

NAVAL AIR TRAINING COMMAND



NAS CORPUS CHRISTI, TEXAS

CNATRA P-562 (Rev 08-14)

FLIGHT TRAINING INSTRUCTION



MULTI-ENGINE FLIGHT TRAINING INSTRUCTION

TC-12B

2014



DEPARTMENT OF THE NAVY
CHIEF OF NAVAL AIR TRAINING
250 LEXINGTON BLVD SUITE 102
CORPUS CHRISTI TX 78419-5041

CNATRA P-562
N713
8 Aug 14

CNATRA P-562 (08-14)

Subj: MULTI-ENGINE FLIGHT TRAINING INSTRUCTION, TC-12B

1. CNATRA P-562 (08-14) PAT, "Multi-Engine Flight Training Instruction, TC-12B" is issued for information, standardization of instruction and guidance to all flight instructors and student aviators within the Naval Air Training Command.
2. This publication shall be used as a guide for completion of Advanced Multi-Engine Flight Training curricula for all student pilots.
3. Recommendations for changes shall be submitted via CNATRA TCR form 1550/19 in accordance with CNATRAINST 1550.6 series.
4. CNATRA P-562 (New 08-09) PAT is hereby cancelled and superseded.


M. B. TATSCH
By direction

Distribution:
CNATRA Website

FLIGHT TRAINING INSTRUCTION
FOR
MULTI-ENGINE FLIGHT TRAINING INSTRUCTION
TC-12B
P-562



LIST OF EFFECTIVE PAGES

Dates of issue for original and changed pages are:

Original...0...9 Nov 09 (this will be the date issued)

Change Transmittal...1...19 Oct 10

Revision...1...8 Aug 14

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 310 CONSISTING OF THE FOLLOWING:

Page No.	Change No.	Page No.	Change No.
COVER	0	A-1	0
LETTER	0	A-2 (blank)	0
iii – v	0	B-1 – B-11	0
vi (blank)	0	B-12 (blank)	0
vii – xi	0	C-1 – C-10	0
xii (blank)	0	D-1 – D-3	0
1-1 – 1-44	0	D-4 (blank)	0
2-1 – 2-15	0	E-1 – E-6	0
2-16 (blank)	0	F-1 – F-34	0
3-1 – 3-6	0	G-1 – G-3	0
4-1 – 4-125	0	G-4 (blank)	0
4-126 (blank)	0	H-1 – H-2	0
5-1 – 5-20	0	I-1 – I-4	0
6-1 – 6-8	0		

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

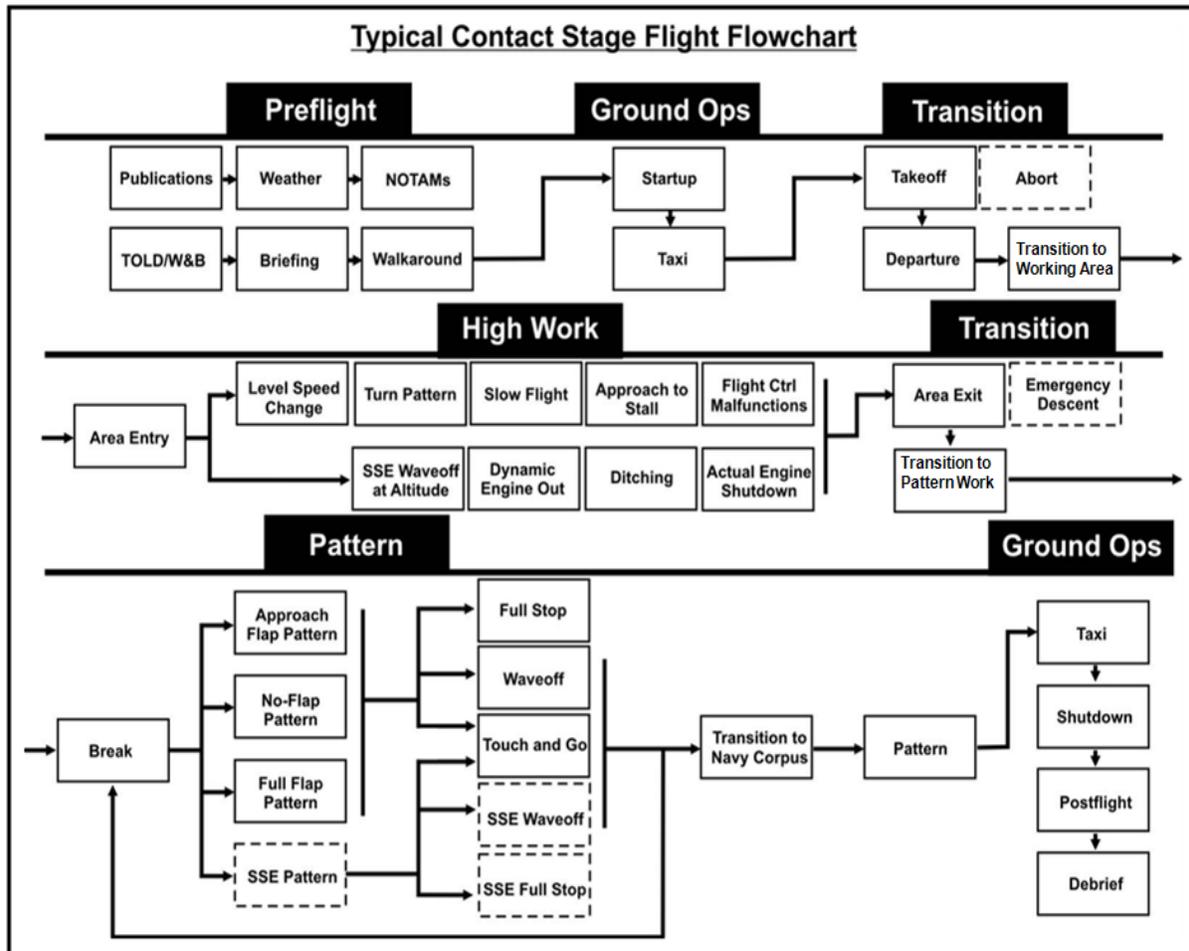


Figure 1-1 Typical Contact Stage Flight Flowchart

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.

Flight Training Instruction (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 Naval Air Training and Operating Procedure Standardization (NATOPS) is a guide to the aircraft, this FTI is a guide to the Maritime Multi-Service Pilot Training Syllabus (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.”

Crew Resource Management. "The IP usually sits in the right seat and will act as pilot monitoring (PM), 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 pilot flying (PF). For training purposes, certain duties normally delegated to the PF or PM may be restricted at the discretion of the IP. The PF's level of situational awareness (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 altitude selector, 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.

Observer (OBS) Duties. The student not in the cockpit is designated the OBS, and shall take an active role in executing crew duties. The OBS should always be seated directly behind the Student Military Aviator (SMA) in the cockpit. 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 feel free to notify the crew of anything that may affect flight safety.

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.

Inadvertent Instrument Meteorological Conditions (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 1-6 completed. Complete item 7 if aircraft is issued prior to brief.

1. **Publications.** Prior to each brief, SMAs shall pick up a navigation bag with current FLIP publications from the lockers outside the duty office. The list of publications in each bag is posted on the lockers. Check to ensure the pubs in the bag are current and include:

- a. IFR Enroute Supplement (1)
- b. Flight Information Handbook (1)
- c. Enroute Low Chart covering South Texas (1) (Low 19/20 as of Sept 2011)
- d. Enroute High Chart covering South Texas (1) (High 7/8 as of Sept 2011)
- e. Terminal Low Altitude Instrument Approach Plate for South Texas and Central Texas (2 each) (Vol 10 and Vol 11 as of Sept 2011)
- f. Terminal Change Notice (TCN) when issued and applicable for local operations (2)

Students must also carry: TC-12B NATOPS manual (with Standard Operating Procedures (SOPs)), In-Flight Guide (Blue Brains), Flight Training Instruction, course rules, Flashlight, dog-tags, flight gloves, and fuel packet (at IP discretion), and any additional equipment required by NATOPS and OPNAVINST 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. For all categories of airfields contact pattern weather minima will be 500' below clouds and 3 NM visibility (e.g. NGP 800' AGL pattern requires 1300' and 3 NM)."

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 DD175-1 Canned Weather Brief should be used. These canned weather briefs may be found on the Internet. See the squadron IT representative for current download procedures.

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), Jeppesen NavData Alerts/NOTAMs and GPS NOTAMs. Use the DoD NOTAMs website. 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).

NOTE

SMAAs add NOTAMs for KNOG, KALI, KHRL, KBRO, KVCT, KNQI, and KPIL prior to the brief.

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.

NOTE

SMAAs shall bring a completed TOLD card to the brief based on weather conditions forecast for takeoff time. TOLD shall be calculated using a 12,500 lb aircraft on the runway most closely aligned with the prevailing wind, using forecast gust for the crosswind component and ZERO headwind. If the runway is wet, assume ¼ inch standing water and complete the “For other than dry runway” section. This does not preclude the IP from re-calculating takeoff performance using actual headwinds.

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 binder at maintenance issue is sufficient. 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.

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/duty station/activity and debarkation point (if not final destination of the aircraft). The Pilot in Command (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. Ensure the PIC signs for the aircraft (designated student if solo) and place the logbook in the appropriate slot.

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.

Aircraft Inspection and Acceptance Record (AIA) (OPNAV 4790/14 1). The AIA or “A” sheet provides for:

- a. Pilot Flying (PF) acceptance of the aircraft in its present condition.
- b. Certification by maintenance personnel the aircraft is ready for flight and lists fuel, oil, and oxygen on-board.
- c. Certification by the PIC of full responsibility for safe operation of the aircraft and the safety of all personnel aboard.

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 (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.

9. **Aircraft Inspection (Walk around).** 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. Do not leave any panels open. Never leave fuel or oil caps off, as foreign material may enter the system.

NOTES

1. Inspect the tires carefully for proper inflation, excessive wear, splits in the tread, sidewall abrasions, and bulges. These may be indicative of a hard landing requiring a maintenance inspection before flight.
2. Always ensure you are pre-flighting 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. Utilize lineman to remove chocks at NGP. 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 conduct 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

1-8 CONTACT STAGE

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 wing tip drawn to the other wing tip. 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, confirming the left prop is feathered 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

A lineman is required 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 Maintenance Control on UHF 358.8. A start brief shall be given. Instructors may accept a “standard” brief during subsequent evolutions with the same student.

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 an External Power Cart be required, see NATOPS.

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."
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 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** conditions 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 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 into “line up and wait” or “takeoff”, clear the downwind, base, final, and the runway for traffic. Then direct the PM to “*continue*” the 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 and anti-ice while taxiing onto the runway before calling for the checklist. (Turn on strobe, beacon, recognition, and landing lights for all takeoffs and landings. Recognition lights will be on when the aircraft is below 10,000 feet. Minimum anti-ice equipment is known as the “hot five” (two pitot heats, two fuel vent heats, and stall warning heat) shall be on for every flight.) You may request the PM to tweak the condition levers to 65% as required by the checklist in order to keep your attention focused on positioning the aircraft. While holding the brakes, advance the power levers to the 12-o’clock position. Allow prop RPM to stabilize at 2000 RPM with torque indications matched. Check engine/flight instruments and both nacelles for secure caps, panels and no leaks. Check autofeather armed lights on (N1>90%), and note heading aligned with the runway. Excessive time on the runway checking instruments 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, set at least 2100 ft-lbs torque, and check ITT within limits 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. 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.

Crosswind takeoffs. Shall be accomplished in accordance with NATOPS.

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 required communication on the runway during takeoff should be “rotate,” “abort,” or “[state a malfunction].”

WARNING

During critical phases of flight, (i.e., takeoff, landing, initial climbout, waveoff, VFR landing pattern), the PF shall keep one hand on the power levers to facilitate immediate response of thrust.

Raise the gear when airborne with two positive indications of climb (increasing altitude and positive Vertical Speed Indicator (VSI)). Use the verbal/visual challenge using a thumbs-up and the phrase “gear up.” If PM agrees with decision to raise gear, PM will also give thumbs-up and say, “gear up.”

WARNING

To prevent inadvertent cycling of the landing gear, always give a thumbs-up/down with verbal challenge “gear up/down” when changing the landing gear configuration. Wait for visual/verbal confirmation from PM before moving the landing gear handle.

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.
2. Solos shall not practice aborted takeoffs of any kind.

2. Departure

After the gear is selected up, turn off the landing lights. Check the flaps up at Vyse. At a minimum of 500' AGL, smoothly reduce torque to 1900 ft-lbs and then the props 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 SHALL 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 proceeding directly to Cabaniss or Corpus International via course rules.

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 8000 AGL and 5000 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.** Climb, cruise, descent, and transitions between phases are the basis for all flight maneuvers. A table of standard parameters is provided below. Torque settings are approximate and will differ widely due to differences 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.

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.

TC-12B Power Settings:

Maneuver	KIAS	Prop RPM	Torque	ITT
Slow Cruise	140	1700	750	-
Normal Cruise	150	↓	800	-
Maneuvering Cruise	170	↓	1000	-
Fast Cruise	200	↓	1600	-
Cruise Climb				
SL-10K	155	1900	2230	700
10K-20K	135	↓	-	↓
20K-25K	125	↓	-	↓
above 25K	115	↓	-	↓

Figure 1-2 TC-12B Power Settings

TC-12B Climb Airspeeds (1900 RPM):

Climb From Cruise. To enter climb from cruise:

- a. Raise the nose to the climb attitude and transition to the appropriate climb airspeed, and adjust 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 (i.e., 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 – 170 KIAS
- b. Fast cruise – 200 KIAS
- c. Slow cruise – 140 KIAS
- d. Normal cruise – 170 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 170 KIAS with props at 1700 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 1700 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 forward and trimming accordingly.
- c. Gear – Down, Landing Checklist complete.
- d. Airspeed – Stabilized at 120 KIAS. Power must be added as the aircraft nears its target airspeed (approximately 1100 ft-lbs).
- e. Turn – In either direction for 90° at 30° AOB. Extra power may be required to maintain airspeed in the turn due to the drag from the gear and flaps. 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 – Full (IAW flap limiting speeds). Anticipate ballooning and counter with trim.
- g. Airspeed – Slow to 100 KIAS. Power must be added as the aircraft nears its target airspeed (approximately 1100 ft-lbs).
- 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 cycle the gear or flaps while in transit. Observe gear cycle limitations.
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) or 8000 feet AGL minimum (5000 feet above cloud deck).
 - iv. Yaw damp – Off.
 - v. Props –1700 RPM.
 - vi. Stall Speeds – Reviewed.
 - vii. Clearing turn – 90° of turn at 30° AOB.
- b. **Clean, Power Off**
- i. Ensure Stall Checklist completed.
 - ii. Roll into 30° AOB (clearing turn).
 - iii. Power – 600 ft-lbs.
 - iv. Roll wings level after 90° of turn.
 - v. Power – 200 ft-lbs.
 - vi. Maintain wings level and zero VSI.
 - vii. Stop trim at 120 KIAS.
 - viii. 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 30° AOB (clearing turn).
 - iii. Power –600 ft-lbs.
 - iv. Select flaps approach. Maintain altitude.
 - v. Select gear down and complete the Landing Checklist.
 - vi. Roll wings level after 90° of turn.
 - vii. Flaps – Full down.

- viii. Power – 200 ft-lbs.
 - ix. Maintain wings level and zero VSI.
 - x. Stop trim at 95 KIAS.
 - xi. Immediately recover at the first indication of stall as outlined in the stall recovery procedure.
- d. **Approach Turn**
- i. Ensure Stall Checklist completed.
 - ii. Roll into 30° AOB (clearing turn).
 - iii. Power – 600 ft-lbs.
 - iv. Select flaps approach. Maintain altitude.
 - v. Select gear down and complete the Landing Checklist.
 - vi. After 90° of turn maintain 30° AOB.
 - vii. Power – 200 ft-lbs.
 - viii. Maintain AOB, altitude and zero VSI.
 - ix. Stop trim at 110 KIAS.
 - x. Recover as first indication of stall as outlined in the Stall Recovery procedure.
- e. **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

1. Solos shall not practice stalls.
 2. If no stall indications are received by the calculated stall speed, the maneuver shall be terminated and the aircraft returned to maintenance.
- f. **Stall Recovery.** Immediately regain flying speed with minimal altitude loss when recovering from a stalled condition. The TC-12B climb performance will provide zero altitude loss for any stall 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 slightly to minimize altitude loss).
 - (c). Level wings.
 - (d). Center the ball.
 - ii. Flaps – Approach (unless already up). Ensure the aircraft is level or climbing with 90 KIAS or greater prior to raising the flaps to approach.
 - iii. Gear – Up.
 - iv. Flaps – Up (at V_Y).
 - v. Airspeed – Maintain 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.

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.

NOTE

The PF shall brief the crew when rudder trim is being used to offset an asymmetric power situation.

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

Complete memory items on the Emergency Engine Shutdown or Engine Failure After Takeoff Checklists prior to asking “Did the prop feather, did the fire go out?”

Emergency Engine Shutdown Checklist shall be conducted IAW NATOPS, using the following example:

PF “This will be an emergency shutdown of the Left/Right engine.”

PF “Left/Right Condition Lever Fuel-Cutoff – Concur?”

PM “Concur/Simulate”

PF “Left/Right Prop lever Feather – Concur?”

PM “Concur/Simulate”

PF “Left/Right Firewall valve not required, Left/Right Fire Extinguisher not required”

Or

PF “Left/Right Firewall valve closed – Concur?”

PM “Concur/Simulate”

PF “Left/Right Fire Extinguisher Discharge – Concur?”

PM “Concur/Simulate”

PF “You have the Comms, declare an emergency, this will be a full stop landing.”

Time permitting; complete the rest of the EESD Checklist.

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 TC-12B 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 by setting 200 ft-lbs of torque. This action results in achieving zero thrust. A windmilling prop can be simulated by placing the power lever to idle.

- 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.

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 OPNAVINST 3710.7 series.

For malfunctions that allow a restart after shutdown (i.e., chip light with no secondary indications), complete the Emergency Engine Shutdown Checklist, then execute the Starter Assisted Airstart Checklist down through Step 7. 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 valve during simulated training.

The emergency report should be given by the pilot monitoring and 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.

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. Props should be placed full forward for max rate of climb.

Level off on a 1000 feet altitude plus 800 (i.e., 4800, 5800, etc.), 140 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 130 KIAS. Continue the turn to “final,” rolling out at 250 feet and 120 KIAS.

When IP calls “*Waveoff*” execute the memory items for the Single-Engine Waveoff Procedures IAW *NATOPS Chapter 15*.

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 ($\frac{1}{4}$ to $\frac{1}{2}$ out towards the operating engine) while using up to 5° 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 170 KIAS. Maintain level flight before setting a takeoff attitude. Utilize the following procedures:

- a. Switches – Set (prop sync - off, rudder boost - as desired).
- b. Props – Full forward.
- c. Trim – 3° up and do not re-trim until after takeoff.
- d. Power – 400 ft-lbs. Utilize pitch to maintain altitude as airspeed bleeds off.
- e. Altitude – Minimum 5000 feet AGL (VMC to deck) or minimum 8000 feet AGL (5000 feet above cloud deck).
- f. Gear – Down, Landing Checklist complete (Flaps - Up for normal takeoff configuration).

NOTE

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

ONE – Prop Sync Switch – Off.

TWO – Propellers - full forward.

THREE – 3 degrees of trim.

FOUR – 400 ft-lbs torque.

FIVE – 5000 ft minimum.

GEAR DOWN, LANDING CHECKLIST.

- g. Airspeed – Slow to 105 KIAS while maintaining altitude. Nose attitude will need to increase as airspeed decelerates.
- h. Approaching 105 KIAS, the IP will call “Go.” Set torque – 2100 ft-lbs.
- i. Once takeoff power is set, the IP will call “Rotate.”

NOTE

The IP may elect to call “Go” at a speed higher than 105 KIAS to avoid the stall warning horn from sounding at heavier gross weights and higher altitudes.

- j. Establish a positive rate of climb at 7-10 degrees (MAX) pitch up on Attitude Indicator

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 (i.e., a cloud) to assist in controlling yaw. Immediately stop the yaw utilizing rudder and aileron while lowering the nose toward the horizon. Substantial rudder pressure will be required. Use a maximum of 5° 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.

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 contain 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 working areas, 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:

Altitude. For any power on ditching scenario, the aircraft should be stabilized in the proper configuration, on ditch heading and airspeed 200-300 feet above the assigned ditch altitude, then descent via the parameters of the intended ditch. In an immediate ditch scenario (i.e. wing or engine fire that does not extinguish), initiate an expeditious descent to 200-300 feet above the water and **MOMENTARILY** stabilize the aircraft to ensure airspeed and rate of descent are on parameters at water entry.

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 cartwheeling 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 140 KIAS, while maintaining your present altitude as long as possible.

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 two items as altitude permits) and Ditching Checklists. Approaching 200 feet above simulated water impact, select flaps to approach and trade airspeed for rate of descent to arrive at 100 KIAS with wings-level in a nose high attitude with less than 500FPM on simulated impact.

- 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 (i.e., 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 two 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 this is to do the “A-B-Cs.”

ATIS – Obtain ATIS.

Brief – Calculate your fuel as required, give the Touch-and-Go Brief, and discuss your plan to get to the airfield.

Checklist – Call for the Approach Checklist.

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 during the transition from the high work to low work.

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.

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. Report the numbers, or as directed.
 - a. When cleared, smoothly roll into a level bank, not to exceed 45°.

- b. Select approach flaps and anticipate ballooning. Utilize the horizon in conjunction with the attitude gyro to maintain a smooth, level turn.
- c. Place props full forward.
- d. Select gear down (182 KIAS maximum) and complete the Landing Checklist. Landing, recognition, beacon, and strobe lights are left on in the traffic pattern.
- e. Adjust AOB to roll out on downwind with the runway on the fuel-cap. Slow to 140 KIAS. Due to the extra drag from the props placed full-forward, it may be necessary to add power to stabilize airspeed at 140 KIAS. When wings level on downwind descend to pattern altitude.

Downwind Entry. A downwind entry is made at 1000' (AGL), preferably on a 45° angle. Transition to 140 KIAS, intercept midfield, and turn downwind. Transition to the landing configuration and descend to pattern altitude once established on downwind.

Base Entry. A base entry is performed by arriving at the 90° position with 130 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, 180° position (abeam), approach turn (base), 90° position, and final. All altitudes listed below are AGL.

Observer responsibilities include maintaining a lookout for traffic, monitoring the radios, counting landings, checking three green lights 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.

NOTE

In order not to overtake other aircraft in the pattern, the maximum airspeed in the pattern shall be 140 KIAS at all times.

- a. **Upwind.** The upwind leg is flown along the extended runway centerline at an altitude of 300-500 feet AGL and a maximum airspeed of 140 KIAS. Crab into the wind to maintain centerline. Reduce power to approximately 1500-1600 ft-lbs torque for a more controllable climb. After receiving Tower clearance for downwind, clear left and right, and turn as soon as possible after reaching 300 feet, with the required interval. An immediate turn prevents 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.

Normal interval for a TC-12B, T-44A/C, or a T-45: If a TC-12B, T-44A/C, or a T-45 is in its crosswind turn, the interval is abeam the wing. If a TC-12B, T-44A/C, or T-45 is a full stop, allow it to pass 30° behind the wing, unless a practice waveoff is desired. Normal interval behind touch and go or full stop T-34 traffic in the pattern is 45° behind the wing. Interval should always be sufficient to enable a waveoff without passing airborne traffic.

- b. **Crosswind.** Scan the horizon and attitude gyro in the crosswind turn. Maximum AOB is 30° in the pattern. Maintain balanced flight and 140 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 140 KIAS. If a no flap landing is desired, leave flaps up.
- c. **Downwind.** Scan the attitude gyro, horizon, and IVSI to maintain pattern altitude and 140 KIAS with the aircraft trimmed. Proper no-wind spacing is obtained by placing the wingtip on the runway. Crab into the crosswind as required in order to obtain 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. No later than midfield, ensure the aircraft is configured and call for the Landing Checklist. Complete the checklist while adding power as required to maintain 140 KIAS. Do not respond “*Down and locked*” until all three gear indicators illuminate green. ***The objective is to maintain a consistent ground track, while compensating for winds with bank angle during the crosswind and final turns.***
- d. **Abeam Position.** 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 B.

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.

- e. **180 Position.** No-wind turns are made abeam the intended point of roll-out. 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. Delay the turn off the 180 for patterns with calm winds or a slight tailwind on final. Maintain as tight a pattern as possible. Reduce power as required (approximately 500-600 ft-lbs) and roll into a 20-30 degree bank. Maintain approximately 600-800 VSI during the descent. The turn angle should be adjusted to compensate for strong winds. AOB and power required will 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. **90° Position.** Make corrections as necessary to arrive at the 90° position perpendicular to the runway, at 130 KIAS, 500 ft, in balanced flight with the aircraft trimmed.

- g. **Final.** Continue the final turn, maintaining balanced flight and a maximum of 30° AOB. Arrive on extended runway centerline with power stabilized for the appropriate airspeed, approximately ½ mile from the threshold, at approximately 200-300 feet AGL. 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 aimpoint while in the contact pattern, thus the descent angle is slightly steeper than a standard 3° instrument approach glideslope. On final, verify three green lights, gear handle down with no red light, then respond “*Three down and locked, review me complete.*” The PM shall verify three green lights, the gear handle down with no red light, and then respond “*Reviewed complete.*” The landing should be made in the first 1000 feet of the runway. In gusty wind conditions, consideration should be given to maintaining 5 to 10 knots above normal speeds. Maximum crosswind component is 25 knots.

During contact training, the props should be placed full forward on the first touch and go and left there while in the pattern.

- h. **Approach Flap Landing.** Approach flap landings are the standard landing profile for the TC-12B. Approach flaps allows comfortable landing airspeeds without requiring high power settings by providing additional lift without dramatically increasing drag. Roll onto final at 120 KIAS. Cross the threshold at V_{REF} . Slowly close the power levers while bringing the nose up (flare). Typical landing speeds are 90-100 KIAS.

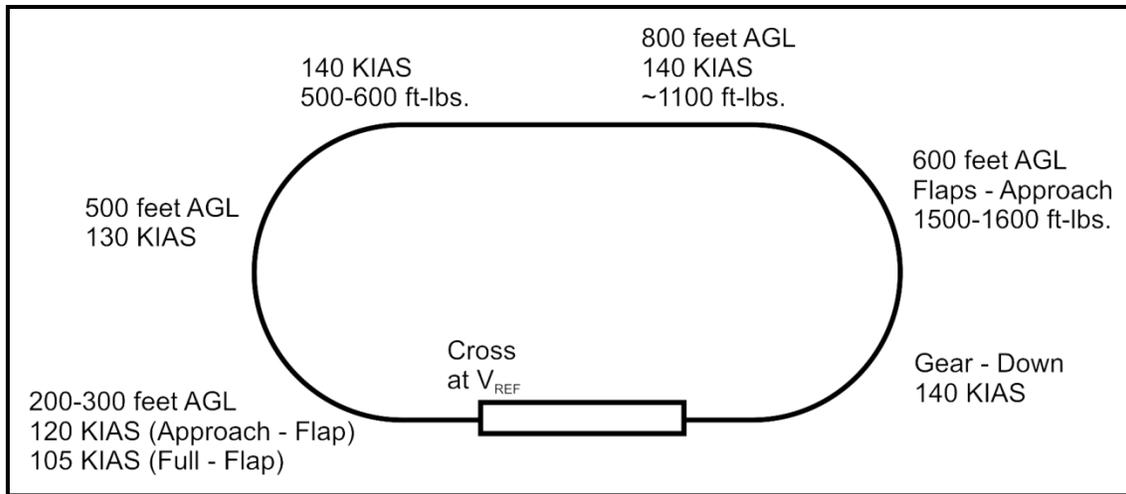


Figure 1-3 TC-12B Normal Landing Pattern

- i. **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. A typical brief following a no-flap situation can be found in the Typical Briefs And Voice Procedures Appendix B. Fly a slightly wider pattern on downwind. Check for new V_{REF} speeds and push the Ground Proximity Warning System (GPWS) Flap Override button on the glareshield. The same airspeeds and altitudes apply through the 180. Fly 140 KIAS through the 90. Roll onto final at 132 KIAS minimum. 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 V_{REF} . Slowly close the power levers while gradually bringing the nose up (flare). Avoid making abrupt pitch-up corrections. Average touchdown speeds are 110-120 KIAS. The aircraft will tend to balloon and then sink rapidly as airspeed nears the stall.

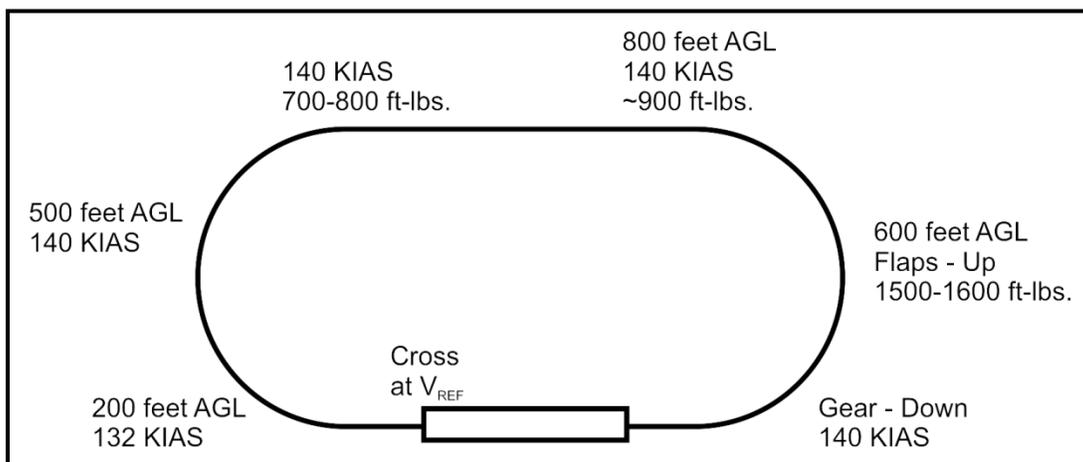


Figure 1-4 TC-12B No Flap Landing Pattern

- j. **Full Flap landing.** Follow the same procedures as the approach flap landing. Check for new V_{REF} speeds on downwind. Select full flaps before rolling out on final and slow to 105 KIAS. When selecting full flaps, hold the nose forward to prevent ballooning above glideslope, then relax back pressure, adjust the nose attitude, and trim noseup as the aircraft decelerates. Cross the threshold at V_{REF} . Slowly close the power levers while bringing the nose up (flare). Beware of porpoised and flat landings. Typical landing speeds are 80-90 KIAS.
- k. **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. Normally, the power levers will be at idle when the aircraft touches down. Utilize electric trim to relieve control pressure while setting the desired flare attitude but do not hold continuous electric elevator up trim in the flare.

WARNING

A porpoised landing may occur if the nosewheel touches down before the main mounts. The nose will generally bounce back up and induce an uncontrollable oscillation until airspeed decreases. If a porpoised landing is encountered, cross-check your airspeed, reduce power levers to idle and apply back pressure to maintain a “flare attitude” until the oscillation stops. 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 prohibited. There must be no question as to who has the controls during this critical phase of flight.

- l. **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 on circumstances. Prolonged full reversing with resultant airframe vibration, engine noise, and possible prop erosion should be avoided. Augment reverse with smooth, even braking as required. Prop reverse is more effective at higher airspeeds and brakes more effective at lower airspeeds. Move power levers out of the reverse range no later than 40 KIAS. Scan well outside the aircraft to maintain centerline. Come to a slow taxi before making any abrupt

turns to avoid stressing the gear. The After Landing Checklist shall not be initiated until clear of the runway.

- m. **Touch and Go.** Touch-and-Go landings are an integral part of the curriculum. They require concentration, a quick scan, and a thorough briefing. Crosswind corrections must be maintained 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 B.

V_R and V_{REF} will be reviewed every 30 minutes or 500 lbs. of fuel used, whichever comes first. Brief speeds while on downwind.

The landing gear may be left extended during the normal pattern. The Landing Checklist should be conducted before the 180 on each pass. Propellers should be kept full forward, 2000 RPM, in the landing pattern for maximum Shaft Horse Power (SHP).

After touchdown, the PF shall:

- i. Advance the power levers to 12 o'clock position and direct the PM to Reset Flaps, & Trim.

NOTES

1. Both condition levers may not be set exactly at 65% after performing actual engine shutdowns during high work. Yawing tendencies may result until condition levers are matched up.
 2. Asymmetric prop spool-up time will cause aircraft yawing tendencies if power levers are advanced abruptly.
- ii. When PM calls "Go," advance power levers to 2100 ft-lbs torque (minimum of 1800 ft-lbs torque). Do not remove your hand from the power levers until the aircraft is climbing and well clear of the ground.
 - iii. Execute a normal takeoff when PM calls "Rotate," but not less than V_R .
- n. After touchdown, the PM shall:
- i. Raise the flaps.
 - ii. Reset elevator trim to 3° up. Check props at 2000 RPM. Call "Go."

- iii. Back up the power levers, monitor engine instruments, verify takeoff power set (minimum of 1800 ft-lbs), and call “*Rotate*” at a minimum of V_R . Fine-tune power levers as required to prevent exceeding limits.
 - iv. Leave the gear down, reduce power to 1500-1600 ft-lbs, and accelerate to a maximum of 140 KIAS while establishing a 7-10 degree noseup climb, and proceed with upwind procedures. 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 30° 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 either pilot feels an unsafe condition exists.
 - f. Give consideration to waving off if touchdown cannot be accomplished on the first one-third of the runway.

Continue climb to pattern altitude unless course rules dictate otherwise (e.g. 500’ at Navy Corpus) 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 are cleared for the option, you are cleared for a touch and go or a low approach. 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 go’s, 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.

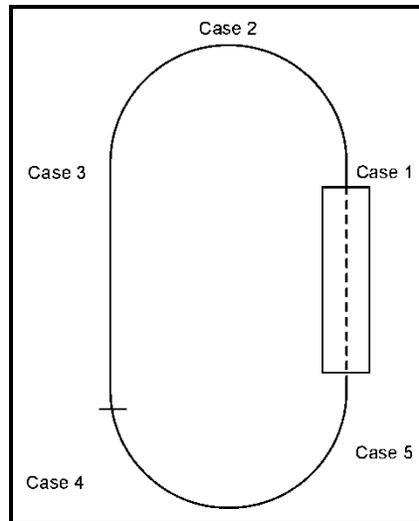


Figure 1-5 SSE Pattern

5. **Simulated Single-Engine Landing Pattern.** The SSE landing pattern acquaints the student with procedures required to land safely following power loss. The SSE pattern is very similar to a normal pattern except that considerations are made for decreased performance and reduced directional control. The “power up, rudder up, VLOF, clean up” method is a good technique to remember whenever experiencing power loss or anticipating engine shutdown due to malfunction or emergency. Smoothly add power as required and simultaneously apply the appropriate rudder. Rudder boost may or may not be operative and the SMA should practice each method. 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. Clean up the aircraft configuration as required.

With an emergency or malfunction in the pattern, check for secondary indications (i.e., engine instruments, fuel/oil leaks, or smoke/flames, etc.) and complete the appropriate checklist. Verify procedures corrected the malfunction (i.e., prop feathered, fire extinguished, etc.), and declare an emergency. Under simulated emergency conditions, direct the IP to handle the comms, declare an emergency, and request a full-stop landing. 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. Trim the aircraft throughout the entire pattern.

Fly the depicted SSE Landing Pattern on the following page.

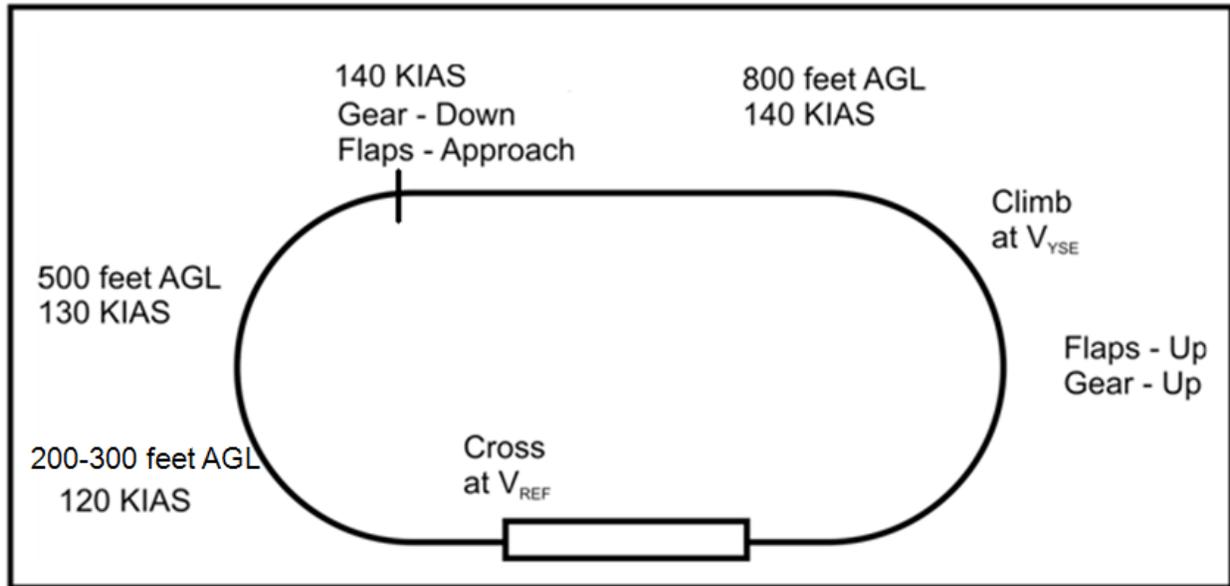


Figure 1-6 TC-12B SSE Landing Pattern

The SSE pattern is divided into five “Cases”:

Case 1. Takeoff to Crosswind.

