN x 100) = 1050 FT/MIN

Calculating a Visual Descent Point (VDP). The first step to computing a VDP is to divide the Height Above Touchdown (HAT) from the IAP by your desired descent gradient. Most pilots use a 3° (300 ft/NM) glidepath for landing. Here is the formula to use:

HAT/Gradient (normally 300) = VDP in NM from end of runway

Now that you know how far the VDP is from the end of the runway, you may add this distance to the DME at the end of the runway to get a DME for your VDP. Armed with this information, it is easy to compute the distance from the FAF to the VDP. This distance is important in computing the descent gradient necessary for final approach. Using the FAF altitude, the MDA, and the distance from the FAF to the VDP, you can compute a descent gradient from the FAF to the VDP along with a target VSI to ensure you are meeting the desired descent gradient.

Example: HAT = 420 FT, MDA = 840 FT MSL, DME at the end of the runway = 0.5 DME, FAF = 6 DME

FAF altitude = 2500 FT MSL, desired landing gradient = 300 FT/NM, Approach airspeed = 150 KIAS GS

VDP = HAT/Gradient = 420/300 = 1.4 NM from end of runway

VDP DME = DME at end of runway + VDP distance = 0.5 DME + 1.4 DME = 1.9 DME

Descent Distance = FAF DME - VDP DME = 6.0 DME - 1.9 DME = 4.1 DME

Altitude to lose = FAF altitude - MDA = 2500 - 840 = 1,660 FT

Descent Gradient = altitude to lose/distance = 1660/4.1 = 405 FT/NM (4° descent gradient)

VSI = Angle (NM/MIN x 100) = 4 (2.5 x 100) = 1,000 FT/MIN

With this information you can depart the FAF maintaining a 4° descent gradient (400 ft/NM). Your target VSI is 1000 ft/min. Each mile you should lose 400 feet. At 5 DME, you should be at 2100 feet, at 4 DME, 1700 feet, etc. Continue this descent gradient until reaching the VDP at 840 feet MSL. Hopefully, at the VDP, you’ll have the runway in sight. Adjust your descent to a 300 ft/NM gradient and pick up your normal aim point.

VDP Timing. Another way to figure out when you are at the VDP is by using the following timing methods. These can be helpful for non-DME approaches where timing is the primary/only method of identifying the FAF.

1. Timing to MAP (from timing box)/NM from FAF to MAP = Seconds Per Mile

2. (Seconds Per Mile) x FAF to VDP Distance (NM) = Time (in seconds) to VDP

Example: To compute our timing to a VDP from the FAF on the NDB RWY 13 at CRP, GS=120 knots

a. First, compute our VDP: HAT/300 = 637/300 = 2.1 NM from end of runway.

b. The distance from the FAF to the runway is 4.8 NM; FAF to computed VDP is 4.8 - 2.1 = 2.7 NM.

c. Use the timing formula:

i. 144 seconds (from timing box)/4.8 (NM from FAF to MAP) = 30 seconds per mile

ii. 30 (seconds per mile) x 2.7 NM = 81 seconds = 1 minute 21 seconds. Or, using another, easier formula:

Timing to MAP (from timing box) – 10% of HAT = Time (in seconds) to VDP

Same example: 144 seconds (from timing box) - 10% of 637 = 144 - 63 = 81 seconds = 1 minute 21 seconds

Determining Turn Radius/Lead Points. Turn radius is not really a 60-to-1 relationship; however, it is important to determine your turn radius at various altitudes and airspeeds. An aircraft's turn radius is dependent on TAS and AOB. The higher the TAS, the larger the turn radius. As bank angle is increased, the turn radius decreases. In order to develop a technique for determining your turn radius, you must keep one of the variables (TAS or bank) constant. Since most procedures are based on a 30° bank, the following two relationships will provide the distance required to turn an aircraft 90° using 30° of bank. The first relationship is easier to use, but is not as accurate.

TR = NM/MIN – 2 or ***TR = (NM/MIN)2/10***

Example: 150 KIAS~160 KTAS~2.67 NM/MIN

2.67 – 2 = .67 NM (using first formula)
(2.67) 2/10 = .71 NM (using second formula)

The following formula will provide you the TR for a standard rate turn (SRT):

SRT = 0.5% of TAS (or GS)

Example: 0.5% of 160 KTAS = 0.8 NM turn radius

While we are discussing standard rate turns, here are a couple of relationships that will give you the bank angle to approximate the SRT:

Bank Angle for SRT = (TAS/10) + 7

Example: 160 KTAS; (160/10) + 7 = 23° of bank

Bank Angle for ½ SRT = (TAS/20) + 7

Arcing Lead Points. Now that we know how to determine turn radius, you can use the following 60-to-1 formulas to compute arcing lead radials:

Radials per NM = 60/Arc (DME)

Example: On a 10 DME arc, there are 6 radials per nautical mile.

Lead radials = TR x Radials/NM

Example: If our turn radius is 0.8 NM, and we are on a 10 DME arc, our lead point will be 4.8 (~5) radials prior to the desired radial.

APPENDIX F
T-44C COCKPIT PROCEDURES

F100. INTRODUCTION

The pilot flying (PF) will initiate and is responsible for the proper execution of all checklists. The pilot monitoring (PM) ensures all checklists are completed when appropriate. The "challenge and reply" method is utilized for normal checklists, whereby the PM challenges each item of the checklist and the appropriate crewmember (PF, PM, Left Seat Pilot [LS], Right Seat Pilot [RS], or OBS) performs the required action and responds with the exact reply per the checklist card. DO NOT repeat the challenge, only the reply. During emergencies, the "challenge-reply-reply" method is utilized. The PM will read the challenge and the reply for non-memory items. The appropriate crewmember will then complete the required action and respond with the reply. To facilitate good CRM, students may add "left/right" to the response but this is not required and does not detract from standardization.

If a particular checklist item is required to be performed by the PM, he/she will read the challenge, complete the action, then reply. When the response is listed as "as required," the crewmember will respond by stating the present operating status of the system. Some checklist items performed by the PM may require direction as to the desired action. If there is a desire to delay completion of a checklist, direct the PM to *"Hold the checklist."* When ready to continue the checklist, direct the PM to *"Continue the checklist."* The PM will report the completion of all checklists. The instructor must ensure the student verbalizes the correct responses to all checklist items. The Landing Checklist is never held.

This Appendix is only a training aid to augment NATOPS and must be read ***in conjunction with*** NATOPS. All non-memory item checklists will be referenced during performance to include the landing checklist.

Aircrew should not touch the screens of the FMS, ESIS, MFD, or PFD at any time.

F101. BEFORE START CHECKLIST

Pound (#) items constitute an abbreviated Before Start Checklist that may be utilized on the ground when a subsequent restart of one engine is intended. The abbreviated Before Start Checklist may be utilized after, and only after, the abbreviated Secure Checklist has been executed.

The Before Start Checklist ensures aircraft systems are functioning properly and all switches are properly set prior to engine start. The following checklist is predicated on a battery start:

1. **SEATBELTS** ***"FASTENED"*** **(PF, OBS, PM)**

   PF ensures all personnel have seatbelts fastened. The lap belt must be snug around the hips and not riding up toward the chest. The belts should operate freely. The OBS may remain unbelted until the cabin door is closed (just prior to start on hot days).

2. **PARKING BRAKE** ***"SET"*** **(LS)**

LS ensures brake handle pulled out fully and brakes pumped firm. RS cannot set the parking brake.

3. **CIRCUIT BREAKERS** ***"SET"*** **(PF, PM)**

LS ensures pedestal and fuel circuit breakers (CBs) are set. RS ensures right sub-panel and engine instrument CBs are set.

4. **ELECTRICAL PANEL** ***"SET"*** **(PF)**

PF ensures starter, auto-ignition, avionics master, aux battery, and battery/generator (gang bar) switches are OFF.

5. **EMERGENCY STATIC AIR** ***"NORMAL"*** **(RS)**

RS ensures emergency static air switch is NORMAL.

6. **AUDIO CONTROL PANEL** ***"SET"*** **(PF, OBS, PM)**

PF and PM individually set audio switches and volumes. The following is a typical set-up:

a. VHF audio – On (PF, PM)

b. V/UHF audio – On (PF, PM)

c. Transmit selector – V/UHF (PF), VHF (PM)

d. SPKR – OFF (PF, PM, OBS)

e. MIC – BOOM (PF, PM)

f. VOX, RX, ICS VOL – Volume Set, ensure VOX is set to the 9 o'clock position or ICS will be cut out (PF, PM)

g. ISO/EMR/NORMAL – NORMAL (PF, PM, OBS)

h. 121.5 EMER – Pushbutton in (PF)

i. Transponder – STBY (PF)

j. ADC, AHRS, RMT TUNE, RTU/CDU TUNE, DG SWITCHES – NORMAL (PF)

k. NOISE CANCELLATION SWITCH – ON (PF, PM)

7. **GEAR** ***"DOWN"*** **(PF)**

PF ensures gear handle is in the down position and J-hook engaged. Do not touch the gear handle on the ground.

8. **FLAPS** ***"CORRESPOND"*** **(PF, PM)**

PF and PM ensure flap handle corresponds visually with flap position.

Flap indicator will be inoperative with no power on the aircraft.

9. **CONDITION LEVERS** ***"FUEL CUTOFF"*** **(PF)**

PF ensures condition lever(s) are at FUEL CUTOFF and sets friction.

10. **PROPS** ***"FULL FORWARD"*** **(PF)**

PF moves props from FEATHER to full forward and sets friction.

11. **POWER LEVERS** ***"IDLE"*** **(PF)**

PF ensures power levers are down and against the idle stop and sets friction.

CAUTION

Do not move the power levers aft of the idle position when the engines are not running. Damage to the reversing mechanism will result.

12. **LIGHTS** ***"AS REQUIRED"*** **(LS)**

Beacons are on any time the engines are turning. Display navigation lights during the period 30 minutes before official sunset until 30 minutes after official sunrise, or at any time when prevailing visibility, as seen from the cockpit, is less than 3 statute miles. Turn on navigation lights during formation taxi.

13. **ANTI-ICE/DEICE** ***"OFF"*** **(LS)**

LS ensures all anti-ice/deice switches are OFF and ice vane controls are in.

14. **FUEL PANEL** ***"CHECKED, SET"*** **(LS)**

LS performs the following checks:

a. Fuel panel CBs – In.

b. Firewall shutoff valve switches – Open. Safety guards-in place and wired.

c. Crossfeed Valve – Open. Check crossfeed light on.

d. Crossfeed Valve – Closed. Check crossfeed light out.

e. Boost pumps – On. Check battery ammeter for discharge as each pump is turned on. Pump operation may be audible.

e. Battery – On. Check LH and RH Fuel Pressure annunciator lights out.

15. **FUEL QUANTITY** ***"CHECKED"*** **(LS)**

NOTES

1. LS checks and reports total indicated fuel in LH and RH systems. Ensure maximum split of 100 lbs. LS checks and reports indicated fuel in LH and RH nacelle tanks and quantity out of the yellow range. Ensure maximum split of 50 lbs.

2. Do ***not*** tap the fuel quantity indicators at any time.

16. **ANNUNCIATOR PANEL** ***"CHECKED"*** **(PF)**

a. PF and PM perform the following check:

b. RS presses and holds Press-to-Test button. LS ensures all annunciator lights, "Terrain," "Pull Up," and "Terrain NA" lights illuminate, EMER 121.5 illuminated, and Fault Warning light flashing.

c. LS resets Fault Warning light and ensures the light goes out.

