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INSTRUMENT RATING · AIRPLANE

Instrument Rating Study Guide

The material behind the ACS, explained so you can use it in the airplane

Organized by FAA-S-ACS-8C, Instrument Rating Airplane. Every Area and Task, with an in-depth look at the subject matter: regulations, weather, instruments, navigation, approaches, and emergencies.

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This free sample is from the Instrument Rating Study Guide: the holding procedures Task, with its in-depth chapter on entries, timing, and wind correction. Free to share in this form. Independent study material, not an FAA publication, and not a substitute for your POH/AFM or flight instruction. Always verify against current FAA sources.

IR.III.B Holding Procedures

References: 14 CFR part 91; AIM; FAA-H-8083-2, FAA-H-8083-3, FAA-H-8083-15, FAA-H-8083-16, FAA-H-8083-25

Objective: *To determine the applicant exhibits satisfactory knowledge, risk management, and skills associated with holding procedures solely by reference to instruments.*

WHAT THE EXAMINER IS LOOKING FOR

That you can enter, fly, and leave a hold correctly, and that you understand when holding creates a fuel and decision problem.

WHAT YOU NEED TO KNOW

- **The pattern.** A standard hold uses **right turns**, inbound leg of one minute at or below 14,000 ft (1.5 minutes above), and the inbound course to the fix. A **non-standard** hold uses left turns. A hold can be defined by a navigation fix and radial, by DME legs, or by GPS.
- **Entries (K1).** The three recommended entries are **parallel**, **teardrop**, and **direct**, determined by the heading you arrive on relative to the holding course. Draw the holding course through the fix, then draw a line through the fix at **70°** to the outbound course. For a standard (right-turn) hold: arriving from the holding (non-turn) side, within the 70° sector next to the outbound course, you fly a **parallel** entry. Arriving within the 110° sector on the opposite side, you fly a **teardrop** entry. Arriving from anywhere in the remaining 180° sector, which contains the inbound course, you fly a **direct** entry. Be able to draw it for left-turn holds too (mirror image).
- **Speeds.** Maximum holding airspeeds for civil aircraft: **200 knots** up to 6,000 ft MSL, **230 knots** from 6,001 to 14,000, and **265 knots** above 14,000 (some locations have lower limits). In light airplanes this rarely limits you, but know it. Slow to or near maneuvering speed when approaching the fix if turbulence is likely.
- **Timing and wind correction.** Time the outbound leg to produce a one-minute inbound leg (adjust after the first circuit). Correct for wind by using a **drift correction** on the inbound and a larger correction on the outbound (about three times the inbound correction), and adjust the timing.
- **Reporting.** Report entering the hold if you are not in radar contact, and report leaving as instructed. Know the **EFC (expect further clearance)** time and what you do if you lose communications while holding.
- **Fuel and risk (R1 to R3).** Holding burns fuel with no progress. If assigned an unexpected EFC, recalculate your fuel and alternate, and be ready to declare **minimum fuel** or an emergency. Holding often means weather is deteriorating at the destination, so prepare your alternate.

HOW TO DO IT WELL

- **A repeatable procedure.** Slow down and configure before the fix, determine the entry before you arrive, fly the entry, time the first outbound leg (or use DME or GPS), and adjust. Use the heading indicator, not the compass, to track headings, and keep the airplane in trim.
- **Use your tools carefully.** In a GPS airplane, the hold may be loaded by the system, but you must still know the entry and monitor the autopilot or the CDI.
- **Draw the pattern.** Sketch the holding course, the fix, and your arrival heading. The entry usually becomes obvious.

WHAT YOU MAY RUN INTO

- A hold clearance with non-standard details (left turns, a DME leg, or a different radial). Determine the entry, fly it, and correct for wind.
- "You've been given an EFC of 40 minutes. You have 1:10 of fuel. What now?"
- A fix where the examiner gives you a heading and asks which entry you use, without an aid.

COMMON MISTAKES

- Choosing the wrong entry because you did not draw it.

- Failing to correct for wind on the outbound.
- Overshooting the fix at high speed.
- Not recalculating fuel for the delay.
- Letting the airplane drift out of the protected airspace.

HOW TO PREPARE

- Practice entries on paper until you can do it in five seconds.
- Fly holds in different winds and with different fix types.
- Rehearse the fuel and diversion decision for a long EFC.

> **Your airplane:** Slowing and configuring for holding depends on **your airplane's** power settings and speeds. Know the power for your holding airspeed and your fuel burn at that setting.

