

National Airspace System

Navigation and Flight Planning

NOTAMs

ATC and Flight Following

Night Operations

High Altitude Operations

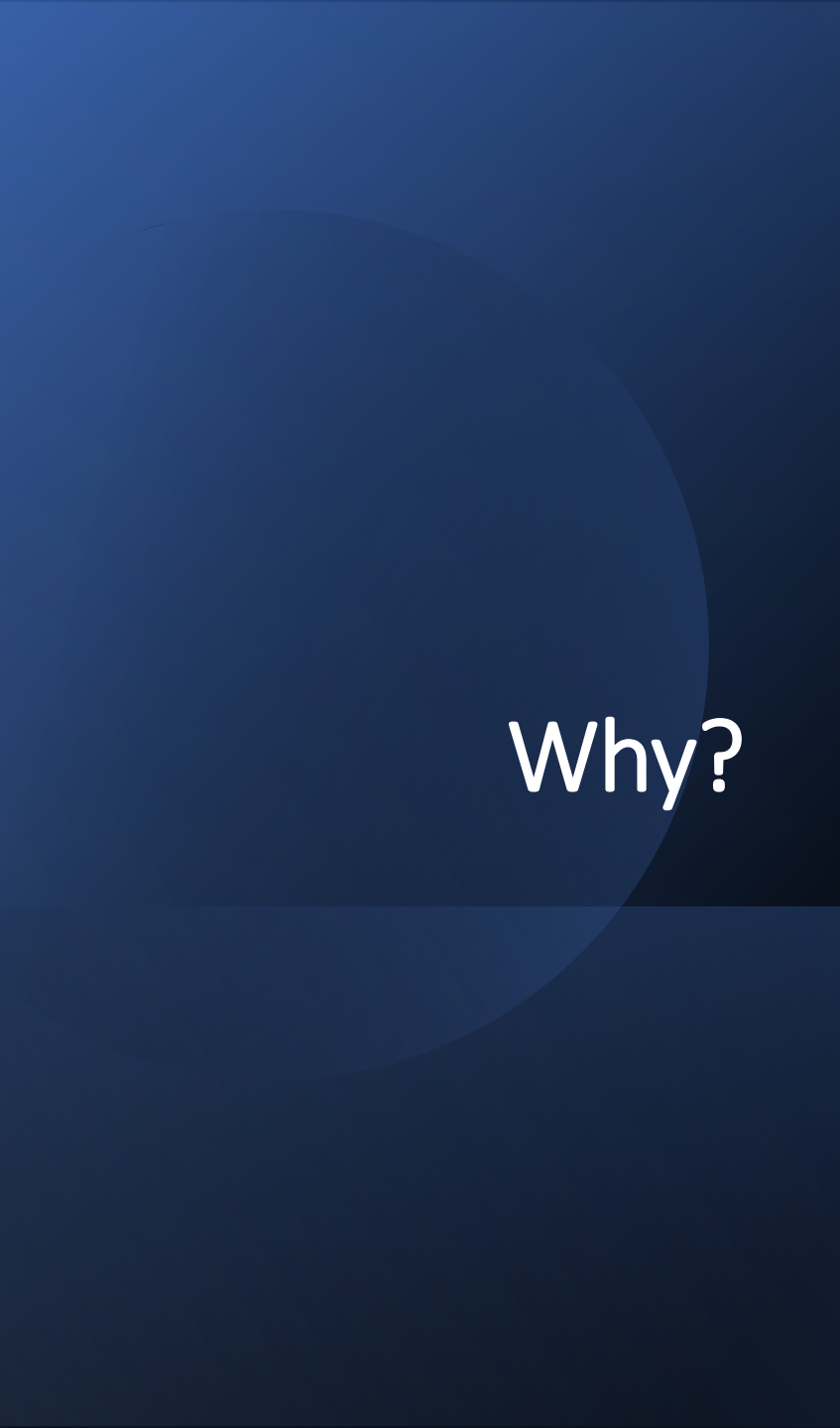
GPS

ADS-B

VORs/Nav With GPS Waypoints

National Airspace System





Why?

