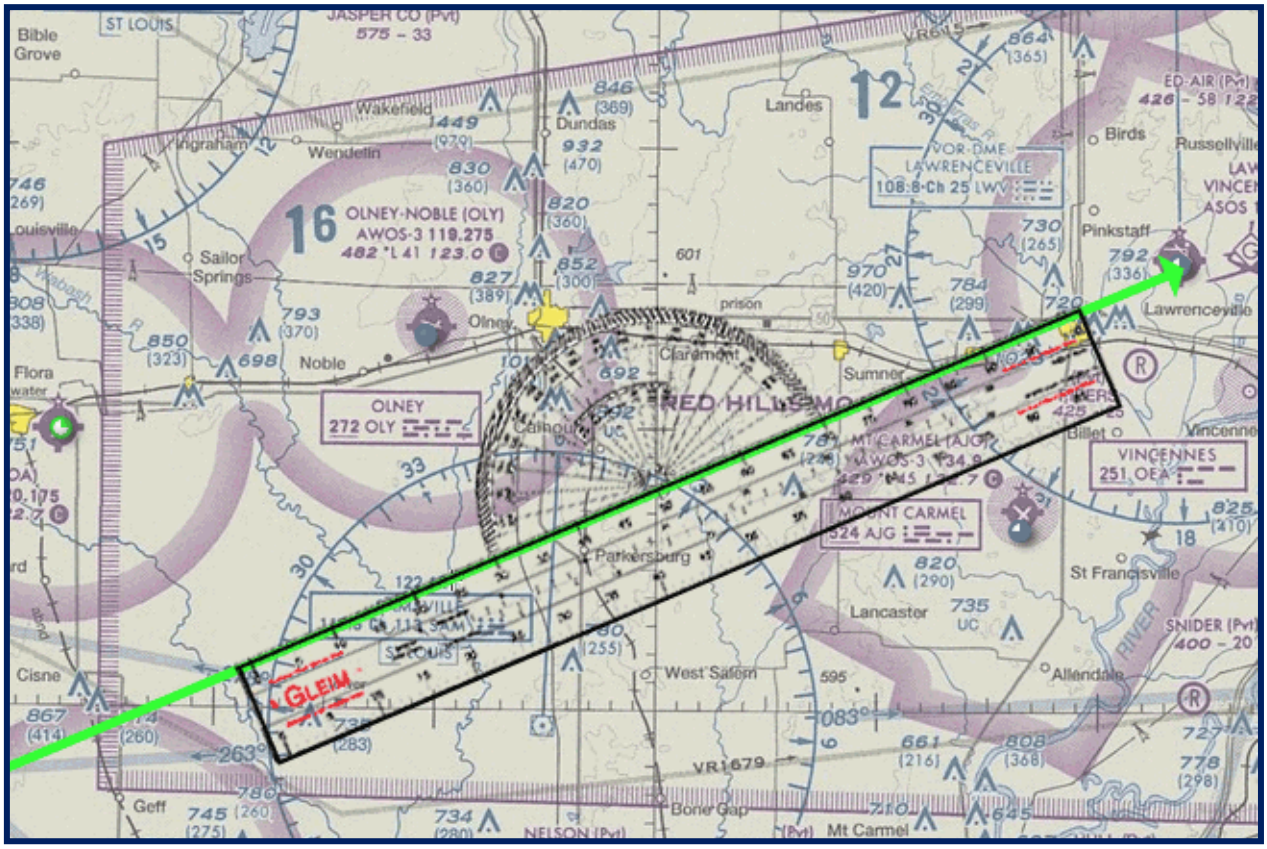
Flight Planning
Using an Aeronautical Chart



By Laura Million

INTRODUCTION

When a driver in an automobile takes a trip, one hops in the car and drives. Signs along the highway will point the way to the final destination. When a pilot flies to a location, there are not signs to tell him where to go or roads to help avoid obstacles. A pilot must rely on an aeronautical chart for information to plan the route safely. Getting lost in an aircraft is not an option. Weather, darkness, fuel starvation can all result in a dangerous situation for a pilot not prepared with a specific route, destination and alternative destinations.

Pilots often forgo this step in flight planning because either they feel confident in their knowledge of the area or belief they can just "wing it." This lesson will introduce the aeronautical chart to the students as well as all the useful information that can be found on the chart while planning a flight or during a flight.

OVERVIEW

This packet includes several steps on how to plan a successful flight using an aeronautical chart. Many pilots ignore this portion of flight preperation, especially when flying through familiar airspace to familiar airports. Proper flight planning is not only a smart safety precaution, but FAR 91.103 states that "Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight." (Code of Federal Regulations, Title 14: Aeronautics and Space). Aviation charts present a large amount of useful information in a small area. Aeronautic charts are portable and required during a flight.

When you are finished you will successfully learn how to plot a course using your aeronautical chart, how to identify obstacles, types of airports, and fuel availability. You will also learn

Materials needed

Current aviation aeronautical chart
Navigational Plotter
Airport Facilities Directory
Federal Aviation Regulations (FAR) code book
Flat surface with good lighting
Note pad and pencil
Highlighter (optional)

TOOLS

VFR Aeronautical Chart

First, check to make sure that you have a current VFR Aeronautical Chart (from here out, we will refer to the aeronautical chart as "chart"). CFR 91.503 states "The pilot in command of an airplane shall ensure that the following flying equipment and aeronautical charts and data, in current and appropriate form, are accessible for each flight at the pilot station of the airplane" The expiration date is prominently located on the cover of the chart. See figure 1.1 for location. This chart is the 85th Edition, effective 18 Nov, 2010 to 2 Jun 2011.
Charts are current for approximately 6 months.

North is always at the top of the chart, south at the bottom, east to the right, west to the left.

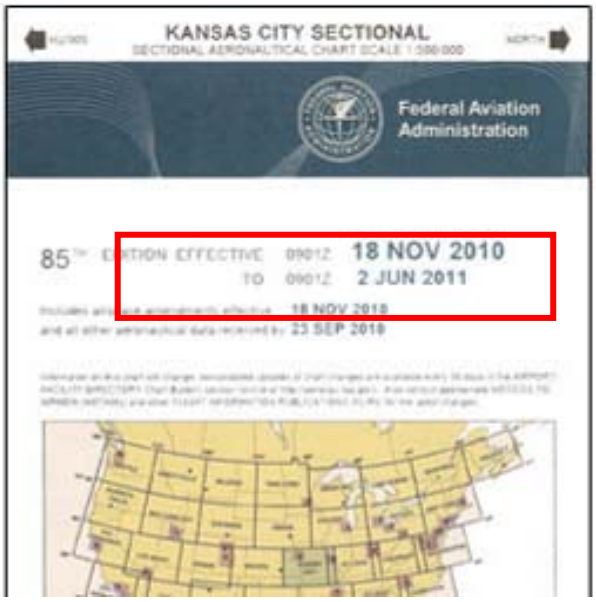


Figure 1.1

Navigational Plotter

The navigational plotter ("plotter") is a ruler like tool that measures the distance on the chart in statute miles and nautical miles. If is very important to always measure distance using the same scale, either Statute miles or Nautical miles. You will be using the nautical miles scale for the VHF Aeronautical Charts.

The plotter will also be used to determine the true course of the flight as well as the total distance and the distance between checkpoints.

CHOOSING YOUR ROUTE

Your home airport is the airport where your plane is stored. The destination airport is the airport you are flying to.

