# Chapter 6
# Holding Patterns

**You've got to know when to hold 'em,**
**Know when to fold 'em,**
**Know when to walk away,**
**Know when to run.**

Kenny Rogers
*The Gambler*

"Hold 'em or fold 'em" is a card player's decision, but when ATC tells a pilot to hold, the controller holds all the cards. Holding is a non-negotiable invitation to chase your own tail for a bit while the controller makes the flow go.

Contrary to popular belief, controllers do not issue holding instructions just to hear pilots stammer and sweat, though that's often a secondary result. ATC's primary job is to keep airplanes under IFR control separated. Just like the college prank of stuffing students into a phone booth, there are only so many airplanes that will fit into a controller's not-so-tiny-but-still-crowded block of airspace while maintaining the required separation. When things get a little too jammed, the controller has to give somebody a timeout.

Holding patterns are aviation's means of allowing pilots to stop in midair so the controller can buy a bit of time. Airplanes are unique (you knew that) in the sense that you can't just tell them to stop. Instead, we have them fly a racetrack pattern around a point defined by one or more navigational aids. We don't want to fold 'em, we just want to hold 'em so everyone can walk away at the right time.

Besides overcrowding, another important reason to hold is if radio communication is lost. Many times an initial IFR clearance will clear you to a point short of the destination, and you will be told to expect further clearance (EFC) by a specific time. If you arrive at the intersection without operable communications radios, the rules say you're to hold until your EFC time and then proceed along the flight planned/filed route. ATC will know to make way for you even though you're incommunicado.

As an instrument pilot, you'll need to know how to define a holding pattern, as well as how to enter one. Sometimes this can be a challenge for instrument students, because it's often the first time they're called upon to simultaneously fly the plane and learn to think ahead of it. That's why the mere mention of holding patterns often sends instrument students running like chickens with the Colonel in close pursuit. Well, don't chicken out. In this chapter I'll tell you all about your rights (and lefts), the commonsense principle that underlies all holding pattern entries, and a 10 cent solution to finding the right way into any holding pattern. So hold on. Here we go.

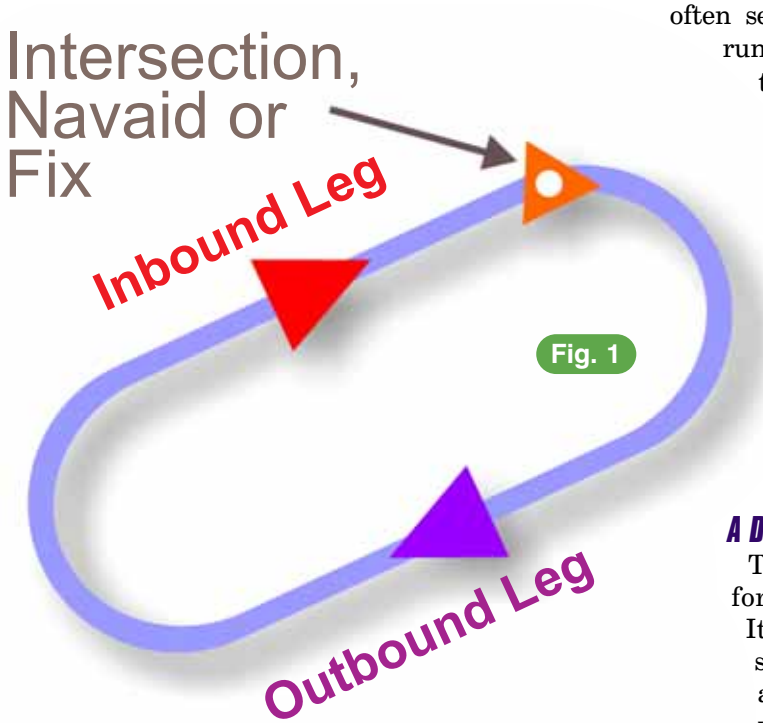



Fig. 1

The holding pattern has one basic form, as shown above. There's always a place and direction to hold, an inbound and outbound leg and whether the turns will be to the right or left.