Why do we have all these different types of airspaces?

To keep VFR traffic away from IFR traffic

Busy Atlanta Area



Class A

Nickname(s)

'Altitude' 'Air'

18000 ft MSL to 60000 ft MSL @ 29.92

VFR visibility requirements

N/A

Equipment requirements

IFR capable, Transponder, Radio

Communication requirements

Must get clearance before entering

Other

IFR rating needed, IFR plan needed

Class B

Nickname(s)

'Busy' 'Big'

VFR visibility requirements

3 SM, clear of clouds

Equipment requirements

Transponder, Radio

Communication requirements

Must get a clearance before entering

Other

Student pilot solo must have an endorsement

Special VFR where airports allow (1 SM, clear of clouds)



Student Pilot Solo not Allowed

AIM 3-2-3 Class B Airspace

b. 2.

Andrews Air Force Base, MD

Atlanta Hartsfield Airport, GA

Boston Logan Airport, MA

Chicago O'Hare Intl. Airport, IL

Dallas/Fort Worth Intl. Airport, TX

Los Angeles Intl. Airport, CA

Miami Intl. Airport, FL

Newark Intl. Airport, NJ

New York Kennedy Airport, NY

New York La Guardia Airport, NY

Ronald Reagan Washington National Airport, DC

San Francisco Intl. Airport, CA

Class C

Nickname(s)

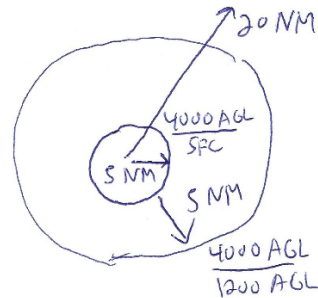
'Crowded' 'Clearance' 'Corporate'

VFR visibility requirements

3 SM, 1000 ft **A**bove clouds, 500 ft **B**elow clouds, 2000 ft from/a **C**ross clouds ('C152' 'ABC')

Equipment requirements

Transponder, Radio



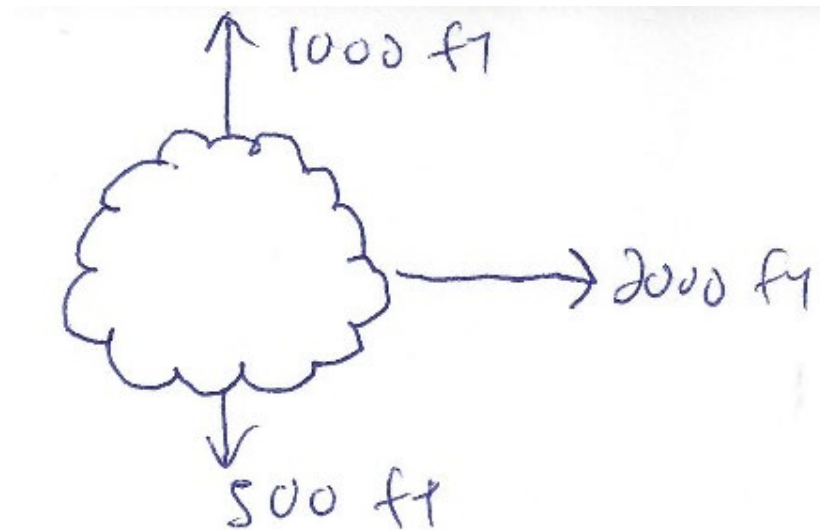
Communication requirements

Must be in communication but do not need specific clearance to enter

Other

Student pilot solo must have an endorsement

Special VFR where airports allow (1 SM, clear of clouds)



‘C152’ ‘ABC’

Why greater spacing above the clouds than below?