Gather the following items:

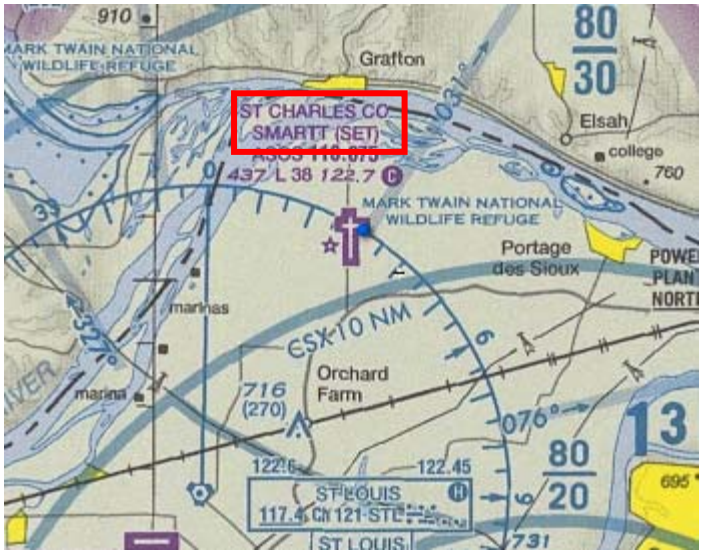
- Chart
- Plotter
- Pencil or highlighter
- Note pad

Calculate the Heading

Step 1: Find your home airport.

For this exercise, our home airport will be St. Charles County Airport – Smartt Field, located north of St. Louis and south of Grafton Illinois.

On your chart, you will see the name of the airport in magenta with the name of the airport (St. Charles Co Smartt) and the airport identifier (SET). The airport identifier is a 3 digit alpha-numeric code. The airport identifier is often preceded by a K, KSET. On the charts, the K is assumed.



Step 2: Find your destination airport.

For this exercise, our destination airport is Columbia Regional Airport between south of Columbia, Missouri and north of Jefferson City, Missouri. Find the airport on your chart.

Quick Quiz: What is the airport identifier for Columbia Regional Airport? _____

Answer: COU – The airport identifier is in parentheses following the airport name.

Step 3: Draw the route
Using the straight edge of the plotter, or a longer straight edge if necessary, draw a line with a pencil from your home airport to you destination airport.

Step 4: Line up the Protractor
You may remember from geometry, a circle has 360 degrees. We will identify our route based on the 360 degrees in a circle. Straight North is 0 or 360 degrees and South is 180 degrees. East is 90 degrees and West is 270 degrees. The 0 is often dropped from the degrees on the chart. However, do not mix up 9 degrees with 90 degrees. Nine degrees should be read at 09 degrees.

Now pick up the plotter in your hands with the curved surface at the top and the Nautical Miles scale facing you at the bottom. You will notice on the protractor, numbers on the outer edge of the round end. These are the degree marking. See figure 1.2.

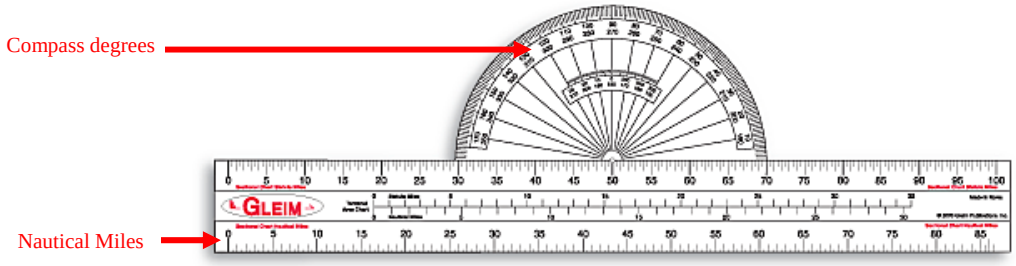


Figure 1.2

Note the small hole in the center of the protractor.

a. Place the small hole in the center of the protractor over a meridian. See Figure 1.3
b. Align the top edge of the ruler with your course line.

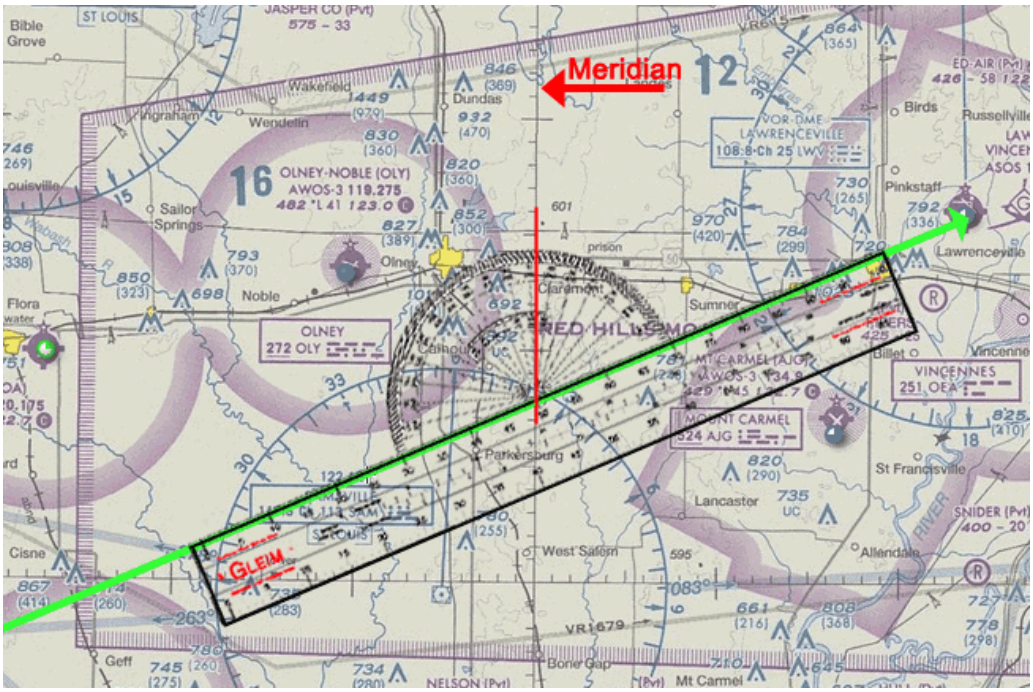


Figure 1.3

Quick Quiz: What are the degrees of the compass?

North: _____
South: _____
East: _____
West: _____

Answer:
North: 360 degrees or 36
South: 180 degrees or 18
East: 90 degrees or 9
West: 270 degrees or 27

Step 5: Read the Heading
Read the direction of the scale over the meridian. In Figure 1.4, the True Course is 266 degrees and the return or reciprocal course is 86 degrees.