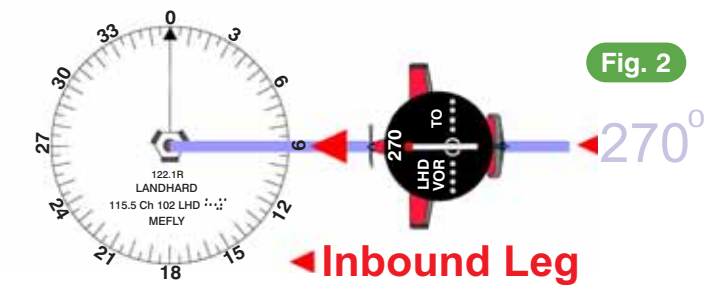
## A Day at the Racetrack

There's only one basic form for a holding pattern. It's racetrack shaped, as shown in Figure 1. Unlike airport traffic patterns, when it comes to holding patterns *right* turns are standard. Left-hand traffic patterns are useful to

VFR pilots because the PIC usually sits on the left side of the airplane. This makes it easier to see the runway environment when landing. For instrument pilots, it doesn't really matter which seat is occupied when it comes to holding patterns, because looking out the window is irrelevant when flying inside a cloud.

If you're going to hold, you need a place at which to hold. This is the focal point of the holding pattern and it can be an intersection, navaid, DME fix, or even a waypoint. There's always a bearing, radial, course or airway leading inbound to this fix, which is why this is called the *inbound* leg of the holding pattern (Figure 2).

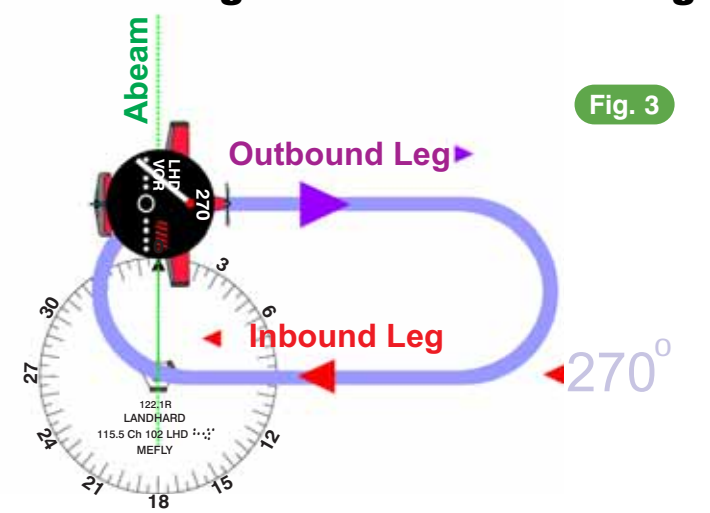
## The Holding Pattern Inbound Leg




There will always be a point (navaid, fix, waypoint) at which you'll hold and you'll always head directly inbound to this point on what is referred to as the *inbound leg* of the holding pattern.

The *outbound leg* begins after you've crossed over the holding fix and made a 180 degree turn. At the completion of the 180 degree turn you will be abeam the fix (approximately) as shown in Figure 3. From there, you'll start your time and fly the direction of the outbound leg for one

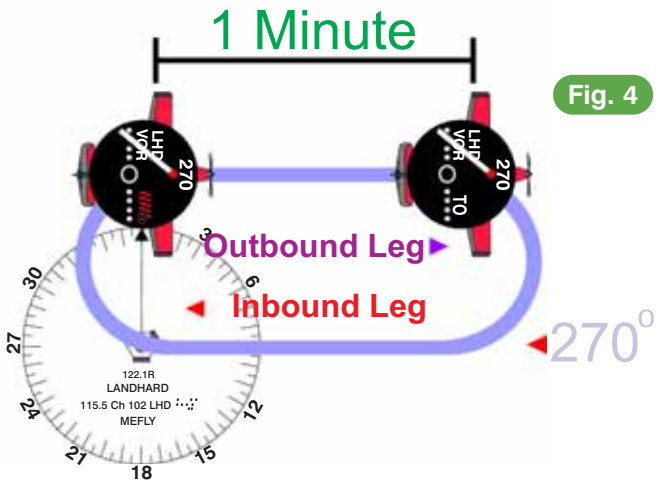
## The Holding Pattern Outbound Leg




The *outbound leg* of the holding pattern is flown in the opposite direction of the inbound leg.

minute (Figure 4). (Technically speaking, you'll only be able to precisely determine when you're abeam the fix if you have ADF or a moving map display. If you don't have either of these, then just start your outbound leg timing when you roll out of the turn.) At the completion of one minute (in a no-wind condition) you'll turn 180 degrees to intercept the inbound leg. If there is no wind, you'll find

## Timing the Outbound Leg




You'll initially fly the outbound leg for one minute then turn to intercept the inbound leg.

that it will take one minute to fly the inbound leg (Figure 5). This sequence repeats itself until ATC or the regulations allow you to leave holding and proceed on course.

Before we proceed further, consider that when ATC gives you instructions to hold, you can expect the following information to be stated in the clearance:

The direction the holding pattern lies in, defined from the holding fix (N, NE, E, SE, S, etc.).

