



HOLDING

1. General Information

- a. The objective of this task is to determine your knowledge of and ability to perform holding procedures.

NOTE: If your airplane is not equipped with DME, you may disregard any reference to that instrument.

- b. A holding pattern involves a combination of simple basic maneuvers -- two turns and two legs in straight-and-level flight or descending when cleared by ATC.
 - 1) Although these maneuvers are far less difficult than some, holding procedures are a common source of confusion and apprehension among instrument pilot trainees, and even some instrument-rated pilots.
- c. There are many reasons for this apprehension, among them the idea that holding implies uncertainty, delay, procedural complications, and generally an increased workload at a time when you are already busy reviewing details of your instrument approach.
 - 1) Another reason involves the normal psychological pressure attending approach to your destination, when you become increasingly conscious of the fact that your margin of error is narrowing.
 - a) The closer you get to landing, the more decisions you must make, and your aeronautical decision making (ADM) needs to be quick, positive, and accurate as you may have fewer chances to correct the inaccuracies.
- d. Like any other flight problem (remember learning to land as a student pilot), the "complicated" holding pattern becomes routine after sufficient study of the procedures in their normal sequence.

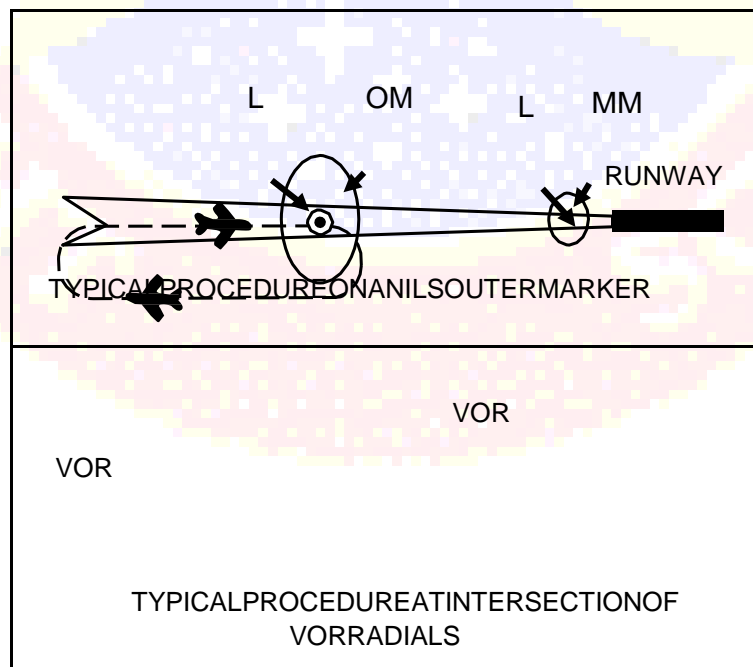
2. Task Objectives

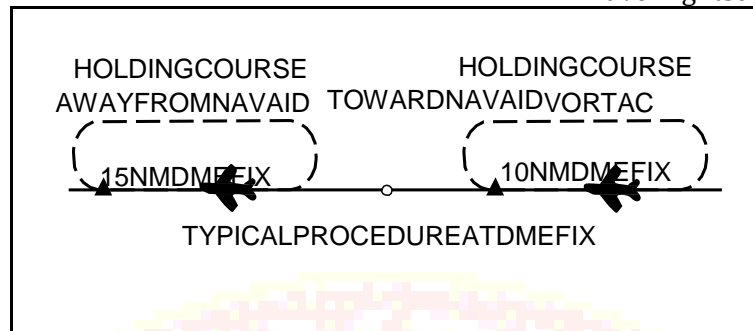
- a. **Exhibit adequate knowledge of the elements related to holding procedures.**
 - 1) Holding instructions
 - a) Whenever you have been cleared to a fix other than the destination airport and delay is expected, it is the responsibility of ATC to issue complete holding instructions (unless the pattern is charted), an EFC (expect further clearance) time, and the best estimate of any additional en route/terminal delay.
 - b) If the holding pattern is charted and ATC does not issue complete holding instructions, you are expected to hold as depicted on the appropriate chart.
 - i) ATC may omit all holding instructions except the charted holding direction and the statement "as published"; e.g., "Hold east as published."
 - ii) ATC will issue complete holding instructions if you request them.
 - c) If no holding pattern is charted and holding instructions have not been received, you should ask ATC for holding instructions prior to reaching the fix.
 - i) This procedure will eliminate the possibility of an aircraft entering a holding pattern other than the one desired by ATC.
 - ii) If you are unable to obtain holding instructions prior to reaching the fix (due to frequency congestion, stuck microphone, etc.), you should hold in a standard pattern on the course on which you approached the fix and request further clearance as soon as