- a. If a malfunction occurs that causes a power loss after takeoff (prior to turning crosswind), execute the Engine Failure After Takeoff procedure. Examples would be a sudden flameout or birdstrike, either of which may result in immediate asymmetrical thrust. This scenario is practiced during the dynamic engine cut and outlined in NATOPS. 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.
- b. If the malfunction requiring the shutdown has not in itself caused a power loss (e.g., fire, chip, or fuel pressure light), simply cleanup and execute the Emergency Engine Shutdown procedure.

After completing the Emergency Shutdown Checklist boldface, determine if the fire has gone out and the prop has feathered, declare an emergency and time permitting, continue the cleanup items on the checklist. Initiate the crosswind turn after the memory items of the Emergency Shutdown Checklist have been completed or earlier if directed by the IP.

WARNING

A positive rate of climb may not be possible with a windmilling propeller. A positive Banking 5° into the operating engine, maintaining the ball nearly centered (1/4 to 1/2 out towards the operating engine to account for sideslip), and feathering the failed propeller are 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 if the inside engine fails. To prevent a dangerous, uncontrollable situation from developing, the aircraft must be rolled wings level at the time when the loss of thrust from the engine occurs. Proceed as follows:

- a. If malfunction has induced a sudden power loss (e.g., flameout or bird strike), add max allowable power on the good engine while *momentarily* leveling the wings, nearly center the ball, and raise the gear and flaps. Maintain a minimum of V_{YSE} . After positive, coordinated aircraft control is assured, re-establish the crosswind turn.
- b. For a non-power loss malfunction which will require an emergency engine shutdown, continue turn to downwind as you raise flaps and gear, delaying execution of the EESD Checklist until wings level on downwind at pattern altitude and 140 KIAS.

Perform the Emergency Engine Shutdown Checklist, then transfer the communications and declare an emergency.

Climb to pattern altitude and accelerate to 140 KIAS minimum. Maximum allowable power may be required initially, but should be reduced when practical.

Case 3. Downwind. Add power, nearly center the ball, and clean up as required to maintain 140 KIAS and pattern altitude.

NOTE

Use good judgment to make your decision whether to cleanup. High gross weight, high density altitude, and/or other traffic in the pattern may require that you clean up to maintain pattern altitude. However, if the downwind 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 for shorter runways.)

Perform the Emergency Engine Shutdown Checklist, then transfer the communications and declare an emergency.

Just prior to the 180 position, select approach flaps, gear down, and complete the Landing Checklist (if not previously completed). The PM is responsible for making the radio call once

communication has been transferred. If low altitude or airspeed does not allow completing the Landing Checklist, inform the PM and the Tower.

Maintain 130 KIAS to the 90. The gear must be down and Landing Checklist 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 just before rolling out on final. Power loss in a descent is normally easy to control with only slight additional power.

Add power to maintain 130 KIAS and nearly center the ball. Do not raise the gear unless committed to a waveoff. Maintain a minimum of 130 KIAS and continue the approach turn. Complete the first two memory items of the Emergency Shutdown Checklist at a minimum and declare an emergency. The remaining items on the Emergency Engine Shutdown Checklist can be handled once on deck.

Should a waveoff be required, complete the remaining items on the Emergency Engine Shutdown Checklist.

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 120 KIAS to the threshold. Accomplish the first two memory items (*optional/recommended*). 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 cross over the threshold at V_{ref} , with power levers at idle 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.

NOTE

Use of full flaps is left to the discretion of the PIC, but is not recommended due to virtually no waveoff capability. Students shall not practice full flap SSE landings.

If a waveoff is required, placing both power levers to maximum allowable should result in an autofeather.

- 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 not to lock the brakes. The maneuver is complete when the aircraft has slowed to a taxi speed on the runway. Following an actual single-engine landing, clear the runway if practicable, then perform shutdown. Single-engine landings should be made 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 B. 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 feet AGL. The IP shall take the controls and execute any waveoff required below 200 feet AGL, utilizing both engines.

The SSE waveoff is a demanding maneuver requiring precise aircraft control and expedient procedures. Smooth and controlled power and rudder inputs are necessary. Climb performance is directly proportional to how well the maneuver is executed. Limited power margins dictate exact execution.

Utilize TC-12B NATOPS Single Engine Waveoff procedures. Direct the PM to make a waveoff call to Tower. If possible, offset slightly from the runway to the pattern side to allow a better view of traffic.

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 (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 (344.6) 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.

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, raise the flaps to UP, 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. 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 walkaround, paying particular attention to fluid leaks, missing panels, and

evidence of birdstrikes. After the postflight inspection is completed, do not delay in performing administrative duties. If a downing discrepancy was discovered on postflight, 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.

**CHAPTER TWO
BASIC INSTRUMENT STAGE**

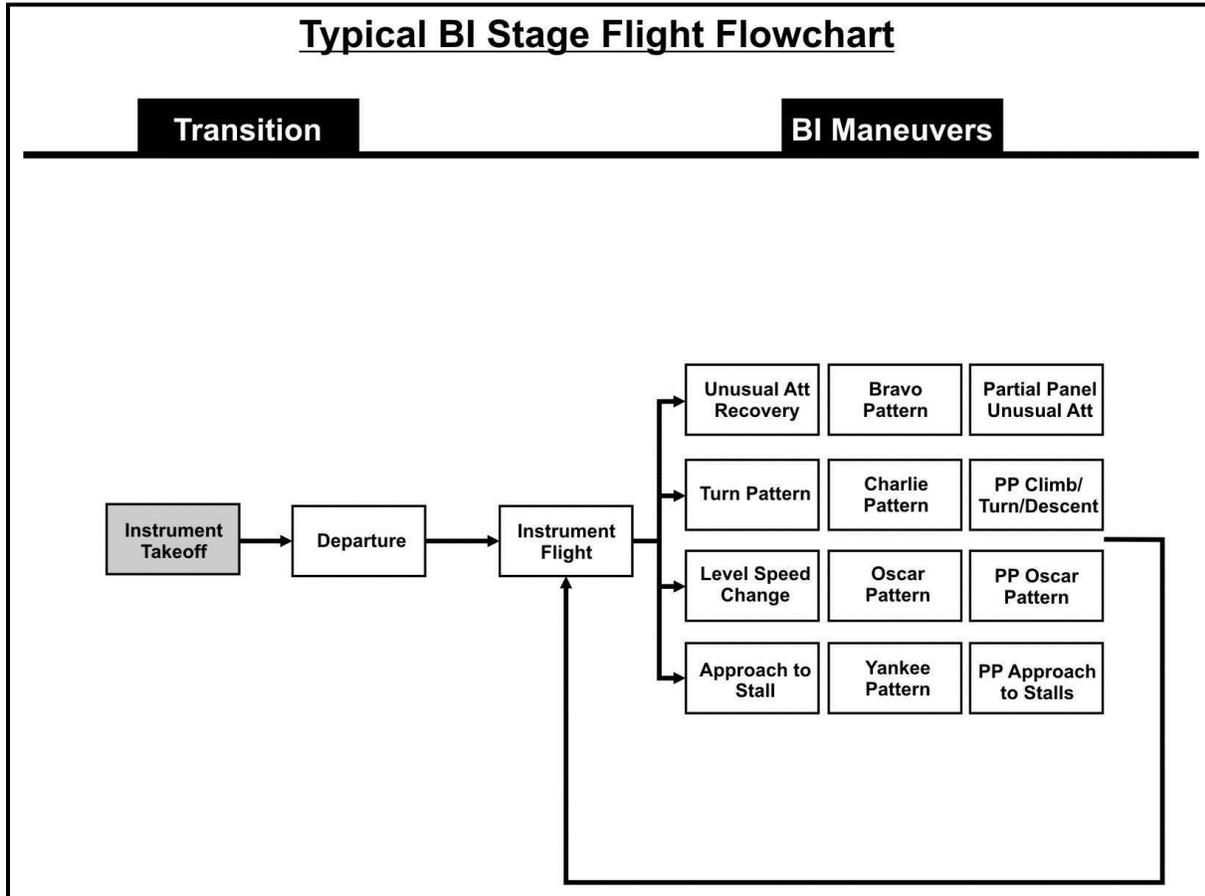


Figure 2-1 Typical BI Stage Flight Flowchart

200. INTRODUCTION

In the 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 the *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 the *TC-12B 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. **Power.**
- b. **Attitude.**
- c. **Trim – 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. Check vertical speed indicator and altitude for positive rate of climb and call for gear up. 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 155 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 2°. Power required is approximately 1300 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 90° 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 900 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 220 KIAS, reduce power. If at any time airspeed drops below 120 KIAS, smoothly advance power to 1500-1800 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.)
TC-12B	500 FPM	150 KIAS	1700	1300 FT-LBS
TC-12B	667 FPM	150 KIAS	1700	1400 FT-LBS
CONSTANT RATE DESCENTS		AIRSPEED	PROP RPM	TORQUE (approx.)
TC-12B	500 FPM	150 KIAS	1700	700 FT-LBS
TC-12B	800 FPM	150 KIAS	1700	600 FT-LBS

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. Actual aircraft power settings may be different than those listed.

1. Begin all patterns on a cardinal heading.
2. The elapsed time may be reset and started for each pattern.

2-6 BASIC INSTRUMENT STAGE

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 170 KIAS and 1700 RPM.

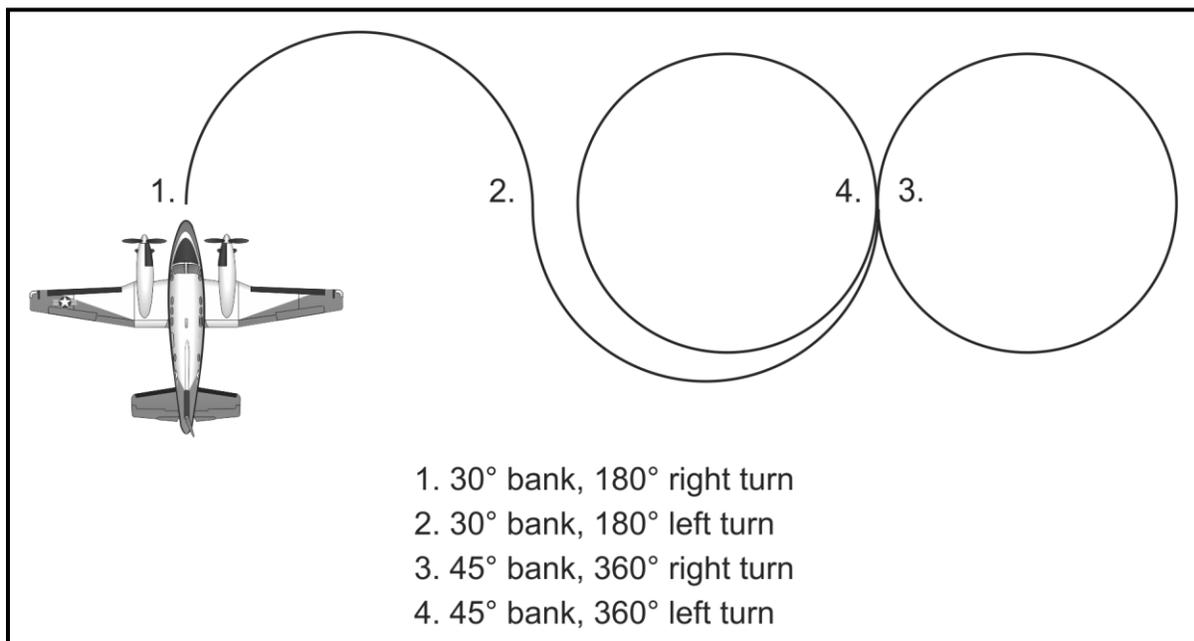


Figure 2-3 Turn Pattern

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 170 KIAS and 1700 RPM.

3. **Oscar Pattern.** Begin the Oscar pattern at 1700 RPM, 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. 900 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- b. Climb 1000 feet at 500 FPM while executing a left SRT for 360° (2 min.).
 - i. 1300 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- c. Transition to straight and level (1 min.).
 - i. 900 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- d. Descend 1000' at 500 FPM while executing a right SRT for 360° (2 min.).
 - i. 700 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- e. Transition to straight and level (1 min.).
 - i. 900 ft-lbs torque (approx.).
 - ii. 150 KIAS.

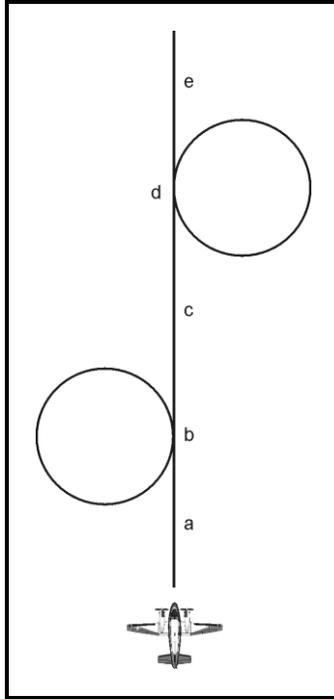


Figure 2-4 Oscar Pattern

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.

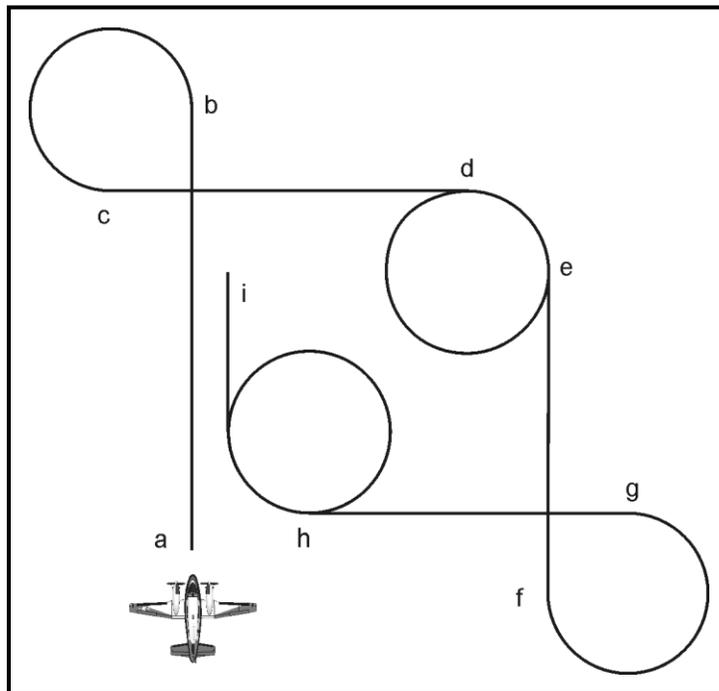


Figure 2-5 Bravo/Charlie Pattern

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. 900 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- b. Climb 1000' at 667 FPM while executing a left SRT for 270° (1.5 min.).
 - i. 1400 ft-lbs torque (approx.).
 - ii. 50 KIAS.
- c. Transition to straight and level (2 min.).
 - i. 1400 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. 700 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- e. Climb 1000' at 500 FPM (2 min.).
 - i. 1300 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- f. Transition to a level left SRT for 270° (1.5 min.).
 - i. 900 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- g. Climb 1000 feet at 500 FPM (2 min.).

- i. 1300 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. 600 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- i. Transition to straight and level (maneuver complete.).
 - i. 900 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 130 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. 1600 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- b. Level left SRT for 180° (1 min.).
 - i. 1700 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- c. Descend 500 feet at 500 FPM (1 min.).
 - i. 1200 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- d. Continue 500 FPM descent while executing a left SRT for 45° (15 sec.).
 - i. 1250 ft-lbs torque (approx.).

- ii. 150 KIAS.
- e. Continue 500 FPM descent (45 sec.).
 - i. 1200 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- f. Continue 500 FPM descent while executing a right SRT for 180° (1 min.).
 - i. 1250 ft-lbs torque (approx.).
 - ii. 150 KIAS.
- g. Transition to straight and level and lower approach flaps (1 min.).
 - i. 1400 ft-lbs torque (approx.).
 - ii. 130 KIAS.
- h. Lower landing gear 10 seconds prior, complete the Landing Checklist, and descend 500 feet at 500 FPM (1 min.).
 - i. 1200 ft-lbs torque (approx.).
 - ii. 130 KIAS.
- i. Waveoff straight ahead (SSE) at 121 KIAS; when safely climbing use right SRT to return to base heading. The maneuver is complete when climbing on base heading at or above 121 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.

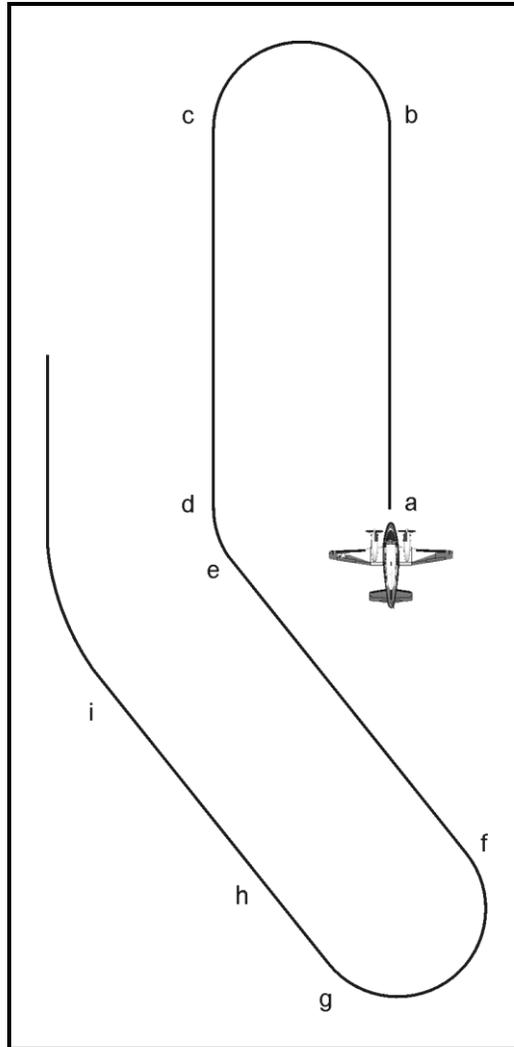


Figure 2-6 Yankee Pattern

204. PARTIAL PANEL MANEUVERS

Partial panel flight is the loss of primary attitude indication and/or heading. In the TC-12B 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. Pitch and roll information can be obtained from the standby gyro in the TC-12B. Constant airspeed climbs/descents (nose) are obtained from airspeed crosschecked with altimeter/clock and VSI. A standard no-heading transition brief can be found in the Typical Briefs And Voice Procedures Appendix B. Refer to the *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 unreliable when the windshield anti-ice system, and/or windshield wipers, and/or condenser blower, and/or forward vent blower are in use ("Big four") on the TC-12B.

1. Timed Turns Using the Magnetic Compass.

- a. Heading indicator 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 1/3 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.
- 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 four" 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 RMI 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 $\pm 5^\circ$ may be very difficult in an actual emergency.

2. Partial Panel Approach to Stalls.

The standby gyro is used therefore the procedures for entry and recovery are the same as full panel approach stalls.

3. Partial Panel Unusual Attitudes.

Use the standby gyro, procedures remain the same as for full panel.

4. Partial Panel Oscar Pattern.

The partial panel Oscar pattern is flown the same as full panel except using the standby gyro and wet compass. Since turns are performed without reference to a heading indicator, the PM must call out the cardinal headings for the PF. The PF will reference their clock for the appropriate elapsed time and evaluate their turn rate from that position and subsequently adjust AOB to compensate for turn rate inaccuracies. The PM will not call out the rollout heading. The PF has three opportunities (cardinal headings) to adjust AOB to fly an adequate standard rate turn.

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CHAPTER THREE NIGHT CONTACT STAGE

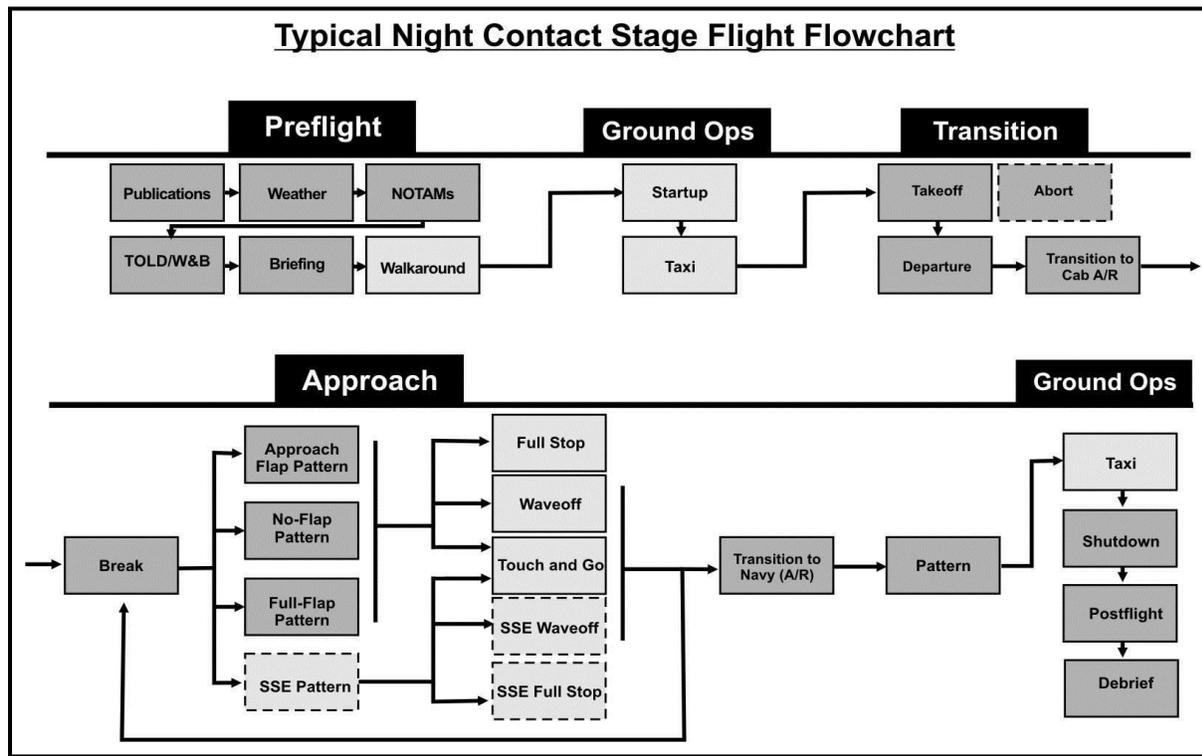


Figure 3-1 Typical Night Contact Stage Flight Flowchart

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 (i.e., 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 (TC-12B)** 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 should use a flashlight to provide extra illumination of the gauges (especially ITT). Panel lights may dim significantly when the starter is energized.
- b. Navigation lights shall be displayed 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 (SM).
- c. Taxi lights should be utilized for all movements during hours of darkness, unless under control of a taxi director. Taxi, beacon, and navigation lights shall remain on while taxiing. Strobe, landing, and recognition lights will be secured upon landing. The taxi light should be secured once under the direction of a lineman.
- d. During transition from dusk to full darkness, cockpit lighting should be gradually dimmed to enhance outside visibility. Attempt to maintain both sides of the instrument panel at nearly the same intensity. 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. When encountering lightning or bright lights, turn cockpit lights to full bright.
- e. Rotating beacon, strobe, and landing lights may be distracting and induce vertigo during adverse weather conditions. Selected lighting may be secured temporarily if required for safe operation.
- f. Ice lights should be used 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.

3-2 NIGHT CONTACT STAGE

- g. The landing lights shall be on at all times when the gear is down, except in adverse weather. Practice night landings without the use of landing lights are not authorized. Recognition lights will be on whenever flying below 10,000 feet. If external lighting is lost, you are solely responsible for traffic separation.

NOTES

1. Keep a flashlight available for immediate use.
2. TRAWING FOUR's aircraft may be differentiated at night as follows: T-44s have a red beacon, TC-12Bs have a white beacon, and T-6s do not have a beacon and their landing lights are on the mainmounts instead of the nose gear assembly.

CAUTION

Leaving the taxi and landing lights on concurrently may lead to failure of the #2 Dual fed bus.

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 Pilot 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 red runway waveoff lights controlled by the tower. *Illumination of the waveoff lights indicate a waveoff is required.*

NOTE

Cabaniss field does not have a beacon or lighted taxiways.

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 3°, often aligned with an

ILS (Instrument Landing System) G/S. An “on-glide slope” 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 an APU 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. When ready for further taxi, turn on the taxi light.

Taxi procedures are the same as daylight except greater caution is required. Exercise extreme caution when taxiing at night and ensure your PM is scanning outside diligently. Avoid being “heads down” when running a checklist during night taxi; if necessary, stop the aircraft until the applicable checklist is complete. A common 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. 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.

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.

303. NIGHT TRAFFIC PATTERN OPERATIONS

Night Traffic Pattern. The night traffic pattern is flown the same as the day contact pattern, but with several unique considerations:

1. Crosswind corrections are not as easy to anticipate due to a lack of visual cues.
2. Concentrate on looking down the entire length of the runway to avoid angling.
3. It is extremely important to hit pattern checkpoints to prevent having to make large corrections.
4. 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.
5. Do not fixate inside the aircraft on rollout, especially during touch and go's. 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, landing and recognition lights as soon as practicable. Turn on taxi light. 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 FIG 7.1.2* for information on night visual illusions and prevention.

CHAPTER FOUR INSTRUMENT STAGE

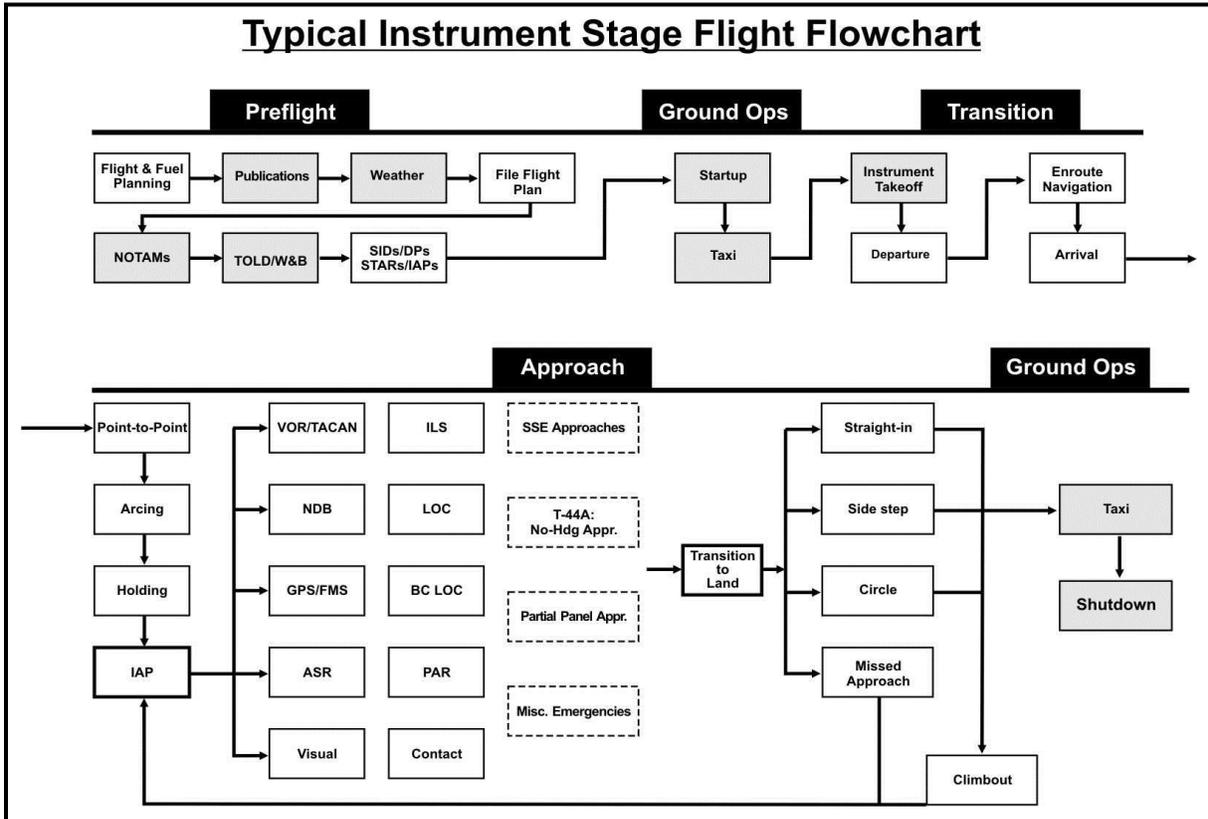


Figure 4-1 Typical Instrument Stage Flight Flowchart

400. INTRODUCTION

Welcome to instrument flying! The purpose of this chapter is to provide procedural information for operating in the instrument environment during intermediate or 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. Additionally, see appendix B, D, E and G of this instruction for further study material. 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***TC-12B NATOPS******GNS/XLS Operator's Manual***

OPNAVINST 3710.7 series, *NATOPS General Flight and Operating Instructions*
<http://doni.daps.dla.mil> , look under instructions tab

VT-35 Standard Operating Procedures (SOP)**CTW-4 Standard Operating Procedures (SOP)**

NATOPS Instrument Flight Manual (IFM)- NAVAIR 00-80T-112: 2006 version available at <https://airworthiness.navair.navy.mil>. CAC card required and account request approved.
Another alternative is through JK search at <https://10.9.9.10/jksearch/src/Start.asp>

Flight Information Publications (FLIPs) (General Planning (GP), Area Planning (AP), IFR Enroute Supplement, Flight Information Handbook (FIH)) <https://www.extranet.nga.mil>
(*Requires .mil and access request)

FTIs: <https://www.cnatra.navy.mil/pubs/>

Master Curriculum Guides (MCGs): <https://www.cnatra.navy.mil/pubs/instruct.htm>

AIM: <http://www.faa.gov/library/manuals/aviation/>

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/aircraft/>

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

NOTES

1. Current editions of many FAA publications can be found here: <http://www.faa.gov/library/manuals>. Browse around or simply type the publication name (e.g., *Instrument Procedures Handbook*) into the search bar.
2. Current editions of many Naval instructions and other documents can be found here: <http://doni.daps.dla.mil>. Browse around or type an instruction (e.g., OPNAVINST 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-bookbag under publications.

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 TC-12B, the crew typically consists of a PF, Pilot Monitoring (PM), and an observer. Utilize these crewmembers to accomplish tasks such as getting ATIS, referencing NATOPS, NOTAMS, Trouble Ts and other things that would distract the PF from their 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 callouts and procedures which optimize task accomplishment.

While these callouts 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 TC-12B by themselves. Utilize the co-

pilot (IP) and observer! Reference appropriate CRM appendix G 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 17 CRP, TAC Z NGP, VOR-A ALI, etc.). Develop a method which works for mandatory brief items in FTI/NATOPS. The “sequential method” 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 B.

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 knee board to avoid stumbling during the response. If the call is for another aircraft, 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. One method is to use the left to right audio toggle switches as a reminder of what needs to be set up. Starting with VHF 1, tune each associated component as required. Continue across the instrument panel and set the HSI selector switches, the RMI paddles, the CDI and the heading bug as required. Using this technique will ensure the radios or NAVAIDs are properly set. (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 in your 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 DD175 and a DD175-1. 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 DD175 to bring to the brief. One student will submit a request for weather. ***Do not submit two 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 TC-12B NATOPS manual 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, 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 4-2) 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/Fuel Packet/Contract Fuel
P	Publications (FLIP) including NATOPS and TCNs
W	Weather
A	“Activate” flight plan (technically file flight plan)
N	NOTAMs
T	TOLD (takeoff and landing data) / Form F (If required)
S	SIDs/DPs/STARs/IAPs/Self (Flying gear, earplugs)

Figure 4-2 Base Ops Drill

1. **Fuel Planning/Packets.** Ensure the aircraft has sufficient fuel per OPNAVINST 3710.7 series/SOPs. Bring appropriate fuel packet if required. If a fuel log is required ensure that it is completed IAW NATOPS Chapter 6 and Appendix D of this instruction.
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

4-6 INSTRUMENT STAGE

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 and 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. 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 airfields 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 websites which are authorized per OPNAVINST 3710.7 series to print and use in flight. Nonofficial website links to publications are not authorized. (AIRNAV.com., etc.). NGAs website is <https://www.extranet.nga.mil> and is only available from a CAC enabled .mil computer. The NACO website 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 (OPNAV, SOPs) for takeoff, filing and weather avoidance criteria.

Non-Precision Approach	Precision Approach
Published Mins \geq 300-1*	Published Mins \geq 200-1/2 or (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 4-3 Standard Instrument Rating Takeoff Minimums

Destination WX (ETA ±1 Hour)	Alternate WX (ETA ±1 Hour)
$0-0 \leq WX < \text{Published Mins}$	$WX \geq 3000-3$
$\text{Published Mins} \leq WX < 3000-3$	NP: $WX \geq \text{Published Mins} + 300-1$ P: $WX \geq \text{Published Mins} + 200-1/2$
$WX \geq 3000-3$	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 4-4 IFR Filing Criteria

- a. **Weather Restriction for Category B Approaches.** Regarding approaches which do not have minimums for category C aircraft published on the IAP, but do have category B minimums published (e.g., Sinton/San Patricio County, Pleasanton Muni); local policy authorizes TC-12Bs, which are normally Category C, to fly these approaches for training as long as the weather is no less than 1000-3.

- b. **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**.”

However, 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 is Not Authorized to be used 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 OPNAVINST 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.

- c. **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. FSS in the same manner as described in Section 404 Preflight Planning (2, f, iii). 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, OPNAVINST 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 canceling a flight plan with FSS will not close out the flight plan at Base Ops. The AIM and OPNAVINST 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 en route, 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 the DINS website (<https://www.notams.faa.gov/dinsqueryweb>) 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.*
 - 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 website 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 number (e.g., 15) and listed as “Unreliable” or having “Pseudo Random Noise (PRN).” All SVs with PRN or otherwise unusable should be deleted from your FMS using the RAIM page.

- (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 TC-12B FMS and can be found on the Jeppesen website. There is a link to the Jeppesen website 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.
- 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 webpage is <https://www.notams.faa.gov/dinsqueryweb> with a backup address of <https://pilotweb.nas.faa.gov/pilotweb>. DINS provides real time NOTAM data validated by the USNS, which includes domestic, international, military and FDC NOTAMs.

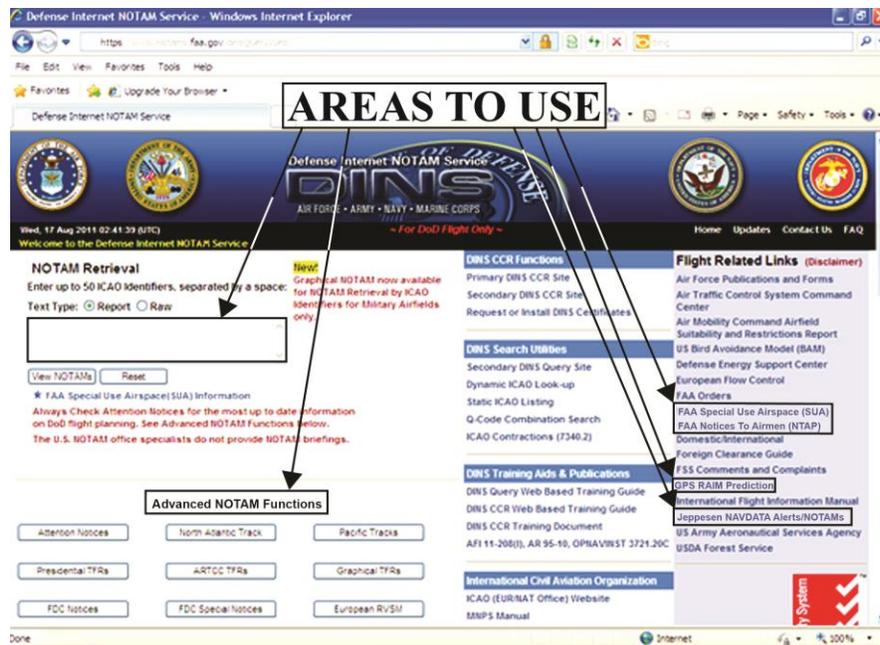


Figure 4-5 DINS Web Page

- 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 must 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. Per Squadron SOP, if carrying 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. See NATOPS Chapter 26 for Form F information.

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 and 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. Departure planning should be for one engine inoperative
- 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. Again, departure planning should be for one engine inoperative.

NOTE

Recent changes in TERPS criteria make the OCS lower and more restrictive. However, there are many departures today that were evaluated under the old criteria that allowed some obstacle surfaces to be as high as 35 feet at the DER. Since there is no way for the pilot to determine whether the departure was evaluated using the previous or current criteria and until all departures have been reevaluated, pilots need to be very familiar with the departure environment and associated obstacles, especially if crossing the DER at less than 35 feet.

- ii. Publish a higher required climb gradient (200’/NM is the minimum for any instrument departure). Refer to additional instrument information appendix E 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 this non-standard weather criteria. Often these notes will be accompanied by an * that gives the option to use your standard departure weather minimums (OPNAV/SOPs) and comply with the published trouble “T” climb gradient.

<p>SHEPPARD AFB/WICHITA FALLS MUNI (KSPS), WICHITA FALLS, TX Amdt 1, 11293</p> <p>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.</p> <p>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.</p>	<p>TULSA INTL (KTUL), OK Amdt 1, 10266</p> <p>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.</p> <p>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</p>
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Figure 4-6 ▽ IFR Take-Off Minimums and Obstacle Departure Procedures

- v. 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.