A place to hold: an intersection, navaid, DME fix or waypoint.

A radial, course, bearing, airway or route on which to hold.

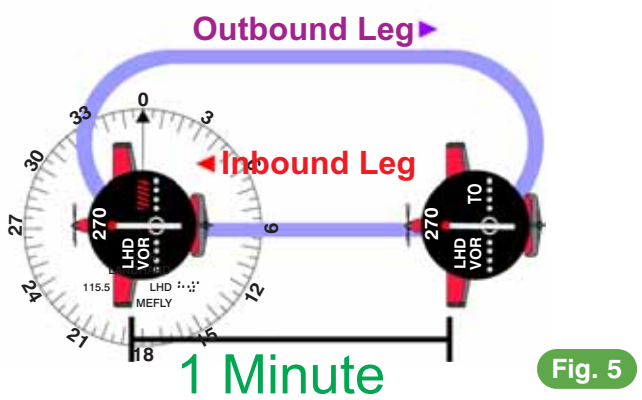
Leg length in miles (or minutes) if you're using DME or area navigation.

A direction of turn, either standard or non-standard when holding.

Time to expect further clearance (EFC), if appropriate.

We'll talk more about these individual items in a bit as well as discuss how to enter a holding pattern as well as exit one. For now, keep in mind that when you're asked to hold, this means you are essentially keeping your airplane within the limits of the airspace, both vertical and horizontal,

## Timing the Inbound Leg

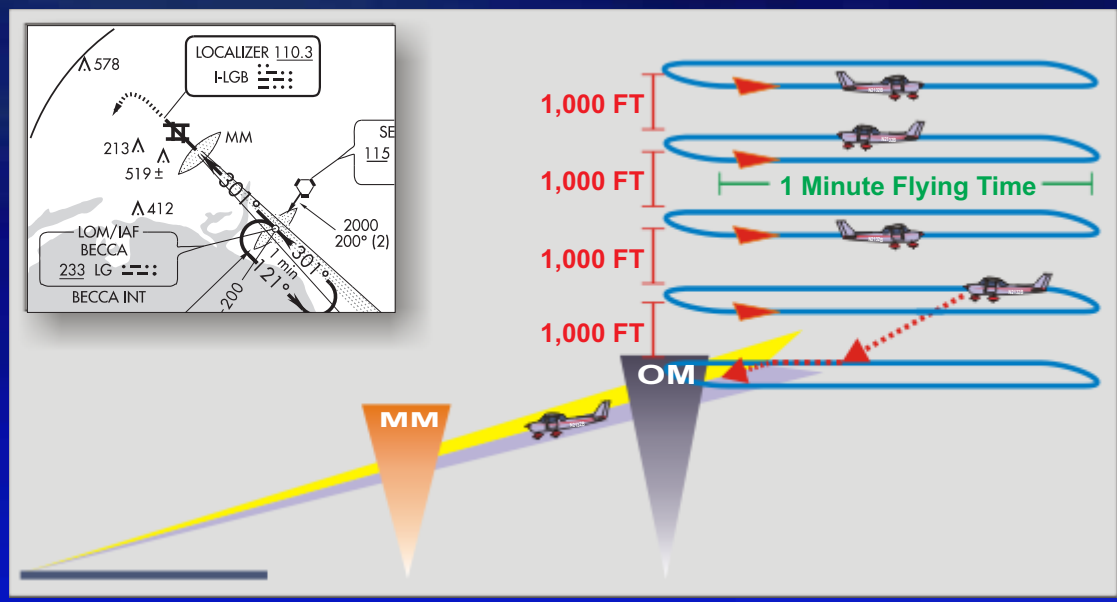



In a no-wind condition, flying the outbound leg for one minute should result in a one minute inbound leg.

## Timed Approaches From a Holding Fix

One time a doctor asked me what I thought of collagen. I said that I thought everyone should get an education. He seemed flustered and changed the subject by asking me what I thought about the problems with Beirut. I said I thought he was a great ball player. Now that was a communication problem that caused confusion, much like the confusion many instrument students experience when they first read about timed approaches from a holding fix.

Timed approaches from a holding fix are often made when ATC has many airplanes arriving for an approach at the same time (they are often done in non-radar environments). To deal with the problem, the controller might stack one airplane on top of another in a holding pattern at 1,000 foot vertical intervals (this often takes place at some fix that's part of the instrument approach structure, like the final approach fix or outer marker) as shown in the figure to the right. Then, when appropriate, the controller will request that an airplane (usually the lowest one in the stack, of course) leave the holding fix at a specific time and fly the approach. Now you know why you must be good at modifying your holding pattern legs to arrive over the holding fix and departing it inbound for the approach.