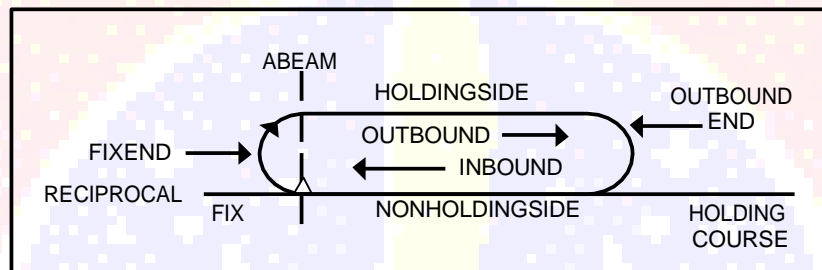
possible.

- In this event, the altitude of your airplane will be protected so that separation will be provided as required.
- d) When no delay is expected, ATC should issue you a clearance beyond the fix as soon as possible and, whenever possible, at least 5 min. before you reach the clearance limit.
- e) An ATC clearance requiring an airplane to hold at a fix where the pattern is not charted will include the following information:
- i) Direction of holding from the fix in terms of the eight cardinal compass points (i.e., N, NE, E, SE, etc.)
 - ii) Holding fix. The fix may be omitted if included at the beginning of the transmission as the clearance limit.
 - iii) Radial, course, bearing, airway, or route on which the airplane is to hold
 - iv) Leg length in miles if DME or RNAV is to be used. Leg length will be specified in minutes if the pilot requests it or the controller considers it necessary.
 - v) Direction of turn if left turns are to be made, the pilot requests this information, or the controller considers it necessary
 - vi) Time to expect further clearance (EFC) and any pertinent additional delay information
- 2) The holding procedure is a predetermined maneuver, with respect to a holding fix, that keeps your airplane within prescribed airspace while awaiting further clearance from ATC.
- a) The holding fix is identifiable by use of NAVAIDs and is used as a reference point in establishing and maintaining the position of your airplane while holding.
 - i) The holding fix can be at a station (VOR), an intersection, a DME fix, or a waypoint (GPS or other type of RNAV).
 - b) Examples of holding are presented below.





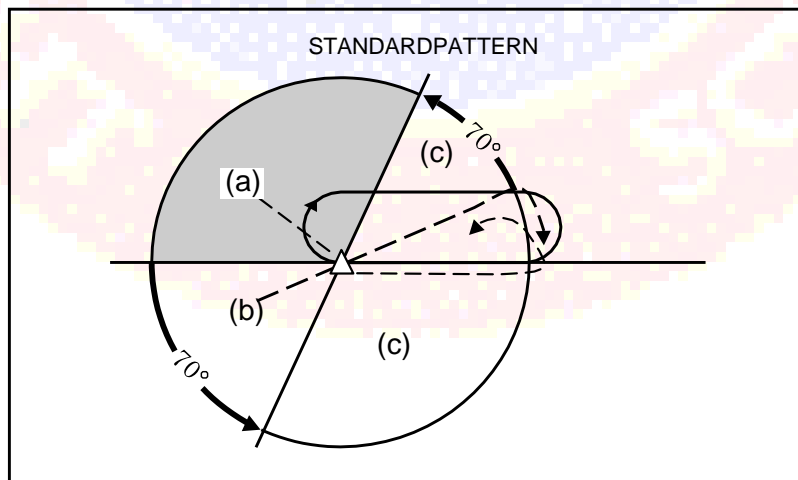
- 3) The holding pattern is a racetrack pattern (with no wind) in which you follow a specified course inbound to the holding fix, turn 180° and fly a parallel course outbound, and then turn 180° back to the inbound course to the holding fix. The holding pattern and descriptive terms are shown in the figure below.