NOTE

Whenever the Fault Warning illuminates, cancel as soon as possible. Should the light illuminate again, this will alert the crew to any other faults.

d. LS confirms dimmer operable by adjusting full up and down then sets to desired level. Observe "Terrain NA" light dims with dim control.

e. RS releases Press-to-Test button.

NOTE

While the Fault Warning light is flashing, the dimmer is inoperative and all annunciator lights are at maximum brilliance.

17. **FIRE DETECTORS** ***"CHECKED"*** **(PF, PM)**

LS rotates the Fire Detection Test switch clockwise and ensures the Fault Warning, LH FIRE annunciator, and LH FIRE EXT PUSH TO EXT lights illuminate. RS ensures RH FIRE annunciator and RH FIRE EXT PUSH TO EXT lights illuminate. LS first reports *"Three"* and RS responds *"Two"* at each selector position. LS shall wait 3 seconds between checking each selector position in order to conduct a proper check. Do not cancel fault warning until switch is rotated back to off.

NOTE

During warm weather operations, if no delay in starting is anticipated, the OBS closes the cabin door, ensures four bolts in place/locking mechanism seated, while crew performs the fire detector check.

18. **OVERHEAD LIGHTS** ***"SET"*** **(PF, PM)**

PF ensures Master Cockpit Lights switch is on and turns Overhead Map Light rheostat full bright. PF checks for operation of OAT gauge light, and pushes Master Cockpit Lights switch as required to extinguish the overhead map light. PF and PM set Pilot Display and Copilot Display rheostat knobs to full bright for Primary Flight Display (PFD) brightness. PF and PM ensure all other lights, including both utility lights, are OFF. If operating at night or in the simulator, set lights as required.

NOTE

Master Cockpit Light switch does not control pilot and copilot PFD rheostats.

19. **OXYGEN** **"*OPEN*" (PF)**

Pull Oxygen Push/Pull knob and ensure green in the regulators.

20. **CABIN DOOR** ***"LOCKED"*** **(OBS, PF)**

PF and OBS ensure the cabin door is locked and CABIN DOOR OPEN annunciator light is out.

21. **CABIN SIGN** ***"AS REQUIRED"* (LS)**

If the OBS has been properly briefed, or if no occupants are in the aft cabin, the sign may be left off. This is desirable at night due to distracting cabin illumination caused by the sign. If carrying passengers, the sign must be utilized or the passengers briefed to fasten seatbelts. PM reports *"Before Start Checklist complete."*

F102. START PROCEDURES

Engine start is a critical procedure requiring total concentration. If not performed correctly, injury to personnel or damage to equipment may occur.

Start engines in accordance with NATOPS. Start procedures and actions (up to the After Start Checklist) are performed from memory. There is no requirement to verbally announce oil pressure on the rise during an engine start. Engines will be started by the left seat pilot acting as PF.

For a battery start, start the right engine first. The PF will time the duration of starter usage and the PM will time from condition lever to low idle and inform the PF if there is no light-off within ten seconds; the PM will also monitor the fire guard. The PM checks the area around the right engine clear. The PF checks the area around the left engine clear and displays two fingers in the front windshield and receives start confirmation from the lineman. PF will place both feet on the brakes during the entire engine start sequence.

A typical brief would be: *"This will be a battery start of the right engine. The left side is clear. Wait for PM to respond with 'Right side clear.'"*

Right Engine Start:

1. **Starter – IGN and ENG Start**

PF engages right starter with right hand while simultaneously starting elapsed time clock with left hand. Ensure RH IGN IND annunciator light is on and call *"ignition."* Call *"rotation"* when N1 increases, not when the prop begins to turn outside.

CAUTION

Starter use is time limited to 40 seconds on and 60 seconds off for two cycles, then 40 seconds on and 30 minutes off.

2. **N1 – Stabilized Above 12%**

3. **Battery Voltage – 18 V or higher**

NOTE

Battery voltage should be 18 volts or greater prior to moving the condition lever to LOW IDLE. If less than 18 volts, a battery change or battery charging is needed before attempting a subsequent start.

4. **Condition lever – LOW IDLE**

PF moves right condition lever to Low Idle after N1 stabilized above 12%. PF mentally counts 10 seconds as a timing back-up. PM commences timing when PF moves condition lever to low idle and informs PF if there is no light-off within 10 seconds. There is no requirement for the PM to inform the PF how many seconds elapsed from Low Idle to light off.

5. **Fuel flow – Note (approximately 100 lbs/hr)**

NOTE

If no fuel flow is indicated after moving the condition lever to low idle on an engine start, the SMA shall wait ten seconds to allow the engine to ignite. If no light off occurs within ten seconds, the start shall be terminated in accordance with NATOPS.

6. **ITT and N1 – Monitor (both engines)**

PF should announce light off from ITT gauge.

CAUTION

1. Do not remove hand from condition lever during the start attempt. If ITT is likely to exceed 925 ºC, move the condition lever to Fuel Cutoff. If a discontinuation is required, maintain slight outboard pressure on the condition lever to prevent binding on the idle stop. Start ITT must not exceed 1,090 ºC for greater than 2 seconds.

2. If no rise in ITT is observed within 10 seconds, execute Abnormal Start Procedure IAW NATOPS.

7. **Starter – Off (50% N1 minimum)**

Stop elapsed clock – check starter time.

8. **Engine Instruments – Check for normal start indications at Low Idle.**

NOTE

On start, do not wait until prop RPM has reached 900-1100. A normal start only requires the oil pressure above 40 psi and N1 and ITT stabilized. Oil Press can exceed 100 psi for start and warm-up.

PF then signals "thumbs up" to the lineman, indicating a normal start.

9. **Power lever – Advance to 70% N1**

10. **Right generator – Reset, On**

PF turns on right generator, notes RH GEN OUT annunciator light extinguished and load indication. Allow battery to recharge while performing flight control and flap checks. Normal generator load will be 0.5 to 1.0 while the battery ammeter will read approximately 60 amps and battery voltage will read 28 VDC (Volts-Direct Current).

Control check: The control check (minimum of rudder) and flap check should normally be completed prior to taxi, while a lineman is available to observe movement.
PF places yoke left wing down, right wing down, full aft, and full forward. PF reports control surface position. PM responds with position report.

NOTE

Controls are checked smoothly and slowly for both correct response and freedom of movement. Check each control surface one at a time.

Reports for a typical control check would be:

(PF) *"Left aileron up."* (PM) *"Down."*

(PF) *"Left aileron down."* (PM) *"Up."*

(PF) *"Elevator up."* (PM) *"Up."*

(PF) *"Elevator down."* (PM) *"Down."*

PF signals for a rudder check and follows the lineman's direction. Check full left, neutral, and full right rudder.

NOTE

The signal for a rudder check is one hand held vertically, with left to right motion. At night, move flashlight beam left and right horizontally.

Flap check: PF signals for a flap check. Select flaps DOWN. PF passes the aircraft controls to the PM, who conducts a control check.

Visually check position and indicator and report. PF signals for flaps to APPROACH. Select flaps to APPROACH. Visually check position and indicator and report. PF signals for flaps UP.

Select flaps UP. Visually check position and indicator and report.

Reports for a typical flap check would be:

(PF) *"Flaps selected DOWN. Indicate DOWN, checked DOWN."* (PM) *"Down."*

(PF) *"Flaps selected APPROACH. Indicate APPROACH, checked APPROACH."* (PM) "Approach"

(PF) *"Flaps selected UP. Indicate UP, checked UP."* (PM) *"Up."*

NOTE

The signal for a flap check is the wrists held together horizontally with hands split and then follow lineman's direction. At night move flashlight beam up and down vertically.

11. **Right Generator-OFF**

PF checks right generator load and secures generator when load is below 0.5.

Left Engine Start:

PF briefs the start of the second engine, displays one finger in the front windshield, and receives start confirmation from the lineman. A typical brief would be: "*This will be a generator assisted start of the left engine. Check the right side clear. The left side is clear, starting the left engine.*" Wait for PM to respond with "*Right side clear.*"

1. **Starter-IGN and ENG START**

PF engages left starter with right hand while simultaneously starting elapsed time clock with left hand. Ensure LH IGN IND annunciator light on and call *"ignition."* Call *"rotation"* when N1 increases, not when the prop begins to turn outside.

2. **N1 – Above 12%**

3. **Generator (Right Engine) – Reset, On**

PF turns on right generator and notes RH GEN OUT annunciator light extinguished.

NOTE

Failure to turn the right generator on will result in a battery start of the second engine. This will place an unnecessary load on the electrical system and also may result in exceeding ITT limits.

4. **Right engine – Monitor ITT**

Pause for a few seconds to observe the right ITT. If ITT is likely to exceed 790 ºC, abort the start. Re-attempt the start with the right engine at 85% N1.

NOTE

A small rise in ITT is normal.

5. **Condition lever – LOW IDLE**

PF moves left condition lever to LOW IDLE after N1 stabilizes above 12% and the right generator has been turned on. PF mentally counts 10 seconds as timing back-up. PM commences timing for 10 seconds when PF moves condition lever to LOW IDLE.

6. **Fuel flow – Note (approximately 100 lbs/hr)**

NOTE

If no fuel flow is indicated after moving the condition lever to low idle on an engine start, the SMA shall wait ten seconds to allow the engine to ignite. If no lightoff occurs within ten seconds, the start shall be terminated in accordance with NATOPS.

7. **ITT and N1 – Monitor (1090 C maximum)**

PF should announce lightoff from ITT gauge.

CAUTION

1. ***Do not*** remove hand from condition lever during the start attempt. If ITT is likely to exceed 925 ºC, move the condition lever to FUEL CUTOFF. If a stop start is required, maintain slight

inboard pressure on the lever to prevent binding on the idle stop. Start ITT must not exceed 1,090 ºC for 2 seconds.

2. If no rise in ITT is observed within 10 seconds, execute Abnormal Start Procedure IAW NATOPS.

8. **Starter – OFF (50% N1 minimum)**

Stop elapsed time clock-check starter time.

CAUTION

Starter use is time-limited to 40 seconds on, 60 seconds off, 40 seconds on, 60 seconds off, 40 seconds on, then 30 minutes off.

9. **Engine instruments –** ***Check for normal indications at LOW IDLE***

NOTE

On start, do not wait until prop RPM has reached 900-1100. A normal start only requires the oil pressure above 40 psi and N1 and ITT stabilized. Oil Press can exceed 100 psi for start and warm-up.

PF then signals “thumbs up” to the lineman indicating a normal start.

10. **Generator (right engine) – OFF**

11. **Fuel quantity indicators – Check**

PF ensures both quantity indicators normal.

NOTE

If either indicator reads zero, the corresponding current limiter may have failed.

12. **Generators – RESET, ON**

PF turns on right generator, notes RH GEN OUT annunciator light extinguished and load indication.

PF turns on left generator, notes LH GEN OUT annunciator light extinguished and load indication

Check that generator loads are within 0.1.

13. **Power levers – IDLE**

14. **Fuel control heat – ON**

PF turns on fuel control heat individually and notes a small increase in electrical load. If no increase is noted when turning on, try turning off to see if a small decrease is noted, then turn back on.

F103. AFTER START CHECKLIST

The After Start Checklist is designed to check/set systems prior to taxi. Minimum time in the line area is desired once the engines have been started. The PF will initiate all actions to obtain ATIS, get a radio check with Montana Base, etc.

1. **ENVIRONMENTAL CONTROLS** ***"SET"*** **(RS)**

RS sets environmental controls as desired.

2. **DC GENERATOR VOLTAGES** ***"CHECKED"*** **(LS)**

LS simultaneously presses both PRESS FOR VOLTS pushbuttons on DC BUS meters and checks voltages 27.45-29.05 Volts (28.25 ±0.8).