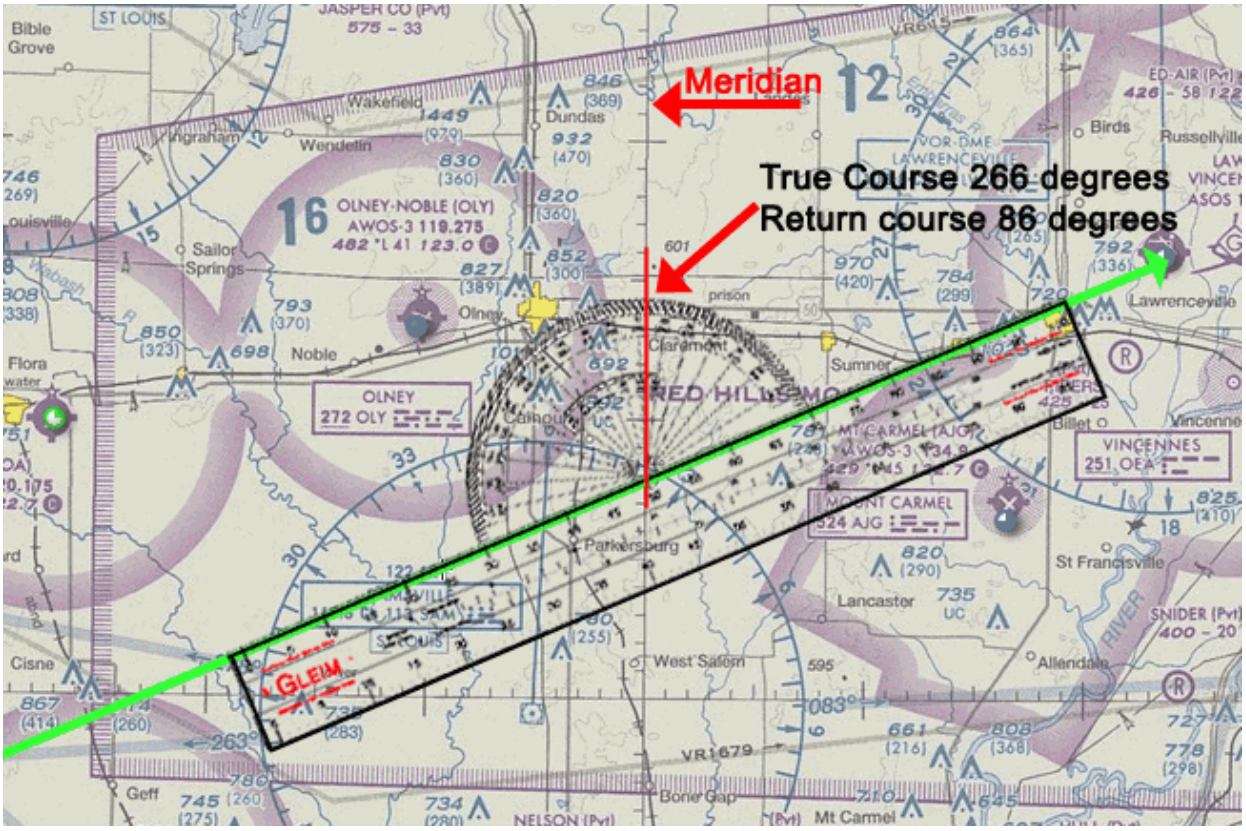


Figure 1.4

When you set your compass or GPS in the airplane, you will use these degrees to calculate your heading.

Now you try it:
Name the five steps to calculate the heading to your destination airport.
Step 1:_____

Step 2:_____

Step 3: _____

Step 4: _____

Step 5: _____

Answers:

Step 1: Determine your home airport
Step 2: Select your destination airport
Step 3: Draw the route
Step 4: Line up the protractor on a meridian
Step 5: Read the heading.

More Practice:

1. Calculate the heading between SET and H19 (Bowling Green)?
2. Calculate the heading between H19 and MYJ (Mexico Memorial)?

Calculate the Distance

Step 1: Find your home airport.

For this exercise, our home airport again is St. Charles County Airport – Smartt Field.

Step 2 Find your destination airport.

For this exercise, our destination airport again is Columbia Regional

Step 3: Measure the distance

Now pick up the plotter in your hands with the curved surface at the top and the Nautical Miles scale facing you at the bottom.
The curved surface is the compass directional markings on the top. The nautical miles scale is at the bottom straight edge.
On the chart, place the 0 of the nautical miles scale in the center of SET. Align the straight edge over COU. You may have to turn the plotter up-side down. The distance between SET and COU is 85nm. If you don't wish to read the plotter up-side down, place the 0 of the nautical miles scale in the center of COU and measure to SET. The distance is still 85nm.

Question: Name the three steps in finding the distance between two airports?

Step 1:_____

Step 2:_____

Step 3: _____

Answers:
Step 1: Find your home airport
Step 2: Find the destination airport
Step 3: Using the plotter, measure the distance in nautical miles.

More Practice:

3. What is the distance between SET and H19 (Bowling Green)?
4. What is the distance between H19 and MYJ (Mexico Memorial)?
5. What airport is 33nm from MYJ?

LANDMARKS AND OBSTACLES

Landmarks

All aeronautical charts come with a legend for identifying many landmarks and other topographical information. The most common landmarks are roads, rivers, lakes, railroads, power transmission lines, and towns. See Figure 2.1 below for the most common landmarks.

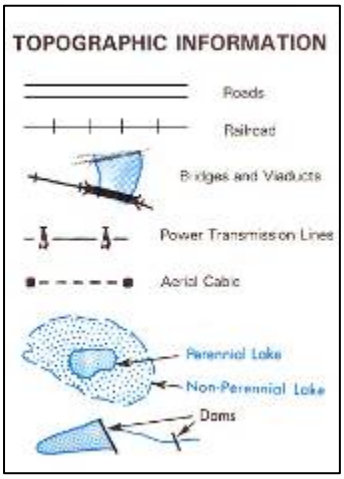
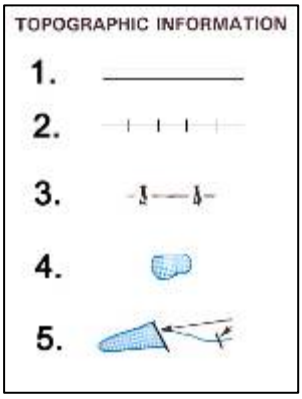


Figure 2.1

A full legend is located on your chart. When doing any flight planning, refer to the legend for labels of icons.

Now you try it:
Match the icon to the landmark.



A. Power Lines
B. Lakes
C. Dam
D. Railroad
E. Road

Answers:
1. E – Roads
2. D – Railroad
3. A – Power Lines
4. B – Lake
5. C – Dam

Obstructions

Obstructions are generally tall towers that can be a hazard to an airplane. Towers have separate icons for towers above 1000 above the ground (AGL) and below 1000 AGL. See the legend in figure 2.2.

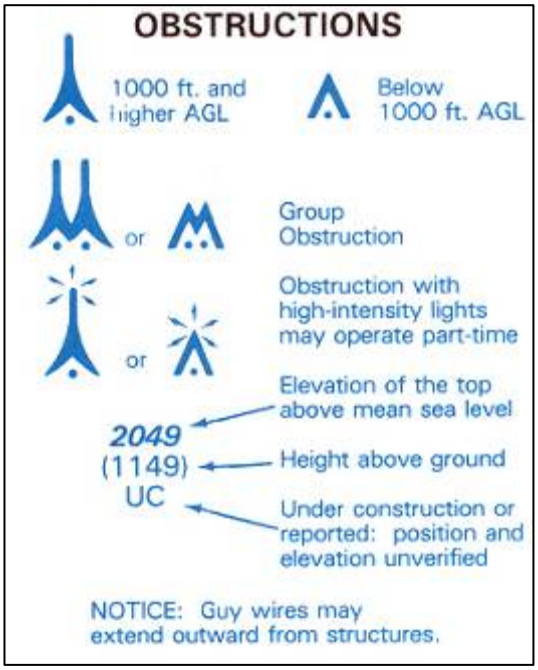
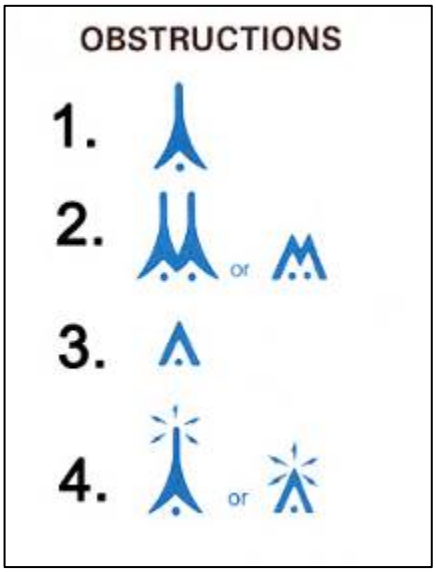


Figure 2.2

Now you try it:
Match the icon to the obstructions.