- 4) Whenever aircraft are holding at an outer fix, ATC will usually provide radar surveillance of the outer fix holding pattern airspace area, or any portion of it, if it is shown on the controller's radar display.
- The controller will attempt to detect any holding aircraft that stray outside the holding pattern airspace area and will assist any detected aircraft to return to the assigned airspace area.
 - Many factors could prevent ATC from providing this additional service, such as workload, number of targets, precipitation, ground clutter, and radar system capability.
 - These circumstances may make it unfeasible to maintain surveillance of the holding pattern airspace area.
 - The provision of this service depends entirely upon whether controllers believe they are in a position to provide it and does not relieve you of your responsibility to adhere to an accepted ATC clearance.
- 5) If you are established in a published holding pattern at an outer fix at an assigned altitude above the published minimum holding altitude (MHA) and are subsequently cleared for the approach, you may descend to the published MHA.
- The holding pattern would be only a segment of the IAP if it is published on the IAP chart and is used in lieu of a procedure turn.
- 6) For those holding patterns in which there is no MHA, when you receive your approach clearance, you must maintain your last assigned altitude until you leave the holding pattern and are established on the inbound course.
- Once established, the published minimum altitude of the route segment being flown will apply.
 - It is ATC's responsibility to assign you a holding altitude that will permit a normal descent on the inbound course.



- 7) Holding patterns at the most commonly used holding fixes are depicted (charted) on low/high altitude en route, area, and STAR charts.
- You are expected to hold in the pattern depicted unless specifically advised otherwise by ATC.
- b. **Change to the holding airspeed appropriate for the altitude or your airplane when 3 min. or less from, but prior to arriving at, the holding fix.**
- You are required to start a speed reduction when 3 min. or less from the holding fix.
 - You should cross the holding fix, initially, at or below the following maximum holding airspeeds (indicated) for the appropriate altitude:
 - MHA to 6,000 ft. MSL -- 200 kt.
 - 6,001 ft. MSL to 14,000 ft. MSL -- 230 kt.
 - 14,001 ft. MSL and above -- 265 kt.
 - Nonstandard maximum holding airspeeds will be depicted by an icon on the IFR chart.
 - The icon is a standard holding pattern symbol (racetrack) with the airspeed restriction shown either in the center or next to the holding pattern symbol.
 - In your airplane, you will most likely use the approach airspeed for your holding airspeed.
 - Your instructor will provide you with airspeed, configuration, and power setting for your airplane.
 - In your airplane, holding airspeed is _____.
 - While not required, the further reduced airspeed/power setting will provide you with greater fuel savings and endurance.
- c. **Explain and use an entry procedure that ensures that your airplane will remain within the holding pattern airspace for a standard, nonstandard, published, or nonpublished holding pattern.**
- While other entry procedures may enable you 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.
 - The entry procedure sectors are based upon the direction of the inbound holding course and a line drawn 70° to it from the holding fix, as shown in the FAA figure on the next page.



- Standard pattern** -- All turns are to the right (as shown above).
- Nonstandard pattern** -- All turns are to the left.