3. **AUX BATTERY/AVIONICS MASTER** **"*CHECKED/ON*" (PF)**

PF performs the following check:

a. Momentarily place AUX/BATT switch to TEST then turn AUX/BATT switch to ON/ARMED position and verify the AUX/ON light illuminates and the RTU powers up.

b. Turn the Avionics Master switch ON, confirm that the AUX/Batt light extinguishes, and wait for the AHRS #1 to align before proceeding to step 6. (This will take approximately 30-35 seconds)

NOTE

Setting the ESIS Switch to ON prior to AHRS #1 alignment may result in ESIS drift. Should this occur, correct the problem utilizing the FAST ALIGN option in the ESIS menu once the ESIS itself has aligned.

c. Once Avionics Master and AUX/BATT are on, PF, PM, OBS don headsets and perform ICS checks.

NOTE

If full anti-ice/device checks are being conducted, consideration should be given to utilizing the lineman to check proper inflation/deflation of the pneumatic boots on the vertical stabilizer and elevator. Coordination with lineman to check proper inflation/deflation of the boots should be done prior to starting engines.

4. **TRANSFER PUMPS** ***"CHECKED, AUTO"*** **(LS)**

LS performs the following checks:

a. LS holds TRANSFER TEST switch in L position and places left TRANSFER PUMP switch to AUTO. Check for a momentary flicker of LH NO FUEL TRANSFER annunciator light. Reset FAULT WARNING if illuminated.

b. Repeat test for right transfer pump.

c. Verify both pumps are in AUTO.

NOTE

If flicker is not visible, check annunciator panel dim switch. If it is set too low, flicker may not be visible.

5. **CROSSFEED** ***"CHECKED, AUTO"*** **(LS)**

LS performs the following checks:

a. Crossfeed valve – AUTO

b. Left boost pump – OFF

c. LH FUEL PRESS annunciator light will illuminate and almost instantly go out as the crossfeed valve opens. Verify the FUEL CROSSFEED annunciator light on. Reset the FAULT WARNING light if illuminated.

d. Left boost pump – ON

e. Crossfeed valve – CLOSED then AUTO. Closing the crossfeed valve resets the system.

f. Repeat test (Steps b-e) for the right boost pump.

g. Verify the crossfeed valve is in AUTO.

At NGP, in order to free the lineman, hold the checklist after completing Step 5 (AHRS 1 and 2 Aligned). Brief the PM to "Let base know we are out of the chocks. Keep me clear on the right during all taxi and ground ops." Signal “brake check” to the lineman. When signaled to move forward, report “Clear left.” PM responds “Clear right.” The pilot should then depress both brake pedals and push the brake handle in, taxiing slowly forward as directed for a brake check.

After the brake check, salute the lineman, set the parking brake, and direct the PM to *“Continue the checklist.”*

6. **ESIS SWITCH** **“*ON*” (PF)**

After brake check, PF turns ESIS Switch – ON.

NOTE

Do not taxi until the ESIS has aligned.

NOTE

With the AUX/ON light illuminated and the ESIS switch ON, the Avionics Essential Bus is providing power to the ESIS display, RTU, COM 1, NAV 1 pilot’s, co-pilot’s, and observer’s audio system.

WARNING

Unless a greater emergency dictates otherwise, the ESIS shall remain on for the duration of the flight.

7. **GENERATOR LOAD** ***“CHECKED”* (LS)**

LS checks left and right generator load within 0.1. If either individual load is above .5, reduce electrical load (turn off heater or air conditioner if not required), or increase N1. Match both condition levers at the same N1 setting if a position above LOW IDLE is required (refer to ***NATOPS, Figure 4-2, Part 1, page 4-7***).

8. **MFD** ***“CHECKED/SET”* (PF)**

Set MFD switch to ON (if not already).

a. Verify self-test passed. Press LSK to allow database check.

b. Check database currency and press LSK.

c. Select TRFC on the MFD.

d. Using the control knob, select TST on the display.

e. Observe test pattern on display and verbal "TAS SYSTEM TEST OK."

f. Set view to NORMAL for local training missions, set range as desired and rotate control knob to ON.

g. Verify TERR N/A annunciator light is out.

h. Select TERR on the MFD.

i. Using the control knob, select TST on the display.

j. Observe test pattern on display and verbal *"EGPWS SYSTEM OK."* Set range as desired and Select Normal.

k. Select MAP and set overlay/range as desired. Typical setting is TAS overlay with range set to 10-20 NM.

PF directs PM to *"Hold the checklist."* Then, select channel 3 and request taxi. During taxi, it is extremely important to clear before crossing any runways or taxiways.

Depart line area and enter taxiway. Note proper turn needle and ball deflection as you turn onto the taxiway from the line area, ensure the Turn needle/Ball, ESIS, and PFD slip/skid bars properly deflect. PF will report the following: *"Needle Left/ (Right), 1-2-3 Right/ (Left) ball."*

Once on taxi centerline slowly pull both power levers into reverse and note symmetric acceleration on both engine N1 gauges. Noting prop RPM gauge indications does not satisfy this check. The intent is to ensure symmetric "engine" spool-up not propeller spool-up. Utilize minimum reverse required to verify proper operation and then return power levers towards idle. It is not necessary to bring the aircraft to a complete stop. Have the PM take the controls momentarily for a brake check.

Direct the PM to "*Continue the checklist."* Do not taxi between runway/taxiway edge lighting while making final turn in the runup areas.

CAUTION

Minimize use of reverse at slow taxi speeds. Use of reverse range in surface areas containing loose sand or small stones may cause propeller blade erosion.

9. **TRANSPONDER** ***"AS REQUIRED"* (RS)**

NOTE

Typical alignment time for the ESIS is appropriately 2-3 minutes with a maximum expected alignment time of 6 minutes. It is possible to conduct further checks while the ESIS is aligning. Select V/UHF channel 1 and ensure ATIS is copied prior to taxiing. If required, select channel 2 and put clearance on request.

10. **TURN INDICATORS** ***"CHECKED"*** **(PF, PM)**

Only one direction for turn needle, ball, and slip checks is required.

11. BRAKES ***"CHECKED"*** **(PF, PM)**

PM reports *"After Start Checklist complete."*

F104. ENGINE RUNUP CHECKLIST

Pound (#) items constitute an abbreviated checklist that may be utilized by an aircrew making their second or subsequent takeoff during the same day operations.

The engine runup checks operation of essential systems, which cannot be checked prior to start or at idle.

1. **PARKING BRAKE** ***"SET"*** **(LS)**

Brief the PM to "Monitor for movement during the engine runup." LS ensures brake handle pulled out fully and brakes pumped firm. PF will keep both feet on the brakes for the entire Runup Checklist. PM will notify the PF if movement is detected and will immediately depress the brakes if any movement is noted.

2. **ENGINE INSTRUMENTS** ***"CHECKED"*** **(LS)**

LS ensures both power levers are at IDLE and condition levers are at LOW IDLE.

NOTE

Whenever moving the condition levers to LOW IDLE, pinch the levers together, and then move the levers very slowly. If a LOW IDLE stop is weak, or a lever is moved rapidly, flameout may result. Should flameout occur, ***do not*** move the condition lever back to LOW IDLE; bring it fully into FUEL CUTOFF. After notifying Ground, the engine may be restarted using the appropriate checklist.

LS checks all engine instruments for normal indications:

a. ITT – 685 ºC maximum

b. Torque – 100-200 ft-lbs

c. Prop RPM – 900-1100 RPM

d. N1 – 51-54%

e. Fuel flow – 100 lbs/hr (approximately)

f. Oil temp – 10-99 ºC

g. Oil press – 40-100 PSI

3. **SUCTION AND PNEUMATIC PRESSURE** ***"CHECKED"*** **(LS)**

Power levers must be set to at least 70% N1.

LS ensures suction 4.3-5.9 inches Hg (5.1 ±0.8) and pneumatic pressure 12-20 PSI (16 ±4).

4. **OVERSPEED GOVERNORS** ***"CHECKED"*** **(P)**

LS performs the following checks:

a. Prop levers – full forward

b. Power levers – Set prop RPM less than 1900 RPM.

c. PROP GOV TEST switch – TEST (up position)

NOTE

Maintain a firm grip on the switch. DO NOT release the switch while the test is being performed. An abrupt surge in prop rpm may result.

d. Power levers – Advance until prop RPM stops increasing (1900 2100 RPM). ITT and Torque should continue to increase while prop RPM remains stabilized. Never allow prop RPM to exceed 2200 RPM

e. Power levers – Slowly retard prop RPM to 1900 RPM.

f. PROP GOV TEST switch – Release.

5. **PRIMARY GOVERNORS** ***"CHECKED"*** **(LS)**

With prop RPM still set at 1900 RPM, LS performs the following checks:

a. Prop levers – Move both aft. Stop when prop levers reach the detent. This will be felt as increased resistance. Be careful not to allow prop levers to enter into the FEATHER position. If FEATHER is inadvertently selected, bring the props forward immediately.

b. Prop RPM – Stabilized between 1600-1800 RPM

c. Prop levers – Slowly full forward

d. Prop RPM – Returns to approximately 1900 RPM

6. **AUTOFEATHER/AUTOIGNITION** ***"CHECKED/OFF"*** **(LS)**

LS performs the following checks:

a. Power levers – set approximately 500 ft-lb torque

b. ENG AUTO IGN SWITCHES (2) – ON. Observe LH and RH AUTO IGNITION ARMED annunciator lights (green) illuminated.

c. AUTOFEATHER switch – HOLD TO TEST (down position); observe (2) green AUTOFEATHER ARMED annunciator lights illuminated. If lights do not come on, advance the power levers slightly.

d. Left power lever – Retard slowly. As torque reaches 410 ±50 ft-lbs, check RH AUTOFEATHER ARMED annunciator light out, LH AUTO IGNITION ARMED annunciator light out and LH IGN IND annunciator light (amber) illuminated. At 200 ±40 ft-lbs check LH AUTOFEATHER ARMED annunciator light flashing. This indicates the prop is feathering. After prop RPM decreases to 800 RPM, advance left power lever to 500 ft-lbs torque. Note both the AUTO FEATHER ARMED annunciator lights and AUTO IGNITION ARMED lights are illuminated (four green lights).

e. Right power lever – Retard slowly. As torque reaches 410 ±50 ft-lbs, check LH AUTOFEATHER ARMED annunciator light out, RH AUTO IGINITION ARMED annunciator light out and RH IGN IND annunciator light illuminated. At 200 ±40 ft-lbs check RH AUTOFEATHER ARMED annunciator light flashing. This indicates the prop is feathering. After prop RPM decreases to 800 RPM, retard both power levers to idle.

f. AUTOFEATHER TEST switch – Release after noting right prop feathering cycle terminated and prop RPM indicates 900-1100 RPM.

g. ENG AUTO IGN switches (2) – Off. Ensure both IGN IND annunciator lights out.

7. **MANUAL FEATHER** ***"CHECKED"*** **(LS)**

LS performs the following checks:

a. Power levers – IDLE, prop RPM stabilized. (Power must be at idle).

b. Prop levers – FEATHER. Simultaneously pull both prop levers firmly aft, past the detent, to the stops.

c. Prop RPM – Note prop RPM decrease as props feather.

d. Prop levers – full forward after prop RPM decreases below 800 RPM.

e. Prop RPM – Note prop RPM returns to 900-1100 RPM.

NOTE

If propeller RPM does not read between 900 and 1,100 rpm with the power levers at idle and the condition levers at low idle, perform a low pitch torque check (check flight item 5 in paragraph 10.6 of the NATOPS) to ensure propeller flight idle stops are correctly adjusted.