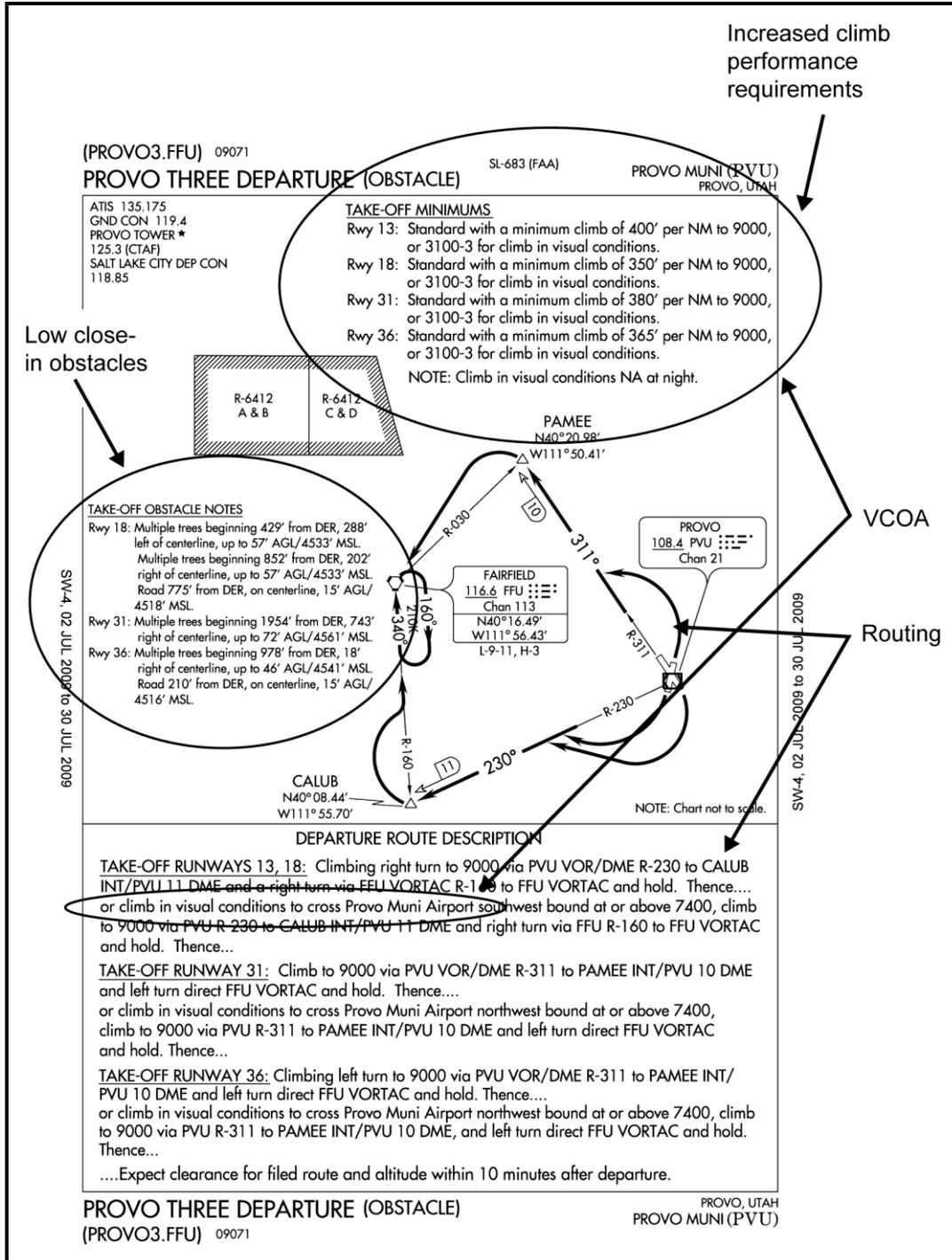


Figure 4-7 TERPS Design Options

- 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.

- i. **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.” 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.

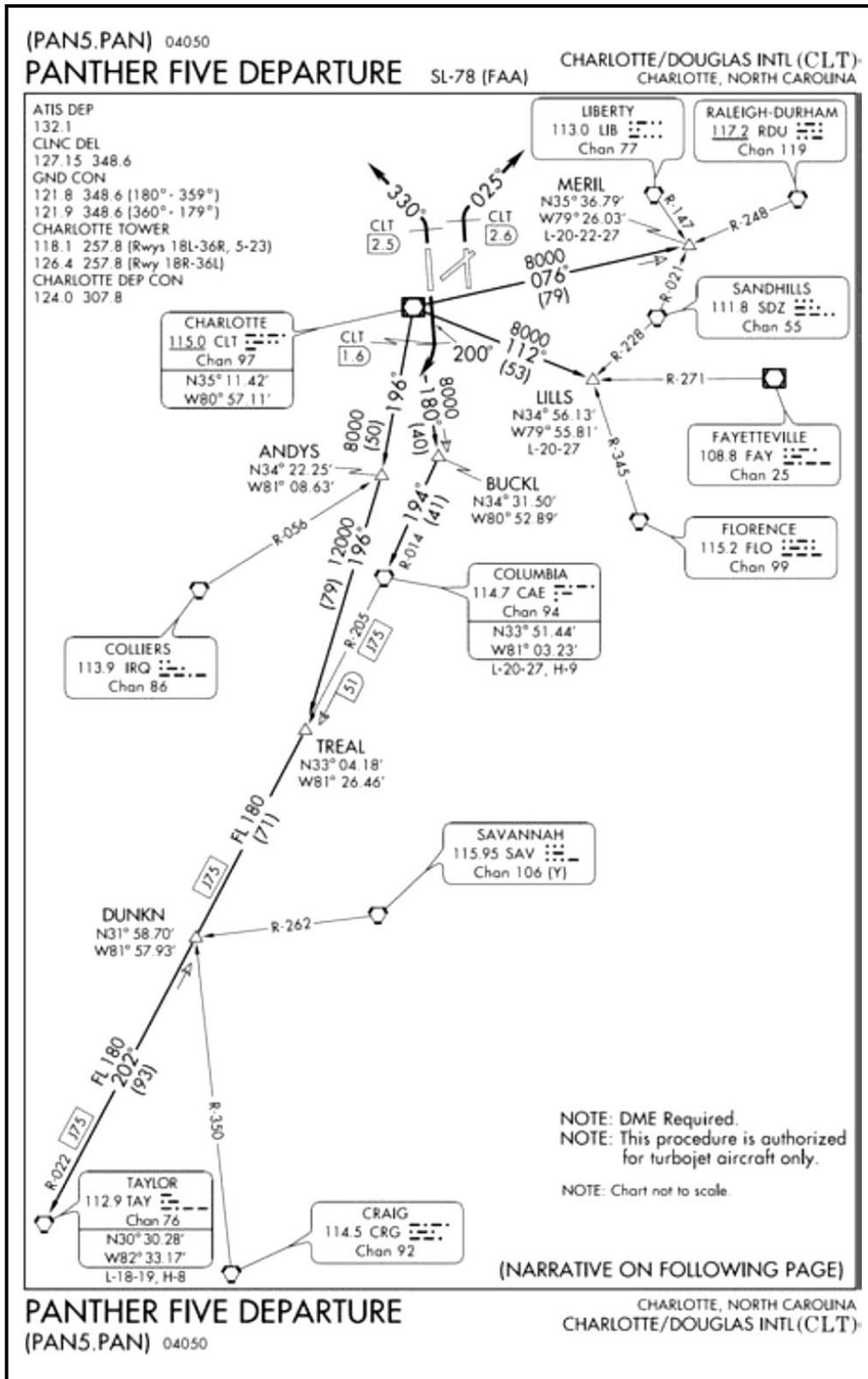


Figure 4-8 Pilot NAV SID

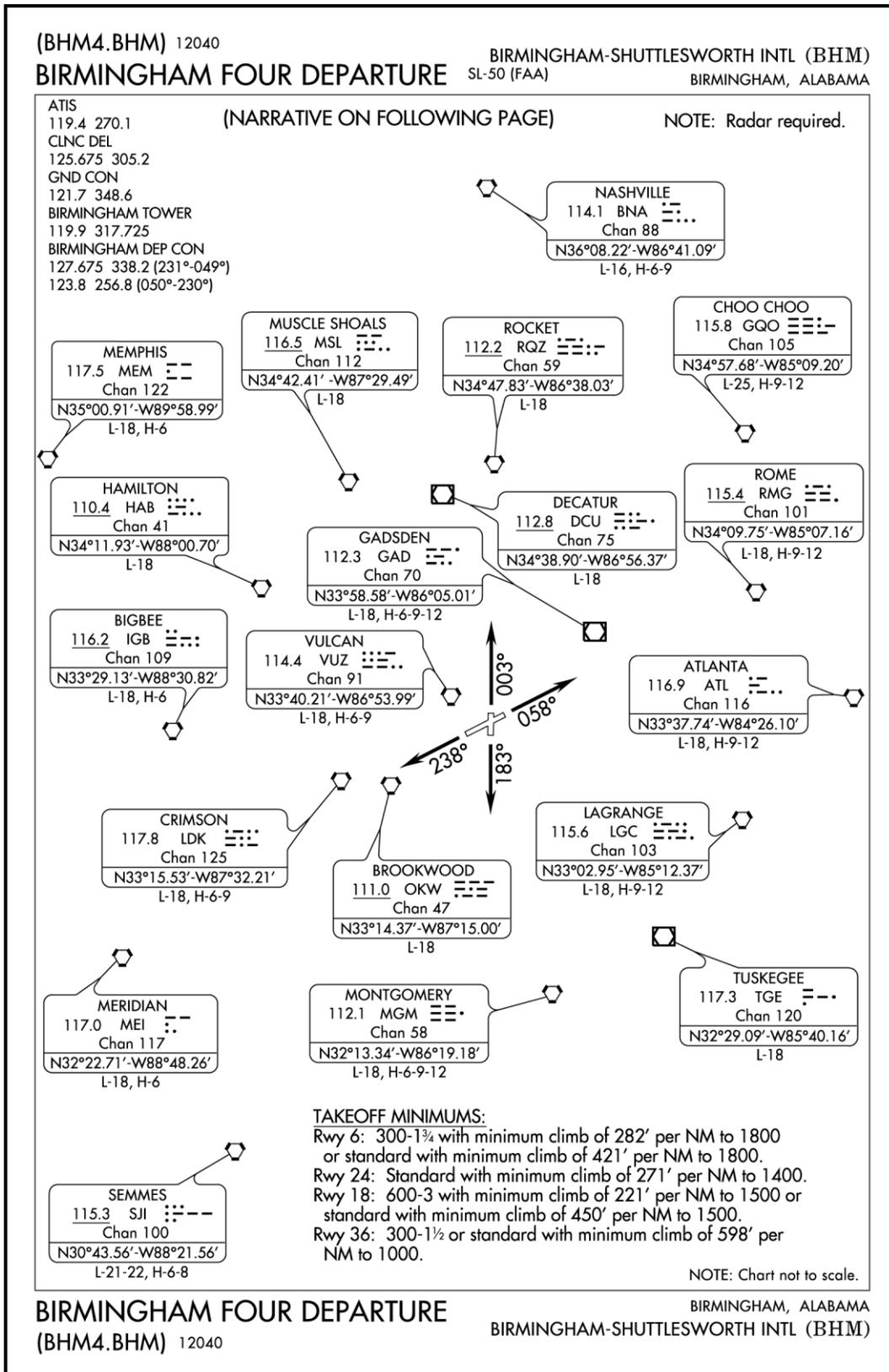


Figure 4-9 Vector SID

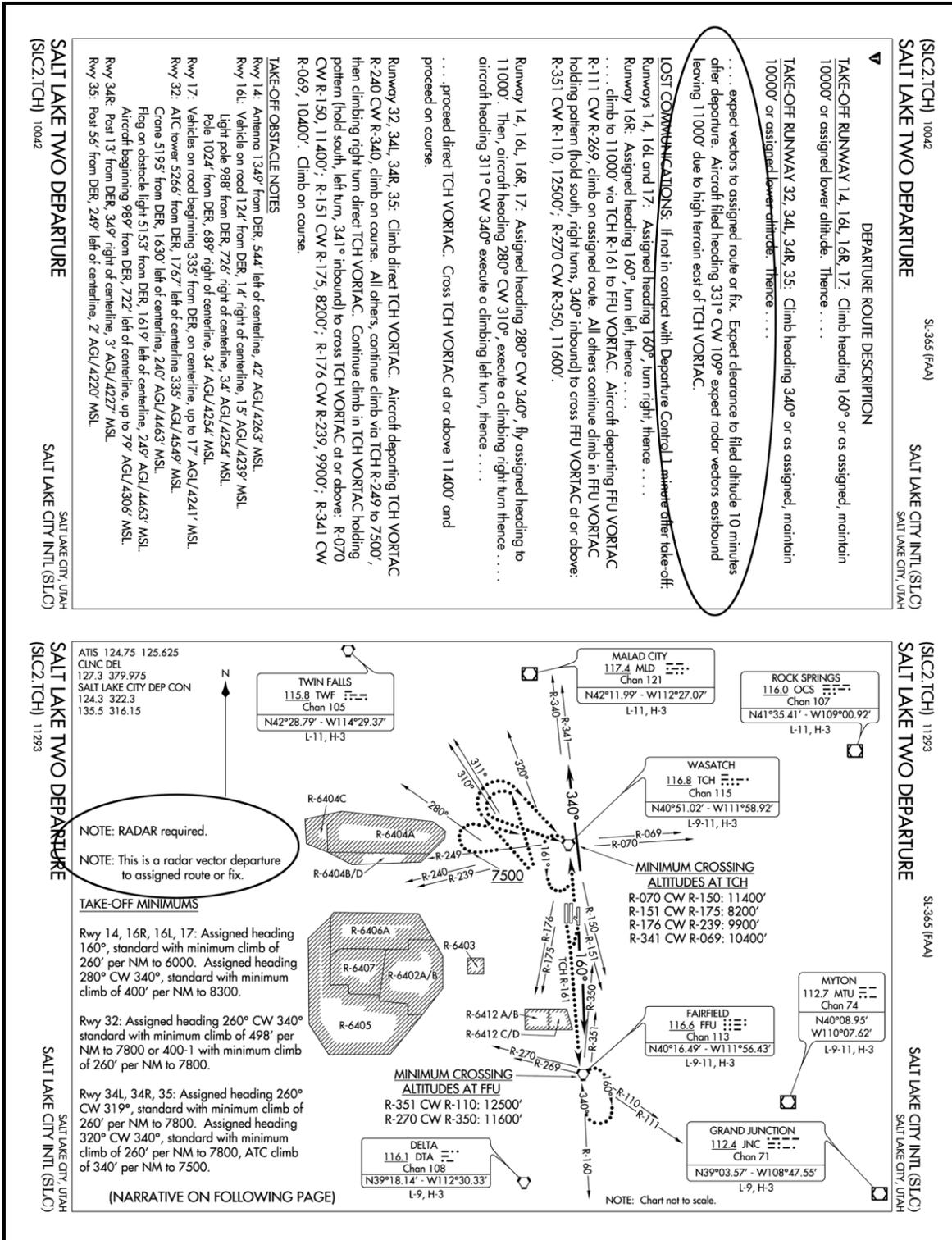


Figure 4-10 Vector SID with Pilot NAV

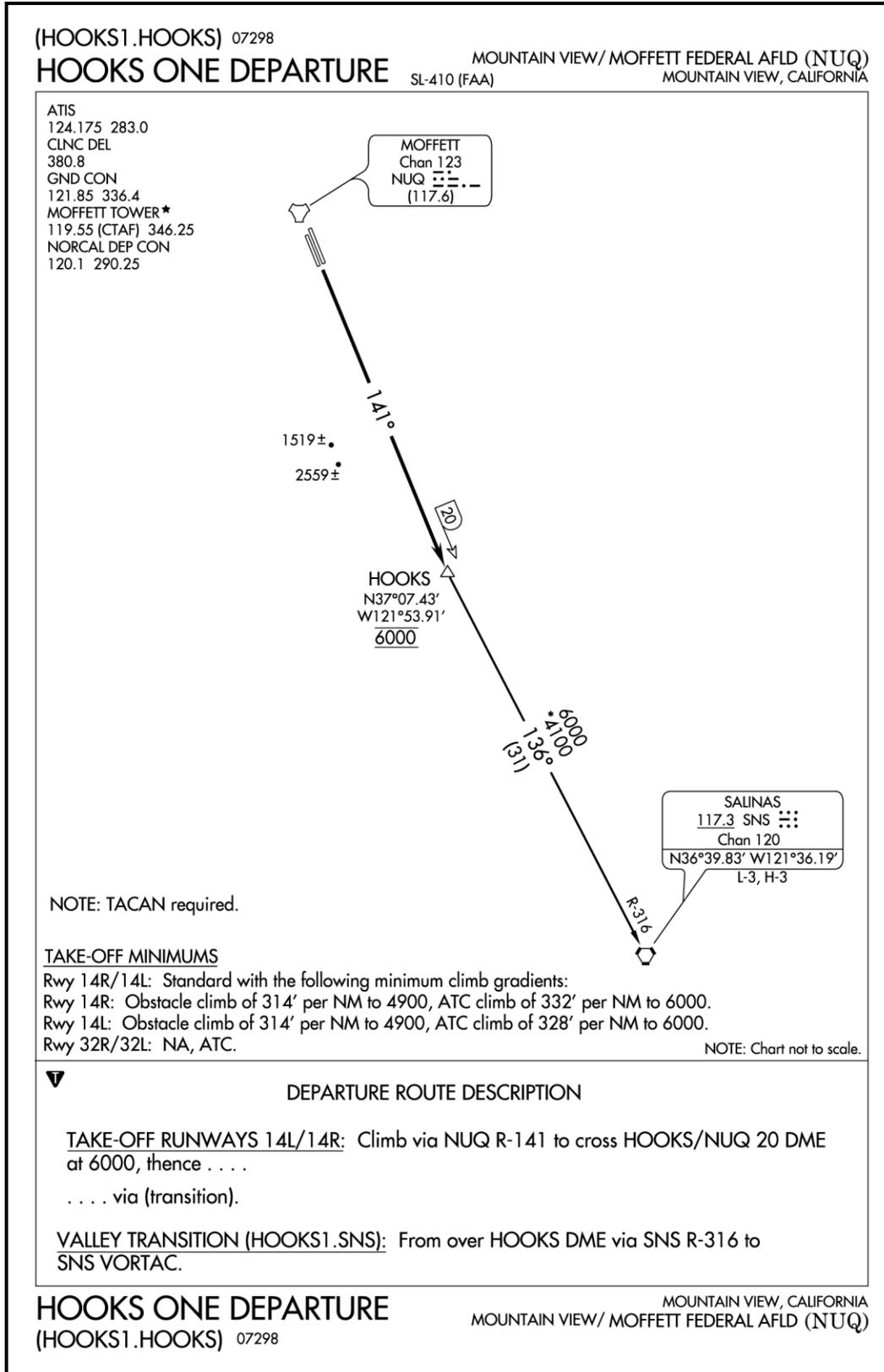


Figure 4-11 Military SID

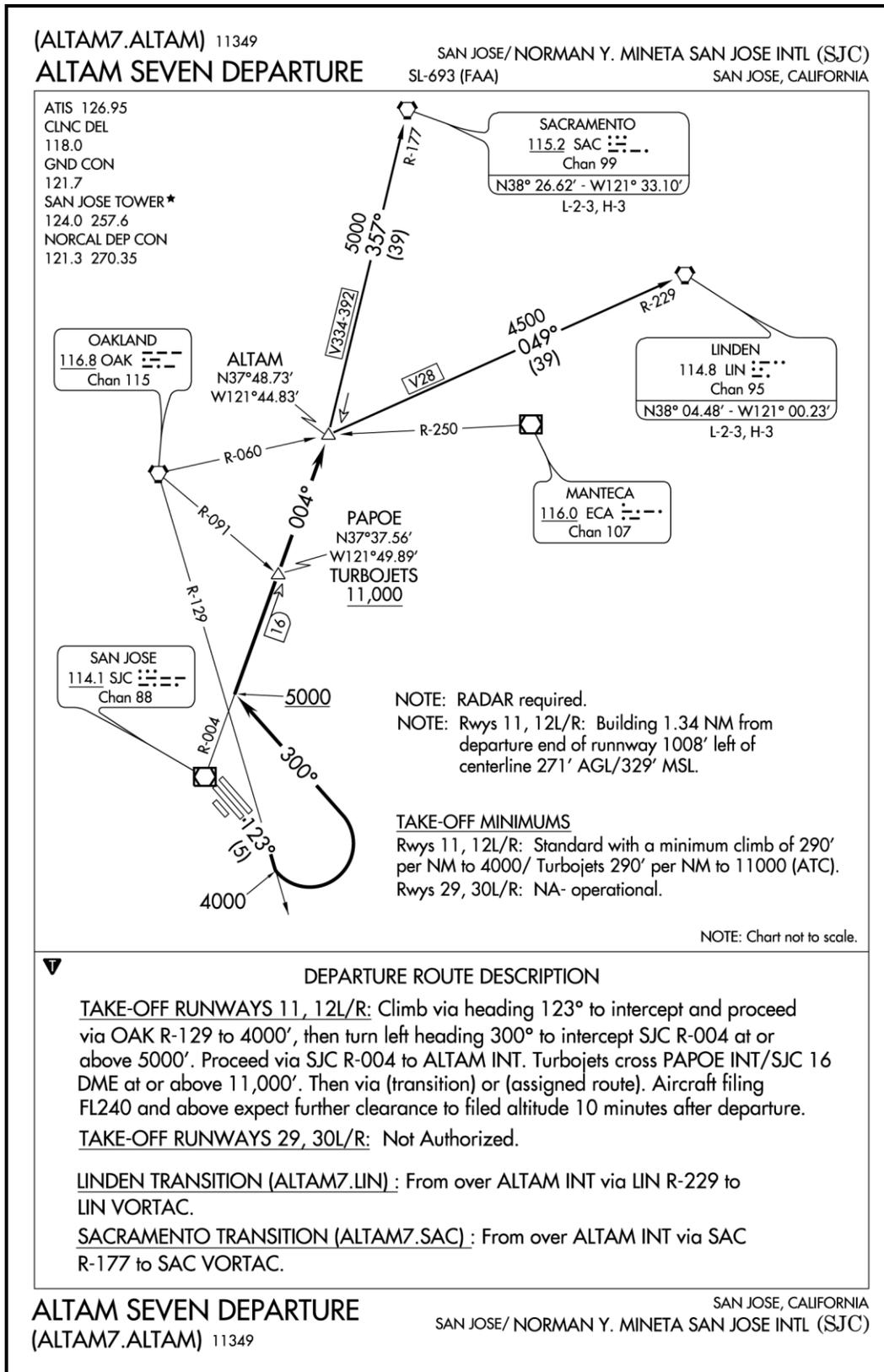


Figure 4-12 Civil SID

- 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 DD175-1 weather brief.
- b. Not bringing the DD175-1 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 (i.e., 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.

- 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 should be considered 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.
 - 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. The only positive method of identifying a station is by its Morse code identifier or the recorded automatic voice identification, indicated by the word “VOR” following the station name. Listening to other 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 course warning flag (VOR, TAC, ILS) or the aural Morse code identifier (NDB) continuously to ensure adequate signal reception strength.
 - d. **Select.** Select the proper HSI or RMI mode of operation. (i.e., What NAVAID should the needles display?)
 - e. **Set.** Set the selector switches to display the desired information on the navigation instruments.
3. **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 RMI (VOR or NDB) or upper lubber line of the HSI (TAC). Adjust aircraft heading, as necessary, to keep the bearing pointer under the top index or upper lubber line. 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

Do not simply turn to put the head of the bearing pointer under the top index. Think about where the wind is coming from and how strong it is, then put in a correction immediately.

4. 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 RMI only, such as proceeding direct to a NDB).

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, it may not! Remember to push the head to the course, or conversely, pull the tail to the course.

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

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. Until verified by radar or other navigation equipment, consider this bearing information unreliable.

5. **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 pointer pointing to the desired course. The CDI and bearing pointer 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.

6. 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.

7. **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 pointer and range indicator during the turn, and roll out with the bearing pointer 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 pointer 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 pointer. The rate of movement of the bearing pointer is governed by the size of the arc being flown, aircraft TAS, wind direction and velocity. Refer to Appendix E. Five radials works 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 pointer, 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 pointer 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 pointer 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 pointer 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 selected 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:

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

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 pointer 5 to 10 degrees above the selected reference point. Maintain heading until the bearing pointer moves 5 to 10 degrees below the reference point. The range should decrease slightly while the bearing pointer is above the reference point, and increase slightly when below the reference point.

Corrections. A technique to correct back to the arc: change aircraft heading to displace the bearing pointer 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.

8. **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. **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 pointer and the radial on which the desired point is located.
 - iii. **HSI.** 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 pointer (TACAN needle) and the head of the CDI.
- c. **Adjustments for DME.** The initial turn may be adjusted to roll out on a heading other than halfway between the bearing pointer 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 pointer (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 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.

- d. **Visualize.** Visualize the aircraft position and the desired point on the compass card of the RMI or HSI. The following factors must be understood when visually establishing the aircraft position and the desired point on the compass card:

- i. **Station Location.** The station is located at the center of the compass card, and the compass rose simulates the radials around the station.
 - ii. **Aircraft Position.** The aircraft position is visualized along the tail of the bearing pointer.
 - iii. **The 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 pointer or the new fix) is established at the outer edge of the compass card. 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 card.
- e. **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 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 card. 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 RMI as the imaginary line between the two points.
- f. **Adjust Heading.** Adjust aircraft heading as necessary and proceed to the point.
- i. **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.
 - ii. **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 card.
- g. **Update.** Update heading enroute to refine your solution and correct for winds.

NOTE

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.

9. 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 HSI select switch (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 pointer 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 for the TC-12B 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 4-14)**
- 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.

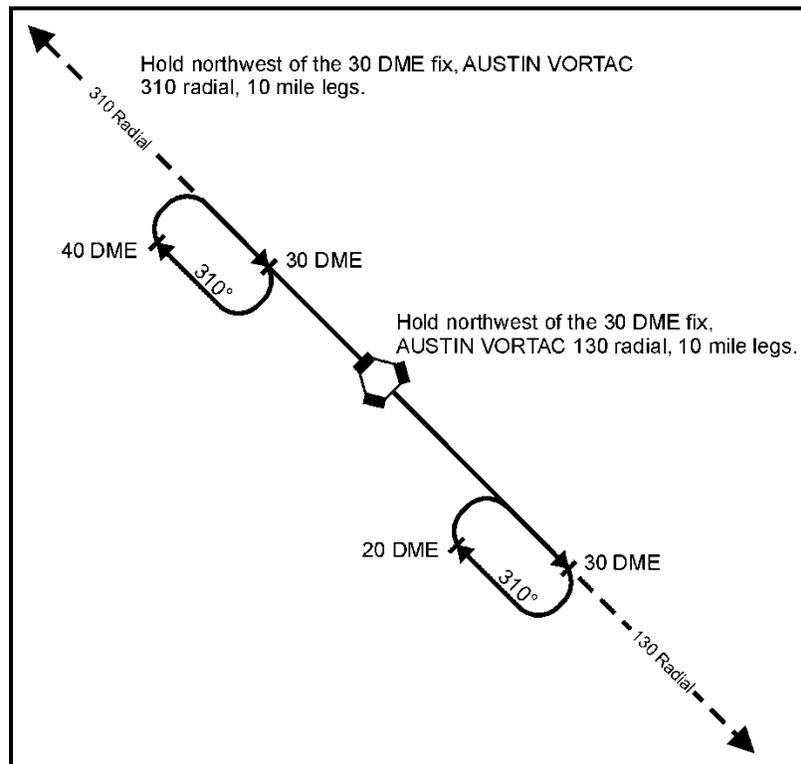


Figure 4-14 Copying Holding Instructions

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.” (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.

In calculating abeam the fix, 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. A good technique is to determine the holding course, 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

Another common mistake is not timing when over the holding fix/outbound when executing a teardrop entry. For a teardrop entry, time when over the holding fix, not once wings level outbound.

NOTE

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

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 RMI. 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.

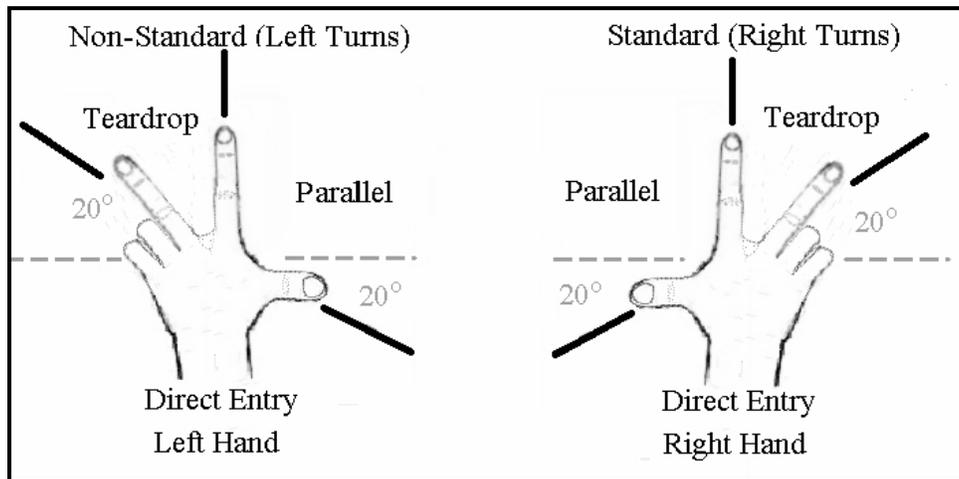


Figure 4-15 Holding Pattern Entry Technique

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 ($\pm 5^\circ$) 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.

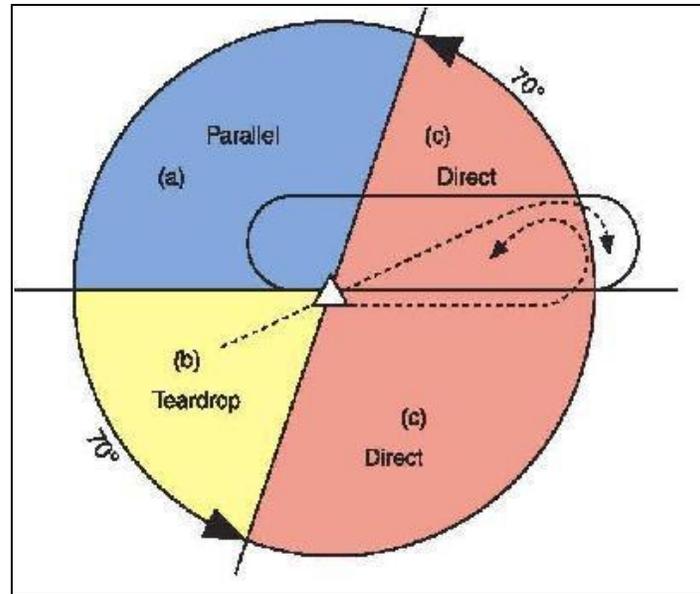


Figure 4-16 Holding Pattern Entry Procedures

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 for.

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 4-17*). 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.

NOTES

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

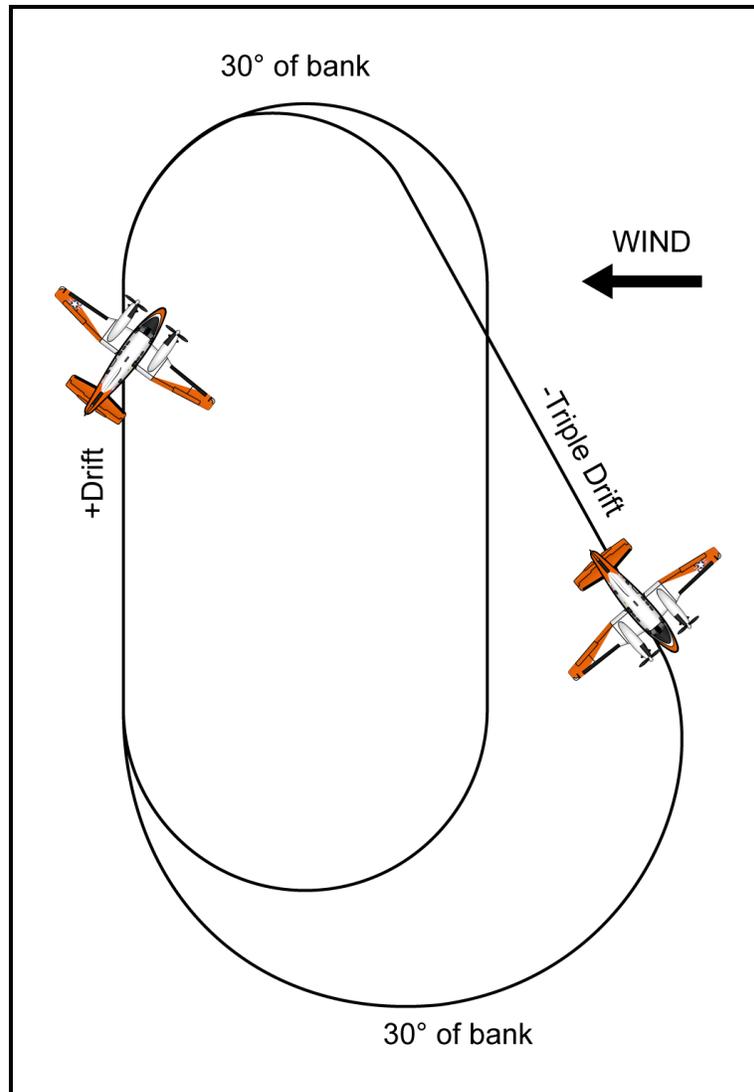


Figure 4-17 Triple Drift

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 standalone 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 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.** If communication is lost in a holding pattern, commence a descent and approach at the EFC time. If no EFC time is given, commence a descent at your ETA or amended (with ATC) ETE. If holding at a fix that is not an IAF, leave holding at the EFC time or if none has been received, upon arrival over the fix. Then proceed to an IAF and commence a descent and approach as close as possible to the ETA filed or amended (with ATC) ETE.

10. 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 B for more information.

Approach/Landing Minimums. Before commencing an approach using any approach procedures, pilots must meet the approach criteria established in OPNAVINST 3710.7 series, 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 TC-12B is a multi-piloted aircraft, however, for most training events, we must observe single-piloted aircraft criteria. (Reference Squadron SOPs and OPNAVINST 3710.7 series.)

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 approach being conducted. However, once an approach has been 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 OPNAVINST 3710.7 series).

NOTE

Approach minimums less than 200-1/2 are authorized when the appropriate multi-piloted approach clearance and criteria are satisfied IAW squadron SOP.

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 B.

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 **▽**, or “Trouble T”, indicating take-off minimums not standard and/or departure procedures are published. 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 glide path. (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. 3X 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 $[2 \times (\text{altitude to lose})] + 10 = \text{miles}$.

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 this *FTI "Additional Instrument Information" Appendix E*). 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. CTAF/Unicom Voice Reports. When operating at uncontrolled fields, the student shall monitor ATC and the advisory frequency (CTAF/UNICOM). CTAF/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 CTAF/UNICOM by Approach or Center, students shall assume the CTAF/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 CTAF/UNICOM communication procedures in *AIM 4-1-9*. For CTAF/UNICOM position reports, use “*Navy King Air XXX*” instead of “*Navy 5GXXX*” so traffic can better understand who and what we are. 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 CTAF/UNICOM, call out your position in reference to the field, not in reference to a fix (i.e., “*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., “*Alice traffic, Navy King Air 324 is 10 miles to the NW, inbound straight-in 13, we’re going to low-approach and climb out to the SE at 3000 feet, Alice traffic.*”)

Make, at a minimum, a 10 mile call, downwind, base, final, and departing.

6. 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. **RI 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 typically providing obstacle clearance 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 and NATOPS IFM* 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 the where the arrow points to 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 one of the following “Six T's” techniques which may help in accomplishing 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. CDIs on Approaches – When flying an approach, set your CDI on the **INBOUND** course. There are only two exceptions to this general Rule.
 - i. LOC BC – Always set the front course. (To prevent reverse sensing.)
 - ii. GPS – The CDI must always be set to the course that is shown in the FMS. (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 (i.e., 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 Outbound. 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:

Restrictions. Do not execute a PT or HILO PT in the following situations (many people use the memory aid “SNERT”).

- When ATC issues clearance for a “Straight-in” approach.
- If flying the approach via No PT routing (depicted by a solid black line from an outlying feeder-fix).
- When Established in holding, subsequently cleared the approach, and the holding course and PT course are the same.
- When ATC provides Radar vectors to the final approach course.
- 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.

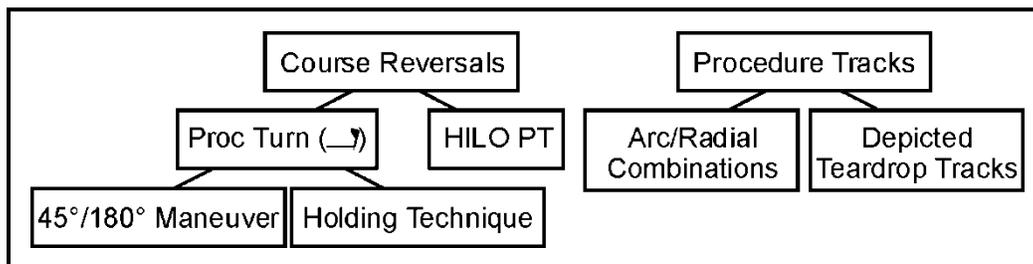


Figure 4-18 Breakdown of Low Altitude Approach Categories

NOTE

The “holding technique” discussed here encompasses both the “racetrack pattern” and “teardrop PT” referred to in *AIM Section 5-4-9*.

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.

- a. **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. Figure 4-23 gives you an idea of what the PT airspace looks like.

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.

