VOR TRACKING AND VOR APPROACHES 6

Enroute Tracking

Principles

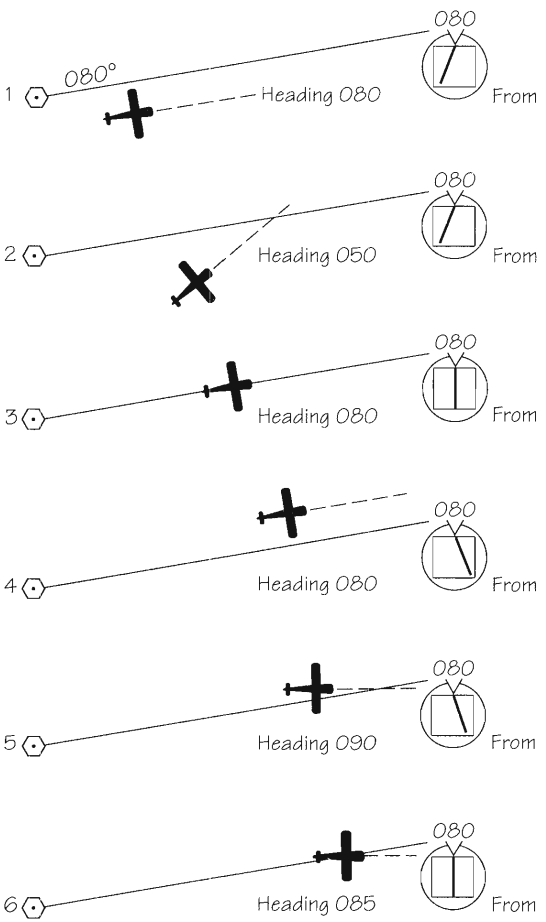
Since airways usually run in straight lines between VOR stations, and since many IFR approaches are based on VOR stations, a key skill in IFR flying is the ability to track radials without great effort. It has to become second nature to you, so you can devote your attention simultaneously to the various other tasks that make for safe cruising flight or a safe approach.

Flying outbound from a VOR is easier than inbound tracking because the farther you go from the station, the more widely separated are the radials. Near the VOR the distance from the 240 radial to the 241 radial (for example) may be only a few feet, but at a distance of 30 miles it is half a mile. Thus, if you start outbound from the VOR with your OBS set to the radial you want to track, and the omni needle is slightly off center, you have plenty of time to try out different heading corrections until the needle finally centers. But, as you'll discover, things have to be done much faster flying inbound because as you get closer to the VOR, the needle will move much more quickly away from the center position unless you pin down the crab correction faster. In a surprisingly short time the needle can move full scale and be "pinned to the peg."

To track a radial outbound, you first have to intercept it. Usually 30 degrees is a good intercept angle, but depending upon how far you are from the radial, you may want to choose a much larger angle or a smaller one (as small as a few degrees). It's just a matter of simple common sense. You don't want to spend all day intercepting the radial, but then neither do you want to fly right past it and then have to intercept again from the other side.

Fig. 6-1 gives the procedure, step by step. Suppose you want to intercept and track outbound the 080 radial, and that your position is somewhat to the right, perhaps on the 100 radial, as in (1). Set up the radial you want on the OBS, and turn to that heading. The indicator will show FROM, and you will be flying approximately parallel to the course you have chosen. The needle will then show you the

position of that radial; in this example, the needle will point to the left. Now, as in (2), turn toward the needle by an amount you think should be a good intercept angle, say 30 degrees; your heading will be 050 and you should be flying toward the chosen radial. Hold your heading exactly, and see whether the needle moves toward the center. If there is no movement at all in about 30 seconds, increase your intercept angle, i.e., turn further left to a new heading, perhaps to 040. Again wait, then again change heading if necessary. Of course, you won't exceed a 90-degree intercept angle, because that would have you flying back toward the station.



Intercepting and tracking outbound.