PM reports *"Engine Runup Checklist complete."*

NOTE

After the Engine Runup Checklist is complete, the PF shall reset N1 via the condition levers as appropriate per ***NATOPS Figure 4-2***.

F105. BEFORE TAKEOFF CHECKLIST

Pound (#) items constitute an abbreviated checklist used for aircrew making their second or subsequent takeoff during the same day."

When executing the abbreviated Before Takeoff Checklist, the correct response is "checked/set" for all applicable checklist items, with the understanding that not all items require a full check and response at this time. The "checked" portion of the response satisfies the requirement that the item was previously checked during the initial completion of the full Before Takeoff Checklist.

The Before Takeoff Checklist is designed to check the remaining systems and configure the aircraft for takeoff.

1. **AUTOPILOT/YAW DAMP** ***"CHECKED/ DISENGAGED"*** **(PF, PM)**

PF and PM perform the following checks:

a. PF engages the autopilot and presses the AP/YD disconnect button on the control wheel. Observe that the autopilot disengages and is accompanied by a warning horn and PFD indication. PF then ensures flight controls operate freely.

b. PF engages autopilot and directs the PM to press the AP/YD disconnect button on the control wheel. Observe that the autopilot disengages and is accompanied by a warning horn and PFD indication. PM then ensures flight controls operate freely.

c. PF reengages the autopilot and disconnects with the autopilot bar. PF then ensures flight controls operate freely.

CAUTION

Do not check the autopilot while taxiing. ***Do not*** attempt to move the controls while the AP is engaged. Damage to the AP servos will result.

d. Verify the AP is disengaged and autopilot bar in the down position. PF and PM press their respective FD button on the FGP to remove command bars from the PFD.

NATOPS lists additional checks, which may be performed. Additional checks are not desired on student training flights and will not normally be performed.

WARNING

Engagement of the yaw damp during takeoff or landing may result in severe directional control problems.

2. **ELECTRIC TRIM** ***"CHECKED"*** **(PF, PM)**

PF and PM perform the following check:

a. Split switch (on yoke) – Individually move each half of split switch and note the elevator trim wheel does not move. Do not rush the check.

b. Split switch – Move both halves of split switch and note smooth movement of the trim wheel. Perform check in both directions. While trim wheel is moving during the second half of the check, depress and hold the red AP/YD button (to the second detent) on the yoke to disengage the electric trim. Note the trim wheel stops and a red TRIM annunciator illuminates on the PFD. Release the AP/YD button, and note trim re-engages before releasing the split switch.

c. PM repeats Steps a. and b.

NOTE

The only way to permanently disengage the electric trim is to pull the PITCH TRIM circuit breaker on the RS subpanel

3. **TRIM TABS** ***"SET"*** **(PF, PM)**

PF normally sets the following: Aileron – 0, Rudder – 0, Elevator – 2 up

NOTE

At high gross weights and aft Center of Gravity (CG), consideration should be given to utilizing less nose up trim for takeoff.

4. **CONTROLS** ***"CHECKED"*** **(PF, PM)**

Check as previously described, if not already checked. A second check is unnecessary.

5. **FLAPS** ***"CHECKED, UP"*** **(PF, PM)**

Check as previously described, if not already checked. Visually confirm the flap handle, flap position indicator, and flaps are all in the UP position.

6. **PROPS** ***"FULL FORWARD"*** **(PF)**

PF ensures prop levers are full forward.

7. **PROP SYNC** ***"OFF"*** **(PF)**

PF ensures prop sync switch is OFF.

8. **AUTOFEATHER** ***"ARMED"*** **(LS)**

LS selects autofeather ARMED.

9. **ANTI-ICE/DEICE** ***"CHECKED AS REQUIRED"*** **(PF, PM)**

Full anti-ice/deice checks are practiced during cockpit procedures trainers (CPTs) and must be memorized. A minimum of one full anti-ice/deice check is required prior to C4203. If flight into icing conditions is anticipated and/or on the first leg of a cross-country flight, full anti-ice/deice checks must be completed. Check pitot heat on every flight. Monitor load meter to ensure each system is operational and minimum N1 is maintained for the load condition. Conduct anti-ice/deice checks IAW ***NATOPS Chapter 19.*** If pitot heat is the only item checked, PF and PM respond, *"Pitot heat checked."*

10. **STALL WARNING** ***"CHECKED"*** **(LS)**

LS moves stall warning test switch to test position and verifies stall-warning light illuminates and stall-warning horn sounds.

11. **RADAR** ***"CHECKED/STANDBY"*** **(PF, PM)**

a. Ensure both PFDs are in 120° format using R1 soft key

b. Ensure RLSK on PFD shows RDR in blue/on.

c. PF Selects Radar on the Display Control Panel (DCP), confirm system is in STBY.

d. Ensure STAB is ON.

e. Ensure GAIN is in NORM.

f. Ensure SECTOR SCAN is OFF.

g. Ensure TARGET is OFF.

h. Using the MENU ADVANCE knob, PF selects TST on the display.

i. Observe two sweeps of test pattern on both PFDs. Each PFD receives pattern refresh every other sweep. The test pattern may take a few moments to show.

j. PF selects STBY.

12. **FLIGHT INSTRUMENTS** ***"CHECKED/SET"*** **(PF, PM)**

PF and PM check flight instruments for proper indications:

a. Ensure no comparator/warning flags are visible on either PFD.

b. Ensure V Speeds are set as follows V_T-102, V_2-102, V_R-91, V_1-91, V_{REF}-110. Select V_T, V_R, and V_{REF} for display.

c. Ensure ESIS indications (heading, attitude, VSI, slip/skid) match PFD indications

NOTE

ESIS airspeed will indicate 40 instead of zero while stationary.

d. Set ESIS backlighting as desired.

A typical response would be: (PF) *"My heading 130, ESIS heading 130, no comparators or warning flags V_T, V_R and V_{REF} selected."* PM reports *"My heading 130, no comparators or flags"* and any discrepancies.

NOTE

V_1, V_R, and V_2 are automatically removed from the airspeed tape at 150 KIAS

13. **ALTIMETERS** ***"CHECKED/SET"*** **(PF, PM)**

PF and PM perform the following checks:

a. Barometric Altimeter (BA):

Check the current altimeter setting is selected with no comparators or warning flags visible. Ensure the barometric altimeter indicates within ±75 feet of airport elevation and compare LS, RS and ESIS altimeter readings.

Set RA minimums to 500 feet for local day VFR training sorties or BA/RA minimums, as appropriate, for IFR training sorties. For normal operations, PF should display BA minimums and PM display RA minimums for back-up.

NOTE

See the airport diagram for specific field elevations.

b. Radar Altimeter (RA):

Depress radio altimeter test button and verify proper indications. Both altimeters should show a rise of 50 feet and the green RAD ALT display should show 50 ±5 feet.

NOTE

Do not confuse HAT with HAA. HAT refers to Straight-in approach minimums (precision or non-precision). HAA refers to circling approach minimums.

A typical response would be: (PF) *"PFD set 30.12 reading 30 feet, ESIS set 30.12 reading 30 feet BARO set 520/RADALT set 500, I'm up BARO and RADALT checks."* (PM) *"Set 30.12, reading 30 feet, RADALT selected"* and reports any discrepancies.

14. **FMS** ***"CHECKED/SET"*** **(PF, PM)**

PF will tell PM to *"Hold the checklist,"* and contact clearance delivery in accordance with the Typical Briefs and Voice Procedures Appendix to copy the IFR clearance if appropriate.

NOTE

Before going heads down to load FMS data, the controls should be passed to the PM.

Typical response would be *"Sir/Ma'am, you have the controls. I will be heads down."* Using the clearance information, or typical VFR configuration, set up FMS for flight as follows:

a. Status – Verify FMS database is current and ensure UTC time and date correct.

b. Pos Init – MANDATORY (gives FMS permission to navigate)

   * Initialize the position with the most accurate position data available. (GPS is usually most accurate and latitude and longitude position data is available on the POS INIT 2/2 page.)

c. Flt PLN – Enter departure and destination airports and flight planned route. (Technique – push EXEC after each page)

d. Dep/Arr – Enter departure as required.

e. Legs – Verify waypoints and address discontinuities.

f. Check RAIM – IDX button then GPS CTL.

   Ensure GPS sensor is enabled.

   Ensure arrival airport is accurate and enter ETA to ensure RAIM availability.

15. **RADIOS/NAVAIDS** ***"CHECKED, SET"*** **(PF, PM)**

NOTE

Do not check the active radio while taxiing.

a. V/UHF

   Set desired display intensity (Press ENT then 8 for dim or 9 for bright)

   Check squelch on.

Verify function switch TR+G (selected frequency + Guard).

Select desired frequency or preset frequency.

NOTE

Typical display reading should be P3, U, up arrow, AM with "GO" light illuminated (if using CH 3 ground at NGP).

b. VHF

Set desired display intensity on RTU. Depress and reset EMER 121.5 button and ensure button is illuminated and frequency displayed in RTU active window, side tone will sound.

Set appropriate frequency in preset and active.

c. NAV 1 and NAV 2

Set appropriate frequency in preset and active using RTU. If desired, go to menu by depressing L2 soft key twice and verify RMT TUNE is on. Depress L3 (Preset page) soft key and select tune mode to manual or preset. Depress L4 twice to return to main screen.

Tune and identify all NAVAIDS with appropriate frequencies. Your Instrument Approach Plate for the airport should be open for reference and properly secured with an approach plate clip or other device.

Repeat step for NAV 2 after depressing ½ hard key on RTU.

d. ADF

Set appropriate frequency in active window on RTU. If desired, go to menu by depressing R3 soft key twice and verify MODE is in ADF and BFO is in OFF. Depress L3 (Preset page) soft key and select tune mode to manual or preset. Depress L4 twice to return to main screen.

e. Transponder/ADS-B OUT (ATC)

Set appropriate Mode A (squawk) code in active window on the RTU. Go to the menu using the L3 soft key and verify ALT is on. Depress L4 to return to main screen. The TUN page on the CDU may also be utilized to accomplish the same task.

For Aircraft with ADS-B OUT, ensure appropriate Flight ID is in the same active window as the squawk code on the RTU. Flight ID may be turned on and set using the RTU's ATC menu using the L3 soft key. Flight ID may also be turned on and entered via the CDU by going to TUN > Next Page > Enter Flight ID.

Figure F-1 Transponder/ADS-B OUT (ATC)

f. TACAN

Verify ON/OFF switch is ON.

Verify A/A (air to air) or A/G (air to ground) switch is A/G position.

Tune appropriate frequency using TACAN control head. No test is required.

NOTE

The vast majority of TACAN stations are in the X band. Only a few sites, such as Vandenberg AFB, utilize Y. Also DME is only available from TAC when selected as the #1 NAV source. TACAN identifications are broadcast approximately once each 37.5 seconds.

Identify Morse code identifier.

Verify ID and adjust volume as required.

16. **PFD/FGP/ESIS** ***"SET"*** **(PF, PM)**

a. Ensure PFD is in 360° format using R1 soft key.

b. Select appropriate NAV source to CDI by:

Select NAV/BRG hard key on DCP.

Select desired NAV source to bearing source 1 (CRP VORTAC in VOR 1 for Contact flights).

Select same source to CDI using L1 soft key.