Descent Inbound. Consider established inbound IAW Figure 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	WITHIN 5 RADIALS
LOCALIZER	INSIDE FULL SCALE DEFLECTION
GPS	INSIDE HALF SCALE DEFLECTION
NDB	WITHIN 5 BEARINGS

Figure 4-19 Established Inbound Table

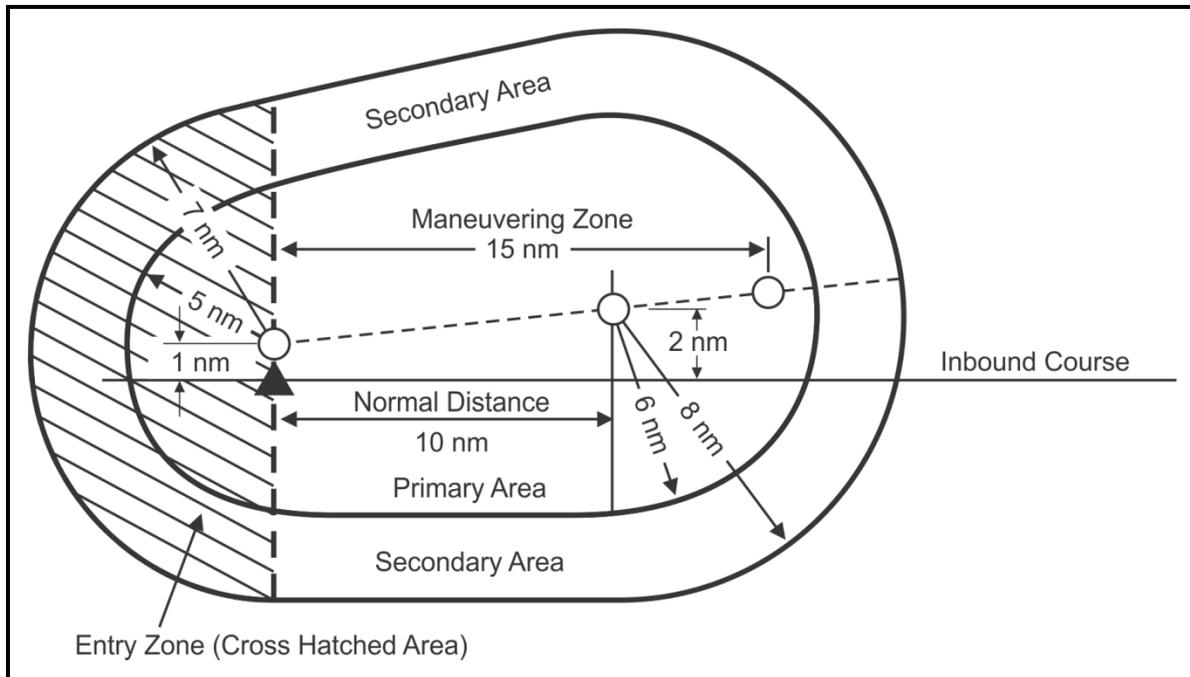


Figure 4-20 TERPS PT Protected Airspace

- 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 Turn. 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 4-19).

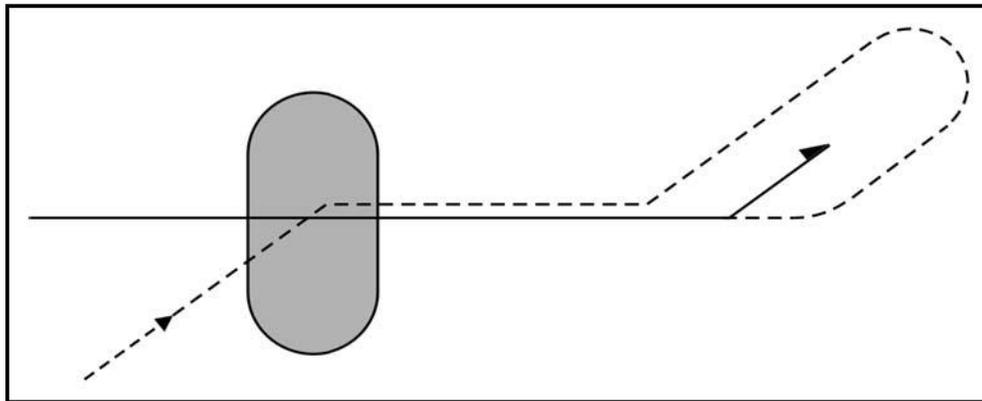


Figure 4-21 45°/180° Maneuver

- 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**.
- (a). **Entry.** Enter the PT according to the holding entry procedures described in the holding section with the following exceptions:
 - (b). **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 TC-12B at some high altitude airports.
 - (c). **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.

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.

- (d). **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).
- (e). **Descent.** As described in Low Altitude Instrument Approach Procedures. Do not descend from the PT completion altitude until established on the inbound segment of the approach. (Figure 4-19).

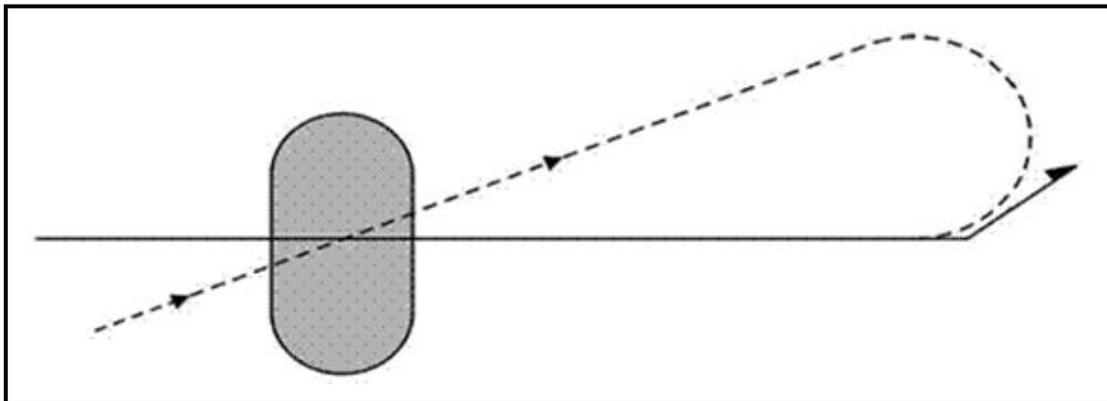


Figure 4-22 Teardrop Entry

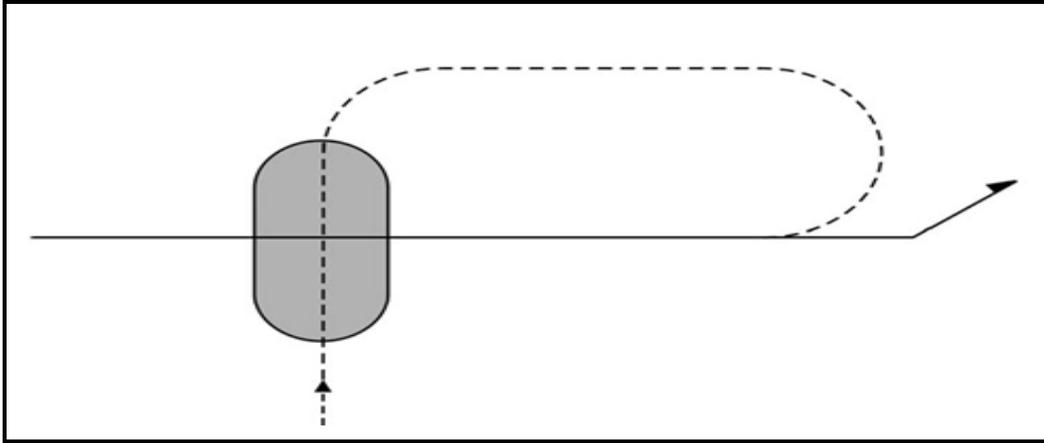


Figure 4-23 Direct Entry

- b. **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.

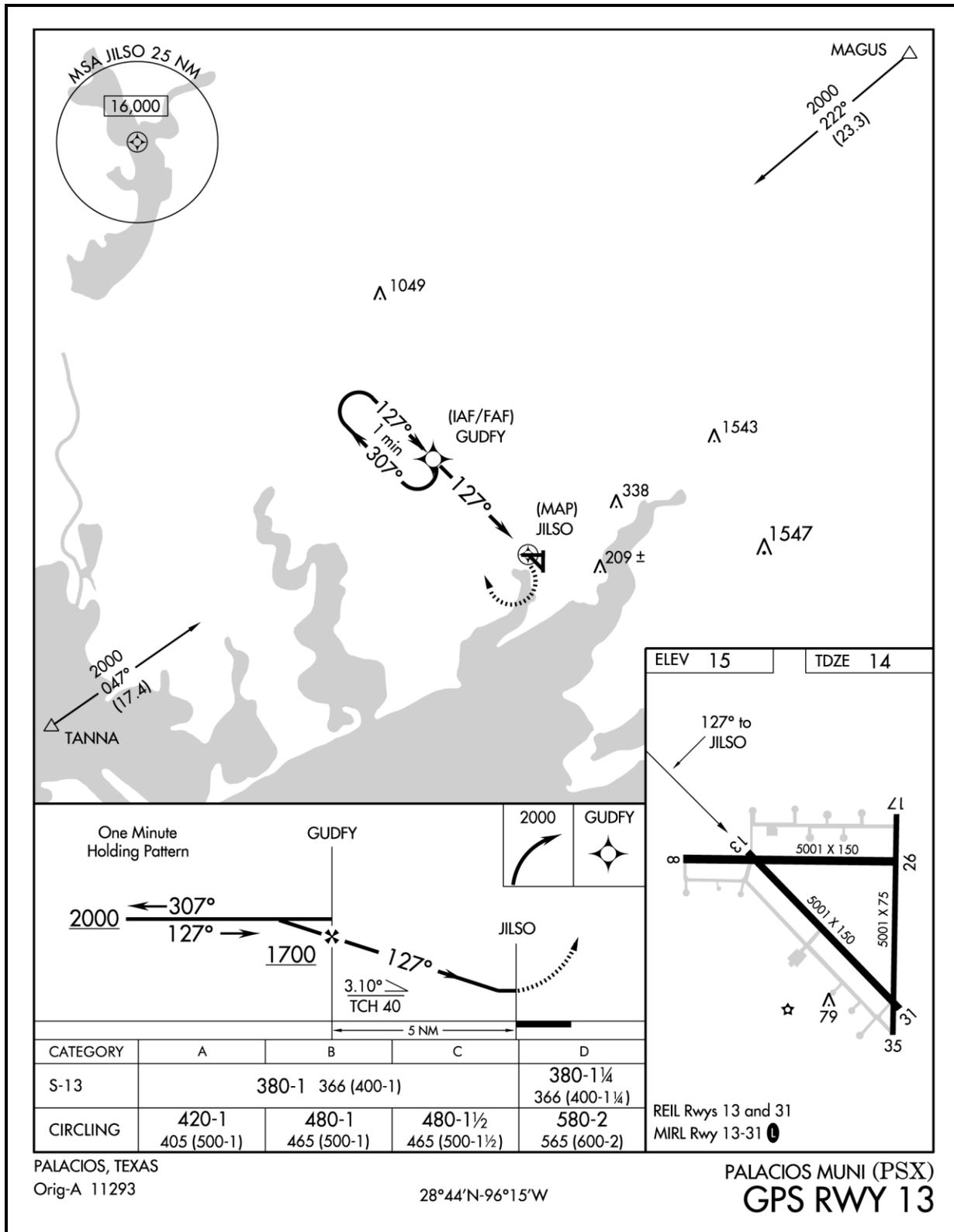


Figure 4-24 HILO Approach

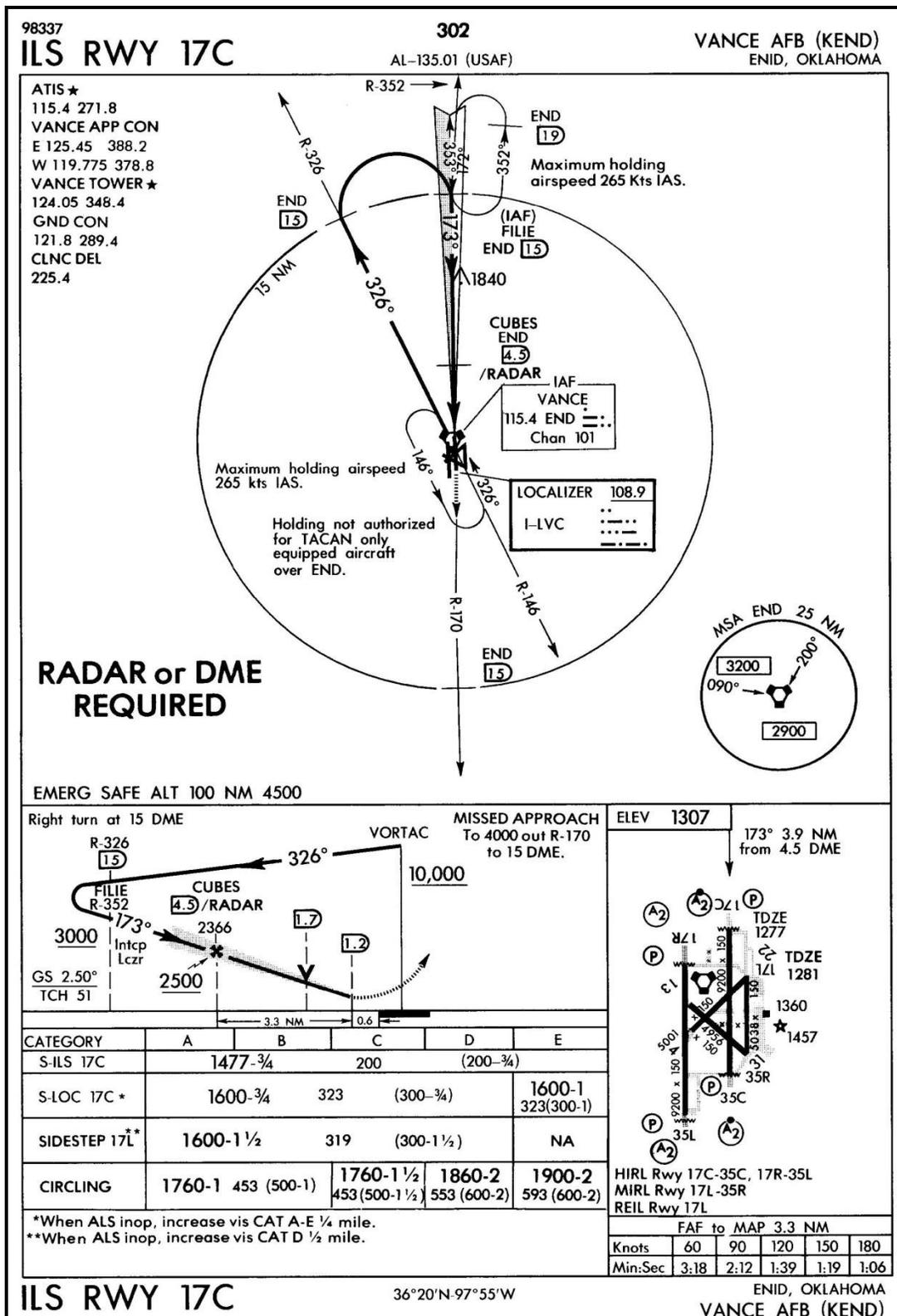


Figure 4-25 Depicted Teardrop

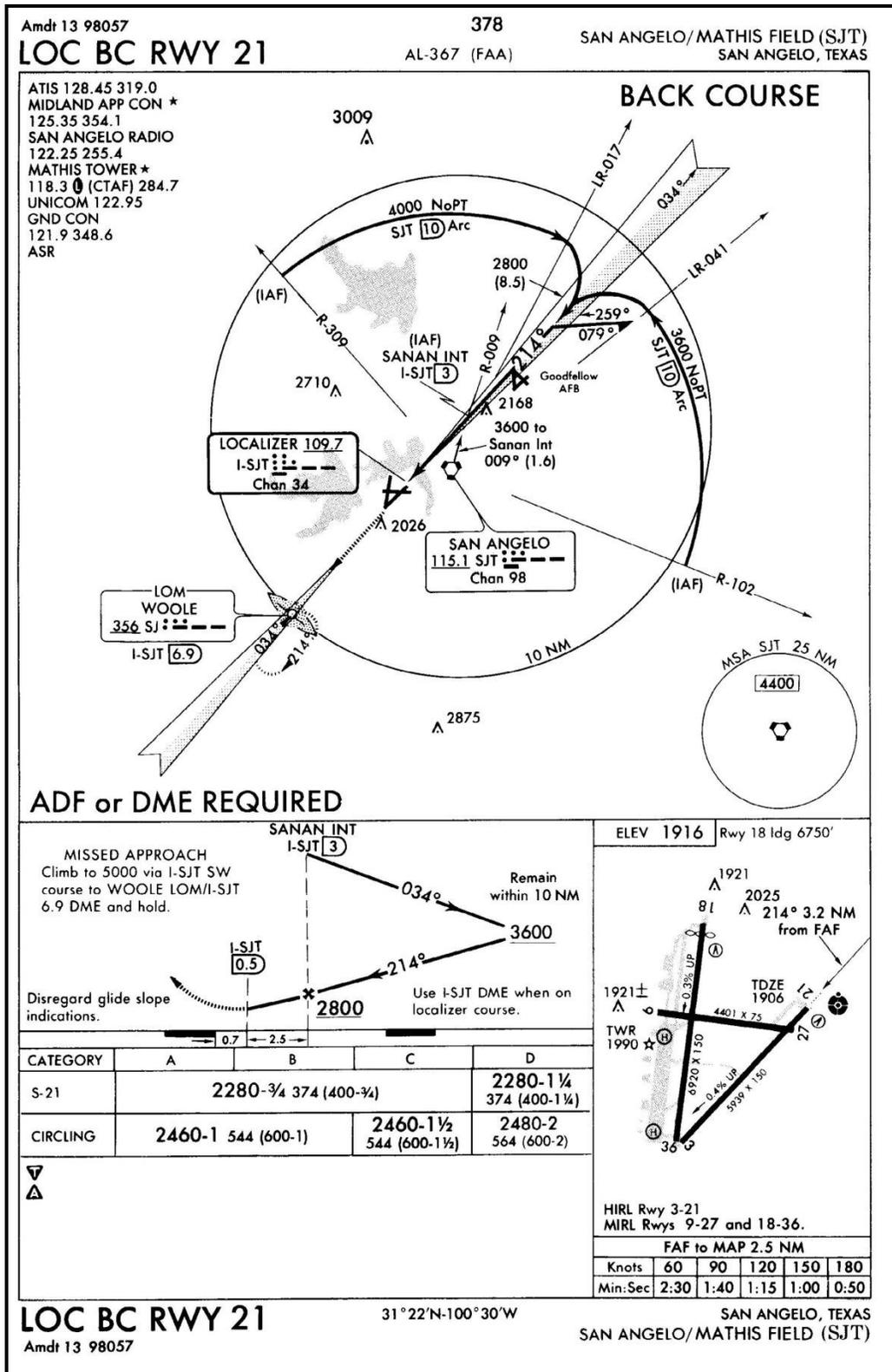


Figure 4-26 Arc/PT Approach

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 in Low Altitude Instrument Approach Procedures.

Descent. As described 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 4-19).

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, so it usually is greater than required for the TC-12B.
- 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 130 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
NORMAL	1 ½ dots below glideslope or 3 NM prior to FAF	3 NM prior to FAF	Base or Dogleg to final	Base or Dogleg to final

Figure 4-27 Normal Configuration Points

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. 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.
3. When executing a no flap instrument approach, Maintain 140 KIAS, configured for landing when crossing the FAF. Transition to 132 KIAS on a ½ mile final, slowing to V_{REF} when crossing the threshold.

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 ground speed; 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. 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.
3. 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.
4. 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 (i.e., timing is not published), the approach is not authorized.
5. 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.

NOTES

1. During a SSE approach, use of rudder trim is not recommended. If used, the PF shall brief the crew when rudder trim is being used to offset an asymmetric power situation. In all SSE cases, rudder trim shall be centered by the FAF on an instrument approach
2. 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 F. 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 technique", 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, ground speed, and VVI combinations.
 - i. Another technique is to half your ground speed and add a zero.
 - ii. E.g., 140 ground speed = 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.
- h. VDA does have limitations associated with computations based on ground speed 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 TC-12B 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 (MAP) 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:

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

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

$$\text{VDP} = \text{HAT/Gradient} = 420/300 = 1.4 \text{ NM from end of runway}$$

$$\text{VDP DME} = \text{DME at end of runway} + \text{VDP distance} = 0.5 \text{ DME} + 1.4 \text{ DME} = 1.9 \text{ DME}$$

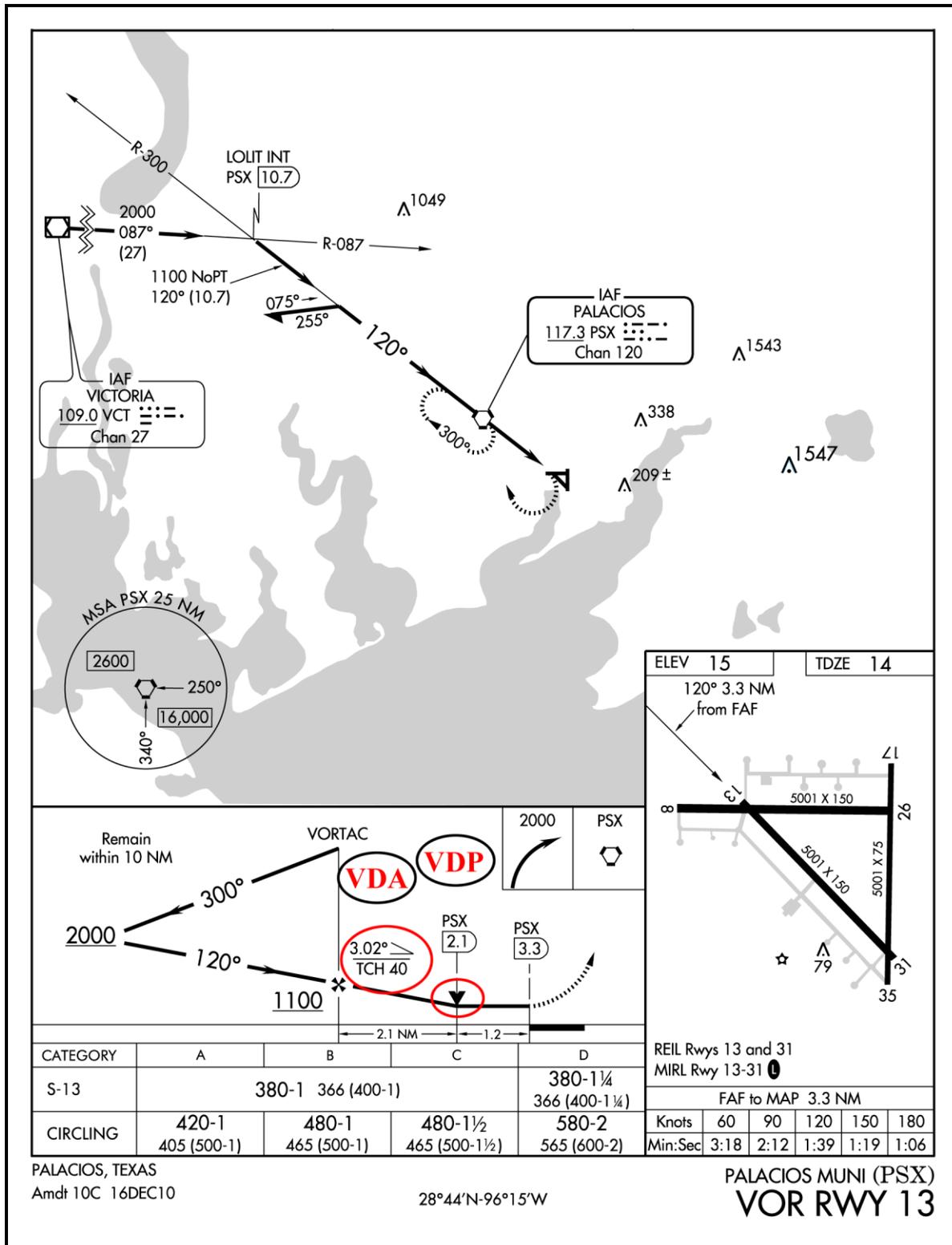


Figure 4-28 Vertical Descent Angle/Visual Descent Point

6. **Runway Environment.** Descent below MDA is authorized IAW appropriate service directives (OPNAV/SOPs):

The runway environment is commonly defined as:

- a. The approach light system
- 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 glide-path 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.

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.)

Option #1: Fly a normal glide path (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 minimum and you don't have good visibility.

Option #2: Take over visually and aim for the first 500' (i.e. the runway numbers). 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 130 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 arrive at 120 KIAS no later than a ½ NM final (132 KIAS if on a No-Flap approach).

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.
- g. Not transitioning to normal pattern airspeeds prior to 1/2 NM final.

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.** Students are encouraged to visit the Air Traffic Control Facility in building 60 behind the Base Operations hanger and observe the GCA final controllers "in action." 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 (i.e., 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**

Controller. The controller will inform the pilot of the runway to which the approach will be made, the MDA, and the 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.

Descent. 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.

Course 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.

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.

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)

Controller. A PAR is a precision approach, where the final controller has radars both for azimuth and elevation, allowing them 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.

Descent. Approximately 10 to 30 seconds before final descent, the controller will advise the aircraft is approaching the glide-path. 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 glide-path.*” At that point, establish the predetermined rate of descent. When the airspeed and glide-path 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 $\pm 100'$ of where you want it and make small corrections, it will be a more stable approach.

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 glide-path for the approach requiring power and pitch corrections to get back on glide-path.

Course and Glide-path guidance. The controller issues course and glide-path guidance, and frequently informs you of any deviation from course or glide-path. The controller’s terminology will be: “*on course, on glide-path, slightly/well above/below glide-path,*” 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 glide-path, holding above/below glide-path, 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.

Corrections. 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 glide-path.

Heading 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 $\frac{1}{2}$ 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 glide-path 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 OPNAVINST 3710.7 series).

Single-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.

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 Kleberg County, KIKG).

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 you are above localizer mins, consider yourself transitioned to a localizer approach and proceed accordingly (i.e., 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 will probably just blow through the CDI on the other side. Try and 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 probably just blow through the CDI on the other side. Try and 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 glide-path 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 TC-12B 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 (if SSE, raise the gear and continue the approach if possible using non-precision procedures: CRAT p. 4-103). If the localizer fails, the procedure is not authorized. Reference the *NATOPS* 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. When on radar vectors and you are not told that you will be vectored across final, it is acceptable to query the controller, as you may have been forgotten about.

- 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. Another good technique is to perform the LIDS check when you have received your first vector when being radar vectored to final.

Localizer. 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. Tune the TACAN to the localizer associated DME frequency, if applicable.

Selector switches. This ensures that your NAV source selector switch is set to give the correct information to the CDI.

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 established on the localizer course, outside the glideslope intercept altitude (GSIA) or FAF, descents should be flown using the dive and drive method obeying any stepdown altitude restrictions. The altitude and location of the “lightning bolt” symbol on the approach plate is the highest altitude at which the glideslope can be used for primary guidance and the glideslope is only flight checked to be intercepted from below the GSIA. If the approach plate shows an alternative lower GSIA and ATC directs a lower altitude, then the resultant lower intercept becomes the FAF. 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 (⚡).

NOTES

1. The glideslope is flight checked to a fixed distance, usually 10 miles. Glide slope intercepts beyond this point may be affected by false glideslope signals. The glideslope transmitter creates a mirror image that produces a false glideslope at about twice the angle of incidence above the real glideslope, i.e. a 6 degree glideslope that would be recognized by a higher rate of descent than normal.
2. Interception and tracking of the glideslope prior to the published GSIA does not ensure that minimum, maximum and/or mandatory altitudes published for any preceding fixes will be complied with during the descent. If you choose to track the glideslope prior to the GSIA, you remain responsible for complying with published altitudes for any preceding stepdown fixes encountered during the descent.
3. 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 glide-path 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 flightpath (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).

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 Altitude/Height (DA/DH).** 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.

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 5-4-23** 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 5-4-25* for information on contact approaches. A contact approach is one where an aircraft on an IFR flight 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” 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

- 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 or unnecessarily requesting a gear warning on a no-gyro radar approach.
- c. Chasing a calculated VSI and not using the control instruments to establish a rate of descent.
- d. Over-controlling course and/or glide-path on final.
- e. 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.
- f. 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 glide path, 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 wave-off 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 glide-path orientation once visual cues come into view and the visual transition is begun.

NOTES

1. Once the decision to land has been made, you have a few options, depending on conditions (weather, runway length, etc).
2. (Non-Precision) Fly a normal glide path (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 minimums and you don't have good visibility.
3. (Non-Precision) Take over visually and aim for the first 500', i.e. the runway numbers. You may want to do this if runway length is a consideration.
4. (Precision) Continue on the ILS glideslope path while bringing in outside references (VASI or PAPI) to assist you. Keep your aim down the runway to the 1000' runway aiming point markings. If runway length is a consideration and weather/visibility is not an issue, you can elect to take over visually and aim for the first 500', i.e. the runway numbers.

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: 130 during normal and single-engine situations, 140 KIAS with a no-flap configuration. 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.

NOTES

1. Circling obstruction clearance areas (which provide required obstacle clearance of 300 feet) are determined by aircraft category; the TC-12B is a Category C aircraft. Maneuver the aircraft to remain within the circling area (Figure 4-29). If it is necessary to maneuver at speeds in excess of the upper limit of the speed range authorized for your Category C = 121-140 KIAS, use the next higher landing category. When you request circling MDA from the controller for a circling ASR approach, state your aircraft category.
 2. 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 130 KIAS until in a position to place the aircraft on a normal glide-path 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 130 KIAS until in a position to place the aircraft on a normal glide-path 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 glide-path 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.

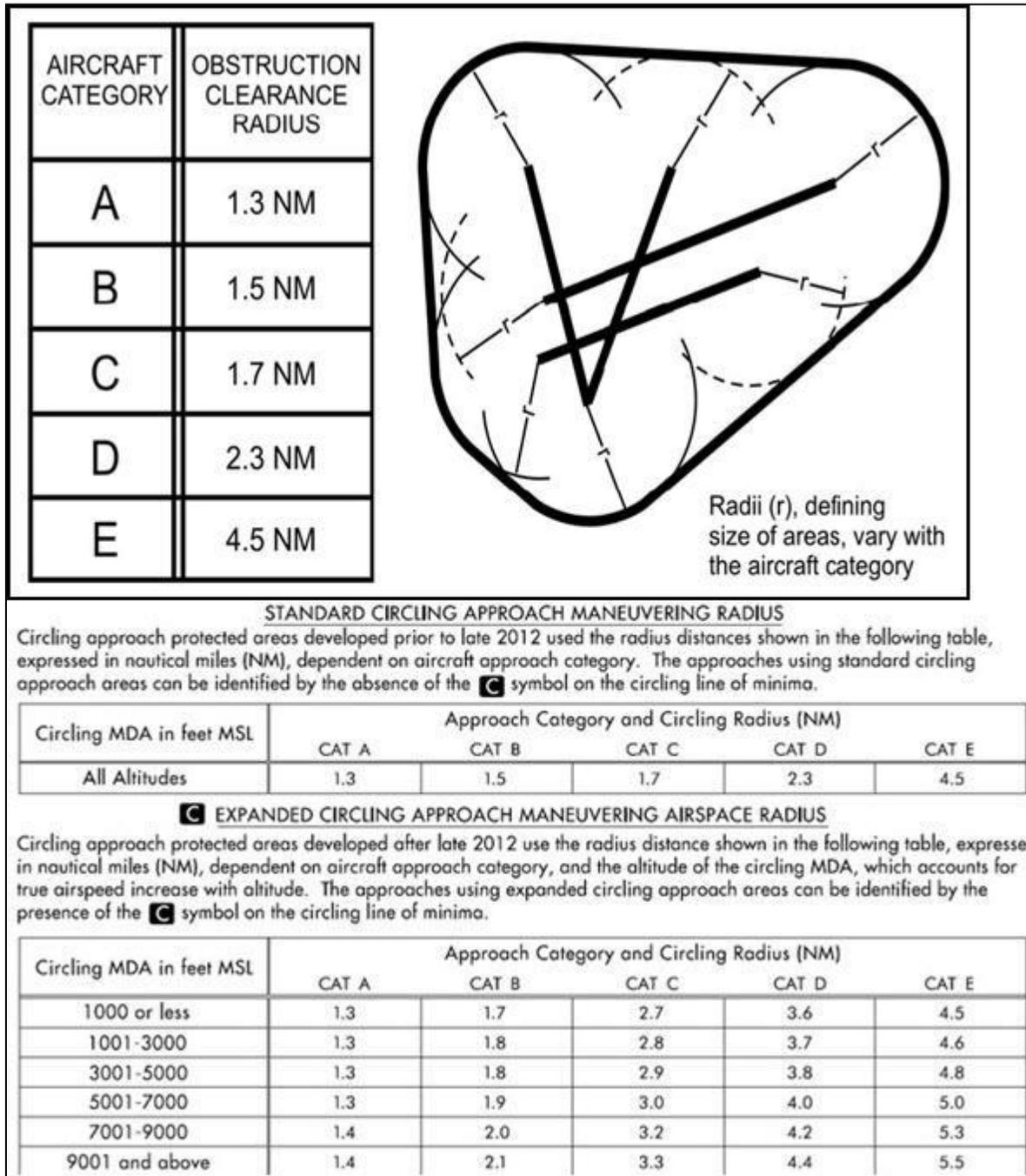


Figure 4-29 Circling Obstruction Clearance Area

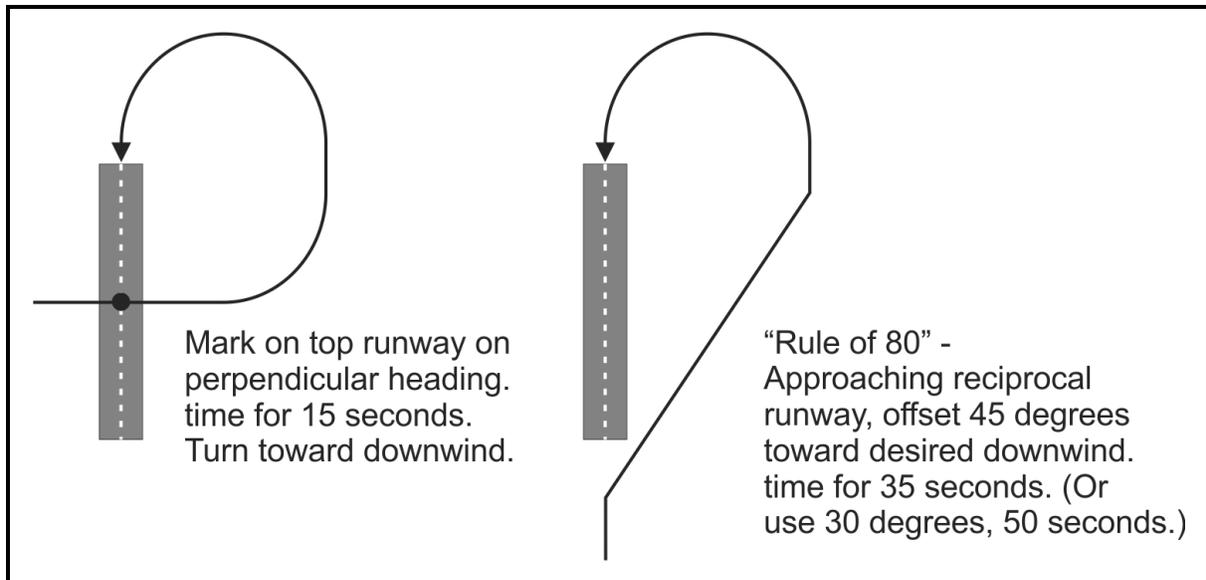


Figure 4-30 Example Circling Techniques

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 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 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 height (DH) with the assumption that the aircraft will descend slightly below the DH. It is procedurally incorrect and unnecessary to execute a missed approach prior to the DH to avoid dropping below the DH.
 2. Stabilized non precision approaches simulate a constant glide slope 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/altitude alerter, etc.) for remembering the climb-out instructions, since they are expected to be able to fly all clearances without instructor intervention.
- d. **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,” page 4-94.
- e. **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.*”

- f. **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; confirm airspeed is above V_{YSE} 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.
- g. **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.

- h. **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.
- i. **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.
- j. **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 (i.e., 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.

Figure 4-31 shows examples of circling missed approaches. As you can see, an initial turn was made towards the landing runway, then the aircraft was turned to get on the “dotted line.”

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.”