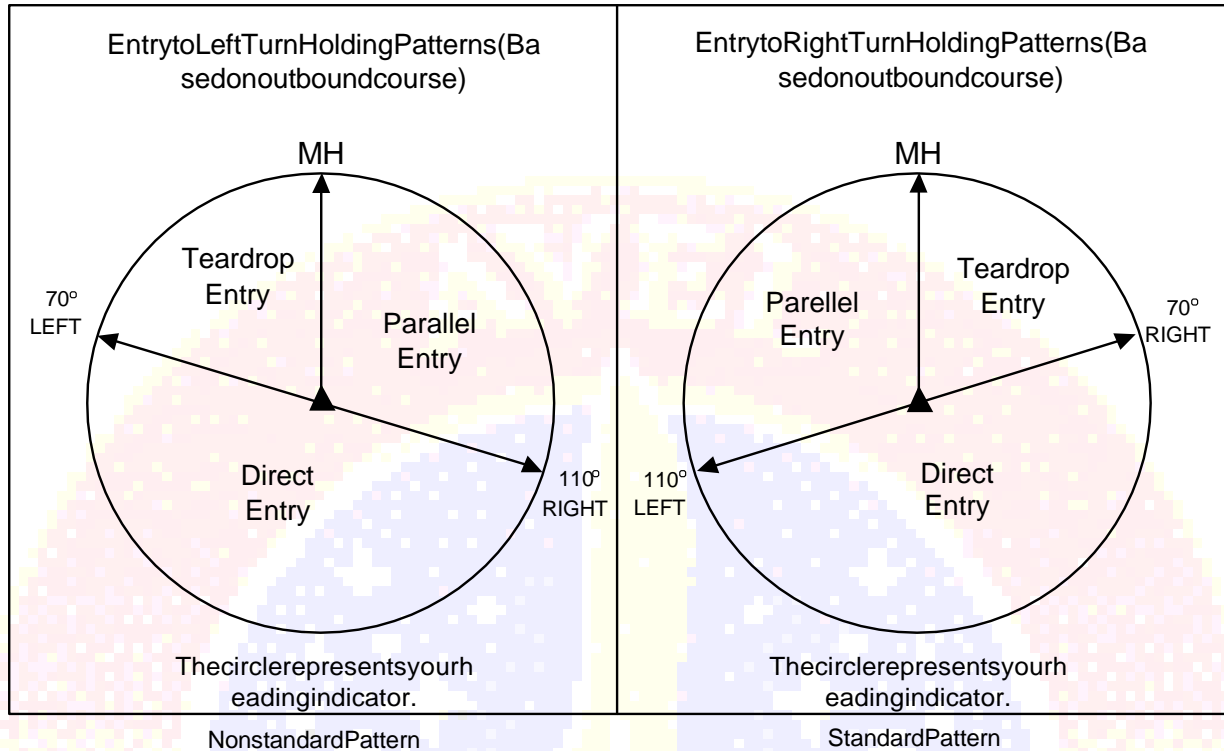


- i) A nonstandard pattern is drawn in the same manner as the standard pattern, except at the fix the turn is left (not right).
 - ii) From the inbound course, a line is drawn 70° to it from the fix, cutting the outbound leg at about one-third of its length.
 - c) All turns are made at standard rate, i.e., 3° per second.
- 3) The FAA holding pattern entry diagram above and FAA entry procedures described in 4), 5), and 6) confuse many pilots because they are based on the position from which you are approaching the holding fix, rather than on your heading to the holding fix and the desired outbound course in the holding pattern.
- 4) **Parallel entry procedure.** When approaching the holding fix from anywhere in sector (a), as illustrated above, you should use the parallel entry procedure. Once you have crossed the holding fix, turn to a heading to parallel the holding course outbound on the non-holding side for 1 min.; then turn in the direction of the holding pattern through more than 180° , and return to the holding fix or intercept the holding course inbound.
- 5) **Teardrop entry procedure.** When approaching the holding fix from anywhere in sector (b), as illustrated above, you should use the teardrop entry procedure. Once you have crossed the holding fix, turn outbound to a heading (outbound heading minus 30° for a standard pattern or outbound heading plus 30° for a nonstandard pattern) for a 30° teardrop entry within the pattern (on the holding side) for a period of 1 min.; then turn in the direction of the holding pattern to intercept the inbound holding course.
- 6) **Direct entry procedure.** When approaching the holding fix from anywhere in sector (c), as illustrated on the previous page, you should use the direct entry procedure. Once you have crossed the holding fix, you would turn to follow the holding pattern.
- 7) The better you visualize your airplane's ground track to the holding fix and the ground track of the holding pattern, the easier it is to select and execute the proper entry.
- 8) You may allow $\pm 5^\circ$ in heading when determining the appropriate entry procedure.
 - a) Thus, if you are approaching the holding fix on an entry sector boundary, you may use either of the two entries.
- 9) One popular method with many CFIs and IFR pilots is to use the HI to help visualize the entry procedure.
 - a) When heading toward the holding fix, note your heading.
 - b) Next locate the holding pattern outbound course on your HI.
 - c) For a **nonstandard pattern** (left turns), illustrated on the left below:
 - i) If the outbound course is located between your heading and 70° to the left, use a teardrop entry.
 - ii) If the outbound course is located between your heading and 110° to the right, use a parallel entry.
 - iii) If the outbound course is located anywhere else, use a direct entry.
 - d) For a **standard pattern** (right turns), illustrated on the right below:
 - i) If the outbound course is located between your heading and 70° to the right, use a teardrop entry.
 - ii) If the outbound course is located between your heading and 110° to