Holding in Depth: Entries, Timing, and Wind Correction

Vocabulary

- **Holding fix:** the point the pattern is built around (a navaid, intersection, DME fix, or GPS waypoint).
- **Holding course (inbound course):** the course you fly toward the fix on the inbound leg. The clearance gives you the direction from the fix (for example, "hold west on the 270 radial"). The inbound course is the **opposite** (090).
- **Standard pattern:** right turns. **Non-standard pattern:** left turns.
- **Outbound leg** is flown away from the fix, and is timed so the inbound leg takes one minute (1.5 minutes above 14,000 ft MSL).
- **EFC** (expect further clearance) is the time at which ATC expects to clear you from the hold. If you lose communications, you leave at the EFC.

Decoding a holding clearance

A full clearance has these parts: **direction from the fix**, **fix name**, **radial or course**, **leg length** (time or DME), **turn direction** (if not standard), and **EFC time**. Example: "Cessna 123, hold west of the ABC VOR on the 270 radial, 10 mile legs, left turns, expect further clearance at 1530." That means a **non-standard (left-turn) pattern** west of the fix, flying **inbound on 090**, with **DME-based legs** (10 NM outbound), and an EFC at 1530.

Determining the entry

Use the **heading** you are flying when you reach the fix, compared with the **inbound course**. Draw it: put the fix in the center, draw the inbound course arriving at the fix, draw the outbound course leaving, and draw a line through the fix at **70 degrees** to the outbound course, creating three sectors.

Entry	When it applies (standard hold)	How to fly it
Direct	You arrive from the broad sector that includes the inbound course (about 180 degrees wide).	Cross the fix and turn to the outbound heading in the direction of the holding turns. Time the leg.
Teardrop	You arrive from the narrower 110-degree sector on the side of the holding turns (the non-holding side of the outbound course is 70 degrees).	Cross the fix, turn to a heading about 30 degrees off the outbound course toward the holding side, fly for the leg time, then turn in the direction of the holding turns to intercept the inbound course.
Parallel	You arrive from the 70-degree sector on the non-holding side of the outbound course.	Cross the fix, turn to fly parallel to the outbound course (the heading of the outbound leg), fly for the leg time, then turn toward the holding side (a turn of 180 degrees, opposite to the hold turns), and return to the fix.

*A practical way to check: a **direct** entry rarely needs more than one turn of the pattern, a **parallel** entry puts you on the non-holding side of the course first, and a **teardrop** puts you on the holding side first. Always **sketch it**, and **verify with your heading indicator** (the GPS may offer an entry suggestion, but you should still understand it).*

Speeds, timing, and wind

- **Slow down** before reaching the fix. In most light airplanes, slow to a comfortable holding speed (often at or below maneuvering speed in turbulence). Maximum holding airspeeds are **200 knots** to 6,000 ft, **230 knots** 6,001 to 14,000, and **265 knots** above 14,000 (check the current AIM and the chart for exceptions).

- **Timing.** Start the timer **abeam** the fix or when wings are level outbound, whichever is later. Time the outbound leg for **one minute** (or the time given). Adjust the outbound time on later circuits so the inbound leg is one minute.
- **Wind correction.** On the inbound leg, correct the heading to hold the course, and note the **drift correction**. On the outbound leg, use **about three times** the inbound correction angle (for example, a 5-degree correction inbound means a 15-degree correction outbound), and adjust the timing: with a headwind inbound, shorten the outbound leg, and with a tailwind inbound, lengthen it.
- **Turns.** Use **standard rate** (3 degrees per second) or a bank of **no more than 30 degrees**, whichever is less. A turn of 180 degrees at standard rate takes **one minute**.
- **Reporting.** Report entering the hold (if not in radar contact) and when leaving it. Report an **altitude change** or an inability to hold.

GPS holding and holds with a published pattern

In a GPS airplane, a published hold may be loaded as part of the procedure, and the system will **suspend** waypoint sequencing at the holding fix. You must **manually resume** (unsuspend) when you leave the hold. For a hold in a flight plan that is not published (an ATC-assigned one), you may need to build the pattern with the **hold** function, and check **inbound course, direction, turn direction, and leg length**. In either case, verify with the heading indicator and be ready to fly it by hand.

Fuel and risk

Holding burns fuel and delivers no progress. When ATC gives an EFC, calculate your **time remaining** to the point where you must divert to your alternate with legal reserves. If the EFC is later than that point, **tell ATC** that you will need to divert, or declare **minimum fuel**. If fuel is critical, declare an **emergency**. Holding is also a signal: **why** is ATC holding you (weather, traffic, a closed runway), and what does that mean for the destination and the alternate?

That was a sample.

The full guide explains every Task the same way.

The full Instrument Rating Study Guide (88 pages) includes:

- Every Instrument Rating Airplane ACS Area and Task, in ACS order
- In-depth chapters on weather, systems, approaches, and lost communications
- What the examiner looks for and the common mistakes for each Task
- A numbers-to-know quick reference and a checkride scenario bank

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