Understanding VORs for Glider Pilots

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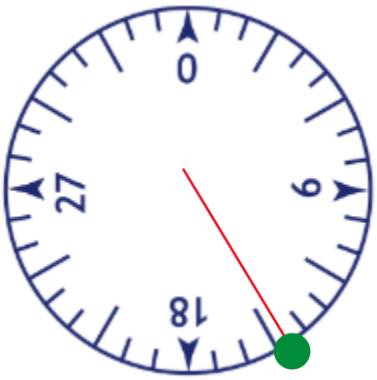
The FAA knowledge test includes questions on VOR navigation despite VORs in gliders being extremely rare outside of touring motor gliders. However, VOR radials are used widely to describe locations and the boundaries of certain airspace such as TFRs (temporary flight restrictions) and Class B airspace. Therefore, a solid understanding of what is meant by terminology such as “radials” is important.

Radials

Direction from the station is expressed as “radials”. Radials stretch out FROM the station. The radials are numbered in degrees clockwise from Magnetic North. If you are due East of the station you are on the 090° radial, South: on the 180° radial, etc.

Here are two TFR excerpts using VOR station references.



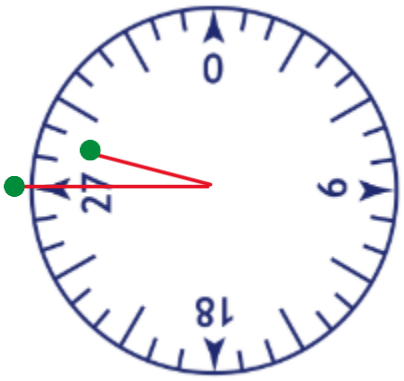
`Center: On the LOS ANGELES VORTAC (LAX) 149 degree radial at 11.6 nautical miles`

Here the center of the area is 11.6 nautical mile southeast of the Los Angles VOR on its 149° radial.

`Airspace Definition:`

`Region bounded by:`

Latitude:	Longitude:	FRD:
From:	34°04'47"N	118°44'11"W SMO272014.6
To: 34°05'04"N		118°37'42"W SMO282009.6



Here the first part of the area uses the given LAT/LONG coordinates or from the SMO (Santa Monica) VOR 272° radial at 14.6 NM (west of the station) to the SMO VOR 282° radial at 9.6 NM (a point northeast of that)

What the VOR receiver "knows"

The VOR receiver only knows one thing: your direction relative to the station. It does not know which way you are heading or moving. It can display its information from two points of view: going toward the station TO, or going away from the station FROM.

Note: Because magnetic north drifts over time, and VOR stations are not regularly adjusted for this there may be a few degrees difference between the actual VOR station orientation and Magnetic north). Some VOR stations in areas where there are large differences between True and Magnetic North (such as parts of Northern Canda) the station is oriented to True North.

Course Selector

A knob allows the user to select the course referenced by the display. The knob is called the Omni Bearing Selector or OBS. Rotating the OBS rotates the ring of courses around the instrument. (This ring does NOT move with changed in aircraft heading.)

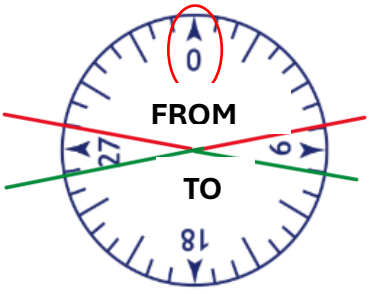
We can use the OBS to select the course we would like to follow or to find our direction (radial) from the station.

Using the OBS

VOR navigation involved flying directly to or from VOR stations along a desired radial. The OBS allows us to select the radial to fly on or reference.

TO/FROM flag

The TO/FROM flag indicates if the selected course will take you TO or FROM the station.



You can rotate the OBS to select a course to go TO or FROM as desired.

Imagine yourself standing in a location North of the station. If you face away from it, you probably would like guidance to keep you on course moving FROM the station

If you are facing toward the station, you probably want guidance moving TO the station.

With a course of 0° selected the TO /FROM indications will be as illustrated here with "FROM" and "TO" areas. If we're south of the station TO will be indicated, if we're north of the station, FROM will displayed.

In between those areas, the TO/FROM flag is hidden or shows a flag.

Remember it doesn't matter if you actually are going to or from the station, only if flying the selected course would move you in that direction from where you are at the moment.

Where Am I?

The needle is called a course deviation indicator or CDI.

When the needle is centered, you are on the selected course.

To see where you are relative to the station, you could simply turn the OBS knob until the FROM flag is displayed and the needle is centered. The top pointer will then display your radial.

Some displays do not include the words TO and FROM and simply have an arrow where pointing up is TO and pointing down is FROM.

Both of these indications show you directly North of the station, on the 360° radial.

Notice that the TO/FROM flag points away from the radial you are on.