A. Obstruction under 1000 feet
B. Obstruction with high intensity lights
C. Group obstructions
D. Obstruction over 1000 feet

Answers:
1. D - Obstructions over 1000 feet
2. C – Group Obstructions
3. A – Obstructions under 1000 feet
4. B – Obstructions with high intensity lights

Landmarks and Obstructions along a route

Since there are no road signs in the sky, a pilot should be able to identify landmarks and obstacles to guide the plane to the destination airport and to ensure that the plane does not fly too far off route. In your next lesson, you will learn to fill out a flight plan. You will identify landmarks and obstructions as part of your flight plan. For now, we will just identify them.

In figure 2.3, the green line below indicates the flight path. As you fly along, you will notice things such as major roads, high tension lines, rivers, railroads and small lakes. These will help you quickly find your place on the chart as you fly.

Figure 2.3

Now you try it: Circle and label a railroad, a river, a road and tower along the flight path or within 10 miles (about an inch and a half on this picture) of the route from SUS to JEF. The green line is your flight path.

Minimum Distance Above the Ground

All pilots must fly safely above the ground and within a safe distance of all obstacles. What are the safe distances for a pilot? The FAR 91.119.b states "Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of **1,000 feet above the highest obstacle** within a horizontal radius of 2,000 feet of the aircraft."

Therefore, if the top of the town's radio transmitter is at an altitude of 1000 feet, an airplane can fly no lower than 1000 feet over the transmitter.

Over areas other than congested areas FAR 91.119.c states that a plane can fly no lower than "an altitude of **500 feet above the surface**, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure."

Now you try it:
Aircraft must remain _____ feet over congested areas and over _____ feet above all other terrain.

Answer: Aircraft must remain 1000 feet over congested areas and over 500 feet above all other terrain.

Emergency Frequency

In case of emergency, a pilot can transmit on the emergency radio frequency of **121.5**. This emergency frequency is monitored by most air traffic control towers, Flight Service Stations, and other search and rescue operations. This frequency should only be used in a true emergency such as an imminent crash.

Now you try it:
The emergency radio frequency is _____

Answer: The emergency radio frequency is 121.5

AIRPORTS

Airspace – Class E, Class D, Class C, Class B

As you will remember from a previous lesson, that all airspace is classified as Class A, Class B, Class C, Class D, Class E and Class G. The four main airspaces that we need to be most familiar with are the airspaces surrounding airports of Class E, Class D, Class C and Class B airspace. You have also learned in a previous lesson the characteristics of each of the airspaces. In this lesson, we will be concerned mostly with identifying the type of airspace by its markings on the chart.

Class E Airspace

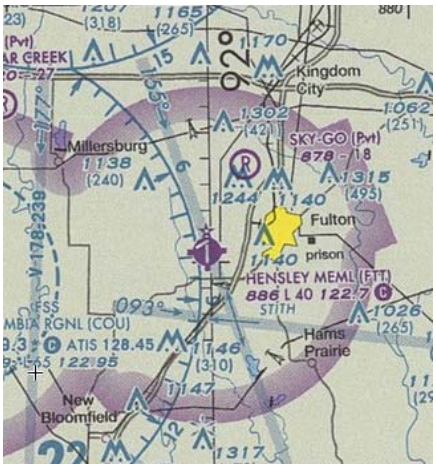


Figure 3.1

Class E airspace are for the small public airports such as St. Charles County Airport near Portage des Sioux, MO or Hensley Memorial Airport near Columbia MO. You will learn in another lesson about the communications and requirements for Class E airspace. Class E airspace is denoted on the chart has having a magenta shading surrounding the airport. See Figure 3.1.

Airports with Class E airspace do not have control towers.

Class D Airspace

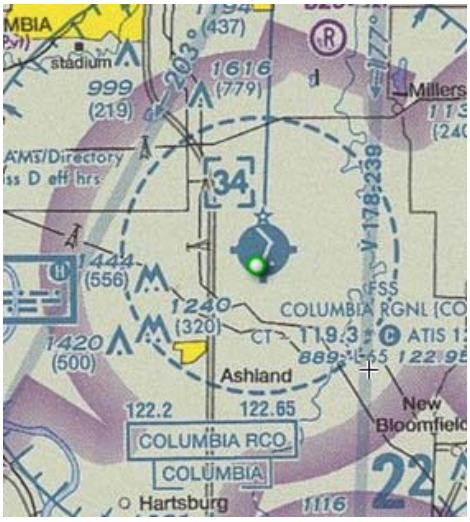


Figure 3.2

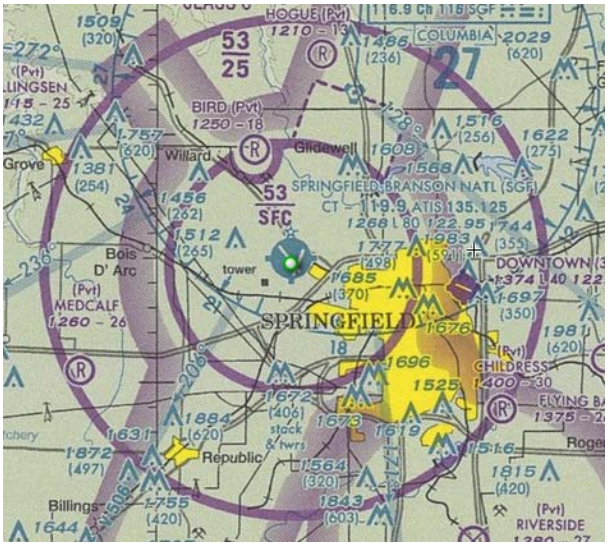
Class D airspace are for the medium sized airports such as Spirit of St. Louis Airport near Creve Coeur MO or Columbia Regional Airport near Columbia MO. You will learn in another lesson about the communications and requirements for Class D airspace. Class D airspace is denoted on the chart has having a dotted blue line pr dotted magenta line surrounding the airport. See Figure 3.2.

Airports with Class D airspace are usually in or near a medium city.

When the control tower of an airport with Class D airspace closes for the night, the airspace reverts to Class E airspace. Note the magenta shading around the Class D ring. Consult your Airport Directory for Control Tower hours of operation for your airport.

Class C Airspace

Class C airspace are for the medium sized airports such as Springfield/Branson National near Springfield MO or Abraham Lincoln Capital Airport in Springfield IL. You will learn in another lesson about the communications and requirements for Class C airspace. Class C airspace is denoted on the chart has having 2 magenta circles surrounding the airport. See Figure 3.3.