the left, use a parallel entry.

iii) If the outbound course is located anywhere else, use a direct entry.



d. **Recognize arrival at the holding fix and initiate prompt entry into the holding pattern.**

- 1) Since a holding fix may be at a NAVAID site (VOR), an intersection, a DME fix, or a waypoint (GPS or other type of RNAV), you must be able to recognize when you are at the holding fix.
 - a) At a NAVAID site, station passage indicates you are at the holding fix.
 - b) While tracking on a radial, an intersection is identified by correctly identifying a cross radial that identifies that intersection.
 - c) Correctly reading the DME from the appropriate VORTAC will indicate arrival at the DME fix.
 - d) Understanding how your IFR-certified GPS or other type of RNAV system indicates arrival at a waypoint and the course information is essential. Manufacturers present this information in various styles.
- 2) Once you arrive at your holding fix, you should promptly execute the appropriate FAA-recommended entry into the holding pattern.

e. **Comply with ATC reporting requirements.**

- 1) You are required to report the time and altitude (or flight level) upon reaching the holding fix.
 - a) You are also required to report when leaving any assigned holding fix or point.
- 2) To aid you in remembering the necessary procedures and reports required upon entering the hold, you should learn and use the “five T’s” each time you are at the fix. As soon as you start your entry, you should perform and confirm each one.



- a) **Turn.** As soon as you cross the holding fix, you must turn to the required heading for the appropriate entry (i.e., parallel, direct, or teardrop).
 - i) Once established, turn to the outbound heading.
- b) **Time.** Begin your outbound timing of 1 min. when you cross the fix for teardrop and parallel entries or when you complete the turn to the outbound heading or are abeam the fix for a direct entry.
 - i) When turning inbound, begin timing to the fix when the wings are level.
- c) **Twist.** After you cross the fix, you should twist the OBS setting to the inbound course.
 - i) Check and adjust your HI, once the wings are level, after each turn.
- d) **Throttle.** You are required to reduce speed to an appropriate holding speed for your particular make and model airplane within 3 min. prior to arriving at the fix.
 - i) Even if your airplane does not reach these maximum speeds, it is still a good idea to slow down to the approach airspeed.
 - ii) It will make the holding pattern easier to fly, keep you within protected airspace, and conserve fuel.
- e) **Talk.** You are required to report your entry into the hold, the altitude at which you are holding, and the time you arrived at the holding fix. This is very important to the controller and his or her handling of other aircraft around you.
 - i) Report leaving the holding fix.
- f. **Use the proper timing criteria, where applicable, as required by altitude or ATC instructions.**
 - 1) The inbound leg should be 1 min. at or below 14,000 ft. MSL.
 - a) Above 14,000 ft. MSL, the inbound leg should be 1.5 min.
 - 2) The initial outbound leg should be flown for 1 min. or 1.5 min. (appropriate to altitude). Timing for subsequent outbound legs should be adjusted, as necessary, to achieve proper inbound leg time.
 - a) You may use any navigational means available (i.e., DME, RNAV, etc.) to ensure the appropriate inbound leg times.
 - 3) Outbound leg timing begins abeam the fix. If the abeam position cannot be determined, start timing when the turn to the outbound heading is completed; i.e., when wings are level.
 - a) At a VOR, outbound timing starts when the TO/FROM indicator reverses (i.e., changes from FROM to TO if OBS is set to inbound course).
 - b) At an intersection or waypoint, outbound timing starts at the completion of the outbound turn, since the abeam position cannot be determined.
 - c) At a DME fix, outbound timing starts at the completion of the outbound turn, since the abeam position cannot be determined.
 - 4) You must adjust your outbound leg time to ensure your inbound leg is 1 min. (at or below 14,000 ft. MSL) or 1.5 min. (above 14,000 ft. MSL).
 - a) One method to adjust your outbound leg timing is to double the inbound time deviation from the required time (e.g., 1 min.) and apply it to the outbound timing.
 - i) If the inbound leg is 50 sec. (10 sec. short of the required 1 min.), double the deviation to 20 sec., and add it to the outbound time for