Timed approaches may be conducted when the following conditions are met:

1. A control tower is in operation at the airport where the approaches are conducted.
2. Direct communications are maintained between the pilot and the Center or Approach controller until the pilot is instructed to contact the tower.
3. If more than one missed approach procedure is available, none require a course reversal.
4. If only one missed approach procedure is available, the following conditions are met:
   (a) Course reversal is not required; and,
   (b) Reported ceiling and visibility are equal to or greater than the highest prescribed circling minimums for the approach chart.
5. When cleared for the approach, pilots shall not execute a procedure turn (14 CFR Section 91.175).

Courtesy Microsoft Flight Simulator

### Holding Above 14,000' MSL

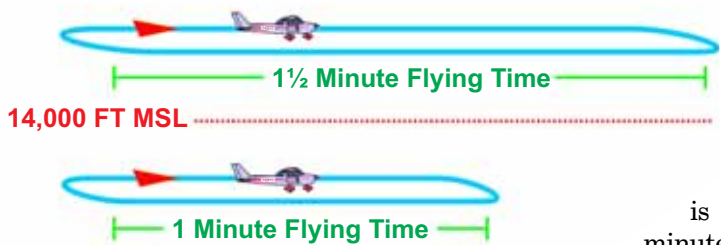



Fig. 6

The objective when flying a holding pattern is to have a one-minute inbound leg (unless you're holding above 14,000 feet MSL, in which case you'll want a 1 ½ minute inbound leg) as shown in Figure 6. Flying a one-minute inbound leg is a snap in a no-wind condition. Fly outbound for a minute, turn inbound, and it should take one minute from the time you fully reverse course to reach the holding fix (Figure 7). Blow a little wind on this mixture, however, and things change. Now you must modify the time you fly your outbound leg to allow you to end up with an inbound leg that's one minute in length.

### No Wind Holding

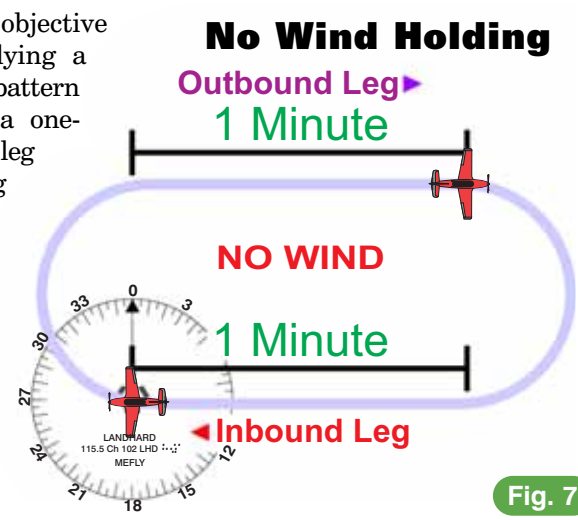



Fig. 7

that the controller has provided for you. Stay within these limits and you don't have to worry about invoking the CDW or *collision damage waiver* in your airplane rental agreement (sorry, only cars have CDWs, because only cars have bumpers).