Airports with Class C airspace are usually in or near a large city. The yellow areas on the chart denote city boundaries.

When the control tower of an airport with Class C airspace closes for the night, the airspace reverts to Class E. Note the magenta shading around the Class D ring. Consult your Airport Directory for Control Tower hours of operation for your airport.

Figure 3.3

Class B Airspace

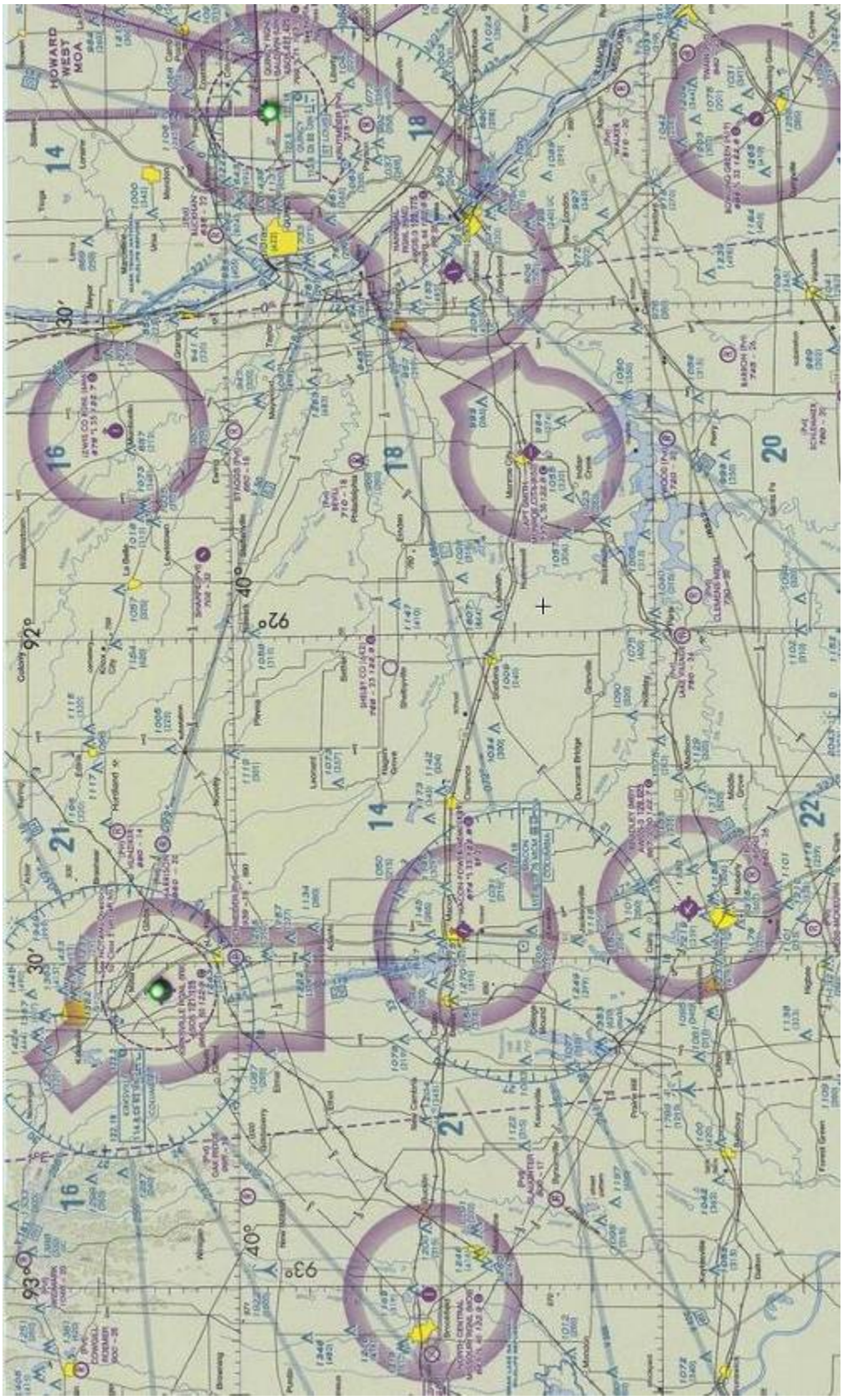
Class B airspace are for the big airports such as St. Louis Lambert International or O'Hare International in Chicago. You will learn in another lesson about the communications and requirements for Class B airspace. Class B airspace is denoted on the chart has having 3-4 blue circles surrounding the airport. See Figure 3.4.

Airports with Class B airspace are usually in or near a large city. The yellow areas on the chart denote city boundaries.

Figure 3.4

Now you try it

On Figure 3.5, label the Class D and the Class E airports. Rotate the page to view the chart better.



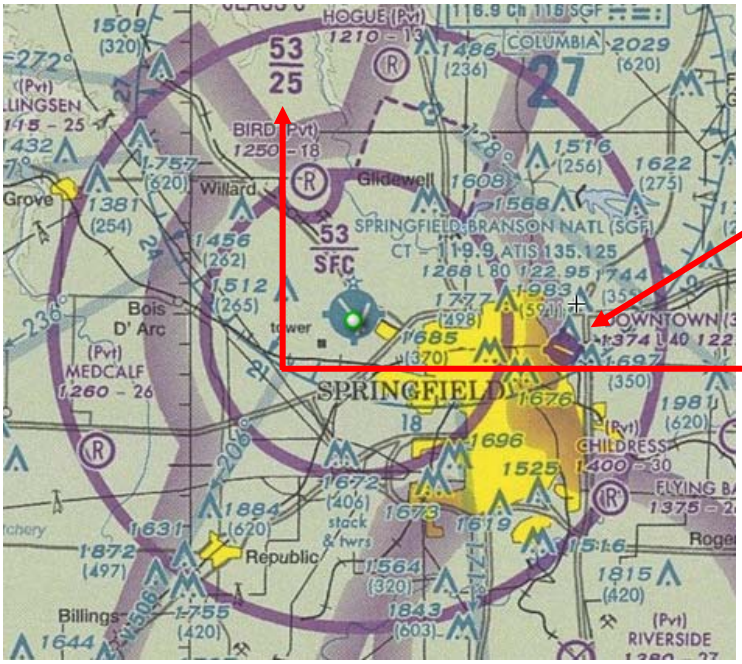
Answers:
Class D: Quincy Regional
Kirksville Regional
Class E: Hannibal Regional
Capt Smith/Monroe City
Lewis Co Regional
Bowling Green
Macon Tower Memorial
Bradley
North Central MO Regional

Figure 3.5

Ceiling and Floor Height

Class C Airspace

You have learned in a previous lesson how airports with Class C and Class B airspace have different altitude rings that allow pilots to fly under the Class C and Class B airspace. Identifying how high a plane can fly near the Class C and Class B airspace without entering the airspace is critical.



Notice Springfield/Branson National airport is a Class C airspace (two magenta rings).

Also notice that Downtown airport is inside the outer ring.

The magenta numbers inside the ring denotes the ceiling and floor of that airspace. The ceiling is the highest altitude (5300 feet) and the floor is lowest altitude (2500 feet) of the outer ring of the class C airspace.

To save space, the 00 are dropped from the numbers.

Figure 3.6

Therefore, an airplane flying out of Downtown airport can fly as high as 2499 feet and avoid the Class C airspace. See Figure 3.7

The inner ring has a number of 53/SFC. The ceiling of the airspace is 5300 feet and the floor is the surface of the ground.