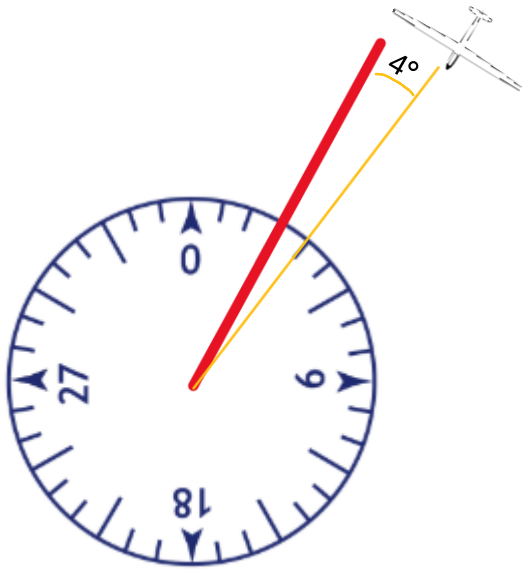
When the Needle isn't Centered

When the CDI needle is not centered, it shows how far you are from the selected course in degrees. Full scale deflection is 10°, so each "dot" represents 2° of deviation from the desired radial. To interpret the needle, imagine that the aircraft is at the center of the display and the needle represents the course line.

We would like the needle to graphically represent the course. If we're left of course the needle should be to the right and vice versa.

Because the left/right indications would be the reverse of each other depending on which way you're facing, the VOR receiver allows you to orient the display for whether you are going TO or FROM the station so that the steer left or right indications are not confusing.

In the illustration below we want to fly **inbound** on the 30° radial, therefore we select an inbound course of 210°. With 210 selected, the CDI is 2 dots or 4° to the right (we are on the 34° radial). If we're heading southwest the course centerline is off to our right.



An excellent VOR simulator is here:
https://flightapps.erau.edu/interactive/navigation/vor.html

Now let's get to the FAA question graphics.

The FAA Private pilot graphics supplement only gives 9 VOR indications that test questions are based on. So, considering if you are only viewing this from a glider pilot viewpoint and will not be navigating using VOR receiver, we don't' need to get any deeper than that.

Let's review the possible questions.

The graphics are from the testing supplement FAA CT -8080-2H
https://www.faa.gov/sites/faa.gov/files/training_testing/testing/supplements/sport_rec_private_akts.pdf

The VOR indications are found in figure 28 on page 2-27.

Our location is depicted with a yellow line in each example.

<table>
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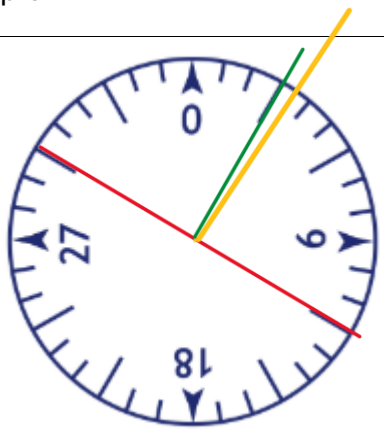
<td> 

Here a course of 210° will take us TO the station, so we are northeast of the station, and to the course is 4° to the right.

We are on the 34° degree radial.

We are somewhere on the yellow line.</td>
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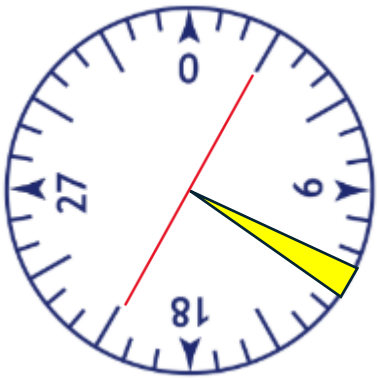
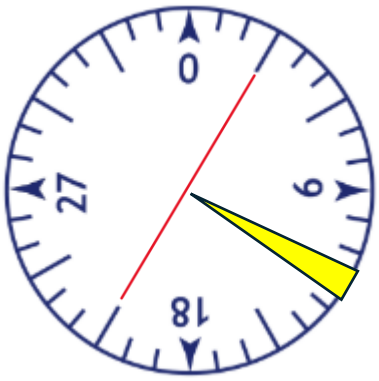
	 Here, a course of 210 will take us FROM the station and the needle is centered. So, we are southwest of the station on the 210 degree radial.
	 This one's a little trickier. The TO/FROM indicator is not displayed, so we're between the TO and FROM areas. But with a course of 210 the course is to the right, so we are southeast of the station on approximately the 120° radial.

4  	 Here, a course of 210° will take us TO the station and we are 2° (one dot) right of course. So, we're northeast of the station on the 028° radial.
5  	 Here's an easy one. A course of 210 will take us TO the station and we are directly on the selected course. We are on the 30° radial.

6  	 Here a course of 210 will take us FROM the station, so we are southwest of the VOR, and we are 2° right of course, so we're on the 208° radial.
7  	 Here's another one where we're between the TO and From regions , and on a course of 030, the course is to the left. We're along the same area as in number 3.

8  	 Here a course of 030 will take us TO the station (so, we're southwest of it) and we are on the selected course. We are on the 210° radial.
9  0	 Here a course of 030 will take us FROM the station, so we are northeast of it. The needle is centerd, so we are directly on the 030° radial.

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Applying Radial to the Sectional Chart

You may then be asked to apply those indications to sectional chart graphics.

Here just use a straight edge to draw the position against the VOR compass rose on the chart. If given a distance, you can use the distance scale at the base of the chart for nautical miles, statute miles, or kilometers.

In this example below we are asked to identify what is on the Sulphur Springs VOR at 25 nautical miles.

We mark our ruler/paper with 25 miles from the scale provided. Then line up the edge with the VOR symbol and the 295 radial on the compass rose to find the city of Ladonia.