Select desired NAV source to preset (CRP VORTAC in VOR 2 for Contact flights).

c. PF and PM set CDI as appropriate using CRS1/2 knob on FGP. Normally set runway heading for emergency return to the departure runway; however, other appropriate settings could be 130º if outbound for Central/South Seagull, 100º for north Seagull, the outbound radial to intercept or the final approach course for the approach in use.

d. Select 150/170 as appropriate using SPEED knob on FGP.

e. Set desired altitude using ALT select knob on FGP. Typical setting would be 2500 for VFR departure (setting 500 results in aural/visual warning for *"less than 1000 to go"*) or 1600 for IFR departure from KNGP.

f. PF sets heading bug as desired as long as it provides useful information (e.g., Takeoff winds, initial heading, runway heading, etc.). See the FTI for further guidance.

g. PF sets a course for an emergency return in the ESIS. This is done by pressing the MENU button on the ESIS, then using the adjustment knob to scroll to "SET CRS," depressing the adjustment knob to select the SET CRS option, spinning in the course, and then depressing the adjustment knob again. Also, ensure the ESIS is displaying NAV1 information; if it is not displaying NAVAID information, enter the menu again, scroll to "NAV ON" then depress the knob.

Typical (PF) response *"I have VOR 1 as Primary and FMS in the preset. My number one needle is selected VOR 1, number two needle is selected VOR 2. Traffic selected, Radar is deselected, and I'm up 360 format. My course is set 130, heading bug is set 105, speed is set 200, altitude is 2500 for course rules departure, and ESIS is set 132 for the emergency return."* (PM) *"My primary is VOR 1, FMS preset, number one needle is selected VOR 1, number 2 is selected VOR 2, traffic overlay, 360 format, and course set 130."*

The response above is not required; however, it is a good technique to ensure proper setup.

17. **PRESSURIZATION** ***"SET"*** **(PF)**

PF sets:

a. Rate control knob to midpoint of travel (approximately one o'clock position).

b. Cabin controller to field elevation plus the correction factor per ***NATOPS Figure 2-21***.

c. Select PRESS on the pressurization dump switch.

18. **BLEED AIR** ***"AS REQUIRED"* (RS)**

PF directs PM to select desired position.

19. **CREW** ***"BRIEFED"* (PF)**

Brief the PM in accordance with the Typical Briefs and Voice Procedures Appendix, as appropriate. At a minimum, brief the PM on the takeoff, instrument departure procedures, and intended type of recovery if an emergency is encountered after takeoff. At the completion of the brief, PF asks *"Any questions?"* PF answers any questions, and then replies, *"Briefed, hold the checklist."*

PM calls for further taxi. Approaching the hold-short, switch to channel 4 and request takeoff clearance in accordance with the Typical Briefs and Voice Procedures Appendix. If there is sufficient time prior to being cleared onto the runway, the PF is encouraged to check total and nacelle fuel quantities in the most expeditious manner to minimize takeoff delays. Once cleared for "takeoff," or "line up and wait," clear the downwind, base, final, and the runway for traffic. Then direct the PM to "continue" the Before Takeoff Checklist while crossing the hold short line and taxiing into position for takeoff on the runway centerline with minimal usable runway behind the aircraft.

20. **ANTI-ICE/DEICE** ***"SET"* (LS)**

LS turns on anti-ice/deice equipment IAW ***NATOPS Chapter 19***. Normally, only the left and right pitot heat is necessary.

21. **LIGHTS** ***"SET"* (LS)**

LS places the following switches on:

a. LEFT and RIGHT LANDING

b. TAXI

c. NAV (night or when visibility is less than 3 statute miles)

d. ICE (night only)

e. BEACON (already on)

f. STROBE (on once taking the active runway for departure and off after exiting all active runways upon landing)

22. **TRANSPONDER** ***"SET"* (RS)**

RS switches XPDR switch below RTU from STBY to ON.

23. **CONDITION LEVERS** ***"HIGH IDLE"* (PF)**

PF places both condition levers full forward and verifies 70-73% N1 with power levers at idle.

24. **AUTOIGNITION** ***"ARMED"* (PM)**

PM reports *"Takeoff Checklist complete."* When cleared for takeoff, set 70-80% N1, check left wing/nacelle for fuel caps in place, panels secure, and no fluid leaks. Check PFD and ESIS headings aligned with the runway, no abnormal flags, and engine instruments/props stabilized. Check total/nacelle fuel quantities if not already checked. When satisfied there are no malfunctions and ready for takeoff, report *"checked left."* The RS will do the same for the right wing/instruments and report *"checked right."* Commence takeoff roll IAW the FTI.

F106. CLIMB CHECKLIST

The Climb Checklist is designed to check and set systems after takeoff, when safely established in a climb. PF should normally call for the appropriate Climb Checklist any time after passing 1000 feet AGL when cockpit duties permit. PF calls *"Abbreviated Climb Checklist"* if remaining in the local area. If PF calls *"Abbreviated Climb Checklist,"* PM completes items 1 through 4. If PF calls *"Climb Checklist,"* PM completes the entire checklist. Neither checklist is required if entering directly into the home field bounce pattern or proceeding directly to and from Cabaniss.

1. **GEAR** ***"UP"* (PM)**

PM ensures gear handle up, light in gear handle out, and three green lights out.

2. **FLAPS** ***"UP"* (PM)**

PM ensures flap handle UP and flap indicator pointing UP. A visual check of flap position is not required unless experiencing a malfunction.

3. **INSTRUMENTS/NACELLES** ***"CHECKED"* (PF, PM)**

LS checks engine and flight instruments, total and nacelle fuel quantities (return quantity switch to TOTAL), and left wing and nacelle for fluid leaks, loose panels, and other discrepancies. RS also checks engine and flight instruments, and the right wing and nacelle. If there are no discrepancies, the appropriate checklist response is *"checked"* for both pilots.

NOTE

Utilize ice lights for wing and nacelle checks at night.

4. **LIGHTS** ***"SET"*** **(LS)**

LS turns landing, taxi, and ice lights OFF.

NOTE

When departing at night and not performing Climb Checklist or Abbreviated Climb Checklist, secure ice lights after takeoff, when cockpit duties permit.

PM reports *"Abbreviated Climb Checklist complete"* or continues with full checklist.

5. **AUTOFEATHER** ***"AS REQUIRED"*** **(LS)**

LS selects Autofeather OFF, unless low altitude operations requiring autofeather are planned.

6. **PROP SYNC** ***"AS REQUIRED"*** **(PF)**

PF selects 1900 RPM on left propeller RPM, then and fine-tunes the right propeller for least prop noise, then selects prop sync ON if desired.

7. **PRESSURIZATION** ***"CHECKED"*** **(PM)**

Pressurized, PM checks:

Depending on ambient altitude and system efficiency, the differential (short needle) should increase from zero as the cabin pressurizes. The long needle will indicate cabin altitude. If desired cabin pressure indications are not correct, call for the Loss of Pressurization checklist.

Unpressurized, PM checks:

Differential (short needle) should remain at zero while the cabin altitude climbs with the aircraft (long needle). Cabin altitude should indicate approximately the same as the barometric altimeter. The cabin rate of climb should indicate the approximate aircraft rate of climb.

8. **CABIN SIGN** ***"AS REQUIRED"*** **(LS)**

LS selects desired position, normally OFF.

9. **TAS** **"AS REQUIRED" (PM)**

PM sets TAS view. This will usually be set to NORMAL.

Cruise Climb:
Sea Level to 10,000 feet – 150 KIAS
10,000 to 20,000 feet – 130 KIAS
20,000 to 25,000 feet – 120 KIAS

Above 25,000 feet – 110 KIAS

CP reports "Climb Checklist complete."

F107. CRUISE CHECKLIST

Perform the Cruise Checklist if operating above 10,000 feet or if the leg is planned to exceed 1 hour. Initiate after level-off at cruise altitude.

1. **INSTRUMENTS/NACELLES** ***"CHECKED"*** **(PF, PM)**

LS checks engine and flight instruments, total and nacelle fuel quantities (return quantity switch to TOTAL), and left wing and nacelle for fluid leaks, loose panels, and other discrepancies. RS also checks engine and flight instruments, and right wing and nacelle. If there are no discrepancies, the appropriate checklist response is *"checked"* for both pilots.

2. **ALTIMETERS** ***"SET"*** **(PF, PM)**

If below FL 180, ensure current altimeter setting (within 100 NM) is set.

If FL 180 or above, ensure 29.92 is set.

3. **PRESSURIZATION** ***"CHECKED"*** **(PM)**

PM checks cabin altitude and differential. Verify proper indications and cabin altitude no higher than 10,000 feet.

4. **TAS** ***"AS REQUIRED"*** **(PM)**

PM sets TAS view. This will usually be set to NORMAL.

5. **FUEL LOG** ***"AS REQUIRED"*** **(PM)**

Crew initiates a fuel log if required. In conjunction with periodic fuel calculations pilots should also inspect engine instruments, wings, and nacelles.

PM reports *"Cruise Checklist complete."*

F108. DESCENT CHECKLIST

The Descent Checklist must be completed anytime the Cruise Checklist has been completed. Commence the Descent Checklist upon descending through FL 180 or upon initial descent from cruise altitude if lower.

NOTE

Approximately 75 percent N1 (single engine 85 percent N1) is required to maintain the pressurization schedule during descent. The Descent Checklist must be completed anytime the Cruise Checklist has been completed.

1. **ALTIMETERS** ***"SET"*** **(PF, PM)**

Set current altimeter setting (within 100 NM). If still above FL 180, you may leave 29.92 set until passing FL 180, then set current altimeter. If proceeding to an uncontrolled field, set the ASOS altimeter setting within 25 NM of the field.

2. **PRESSURIZATION** ***"SET"*** **(PM)**

PM sets pressurization controller to the destination elevation plus 500 feet (corrected for reported altimeter setting). Refer to ***NATOPS Figure 2-21 (Part 1, page 2-53)***.

3. **WINDSHIELD ANTI-ICE** ***"AS REQUIRED"*** **(LS)**

Normally OFF. If descending into icing conditions or from cold cruise altitude temperatures into warm, humid air, select BOTH and note appropriate rise in generator load. Turn the system off when no longer required.

NOTES

1. Use of windshield anti-ice distorts optical qualities of the windshield and impairs vision slightly. Use it only when required.

2. PILOT may be selected instead of BOTH if windshield anti-ice is required during single-engine or other electrical load-restricted situations.

4. **TAS** **"*AS REQUIRED*" (PM)**

Set Above, Below, Unrestricted, or Normal as desired.

PM reports *"Descent Checklist complete."*

F109. APPROACH CHECKLIST

The Approach Checklist must be performed whenever the Climb Checklist is completed. If the full climb checklist is performed, the full approach checklist must be performed. If PF calls for *"Approach Checklist,"* PM commences checklist at Step 1 and completes the entire checklist. If PF calls for *"Abbreviated Approach Checklist,"* PM completes Steps 5 through 10.

1. **CABIN SIGN** ***"AS REQUIRED"*** **(LS)**

   If the OBS has been properly briefed, or if no occupants are in the aft cabin, the cabin sign may be left OFF. This is desirable at night due to distracting cabin illumination caused by the sign. If carrying passengers, the sign must be utilized, or the passengers briefed to fasten seatbelts.

2. **AUTOFEATHER** ***"ARMED"*** **(LS)**

   LS selects autofeather ARMED.

3. **BRAKE HANDLE** ***"IN"*** **(LS)**

   LS ensures brake handle is fully depressed.

4. **PROP SYNC** ***"OFF"*** **(PF)**

   PF selects prop sync OFF.

   (PM commences Abbreviated Approach Checklist at Step 5 if appropriate.)

5. **AUTOPILOT/YAW DAMP** ***"AS REQUIRED"*** **(PF)**

   If flying a coupled approach AP/YD may remain engaged otherwise should be noted off on PFD display. PF must turn AP/YD off before 180 ft AGL.