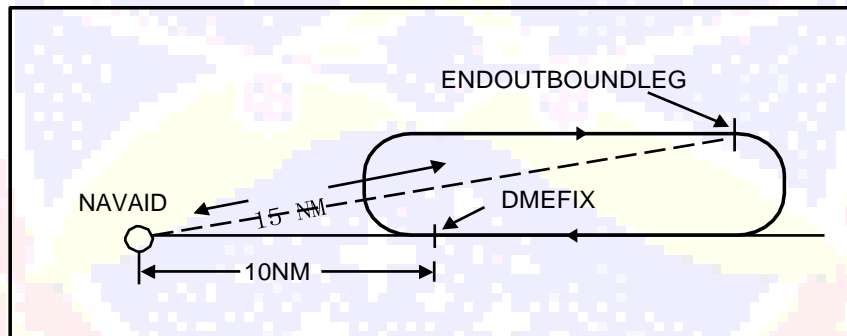


a new time of 1 min. 20 sec.

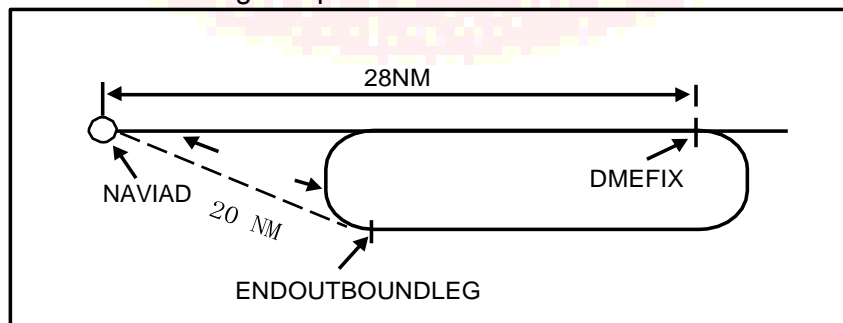
- ii) If the inbound leg is 1 min. 15 sec. (15 sec. more than the required 1 min.), double the deviation to 30 sec., and subtract it from the outbound time for a new time of 30 sec.
- b) For excessive deviations from the required inbound time (e.g., 1 min.), other adjustments may be appropriate (e.g., equal to or half of the deviation added to outbound time).
 - i) If the inbound leg is 2 min. (1 min. more than the required 1 min.), halve the 1-min. excess and subtract 30 sec. for a new outbound time of 30 sec.
- c) Continue to make progressive adjustments until the correct outbound time is determined.
- d) This step is done simultaneously with item h. on the next page. Changes in outbound timing will affect outbound heading and vice versa.

g. Comply with pattern leg lengths when a DME distance is specified.

- 1) DME holding is subject to the same entry and holding procedures except that distances (expressed in NM) are used in lieu of time values.
- 2) ATC specifies the outbound leg length.
- 3) The end of the outbound leg is determined by the DME reading.
 - a) EXAMPLE: When holding at a DME fix and the inbound course is toward the NAVAID, the fix distance is 10 NM, and the leg length is 5 NM, the end of the outbound leg will be reached when the DME reads 15 NM.
 - i) Sample clearance for the holding pattern depicted in the figure below is “. . . hold **east** of the 10 DME fix on the 090 radial, 5-mile legs. Expect further clearance at 1725. Time now is 1655.”



