

Instrument Rating Overview

—by Rod Machado

Instrument Approaches

Okay, time to grab a soda, and get prepared to sip and learn. That's right, get comfortable, because this lesson will consist mainly of a friendly little discussion about the principles of instrument flying. No, nothing super-secret is going to happen. No special handshakes. No passwords. Specifically, we'll talk about what an instrument approach is and why, when, where, and how it's done. When you're finished, you should be familiar enough to handle a basic instrument approach—the kind the pros fly in their jumbo jet airliners.

VFR vs. IFR Flying

In our earlier classes, we spent a great deal of time learning how to fly the airplane visually by looking at the horizon through the window. Pilots refer to this as flying VFR, which stands for flying under Visual Flight Rules. But what happens when you can't see the horizon, such as when clouds are present? Can you still fly? Yes, you can fly IFR, otherwise known as flying under Instrument Flight Rules.

IFR flight allows you to fly in the clouds using your airplane's instruments to maintain control of the airplane and using your navigation equipment (such as VOR) to take you to another airport. This can all be done in the clouds without having to see outside, at least until you're ready to land the airplane, that is. Landing the airplane always requires that you see the runway well enough to land (Yes, even if you carry a lot of insurance and wear a helmet with a roll bar, you still need to see outside to land).

To fly instruments, pilots need an instrument rating, which is obtained after acquiring the private pilot certificate. It requires additional training in such things as maneuvering the airplane by its gauges, advanced navigation, and so on. (And you must also promise not to tell other pilots how much fun it is, or everyone will want to do it). The bulk of instrument training deals with learning to scan the instruments, just like you practiced in the three scan lessons already covered.

You're now ready to move beyond the instrument scan. You're ready for the next level, which, with some software programs, requires that you slay an enormous fire-breathing, multi-eyed beast. Well, not today. Reholster your laser-phaser and sip that soda, Yoda, because we're going to learn how to fly a full-blown instrument approach.

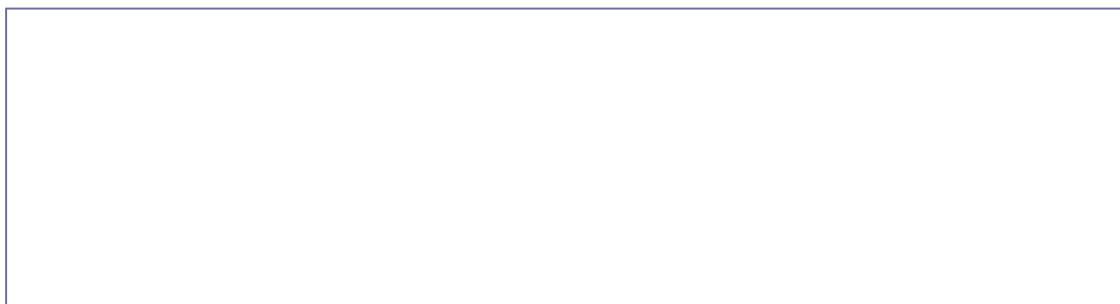
Instrument Flying: The Big Picture

Instrument flying works this way. First, a pilot files an IFR flight plan with air traffic control (ATC). This is like making a dinner reservation at a fancy restaurant in that it alerts the restaurant staff to reserve space for you. Same with ATC. After the plan is filed and you're ready to go, you typically call the air traffic control tower at your departure point and tell them you have a flight plan on file. They say, "Okay, we've accepted your flight plan and you're cleared for takeoff." It's pretty simple, and, unlike a restaurant, you aren't expected to leave a tip.

With flight plan and clearance in hand, you depart, climb into the clouds (if clouds are present), and head on your way. Your objective is to follow the airways aloft to your destination. These airways are constructed from VOR courses that crisscross the country. How do you know which routes to follow? The same way you know which highway to take when you travel on vacation—the roadmap. Pilots, however, use an aerial version of this roadmap that shows all these VOR routes along with their minimum altitudes. These altitudes keep you from getting so low that you knock birds out of trees and people off buildings.

All the while, ATC and its big fancy radar is keeping track of you and anyone else who happens to be flying IFR in your vicinity. If airplanes get too close, the radar controller separates the airplanes with verbal commands. No, not commands like, "Hey, look out!" or "Dive! Dive! Dive!" or "Oh, the humanity!" The controller simply vectors airplanes (gives headings to fly) away from each other until the collision danger has passed.

As pilots approach the destination, they reach into their flight bag and bring out a special piece of paper that seems thin enough to be a Kleenex (but don't blow your nose with it, or the passengers will think Zamfir, master of the pan flute, is flying the airplane). The paper I'm referring to is called an instrument approach chart. It contains detailed instructions on how to leave the en route portion of the flight, approach the airport, and land, all the while using some means of electronic navigation (typically VOR). Most big airports have one or more of these instrument approaches (and charts). Figure 1 shows a typical VOR instrument approach chart.