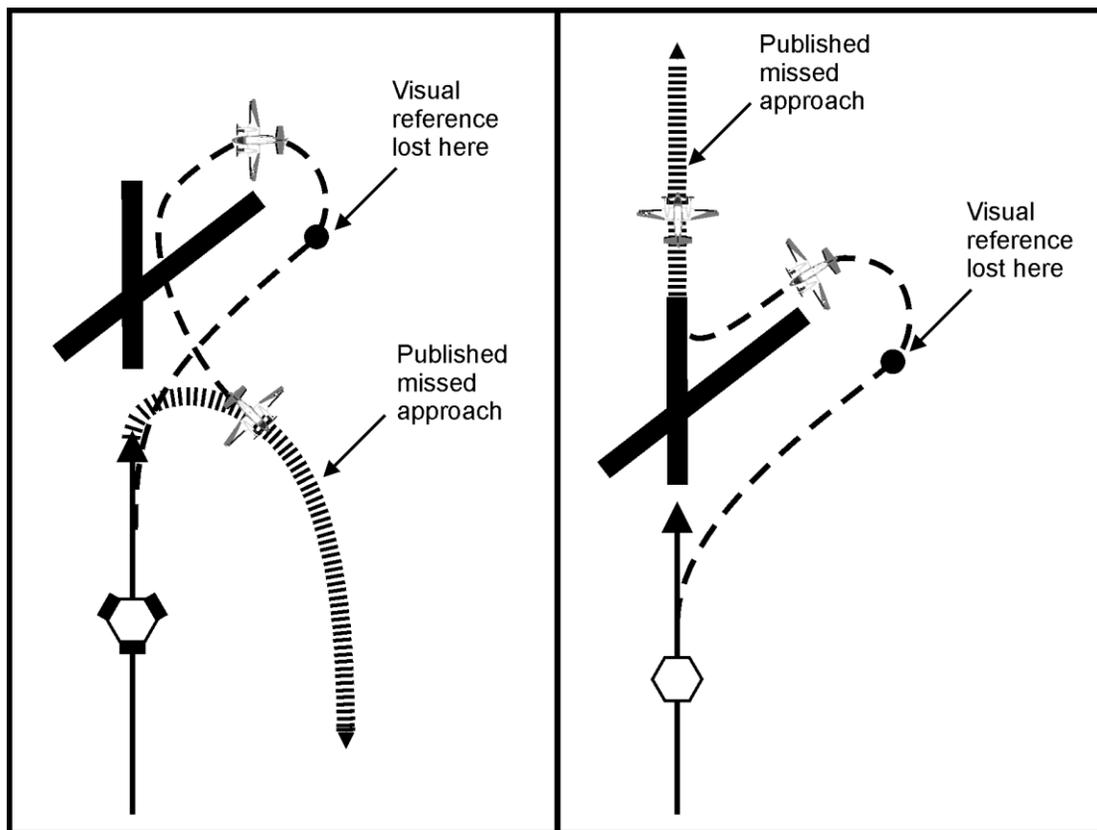


Figure 4-31 Missed Approach from the Circling Approach

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 Contacts 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: Destination, Route, Altitude, Fuel and Time 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, 140-150 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 Precision Approach.** If flying a single-engine or SSE ILS, PAR, or SSE ASR w/recommended altitude:

Once established on final and approaching the configuration point, lower the flaps to approach, set the props full forward, and slow to 130 KIAS any time after the normal configuration point; gear should be left in the “up” position. Just before the configuration point, lower the gear and complete the Landing Checklist. There should not be difficulty in maintaining 130 KIAS, fully configured, when in the descent. Begin descent with sufficient power on the available engine to maintain glide-path and airspeed. A strong cross-check and appropriate control inputs will ensure the aircraft does not get low or slow.

NOTE

If, at any time, you are unable to maintain glide-path or airspeed, you should retract the gear or clean up completely to eliminate drag. After re-establishing glide-path and airspeed, reconfigure and complete the Landing Checklist again.

	PRECISION	NON-PRECISION	RADAR APPROACH PAR	RADAR APPROACH ASR
SSE (also see Emergency Procedures)	½ dot below glideslope at glideslope intercept altitude	In safe position to land	10 sec gear warning	(1) 10 sec gear warning (2) Safe position to land

Figure 4-32 SSE Configuration Points

NOTES

1. On a SE non-precision approach, configure with field in sight and intercepting a normal landing glide path.
 2. For a SE circling approach, configure 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 glide-path. If you get well below those altitudes, however, you must clean up the gear until in a safe position to land.
 4. No Flap Approaches. When executing a no flap instrument approach, Maintain 140 KIAS, configured for landing when crossing the FAF. Transition to 132 KIAS on a ½ mile final, slowing to V_{REF} when crossing the threshold.
- b. **Single-Engine Non-Precision Approach.** If flying a single-engine or SSE non-precision approach (including VDA approaches):

Configure flaps to approach, set the props full forward, and slow to 130 KIAS any time after the normal configuration point, but before the FAF. The gear should be left in the “up” position. During warmer months it may be impossible to maintain level flight and 130 KIAS with the gear down. There should not be difficulty in maintaining 130 KIAS in level flight with the flaps at approach and the gear retracted. However, if at any time you are unable to maintain altitude or airspeed, you should clean up completely to eliminate drag. 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 130 KIAS at 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.

NOTES

1. During SSE training, ensure the gear is down no later than the 90° position or one mile from the threshold; there is a possibility the “wheels watch” (Navy fields) may fire a flare if the gear is held beyond this point.
 2. For 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 will usually have MUCH more time to handle the EP than you did on downwind. SLOW DOWN and keep your SA on the 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 (i.e., ILS to LOC transition) you must clean up per above guidance unless the field is in sight and you are in a position to land, as if 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 gear when intercepting the appropriate VFR pattern checkpoint. The Landing Checklist must be complete no later than the 90° position. Airspeed may be reduced from 130 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 wave-off. Use maximum available power on the good engine and establish a positive rate of climb with 7 to 10 degree nose-up pitch. Maintain 121 KIAS (V_{YSE}) in the climb (115 KIAS may be used if necessary for best rate of climb). When assured you will not touch down, retract the gear; confirm airspeed is above V_{YSE} 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.

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.** A VOR approach can be flown using the needles on the RMI. Use the same technique as in normal NDB approaches and reference NIFM 21.3.3.1 and 31.3.5.1. 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. **TACAN.** TACAN approaches can be flown using just the bearing pointer on the HSI.

If you have to fly a TACAN approach without the CDI, you will have to mentally calculate the radial you are on as there is no needle (just the pointer) in the aircraft. The "RMI only" techniques above will be applied using the HSI.

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 reciprocal of the outbound course; again the pointer will “fall” to the heading bug when on an intercept heading. Complete the intercept, in this case, by turning away from the pointer so it is on the lower lubber line mark. Maintain course by keeping the pointer 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. Partial Panel. (Heading Indicator Inoperative or Heading and Attitude Indicator Inoperative).

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 4") that may influence the wet compass if the malfunction is a heading problem. See the Typical Briefs and Voice Procedures Appendix B for a typical brief for partial panel malfunctions.

Advise Controller. If the heading indicator should fail during flight, advise the radar controller and request a no-gyro radar approach. The final approach may be either precision or surveillance.

Turns. Perform turns during the transition to final by establishing an AOB on the attitude indicator that will approximate a SRT, not to exceed 30 degrees of bank. If attitude information is also unavailable, a single needle width deflection of the pilot's turn needle will indicate a SRT. Perform turns on final by establishing an AOB that will approximate a ½ SRT. If unable to comply with these turn rates, advise the controller so he may determine lead points for turn and heading corrections. Initiate turns immediately upon hearing the words "turn right" or "turn left." Stop the turn on receipt of the words "stop turn." Acknowledge the controller's commands to start and stop turns until advised not to acknowledge further transmissions.

NOTES

1. Do not begin using ½ SRTs on final until the controller tells you. The controller may want SRTs even on final if abnormal conditions exist (i.e. strong crosswinds, etc.)
2. Big Four: Air Conditioning, condenser blower, windshield heat, and windshield wipers.

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.

1. **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*.

2. **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.

3. **Fuel Planning.** Any off-station flight involves fuel planning. A fuel log is required per NATOPS. See appendix D of this instruction and NATOPS Chapter 6 for more information. 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. Additionally, the IFR Supplement lists the website to use for identifying military contract fuel locations. 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.

4. **Enroute Weather.** Ensure your weather forecast is updated at least once enroute on all cross-country flights. The TC-12B 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.

5. **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) or King Air 200 (fill outboard tanks first) as appropriate. 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).

6. **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.

- a. **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.
- b. **“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 5G304, 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.

7. **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 the autopilot is used alone, control the aircraft with the manual pitch wheel and roll knob. When coupled, the autopilot controls the aircraft using commands generated by the flight director. Touch control steering may be used anytime the autopilot is engaged. Power levers must be adjusted manually to obtain desired performance. 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. When changing the desired heading while in HDG mode, move the heading bug a maximum of 135° in the direction of the turn.
- c. The autopilot will roll to bank angles up to 27°.
- d. Engage V/L, APP ARM, or REV when an intercept angle less than 90° has been established.
- e. 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.

8. **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 throttles.

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.

9. **Right Seat Orientation.** The purpose of right seat events is to better prepare students for follow-on assignments as a copilot or second pilot. 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.

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. There are a few minor differences in right seat instrumentation (turn and slip indicator in a different location, RADALT is on the left panel), but your instrument crosscheck will be very similar. 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 GNS/XLS Operator’s Manual. Correct 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 and AIM 5-4-1 for information on GPS/RNAV approaches.

Study Other Sources. This section is a brief overview of FMS/GPS procedures and cannot provide by itself the knowledge required to use FMS/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/GPS installed in the TC-12B aircraft. The following sources provide additional information: the FMS/GPS computer courseware, GNS/XLS Operator's Manual, *NATOPS Flight Manual*, AIM, IFM, and AFMAN 11-217.

Receiver Autonomous Integrity Monitoring (RAIM). The operational status of the global navigation satellite system (GNSS) operations depends upon the type of equipment being used. For *GPS*-only equipment TSO-C 129(a), of which the TC-12B is, 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. This prediction program is referred to as RAIM. 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 detection exclusion (FDE), refers to the ability of the receiver to exclude a failed satellite from the position solution and is provided by some GPS receivers. (The TC-12B has both RAIM & FDE capability.) *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* and another type indicates that the *RAIM* 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. In the TC12B, if either of these situations occur, an amber *MSG* light will illuminate on the *FMS* annunciator panel. On the FMS control unit the "Message" light will flash and the PM will need to press the MSG button to view details on either the system or sensor page. See a complete list of system/sensor messages in the GNS/XLS operator's manual, page 2-76. During normal operation, RAIM and FDE can be checked by selecting the GPS Sub-Section page 2-3 from the Navigation 4-4 page.

Navigation Database. Navigation databases supporting GPS equipment certified for enroute and terminal operations contain, airports, VORs, VORTACs, NDBs, TACANs, and 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 TC-12B is a Jeppesen NavData Database. Most military aircraft use a different database, called the DAFIF database. In many receivers, including the TC-12B, an up-datable 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. Verification that the database update was performed can be reviewed in the aircraft forms in maintenance control.

NOTE

All approach procedures to be flown must be retrievable from the current airborne navigation database. Aircrew cannot create their own approach procedures.

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. Review NOTAMs by referring to the installation NOTAMs for your destination and any alternates. GPS satellite outages are issued as GPS NOTAMs using pseudo random noise (PRN) number or satellite vehicle number (SVN) and can be accessed using the “KGPS” identifier. It is important any affected satellites be de-selected. This ensures the particular satellites de-selected are not used for the navigation solution or RAIM calculations. If the NOTAM describes the satellite as Pseudo Random Noise, it is not necessary to de-select it, since there is just some noise in the signal. The satellite is not bad. De-selecting in this case, however, may help the system cycle through good satellites faster. If, however, the NOTAM indicates a SV is “unreliable”, aircrew should de-select the satellite. NavData Alerts/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 website (<http://www.jeppesen.com/company/alerts/alerts.jsp>). A link to this website is also provided on the DINS page (<https://www.notams.faa.gov/dinsqueryweb>). Check these before flight.

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.

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.

Required Navigation Performance (RNP). 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) 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.

SEGMENT	RNP LEVEL	CDI SENSITIVITY	PRIMARY ROUTE WIDTH (NM) – (CENTERLINE TO BOUNDARY)
Enroute	2.0	+/- 5.0 NM	8.0 NM (+4.0)
Initial	1.0	+/- 1.0 NM	4.0 NM (+2.0)
Intermediate	1.0	+/- 1.0 NM	4.0 NM (+2.0)
Final	0.3	+/- 0.3 NM	1.2 NM (+0.6)
Missed Approach	1.0	+/- 1.0 NM	4.0 NM (+2.0)
Departure	1.0	+/- 1.0 NM	4.0 NM (+2.0)

Figure 4-33 RNP Levels Table

Course Sensitivity. Course sensitivity depends on what phase of flight you are in. The Course Deviation Indicator (CDI) sensitivity related to GPS equipment varies with the mode of operation. Figure 4-33 above, details the modes and provides the indicated CDI scaling. When the CDI sensitivity decreases based on the phase of flight, it does not do so abruptly. The CDI sensitivity begins to ramp down approximately 2 NM prior to 30 NM (Terminal Mode/Approach Mode Armed) and 2NM prior to the FAF (Approach Mode/Approach Mode Active). This prevents an abrupt change in the CDI should the aircraft be off the prescribed course.

NOTE

Your current sensitivity can be viewed or manually changed in the NAV 2/4 page next to XTK. You can change your sensitivity from ENRTE (5.0), TRMNL (1.0), or APRCH (0.3) by selecting the XTK and pressing the PRV or NXT key.

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. Established on course is half-full scale deflection or 2.5 NM.

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 NM. This must take place prior to descending on an instrument approach. Established on course is half-full scale deflection or 0.5 NM.

- a. When entering the terminal area from the enroute structure and the CDI sensitivity scales down to ± 1 NM, a verbal response is required prior to descending past the IAF. When the approach mode is “armed,” a MSG annunciator light will illuminate and when the message page is selected it will read on the system page “APRCH ARMED”, a verbal response of “*Approach Mode Armed*” is required by the PM.

- b. A MSG annunciator will not be seen and associated system message of “APRCH ARMED” will not appear 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 NM.

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. There are multiple ways in the TC-12B to tell if this has taken place. Once this is verified, a response of “*Approach Mode Active*” can be made. This must take place prior to descending from the FAF. Reminder: verifying FMS/GPS operation require proper CRM. Utilize the PM properly during this critical phase of flight.

- a. The primary method of identifying the CDI sensitivity changes to ± 0.3 NM is the green APPR annunciator light.
- b. When the CDI starts to change to ± 0.3 NM, a MSG annunciator light will illuminate and the message system page will state APRCH mode active.
- c. The final way to verify the change is to check the NAV 2/4 page and ensure the XTK is APRCH. This may be needed if the APPR light is not working.

Missed Approach Mode. When navigation to the missed approach holding point is activated (i.e. crossing the fence/selecting direct to the missed approach hold point), 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 the Active Approach Mode to the Missed Approach Mode and the CDI from ± 0.3 to ± 1.0 . Once this is done, the aircraft is no longer guaranteed obstacle clearance.

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.

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 ILS, 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 (Along Track Distance (ATD)). 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.

GPS Approach Rules & Restrictions. There are several important operating restrictions when using GPS.

- a. 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.
- b. 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.
- c. 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.

- d. 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.
- e. Instrument approaches must be accomplished in accordance with approved instrument approach procedures retrieved from the FMS database using the current update cycle.
- f. Instrument approaches must be conducted in the FMS Approach mode, and GPS integrity monitoring (RAIM) must be available at the FAF.
- g. 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, identify, or monitor any other NAVAID (though this is NOT recommended).
- h. Only LNAV MDA minimums will be used. The TC-12B is not certified for VNAV or DA approach minimums. In this aircraft, you may encounter glideslope indications while executing certain GPS/RNAV approaches. Again, the TC-12B is not certified to fly this glideslope down to VNAV or DA approach minimums.
- i. Do not descend on an approach unless:
 - i. FMS is in proper mode (i.e., Approach Mode with “Approach Mode Active”).
 - ii. Inside the FAF, the aircraft is established on final approach when the CDI is half-full scale deflection. This indicates the aircraft is within ± 0.3 NM of centerline.
 - iii. 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 $> 90^\circ$ of intercept.
 - iv. Always have the CDI set to the course you are on, even if it is not an inbound leg (e.g., on a VOR or GPS PT overlay approach outbound, set the outbound course in the CDI, then change it to the inbound course once on the 45/180). The CDI acts as a LOC CDI does. This means no matter where it is set, it displays the same information. This could lead to confusion if an incorrect CDI course is set.
 - v. 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.

- vi. 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.
- vii. 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.
- viii. At the MAP, the FMS/GPS will not automatically sequence to the next required waypoint; therefore, the aircrew (i.e. the PM) must manually sequence the FMS/GPS to the missed approach waypoint by selecting/highlighting (i.e. crossing the fence) the waypoint in the active FPL page or by using the direct function.

WARNING

Do not cycle the FMS/GPS past the MAP prior to going missed approach, unless you are climbing to the missed approach altitude. Doing so will change the FMS/GPS mode from the Active Approach Mode to the Missed Approach Mode and the CDI from ± 3.0 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.

- ix. 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.

GPS Approach Execution. As previously mentioned, executing a GPS approach is very similar to executing any non-precision approach. For example, the approach begins at an IAF in which a procedure turn or procedure track can then be flown to the FAF. At the FAF, a descent to the MDA along a FAC is flown to MAP. Then finally, a holding point (HP) can be selected and flown to upon a missed approach if required. The following is a step by step list to ensure GPS approach execution is conducted properly. Also, refer to the GPS Procedures handout in this FTI, Appendix I.

Select the GPS approach within the database. Within the active flight plan (FPL) or within a stored flight plan, a GPS approach can be selected for an airport that is within the database. Approaches are listed by airport identification (KNGP, KCRP, etc.). Verify the waypoints for that approach. Do this by cross checking the waypoints that the GPS has listed with the waypoints on the approach plate.

Ensure the approach is “armed”. Within 30 NM of the terminal area, if an approach is loaded and selected, the FMS should “arm” the approach. Check for this by pressing the message “MSG” button. This page will list the airport identifier and whether the approach is armed or not. Also, on the NAV 2/4 page the mode of the FMS can be checked as well. The GPS should be in the TRMNL mode.

ABCs. Get ATIS, complete the approach brief, and execute the approach checklist.

Fly the approach. Once cleared, fly to the IAF. For a *Standalone Approach* (T or TAA) you can get cleared to a transition fix. If cleared to an IAF, the PF should select FMS and have the PM sequence the GPS direct to that IAF. Fly to the IAF by following the magenta needle and keeping the CDI centered like any non-precision approach.

Approaching the IAF the waypoint “WPT” light will illuminate. Have the PM verify that the GPS will cycle to the next waypoint on the approach and that the GPS is in “AUTO.”

As you near the “fly by” IAF the needle will continue to point to that IAF until you pass abeam. However, the CDI will change deflection prior to that point and give you guidance to the next course for the next waypoint on the approach, based on current ground speed and winds aloft. At the calculated lead point, turn the aircraft as required to intercept that new course. Descend as required. A procedure turn is usually not required on these types of GPS procedure tracks.

NOTE

If there is a HILO depicted at the IAF and the controller didn't specify "straight-in" in your approach clearance, ask if they want you to execute the PT. Reference FAR 91.175.

As you approach the next waypoint, normally, one more turn to the final approach course will be required. The needle and CDI will act the same as previously described as you approach the next fly by waypoint. Turn onto the FAC; descend as required (within half-scale deflection). Center the CDI.

3 NM prior to the FAF slow and configure; for SSE, slow and get flaps to approach and place props full forward but hold the gear until in a safe position to land.

2 NM prior to FAF the "APPR" light will illuminate. This means the approach mode is active and the CDI is set to 0.3NM sensitivity. Continue to fly the course inbound keeping the CDI centered. You may also have the PM verify that the approach mode is "active", by pressing the message button. The PM must also verify the next waypoint. The next waypoint is normally the runway or on some approaches there may be a step-down fix prior to the runway. Bottom line; always have the PM verify that the GPS cycles to the next appropriate fix during all GPS approaches.

Once at the FAF, the needle will swing off momentarily then sequence to the runway or step-down fix. The CDI should be flown to remain centered and then descend to the LNAV MDA or step-down fix as required.

At the MDA, fly to the runway (MAP) with the CDI centered. Once the runway is in sight, transition to landing as described previously in this instruction. Execute a missed approach if required. As the aircraft approaches the MAP (runway) and at the LNAV MDA, the crew must be prepared to make a landing transition or execute a missed approach. The MAP is always a flyover WPT and must be flown over especially if executing the missed approach procedures.

After over flying the MAP, the needle and CDI will still provide guidance to the MAP and must be changed to provide guidance to the holding point (HP). This is done by having the PM "cross the fence". On the active flight plan page, the GPS will list the MAP then a fence "+++++" followed by the HP. The PM needs to highlight and select the HP. Then the GPS needle and CDI will provide navigational guidance.

Fly to the HP and prepare to hold. For GPS holding, ensure the GPS is in "manual". The PM can highlight "auto" on the NAV page 1/4, then select "BACK" followed by "ENTER", to place the GPS into manual for holding.

GPS Holding is relatively simple for several reasons. The CDI can be used to fly outbound of the HP as well as flying inbound to the HP. Once outbound of the HP, spin in the outbound course and center the CDI. When turning inbound to the HP, again spin in the inbound course and center the CDI as you fly to the HP. In manual, the along track distance (ATD) will count

up when outbound from the fix then prior to reaching the required outbound distance the CDI will change deflection to the inbound in a turn to the inbound course will be required. ATD will then count down to the HP. Keep the CDI centered. The needle will remain steady on and point to the HP while holding in manual.

If executing a **procedure turn** on a GPS approach, load the approach as previously described and ensure the approach is armed. Once cleared, fly direct to the IAF defined for the procedure turn. The GPS shall remain in “auto” because the GPS will build in one turn for the procedure turn at the IAF then fly back to the IAF inbound for the remainder of the approach.

Fly the remainder of the FAC as previously described above. Remember it is important to have the PM verify that the GPS will cycle to the next appropriate waypoint on the approach as you are flying the approach. Also, be aware that the CDI will become “more sensitive” once the aircraft is flown within 2 NM of the FAF. Have the PM confirm that approach mode is active once you see the “APPR” light illuminate on the instrument panel.

Executing **radar vectors to a GPS Final Approach Course (FAC)** is very much like receiving vectors to final on any other approach. As mentioned prior in this section, it comes down to properly setting the GPS to ensure a successful approach. Select and load the approach as previously described. Ensure the approach is armed. Once receiving vectors, you will want to have the GPS provide navigation to the FAF. Have the PM use the “direct” function to the FAF. The magenta needle will point to the FAF and the CDI will provide course guidance, and the DME will give along track distance (ATD). Having the FAF navigational guidance provides the crew with situational awareness during radar vectors.

Next, proper use of the “HDG” page ensures the CDI will properly display course guidance during vectors to the FAC. Once on base or dog leg, press the “HDG” button. The current aircraft heading will be highlighted. You can change that number to reflect the assigned heading (if still in the turn) or leave it and press “ENTER”. “Heading Select” will then be highlighted. Change this to “Intercept” by pressing “BACK”. Then press “ENTER”. Next, the FAF must be entered. Ensure that the name of the FAF is highlighted. If not, press the “BACK” button until it can be selected. Additionally, the DTK is highlighted in order to be referenced or changed if needed. If the DTK does not match the FAC, then change the course by typing in the inbound course and press “ENTER”. After confirming that the heading vector will provide guidance to the FAF, press “ENTER” one more time and now an intercept will be planned into the GPS to provide FAC guidance to the FAF. Fly the remainder of the approach as previously stated in this section, ensuring the FMS properly sequences.

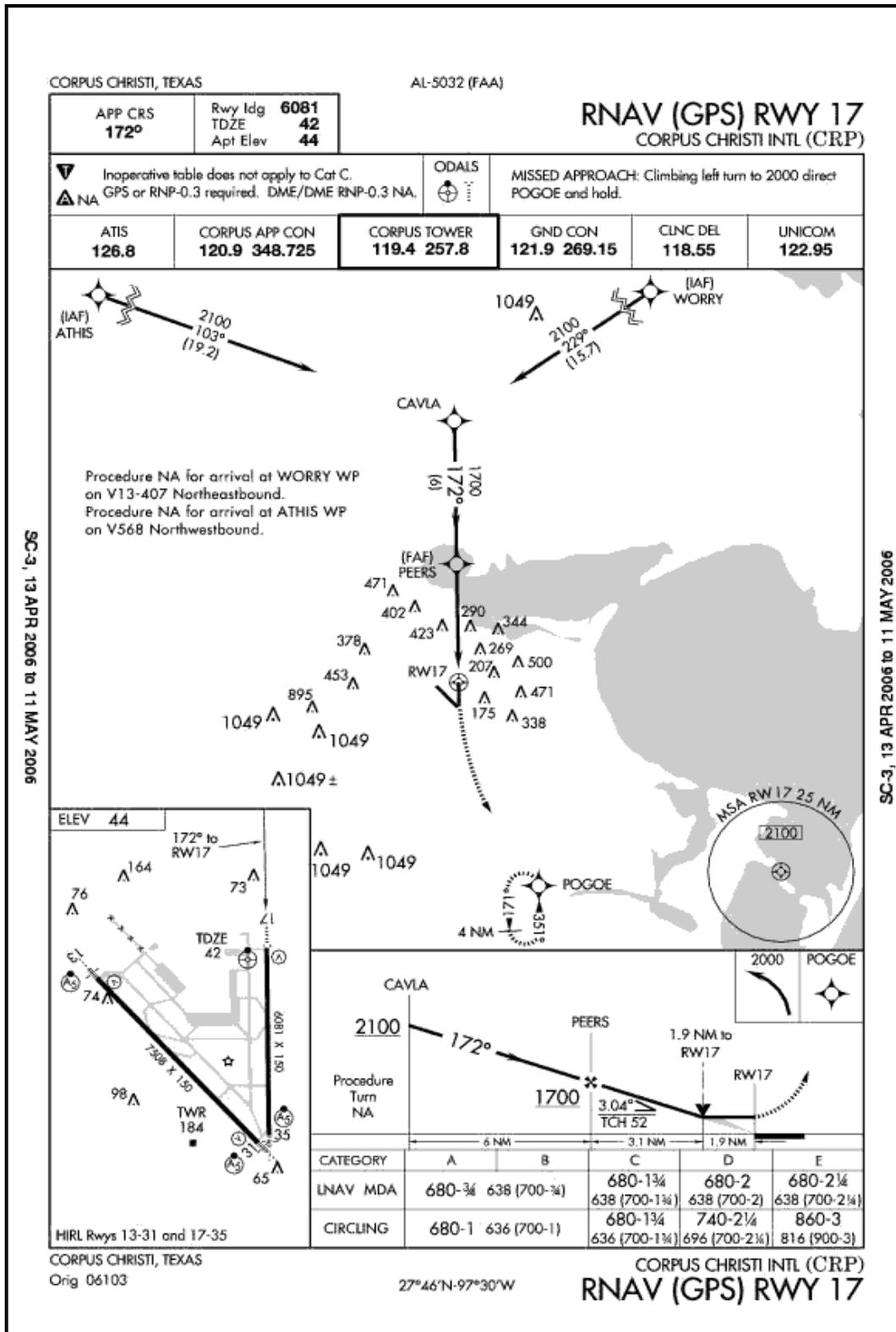


Figure 4-34 GPS “Stand-Alone” Approach

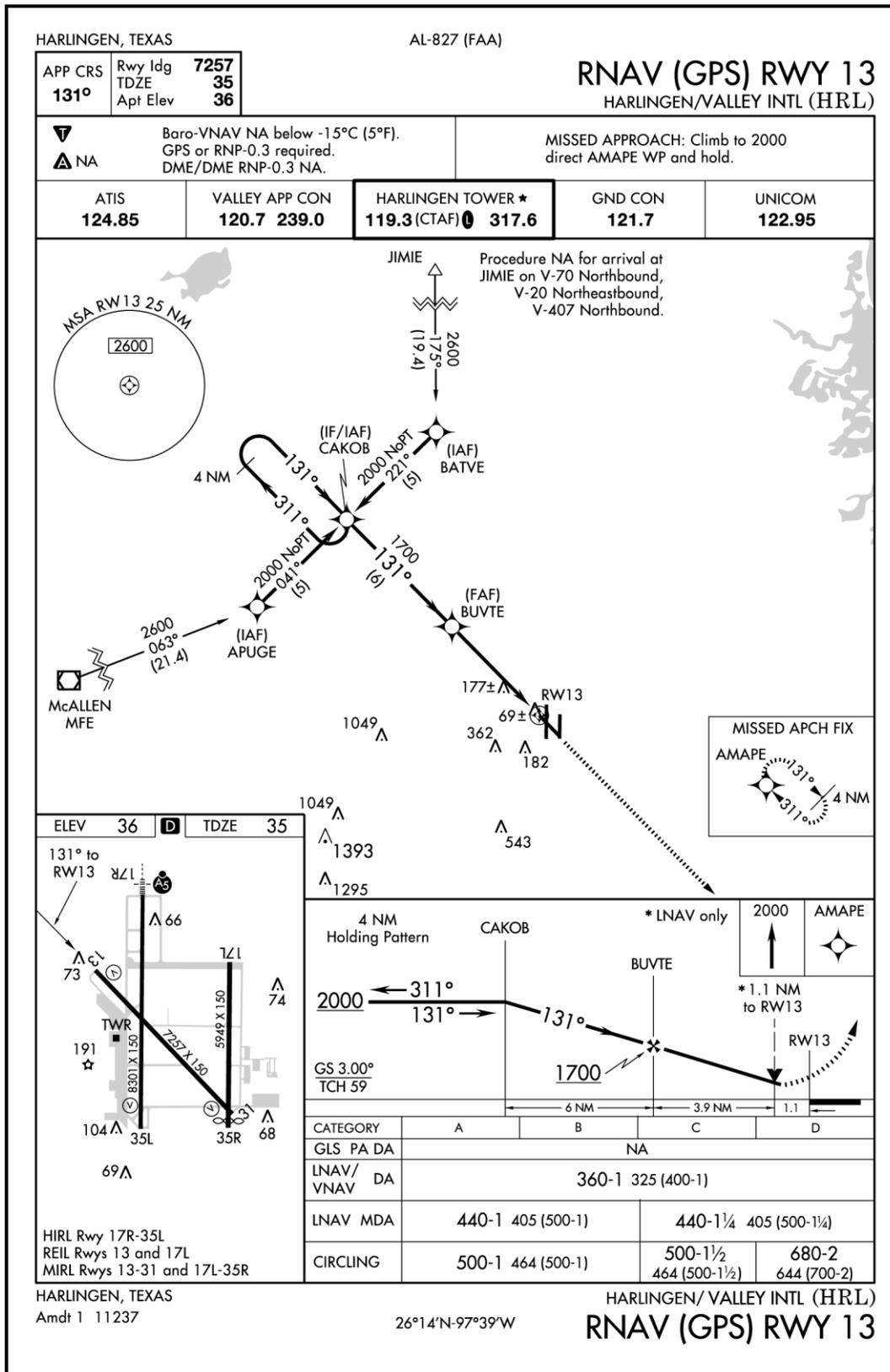


Figure 4-35 GPS “T” Approach

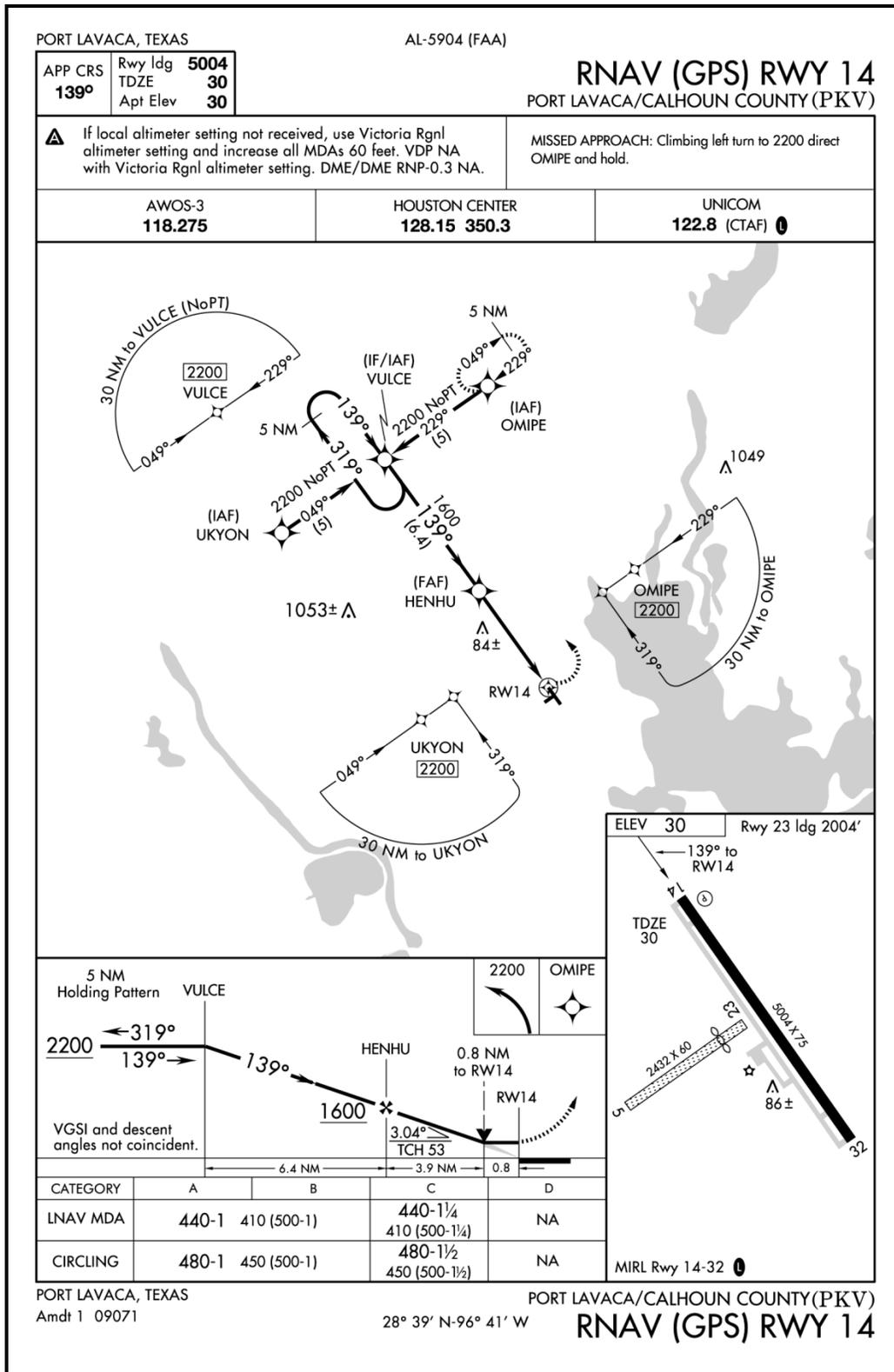


Figure 4-36 GPS “TAA” Approach

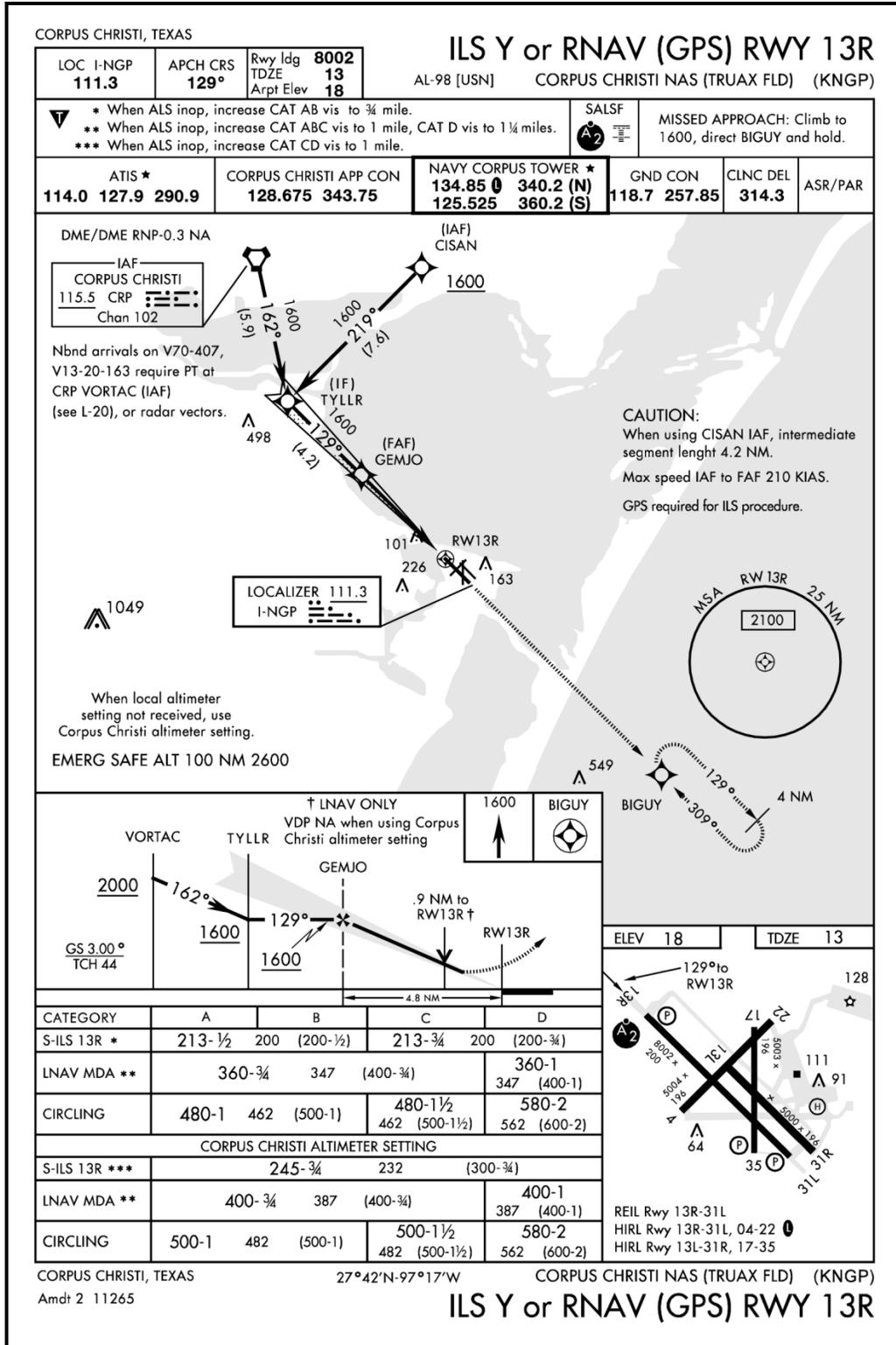


Figure 4-37 GPS “Overlay” Approach

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CHAPTER FIVE FORMATION STAGE

500. INTRODUCTION

The Formation Stage is very brief in comparison to the 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.