## Adjusting the Outbound Leg to Give You a One Minute Inbound Leg

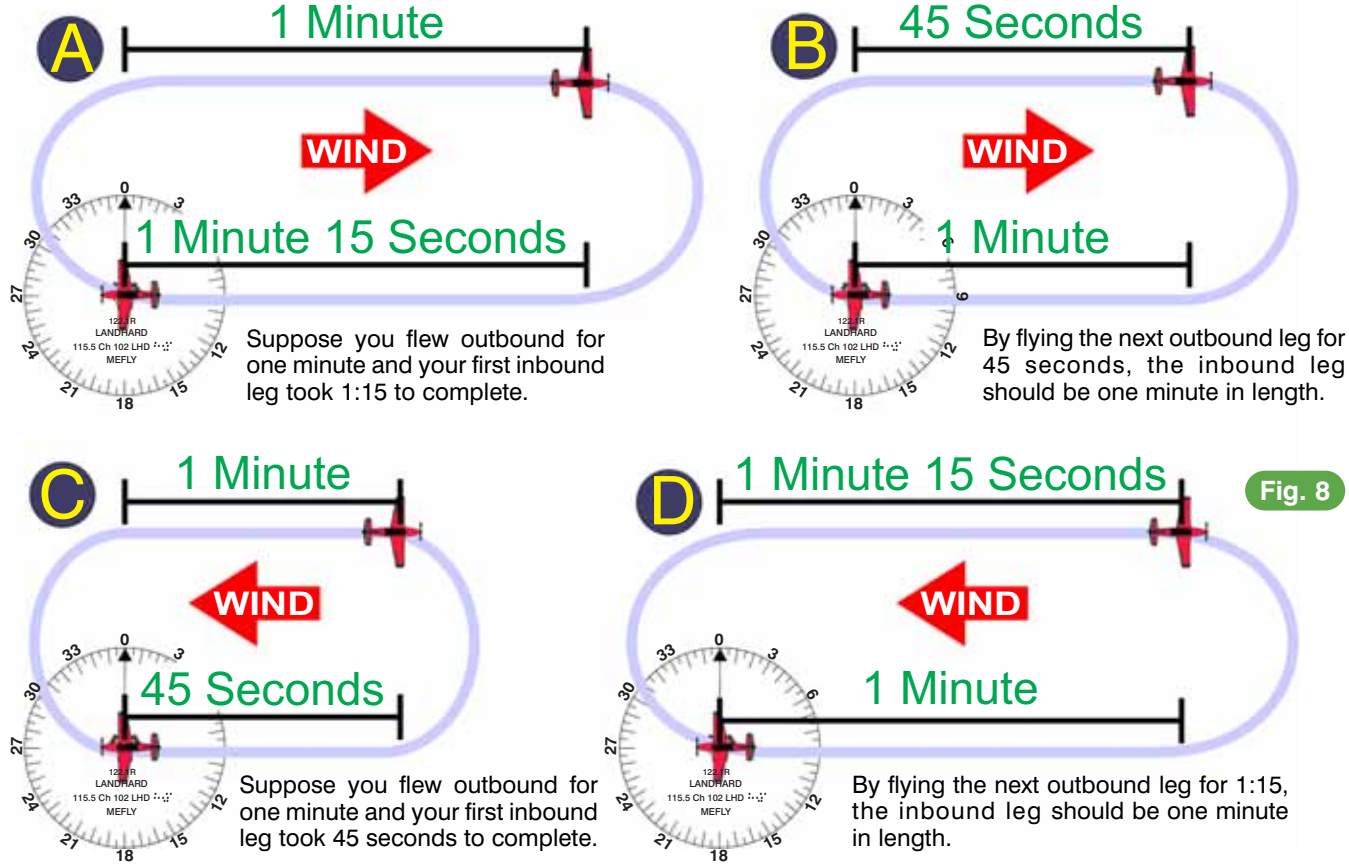



Fig. 8

That's why when you enter a holding pattern and cross the holding fix, you fly a one minute outbound leg then turn to intercept the inbound leg. You time the inbound leg and hope it's one minute long. If it is, then you should immediately run to Las Vegas and bet big time, because it's your lucky day. If there's wind aloft, it's likely that your inbound leg will be longer or shorter than a minute. No problem. Just take the difference and add it (if the inbound leg was too quick) or subtract it (if the inbound leg took too long) to your next outbound leg (Figure 8).

For instance, suppose your first inbound leg is one minute and 15 seconds. It's likely that you have a tailwind on the outbound leg (or a headwind on the inbound leg) as shown in Figure 8A. To compensate, take the difference in time between the inbound and outbound legs and add or subtract this from the time on your next outbound leg (you should intuitively know whether to add or subtract this time). Once again, if your first inbound leg was one minute and 15 seconds you have a tailwind on the outbound leg. So, fly the next outbound leg for 45 seconds as shown in Figure 8B. This should give you the desired one minute inbound leg times on all further holding pattern circuits. If, on the first pattern circuit, your inbound leg was only 45 seconds long (Figure 8C), then fly your next outbound leg for one minute and 15 seconds (Figure 8D). This is a fairly accurate way of modifying the outbound leg to provide you with an inbound leg one minute in length.

So what's the big deal about flying a holding pattern that has a one minute inbound leg? The basic reason is to have a holding pattern that takes a known period of time to complete and knowing this means you can modify (cut short) your outbound leg if ATC were to ask you to leave the fix at which you are holding (the holding fix) at a specific time. When might ATC do this? One common instance is where you're doing what is known as *timed approaches from a holding fix* (see sidebar previous page).