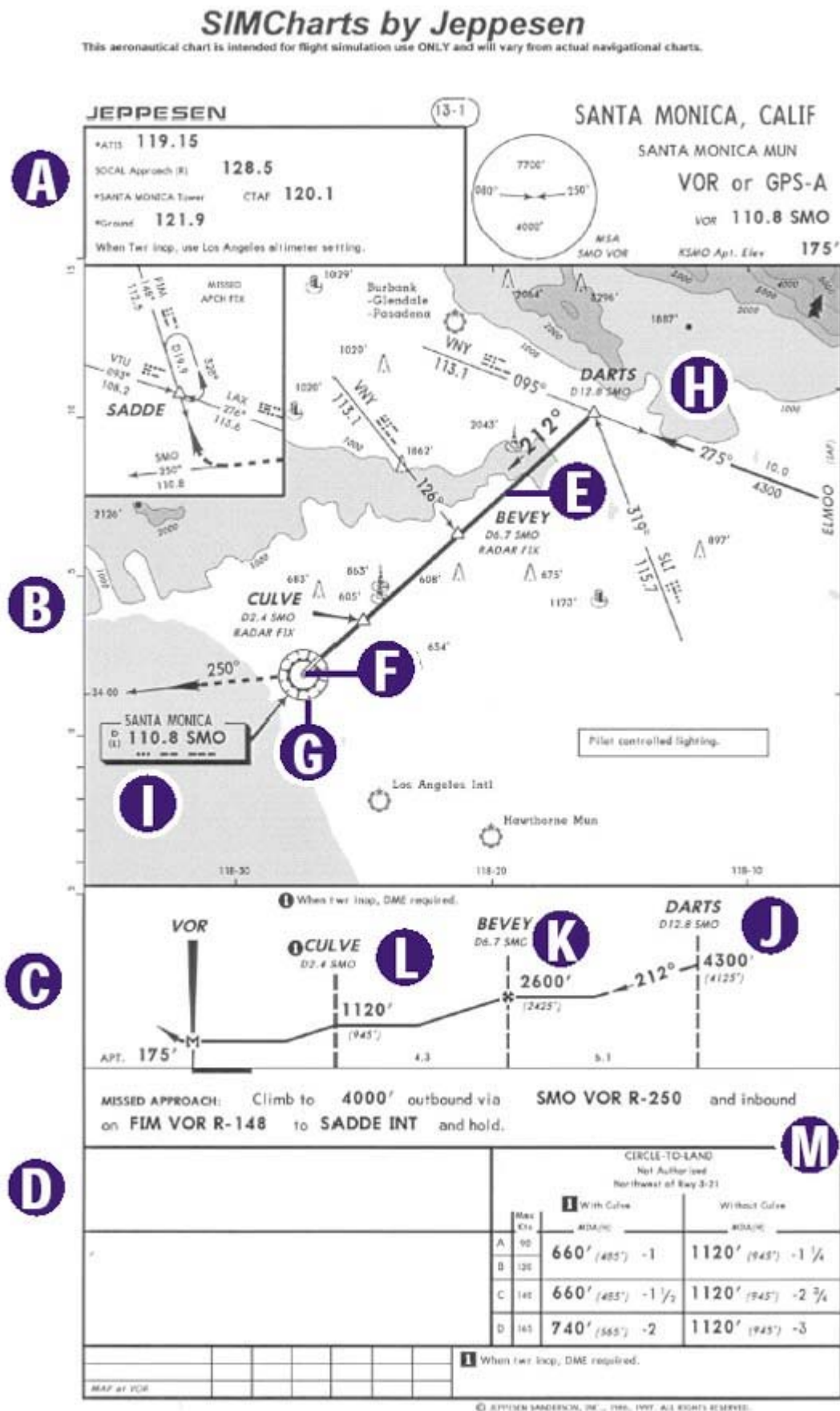


Figure 1

The Approach Chart

Instrument approach charts have several things in common. First, at the top, they show the frequencies you'll use to talk to the local air traffic controllers (section A). Below this is a plan view, which shows the electronic navigational aids that you'll use to fly to the airport (section B). Below that is something known as the profile view, which gives you a few of the preliminary minimum altitudes you'll use as you descend to the airport (section C). Finally, at the bottom, is the minima section (section D). This shows you the minimum altitude to which you can descend as you fly toward the airport.