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 four aircraft or two sections.

2. **Prohibited Maneuvers/Flight Conditions**

- a. Intentional Form Flight in IMC.
- b. Night Formation Flight.
- c. Division Formation Flight. TC-12B formation training will be conducted in section formation only.
- d. Fan Breaks. Breaks wherein both aircraft execute break turns at the same time.
- e. Section Takeoffs and Section Landings.

3. **Formation Brief.** The formation brief shall be conducted by the flight leader and attended by all members of the flight. A good brief is the key to formation flying. 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 (i.e., 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 his aircraft is flown precisely, giving his wingman a stable platform to follow.

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 performed 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 not previously briefed use the following sequence:

When directed to another frequency, lead PF directs wing on internal frequency “*Stingray 316 and flight, switch button ____.*”

- c. **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 Characteristics of the TC-12B.** The TC-12B does not have a 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 horizontal stabilizer extends approximately 6 feet 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 “playmate’s” aircraft on the flight line. This may enable observation of difficulties before/during engine starts.

During the Before Start Checklist, navigation lights will be turned on to identify the aircraft as a part of a formation flight, VHF 1 will be tuned to the primary and secondary internal communication frequencies, and the lead aircraft’s squawk will be placed in the transponder.

The flight leader will initiate flight check-in on “formation common.” When wing reports “ready to taxi”, lead will call for taxi: “*Stingray 317, flight of two, Wingman 311, across from hanger 55, taxi with information Tango.*”

If IMC is expected during transit to working area, aircraft shall coordinate IFR clearances individually, depart individually, and rendezvous in VMC. Lead will obtain a block assignment and pass assignment and squawk to wing.

In the runup area, leave sufficient room for wing to position his aircraft.

When the takeoff brief has been completed, wing will report “*Two is ready for taxi.*”

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 flight leader will 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 flight leader’s transponder malfunctions. The flight leader, when flying wing, must remember to “ident” when requested by ATC.

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 the 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 170 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 2000 ft-lbs. in climbs and when accelerating, and no less than 500 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 (i.e., continue turn/climb, breaking off right/left).

Lead: "Stingray Flight, new airspeed 200 knots."

Wing: "Two" or "Standby."

Lead: "Stingray Flight, 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 windscreen adjacent to lead's horizontal stabilizer and report "Two is in". Set power, perform nacelle and instrument checks, and check the other aircraft for loose panels, leaks etc. With takeoff clearance, lead begins a normal takeoff roll. Wing begins a takeoff roll 5 seconds after the lead. Wing calls "Two is airborne" when the gear is retracted.

5. **Running Rendezvous.** Lead will climb out on course rules, accelerating to 150 KIAS. Wing will accelerate to lead's airspeed plus 30 KIAS to control rate of closure. If lead has commenced turnout, use radius of turn to expedite rendezvous. Wing will position in starboard parade as soon as practical. This is a demanding maneuver due to the apparent lack of perceived relative motion in the initial stage. When relative motion first appears, reduce power to control

closure rate. If closure rate cannot be controlled with power at idle, execute an underrun. When joined, report, *“Two is aboard starboard.”* During course rules departures and transit, maintain flight integrity

6. **Under-Run.** If wing fails to recognize or control a rapid closure rate, execute under-run 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 *“Two is Under-Running.”*
- f. When relative motion is under control, join in the assigned position.

7. Checkpoints

Normal parade position is on the lead’s 45° bearing line. The following checkpoints are applicable from both sides of lead.

Bearing line is maintained by aligning the ventral fin (mud rudder) over the wingtip of the outboard wing.

Maintain step-down, keeping the entire inboard nacelle exhaust stack tangent to lead’s inboard wing.

Relative closeness is subjective, but a guide is close enough to the lead aircraft to make out the bureau number on the mud rudder.

For “turns into,” the sight picture remains the same because wing turns on lead’s axis. For “turns away,” wing turns on his/her own axis, maintaining altitude. The bearing line sight picture remains the same. Step-down is now maintained by keeping the bottom of the outboard nacelle on the horizon. In addition, lead’s outboard exhaust stack will become visible. This checkpoint ensures safe step-down clearance in the event there is no clearly defined horizon line.

Identify the “double step-down” position, which will be used for crossunders, lead changes, and rendezvous by keeping half of lead’s outboard nacelle exhaust stack tangent to lead’s outboard wing. The bearing line checkpoint remains the same.

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 5-1 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 the wing in position.
- b. Clear the area.
- c. Transmit the turn signal, *“Stingray Flight, left/right 180 with a rollout.”* When wing responds, smoothly roll into the turn. Maintain altitude, AOB, and a constant power setting. Roll out of turns using *“Stingray Flight, roll-out”* or *“Stingray Flight, reversal”* and the same rate of roll.



Figure 5-2 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 the 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 further 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 “*Stingray Flight, cleared to cross under.*”

Wing will stabilize in the parade position before commencing the crossunder. Begin by moving into the “double step-down” position. Execute a slight wing flash 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” and then climb into the parade position. Report “*Two is established port/starboard parade.*”

11. **Free Cruise.** The cruise position is designed to reduce workload and save fuel when flying formation for extended periods. Wing maintains the lead between the 11 o’clock and 1 o’clock position and 500-1000 feet nose-to-tail distance. Wing maintains a constant power setting of 1300 ft-lbs. and maintains position by using radius of turn advantage.

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 “*Stingray Flight,*

cleared to free cruise,” and sets 1300 ft-lbs. Wing falls into trail 500-1000 feet behind lead and places lead approximately on or below the horizon. When in position, wing reports *“Two is in position.”* Both aircraft will maintain a constant power setting of 1300 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 50° AOB or 30° nose up/down. Lead shall not exceed 220 KIAS or get slower than 140 KIAS. Wing will remain within NATOPS airspeed limits. Any unsafe condition will be identified 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 reform, lead transmits *“Slowing to 170 KIAS, 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 airspeed and radius of turn. The limited visibility from the TC-12B cockpit requires we move in on the 45° bearing from a significant step down position. Thus, we end up climbing while joining, requiring power to maintain airspeed.

- a. **Lead.** When level at 170 KIAS, check the wing in the starboard parade position and clear the area. Transmit *“Stingray Flight, breakup and rendezvous.”* When wing responds, sharply roll to left 30° AOB. Maintain altitude, airspeed, and 30° AOB until wing calls “column”. Upon receipt of wing’s “column” report, roll the aircraft sharply to 45° left AOB initially (flash), and then decrease to 20° AOB. Maintain 20° AOB, airspeed, and altitude until wing reports in position. The maneuver is considered complete when wing reports *“Two is aboard starboard.”*
- b. **Wing.** As the lead approaches the 10 o’clock position, break left at 30-45° AOB while descending 200 feet. Adjust power to maintain 170 KIAS throughout the turn. Maintain visual contact with the lead aircraft. Vary AOB as necessary to establish a 500-1000 foot interval. Staying outside lead’s radius of turn easily does this. 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 until you are inside lead's radius of turn. Adjust AOB as necessary to move onto the 45° bearing line. Getting on the bearing and staying there may require significant AOB corrections. If the outboard half of lead's wing becomes visible aft of the lead's vertical stabilizer, you are too far behind the bearing or sucked. Correct this by increasing AOB. If lead's outboard wing becomes completely hidden behind the lead's 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 170 KIAS.

- c. **Join-Up.** The join-up phase of the rendezvous begins when the distance between aircraft is approximately 50-100 feet. Adjust position to stabilize briefly at the "double step-down" then accomplish a crossunder utilizing power into the starboard parade position outside of lead's radius of turn. This will require a significant power increase since you will be moving outside of lead's turn radius and climbing approximately 40 feet at the same time. Report "Aboard" when stable in the starboard parade position.



Figure 5-3 Rendezvous Join-Up

13. **On-Top (TACAN) Rendezvous.** An on-top or TACAN rendezvous is a visual maneuver employed to rendezvous a flight above the weather after takeoff or during the mission if the flight is separated. The rendezvous is normally executed in a holding pattern off of a TACAN fix (radial/DME) at a specified airspeed, altitude, and direction. Lead will announce his position to the wingman. The wingman will approach lead's position 1000 feet below lead. Upon visually acquiring lead, the wingman will call "Visual" and request to join the formation. Upon receiving clearance to join, wing shall utilize the rendezvous procedures as detailed in the Breakup and Rendezvous section.

14. **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, he/she shall signal wing with *“Stingray Flight, cleared for lead change.”* Wing shall respond *“Two.”*

If maneuvering from starboard parade, execute a crossunder but do not stabilize in opposite parade. Continue moving out to a lateral wingtip-to-wingtip separation of approximately 100 feet while moving forward of lead’s wingtip, and to a slight step-up position. 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 at lead’s 10 o’clock position, wing reports *“Stingray 3XX in position for the lead.”* Lead shall then transmit *“Stingray 3XX you have the lead.”* The new lead reports *“Stingray 3XX has the lead, you are cleared to join starboard parade.”* 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 using the running rendezvous procedures. The new lead shall maintain straight-and-level flight until the new wing reports *“Two is aboard starboard.”*

15. **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.

In the case of an IMC recovery, it will be necessary to separate the formation to recover. If the decision is made to recover individually, lead will contact ATC and request IFR clearances for both aircraft and be directive with wing on the internal frequency on how to dissolve the flight.

If weather permits a VMC recovery, proceed via course rules. 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 under-run the lead during the initial stages of the descent.

16. **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 200 KIAS on extended runway centerline. When cleared to break, lead will check wing in proper position, rapidly roll into a 45° 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 (140 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 Corpus Tower, Stingray 3XX and flight, left 180, both aircraft three down and locked, full stop/touch and go.*” Reduced runway separation is approved for formation touch and go and full-stop landings.

Both aircraft land on centerline; wing will be 15-20 seconds in trail. If performing more than one landing, the ideal separation is for wing to touch down just as the lead is rotating. Lead shall touch down as close to the numbers as is safely feasible to preclude wing flying through lead’s vortices on short final.

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 TC-12B 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.** 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 “*Dash 2 Lost Sight*” 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, using wing’s clock 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 or lead transmit “*IMC breakup*” on internal communications. Lead climbs 500 feet and wing descends 500 feet while simultaneously turning away from lead’s base heading for 45 degrees of heading change for 1 minute. Lead will then be directive with base heading, altitude, and airspeed.

Lead, transmits “*IMC breakup, base altitude _____, base heading _____, base airspeed _____.*” Base altitude is the altitude lead climbs up to and base heading is the new heading that the aircraft are turning to. Base altitude will be ESA + 500 feet or above.

Wing reports level heading and altitude (should be 500 feet less than base altitude and on base heading).

If VMC is quickly regained, lead will coordinate a rendezvous. If VMC is not quickly regained, lead will coordinate with ATC for IFR handling.

- 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 assume a position abeam lead and rapidly rock wings and flash his/her rotating beacon/navigation lights. Lead will rock wings and flash rotating beacon/navigation lights to acknowledge. Upon lead’s acknowledgement wing will resume the starboard parade position. Lead will inform ATC of NORDO wingman 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 full stop landing. Wing will perform a full-stop landing. Any waveoff executed by lead should be followed by wing.

NOTE

The NORDO aircraft still maintains responsibility for confirming status of ALDIS lamp signals and/or wave off lights.

- e. **Lead – Lost Communications.** Lead will rock wings rapidly and flash rotating beacon/navigation lights. This will catch the wing’s attention, signal lost communications, and clears the wing to maneuver for a lead change. Wing acknowledges by pulling into a position abeam lead and rapidly rock wings and flash rotating beacon/navigation lights to acknowledge the lost communications condition and signify they have assumed the lead. The lost communications aircraft will drop back into starboard parade as wing. The aircraft with the good radios will then lead the formation home already specified in the wing lost communication procedures.
- 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. The aircraft with the engine failure will assume the lead. 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.
- h. **Aborted Takeoff.** If the lead aircraft aborts a takeoff, the entire flight shall abort. Lead PF must immediately notify wing on internal frequency and PM must notify Tower on tower frequency by making a “Stingray 3XX flight aborting” call. Lead

attempts to remain 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 must allow lead to become safely airborne before notifying the Tower and lead. Lead shall continue his takeoff and return to land at his 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.

NAVY SNA FORMATION BRIEF VT-35 / TC-12B	
<p>LEAD: _____ DASH 2: _____</p> <ol style="list-style-type: none"> WEATHER GROUND PROCEDURES <ul style="list-style-type: none"> LEAD COORDINATES CLEARANCE AND TAXI RADIO PROCEDURES AND FREQUENCIES <ul style="list-style-type: none"> FLIGHT: <ul style="list-style-type: none"> PRIMARY: 149.95 SECONDARY: 140.52 ABORTED TAKEOFF <ul style="list-style-type: none"> LEAD / WING RESPONSIBILITIES TAKEOFF AND CLIMBOUT PROCEDURES <ul style="list-style-type: none"> CLIMBS NOT MORE THAN 2000 FT-LBS / 170 KTS INITIAL RENDEZVOUS <ul style="list-style-type: none"> RUNNING: LEAD 150 KTS / WING 30 KTS CLOSURE TACAN: RADIAL / DME AS ASSIGNED BY LEAD FLIGHT PATH / OPERATING AREA SEQUENCE OF EVENTS <ul style="list-style-type: none"> STARBOARD PARADE <ul style="list-style-type: none"> LUBE THE LINE TURNS INTO / TURNS AWAY GROSSUNDER <ul style="list-style-type: none"> PORT PARADE TURNS INTO / TURNS AWAY GROSSUNDER <ul style="list-style-type: none"> BREAKUP AND RENDEZVOUS LEAD CHANGE REPEAT FOR NEW LEAD / WING FREE CRUISE (NAVY ONLY) RUNNING RENDEZVOUS RTB PROCEDURES <ul style="list-style-type: none"> WING PASSES ATIS TO LEAD DESCENTS >= 500 FT-LBS OVERHEAD SAFETY PROCEDURES <ul style="list-style-type: none"> UNDERRUN PROCEDURES <ul style="list-style-type: none"> KNOCK IT OFF EMERGENCIES <ul style="list-style-type: none"> LOST COMM MIDAIR AIRCRAFT MALFUNCTIONS 	<p style="text-align: center;">FREE CRUISE</p> <p>1300#S Q LEAD 45 DEG AOB A/S 140 – 220 +/- 20 DEG PITCH</p> <p style="text-align: center;">WING IS LIMITED TO NATOPS UTILIZES LEAD/ PURE/ LAG PURSUIT TO MAINTAIN INTERVAL</p> <p>TANKER GIVES ALTITUDE, ALTIMETER AND ARCT</p> <p>TANKER CAN/SHOULD GIVE "DOWNWIND" AND "IN THE TURN" CALLS</p> <p style="text-align: center;"> TANKER 210 KTS; 3.5 NM/MIN BOTH 170 KTS AR SPEED RECEIVER 150 KTS; 2.5 NM/MIN </p> <p style="text-align: center;"> ARCP (TANKER) 9 MILES ARIP (RECEIVER) -6 MINS (TANKER) 2.5 TO 3 MILES -3 MINS (RECEIVER) -5 MINS (TANKER) -3 MINS (TANKER) </p> <p>RECEIVER: "TANKER INSIGHT, YOU HAVE THE LEAD"; " (POSITION), REQUEST TO JOIN "</p> <p>TANKER: "CLEARED TO JOIN"</p> <p>RECEIVER: "REQUEST ASTERN"</p> <p>TANKER: "CLEARED ASTERN"</p> <p>RECEIVER: "STABLE ASTERN"</p> <p>TANKER: "CLEARED TO CONTACT"</p> <p>RECEIVER: "OFFLOAD COMPLETE"</p> <p>TANKER: "CLEARED DISCONNECT AND GO REFORM"</p>
<p>JOIN: 200' BELOW</p> <p>ASTERN: LOWER ¼ EXH STKS T-TAIL AT TOP OF WINDSCREEN</p> <p>CONTACT: LOWER ¼ EXH STKS BEACON AT TOP OF WINDSCREEN</p> <p>REFORM: 200' BELOW 200' BEHIND</p>	<p>JOIN: 200' BELOW</p> <p>ASTERN: LOWER ¼ EXH STKS T-TAIL AT TOP OF WINDSCREEN</p> <p>CONTACT: LOWER ¼ EXH STKS BEACON AT TOP OF WINDSCREEN</p> <p>REFORM: 200' BELOW 200' BEHIND</p>

Figure 5-4 Navy SNA Form Kneeboard Card

MARINE SNA FORMATION BRIEF

VT-35 / TC-12B

LEAD: _____ DASH 2: _____

1. WEATHER
2. GROUND PROCEDURES
 - LEAD COORDINATES CLEARANCE AND TAXI
3. RADIO PROCEDURES AND FREQUENCIES
 - FLIGHT:
 - PRIMARY: 149.95
 - SECONDARY: 140.52
4. ABORTED TAKEOFF
 - LEAD / WING RESPONSIBILITIES
5. TAKEOFF AND CLIMBOUT PROCEDURES
 - CLIMBS NOT MORE THAN 2000 FT-LBS / 170 KTS
6. INITIAL RENDEZVOUS
 - RUNNING: LEAD 150 KTS / WING 90 KTS CLOSURE
 - TACANI: RADIAL / DIME AS ASSIGNED BY LEAD
7. FLIGHT PATH / OPERATING AREA
8. SEQUENCE OF EVENTS
 - STARBOARD PARADE
 - LUBE THE LINE
 - TURNS INTO / TURNS AWAY
 - CROSSUNDER
 - TURNS INTO / TURNS AWAY
 - PORT PARADE
 - TURNS INTO / TURNS AWAY
 - CROSSUNDER
 - BREAKUP AND RENDEZVOUS
 - LEAD CHANGE
 - REPEAT FOR NEW LEAD / WING
 - RUNNING RENDEZVOUS
 - TAC FORM AND AERIAL REFUELING
9. RTB PROCEDURES
 - WING PASSES ATIS TO LEAD
 - DESCENTS >= 500 FT-LBS
 - OVERHEAD
10. SAFETY PROCEDURES
 - UNDERRUN PROCEDURES
 - KNOCK IT OFF
11. EMERGENCIES
 - LOST COMM
 - MIDAIR
 - AIRCRAFT MALFUNCTIONS
 - INADVERTENT IMC
 - LOST SIGHT / BLIND

The diagram illustrates various tactical formation maneuvers. It shows a central horizontal line representing the formation axis. Above and below this axis, curved arrows indicate specific maneuvers: 'TACTURN L/R' (top left), 'CALLS OR 7 O'CLOCK' (top right), 'IN PLACE L/R' (middle left), 'WING OUTSIDE (HIGH)' (middle right), 'CROSS COVER' (top center), 'BREAK L/R' (top left), '45° AOB' (top left), '45° AOB' (middle right), 'PINCH' (top left), 'DIG' (top right), '30° AOB' (top right), '30° TURN RESUME' (top right), and '45° AOB' (bottom right). A dashed line indicates a 9-mile distance between two points, with time markers: '-6 MINS (TANKER)' and '-3 MINS (TANKER)' on the left, and '-3 MINS (RECEIVER)' on the right. Labels 'ARCP' and 'ARIP' are also present.

TANKER 210 KTS; 3.5 NM/MIN
RECEIVER 150 KTS; 2.5 NM/MIN

BOTH 170 KTS AIR SPEED

9 MILES

2.5 TO 3 MILES

ARCP

ARIP

-6 MINS (TANKER)

-3 MINS (TANKER)

-3 MINS (RECEIVER)

TANKER GIVES ALTITUDE, ALTIMETER AND ARCT
TANKER CAN/SHOULD GIVE "DOWNWIND" AND "IN THE TURN" CALLS
RECEIVER: "TANKER INSIGHT, YOU HAVE THE LEAD"
TANKER: "REQUEST TO JOIN (LOW AND LEFT)"
RECEIVER: "CLEARED TO JOIN"
TANKER: "REQUEST ASTERN LEFT / RIGHT"
RECEIVER: "CLEARED ASTERN LEFT / RIGHT"
TANKER: "STABLE ASTERN LEFT / RIGHT"
TANKER: "CLEARED TO CONTACT"
RECEIVER: "OFFLOAD COMPLETE"
TANKER: "CLEARED DISCONNECT AND GO REFORM"

JOIN:	45° BEARING
	200' BELOW
ASTERN:	200' BEHIND
	50' BELOW
CONTACT:	1 MIN IN POSITION
	50' AFT
REFORM:	45° BEARING
	200' BELOW
	200' BEHIND

Figure 5-5 Marine SNA Form Kneeboard Card
See CNATRA P-557 for Tactical Formation Procedures.

FORMATION BRIEF ALPHA
VT-35/TC-12B

LEAD: _____**DASH 2:** _____

1. Weather
2. Ground Procedures
 - Lead coordinates clearance and taxi
3. Radio Procedures and Frequencies
 - Flight Primary: 149.95 Secondary: 140.52
 - External as assigned by ATC
4. Aborted Takeoff
 - Lead/Wing Responsibilities
5. Takeoff and Climbout Procedures
 - Climbs not more than 2000 ft-lbs (150 KTS)
6. Initial Rendezvous
 - Running: Lead 150 knots/ Wing 30 knots closure
 - TACAN: Radial/DME as assigned by Lead
7. Flight Path/Operating Area
8. Sequence of Events
 - Starboard Parade
 - Lube the Line
 - Turns away/Turns into
 - Crossunder
 - Port Parade
 - Turns away/Turns into
 - Crossunder
 - Free Cruise (Navy students only)
 - Running Rendezvous (Navy students only)
 - Breakup and Rendezvous
 - Lead Change
 - Repeat for new lead/wing
 - Tanker and Tac Turns (Marine students only)
9. RTB Procedures
 - Lead passes ATIS to wing
 - Descents no less than 500 ft-lbs.
 - Transits at 200 KTS
 - Overhead

- 10. Safety Procedures
 - Underrun Procedures
 - Knock It Off

- 11. Emergencies
 - Lost Comm
 - Midair
 - Aircraft malfunctions
 - Inadvertent IMC
 - Lost sight

CHAPTER SIX OVER-WATER NAVIGATION STAGE

600. 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 TC-12B'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. 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.

601. PREFLIGHT PLANNING

Careful preflight planning, as with all other phases of flight, is essential for a safe, productive over-water 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 Horizontal Weather Depiction (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, single-engine range along with other possible malfunctions. While on-station, minimum fuel consumption is a priority. Expect fuel flow to average near 650 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.

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 6-1 Flight Plan

3. **Composite Flight Plan.** A composite flight plan (Figure 6-1) 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.

Contact the other multiengine squadron the night prior for possible airspace conflicts. Prepare a composite flight plan 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.

602. 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.

6-2 OVER-WATER NAVIGATION STAGE

603. 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, LPU’s are required. During rigging, my scan will be outside, yours should be inside. Call me slow at 140 KIAS, call out my altitude every 100 ft, and ‘Rate of descent’ 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 (i.e., 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 6-2:

- a. Port Bow
- b. Port Beam
- c. Port Quarter
- d. Stern
- e. Starboard Quarter
- f. Starboard Beam
- g. Starboard Bow
- h. Overhead

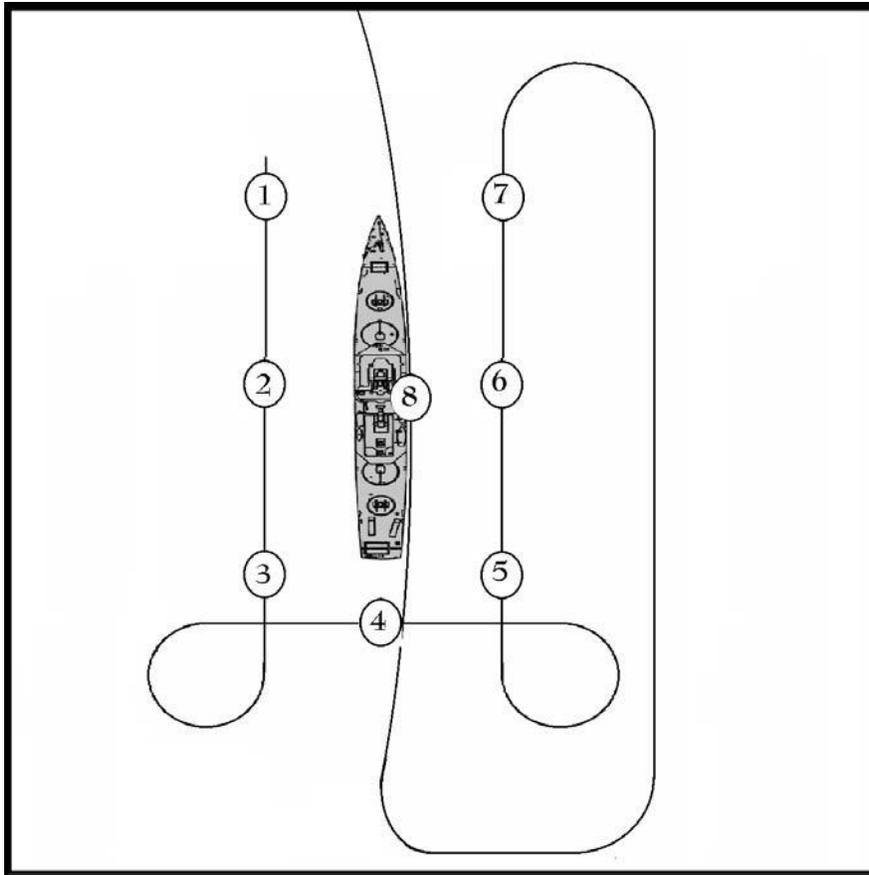


Figure 6-2 Eight-Point Rig

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 ship's 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 degrees left AOB arcing over the top of the ship.

7. **Quick Rig and Banana Rig.** The quick rig (Figure 6-3) and the banana rig (Figure 6-4) 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.

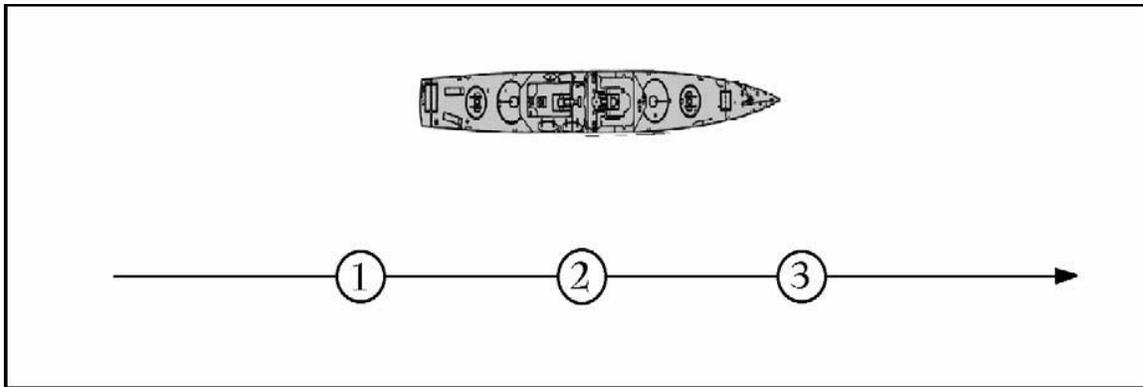


Figure 6-3 Quick Rig

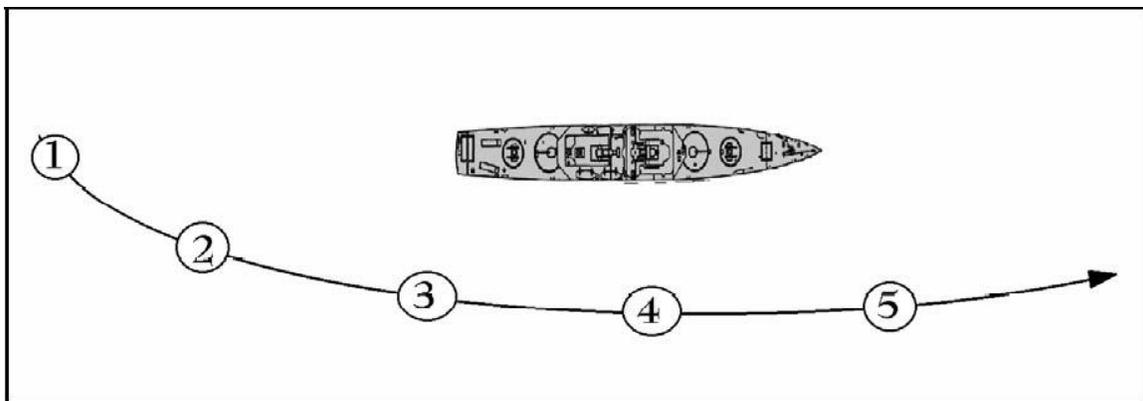


Figure 6-4 Banana Rig

8. **Airspace.** You normally will encounter two types of airspace during over-water 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 OPNAVINST 3710.7 series, 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.

604. 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.

605. 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 (Confess, Climb, Communicate, Conserve, and Comply). If over-water, turn west until intercepting the coast. 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.** OPNAVINST 3710.7 series lists the requirements for survival equipment. Anti-exposure suits are required if air temperature drops below 32° F

and/or water temperature is below 50° F (60° F at CO's discretion). For a water temperature of 60° F, survival time is two hours or more. LPAs are unusable in the TC-12B due to their bulk, which would restrict movement in the cockpit. LPU-32B life preservers have been procured by the wing and will be available in the SAFETY/NATOPS office. 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 OPNAVINST 3710.7 series Chapter 8.

**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.

TC-12B VFR flights use Stingray and IFR flights use Navy 5 Golf.

Contact Flights

1. Obtain ATIS, then call for taxi:

“Navy Corpus Ground, Stingray 312, 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, Stingray 312, request blocks available.” or

“Seagull, Stingray 312, 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, Stingray 312, request blocks available.” or

“Seagull, Stingray 312, request three blocks available.”

“Navy Corpus Clearance Delivery, Navy 5 Golf 312, Quick Two on request.”

“Navy Corpus Ground, Navy 5 Golf 312, taxi from (state location), with information Delta.”

Once you complete checking “RADIOS/NAVAIDS” on the Takeoff Checklist, copy your clearance:

“Navy Corpus Clearance Delivery, Navy 5 Golf 312, ready to copy.”

NOTE

Read back clearance and set NAVAIDS for departure.

2. Upon reaching “CREW” on the Takeoff Checklist, brief the takeoff IAW the normal briefings of this Appendix.
3. When reaching “Anti-ice/Deice” on the Takeoff Checklist, hold the checklist and call for further taxi:

“Navy Corpus Ground, Stingray 312, further taxi.”

4. Approaching the hold short, request takeoff clearance:

“Navy Corpus Tower, Stingray 312, 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:

“Stingray 312, hold short.”

- b. If instructed to line up and wait:

“Stingray 312, line up and wait.”

- c. If cleared for takeoff:

“Stingray 312, 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:

“Stingray 312, cross 13L, line up and wait 13R.”

5. Initial contact with Departure:

“Corpus Departure, Stingray 312, off Navy Corpus, passing 800 for 2500, course rules to Seagull/Delta/etc.”

For Departure to Seagull:

- a. Approaching the CRP 130 at 26 enroute to Seagull:

“Corpus Departure, Stingray 312, terminate.”

- b. Initial contact with Seagull:

“Seagull, Stingray 312, on the 130 climb radial, passing three thousand for block 3 central.”

- c. Once established in block:

“Seagull, Stingray 312, established block two central.”

Leaving Seagull:

“Seagull, Stingray 312, approaching the 156/100 descent radial at ___ DME, vacating block_____, leaving _____ft terminate.”

6. Initial contact with Approach for recovery:

“Corpus Approach, Stingray 312.”

NOTE

Wait for Approach Control to answer you, then go ahead with your request.

“Corpus Approach, Stingray 312, _____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, Stingray 312, terminate.”

“Corpus Approach, Stingray 312, Harlingen in sight, terminate.”

9. Initial contact with Tower:

“Navy Corpus Tower, Stingray 312, Point Shamrock, touch and go/full stop.”

“Navy Corpus Tower, Stingray 312, Point Shamrock, Sunrise transition on request.”

“Navy Corpus Tower, Stingray 312, Point Sunrise, touch and go/full stop.”

“Orange Grove Tower, Stingray 3122, five miles south, touch and go.”

“Cabaniss Tower, Stingray 312, Point Sunrise, touch and go.”

10. Report the initial:

“Harlingen Tower, Stingray 312, initial runway 17.”

11. When over the approach end of the duty runway:

“Navy Corpus Tower, Stingray 312, numbers for the break.”

12. When abeam intended point of landing:

“Cabaniss Tower, Stingray 312, left/right 180, three down and locked, touch and go/full stop.”

13. When ready to depart Cabaniss:

“Cabaniss Tower, Stingray 312, Sunrise on request.”

14. If on an extended upwind and feel the Tower has forgotten about you:

“Navy Corpus Tower, Stingray 312, for downwind.”

15. When clear of the duty runway, call for taxi:

“Navy Corpus Ground, Stingray 312, 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”*)

B-4 TYPICAL BRIEFS AND VOICE PROCEDURES

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, Navy 5 Golf 312, IFR to (first destination)."

"Navy Corpus Clearance Delivery, Navy 5 Golf 312, Tango-3 on request, first event, VOR 17 at Corpus International."

"Navy Corpus Clearance Delivery, Navy 5 Golf 312, GCA-1 on request, eight GCA's."

"Navy Corpus Ground, Navy 5 Golf 312, taxi from Echo Line, with information Papa."

When you complete checking "RADIOS/NAVAIDS" on the Takeoff Checklist, copy your clearance:

"Navy Corpus Clearance Delivery, Navy 5 Golf 312, 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 5G311, 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, Navy 5 Golf 312, further taxi."

4. Approaching the hold short, request takeoff clearance:

"Navy Corpus Tower, Navy 5 Golf 312, 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:

“Navy 5 Golf 312, hold short.”

- b. If instructed to line up and wait:

“Navy 5 Golf 312, line up and wait.”

- c. If cleared for takeoff:

“Navy 5 Golf 312, 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:

“Navy 5 Golf 312, cross 13L, line up and wait 13R.”

NOTE

A back taxi is needed for TC-12B aircraft from intersection 4/22 at 13R.

5. Initial contact with Departure:

“Corpus Departure, Navy 5 Golf 312, off Navy Corpus, passing 1000 for 1500.”

NOTE

If canned departure changed after going to Tower frequency or suspect some confusion with approach knowing what departure you are flying, it is a good idea to specify departure name i.e., *“Bay 4.”*

6. Initial contact with Approach:

“_____ approach, Navy 5 Golf 312, 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, Navy 5 Golf 312, clear on Echo, taxi to my line/VT-35 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. **Takeoff duties:** The following are minimum duties the PM will accomplish during a VFR takeoff. There is no need to brief the duties prior to each takeoff. Instead the PF will state:

“Takeoff procedures are standard. Rotate at (V_R).”

The PM will back up the PF on the power quadrant and monitor the engine and flight instruments. The PM will call out any malfunctions. All emergencies will be handled in accordance with NATOPS. The PM will call rotate at V_R and note the time of takeoff.

- 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. **IFR takeoff duties:** The following are minimum duties the PM will accomplish during an IFR takeoff. There is no need to brief the duties prior to each takeoff. Instead the PF will state:

“Takeoff procedures are standard. Rotate at (V_R).”

The PM will back up the PF on the power quadrant and monitor the engine and flight instruments. The PM will call out any malfunctions. All emergencies will be handled in accordance with NATOPS. The PM will call rotate at V_R and note the time of takeoff. During the flight, the PM will handle the communications and record all clearances, headings, altitudes, frequencies, and ATIS information.

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:

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. **No Flap Brief (TC-12B):** After selecting approach flaps, if a rolling condition is encountered or the flaps do not move.

“Flaps selected approach, indicate up, visually checkup. Check yours.”

[IP will respond with simulated flap indications.]

If simulated not split condition and function cannot be restored:

“Open the NATOPS and review the Flap System Failure procedures. It will direct us to pull the wing flap motor circuit breaker and land in the existing flap configuration. This will be a no-flap pattern, new speeds are _____. Any questions?”

If simulated split condition:

Perform the Boldface Procedures IAW NATOPS.

2. **Partial Panel (TC-12B):** In flight, the attitude system fails.

“I’ve lost my attitude system, how is yours?”

[IP responds with simulated attitude failure indications.]

“Check circuit breakers and switch to the opposite inverter.”

[IP will state if this fixed the situation]

“Are we able to proceed VMC?”

[IP will respond “yes” or “no.” If not, continue.]

If it is necessary to use the wet compass for navigation:

“Secure the big four (windshield wipers, windshield heat, air conditioning, and blower motor) are you familiar with wet compass characteristics?”

[IP will respond “yes” or “no.” If not, you must brief the wet compass characteristics.]

“Call out cardinal headings and headings when requested to the nearest five degrees. You have the comms, declare an emergency. Get me [an appropriate instrument

procedure, such as ‘a no-gyro PAR’.]”ring the brief, or you may lose situational awareness.