When doing timed approaches from a holding fix, ATC might ask you to leave a holding fix inbound at a specific time. I'm talking about leaving that point at a specific minute here, so you must be Johnny on the "Mickey

## Timing the Holding Pattern

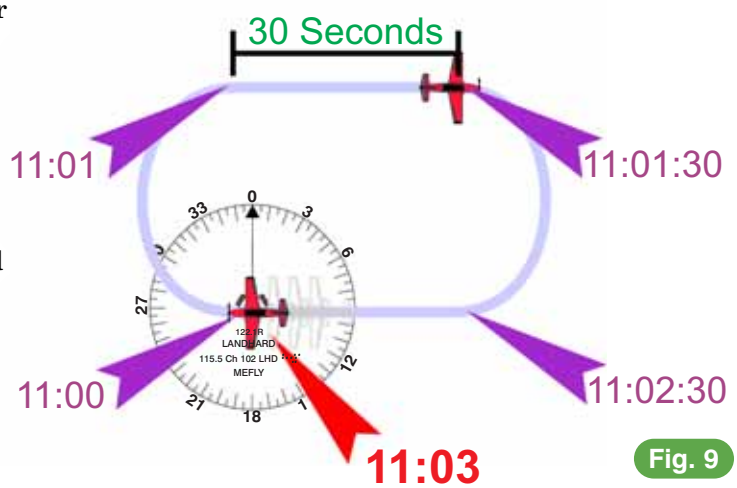



Fig. 9

Mouse watch" spot with time management. If it takes you four minutes to fly a complete holding pattern (two minutes for two 180 degree turns and two one-minute legs) then you should know how to modify your pattern to cross the holding fix at the specified time. For instance, suppose the time is 11:00 and you've just reaching the holding fix (Figure 9). Suddenly, ATC asks you to report the fix inbound at 11:03. You've got to go out, turn around, and get back in three minutes instead of the usual four. How long do you fly the outbound leg? Try flying the outbound for 30 seconds before turning inbound (a no-wind condition is assumed here).

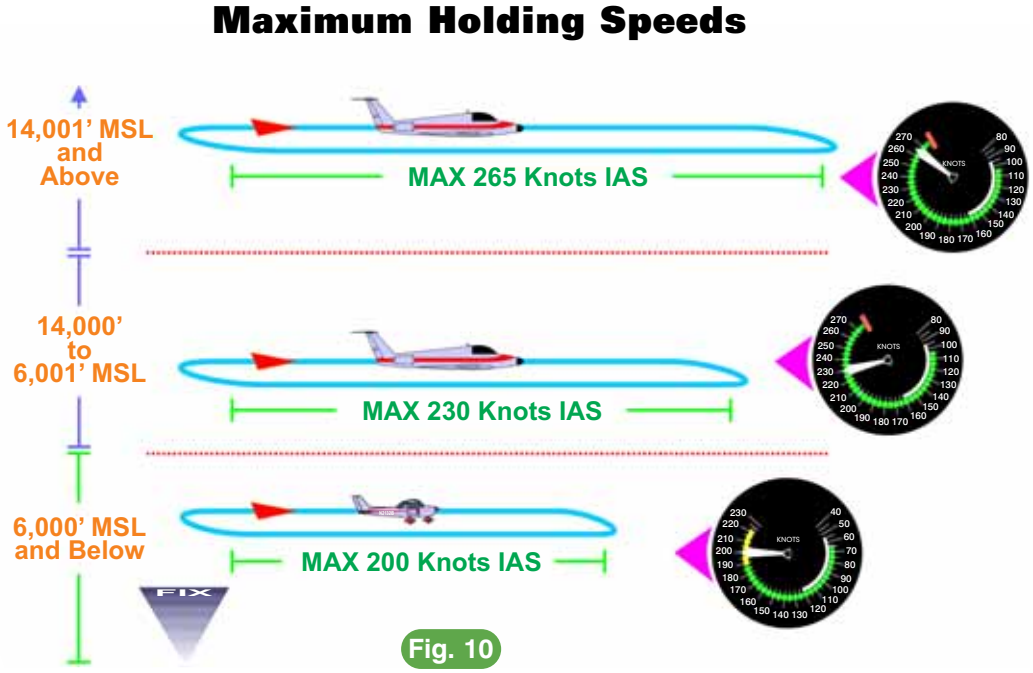



Fig. 10

In case you're thinking about purchasing a used SST on e-Bay and doing your instrument training in it, here's a note of caution. You can't fly the holding pattern at the speed of sound, because you'll hear about it an hour after you land. Why can't you fly a holding pattern at any airspeed you want? Well, because the FAA says so, but they say it for a good reason. Part of the holding pattern concept is that you'll remain within a well-defined chunk of airspace. Protecting you from other airplanes, protruding mountains, and other immovable objects depends on ATC having some idea of how big the holding pattern will be, and ten miles a minute is not part of the plan. If you're holding anywhere at or below 6,000 feet MSL, the maximum holding speed is 200 KIAS; from 6,001 to 14,000 feet MSL, the maximum holding speed is 230 knots; from 14,001 feet MSL and above, the maximum holding speed is 265 knots (Figure 10). Keep in mind that when cleared to a fix at which you'll hold, you should start your speed reduction to at or below the holding speed when you are three minutes or less from the holding fix. This way you won't surprise ATC by slowing down 100 miles early.