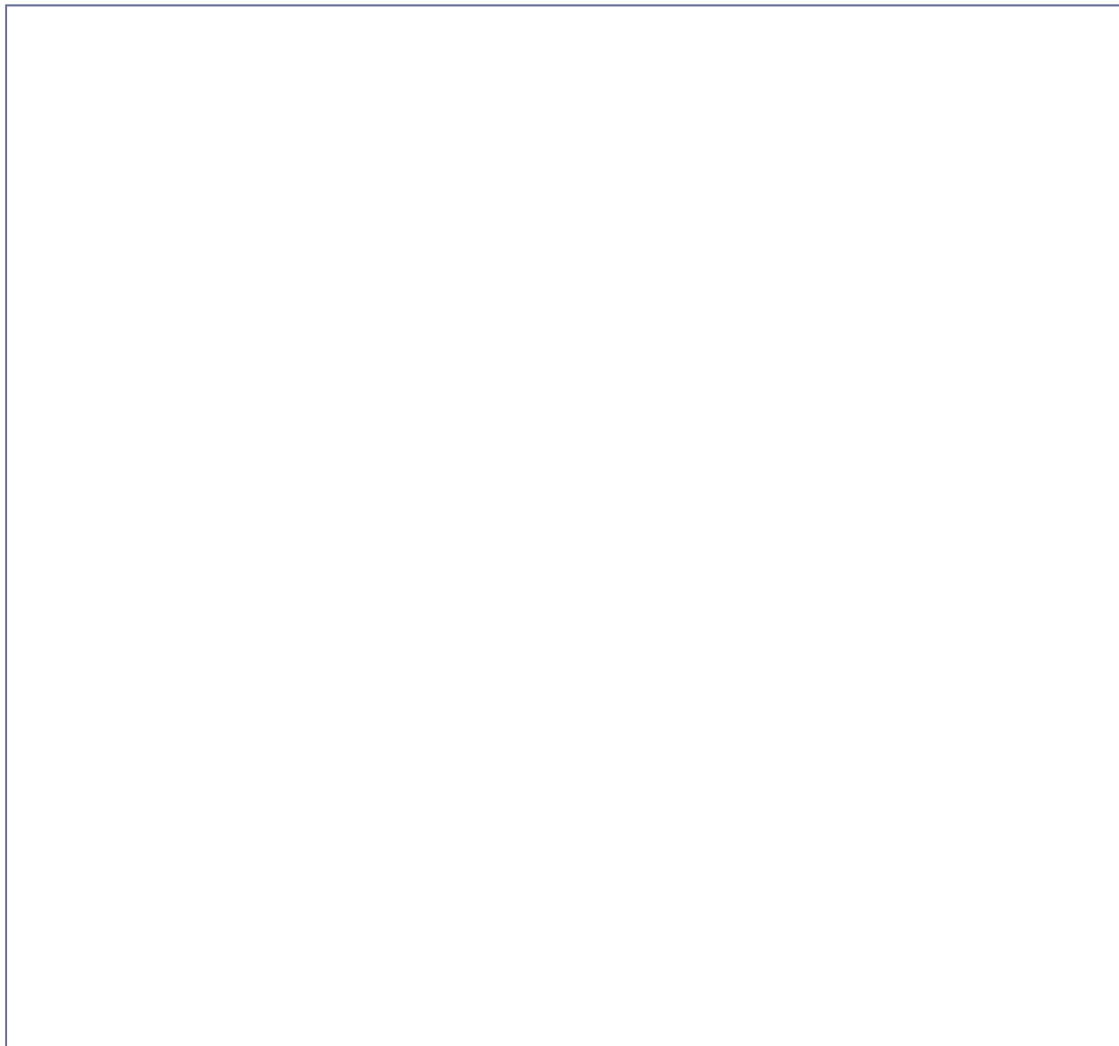
There is a point known as the missed approach point, or MAP, and it's shown on all approach charts. At the MAP, the pilot must see the runway clearly enough to land. This point is normally shown by the symbol "M" in the profile section (section C). If you can't see the runway clearly enough from the MAP, you must make a missed approach. This means you'll most likely go to another airport that has better weather.

Now that I've marinated your noodle with these ideas, I'm sure you're curious about how to fly an instrument approach. Let's find out. While there are several common types of instrument approaches, let's examine the most common one first. It's called the VOR approach.

The ILS Approach

The ILS consists of two electronic beams: one provides horizontal guidance; the other, vertical guidance. What makes this approach more useful than a VOR approach is that it takes you directly to the runway and sets you up for a landing from a comfortably low altitude. The VOR (and other approaches) just take you over the airport, sometimes at hundreds of feet above the runway. This, of course, makes it more difficult to transition from the instrument approach to the actual landing. The localizer portion of the ILS is much more sensitive than the VOR course. By sensitive, I don't mean it will cry if you yell at it. I mean that the needle response to course deviation is quicker than that of a VOR. This makes it a little more challenging to keep the needle centered in the display (Note that the glideslope needle is also quite sensitive).