Fig. 6-1

Let's suppose the needle starts to move after your first heading change. Watch its rate of movement closely. The whole point is to intercept the radial

smoothly. You don't want to overshoot and then make an abrupt turn with excessive banking to get back on the radial again. So, as the needle moves toward the center, begin your turn toward the heading you'll eventually want, i.e., the course of the radial, in this case 080 degrees. This should bring you to the situation depicted in (3), where you are on course, heading 080, with the needle centered.

As soon as you detect a slight but definite movement of the needle in either direction, make a small heading correction toward the needle. In (4), a right crosswind has evidently drifted you to the left. Your heading is still 080, but the needle shows you that your chosen course is now to your right. In (5) you have made a 10-degree correction toward the needle, so your heading is now 090. Soon the needle will center again. Since heading 090 would now take you across to the other side of the course, take out half of your correction as soon as the needle centers. Now, as in (6), your heading is 085, probably just right to compensate for the crosswind, and the needle stays centered.

Reference heading. If you do a good job of holding your headings, and if your DG hasn't precessed, the only cause of needle deviation will be wind drift. Information gained in this way about the prevailing wind will be useful to you in flying holding patterns, as described in the next chapter. When you make heading corrections, how large should they be? That depends on how far you are from the VOR; the farther away you are, the larger the corrections can be to compensate for a given amount of needle deviation. The needle measures only the angular distance off course, and a given angular distance means a greater actual distance, the farther you are from the station. With a DME this problem becomes very simple; just make your initial heading corrections in degrees equal to your distance in miles from the station. If you know or can guess the distance, you can apply the same rule even without a DME. Otherwise, use trial and error. If a 20-degree correction starts the needle moving back to the center too quickly, take out half the correction, and if 10 degrees is still too much, make it five degrees. The important principle is to make your corrections promptly and frequently. Don't wait until the needle is nearly up against the peg. The initial aim is to stop the needle wherever it is on the scale, i.e., to put an end to the drifting tendency. **Note the heading at which this happens,** for this *reference heading* will be the heading you'll want to fly finally, after you're on course again. From your reference heading correct a little more, to center the needle. Finally, with the needle centered, go back to your reference heading to keep it there.

The key to this whole exercise is your ability to fly an absolutely constant heading, and for this your DG is the primary control instrument. The omni needle is your monitoring instrument; it tells you whether your constant heading is correct or not. Don't "chase the needle," i.e., don't become impatient and make larger and larger heading changes toward the needle, or before you realize what is happening, the needle will swing past the center and you'll be chasing it on the other side. You might get away with rough technique flying outbound, but it will

never work flying inbound, when ever smaller and more delicate heading changes are needed as you approach the VOR.

What's new in this exercise is that you have to include the omni needle in your scan. Very likely, you'll be so busy at first trying to keep it centered that you'll concentrate on your heading to the detriment of altitude. The trick is to include more and more instruments in your scan, without neglecting any one. Just as you did before the VOR tracking problem complicated matters, you must pay especial attention to correcting altitude deviations while they are small, using prompt but very slight yoke pressure.

When you are well established on the radial, flying outbound, make a standard-rate turn and intercept the same radial inbound. IFR students have a lot of trouble with the concept of tracking a radial inbound, because they forget that the course will be the reciprocal of the radial. Thus, tracking the 080 radial inbound means flying a course of 260 degrees. The OBS must be set for 260, and the indicator will show TO. In all VOR navigation, the OBS setting must correspond approximately with your heading, as shown on the DG, whether you are flying to the station (the indicator will show TO) or from the station (the indicator will show FROM). If this rule is followed without exception, you will always make corrections by flying toward the needle. The only time this principle is not operative is in flying the back course of a localizer, where you have no choice but to fly with "reverse sensing," i.e., to make corrections away from the needle.