Since the Class C airspace ceiling is 3500 feet, an airplane could fly over 5300 feet altitude, and the pilot would not have to talk to the control tower.

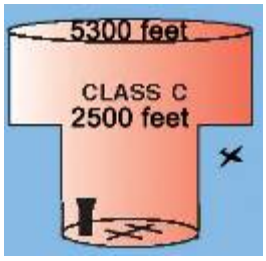


Figure 3.7

Class D Airspace

Class D airspace does not have layers, it is a cylinder (See figure 3.8) from surface to ceiling. The ceiling elevation is listed as one number. See Figure 3.9.
For Columbia Regional, the ceiling is 3400 feet.

Figure 3.8

Figure 3.9

Now you try it:

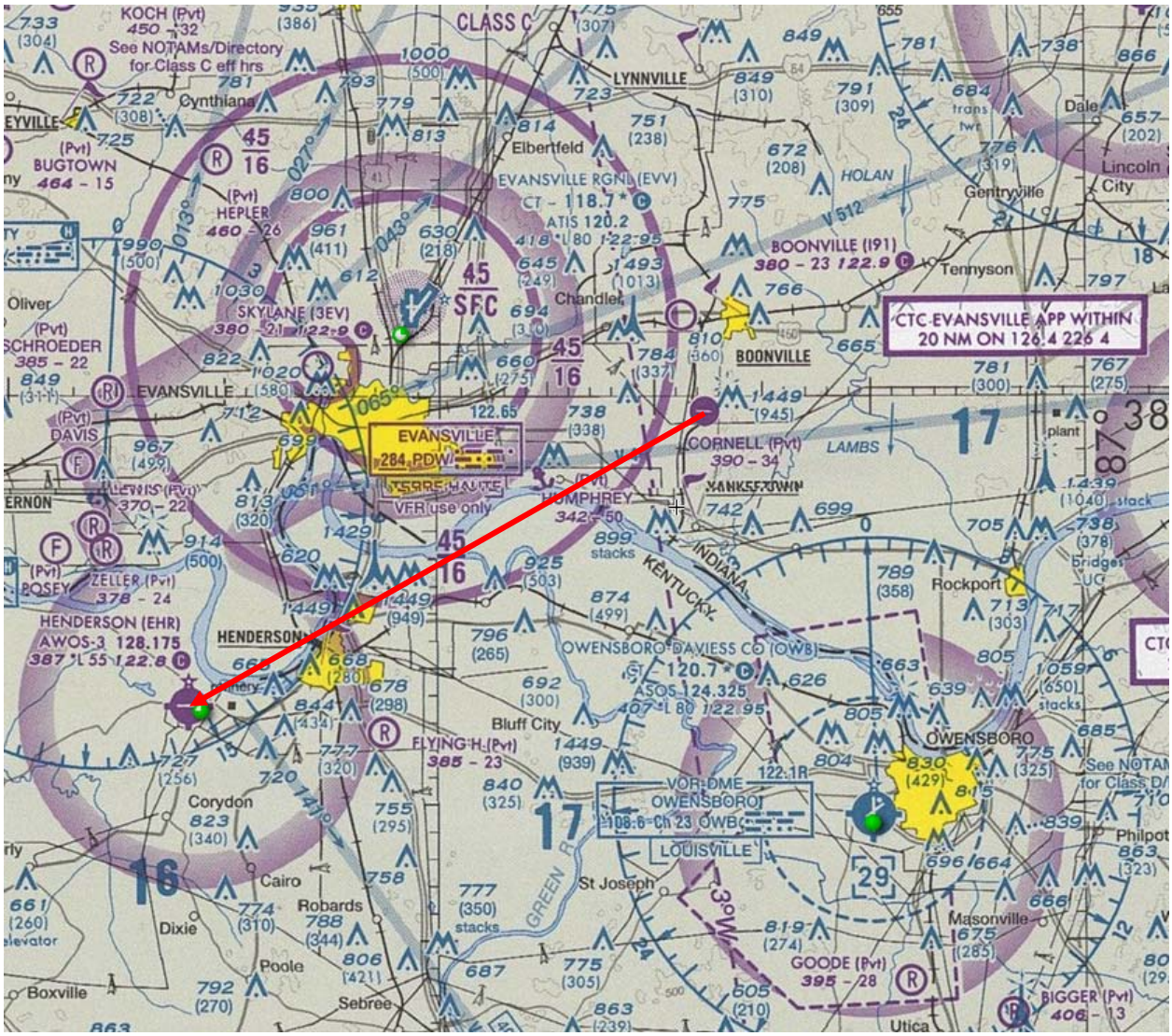


Figure 3.10

Using Figure 3.10 fill in the blanks:

What is the ceiling for Evansville Regional Airport:_____

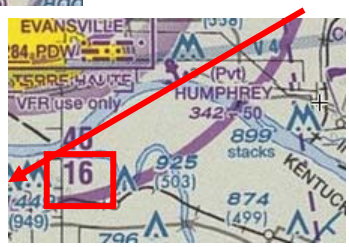
If the red arrow is your flight path, how high can you fly when you are crossing the Ohio River, just south of Evansville? _____

What is the lowest I can fly if I am flying over the Owensboro - Daviess County Airport without talking to the control tower? _____

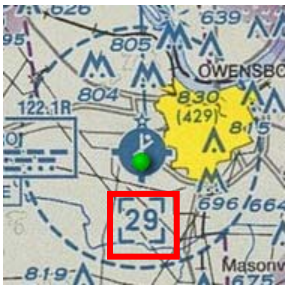
Answers:

What is the ceiling for Evansville Regional Airport: **4500 feet**
The top number in hundreds of feet, is the ceiling.

If the red arrow is your flight path, how high can you fly when you are crossing the Ohio River, just south of Evansville? **1600 feet**
The lowest part that you can fly under of the Class C airspace as you cross over the river is 1600 feet.



What is the lowest I can fly if I am flying over the Owensboro Daviess County Airport without talking to the control tower? **2900 feet**
The number is brackets is the ceiling.



Radio Frequencies

As you have already learned, most airports require you to either talk to a control tower or call your flight positions over the radio. It is critical that you identify the radio frequencies of the destination airport as well as the frequency of the airspace you will be traveling through. This information can be found in your Airport Directories however, if your directory is more than 6 months old, the information might be outdated. The information listed on your chart is more current.

Types of frequencies

CTAF – Common Traffic Advisory Frequency – the radio frequency used to coordinate air traffic at airports in Class E airspace or in route between airports.

ATIS – Automatic Terminal Information System – used for weather information, airport status, etc.

Ground – Used at airports with Class C and D airspace, this frequency is used to coordinate traffic on the ground. Ground control handles traffic until right before takeoff and as soon as a plane departs the active runway.

Control Tower – This frequency links a pilot directly to the air controller for instructions for take-off, pattern altitude and landing position. Acts as ground control at airports in Class D airspace.

AWOS – Automated Weather Observation System – Automated weather available at non-towered airports.