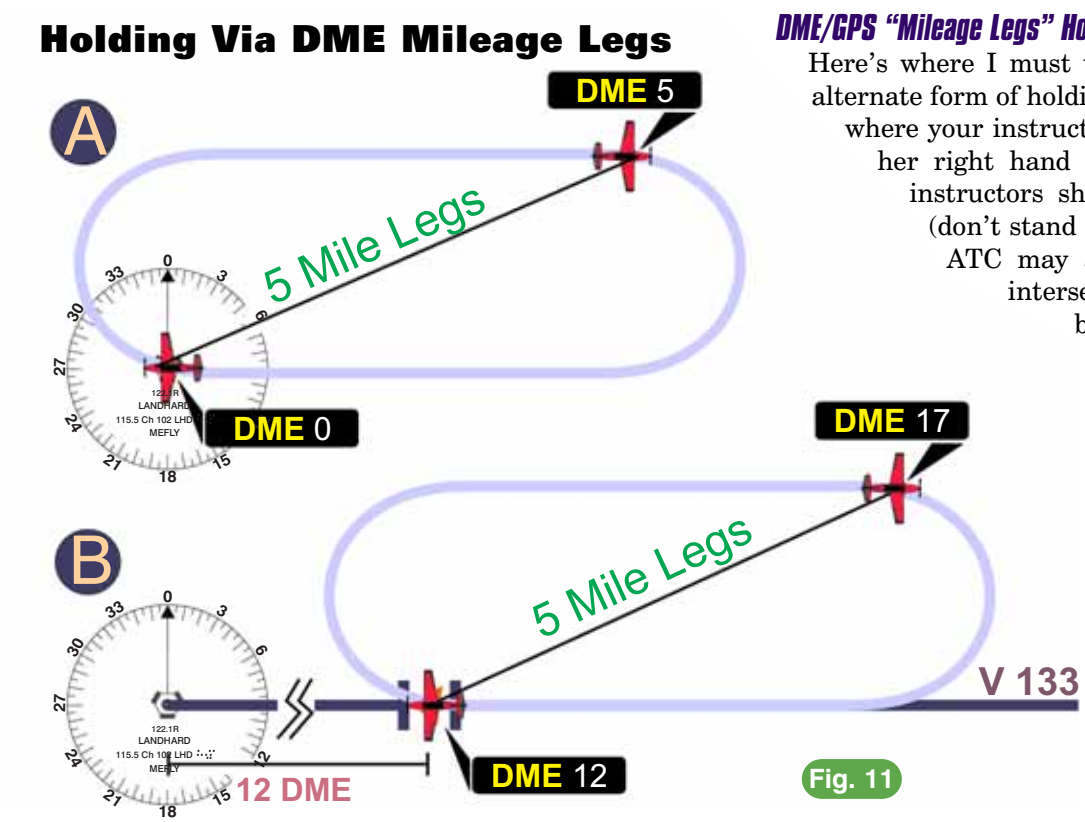



Fig. 11

### DME/GPS "Mileage Legs" Holding

Here's where I must tell you something about an alternate form of holding legs. This isn't a situation where your instructor holds your leg with his or her right hand instead of the left, because instructors shouldn't be holding your leg (don't stand for it). There are times when ATC may ask you to hold, not at an intersection, waypoint, or navaid, but on a specific course (typically a VOR course) with the outbound leg identified by specific mileage values as shown in Figure 11A. In this instance you are holding east of the VOR with 5 mile legs. You may be asked to define the inbound holding course by either VOR, GPS, or any other RNAV means of navigation (as you'll learn about shortly). The mileage values you'll use

### Say Again?

Voices all tend to sound so much alike through headphones and intercoms that you sometimes can't tell if what you're hearing is coming from your own aircraft or someone else's, as the following conversation shows all too well. In this case, a helicopter was in a holding pattern at an altitude of 3,000 feet over the Cubla beacon, which is an electronic navigation aid.

**Helicopter pilot to Approach Control:** "*Affirmative, I'm holding at 3000 over Cubla beacon.*"

**Second voice, also on the same frequency:** "*NO! You can't be doing that! I'm holding at 3,000 over that same beacon and at the same altitude, too!*"

**Brief pause, then the first pilot's voice again (loudly):** "*You idiot, you're my co-pilot!!*"

will always be in nautical miles, since all common forms of navigation equipment are calibrated in these values.