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.”*

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APPENDIX C
AIRCRAFT HAND SIGNALS

1. Affirmative (all clear)
2. Negative (not clear)
3. Proceed to next marshaller
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 (P)
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 (P)
26. Insert chocks and/or install tiedowns (P)
27. Hot brakes
28. Lights (on/off)
29. I have command
30. Pass control

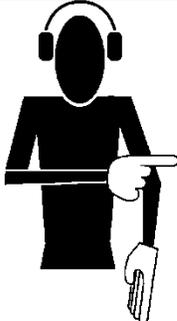
SIGNAL	DAY	NIGHT
<p>①</p> 	<p>Hand raised, thumb up.</p>	<p>Same as day signal with addition of wands.</p>
<p>②</p> 	<p>Arms held out, hand below waist level, thumb turned downwards.</p>	<p>Same as day signal with addition of wands.</p>
<p>③</p> 	<p>Right or left arm down, other arm moved across the body and extended to indicate direction to next marshaller.</p>	<p>Same as day signal with addition of wands.</p>
<p>④</p> 	<p>Arms above head in vertical position with palms facing inward.</p>	<p>Same as day signal with addition of wands.</p>

Figure C-1 Hand Signals

SIGNAL	DAY	NIGHT
<p>⑤</p> 	<p>Arms down with palms towards ground, then moved up and down several times.</p>	<p>Same as day signal with addition of wands.</p>
<p>⑥</p> 	<p>Point right arm downward, left hand is repeatedly moved upward - backward. Speed of arm movement indicates rate of turn.</p>	<p>Same as day signal with addition of wands.</p>
<p>⑦</p> 	<p>Point left arm downward, right hand repeatedly moved upward - backward. Speed of arm movement indicates rate of turn.</p>	<p>Same as day signal with addition of wands.</p>
<p>⑧</p> 	<p>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.</p>	<p>Same as day signal with addition of wands.</p>

Figure C-2 Hand Signals

SIGNAL	DAY	NIGHT
<p>9</p> 	<p>Arms crossed above the head, palms facing forward.</p>	<p>Same as day signal with addition of wands.</p>
<p>10</p> 	<p>"ON" Arms above head, open palms and fingers raised with palms toward aircraft, then fist closed.</p> <p>"OFF" Reverse of above.</p>	<p>"ON" Arms above head, then wands crossed.</p> <p>"OFF" Crossed wands, then uncrossed</p>
<p>11</p> 	<p>Arms by sides, palms facing forward, swept forward and upward repeatedly to shoulder height.</p>	<p>Same as day signal with addition of wands.</p>
<p>12</p> 	<p>Point right arm down and left arm brought from overhead, vertical position to horizontal position repeating left arm movement.</p>	<p>Same as day signal with addition of wands.</p>

Figure C-3 Hand Signals

SIGNAL	DAY	NIGHT
<p>13</p> 	<p>Point left arm down and right arm brought from overhead, vertical position to horizontal forward position, repeating right arm movement.</p>	<p>Same as day signal with addition of wands.</p>
<p>14</p> 	<p>A beckoning motion with right hand at eye level.</p>	
<p>15</p> 	<p>Left hand raised vertically overhead, palm towards aircraft. The other hand indicates to personnel concerned and gestures towards aircraft.</p>	<p>Same as day signal with addition of wands.</p>
<p>16</p> 	<p>Arms down, fists closed, thumbs extending inwards, swing arms from extended position inwards.</p>	<p>Same as day signal with addition of wands.</p>

Figure C-4 Hand Signals

SIGNAL	DAY	NIGHT
<p>(17)</p> 	<p>Arms down, fists closed, thumbs extended outwards, swing arms outwards.</p>	<p>Same as day signal with addition of wands.</p>
<p>(18)</p> 	<p>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.</p>	<p>Same as day signal with addition of wands.</p>
<p>(19)</p> 	<p>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).</p>	<p>Same as day signal with addition of wands.</p>
<p>(20)</p> 	<p>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.</p>	<p>Similar to day signal except that the wand in the left hand will be flashed to indicate the engine to be started.</p>

Figure C-5 Hand Signals

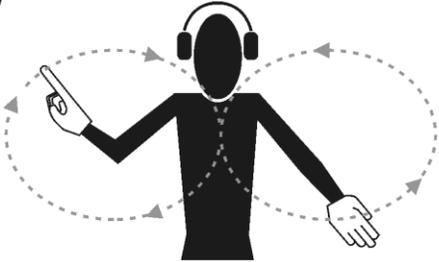
SIGNAL	DAY	NIGHT
<p>(21)</p> 	<p>Either arm and hand level with shoulder, hand moving across the throat, palm down. Hand is moved sideways, arm remaining bent. Other arm pointing to engine.</p>	<p>Same as day signal with addition of wands.</p>
<p>(22)</p> 	<p>Describes a large figure eight with one hand and points to the fire area with the other hand.</p>	<p>Same as day signal with addition of wands.</p>
<p>(23)</p> 	<p>Hands in front, palms together horizontally then opened from the wrist crocodile-mouth fashion.</p>	<p>Same as day signal with addition of wands.</p>
<p>(24)</p> 	<p>Hands in front horizontally, with palms open from the wrists, then suddenly closed.</p>	<p>Same as day signal with addition of wands.</p>

Figure C-6 Hand Signals

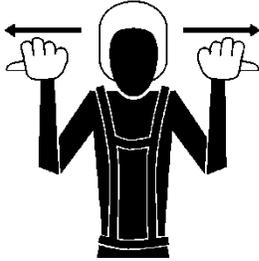
SIGNAL	DAY	NIGHT
<p>(25)</p> 	<p>Swings arms apart, thumbs extended outwards.</p>	<p>Using hand held light or flashlight, gives on/off signals at one second intervals.</p>
<p>(26)</p> 	<p>Swings arms together, thumbs extended inwards. In single piloted aircraft, pilot may swing one arm alternately from each side, thumb extended inwards.</p>	<p>Moves hand held light or flashlight at eye level in a horizontal plane alternately inwards from each side.</p>
<p>(27)</p> 	<p>Makes rapid fanning motion with one hand in front of face and points to wheel with other hand.</p>	<p>Same as day signal with addition of wands.</p>
<p>(28)</p> 	<p>Points to eyes with two fingers to signal "lights on."</p>	<p>Flashing wands.</p>

Figure C-7 Hand Signals

SIGNAL	DAY	NIGHT
<p>(29)</p> 	<p>Hold one hand open, motionless and high above head, with palm forward.</p>	<p>Same as day except with wand.</p>
<p>(30)</p> 	<p>With both arms shoulder height, point in direction of person receiving control.</p>	<p>Same as day except amber wands.</p>

Figure C-8 Hand Signals

Aircraft handling signals are used as a form of communication between aircrewmembers 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 Log											
Time	Indicated		Computed		Total Fuel	Fuel Flow	Est Time To Go Fuel	Dist(NM) To Go	Ground Speed	ETA Enroute	Remarks
	Left	Right	Left	Right							
Preflt (2)	(2)	(2)	(1)	(1)	(1)						
Takeoff (4)	(3)	(3)	(3)	(3)	(3) I (3) C	(5) L (5) R					
Level of f (6a) (12)	(6c)	(6c)	(7)	(7)	(6d) I (6d) C	(6d) L (6d) R	(9) I (9) C	(10)	(6d)	(10)	(6b/8)

Figure D-1 Sample Blank Fuel Log with Legend

Fuel Log											
Time	Indicated		Computed		Total Fuel	Fuel Flow	Est Time To Go Fuel	Dist(NM) To Go	Ground Speed	ETA Enroute	Remarks
	Left	Right	Left	Right							
Preflt 0745	1250	1260	1296	1296	<u>2510</u> I 2592 C						
Takeoff 0800	1220	1210	1266	1266	<u>2430</u> I 2542 C						
Level of f 0830	1050	1080	1116	1116	<u>2130</u> I 2232 C	300 L 300 R	<u>3+41 I</u> 3+56 C	725	210	3+27	25 NM S PSX
0900	950	980	1016	1016	1930 I 2032 C	200 L 200 R	<u>3+11 I</u> 3+26 C	620	210	2+57	75 NM N PSX

Figure D-2 Sample Completed Fuel Log

Fuel logs are required items on cross-country flights. OPARS may be used as an aid to aircrews for fuel management. Most long-range aircraft utilize fuel logs to assess mission endurance and

to cross-check fuel quantity gauges that may be subject to error. The primary purpose of the TC-12B fuel log is to expose the SMA to the procedures and considerations involved in proper fuel planning. Required entries are as follows:

1. During preflight planning – Step 1
2. Before engine start – Step 2
3. Before takeoff – Step 3
4. Midway through the climb – Step 3
5. At the top of the climb – Steps 3-8
6. Every 30 minutes thereafter – Step 9

Indicated fuel quantity and fuel flow is read directly from the gauges. The following example is based on a flight commenced at 0800 with an OAT of 70F/21C, cruising altitude of 20,000 feet, departing at sea level, taxiing at a ramp weight of 12,590 lbs., and no alternate required. Practice is essential to remember when and how a fuel log entry is made.

Step 1. Determine and record computed fuel: 386 gallons at 6.75 lbs./gal equates to 2606 lbs. Subtract 90 lbs. for runup and record under computed fuel (2516 lbs.). Fuel density is determined by the temperature of the fuel at the time of fueling, but is assumed to be the current temperature for the first leg of the flight.

Step 2. Record indicated fuel and time immediately before engine start. (1250 left/1260 right/2510 total and time 0745)

Step 3. Record the following information:

- a. Indicated fuel quantity immediately before takeoff (1190 left/1210 right).
- b. Takeoff time (0800).
- c. Fuel flow midway through the climb (750 lbs./hr. at 10,000 feet, climbing to 20,000 feet).
- d. Indicated fuel quantity at Top Of Climb (TOC) (1130 left/1145 right/2275 total).
- e. Time at TOC (0810).
- f. Note distance remaining to next DME fix (24 NM to X).

Step 4. Determine (CR-2/calculator/NATOPS) and record computed fuel: TOC is 2391 lbs. = 2516 lbs. - 125 lbs. (125 lbs. = 750 lbs./hr. for 10 minutes (0810 TOC - 0800 T/O)) 0840

computed fuel is 2141 lbs. = 2391 lbs. - 250 lbs. (250 lbs. = 500 lbs./hr. fuel flow for 30 minutes).

Step 5. Subtract 655 lbs. (125 lbs. for approach and 530 lbs. for yellow arcs) from both indicated and computed fuel and record under fuel. Also subtract estimated fuel required for holding, extra approaches, and/or alternate (destination IAF to alternate IAF) if required (2275 lbs. - 655 lbs. = 1620 lbs.; 2391 lbs - 625 lbs. = 1736 lbs.). 0840 fuel is 2025 lbs. - 655 lbs. = 1370 lbs. and 2141 lbs. - 655 lbs. = 1486 lbs.

Step 6. Once enroute airspeed (max. range/max. cruise/composite-instructor discretion) is reached, record actual fuel flow and compute estimated time remaining fuel for both indicated and computed (1620 lbs. at 500 lbs./hr. = 3 + 12; 1736 lbs. at 500 lbs./hr. = 3 + 25).

Step 7. Record GS and distance remaining and compute estimated time remaining enroute to your destination IAF (745 miles remaining at 270 knots GS = 2 + 50).

Step 8. Compare estimated time remaining enroute to the lower of the two times (indicated or computed) listed under estimated time remaining fuel.

Step 9. Every 30 minutes after TOC time, record indicated and computed fuel and repeat Steps 5 through 8.

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APPENDIX E ADDITIONAL INSTRUMENT INFORMATION

E100. 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:

$$1^\circ = 1 \text{ NM at } 60 \text{ NM} \quad (60 \text{ NM from the station, there is } 1 \text{ NM between each radial)}$$
$$1^\circ = 100 \text{ FT at } 1 \text{ NM} \quad (1^\circ \text{ climb or descent gradient results in } 100 \text{ FT/NM)}$$

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:

$$\text{NM/MIN} = \text{TAS}/60$$

Examples: 120 KTAS = 2 NM/MIN

$$150 \text{ KTAS} = 2.5 \text{ NM/MIN}$$

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:

$$\text{TAS} = \text{IAS} + (2\% \text{ per } 1,000 \text{ FT}) \times (\text{IAS})$$

Example: 3,000 FT; 150 KIAS

$$\text{TAS} = 150 + (2\% \times 3) (150) = 150 + (.06) (150) = 159 \text{ KTAS}$$

Another easy but less accurate Rule of thumb (best used above 10,000 feet) to determine TAS is:

$$\text{TAS} = \text{IAS} + (\text{FL}/2) \quad \text{or} \quad \text{“Add 5 KIAS per 1,000' to IAS”}$$

Example: FL 200; 175 KIAS

$$\text{TAS} = 175 + (200/2) = 275 \text{ KTAS}$$

If one degree equals 100 ft/NM, then our VSI can be calculated numerous ways:

$$\text{VSI for } 1^\circ \text{ pitch change} = \text{NM/MIN} \times 100 \text{ FT}$$

$$\text{VSI} = (\text{Pitch Angle}) \times (\text{NM/MIN} \times 100)$$

$$\text{VSI} = (\text{Gradient}) \times (\text{NM/MIN}) = (\text{FT/NM}) \times (\text{NM/MIN})$$

Example: For 150 KTAS and a 2° pitch change

$$\text{TAS}/60 = \text{NM/MIN} \quad 150/60 = 2.5 \text{ NM/MIN}$$

$$\text{VSI for } 1^\circ \text{ pitch change} = \text{NM/MIN} \times 100 = 2.5 \times 100 = 250 \text{ FT/MIN}$$

$$\text{VSI for } 2^\circ \text{ pitch change} = 2 \times (\text{NM/MIN} \times 100) = 2 \times (2.5 \times 100) = 500 \text{ FT/MIN}$$

Precision Glide Path. The glide path published for an approach will be the same for every aircraft. Therefore, a pitch change equal to the published glide path can be made on the attitude indicator when intercepting the glide path. Aircraft speed has no effect upon the amount of pitch change required when intercepting the glide path. Speed only affects the time required to fly the final approach segment and your rate of descent (VSI). Prior to intercepting the glide path, 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 glide path, 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:

$$\text{VSI for a } 3^\circ \text{ glideslope} = (\text{GS} \times 10)/2 \text{ or “Half the groundspeed and add a zero”}$$

Example: 130 KIAS; 10 KIAS headwind; GS = 120 KIAS
 $(120 \times 10)/2 = 600 \text{ FT/MIN VSI}$

VSI for a 2½° glideslope = [(GS X 10)/2] – 100

Example: 130 KIAS; 10 KIAS headwind; GS = 120 KIAS

$$[(120 \times 10)/2] - 100 = 500 \text{ FT/MIN VSI}$$

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: $VSI = (\text{Pitch Angle}) \times (\text{NM/MIN} \times 100) = 3.5^\circ \times (3\text{NM/MIN} \times 100) = 1050 \text{ FT/MIN}$

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:

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

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

$\text{VDP} = \text{HAT/Gradient} = 420/300 = 1.4 \text{ NM from end of runway}$

$\text{VDP DME} = \text{DME at end of runway} + \text{VDP distance} = 0.5 \text{ DME} + 1.4 \text{ DME} = 1.9 \text{ DME}$

$\text{Descent Distance} = \text{FAF DME} - \text{VDP DME} = 6.0 \text{ DME} - 1.9 \text{ DME} = 4.1 \text{ DME}$

$\text{Altitude to lose} = \text{FAF altitude} - \text{MDA} = 2500 - 840 = 1,660 \text{ FT}$

$\text{Descent Gradient} = \text{altitude to lose/distance} = 1660/4.1 = 405 \text{ FT/NM (4° descent gradient)}$

$\text{VSI} = \text{Angle (NM/MIN} \times 100) = 4 (2.5 \times 100) = 1,000 \text{ FT/MIN}$

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 ft. 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 ft 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. $144 \text{ seconds (from timing box)}/4.8 \text{ (NM from FAF to MAP)} = 30 \text{ seconds per mile}$
 - ii. $30 \text{ (seconds per mile)} \times 2.7 \text{ NM} = 81 \text{ seconds} = 1 \text{ minute } 21 \text{ seconds}$. Or, using another, easier formula:

Timing to MAP (from timing box) – 10% of HAT = Time (in seconds) to VDP

Same example: $144 \text{ seconds (from timing box)} - 10\% \text{ of } 637 = 144 - 63 = 81 \text{ seconds} = 1 \text{ minute } 21 \text{ seconds}$

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.

$$TR = NM/MIN - 2 \text{ or } TR = (NM/MIN) 2/10$$

Example: 150 KIAS~160 KTAS~2.67 NM/MIN

$$2.67 - 2 = .67 \text{ NM (using first formula)}$$

$$(2.67) 2/10 = .71 \text{ NM (using second formula)}$$

The following formula will provide you the TR for a standard rate turn (SRT):

$$\text{SRT} = 0.5\% \text{ of TAS (or GS)}$$

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:

$$\text{Bank Angle for SRT} = (\text{TAS}/10) + 7$$

Example: 160 KTAS; $(160/10) + 7 = 23^\circ$ of bank

$$\text{Bank Angle for } \frac{1}{2} \text{ SRT} = (\text{TAS}/20) + 7$$

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:

$$\text{Radials per NM} = 60/\text{Arc (DME)}$$

Example: On a 10 DME arc, there are 6 radials per nautical mile.

$$\text{Lead radials} = \text{TR X Radials/NM}$$

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 TC-12B COCKPIT PROCEDURES

F100. INTRODUCTION

The SMA shall initiate all checklists. Utilize the “challenge and reply” method. Do not repeat the challenge, only the reply. For normal checklists, the PM challenges you with each item, and you shall reply with the exact response. When the response is listed “as required,” the crewmember will respond by stating the present operating status of the system as listed. If the particular checklist item specifies PM or Right Seat (RS)/Left Seat (LS), the PM or RS/LS will respond with the challenge, complete the action, then reply. Some checklist items performed by the PM or RS/LS may require your direction.

During emergencies, the “challenge - reply – reply” method is utilized. The PM will read both the challenge and the reply for non-memory actions. After the required action is completed, the pilot will respond with the reply. You are responsible for the proper execution of all checklists. If you desire to delay completion, state “*Hold the checklist.*” The Landing Checklist is never held. When ready to finish the checklist, direct the PM to “*Continue the checklist.*” The PM will report the completion of all checklists.

WARNING

These cockpit procedures are meant to augment *NATOPS Chapter 7* and must be used as a supplement, not a replacement. Many NOTES, WARNINGS, and CAUTIONS found in the NATOPS manual have been omitted in the following discussions. NATOPS is the final authority for checklist procedure.

F101. NORMAL PROCEDURES

Interior Inspection – Cockpit

This checklist is commonly referred to as the “Noisy Ramp Check”. It is typically performed by the first student flying, while the IP and second student perform the Exterior Inspection. It is strongly recommended that you memorize this checklist.

1. **Flight controls** – Remove control locks and check for free movement. Ensure the surrounding area is clear. Visually check for proper movement of the control surfaces.

CAUTION

Consideration should be given to wind conditions before removing control locks.

NOTE

The control lock must be in place at any time when a pilot is not in either seat, guarding the controls.

2. **Parking Brake** – Set. Pull the brake handle and pump brakes firmly.
3. **Manual Trim** – Operate tabs through full range of travel.

CAUTION

The elevator trim system must not be forced past the limits that are marked in red on the elevator trim indicator scale either manually, electrically, or by action of the autopilot.

After checking for free movement of the trim system, return elevator trim to “3 UP” position, and center rudder and aileron knobs to 0.

4. **Emergency Gear Control** – Checked.

Ensure that the U-shaped Emergency Engage Handle is in the STOWED position and the pump handle is stowed.

5. **Circuit Breakers** – In. All circuit breakers should be in, unless otherwise noted in the aircraft maintenance forms.
6. **Electrical Switches** – Set. Ensure that all switches on the fuel control panel, pilot and copilot subpanel, overhead panel, and pedestal extension are OFF or AUTO, and landing gear handle is down (DN).
7. **Oxygen System** – Check.
 - a. Oxygen pressure – As required. Check for minimum of 1000 PSI, recommended 1500 PSI for cross-country.
 - b. Passenger manual override – In. (Located behind overhead panel.)
 - c. System ready – PULL ON. Listen for flow of oxygen to the masks.
 - d. Check mask hoses and communication connections are secure.
 - e. Diluter lever – Check that 100% is selected on BOTH regulators.
 - f. Pressure indicator – Check for green on BOTH mask hoses.

- g. Check for proper mask orientation in storage bag – oxygen hose connection to mask regulator should be facing forward. Mask bag should be velcroed together, with mask neatly inside.
- h. Verify Emergency/inflation pressure by squeezing red button on each mask. Listen for flow and check that mask attempts to inflate. It is not necessary to remove the masks from their bags for this step.

8. **Hot Battery Bus/Fuel Panel/Flaps**

- a. Firewall valve circuit breakers –Pull (Both).
- b. Standby pump circuit breakers – Pull (Both).
- c. Firewall valves – CLOSED. Lift red safety guards and position both switches to CLOSED position.
- d. Standby pumps – ON.
- e. Battery – ON. Both FUEL PRESS annunciator lights should be illuminated.
- f. Firewall fuel valves – OPEN. Open valves one at a time and check for corresponding FUEL PRESS annunciator lights to extinguish.
- g. Standby pumps – OFF. Position to OFF one at a time and check for corresponding FUEL PRESS annunciator lights to re-illuminate.
- h. Standby pump circuit breakers – Reset
- i. Firewall valve circuit breakers – Reset
- j. Crossfeed – Position switch to Left, then Right. Green FUEL CROSSFEED annunciator light should illuminate, and both FUEL PRESS lights should extinguish. Position switch back to OFF.
- k. Auxiliary transfer switches – Set to AUTO
- l. No transfer lights – Push to test bulbs
- m. Fuel quantity – Total quantity should match aircraft forms. Ensure that both gauges are working, unless noted in forms.
- n. Flaps – 100 percent. If flaps are not already at 100 percent ensure the area around the control surfaces is clear and then position the flap lever to APPROACH. After position indicator reads 40% Flaps, select flaps DOWN.

- o. Battery – OFF
9. **Windows** – Check for scratches, cracks, and cleanliness.

NOTE

Dirty or “crazed” windows can become a serious hazard to safe taxiing, especially at night.

After completing the Interior Cockpit Inspection, all switches and levers should be set in position for the Before Start Checklist, allowing this checklist to progress very quickly. All NAVAID frequencies should be set up for initial testing during the Takeoff Checklist.

F102. BEFORE START CHECKLIST

This checklist ensures all the switches and systems are properly set before starting engines.

- *1. **SEAT BELTS** **“FASTENED” (LS, RS)**

The OBS may remain unbelted until the cabin door is closed.

- *2. **PARKING BRAKE** **“SET” (LS)**

The parking brake should already be set from the Interior Inspection. Visually check position of the brake handle.

- *3. **CHOCKS** **“REMOVED” (LS)**

Give the lineman the hand signal and wait for him to return the signal (Typical Briefs and Voice Procedures Appendix) confirming that the chocks are removed.

- *4. **CIRCUIT BREAKERS** **“SET” (LS, RS)**

Both pilots should ensure CBs are in.

- *5. **PEDESTAL EXTENSION SWITCHES** **“SET” (LS)**

The pedestal extension switches should be set correctly from the Interior Inspection:

- a. Electric ice vanes – RETRACTED.
- b. Autofeather – OFF.
- c. Avionics master – OFF.
- d. Inverters – OFF.

- e. Generator switches – OFF.
- f. Elevator trim – ON.
- g. Rudder boost – ON.
- h. Engine start switches – OFF.
- i. Auto ignition switches – OFF

6. POWER QUADRANT*“SET” (LS)****CAUTION**

Do not position power levers aft of IDLE while the engines are shut down. This may damage the reverse linkage.

- a. Power levers – IDLE.
- b. Propeller levers – FULL FORWARD.
- c. Condition levers – FUEL CUTOFF.
- d. Flaps –Handle matches position. Should be 100 percent.
- e. Friction lock knobs – ADJUSTED.

7. MANUAL ICE VANES**“IN” (LS)**

Do not extend the manual ice vanes. This would disengage the electrical ice vane motor.

8. GEAR HANDLE**“DOWN” (LS)**

Visually ensure the handle is down and the J hook is engaged.

9. SUBPANEL SWITCHES**“SET” (LS, RS)**

Subpanel switches should be already set from the Interior Inspection:

Left Seat:

Ensure all exterior lights are off.

Ensure all ice switches are off.

MIC switch – NORMAL.

Compass gyro – SLAVE

Prop sync – OFF.

Right Seat:

MIC switch – NORMAL.

Compass gyro – SLAVE.

Cabin temp mode – OFF.

Vent blower – AUTO.

Aft blower – OFF.

Cabin lights – OFF/NO SMOKE & FSB.

***10. LIGHTS** **“SET” (LS)**

Turn on the Rotating Beacon.

Nav lights should be turned on 30 minutes before sunset until 30 minutes after sunrise, or with visibility less than 3 miles.

Overhead panel lights – If operating during the daytime, turn lights off. If operating at night, set lights as required.

11. FUEL PANEL **“CHECKED/SET” (LS)**

- a. The fuel panel should be set correctly from the Interior Inspection:
- b. Standby pumps – OFF.
- c. Aux transfer – AUTO.
- d. No transfer lights – CHECKED.
- e. Firewall fuel valves – OPEN.

***12. OXYGEN SYSTEM** **“CHECKED/SET” (RS)**

This step should be completed during the Interior Inspection.

13. AUDIO PANEL **“SET” (LS/RS)**

The following is a typical setup and can be set during the Interior Inspection:

VHF 1 – LS, RS – ON

VHF 2 – LS – Off, RS – ON

UHF – LS, RS – ON

All other mixer switches – OFF

Transmit selector switch – LS – UHF, RS – UHF

Audio mixers – PHONE/NORM

Interphone select – HOT

Turn on and set control heads to desired channels as required.

*14. **RADAR** **“OFF” (RS)**

Radar – Off.

15. **TRANSPONDER** **“STANDBY” (RS)**

This should be set during the Interior Inspection:

Transponder – STANDBY

Sensitivity – HIGH

Alt RPTG – ON

SEL – 1

16. **ALTERNATE AIR SOURCE** **“NORMAL” (RS)**

*17. **BATTERY** **“ON” (LS)**

*18. **ANNUNCIATOR PANEL** **“CHECKED” (LS)**

Wait for all Master Caution and Master Warning lights to illuminate. Press the test switch and check that lights illuminate and Master Caution and Master Warning lights flash. Note any burned out lights.

*19. **LANDING GEAR/STALL WARNING** **“CHECKED” (LS, RS)**

The RS pushes the gear test switch, ensures the gear handle light illuminates, and the gear horn sounds. The RS then tests the stall warning. The audible warning should sound. Look on the leading edge and watch for the stall vane to vibrate. The standard reply is *“Two lights and a horn, horn and a flicker, checked.”*

***20. FIRE WARNING SYSTEM** **“CHECKED” (LS, RS)**

The RS rotates the test switch. Each pilot checks for three indicator lights on their side (FIRE L/R ENG, MASTER WARNING, and L/R ENG FIRE PUSH TO EXT). Respond *“Three.”* The RS rotates the test switch to LEFT EXT and RIGHT EXT positions. Verify illumination of amber “D” and green “OK” light in each position. Respond *“D, OK.”*

***21. CABIN DOOR** **“LOCKED” (LS, OBS)**

Whoever locked the door will reply *“Locked.”* The LS ensures the light is out and everyone is accounted for then responds *“Locked, lights out.”*

22. CABIN SIGN **“AS REQUIRED” (RS)**

Set the sign according to passenger requirements.

F103. ENGINE STARTING PROCEDURES

Battery Start

The engine start is a critical maneuver and will be memorized. Start the right engine first when performing a battery start. If performing a GPU start, consult NATOPS and start the left engine first. All start sequence actions are performed by the LS pilot. The LS pilot will time start and the RS pilot will time from condition lever to low idle until light off and monitor the fire guard.

Give the typical start brief listed in the Typical Briefs and Voice Procedures Appendix.

1. PROPELLERS **“CLEAR”**

Visually check the area clear. Check camlocks secure, windows closed. If operating without a lineman, each pilot should announce, *“Clear Prop”* out the window.

2. ENGINE **“START”**

Give the lineman the signal for starting the right engine (Aircraft Hand Signals Appendix). Engage the starter and begin timing the start.

- a. Right IGNITION & START switch – ON.

CAUTION

If no ITT rise is observed within 10 seconds after moving the condition lever to low idle, complete Abnormal Start procedures.

Engage the starter and begin timing the start. Check that the R FUEL PRESS light goes off and the R IGNITION light comes on.

Right oil pressure – Check rising.

- b. Right condition lever – LOW IDLE (after N1 stabilizes, 12% minimum).

CAUTION

If N1 stabilizes less than 17%, anticipate a hotter than normal engine start. If N1 stabilizes below 15%, consider using a GPU to prevent excessive start temperature.

Wait for N1 to stabilize and check its reading.

Watch for fuel flow indication and light off.

Do not remove your hand from the condition lever until ITT has stabilized.

- c. Right oil pressure – CHECK.

Ensure oil pressure is rising.

- d. ITT and N1 – Monitor. (1000°C maximum)

For ITT over 1000°C – Execute Abnormal Start procedures.

- e. Right IGNITION & START switch – OFF.

(N1 50% minimum) note the time. Check engine instruments. Give the lineman a thumbs-up to indicate a good start.

- f. Right condition lever – HIGH IDLE.

NOTE

Any time the condition lever is moved, the pilot should monitor ITT.

- g. Right GEN – RESET, then ON.

Turn the generator on and note that the annunciator light extinguishes. This will allow the battery to charge.

- h. Check generator load less than 50%, then Right generator – OFF.

NOTES

1. In cases where a weak battery exists, the control check, flap check, as well as the anti-ice/deice checks listed in the After Start Checklist may be performed while charging the battery between starts. Once the load is below 50%, turn the generator off.
 2. The prop deice checks cannot be performed between starts since the left prop is not turning.
 3. Failure to secure the right generator prior to initiating start of the left engine could result in overloading the right current limiter
- i. Left IGNITION & START switch – ON.

CAUTION

If no ITT rise is observed within 10 seconds after moving the condition lever to low idle, complete Abnormal Start procedures.

Give the typical briefing as stated in the Typical Briefs and Voice Procedures Appendix for the generator-assisted start of the left engine. Clear both sides, give the start signal to the lineman, and begin timing the start

Check that the L FUEL PRESS light goes off and the L IGNITION light comes on

Left oil pressure – CHECK RISING

- j. Right generator – RESET, then ON (after N1 passes 12%).

Failure to turn on the generator will result in a battery start. This will unnecessarily load the electrical system and may lead to a hot start.

- k. Left condition lever – LOW IDLE (after N1 is stabilized).

Monitor the right and left ITT. Do not remove your hand from the condition lever until ITT has stabilized.

- l. Left oil pressure – CHECK

Ensure oil pressure is rising

- m. ITT and N1 – Monitor (1000° C maximum)

Light off should be within 10 seconds. Monitor both engines for limits. The 1000° C limit is for the engine being started only. The right engine limit is 750° C.

- n. Left IGNITION and START switch – OFF.

(N1, 50% minimum), note the time, check engine instruments. Give lineman a thumbs-up to indicate a good start.

3. **CONDITION LEVERS**

“AS REQUIRED”

Set both condition levers to High Idle at this time to allow for air conditioner/pressurization functions.

The flight controls, flaps, and Anti-Ice/Deice checks should be performed at this time while a lineman is available. The LS should first perform a control check of all axes for free and easy movement. Then pass the controls to the RS. While the RS checks his controls, the LS should perform the Flap Check. Use hand signals (listed in the Aircraft Hand Signals Appendix) to verify position with the lineman. Check the flaps in the 100% position. Select flaps to the 40% position. Respond *“Flaps selected approach, indicate approach, checked approach.”* Select flaps to 0% position. Respond *“Flaps selected up, indicate up, checked up.”* Upon completion, the RS will pass controls back to the LS. Perform Anti-Ice/Deice Checks as described in Step 8 of the After Start Checklist.

F104. AFTER START CHECKLIST

The After Start Checklist checks and sets systems that could not be checked before. The LS shall initiate all actions. During this time, obtain ATIS. The RS will get a VHF radio check with base.

1. CURRENT LIMITERS/INVERTERS *“CHECKED/ON” (LS)

- a. Battery – OFF.
- b. Left Generator – OFF.
- c. No. 2 Inverter – ON.
- d. Note torquemeters operational. Move power levers to verify torquemeters.
- e. AC voltage and frequency – CHECK (110 to 120 volts, 390 to 410 Hz).
- f. No. 1 Inverter – ON.

NOTE

Master Warning light may flash due to the momentary illumination of INST INV light.

- g. Note torquemeters operational. Move power levers to verify torquemeters.
- h. AC voltage and frequency – Check (110 to 120 volts, 390 to 410 Hz).
- i. Battery – ON.
- j. Left Generator – RESET, then ON.

***2. DC VOLT AND LOAD** **“CHECKED” (LS)**

27.5 to 29 volts, normal generator loads will be within 10% of each other (paralleling).

***3. AVIONICS MASTER SWITCH** **“ON” (LS)**

Complete an ICS check with the PM and OBS at this time.

***4. RADAR** **“STBY” (RS)**

Select Standby.

***5. ENVIRONMENTAL SWITCHES** **“SET” (RS)**

RS will turn on the air conditioner as required.

***6. ENGINE INSTRUMENTS** **“CHECKED” (LS)**

Check for stable indications within the green arcs.

7. PRESSURIZATION/PNEUMATIC/VACUUM SYSTEM

“CHECKED/AS REQUIRED” (RS)

While the PM accomplishes this test, the PF can listen to ATIS for information.

At 70 % N1 – Bleed Air Valves – INST & ENVIR OFF, pneumatic pressure gauge goes to zero, BL AIR FAIL warning lights illuminate. Set controller to 500 feet below field elevation and rate knob to maximum. Actuate CABIN PRESS switch to TEST and turn ON left bleed valve. Note indication of pressurization after 30 to 45 seconds. Turn OFF left bleed air valve and check cabin pressure return to field elevation. Repeat for the right bleed air valve. Turn both bleed air valves to ON, set controller to 500 feet above field elevation, and set cabin pressure switch to PRESS position.

8. ANTI-ICE/DEICE **“CHECKED/AS REQUIRED” (LS)**

This check is typically performed before initiating the After Start Checklist. Full anti-ice/deice checks are practiced during CPTs and must be memorized. The SMA must perform one full check before C4203.

If on a cross-country flight or icing is anticipated, perform the full test. If anti-ice/deice usage is not anticipated, only check the “hot-five.”

- a. Either generator – OFF. If doing this between starts, one generator should already be off.
- b. Windshield heat – CHECKED. Check pilot WINDSHIELD ANTI-ICE switch in NORMAL and HI, note loadmeter increase for each position. Check copilot WINDSHIELD ANTI-ICE switch in NORMAL and HI, note loadmeter increase for each position.

NOTE

If the windshield temperature is greater than 90°F, windshield anti-ice will not operate.

- c. Propeller deice – CHECKED. This step cannot be accomplished between starts, check:
 - i. Auto – Start timing. Note propeller ammeter 14 to 18 amps. Note momentary deflection every 30 seconds for the full 2-minute cycle.
 - ii. Manual – Hold switch to outer, then inner position. Note approximately 5% load increase for each, prop ammeter inop.
- d. Pitots, stall vane, fuel vents – CHECKED. Turn on all five switches. Turn off individually and note load decreases.
- e. Surface deice – CHECKED.
 - i. Single – Select single. Pneumatic and vacuum pressure fluctuate, wing boots inflate for 6 to 9 seconds. Pneumatic and vacuum pressures fluctuate, wings deflate/tail boots inflate for 4 to 6 seconds. Pneumatic and vacuum pressures fluctuate, tail boots deflate.
 - ii. Manual – Wing and tail boots inflate as long as the switch is held in manual. Pressure and vacuum return to normal when released.
- f. Generators – Both ON.

9. GPWS **“CHECKED” (RS)**

Depress and hold the PULL UP/GPWS TEST indicator, listen and observe the following test sequence.

- a. G/S light on.
- b. GPWS INOP light on.
- c. Glideslope aural signal sent once.
- d. One-second pause.
- e. PULL UP light flashes.
- f. Aural WHOOP-WHOOP PULL UP sent 2 to 3 times.

On completion of the self-test sequence, check that the visual indicators go out.

***10. CONDITION LEVERS** **“AS REQUIRED” (LS)**

Set 65% N1. 65% is recommended while taxiing to reduce noise and reduce the need for heavy braking and/or reverse required at high idle RPM. This also ensures the minimum required N1 for generator load and air conditioner operation.

CAUTION

Ensure both attitude flags are out of view before taxiing.

Respond “*Attitude flag is out, clear left and right.*” Signal the lineman for a brake check. Upon his acknowledgment, release the parking brake, slowly move forward and check brakes. Give “thumbs-up,” follow his directions and release the lineman while taxiing towards the taxiway. Contact Ground for taxi IAW the Typical Briefs And Voice Procedures.

F105. TAXI CHECKLIST

This checklist is accomplished while taxiing to the engine runup area.

During ground operations both pilots will clear their respective side of the aircraft. The PF will taxi the aircraft to the runup area IAW airfield procedures and should complete the steps listed below prior to calling for the Taxi Checklist. After checking the turn indicators, compasses and brakes, call for the Taxi Checklist. Ensure checklist is completed prior to executing subsequent checklists.

1. TURN INDICATORS AND COMPASSES “CHECKED” (LS, RS)

During the first turn onto the taxiway, check for proper turn needle and ball deflection and both compass systems working. Respond “Needle left, ball right, mark heading XXX.” PM verifies information.

2. BRAKES “CHECKED” (LS, RS)

Slowly pull both power levers into reverse. Note symmetric acceleration and N2 spool-up. Do not stop the aircraft or hold reverse too long to prevent prop blade erosion.

Momentarily depress the brakes to check operation. Pass the controls to the RS so that he may test his brakes.

F106. ENGINE RUNUP CHECKLIST

This checklist verifies engine and related systems are operating normally. Ensure the aircraft is parked into the wind and the nose wheel is centered. The RS pilot will notify the PF if any aircraft movement is detected during the engine runup.