WARNING

Engagement of the yaw damp during takeoff or landing may result in severe directional control problems.

6. **FMS** ***"AS REQUIRED"*** **(PF, PM)**

   PF directs PM to set appropriate destination, waypoints, and/or arrival information for the current approach in the active FPLN page. If executing a GPS approach, it is also a common technique to check RAIM and that the Approach Mode is armed at this point.

7. **RADIOS/NAVAIDS** ***"SET"*** **(PF, PM)**

PF directs PM to set all applicable radios and NAVAIDs as required for arrival and approach. Utilize the RTU and TACAN for a visual checklist to ensure all applicable NAVAIDs are set.

NOTE

Aural identification of the TACAN and Marker Beacons is required.

8. **PFDs/FGP/ESIS** ***"SET"*** **(PF, PM)**

a. Set PFD display as follows: PF and PM set primary nav source, preset nav source, NAV 1 and NAV 2 bearing needles as required for the approach.

b. Set FGP as follows: PF verbalizes proper Course, HDG, ALT, and Speed to be set as required by the type of approach or to enhance situational awareness.

c. Set ESIS final approach course if applicable.

Typical response, *"My primary nav source is VOR 1, FMS is in the preset, number one needle selected TACAN number two needle selected VOR 2, traffic overlay, no radar, I'm up 360 format, course is 130, heading 350, altitude 3000, speed 150, and ESIS course set 130."*

9. **ALTIMETERS** ***"SET"*** **(PF, PM)**

PF and PM set destination altimeter setting in PFDs and ESIS, then sets BARO MIN to appropriate DA, DH or MDA and RA MIN to appropriate HAT or HAA. PF will have Barometric Altimeter minimums selected PM will have Radar Altimeter minimums selected for the approach in use during instrument sorties. For VFR sorties PF will set the Barometric Altimeter minimums to 500' above field elevation, PM will set the Radar Altimeter minimums to 500'.

BARO MINS will not be displayed in the Altitude Select window on the PFD unless the CPL arrow points to the side with the BARO MINS selected.

10. **CREW** ***"BRIEFED"*** **(PF)**

PF briefs PM on the approach and landing in accordance with the NATOPS, FTI and Typical Briefs and Voice Procedures Appendix. At the completion of the brief, PF asks *"Any questions?"* PF answers any questions, and then responds *"Briefed."* PF ensures crew/passengers are ready for landing. PM states *"Abbreviated Approach Checklist complete"* or continues with the full checklist.

11. **PRESSURIZATION** ***"SET"*** **(PM)**

PM sets the pressurization controller to the destination elevation plus 500 feet (corrected for reported altimeter setting), or verifies the correct setting if previously performed. Refer to ***NATOPS Figure 2-21 (Part 1, page 2-53).***

WARNING

Do not land pressurized.

PM reports *"Approach Checklist complete."*

F110. LANDING CHECKLIST

The Landing Checklist is never held. It must be completed no later than the 90 position or 1 mile on a straight-in. PF calls "Speed checks, Gear down, Landing Checklist" when calling for the gear handle to be placed down, whether landing is intended or not. PM ensures 155 KIAS or less and states "Speed checks" or "Gear down." RS ensures 155 KIAS or less and places the gear handle down. PM commences the Landing Checklist.

NOTE

If APPROACH flaps are required, as determined by the maneuver being conducted, PF ensures speed 174 KIAS or less prior to calling for APPROACH flaps. PM ensures 174 KIAS or less and places the flap handle to the APPROACH position.

1. **FLAPS** ***"AS REQUIRED"*** **(PF, PM)**

PM checks that the flap handle and flap indicator agree and reports position. A visual check of flap position is not required unless experiencing a malfunction.

2. **LANDING GEAR** ***"DOWN/LOCKED"*** **(PF, PM)**

PF waits for all three indicators to turn green and the light in the gear handle to go out, then reports "Down/locked." PM verifies three green lights and gear handle down with no red light, then responds "Down/locked."

3. **LIGHTS** ***"SET"*** **(LS)**

LS turns on landing and taxi lights:

PM reports *"Landing Checklist complete."*

NOTE

If the gear is retracted or the Landing Checklist is interrupted for any reason, the entire checklist must be completed again prior to landing.

F111. AFTER LANDING CHECKLIST

The After Landing Checklist must be completed after each full-stop landing (unless taxiing back on the active runway for immediate takeoff). The PF shall not call for or perform individual items of the After Landing Checklist until clear of all active runways. As the only exception the checklist may be performed while holding short between parallel runways; however, the strobe light will remain energized until clear of all active runways.

To relieve traffic congestion, it is advisable to contact ground for taxi after clearing the active runway, then call for the checklist as you taxi inbound. Ensure the PF delegates appropriate checklist items to PM to maintain SA and allow full concentration on taxiing the aircraft safely.

1. **CONDITION LEVERS** ***"LOW IDLE"*** **(PF)**

PF slowly places condition levers to LOW IDLE. The PF shall verify that N1 stabilize within the low idle limits prior to responding "LOW IDLE."

NOTE

Whenever moving the condition levers to LOW IDLE, pinch the levers together, then move the levers very slowly. If a LOW IDLE stop is weak, or a lever is moved rapidly, flameout may result. Should flameout occur, do not move the condition lever back to LOW IDLE: bring it fully into FUEL CUTOFF. Execute the Emergency Shutdown on Deck Checklist, and notify ground.

2. **TRANSPONDER** ***"AS REQUIRED"*** **(RS)**

RS selects transponder STBY.

3. **LIGHTS** ***"SET"*** **(LS)**

LS places the following switches OFF:

a. LEFT and RIGHT LANDING

b. TAXI (leave on if low visibility or night)

c. NAV (leave on if low visibility or night)

d. ICE (turn on in line area to illuminate wingtips at night)

e. STROBE (you must be clear of all active runways prior to secure strobes)

4. **ANTI-ICE/DEICE** ***"OFF"*** **(LS)**

LS secures all anti-ice/deice equipment. Leave left and right fuel control heat on if further flight is intended.

5. **AUTO-IGNITION** ***"OFF"*** **(PM)**

PM secures or verifies auto-ignition is OFF.

6. **RADAR** ***"STANDBY"*** **(PM)**

PM verifies radar is in standby.

NOTE

Standby mode is automatically selected 60 seconds after landing.

7. **FLAPS** ***"UP"*** **(PM)**

PM selects flaps UP and/or verifies flaps are UP by checking flap indicator. A visual check of flap position is not required unless experiencing a malfunction.

8. **PRESSURIZATION** ***"CHECKED/DEPRESSURIZED"*** **(PM)**

PM checks cabin altitude indicating field elevation (approximately same as barometric altimeter) and differential indicating zero. This ensures the cabin is not pressurized. If cabin is still pressurized, select DUMP.

9. **BLEED AIR VALVES** ***"AS REQUIRED"*** **(RS)**

RS closes bleed air valves. If PF desires for the valves to remain open, PF briefs PM to leave the valves open. This would only be applicable if taxiing back for takeoff and the cabin door is not to be opened. PM reports *"After Landing Checklist complete."*

F112. SECURE CHECKLIST

Unless cockpit duties preclude it, PF calls *"First six items of the Secure Checklist"* upon completion of the After Landing Checklist. The checklist may be held as required to request parking spot or to report arrival.

1. **TRANSFER PUMPS** ***"OFF"* (LS)**

   LS selects both transfer pumps OFF

2. **CROSSFEED** ***"CLOSED"* (LS)**

   LS selects crossfeed CLOSED.

3. **AUTOFEATHER** ***"OFF"* (LS)**

   LS selects autofeather OFF.

4. **FUEL CONTROL HEAT** ***"OFF"* (LS)**

   LS selects both fuel control heat switches OFF.

5. **TRIM** ***"SET ZERO"* (PM)**

   PM manually sets elevator, aileron, and rudder trim wheels to zero. After aircraft pulls into parking spot, LS sets the parking brake then PF directs PM to *"Continue the checklist."*

6. **ESIS SWITCH** **"OFF" (PM)**

   PM selects ESIS Switch OFF.

7. **PARKING BRAKE** ***"SET"* (LS)**

   LS ensures brake handle pulled out fully and brakes pumped firm.

8. **AUX BATT** ***"OFF"* (PF)**

   PF selects AUX power switch to OFF.

9. **AVIONICS MASTER** ***"OFF"* (PF)**

   PF selects AVIONICS MASTER PWR switch OFF.

10. **CABIN TEMPERATURE MODE** ***"OFF"* (RS)**

    RS selects cabin temperature mode OFF.

11. **VENT BLOWER** ***"AUTO"* (RS)**

    RS selects vent blower AUTO.

12. **PROP(S)** ***"FEATHER"*** **(PF)**

PF pulls both prop levers into FEATHER and ensures prop RPM immediately starts to drop. There is no need to wait for the props to fully feather before continuing the checklist.

13. **CONDITION LEVER(S)** ***"FUEL CUTOFF"*** **(PF)**

PF ensures ITT has been below 650 °C for at least 1 minute. PF places left hand on left condition lever and right hand on right condition lever, then simultaneously selects FUEL CUTOFF with both levers. PF notes ITT decrease and monitors engine instruments for a normal shutdown.

14. **BOOST PUMPS** ***"OFF"*** **(LS)**

LS selects both boost pumps OFF.

15. **FUEL QUANTITY/CURRENT LIMITERS** ***"CHECKED"*** **(LS)**

LS notes normal indication on left and right indicators. If either indicator reads zero, a current limiter may have blown.

16. **OXYGEN** **"*CLOSED*" (PM)**

Push Oxygen Push/Pull knob and decrease pressure to ensure red in the regulators.

17. **LIGHTS** ***"OFF" (*****LS)**

Turn all exterior lights OFF except NAV (if used) and BEACON. Turn NAV and BEACON OFF when props have stopped turning. Return all light switches and rheostats to day/VFR settings. Turn both utility lights OFF and return them to their overhead receptacles if utilized during flight.

18. **GANG BAR** ***"OFF"*** **(LS)**

19. **CONTROL LOCK** ***"AS REQUIRED"*** **(LS)**

LS installs control lock. Ensure chain is not tangled, then:

a. Place guard around engine/prop controls, open side facing aft.

b. Pull yoke aft until hole is visible in tube. Push yoke forward approximately 2 inches until hole in tube and hole in column are lined up. Slide pin into top hole. Route chain around left side of column.

c. Adjust rudder pedals fully aft. Displace left pedal slightly forward and slide metal rod into cylinder on right pedal. Push rod into cylinder enough to allow clearance to move left pedal back to original position. Slide rod into cylinder on left pedal.

20. **WHEELS** ***"CHOCKED"*** **(LS)**

21. **PARKING BRAKE** ***"AS REQUIRED"*** **(LS)**

Release the parking brake upon receiving confirmation that the wheels are chocked. Consideration should be given to keeping the parking brake set if parked on an icy or inclined ramp and/or prop wash/jet blast are present.

PM reports *"Secure checklist complete."*

F113. EMERGENCIES

In the simulator and the aircraft, emphasis is placed on proper handling of emergencies. Selected emergency procedures (bordered by a black cross-hatched margin) can be found on the reverse side of the normal checklist. Asterisked items must be committed to memory. Daggered items require concurrence of both pilots before taking the required action.

The need for concurrence before switch or control lever actuation is paramount, since incorrect action will most likely jeopardize safety to a greater degree. The PF must announce intended action, and then pause for the PM to concur before manipulating a switch or control. Only point to the switch or lever. Do not grab or "hook" it. Failure to follow this sequence may result in fuel cutoff or prop feathering of the operating engine. Timely and correct procedure execution, such as identifying "left" or "right" firewall valves, is essential for the safety of the aircraft, crew, and passengers. Practice engine shutdown procedures in the simulator, moving all related switches and valves as required.