Figure 2 shows the ILS Runway 28R approach chart for Portland International Airport (position A). The localizer frequency is 111.3 MHz (position B). Tuning this frequency in your number one navigation receiver (NAV 1, the top receiver in the stack of two), sets the VOR display to track one and only one specific course that's precisely aligned with the runway. This is called the localizer course, and, in the case of Portland, it's aligned in a direction of 279 degrees (position C).





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Once the localizer frequency is tuned in, you can set the OBS to the inbound course for a heading reference (although the OBS is nonfunctional, since the VOR receiver is now tuned specifically for the localizer course only). Tuning in the localizer automatically activates a specific glideslope frequency, which is not shown on the approach chart.

Let's assume that you're at 3,000 feet (the glideslope intercept altitude) at position D. You're flying a heading of 279 degrees, and the glideslope needle located within the VOR display is above the center position. This means you're below the glideslope. As you maintain 3,000 feet, the glideslope needle will eventually center (meaning you've intercepted it). Now you can begin your constant rate descent as we've previously discussed.

Instead of making the step-like descents as you did with the VOR approach, the ILS allows you to follow an electronic beam down to the missed approach point while avoiding all obstructions in your path (assuming you don't go below the glideslope and start knocking birds out of trees and people off buildings).

As you begin your descent on the glideslope, you'll fly over the outer marker, shown by the feathered vertical area in the profile (position E). This activates a blue marker beacon-light in the cockpit (and an alarm that sounds just like the beeper that goes off when the fries are done at your local burger joint). The outer marker notifies you that you're at a specific point along your descent (5.2 miles from the runway, as shown in the profile view at position F).

How low can you go on the ILS? All the way down to decision height, or DH, which is 280 feet, as shown at position G in the minima section. DH is your missed approach point, and if you don't have the runway in sight by this point, you must execute a missed approach. Yes, I know there is an "M" shown at the beginning of the runway (position H). Sometimes pilots elect to fly this approach without using the glideslope. They do so because they don't have a glideslope receiver or the glideslope isn't working at the airport (someone may have yelled at it, hurt its feelings, and now it won't work). Therefore, the dashed line (position I) in the profile view shows the MDA for the localizer approach, just like the step-down altitudes you saw on the VOR approach. If I were cleared for a localizer approach, I'd cross the outer marker at 1,900 feet (position J), descend to 560 feet (position K), and fly to the MAP. The MAP is identified by time (based on a specific groundspeed from the outer marker) or by DME on the localizer, as shown by position L.

Most everything else about this approach chart should now be familiar to you. For example, suppose you're over Battle Ground VOR (position M) and ATC clears you for the approach. The feeder route from BTG to the ILS is the 135-degree radial (position N). Set your VOR to track outbound on this radial until the localizer is intercepted. How will you know that you've intercepted the localizer? You can set one navigation radio (the bottom one) to navigate from BTG VOR and the other navigation radio (the top one) to receive the localizer. As you track from BTG VOR, you'll know you're over the localizer when the localizer needle centers. The outer marker beacon display will also activate in the cockpit as an additional clue, since the 135-degree course takes you to LAKER intersection (located on the localizer).

At LAKER, fly 099 degrees (position O), descend to 3,500 feet (position P), and make a procedure turn within 10 nm of LAKER. There is one important item you must know about localizers. Because the localizer is a single electronic beam, tracking opposite its inbound direction results in the needle appearing to read in reverse. In other words, when you are flying outbound from the localizer, if the localizer needle moves in one direction (right or left), you must fly in the opposite direction (left or right, respectively) to center it. This is known as reverse sensing. Therefore, as you prepare to fly the procedure turn by tracking outbound on the localizer, you'll have to fly opposite the direction the needle swings to keep it centered.

Once you've completed the procedure turn and are inbound headed 279 degrees, the needle will indicate normally. You may descend to 3,000 feet (the glideslope intercept altitude) once established inbound on the localizer and after making the procedure turn. Track the localizer, and fly the glideslope down to DA. We'll talk more about how to fly an ILS shortly.

That's a lot for an overview, but at least you've been exposed to the fundamentals of flying instrument approaches. Perhaps you feel like you've been exposed to a concussion, too. Granted, it does take a little practice to get good at this. However, flying instrument approaches is a lot of fun. It's even addictive. So don't be surprised someday to find yourself undergoing instrument flying withdrawals if your computer breaks down.

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