Tracking inbound, you'll notice as you get closer to the VOR how much more sensitive the needle becomes. Your headings will have to be held with perfect accuracy, and your heading corrections will become smaller and smaller—10 degrees, then five degrees, then two degrees, eventually even one degree. Refuse to accept a needle that's off center. Make a tiny heading change, then wait just long enough (5-10 seconds when you're very close to the VOR) to see if that did the trick. If not, make another tiny change. The aim in inbound tracking is to cross the VOR with the needle absolutely centered. At the very last moment, as you cross the "cone of confusion" right over the station, you'll recognize the sudden erratic swings of the needle. Don't try to chase it. Just hold your last heading until the indicator flips from TO to FROM.

When you cross a VOR, the rule is TURN, TIME, TWIST, THROTTLE, TALK, in that order. Start the turn to your outbound heading—always fly the airplane first—and, as you do so, note the time; then reset the OBS, if necessary, for your outbound course, the radial you want to intercept. (The "throttle" element enters the picture if you are slowing to holding speed or beginning a descent, as you might do on an approach; practicing enroute tracking will not entail changes of power setting.) When the airplane is well in hand, report to ATC ("talk").

Practice

Find a VOR (let's call it Mystic) where you can safely exercise a few thousand feet above. Pick an altitude (e.g., 4000 ft.) and hold it exactly. Trim the airplane and set the power at a comfortable cruise setting. Now rotate the OBS until the needle centers with the indicator showing FROM. This tells you what radial you are on.

Now your check pilot should call out a command to intercept a nearby radial. Suppose your OBS shows 153. He might say: "2345 Juliet intercept and track outbound the Mystic 160 radial."

You acknowledge: "45 Juliet outbound the Mystic 160," and immediately start a turn to 160. While you are turning, set up 160 on your OBS. Since you were on the 153 radial, the 160 radial is to your right, and the needle will now point to the right. Therefore, don't roll out of your turn at 160, but rather at an intercept heading such as 170, 180, 190 or even greater, depending upon the circumstances. Then you follow the interception procedures already described.

Once you are established outbound, your check pilot should observe you for about three minutes, especially rating your ability to keep the needle centered and hold altitude at the same time. Then he should unexpectedly call out a command to turn and intercept the same or a different radial inbound. For example: "2345 Juliet turn left, intercept and track inbound the 140 radial."

It's going to take you a full minute to turn back toward the VOR, so start doing it immediately. Students are often uncertain about exactly what they are going to do, and consequently do nothing. It's worse to go blundering off into the boondocks after ATC tells you to go somewhere else than it is to start complying promptly even if you haven't got it all worked out in your head. So in this case start the standard-rate left turn as soon as you acknowledge. Also during the turn remember to reset your OBS to the reciprocal of the radial you want to track inbound, in this case to 320. By the time your heading is coming around toward 320, your needle will be giving you good guidance for the intercept.

Now you continue all the way to the VOR, pretending, if you like, that this is a VOR approach, with the VOR right on the field. If your needle isn't centered as you cross the VOR, your chance of completing the approach safely is very poor. Before you reach the VOR, your check pilot should call out a new radial to track outbound. Then as you cross the VOR, you start your turn, note the time, reset the OBS, and report: "45 Juliet at Mystic, one-three, 4000, turning to 180" (or whatever; "one three" here is the time, in minutes past the hour, when you crossed the VOR).

Score Sheet: Enroute Tracking

Session number	1	2	3	4	5	6	7	8	9	10
Date										
ITEM Number of outbound trackings plus inbound trackings										
Altitude deviation greater than 50 ft. (10 points)										
--- greater than 100 ft. (20 additional)										
Pegging the needle during inbound tracking (10 points)										
--- during outbound tracking (20 points)										
Failure to reset OBS on station passage or turning inbound (20 points)										
Failure to report station passage correctly (10 points)										
Forgetting to report station passage (20 points)										
Repeating a clearance incorrectly or failure to repeat at all (10 points)										
TOTAL POINT SCORE										
FINAL SCORE (= Total Point Score divided by sum of outbound and inbound trackings)										