Radio at an airport with Class D airspace

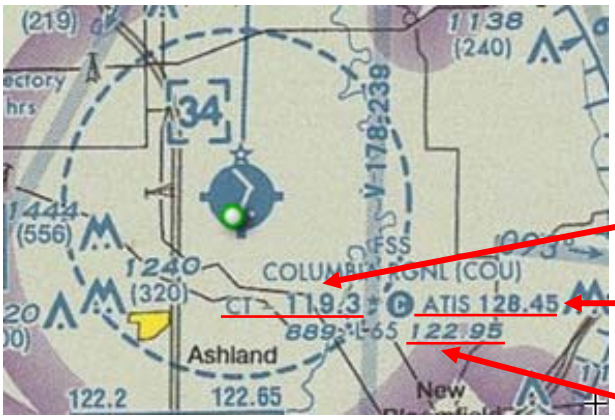


Figure 4.1 is Columbia Regional Airport. Columbia Regional is an airport with Class D airspace so therefore it has a control tower. The Control Tower frequency is preceded by a CT and then the frequency. Columbia's control tower frequency is 119.3.

The ATIS frequency is preceded by ATIS. The Columbia's ATIS is 128.45.

The CTAF frequency (in italics) for the flight to Columbia Regional and for use at the airport when the Control Tower is closed is 122.95.

Figure 4.1

Radio at an airport with Class E airspace

Viertel Memorial is an airport with Class E airspace so it does not have a control tower. Pilots must call their intensions on the radio before approaching the airport.

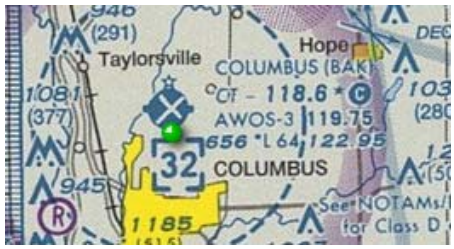
The AWOS 119.625

The CTAF frequency (in italics) is 122.7

Figure 4.2

Now you try it:

What is the CTAF frequency of Washington County airport? _____



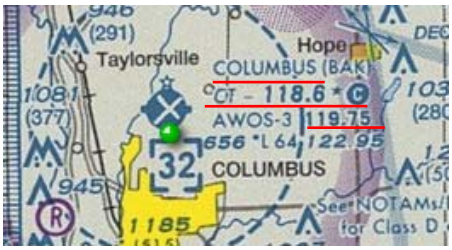
What is the Control Tower Frequency of Columbus? _____

What is the AWOS frequency? _____

What is the CTAF frequency? _____

Answers:

What is the CTAF frequency of Washington County airport?
123.0
The CTAF is in italics.



What is the Control Tower Frequency of Columbus? **118.6**
The control tower frequency is bold and preceded by CT.
What is the AWOS frequency? **119.75**
The AWOS frequency is preceded by AWOS.
What is the CTAF frequency? **122.95**
The CTAF is in italics.

Runway Length and Direction

Determining a runway length and direction does not seem important at first. The runway length may not be critical for most single-engine airplanes, but it is still important to know that information, especially for new destination airports.

Refer to Figure 4.3 for information for Quincy Regional airport. The airport is a Class E airspace so there is no control tower. You will not have a Control Tower to tell you what runway to land on. You will need to gather this information yourself.

Figure 4.3

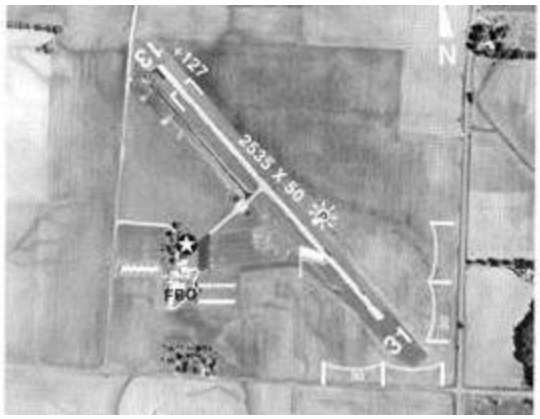
As you will learn in a future lesson, a pilot will contact AWOS to determine the direction of the wind. The direction of the wind determines which runway to select. If the wind is coming out of the north at 355 degrees, the best runway to us use is runway 36.

The runways are numbered by the direction you are facing. You will see the runway number (or direction) listed at the bottom of the runway. The runway name is referred to by both directions. The north/south runway would be referred to as Runway 36-18.

To determine the length of the runway, look on the sides of the runway. Runway 36 is 5397 feet long by 150 feet wide. You probably will not have to worry about the width of a runway in a single-engine plane. The width of a runway is more critical in larger planes.

A 5397 foot runway is more than long enough to land a plane required only 3000 feet to land.

Now you try it:
Can you land at the following airport if you need 3000 feet of runway? Why or why not?

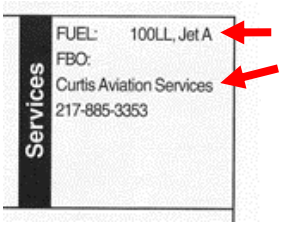


Answer: No. The runway length is only 2535 feet and you need 3000 feet of runway to land safely.

Fuel Availability

A pilot never wants to run out of fuel. That seems like an obvious statement but situations occur when you use up more fuel than you intended or if you cannot land at your destination airport and have to fly further than expected. It is important to identify on your chart which airports have fuel. The Airport Directory will also give you this information.


An airport with fuel will have a star above the airport logo. This tells you that the airport has fuel, but it does not tell you the type of fuel or the hours that the fuel service station is open.



Consult the Airport Directory for the type of fuel and the fuel distributor. You may have to call ahead to determine of hours of operations.

Now you try it:

From the chart to the right, which airport has fuel?

Answer: Franklin airport

ALTERNATIVE AIRPORTS

You can apply the above information to identify alternative airports along the route or beyond the destination airport. It is a good practice to select alternative airports in case of emergency along the route, such as engine trouble or unexpected closure of the destination airport.

You never know when you may need to land early or if you destination airport has suddenly closed due to an accident on the runway. You may not have enough fuel to turn back and you need to land.

Having pre-selected an airport along the route and within 25 miles of your destination prior to the flight will alleviate some stress when the flight does not go as planned.

Airport along the route

You will need to apply all of the above lessons to select an alternative airport along your flight.

Air space – you need to know the type of air space you will be flying to, the CTAF, and whether you will be talking to the control tower or calling your own position.
Communications – you need to know all the frequencies of the airport and surrounding airspace.
Runways – you need to know the runway length and directions so that you can land safely.
Fuel – you need to know the fuel status if you require fuel.
Obstacles and Landmarks – you should know the obstacles and landmarks near your alternative airport to help you find it quickly.

Figure 5.1

If the green line in Figure 5.1 above represents our flight path, a good alternative airport would be Washington Memorial near Washington MO. The airport has fuel (star above the airport), it has good landmarks for identification, (Missouri River) and the town just south of the river.

Another Alternative airport might be Herman near Herman Missouri. A check of the airport directory state that the airport is unattended, so the fuel may not be available at all times.

Now you try:

Your flight path is in green. Identify 3 airports along the route with fuel.

1. _____
2. _____
3. _____

Answer:
Fairfield, Flora, Olney-Noble or Mt. Carmel

Alternative airport from your Destination

You will need to apply all of the above lessons to select an alternative airport within 25 miles of your destination airport.

Air space – you need to know the type of air space you will be flying to, the CTAF, and whether you will be talking to the control tower or calling your own position.
Communications – you need to know all the frequencies of the airport and surrounding airspace.
Runways – you need to know the runway length and directions so that you can land safely.
Fuel – you need to know the fuel status if you require fuel.
Obstacles and Landmarks – you should know the obstacles and landmarks near your alternative airport to help you find it quickly.

Using your plotter, draw a circle 25 miles around your destination airport.