- b) EXAMPLE: When holding at a DME fix and the inbound course is away from the NAVAID, the fix distance is 28 NM, and the leg length is 8 NM, the end of the outbound leg will be reached when the DME reads 20 NM.
 - i) Sample clearance for the holding pattern depicted in the figure below is “. . . hold **west** of the 28 DME fix on the 090 radial, 8-mile legs. Expect further clearance at 1725. Time now is 1655.”





h. **Use proper wind correction procedures to maintain the desired pattern and to arrive over the fix as close as possible to a specified time.**

- 1) The symmetrical racetrack holding pattern cannot be tracked when a wind exists.
 - 2) Compensate for wind effect by drift correction on the inbound and outbound legs.
 - a) First, determine the wind correction angle required while tracking on the inbound course. Once you have determined the wind correction angle inbound, triple it when on the outbound leg to compensate for wind drift during the turns and on the straight legs.
 - i) **EXAMPLE:**If correcting left by 8° when inbound, correct right by 24° when outbound.
 - ii) Note that, while the FAA recommends tripling the inbound wind correction angle, large corrections on the outbound leg (i.e., over 30°) may result in overcompensation. To avoid overcompensation, some pilots will only double the inbound wind correction angle.
 - **EXAMPLE:**If correcting left by 20° when inbound, correct right by 40° when outbound.
 - b) Failure to use this technique may result in your flying into unprotected airspace (i.e., the non-holding side) and/or make it difficult to intercept and establish yourself on the inbound course, resulting in problems maintaining the pattern.
 - 3) Normally it should take you no more than two or three complete circuits to have your wind corrections and the appropriate inbound leg time established.
 - 4) While holding at a fix, when you receive instructions specifying the time of departure from the fix, you should adjust the timing of your holding pattern so you can leave the fix as closely as possible to the time specified.
 - a) After departing the holding fix, you should resume normal speed unless ATC requests otherwise.
 - b) Where the holding fix is associated with an instrument approach and timed approach procedures are being used, you should not execute a procedure turn, unless you advise ATC, since aircraft holding are expected to proceed inbound on final approach directly from the holding pattern when approach clearance is received.
 - c) **EXAMPLE:**You are cleared to leave the holding fix at 1207. As you arrive over the fix, you note the time is 1204. Since each turn requires 1 min. (total of 2 min.), 1 min. remains for both the outbound and the inbound leg. If there is no wind, you would proceed outbound for 30 sec. in order to arrive at the fix at 1207.
 - i) If you have a headwind or tailwind on the inbound course, you adjust the outbound time in order to arrive at the fix at the appropriate time.
- i. **Maintain your airspeed within 10 kt.; altitude within 100 ft.; and headings within 10° ; and track a selected course, radial, or bearing.**
- 1) If you are unable to maintain these limits because of turbulence or other situations, notify ATC.

3. Common Errors during Holding Procedures

a. **Failure to use an entry procedure that ensures you remain in protected airspace.**

- 1) It is strongly recommended by the FAA and your author that you use a parallel,



teardrop, or direct entry procedure, as appropriate.

b. **Failure to recognize holding fix passage.**

- 1) You must divide your attention between your flight and navigation instruments.
- 2) Your holding fix will be at a VOR, a DME fix, or a waypoint.

c. **Failure to comply with ATC instructions.**

- 1) This error is normally due to not understanding the holding clearance.
 - a) Read back the instructions to ATC and ask for clarification of any part you do not understand.

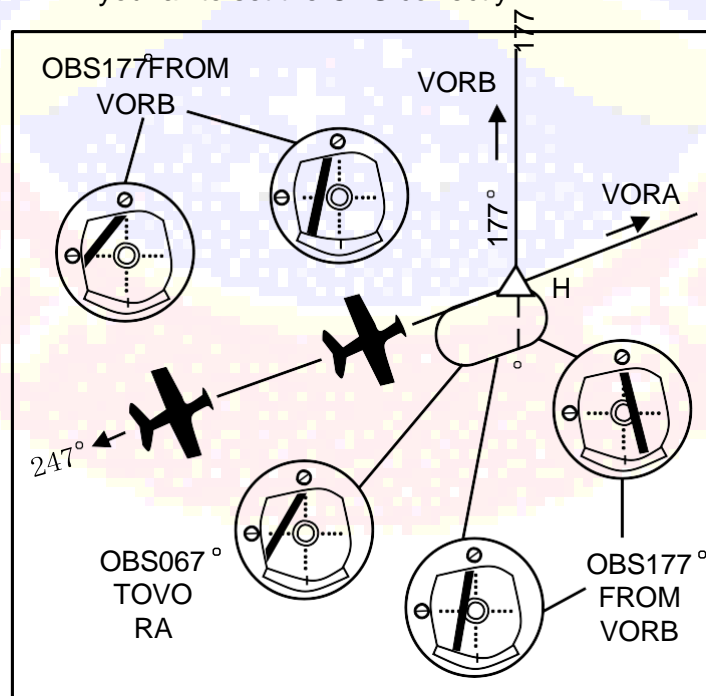
d. **Improper timing and wind drift corrections.**