Suppose ATC said to hold east of the 12 DME fix on Victor 133, with 5 mile legs. The holding pattern would look like what you see in Figure 11B. When the DME reads 12 miles, you turn outbound and fly until it reads 17 miles. Then you turn inbound and repeat the process until ATC figures they've spun you enough and they finally have room for you.

When using GPS, instead of DME values, you use something known as ATD or *along track distance*. The ATD is simply the distance value shown on your GPS unit. If ATC asked you to hold on a specific course and fly 7 mile legs, then you'd do what was just described, using ATD values to determine when to turn inbound.

**Holding Drift Correction**

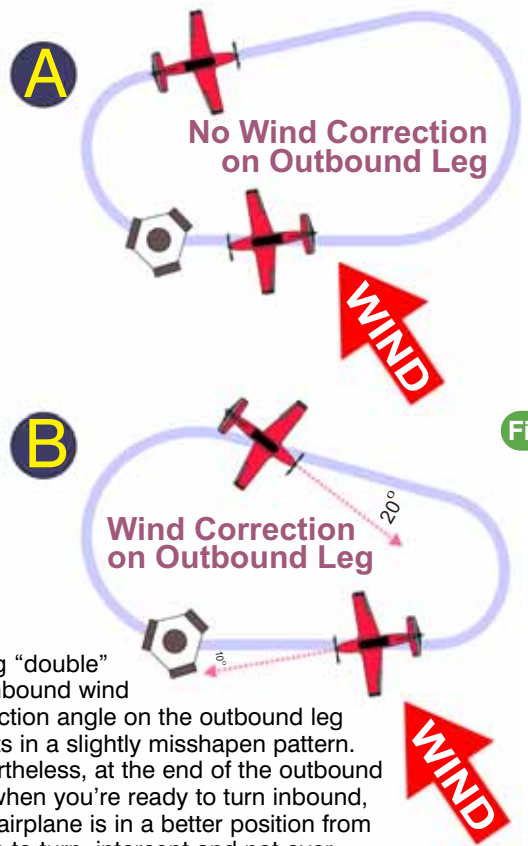



Fig. 12

Flying "double" the inbound wind correction angle on the outbound leg results in a slightly misshapen pattern. Nevertheless, at the end of the outbound leg, when you're ready to turn inbound, your airplane is in a better position from which to turn, intercept and not overshoot or undershoot the inbound leg.

## Holding Pattern Drift Correction

Before we look at how to draw a holding pattern on your chart and how to enter that pattern, we need to chat about something known as *drift correction*. Often, you'll have to apply a drift correction when holding. That's because the air moves (which is why we call such a thing, *wind*). Maybe it's not fair, but that's air. Not correcting for wind drift means your ground track will end up something like what's depicted in Figure 12A. If your patterns look like this, then you can honestly say that you want to fly badly (which has nothing to do with your desire to fly but has everything to do with the way you do it).

At this point in your flying experience, you should be able to identify the drift correction necessary to track the inbound leg of the pattern. If you can't, then Figure 12A indicates what will happen to you on the outbound holding leg. The racetrack shape of the pattern during two 180 degree turns makes it very difficult to remain close to the inbound leg. You could end up either undershooting or overshooting the inbound leg, depending on the wind direction. *No es tan bueno, amigo*.

Here's how to handle wind correction in the holding pattern. The most effective way to correct for wind on the outbound leg is to double the wind correction angle used on the inbound leg. For instance, if you used 10 degrees of drift correction inbound, use 20 degrees on the outbound leg. Doing so results in a slightly misshapen but correctly flown pattern, as shown in Figure 12B. The end result is that at the completion of your inbound turn you're positioned to roll out on the desired bearing or course.

Of course, if you want to get technical about it, it's legitimate to say that if your outbound leg is less than a minute, you'll need a slightly larger (than double) wind correction angle or you'll need a slightly smaller one if the outbound leg is longer than a minute, but that's really splitting "airs." In fact, in the AIM, the FAA recommends that the drift correction angle be tripled, not doubled, on the outbound leg. Realistically, tripling the drift

### Potty Break

**In a holding pattern behind several aircraft...**

***Pilot:*** ...your estimate for our clearance for the approach?

***Controller:*** Bonanza 1234, is there a problem?

***Pilot:*** Do the words, "Daddy, I gotta go potty!" mean anything to you?

***Controller:*** Bonanza 1234, cleared for the approach.