Before securing an engine or immediately after an unexpected power loss, the "power up, rudder up, clean up" technique may be utilized.

Power up

Utilize available power as required to maintain airspeed or prevent loss of airspeed.

Rudder up

Utilize rudder as required to stop the heading change and maintain balanced flight. Trim out control pressures as time permits.

Clean up

Raise gear and flaps as required.
When performing the Emergency Shutdown Checklist, do not configure or call for the landing checklist until the required memory items have been completed

Accomplish Execution of the Emergency Engine Shutdown Checklist in the following manner (the word simulate will be used only during SSE training in the aircraft):

PF	PM
Brief intentions.	
"This will be an emergency shutdown of the left/right engine." Identify the engine to be shut down and place finger on appropriate power lever. PM visually confirms correct power lever	
"Left/right Power lever – Idle, concur?" Slowly retard power lever to idle.	*"Concur"*
Identify prop to feather and point to appropriate prop lever. PM visually confirms correct prop lever and guards against inadvertent movement	
"Left/right Propeller – Feather, concur?"	*"Concur"* or *"Simulate"*
Identify condition lever to close and point to appropriate condition lever. PM visually confirms correct condition lever and guards against inadvertent movement. IP may add power to the "feathered" engine to simulate decrease in drag.	
"Left/right Condition lever – Fuel Cutoff concur?"	*"Concur"* or *"Simulate"*
NOTE: If Prop Fails to Feather, at this point in the checklist, execute the Alternate Prop Feathering Checklist. If the prop is feathered, or upon completing the Alternate Prop Feather Checklist, pull the prop levers to 1900 RPM and continue the Emergency Shutdown Checklist in case of a confirmed/suspected fire or fuel leak. If there is no confirmed/suspected fire or fuel leak, continue with step 7 of the checklist.	
PF will continue with the checklist if fire or fuel leak related. See Chapter One for specific circumstances when the checklist does not need to be continued for a fire or fuel leak. The procedures for executing the remaining memory items are described below:	
Identify appropriate firewall valve by verifying corresponding power lever at idle. Because the firewall valves are aligned fore and aft, it is easy to make a mistake. Do not rush. Point at the appropriate firewall valve. PM visually confirms correct valve.	
"Left/right firewall valve closed, concur?"	*"Concur"* or *"Simulate"*
PF, PM decide if the fire extinguisher is required and point to the appropriate extinguisher. PF, PM visually confirm correct extinguisher.	
"Left fire extinguisher discharge, concur?" or *"Left fire extinguisher not required, concur?"*	*"Concur"* or *"Simulate,"* or *"Concur"*
Or	
If the shutdown was caused by a fire light or a fuel leak on the side opposite the PF, the PF will direct the PM of the action to take. The PM will then point to the fire extinguisher and state the appropriate action.	
"Discharge right fire extinguisher." *"Concur"* or *"Right fire extinguisher not required, concur?"*	*"Right fire extinguisher discharge, concur?"* or *"Concur"*
PF identifies left/right bleed air valve and directs PM to close bleed air valve or performs the action if flying as RS after receiving concurrence from PM. *Concur."* PM closes bleed air valve or simulates closing.	
"Close left/right bleed air valve"	*"Left/right bleed air valve closed, concur?"*
"Concur"	
Decide if the rest of the checklist is required.	
"Continue the checklist"	PM continues as directed.

If an engine fails or requires shutdown, complete the Emergency Shutdown Checklist, turn toward the nearest suitable field, and declare an emergency. If it is determined a restart of the affected engine may be accomplished in case of an unrelated emergency, then you may complete the Starter Assisted Airstart Checklist up to and including "Generator Off." Complete the Approach and Landing Checklists IAW the FTI.

When handling a fire warning light that has no secondary indications, SMAs shall provide the instructor with sound reasoning and their risk assessment if they elect to leave the engine running. NATOPS states, "Even if no secondary indications are observed, consideration should be given to shutdown of the affected engine."

APPENDIX G
THREAT AND ERROR MANAGEMENT (CRM/ORM)

G100. INTRODUCTION

The most essential learning behaviors in the Multi-Engine Pilot Training System are engine out training, instrument flying, and the use of Threat and Error Management (TEM). This Appendix is designed to assist in the development of sound Crew Resource Management (CRM) techniques that will maximize safety and efficiency in follow on aircraft. Keep in mind that CRM is only one important aspect of Threat and Error Management.

NATOPS chapter 22 must be thoroughly understood and utilized in order to safely accomplish required training events. This Appendix will assist in the application of procedures outlined in NATOPS.

G101. CRM WITH AUTOMATION

Due to the complexity of modern aircraft avionic systems, CRM is an essential tool to eliminate task saturation, minimize heads down time by both pilots, and increase situational awareness. The below procedures will help maximize safe operation of automation.

In the T-44C, there are multiple methods to fly the same procedure. This can create confusion between pilots when it is time to fly a departure, route, STAR, or approach. It is imperative to be on the same page about the level of automation to be used during all phases of flight. Therefore, the following techniques will enhance the use of automation through CRM and standardize the usage of the flight director during advanced multi-engine training.

1. The mantra for flight director and autopilot usage is ***select*** and ***verify***. Ensure that the proper flight mode is selected then verified on the Flight Guidance System Display to confirm that the anticipated mode of operation is either activated or in sequence for activation.

2. Other than the go-around mode, the direction for Flight Director inputs by the Pilot Flying and the manipulation of the Flight Guidance Panel by the Pilot Monitoring shall not be conducted until the Pilot Flying establishes a positive rate of climb, the gear is raised, props are brought to 1900 RPM, and the aircraft is climbing through 400 feet AGL and clear of traffic.

3. Be concise about what is desired for the flight director to display. A technique is to use the term “select” for mode selection (HDG, NAV, APPR, VNAV, FLC, VS etc.). Use the term “set” for headings, altitudes, speeds, and vertical speeds.

4. Pilots must remain vigilant about aircraft control including airspeed, courses, and altitudes. The biggest dangers of automation are complacency and trusting systems too much. Flight directors are garbage in = garbage out systems, meaning if false information is selected it can be a distraction or dangerous to flight operation. If the flight director or autopilot is detracting from safety of flight, turn them off and fly manually.

5. During flight director use, there may be times with the PM is unable to select desired modes in a timely fashion because of task saturation. Do not delay the execution of a clearance because of slow actuation of the Flight Guidance Panel.

6. Ensure the PM is briefed about the expectations for mode selection before an approach or go-around. Briefing the expected modes will ensure timely and accurate FGP operation and consequently add to CRM and safety.

CAUTION

PF and PM shall never both be heads down in the cockpit at the same time.

Flight Guidance Panel Operation. Each pilot will normally operate the corresponding CDI selector knob during all phases of flight and ground operation and at all levels of automation usage. During ground operations, the PF will operate the FGP. During flight with the autopilot off, the PF will delegate FGP control to the PM. With the autopilot on, the PF will operate the FGP. Inputs made to the FGP will be verbalized to the crew.

Anytime the FGP captures a new active mode (green) the crew should be alerted. The PF should verbalize to the crew active (green) and armed (white) modes displayed on the PFD.

Flight Director Assisted approaches. For any approaches where the flight director is planned on being used, the PF should brief the modes of planned operation during the approach brief or any time before the approach is commenced.

Example: TACAN 13R NGP. PF states, *"This will be a FD assisted approach using NAV and VS 800 on final."*

Approach	**FGP**		**PFD**	
	LATERAL	VERTICAL	LATERAL	VERTICAL
VOR, TACAN, LNAV LOCALIZER (MDA)	NAV	FLC, VS	VOR, TACAN, LOC, FMS	FLC, VS
ILS (DH)	APPR	N/A	APP LOC 1/LOC 2	GS
LNAV/VNAV (DA)	APPR	VNAV	APPR FMS	VGP
NOTE: FGP modes should be selected prior to FAF when "cleared approach." PFD modes are expected from FAF to MAP or RWY.				

Figure G-1 T-44C Flight Director Matrix

FMS OPERATION. In order to minimize incorrect inputs to the FMS and pilot "heads down" time, all crews shall follow the following procedures during FMS operation.

1. When the aircraft is moving, whether on the deck or in flight, FMS data entry will be accomplished by the PM.

G-2 THREAT AND ERROR MANAGEMENT (CRM/ORM)

2. When on the ground, parked, with the parking brake set, either pilot may enter data into the FMS.

3. PF shall fly the aircraft and maintain a dedicated heads-up lookout. If the PF wishes to be heads-down for an ***extended*** period of time, aircraft control shall be transferred to the PM who shall remain heads-up.

4. If the PM must divert attention away from normal clearing and monitoring duties for an ***extended*** period of time, they shall state, *"heads-down."* Verbal acknowledgment from the PF is necessary to prevent both pilots from being heads-down at the same time.

5. Both pilots shall not be heads-down at the same time. Any crewmember that observes both pilots heads-down at the same time shall alert the PF without delay.

6. Crewmembers shall verbalize when they are *"heads-up"* after completing the heads-down task. The PF shall acknowledge this call and brief any status changes.

7. After data entry, points should be verified by the instructor prior to pressing the execute button. This duty may be delegated to the SMA if the IP feels it necessary.

8. Either pilot will verbalize the need to enter a discontinuity. The PM will enter the discontinuity and advise the PF when the entry is complete.

9. Either pilot will verbalize the need to close up a discontinuity. The PM will receive concurrence from the PF prior to closing up the discontinuity.

10. Either pilot will verbalize the need to enter or edit a waypoint. The PM will enter the waypoint and execute it after receiving concurrence from the PF.

11. The PM should monitor flight progress via the LEGS page, especially in the Terminal environment.

12. Either pilot should verbalize the fact that an annunciator has illuminated. The PM looks up amplifying information, if necessary. The pilots should discuss the situation to determine what actions may be required.

13. "TERM" on the PFD, the PF will verbalize *"Terminal Mode Armed"* and the other pilot will acknowledge the call.

14. In response to the CDI ramping down to ±.3 ("Appr" on PFD,) PF will verbalize *"Approach Mode Active"* and the other pilot will acknowledge the call.

15. After a missed approach, the PF will request approach reselection. The PM will acknowledge and comply, then inform the PF when approach reselection is complete.

16. The PF will verbalize disengaging the FMS from the autopilot. The PM will acknowledge

NOTE

Training events should utilize time on the ground, holding patterns, and extended transit legs for entering information into the FMS. While the student is entering information into the FMS, the instructor should utilize the autopilot in heading and altitude hold mode at a minimum. The autopilot shall not be in NAV mode off of the FMS when the flight plan is executed.

G102. COMMUNICATION

The most important behavior of CRM is communication. Communication can happen in many forms; non-verbal, verbal, within the cockpit, over the radio, and through specific maneuvers between aircraft or individuals on the ground. Precise and timely communication is critical during non-proceduralized phases of flight. For instance, during a circling approach the PF needs to communicate his intensions on how the maneuver will be performed so the PM understands what is expected and can properly back up the PF. Effective communication will enhance situational awareness, safety, and mission effectiveness.

Mandatory Callouts. The mandatory callouts listed in NATOPS are designed to minimize error and enhance situational awareness. The call-outs; however, will not address every possible instance in which communication will be needed, they provide only a framework for good communication and risk management. Additionally, there will be times in which safety of flight overrides the importance of call-outs. ***Remember to aviate, navigate, then communicate***. An improper rudder input or power correction is far more dangerous than forgetting to announce 1000 ft to level.

