THE DME ARC DANCE

Flying a nice, smooth curve is an elegant way to get to the runway. Just remember which way to turn to join the final approach course.

by Fred Simonds

DME arcs are among the most graceful instrument maneuvers we perform. Typically, they lead you around the airport in an elegant and dignified way to the final approach course, like the ladies and gentlemen we are.

This article will help you fly these arcs in an equally graceful yet simple way. We'll start with the basics and end with some fine points.

The Basics

In its simplest form, a DME arc means flying a track that is a constant distance from a VORTAC or VOR/DME facility. The station need not be located on the field, as the approach plate for the VOR 11R approach at Vero Beach, Florida shows (graphic, opposite page).

There are three phases of flying an arc: join it, maintain it and exit from it.

1. Join The Arc

Let us say we are flying north toward the Vero Beach VORTAC (VRB) on the R-164, a segment of V3. About 15 miles south of VRB we are issued an instruction we don't usually hear a lot: "Archer 44939, expect the VOR 11R approach at Vero, arc west on the 7 DME arc." Okay, sounds easy, but what do we actually do?

First, we do nothing. You glance at the DME and we are still 14 miles away, seven miles from the arc. Time enough to plan this out.

In a few miles we'll reduce our speed to 90 knots or so to help prevent blowing through 7 DME. The general rule is simple: lead the arc by turning to join it from 0.5 mile away at groundspeeds of 150 knots or less. So at 7.5 DME we'll begin a turn to, uh, a turn to what heading?

This question highlights one of the most common yet subtle errors in instrument flying. Airplanes fly by heading, a specific number, not loosey-goosey notions like "west" or "I'll figure it out when I get there." The controller gave us a general heading of west, but we must turn to a specific heading that will give us a precise 90-degree tangent to the arc.

Happily, that number is right in front of you. Your CDI indicates 344 degrees TO VRB. The 90-degree tangent to the west is right under that little mark 90 degrees to the left of 344, or 254 degrees. That will be your new heading as you roll out from your left turn. Sweet.

Okay, here's 7.5 miles, time to turn left. Check the DME as you turn. If you overshoot by more than a mile, turn further left than 254 degrees to capture the arc. If you undershoot, roll out of the turn early to a heading slightly greater than 254 degrees to capture it. You get the idea.

The FAA *Instrument Flying Handbook* suggests flying slightly inside the arc, so as to always fly toward it. If you get outside the arc, it's turning away from you, necessitating a greater correction.

By the way, joining an arc from the inside of a circle uses the same technique.

2. Maintain The Arc

Now established on the arc, our new goal is to maintain it. At this point we are flying a heading of 254 degrees and the DME is showing seven miles, or close to it. Now we need a way to fly a curved track that will lead us to the final approach course.

The brute force method is to vary your heading left and right to preserve 7 DME. This works, and compensates for the constantly shifting wind direction as well. But we can do better with the same simple geometry we just used.

Recenter the CDI needle and again read the value 90 degrees to the left. It will indicate some value higher than 254 since we are flying clockwise around the VOR. This is your new approximate heading.

Approximate is the operative word since geometry does not account for wind, whose direction constantly shifts as we arc. But it's a better technique than guessing, and helps maintain a stable arc. Flying a heading also allows you to turn your attention elsewhere briefly, rather than fixating on the DME. If you have an autopilot, use its heading mode to make life easier. If you have a really fancy autopilot, you can program it to fly a 7 DME arc.

The classic DME mantra is "turn 10, twist 10." You allow the needle to reach full-scale deflection, recenter it by twisting it 10 degrees and then turn 10 degrees. (Perhaps it should more logically be called "twist 10, turn 10.") You can also set the OBS 10 degrees ahead and fly that heading until the CDI centers, signaling the need for a further twist and turn.

Either way, you will fly straight-line increments of 10 degrees around the arc, approximating a circle. Technically, you are flying a 36-sided polygon called a *triacontakaihexagon*. Spring that on your examiner!

If you dislike full-scale deflections as do I, try the FAA way: recenter and turn whenever the CDI gets 2-4 degrees from center. It's more work, but more precise.

Once cleared for the approach and on a published segment you may be expected to manage altitude on your own. For instance, if you join the arc at 2,500 feet, once established and cleared, it's up to you to descend to 1,500. The controller may prompt you, but don't count on it.

Some arcs contain stepdown fixes, and you should be on the lookout for these as well.

Flying this VOR approach recently, the controller advised extreme precipitation right in our path if we elected to fly the arc from south turning west. When we asked about our options, the controller creatively solved the problem by offering an arc to the east. While not published and the longer way around, it worked out just right. Ask for options.