- 1) Outbound timing starts when you are abeam the holding fix.
 - a) If the abeam position cannot be identified, timing begins when you roll out (wings level) on the outbound heading.
- 2) The outbound time must be adjusted so that the inbound time is 1 min. (at or below 14,000 ft. MSL) or 1.5 min. (above 14,000 ft. MSL).
- 3) Outbound leg wind drift corrections should be triple the inbound leg wind drift correction.

4. VOR Intersection Holding Examples

a. VOR intersection holding

- 1) Assume that you are tracking inbound on the 247° radial of VOR "A" (i.e., 067° course) and you are to hold at intersection "H."
- 2) If your VOR equipment is limited to one receiver, it is especially important to establish your inbound heading for accurate course following, while orienting yourself to the 177° radial of VOR "B."
 - a) To prevent overshooting the fix for holding entry, you must perform your position checks and tuning accurately and quickly.
 - b) You can easily misinterpret your position with respect to the 177° radial if you fail to set the OBS correctly.



- 3) When establishing a fix or an intersection by means of VOR stations on



either side of your course, the TO/FROM indicator will read FROM if the OBS is set with the radial (not the reciprocal) under the index.

- a) Visualize flying outbound on the 177° radial of VOR "B." If you were west of your course, the CDI would be deflected toward the left as illustrated above in the two top CDI indications in the diagram.
 - b) Note the opposite CDI indication is given if you set the OBS to the R-357 of VOR "B." The TO/FROM indicator will be TO, and you will receive right deflections when west of the 177° radial (visualize flying to the VOR on a 357° course/OBS).
- 4) Roll into a standard-rate right turn as the CDI of VOR "B" centers. As you roll out on the outbound heading, check the CDI to determine the position of the 177° radial.
- a) Initially, you are east of the 177° radial with a right CDI deflection.
 - b) Begin timing for the outbound leg as you roll out on the outbound heading.
 - c) Then tune in VOR "A," setting the OBS on 067°, if you have only a single VOR.
 - d) As illustrated, when you switch to the 067° course to VOR "A," you have a left deflection.
- 5) After 1 min. outbound, execute a standard-rate right turn to intercept the 247° radial of VOR "A" and track inbound to the holding fix (intersection H).
- 6) If you have two VORs, you do not need to switch back and forth from one VOR to the other.
- a) VOR "A" tuned in on VOR 1, OBS set to 067°
 - b) VOR "B" tuned in on VOR 2, OBS set to 177°
5. GPS Holding
- a. No special knowledge about holding procedures is required when using a GPS.
 - b. The most important knowledge you must have is how to operate your GPS receiver in a holding pattern.
 - 1) Each manufacturer requires you to operate the GPS receiver in a specific manner (i.e., just because you know how to operate one make of GPS does not mean you can operate another make of GPS without training).
 - a) Sometimes the GPS receiver is operated differently depending on whether you are at a published holding fix (i.e., the missed approach holding fix) or at an unpublished holding fix.
 - c. When learning to use the GPS for holding operations, use the ground training mode (if available) to learn how to input information, read the display, and interpret the displayed information, before attempting to perform holding procedures in flight.
 - a. As with any new equipment, we strongly recommend you practice using a GPS under controlled circumstances (e.g., with a safety pilot or CFI) before using it in actual IMC conditions.