Missed Callouts. During advanced instrument rides, students can expect instructors to intentionally "miss" required call-outs. This will be used to verify that students are not completely relying on the callouts for situational awareness and basic airwork. When noticing the PM has missed a callout, the PF should question the PM of the missed call in order to ensure both pilots agree with the position of the aircraft in the respective phase of flight. For example, if the PM does not call *"1000 to level,"* the PF should question the PM on the missed call to ensure that the PM agrees that you are in fact 1000 ft to level off altitude.

Deviations. As deviations from planned parameters are noticed, the PM's call should be commensurate to the level or extent of the deviation. For instance, if the PF is 10 knots slow, the PM should state *"Airspeed."* The PF will state *"Correcting."* If the PF continues to operate outside of parameters, the PM should add extra verbiage to the next call and/or direct a required action for the PF, *"Airspeed, 10 knots slow"* or *"Airspeed 10 knots slow, add power."* The amount of direction and extra verbiage stated by the PM should be commensurate to the extent of the deviation. Finally, be familiar with the two challenge rule in NATOPS. Keep in mind that the two challenge rule is designed for breakdowns in communication and safety of flight issues.

Instrument approaches. Callouts are most critical during terminal phases of flight. The following figures are designed to be used as an aid for making required calls during instrument approaches. The approach for the below examples is the ILS/LOC 13 at CRP.

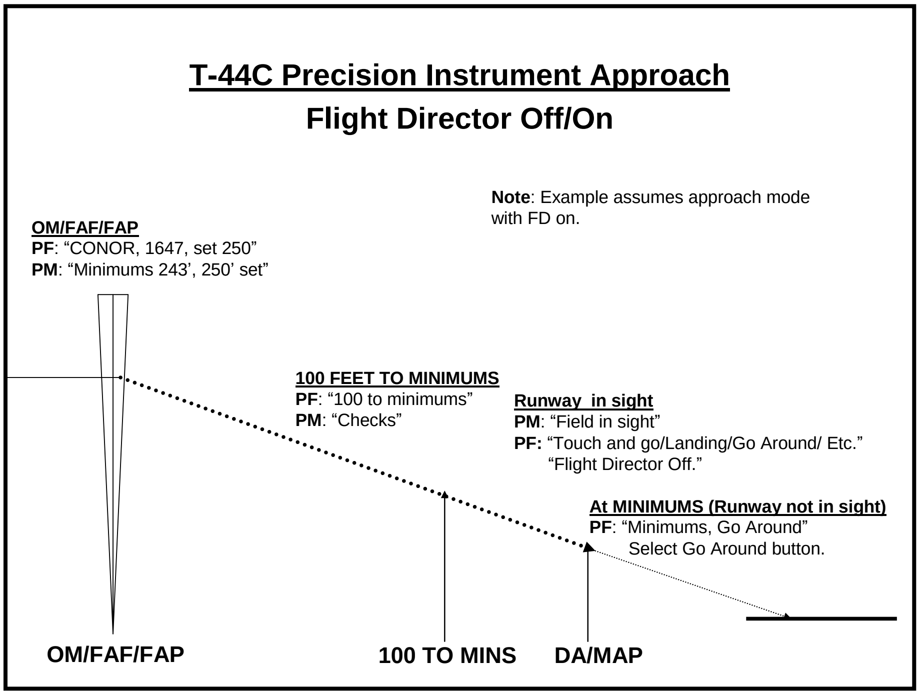


Figure G-2 T-44C Precision Instrument Approach – Flight Director Off/On

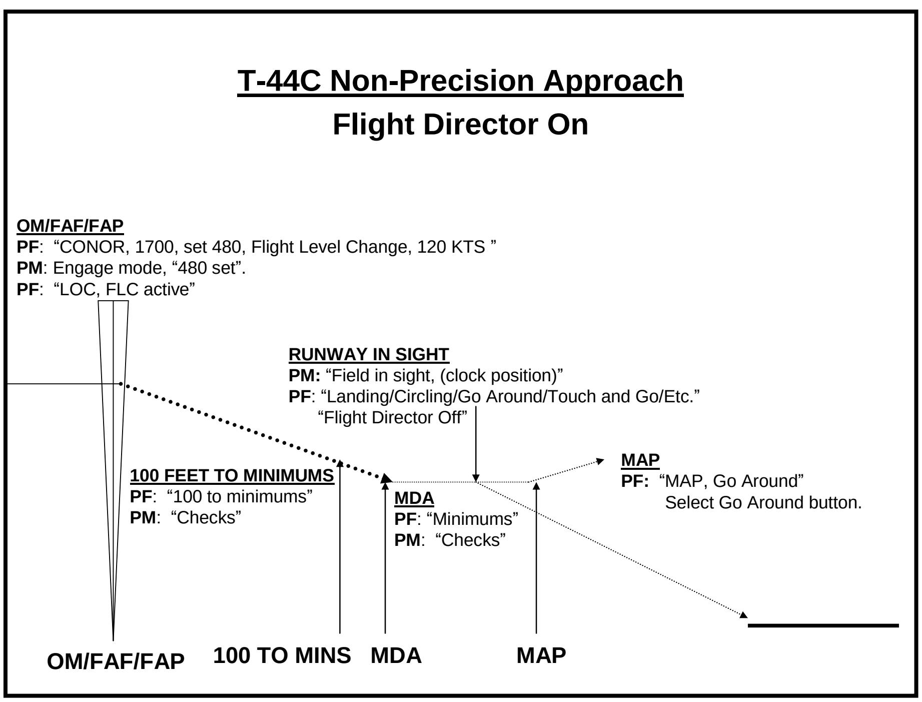


Figure G-3 T-44C Non-Precision Approach – Flight Director On

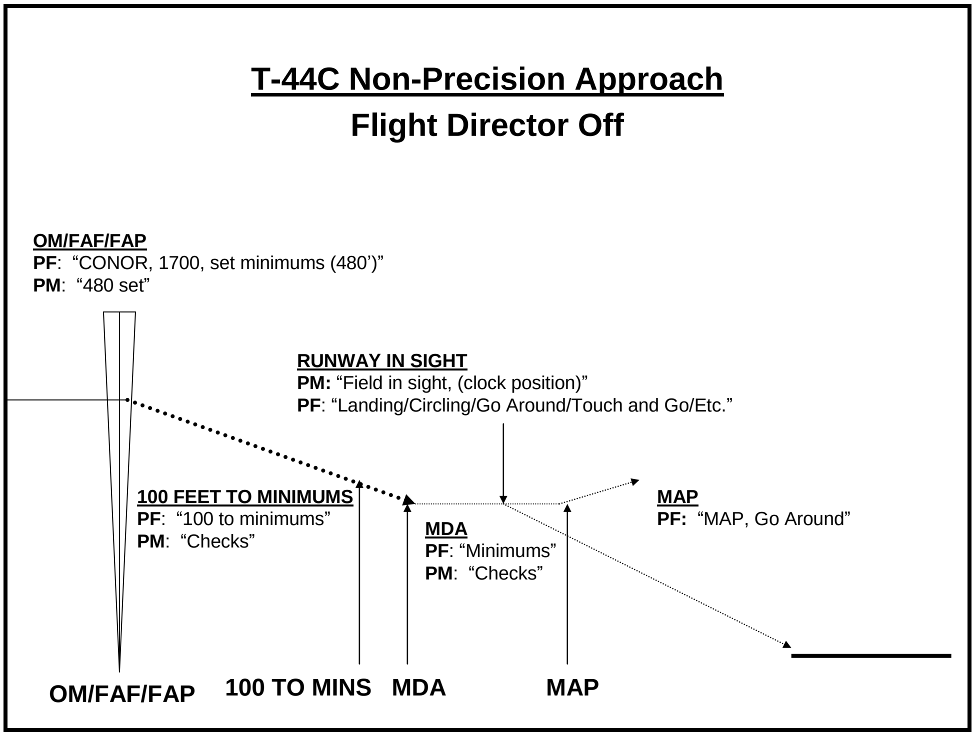


Figure G-4 T-44C Non-Precision Instrument Approach – Flight Director Off

APPENDIX H
MINIMUM CONTROLLABLE AIRSPEED (VMCA)

H100. INTRODUCTION

Vmca is the minimum speed at which directional control can be maintained with an engine inoperative. This speed is established by the manufacturer under the following criteria specified by the Certifying Authority (FAA).

1. Takeoff power set on the operating engine

2. Standard Day (Temperature 15 degrees C and Pressure 29.92" at Sea Level)

3. Maximum takeoff weight

4. Critical engine windmilling (left engine in the T-44)

5. Flaps at takeoff setting

6. Gear Up

7. 5 degrees AOB into the operating engine

8. Maximum allowable aft cg.

86 KIAS is the published Vmca speed for the T-44 under the above conditions; however, engine failures don't only occur under this exact set of conditions and therefore, the actual Vmca in any particular situation may be either more or less than the published value. With regard to the eight variables, you should notice that except for the angle of bank, gross weight, and standard day conditions, all of the remaining items are the worst case (they increase Vmca) or are related to the takeoff scenario. 86 KIAS is considered a “worst case scenario” and staying above this airspeed should allow controllability in a single engine (SE) scenario, it does not guarantee climb performance or even safe stall margin. The following is an explanation of some of the factors and how they affect Vmca.

Banking into the good engine three to five degrees lowers Vmca by vectoring lift to counter yaw (effectively increasing the horizontal component of lift) and also by reducing sideslip. Reducing the sideslip yields greater rudder effectiveness, making possible better control of yaw at slower airspeeds. Conversely leveling the wings or banking away from the good engine will increase Vmca and should be done with caution in a SE scenario.

Maximum weight also decreases Vmca. As you may recall from basic aerodynamics, the lift an aircraft generates must equal the weight. Thus, a lightly loaded aircraft will generate less total lift than a heavier loaded aircraft. Also recall that the total lift is the sum of the vertical and horizontal lift components. Since lightly loaded aircraft generate less lift, there is less horizontal lift (when 3-5 degrees of bank is applied) to control the yaw. The lightly loaded aircraft would therefore require more airflow over the rudder to control the yaw which necessitates a higher Vmca speed.

Maximum power produces the greatest yaw and roll toward the dead engine. In addition, conditions such as denser air, lower altitudes, and lower temperatures that increase engine performance will increase Vmca. The good news is pilots have direct control over this condition. Reducing power on the good engine reduces asymmetric thrust and lowers Vmca; however, keep in mind how reducing power will affect climb performance and stall margin. The pilot must be sure to maintain adequate margin above both stall and Vmca speed at all times when single engine.

A rearward or aft C.G. reduces the lever arm between the C.G. and the rudder. Recall that an airplane rotates about its C.G. along all three axes (in all three planes). The shorter the rudder arm, the more rudder that is required to counteract yaw, so rudder effectiveness is at a minimum, which necessitates higher airspeeds in order to increase the airflow over the rudder to maintain control and therefore the higher Vmca.

The flaps in the takeoff position and the gear up are stipulated because they are indicative to the takeoff scenario. The gear and the gear doors extended tend to act like rudders and act to decrease Vmca. Vmca will increase as we raise the gear. The flaps add drag and help resist the yawing moments set up by the operating engine.

All multi-engine pilots must have a thorough knowledge of Vmca and how it is affected by the current conditions. Having this knowledge will allow a pilot to recognize when an aircraft is approaching Vmca and diagnose the best course of action to facilitate a successful recovery. In order to successfully recover from Vmca, airspeed must be increased or the parameters must be changed, e.g., less asymmetric power, propeller feathered, etc.

See the Aerodynamics Workbook for more information on Vmca.