3. Exit the Arc

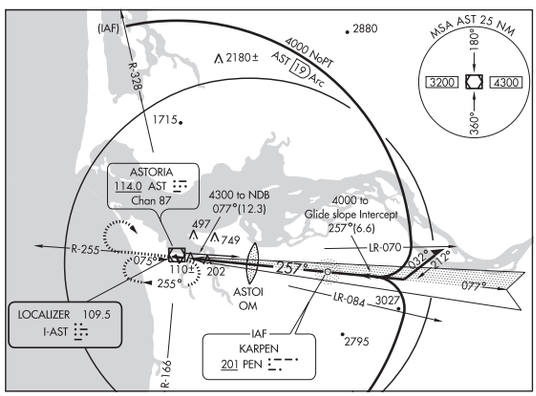
Believe it or not, exiting the arc can be tough because people tend to settle into the turn-10 twist-10 rhythm and lose their situational awareness. It is not uncommon for pilots to go right past the inbound course, in this case 120 degrees.

You have a choice whether to set the OBS with a TO or FROM flag. My rule is simple: "What's next?" If we need 120 degrees TO as we do here, I use TO. This way, once you complete the arc, the VOR is already set with a TO indication, which is just what you need, making the transition smoother and less work. The heading should also be a heads-up that the inbound turn is coming soon. Gauge the turn inbound to arrive at 120 degrees just as the needle centers.

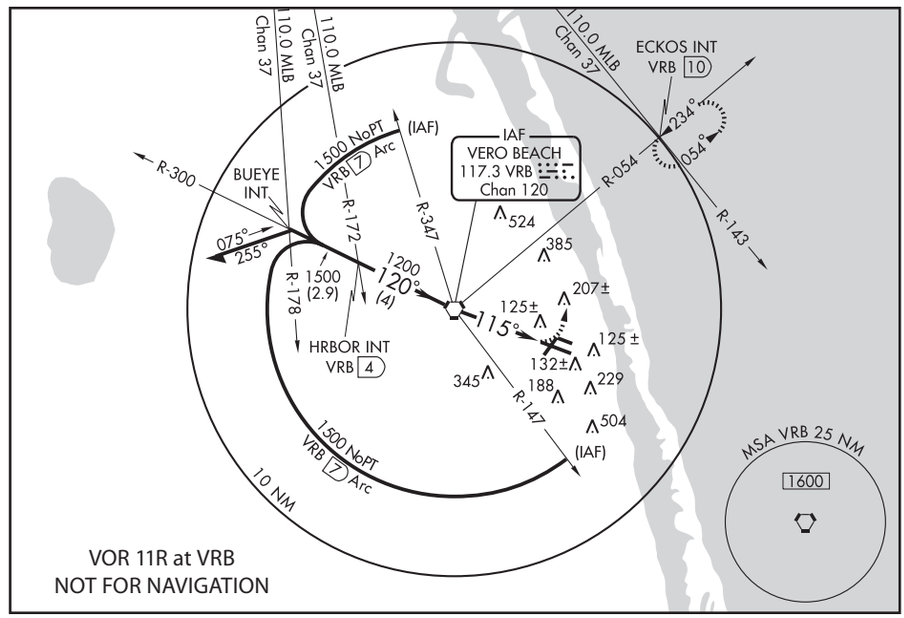
If joining a localizer, when you turn inbound the OBS will already be set for your localizer heading if you are flying the arc and localizer on NAV 1. Better still, fly the arc on NAV 2 and use NAV 1 for the localizer, but don't overlook that centering NAV 1 localizer by fixating on the NAV 2 arc.

Some approaches have lead radials as shown in the ILS 26 approach plate for Astoria, Oregon (left). They are denoted as LR's and are shown as LR-070 and LR-084 from the Astoria VOR. To join the localizer, cross the lead radial, then begin a half-standard rate turn inbound until the localizer needle starts to center.

The technique for joining a VOR radial is nearly the same. For light airplanes doing 150 knots or less, turn about five degrees inbound crossing the lead radial. Note the VOR 11R approach at VRB has no lead radials.



Notice the lead radials (LR) on the ILS 26 approach into Astoria, Oregon. (Not for navigation.)



Fine Points

You probably noticed that the VOR 11R approach does not begin at an arc initial approach fix (IAF), and this is common. Sometimes the ends of the arcs are not denoted as intersections, as with the VOR and ILS approaches shown here. Some GPS arcs have computer-generated fixes at the ends, which makes it easy to set up the transition. VOR or GPS overlay arc approaches may designate intersections at IAFs.

GPS arcs are easy and can be flown very precisely. The Bendix-King KLN 94 shows left/right deviation on the CDI and you fly it just that way right up to the turn inbound. The GNS 430 shows not only a CDI but also the desired track to join, maintain and exit the arc. The G1000 shows the initial turn heading which may not be 90 degrees since it accounts for groundspeed. Some autopilots will fly an arc, but try this in visual conditions before doing it for real in IMC.

In conclusion, DME arcs offer a smooth, stable transition to the final approach course. Take your time, pay attention, and enjoy the ride.

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