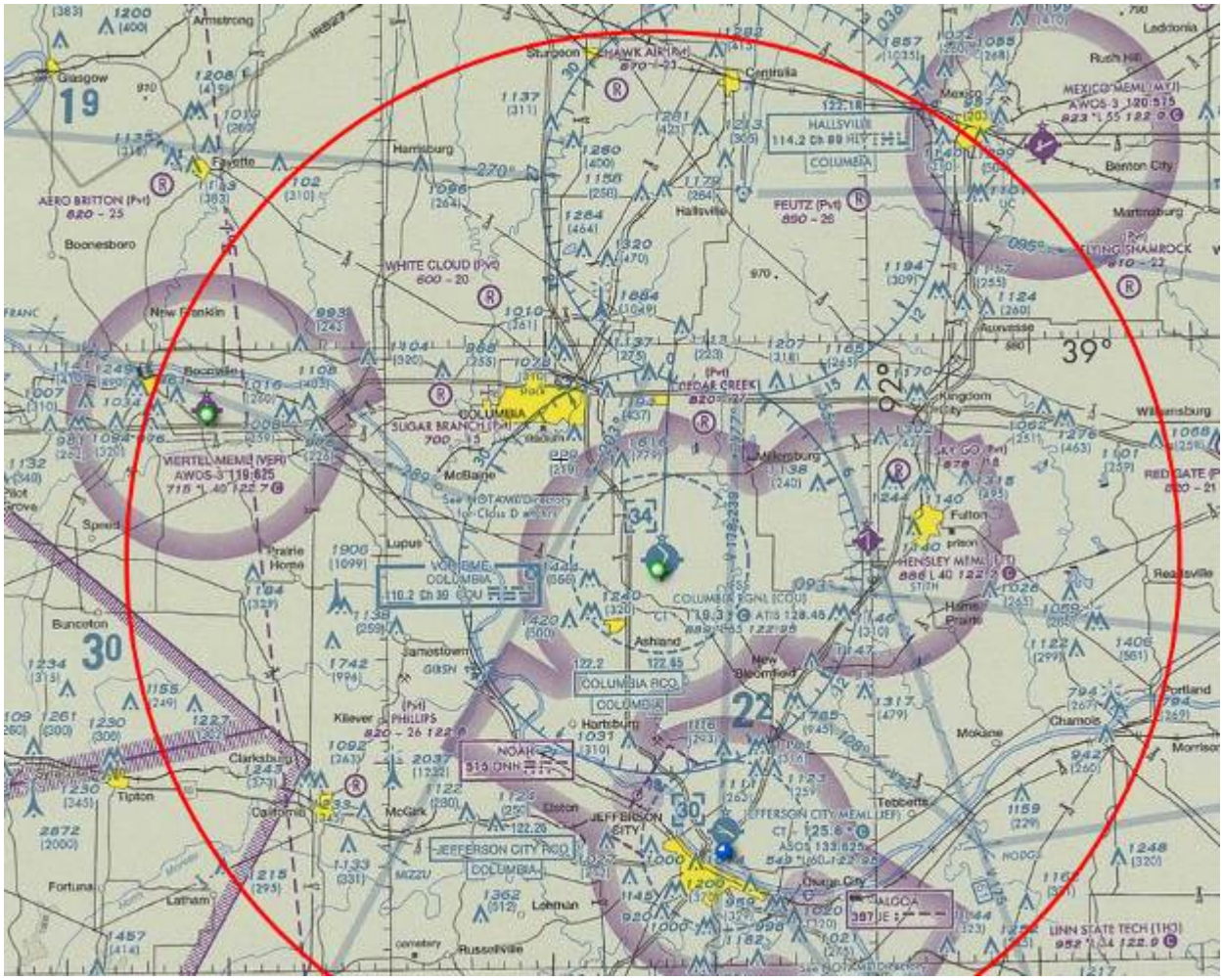


Figure 5.2

In Figure 5.2 the red circle is 25nm around our destination airport of Columbia Regional. There are 3 airports that fall within that circle, Hensley Memorial, Jefferson City Memorial and Viertel Memorial airports that would all make good alternative airports. Notice that Mexico airport falls just outside the circle but might also be included in the list.

The best choice for alternative airport would be Jefferson City Memorial as it is the largest of the three and is closest to a big city in case the pilot has to stay overnight. It will be easy to find transportation to the city of Columbia at a larger city like Jefferson City than from the cities of Fulton or Boonville.

Now you try it:

Your destination airport is Independence (Class D airspace in the lower left corner of image)

Name the primary alternative airport.

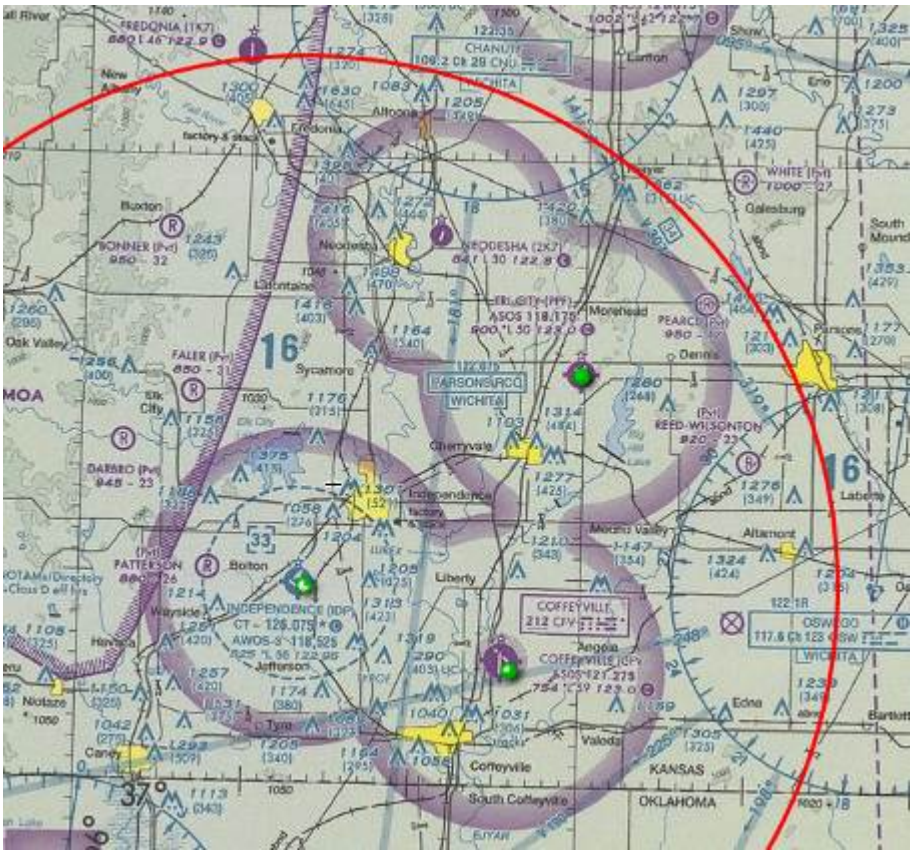
_____

_____

Name a second alternative airport.

_____

_____



Answer:
Primary alternative airport: Coffeyville – it is larger and closer to the city of Independence.
Second alternative airport: Tri City – it's close to Cherryvale for transportation purposes.

This ends your lesson on aeronautical charts. Keep this information you have recorded because you will need some of the information when you fill out a flight plan in a future lesson.