1. PARKING BRAKES “SET” (LS)

Pump brakes firmly.

2. ENVIRONMENTAL SWITCHES “AS REQUIRED” (RS)**NOTE**

The air conditioner has to be OFF during the engine runup due to the right engine being set below the 61% required to operate the air condition system.

The RS will turn off environmental switches as required.

3. CONDITION LEVERS “LOW IDLE” (LS)***4. ENGINE INSTRUMENTS “CHECKED” (LS)**

Check that all indications are symmetric and within operating limits.

5. OVERSPEED GOVERNORS AND RUDDER BOOST

“CHECKED” (LS)

- a. Rudder boost – ON.
- b. Propeller levers – FULL FORWARD.

- c. Propeller governor test switch – Hold in PROP GOV TEST position until both sides have been checked. Do not release the switch while the test is being performed. An abrupt surge in RPM could result.
 - d. Left power lever – Increase until N2 is stabilized at 1830 to 1910 RPM to check overspeed governor. Then continue to increase power until rudder movement is noted. Observe ITT and torque limits.
 - e. Left power lever – IDLE.
 - f. Right power lever – Increase until N2 is stabilized at 1830 to 1910 RPM to check overspeed governor. Then continue to increase power until rudder movement is noted. Observe ITT and torque limits.
 - g. Right power lever – IDLE.
 - h. Propeller governor test switch – Released.
6. **PRIMARY GOVERNORS** **“CHECKED” (LS)**
- a. Propeller levers – FULL FORWARD.
 - b. Set power levers until N2 is 1800 RPM.
 - c. Propeller levers – To DETENT. Smoothly pull prop levers back. Do not pull levers into the feather range.
 - d. Check RPM – 1600 to 1640 RPM.
 - e. Propeller levers – FULL FORWARD.
7. **ICE VANES** **“CHECKED” (LS, RS)**
- Only performed if icing conditions are anticipated. At 1800 RPM, extend ice vanes electrically and check for torque drop. Retract the vanes and check for return to original torque. Assure both ICE VANE EXT lights illuminate during check. The ice vanes can be visually checked from the cockpit. The typical response is *“Ice lights on, vane is extended left, ice lights out, vane is retracted left.”* Pilot in RS will respond appropriately for the right side.
8. **AUTOFEATHER/AUTOIGNITION** **“CHECKED/OFF” (LS)**
- a. Autoignition – ON.
 - b. Power levers – Approximately 500 ft-lbs torque.

- c. Autofeather switch – Hold to TEST. Observe both autofeather annunciator lights illuminated.
- d. Power levers – Retard individually:
 - i. At 410 +50 ft-lbs torque – Opposite AUTOFEATHER annunciator extinguished, corresponding side autoignition annunciator lights on.
 - ii. At 260 +50 ft-lbs torque – Both AUTOFEATHER annunciator lights out (propeller starts to feather).

NOTE

The AUTOFEATHER light on the side being tested will cycle on and off with each fluctuation of torque as the propeller tries to feather. This only happens during the test cycle.

- iii. Return power lever to approximately 500 ft-lbs torque.
- iv. Repeat items with the opposite power lever.
- e. Power levers – Approximately 500 ft-lbs torque, then both idle (both AUTOFEATHER annunciator lights out, neither propeller feathers).
- f. Autofeather switch – Release.
- g. Autoignition switches – OFF.

***9. MANUAL FEATHER** **“CHECKED” (LS)**

Ensure RPM is stable before going to feather. Check for an increase in torque, a decrease in propeller RPM, and that N1 does not change more than 1%.

10. CONDITION LEVERS **“SET” (LS)**

Set condition levers to 65% for air conditioner operation.

11. ENVIRONMENTAL SWITCHES **“AS REQUIRED” (RS)**

The RS will turn the air conditioner back on, as required.

F107. TAKEOFF CHECKLIST

This checklist will check and set remaining switches for takeoff. It is normally accomplished in the runup location.

1. AUTOPILOT/FLIGHT DIRECTOR “AS REQUIRED/OFF” (LS, RS)

If autopilot/flight director usage is anticipated, perform the full test. Otherwise, check that the system can be overpowered, then disengage and check system off. Response in this case would be *“Not checked, off.”*

Elevator trim indicator – Check.

Observe that autopilot trim indicator on autopilot controller shows an average signal of zero with only small deviations. A steady full-scale deflection on the elevator trim indicator denotes automatic synchronization is not functioning, the autopilot should not be engaged.

Turn knob – In center detent position.

Autopilot – Test.

- a. Control wheel to midtravel – Depress AP ENGAGE switch.
- b. Control movement – Check that the system can be overpowered by slowly moving controls through all three axes.

CAUTION

The elevator trim system must not be forced beyond the limits which are marked in red on the elevator trim tab indicator, either manually, electrically, or by action of the autopilot.

- c. If autopilot disengages, do not use.

CAUTION

Overpowering the rudders to the point of audible ratcheting may cause damage to the equipment.

- d. Elevator trim follow up – Checked. Hold control wheel forward of mid-travel. Trim wheel will run noseup after 3 to 5 seconds. Hold control wheel aft of mid-travel. Trim wheel will run nosedown after 3 to 5 seconds.
- e. Pilot AP/YD TRIM DISC switch – Depress through second detent. ELECT TRIM OFF annunciator will illuminate.
- f. Autopilot – Reengage with control wheel at mid-travel. Hold control wheel forward of mid-travel. Trim wheel will not operate and AP TRIM FAIL annunciator will illuminate after 3 to 5 seconds. Hold control wheel aft of mid-travel. Trim wheel

will not operate and AP TRIM FAIL annunciator will re-illuminate after 3 to 5 seconds.

- g. Autopilot TEST button – Depress. Autopilot will disengage and AP DISC and MASTER WARNING annunciators will illuminate.

CAUTION

If autopilot does not disengage when the TEST button is depressed, it indicates autopilot torque monitors are not functioning properly. Do not use autopilot in flight until corrective action has been taken.

- h. Press AP ENGAGE switch. (Control wheel may remain forward.)
- i. Copilot TRIM DISC switch – Depress Autopilot will disengage, MASTER WARNING and AP DISC annunciators will illuminate.
- j. Center the HDG bug on your current heading before proceeding. Depress AP ENGAGE switch. (Control wheel may remain forward.)
- k. Press ALT with AP engaged. The horizontal flight director bars come into view and PITCH COUPLE light illuminates.
- l. Press STBY. All lights should illuminate and flight director bars should be biased out of view.
- m. Press HDG with AP engaged. Both the vertical and horizontal command bars will come into view on the FD indicator, and the ROLL COUPLE and PITCH COUPLE lights will illuminate. Rotate the heading bug on the HSI. The vertical FD bar and control wheel should respond to these inputs.
- n. Press GO AROUND. Check that autopilot and yaw damp disengage and flight director commands approximately 7° noseup, wings-level attitude.
- o. Depress the pilot control wheel AP/YD DISC button and the MASTER WARNING annunciator by depressing its face. This clears all warning and go-around indications.
- p. ELEV TRIM switch – OFF, then ON (resets electric trim and ELECT TRIM OFF annunciator will extinguish).

2. YAW DAMP **“OFF” (LS)**

This can be verified by pushing selector to Bright. This checks that the yaw dampener is not in dim setting and is indeed off.

WARNING

Engagement of the yaw damper during takeoff or landing may result in severe directional control problems

3. ELECTRIC TRIM ***“CHECKED/ON” (LS, RS)***

Pilot individually checks the left/right split switch up/down for no trim wheel movement. Then checks proper operation of whole switch up and down, and disconnects electric trim with yoke disconnect button while trimming.

4. TRIM TABS** ***“SET” (LS, RS)

Aileron – 0, rudder – 0, elevator – 3 up.

5. FLIGHT CONTROLS** ***“CHECKED” (LS, RS)

An initial check should be performed in the line area with a lineman. Re-check at this time to ensure free movement after the Autopilot was disengaged.

6. FLAPS** ***“CHECKED/AS REQUIRED” (LS, RS)

This check should be performed in the line area with a lineman. At this time, ensure they were checked and are now set for takeoff (normally up).

NOTE

TOLD card determines if approach flaps should be used for takeoff on runways with critical length (i.e., NGP Rwy 13L).

7. PROPELLER LEVERS** ***“FULL FORWARD” (LS)**8. PROPELLER SYNC** ***“OFF” (LS)******9. AUTOFEATHER** ***“ARMED” (LS)*****10. RADAR** ***“AS REQUIRED/STBY” (LS)*****NOTE**

Radar check should only be performed if use is anticipated in flight.

- a. STBY pushbutton – Verify depressed, 4 1/2 min warmup.
- b. GAIN control – Fully counterclockwise to PRESET.
- c. INT control – Midpoint.
- d. TILT control – Fully upward.
- e. RANGE control – TEST.
- f. NORM pushbutton – Depress after 4 1/2 min warmup.
- g. INT control – Rotate for desired brightness.
- h. Observe test display for three level pattern with alphanumerical indication of mode, max range, and range markers.
- i. Press CTR pushbutton and observe continuous test display pattern with upper dark bar bordered.
- j. STBY pushbutton – Depressed.
- k. RANGE control – Desired range selected.
- l. Tilt – Set to 0° noseup.

11. **FLIGHT INSTRUMENTS** **“CHECKED” (LS, RS)**

LS and RS check for proper indications.

Airspeed – Less than 40 KIAS.

RMI/HSI – Report heading on each, no abnormal flags.

Turn and slip indicator – Needle erect, ball centered.

Standby gyro – erect, pipper properly adjusted.

Attitude gyro – Press and hold ATT TEST button. Note 20° right bank and 10° pitch up.

IVSI – Approximately zero.

Respond, *“Airspeed less than 40, my RMI 130, your HSI 130, my HSI 128, your RMI 128, turn needle erect, ball centered, 20 and 10, VSI zero.”* The RS will report any discrepancies.

12. ALTIMETERS*“CHECKED/SET” (LS, RS)**

Select ATIS and set the current altimeter. Verify both altimeters are within 75 feet of field elevation, and no OFF flag in pilot altimeter.

With RADALT altitude bug above 100 feet, hold RADALT test and check for 3 DH lights (LS), 2 DH lights (RS). Set altitude bug below 100 feet, all DH lights extinguish, release test, and all DH lights re-illuminate. Set appropriate setting with altitude bug and extinguish flashing MASTER CAUTION (on for GPWS inop light during test).

13. RADIOS/NAVAIDS/FMS*“CHECKED/SET” (LS, RS)**

The audio panel mixer switches may help with a visual checklist when checking and setting radios and NAVAIDs.

After checking all radios and NAVAIDs, request IFR clearance or Seagull block IAW the Typical Briefs and Voice Procedures Appendix and then set all NAVAIDs as appropriate for the departure.

Typical check. Utilize the TINT method for all NAVAIDs.

VHF 1 – Select channel. Verify proper selection for control head. Depress test button, check for squelch and volume.

VHF 2 – Select channel and verify volume.

UHF – Select proper channel. Verify function switch BOTH. Select squelch OFF, verify squelch, back ON.

VOR 1

Localizer

T – Select 111.3 (I-NGP LOC).

I – Select VOR1 mixer switches.

N – No navigation at this point.

T – Depress TEST button. Verify 1½ dots down and right.

VOR

T – Select 114.0 (NGP).

I – Check ID.

N – Center CDI and verify TO/FROM indicating TO. Compare VOR 1 and VOR 2 indications. Max split is 4°. Compare radial and DME information at a known checkpoint if able. Rotate CDI 10° left and right, CDI should match movement.

T – Select course of 003°. Depress TEST button. Course should read 003° and CDI should center at 003° ±2°.

VOR 2 – PM will perform the test as mentioned above.

TAC

T – Select 87X (NGP).

I – Verify ID.

N – Select TAC on HSI switch. Center CDI and check for proper depiction. Compare radial and DME information at a known checkpoint if able. Rotate CDI 10° left and right, CDI should match movement.

T – Select course of 180°. Depress TEST button. Course should read 180° and CDI should center at 180° + 2°.

ADF

T - Select 0391 (ROCKPORT)

I – Verify ID

N - Select ADF on RMI selector switch. Verify needle points to ROCKPORT (approximately 015 - 025)

T - Depress TEST button. Needle should swing counterclockwise 90. Release TEST button, needle should return to proper indications.

FMS Check

Contact stage SMAs should be able to initialize, input a point, and check the FMS prior to calling Radio/NAVAIDS/FMS “Checked/Set.” Refer to GNS-XLS manual for setup procedures.

Typical setup for takeoff

VHF 1 – 134.85 (Tower) and 118.7 (Ground).

VHF 2 – 140.325 (Base).

UHF – Channel 4 (Tower).

VOR 1 – 115.5 (CRP) or 114.5 (ALI).

VOR 2 – 115.5 (CRP) or 114.5 (ALI).

TAC – 102 (CRP) or 30 (ALI).

ADF – 382 (Connor).

CDI – Set for departure.

HSI selector – Set for departure.

Heading Bug – Set for departure.

Set ALT – Set for departure.

XPDR – Set for departure.

NOTE

Ensure IFR clearance or Seagull block is obtained and all appropriate NAVAIDS are set accordingly before responding “*Checked/Set.*”

14. **PRESSURIZATION** **“SET” (LS)**

For local area flights, set an outer scale (CABIN ALT) indication of at least 500 feet above field pressure altitude. To calculate pressure altitude, the pilot must round the field current altimeter setting to the nearest tenth. Then subtract this rough setting from 30.40. Taking the resulting difference and adding a “0” gives the number of feet to be added to the field elevation.

(Examples: NGP altimeter 29.94, rounds to 29.90. $30.40 - 29.90 = .50$. Adding a zero gives 500 feet + field elevation = Set 519 feet. NGP 29.78, set 619 feet, NGP 20.13, set 319 feet.)

For cruise operations set an inner scale (ACFT ALT) indication of planned cruise altitude plus 1000 feet. Rate control selector knob – Set in midrange.

*15. **BLEED AIR** **“AS REQUIRED” (RS)**

Normally OPEN, but as required.

*16. **FUEL PANEL** **“CHECKED _____ POUNDS” (LS)**

Check auxiliary and main fuel quantity. State total fuel weight.

***17. CREW** **“BRIEFED” (LS)**

Conduct crew briefing IAW the Typical Briefs And Voice Procedures Appendix.

After completing the crew brief, the PF should direct the PM to hold the last five and call for further taxi. The last five items will be completed when taking the active runway in preparation for takeoff.

Call Tower IAW the Typical Briefs And Voice Procedures Appendix for takeoff clearance approaching the hold short. After cleared for takeoff or into “line up and wait,” visually clear left, right, and above before crossing the hold short line and call for the “*Last Five*”

***18. ANTI-ICE/DEICE** **“SET” (LS)**

Set a minimum of pitot, stall vane, fuel vent.

***19. LIGHTS** **“SET” (LS)**

Turn on landing, recognition, strobe, and beacon lights. For night, add nav and ice lights.

NOTE

Strobe/beacon lights may be turned off at PIC discretion when encountering conditions of haze, fog, or clouds.

CAUTION

Simultaneous use of the landing lights and taxi light may overload the #2 dual fed bus.

***20. TRANSPONDER** **“SET” (RS)**

Turn on if departing the VFR pattern.

***21. CONDITION LEVERS** **“SET” (LS)**

Condition levers should already be set for 65%.

***22. AUTOIGNITION** **“ARMED” (PM)**

L and R IGNITION ON annunciators should be illuminated below approximately 410 ft-lbs torque.

CAUTION

Prolonged ground operation with autoignition armed will reduce igniter life.

F108. CLIMB CHECKLIST

- *1. **GEAR** ***“UP” (LS)***

Check that gear is up, handle transit light is out, 3 green lights out.
- *2. **FLAPS** ***“UP” (PF)***

Verify flaps are up.
- *3. **NACELLES/INSTRUMENTS** ***“CLEAN AND DRY/CHECKED” (PF, PM)***

Check engine instruments within limits. Visually check fuel caps and exterior panels secure with no leaks. Utilize ice lights for this check at night.
- *4. **LIGHTS** ***“SET” (LS)***

Turn landing and taxi lights off after selecting gear handle up.
- 5. **AUTOFEATHER** ***“OFF” (PM)***
- 6. **PROPELLER SYNC** ***“ON” (LS)***

Propellers should be manually/audibly synchronized before engaging prop sync.
- 7. **CABIN PRESSURIZATION** ***“CHECKED” (PM)***

Verify pressure differential.
- 8. **CABIN SIGN** ***“AS REQUIRED” (RS)***
- 9. **YAW DAMP** ***“AS REQUIRED” (PM)***

As required, 200 feet AGL minimum before activating. Normally off for Contacts/local area flights below 17,000 feet.
- 10. **WINDSHIELD HEAT** ***“AS REQUIRED” (LS)***

NOTES

1. Windshield heat on above 10,000 feet MSL or below 5°C.
2. Passing 10,000 feet MSL, verify O₂ pressure within limits, differential, and cabin altitude.

F109. CRUISE CHECKLIST

This checklist shall be executed while cruising on airways or direct enroute routing above 10,000 feet MSL.

1. **CRUISE POWER** **“SET” (PF)**
Set Max Continuous, Max Range or Max Endurance Torque as appropriate for flight.
2. **NACELLES/INSTRUMENTS** **“CHECKED” (PF, PM)**
3. **ALTIMETERS** **“AS REQUIRED” (PF, PM)**
Set local altimeter assigned by ATC or 29.92 if above FL 180.
4. **PRESSURIZATION** **“CHECKED” (PM)**
Verify pressure differential and cabin altitude.
5. **FUEL LOG** **“AS REQUIRED” (PM)**
Maintain fuel log as required by either using example from the Fuel Log Appendix or OPARS.

WARNING

Above FL 250, verify O₂ pressure within limits. Pressure may indicate slightly lower than normal due to cold ambient outside air temperature.

F110. DESCENT CHECKLIST

1. **ALTIMETERS** **“SET” (PF, PM)**
Set current altimeter. If descending to an altitude above FL 180, leave set at 29.92, but do not forget to set to appropriate setting in the descent.

2. **PRESSURIZATION** **“SET” (PM)**

Cabin altitude selector knob – Set CABIN ALT dial to landing field pressure altitude plus 500 feet. Use the same technique as described in the Takeoff Checklist.

Rate control selector knob – Set index at 12 o’clock position (300 to 500 FPM rate of descent).

3. **ANTI-ICE/DEICE** **“SET” (LS)**

Set windshield heat in NORMAL or HI well before descent into warm moist air to aid in defogging.

NOTE

Use in normal for at least two minutes prior using the high setting. This will aid in preventing the windshield from cracking.

F111. APPROACH CHECKLIST

CAUTION

Propeller operations in the 1750 to 1850 RPM range may cause ILS interference and should be avoided.

NOTE

In low visibility conditions, landing lights may be secured due to light reflections. If a crosswind landing is anticipated, determine crosswind component from NATOPS part XI.

The maximum demonstrated crosswind is 25 knots.

1. **CABIN SIGN** **“AS REQUIRED” (RS)**
2. **AUTOFEATHER** **“ARMED” (PM)**
3. **BRAKE HANDLE** **“IN” (LS)**
4. **PROP SYNC** **“OFF” (LS)**
- *5. **AUTOPILOT/YAW DAMP** **“AS REQUIRED” (PM)**

AP/YD are normally off for approaches, but may be used during coupled/FD approaches to a minimum altitude of 200 feet AGL.

WARNING

The autopilot shall be turned off when conducting operations below 200 feet AGL.

- *6. **RADIOS/NAVAIDs** **“SET” (PF, PM)**
Set for arrival and approach.
- *7. **ALTIMETERS** **“SET” (PF, PM)**
Set barometric altimeter and radar altimeter for arrival and approach.
- *8. **CREW** **“BRIEFED” (PF)**
Perform the briefing IAW the Typical Briefs And Voice Procedures Appendix.
9. **PRESSURIZATION** **“SET” (PM)**
Cabin altitude selector knob – Set CABIN ALT dial to field pressure altitude plus 500 feet.

NOTE

Ensure that the cabin is ready for arrival. Ensure the following are complete:

- a. Seat backs – UPRIGHT.
 - b. Seatbelts – FASTENED.
 - c. Armrest – DOWN.
 - d. Loose gear and cargo – STOWED.
 - e. Passengers – READY.
10. **WINDSHIELD HEAT** **“AS REQUIRED” (LS)**
- F112. LANDING CHECKLIST**

CAUTION

If possible, power levers should be moved out of REVERSE above 40 knots to minimize propeller blade erosion. Care must be exercised when reversing on runways with loose sand or dust on the surface. Flying gravel will damage propeller blades, and dust may impair pilot forward visibility at low aircraft speeds. Do not move the gear handle until cycle is complete.

1. **FLAPS** ***“AS REQUIRED” (PF)***

State the setting.
2. **PROPS** ***“FULL FORWARD” (PF)***

Select propellers full forward for landing.
3. **LANDING GEAR** ***“DOWN AND LOCKED” (PF, PM)***

Ensure the gear is down and 3 green indicators without a transit light.
4. **LIGHTS** ***“SET” (LS)***

Turn landing lights on.

NOTE

The props should be placed full forward before selecting gear down to prevent getting an RVS NOT READY light. The Landing Checklist must be completed in order.

F113. AFTER LANDING CHECKLIST

The After Landing Checklist must be completed after each full-stop landing. Individual items may be completed at the pilot's discretion. Do not call for the checklist until clear of the runway. At the IP's discretion, the PF may taxi while the PM completes items on the checklist. Do not sacrifice aircraft control to accomplish the checklist.

1. **RADAR** ***“STANDBY” (PM)***
2. **TRANSPONDER** ***“STANDBY” (RS)***

Accomplish this task immediately after clearing the runway.
3. **LIGHTS** ***“SET” (LS)***

During daylight, turn off all lights except for the beacon. During night, leave on taxi lights and set lights as required.

4. **ANTI-ICE/DEICE** **“OFF” (LS)**

Turn off all ice protection equipment.

5. **AUTOIGNITION** **“OFF” (PM)**

6. **FLAPS** **“UP” (PF)**

7. **PRESSURIZATION** **“CHECKED DEPRESSURIZED” (PM)**

PM checks zero differential. Verify by opening vent window.

8. **AUTOFEATHER** **“OFF” (PM)**

F114. SECURE CHECKLIST

Call for the checklist once parked in your assigned spot. Only items with an asterisk (*) need be performed if only one engine is to be secured (for passenger pickup/drop-off or maintenance, etc.).

- *1. **PARKING BRAKE** **“SET” (LS)**

2. **AVIONICS MASTER** **“OFF” (RS)**

3. **INVERTERS** **“OFF” (RS)**

4. **ENVIRONMENTAL SWITCHES** **“OFF/AUTO/OFF” (RS)**

CP secures aft vent blower, forward vent blower, and cabin temp mode.

- *5. **PROPS(S)** **“FEATHER**

Monitor stabilized ITT for a minimum temperature for 1 minute.

- *6. **CONDITION LEVER(S)** **“FUEL CUTOFF” (LS)**

CAUTION

Monitor ITT during shutdown. If sustained combustion is observed, proceed immediately to ENGINE CLEARING procedures. During shutdown, ensure the compressors decelerate freely. Do not close the fuel firewall shutoff valves for normal engine shutdown.

7. **STANDBY PUMPS** ***“OFF” (LS)*****NOTE**

The standby boost pumps and cabin entry lights are connected to the hot battery bus. Failure to turn these switches OFF will discharge the battery.

8. **OXYGEN** ***“OFF” (RS)***9. **LIGHTS** ***“OFF” (LS)***

Do not forget indirect lights and overhead panel lights. Turn the beacons off after the propellers have stopped rotating.

10. **GANG BAR (BATTERY AND GENERATORS)*****“OFF” (LS)***11. **CONTROL LOCK** ***“AS REQUIRED” (LS)***

Normally installed.

F115. EMERGENCY PROCEDURES

Both in the simulator and the aircraft, emphasis is placed on correctly handling emergencies. Selected emergency procedures (bordered by a black cross hatched margin) can be found on the reverse side of the normal checklist. Boxed items (* asterisked and boldface in the NATOPS manual) must be committed to memory. Daggered items require concurrence of both pilots before taking the required action. Students should also have a working knowledge of non-memory emergency procedures and should consult NATOPS before handling any “deferred” emergencies.

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, then pause for the PM to concur, before manipulating a switch or control. Failure to follow this sequence may result in fuel cutoff or prop feathering on the only operating engine. Timely and correct procedure execution, such as identifying left or right firewall valves, is essential to safety of the aircraft, crew, and passengers.

Engine shutdown procedures are practiced in the simulator moving all related switches and valves as required.

Before securing an engine, or immediately after an unexpected power loss, quickly utilize the power up, rudder up, clean up method to handle the emergency.

1. **Power up** – Utilize available power as required to maintain speed or prevent loss of speed before completing the shutdown. Do not overtorque or overtemp the engines.
2. **Rudder up** – Utilize rudder as required to stop the heading change and maintain balanced flight. Handle the emergency and then trim as time permits.
3. **Clean up** – Raise flaps-gear-flaps as required and execute the required emergency checklist.

Execution of the Emergency Engine Shutdown Checklist shall be accomplished in the following manner (the word simulate will be used only during SSE training in the aircraft):

STUDENT		IP
Brief intentions.		IP visually confirms.
This will be an emergency shutdown of the left/right engine.		
1.	Left/right condition lever – <i>“FUEL CUTOFF, concur?”</i>	<i>“Concur”</i> or <i>“Simulate”</i>
	Identify condition lever to close and point to appropriate condition lever.	IP visually confirms correct condition lever and guards against inadvertent movement.
2.	Left/right prop lever – <i>“FEATHER, concur?”</i>	<i>“Concur”</i> or <i>“Simulate”</i>
	Identify prop to feather and point to appropriate prop lever.	IP visually confirms correct prop lever guards against inadvertent movement. IP adds power to the feathered engine to simulate decrease in drag.
In case of confirmed or suspected fire or fluid leak, continue the checklist at step 3. If not, go to step 5 and execute those steps as time permits.		
3.	Left/right firewall valve – <i>“CLOSED, concur?”</i>	<i>“Concur”</i> or <i>“Simulate”</i>
	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.	IP visually confirms correct valve.
4.	Left/right fire extinguisher – <i>“DISCHARGE, concur?”</i>	<i>“Concur”</i> or <i>“Simulate”</i>
	Decide if the fire extinguisher is required and point to the appropriate extinguisher.	IP visually confirms correct extinguisher.
<p>NOTE: After completing the first four steps of the Emergency Engine Shutdown Checklist from memory, the student should then ask, <i>“Did the prop feather?”</i> and, if applicable, <i>“Did the fire go out?”</i> The IP will respond according to the emergency that is being simulated.</p> <p>If time and circumstances permit, continue the checklist.</p> <p>NOTES:</p> <ol style="list-style-type: none"> Certain situations may require holding the checklist, transferring communications to the PM, declaring an emergency, and then continuing the checklist. See Contact Stage for specifics. As the PM, the Emergency Engine Shutdown Checklist shall be read from Step 1 by specifying the appropriate engine such as: <ul style="list-style-type: none"> <i>“Left/Right Condition lever is FUEL CUTOFF.”</i> <i>“Left Right Prop lever is FEATHER.”</i> <i>“Left/Right Firewall valve is CLOSED/NOT REQUIRED.”</i> <i>“Left/Right Fire extinguisher is DISCHARGED FOR FIRE/NOT REQUIRED.”</i> Prior to continuing with step 5 of the Emergency Engine Shutdown Checklist, have PM declare an emergency, and if necessary, get vectors to the nearest suitable airfield and then continue the checklist. Once the checklist is completed, consider whether or not the engine can be restarted in case of a subsequent emergency. If so, “preload” the engine with the Starter Assisted Airstart procedure up to the point of engaging the starter. 		
5.	Prop lever – <i>“FULL FWD.”</i> (Operating Eng). (PF)	
6.	Prop sync – <i>“OFF.”</i> (LS)	NOTE: If the right propeller is manually feathered with the Prop Sync On, the propeller may not go completely into feather, but may rotate at low RPM.
7.	Bleed air valve – <i>“ENVIR OFF.”</i> (RS)	
8.	Fire warning system – <i>“CHECKED.”</i> (FOR FIRE). (RS)	WARNING: If the Fire Warning System Check fails, a fire may still exist.
9.	Power lever – <i>“IDLE.”</i> (PF)	
10.	Standby pump – <i>“OFF.”</i> (LS)	
11.	Fuel control heat – <i>“Pull circuit breaker.”</i> (RS)	
12.	Autoignition – <i>“OFF.”</i> (PM)	Turn off the failed engine’s autoignition.
13.	Generator – <i>“OFF.”</i> (PM)	Turn off the failed engine’s generator.
14.	Inverter – <i>“Match operating generator.”</i> (PM)	Select the same inverter as the operating engine. (i.e., Left engine secured, select No. 2 inverter.)
15.	Electrical load – <i>“CHECKED.”</i> (PM)	Maintain load below 100%.
16.	Current limiter – <i>“CHECKED.”</i> (LS)	Perform the current limiter check in NATOPS.

APPENDIX G CREW RESOURCE MANAGEMENT

G100. INTRODUCTION

The most essential learning behaviors in the Multi-Engine Pilot Training System are engine out training, instrument flying, and the use of Crew Resource Management. This Appendix is designed to assist in the development of sound CRM techniques that will maximize safety and efficiency in follow on aircraft.

Respective NATOPS chapters (Chapter 27 TC-12B) 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.

CAUTION

PF and PM shall never both be heads down in the cockpit at the same time.

Flight Director and Autopilot operation. With the autopilot off, the PF should direct the PM to operate the flight director. For example, the PF states “Flight director on, heading and altitude.” If the autopilot is engaged the PF can change the parameters as required.

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 V/L and IAS modes on final.”

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/GPS operation.

1. When the aircraft is moving, whether on the deck or in flight, FMS data entry will be accomplished by the Pilot Monitoring (PM).
2. When on the ground, parked, with the parking brake set, either pilot may enter data into the FMS.

3. The 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. Either pilot will verbalize the need to enter or edit a waypoint. The PM will enter or delete waypoints and make any other FMS/GPS inputs as necessary.
8. The PM should monitor flight progress via the NAV page, especially in the terminal environment.
9. 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.
10. Once the approach is loaded the PF will have the PM verify that the approach is “armed”
11. In response to the “APPR” annunciator and the CDI ramping down to ± 3 , PF will verbalize “*Approach Mode Active*” and the other pilot will acknowledge the call.
12. After a missed approach and in response to the “WPT” annunciator the PF shall request to have the PM select the hold point and have the FMS/GPS proceed direct. The PM will acknowledge and comply, then inform the PF when hold point selection is complete.
13. 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 GPS/FMS.

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

G-2 CREW RESOURCE MANAGEMENT

during non-proceduralized phases of flight. For instance, during a circling approach the PF needs to communicate his intentions 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 callouts, 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 callouts. ***Remember to aviate, navigate, then communicate.*** An improper rudder input or power correction is far more dangerous than forgetting to announce 1,000 ft to level.

Missed Callouts. During advanced instrument rides, students can expect instructors to intentionally “miss” required callouts. 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.

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APPENDIX H MINIMUM CONTROLLABLE AIRSPEED (VMCA)

H100. INTRODUCTION

V_{MCA} 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 TC-12).
5. Flaps at takeoff setting.
6. Gear UP.
7. 5 degrees AOB into the operating engine.
8. Maximum allowable aft C.G.

86 KIAS is the published V_{MCA} speed for the TC-12 under the above conditions. However engine failures don't only occur under these exact set of conditions and therefore, the actual V_{MCA} 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 V_{MCA}) 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 V_{MCA} .

Banking into the good engine three to five degrees lowers V_{MCA} 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 V_{MCA} and should be done with caution in a SE scenario.

Maximum weight also decreases V_{MCA} . 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 V_{MCA} 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 V_{MCA} . The good news is pilots have direct control over this condition. Reducing power on the good engine reduces asymmetric thrust and lowers V_{MCA} . However, keep in mind how reducing power will effect (affect) climb performance and stall margin. The pilot must be sure to maintain adequate margin above both stall and V_{MCA} 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 axis (in all three planes). The shorter the rudder arm, the more rudder that (delete) 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 V_{MCA} .

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 V_{MCA} . V_{MCA} 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 V_{MCA} and how it is affected by the current conditions. Having this knowledge will allow a pilot to recognize when an aircraft is approaching V_{MCA} and diagnose the best course of action to facilitate a successful recovery. In order to successfully recover from V_{MCA} , airspeed must be increased or the parameters must be changed, i.e. less asymmetric power, propeller feathered, etc.

See the Aero Workbook for more information on V_{MCA} .

APPENDIX I GPS PROCEDURES

I100. INTRODUCTION

Anything in brackets is a button on the GPS.

Pre-Departure

Initialization Page

1. [-] to INSERT or verify DATE
2. [-] to INSERT or verify GMT
3. IDENT – VERIFY position
4. [ENTER] three times to verify the INITIALIZATION display

Creating a flight plan

1. [FPL] to display desired FLIGHT PLAN LIST Page if required
2. [-] to position cursor on blank line and display the NEXT FPL number
3. If several Flight Plans are displayed, position cursor anywhere on the page then depress the BACK key to show NEXT FPL number
4. [ENTER] to display FLIGHT PLAN Page
5. Departure Airport Identifier – INSERT
6. [ENTER]
7. Airport Coordinates and Data – Verify
8. [ENTER]

Enroute Waypoints

1. [-] to position cursor over the ***** field if required
2. Type the next waypoint on the FPL
3. [ENTER] the DATABASE WPT page will be displayed
4. Verify data
5. [ENTER] to load the waypoint on the flight plan
6. Repeat 10-13 for remaining waypoints.
7. [-] to position cursor over SELECT
8. [ENTER] stored FPL has now been selected as the active FPL

Loading Jet or Victor Airways

1. [FPL] if required to display the waypoint at which the airway will start
2. [-] to position cursor below the waypoint at which the airway will begin
3. [#] type the JET or VICTOR airway number
4. [+/-] then type WPT ID if known

5. hit [PRV] or [NXT] to find the point on the airway and then hit [ENTER] if final WPT ID not known

Entering a SID

1. FPL] display ACTIVE FPL page
2. [-] to position cursor over the DEPART? Field
3. [ENTER] to display DEPARTURE page
4. DEPARTURE Airport Identifier – VERIFY or INSERT valid identifier
5. [-] position cursor over the desired SID, if required
6. [ENTER]
7. [-] Position cursor over desired transition, if required
8. [ENTER]
9. [-] cursor over desired runway
10. [ENTER]
11. Review
12. [ENTER] to select SID and insert into flight plan

Entering an Approach on a Stored FPL or Active FPL page

1. [FPL] to display desired active or stored FPL page
2. [-] position cursor over APPROACH? Field
3. [ENTER]
4. APPROACH Airport ID – Verify or INSERT valid ID

NOTE

If a circling approach is desired [-] to position cursor over type field so that circle is displayed. [-] to select circle from the list. [ENTER] to select circle. Proceed to step 7

5. [-] to position cursor over the desired RUNWAY on the runway list
6. [ENTER] to select RUNWAY. If a valid runway has been selected, the cursor moves to the first TRANSITION waypoint on the TRANSITION list
7. [-] position cursor over the desired TRANSITION
8. [ENTER]
9. Approach Waypoints – REVIEW
10. [ENTER] to select and load STAR on Flight Plan

Modifying a Flight Plan

Deleting a Waypoint:

1. [FPL] to select desired FPL page
2. [-] to position cursor over the waypoint ID to be deleted
3. [BACK] DELETE? Will appear
4. [ENTER] to delete WP

Adding a Waypoint:

1. [FPL] or [DIRECT TO] if required to display desired active or stored FPL page
2. [-] to position cursor over the waypoint ID that will follow the new entry
3. Waypoint ID – INSERT
4. [ENTER]
5. Waypoint Coordinates – VERIFY or INSERT
6. [ENTER] to add WPT to the FPL

Flight Plan Selection

1. [FPL] until desired FLIGHT PLAN LIST Page appears
2. [-] to position cursor over desired Flight Plan number
3. [ENTER]
4. FLIGHT PLAN Page – Verify flight plan
5. [-] to position cursor over SELECT? [BACK] to toggle between SELECT? and INVERT? which alternates between stored and active FPL
6. [ENTER] to transfer the stored FPL to the active FPL

Creating an Offset Waypoint

1. Select the desired FPL, Direct, or NAV page
2. [-] cursor over the desired identifier location
3. Parent Waypoint IDENT-INSERT with an * following the entry

NOTE- More than 1 offset waypoint is allowed from one parent, using *, *1, *A1, etc. as identifying notation

4. [ENTER]
5. Desired Radial – INSERT
6. [ENTER]
7. Desired Distance – INSERT (NM and Tenths, 1999.9 NM max)
8. [ENTER]
9. POS Coordinates – VERIFY
10. [ENTER]

ENROUTE**Pilot Entered Leg Change**

1. [NAV] to display NAVIGATION Page 1
2. [-] to position cursor over FR field
3. FR waypoint ID – INSERT or VERIFY
4. [ENTER]
5. TO waypoint identifier – INSERT if necessary
6. [ENTER]
7. DIS and DTK – Check

Programming a Heading Intercept to the FAF

1. [HDG] to display the HEADING VECTOR Page
2. Type in the assigned heading
3. [ENTER]
4. [BACK] to display INTERCEPT? Prompt
5. [ENTER]
6. [BACK] until the FAF waypoint is displayed
7. [ENTER] cursor moves to DTK field
8. [ENTER]
9. [ENTER] NAVIGATION Page 1 will be displayed with the TO waypoint, the FAF, and waypoint previous to the FAF in the FR field. The system will now intercept the Final Approach course and sequence to the MAP if the OK ENTER? Prompt was displayed prior to pressing the last ENTER key.