Planes typically descend at 500 fpm and climb at 1000-1500 fpm

To be able to stay in good VFR visibility

It is harder to judge where the altitude of the tops vs the bottom

Class C



Class D

Nickname(s)

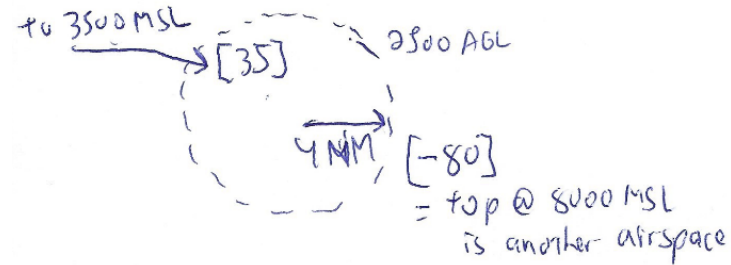
'Dialog' 'Declare'

VFR visibility requirements

3 SM, 1000 ft **A**bove clouds, 500 ft **B**elow clouds, 2000 ft from/a **C**ross clouds (3 'C152' 'ABC')

Equipment requirements

Radio (no Transponder)



Communication requirements

Must be in communication but do not need specific clearance to enter

Other

Special VFR where airports allow (1 SM, clear of clouds)



Class D

Class D

Overnight

When the tower is closed, it could become class E or a class G

The official source of E or G will be the Chart Supplement (A/FD) for that airport

KPDK

CLASS D SVC 0630-2300 MON-FRI, 0700-2300 SAT-SUN; OTHER TIMES CLASS E

KRYY

CLASS D SVC 0700-2300; OTHER TIMES CLASS G

Class G

Nickname(s)

'Go for it'...No towers...Totally uncontrolled

VFR visibility requirements

Day, under 701/1201 AGL, any MSL: 1 SM, clear of clouds

Night, under 701/1201 AGL, any MSL: 3 SM, 'C152'

Day, over 701/1200 AGL, under 10000 MSL: 1 SM, '152'

Night, over 701/1200 AGL, under 10000 MSL: 3 SM, 'C152'

701/1201+ AGL, 10000+ MSL:

5 SM, 1000 ft above clouds, 1000 ft below clouds, 1 SM from clouds ('F5111')

Equipment requirements

Nothing

Communication requirements

None

Class G Weather Minimums

1,200 Feet AGL And Lower, Day

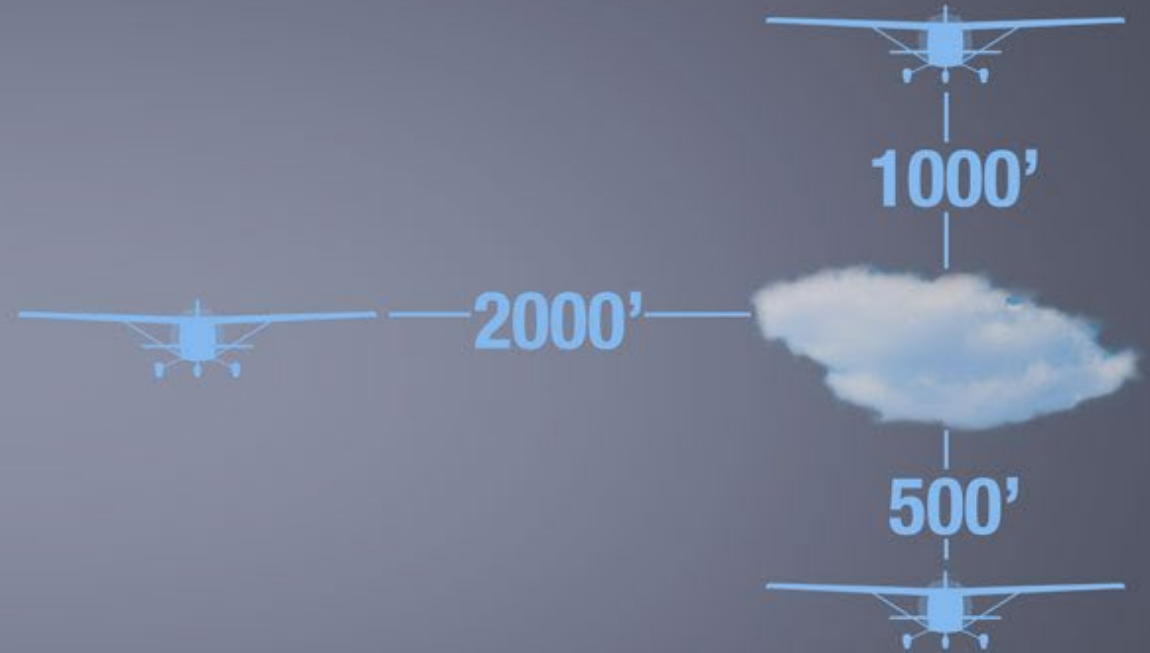
**1 SM
Visibility**



Class G Weather Minimums

1,200 Feet AGL And Lower, Night

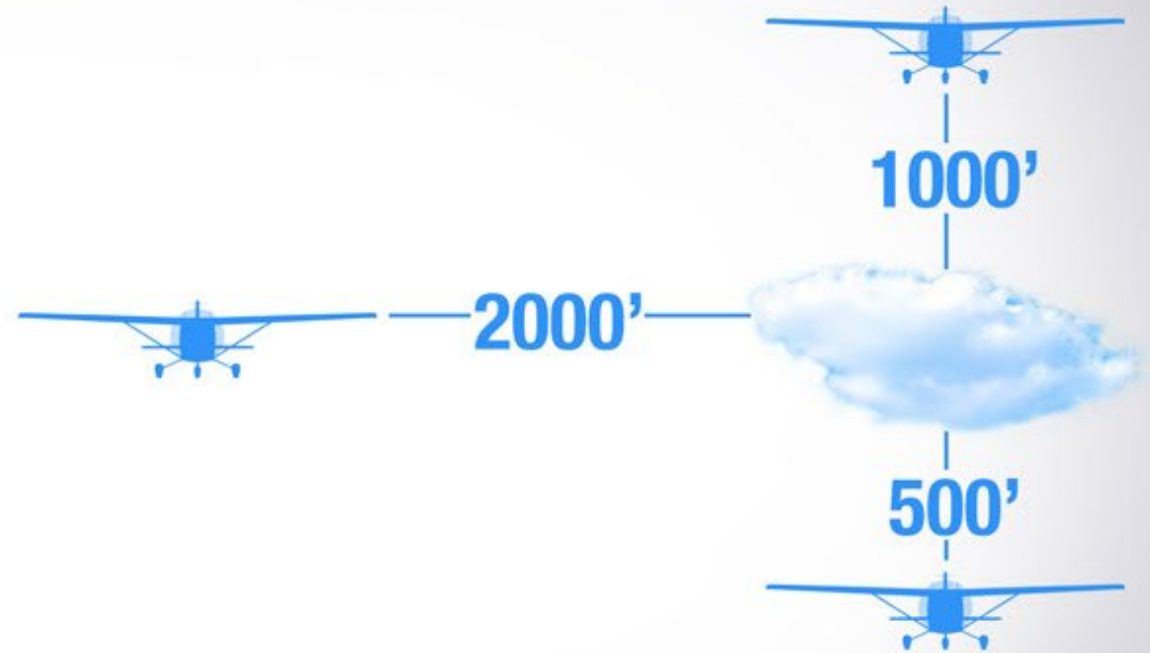
3 SM
Visibility



Class G Weather Minimums

Above 1,200 feet AGL, but lower than
10,000 feet MSL, day

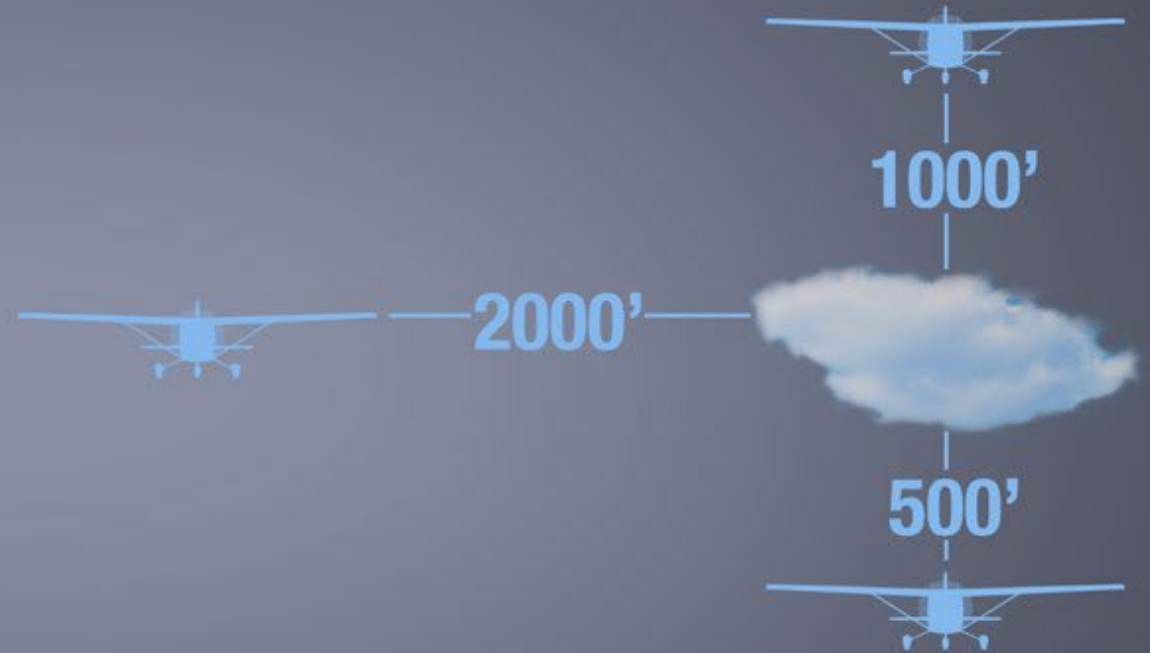
1 SM
Visibility



Class G Weather Minimums

Above 1,200 feet AGL, but lower than
10,000 feet MSL, night

3 SM
Visibility



Class G Weather Minimums

10,000 feet MSL or higher, day or night

**5 SM
Visibility**



Class E

Why

Manage IFR traffic...Keep VFR traffic away from IFR traffic

Nickname(s)

'SETVODA' 'Everywhere (else)'

VFR visibility requirements

Below 10000 MSL:

3 SM, 1000 ft **A**bove clouds, 500 ft **B**elow clouds, 2000 ft from/a **C**ross clouds (3 'C152' 'ABC')

10000+ MSL:

5 SM, 1000 ft **A**bove clouds, 1000 ft **B**elow clouds, 1 SM from/a **C**ross clouds ('F5111')

Equipment requirements

Nothing

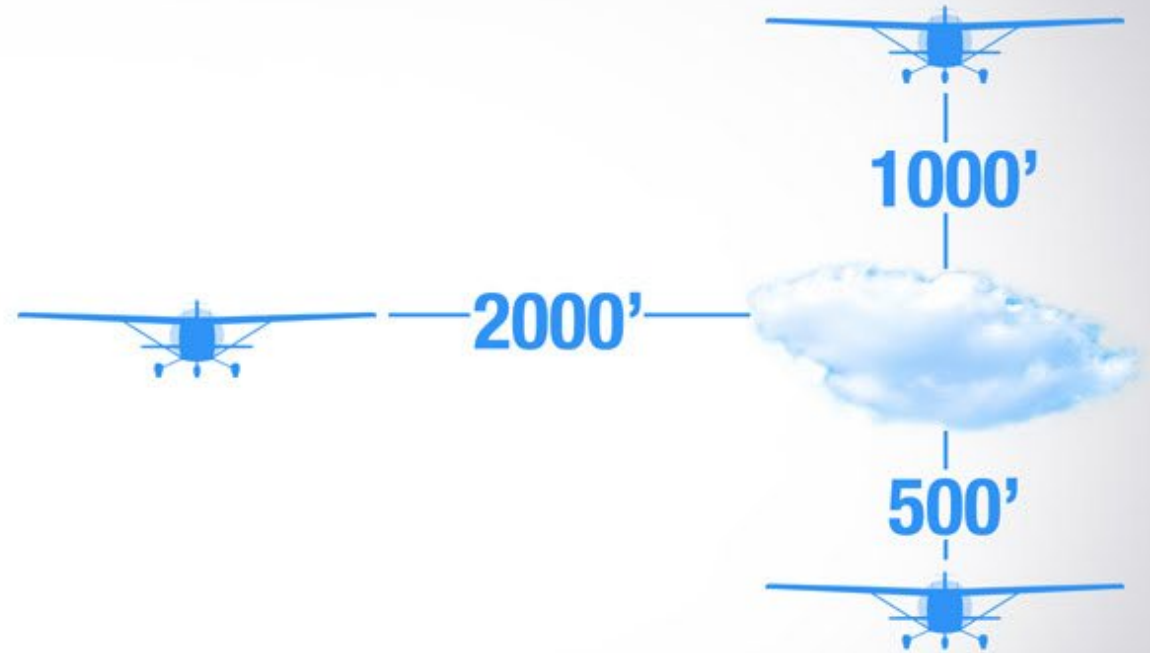
Communication requirements

None in VMC...ATC is available but not required in VMC

Class E Weather Minimums

Below 10,000 Feet

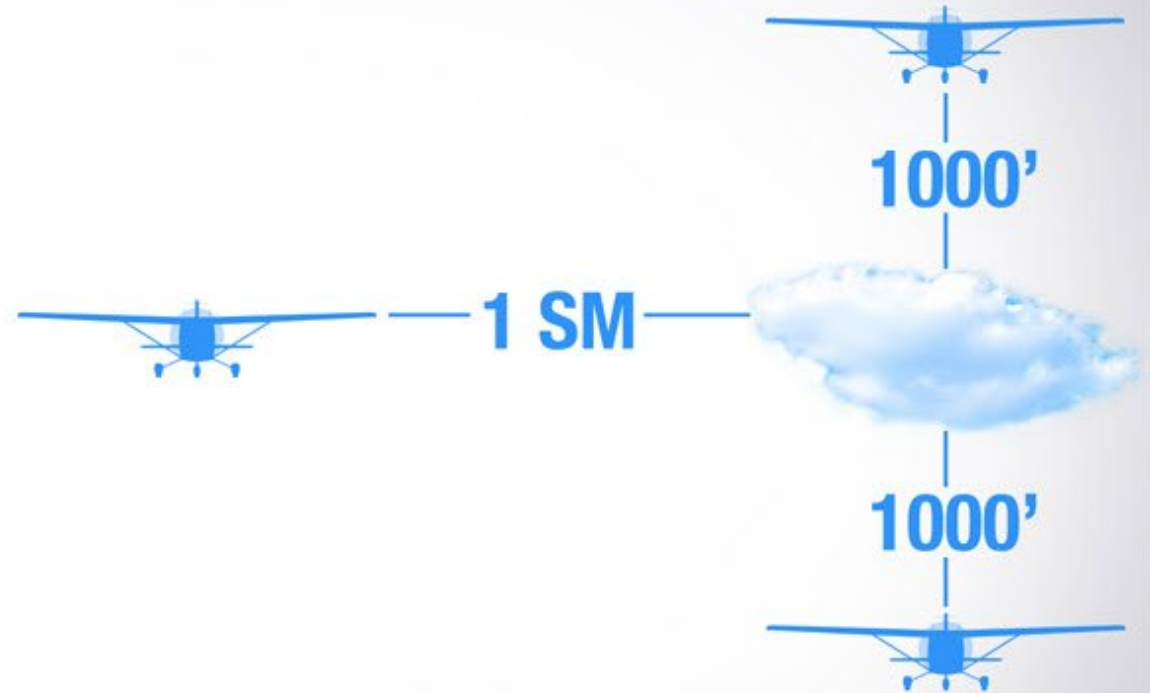
3 SM
Visibility



Class E Weather Minimums

10,000 Feet And Above

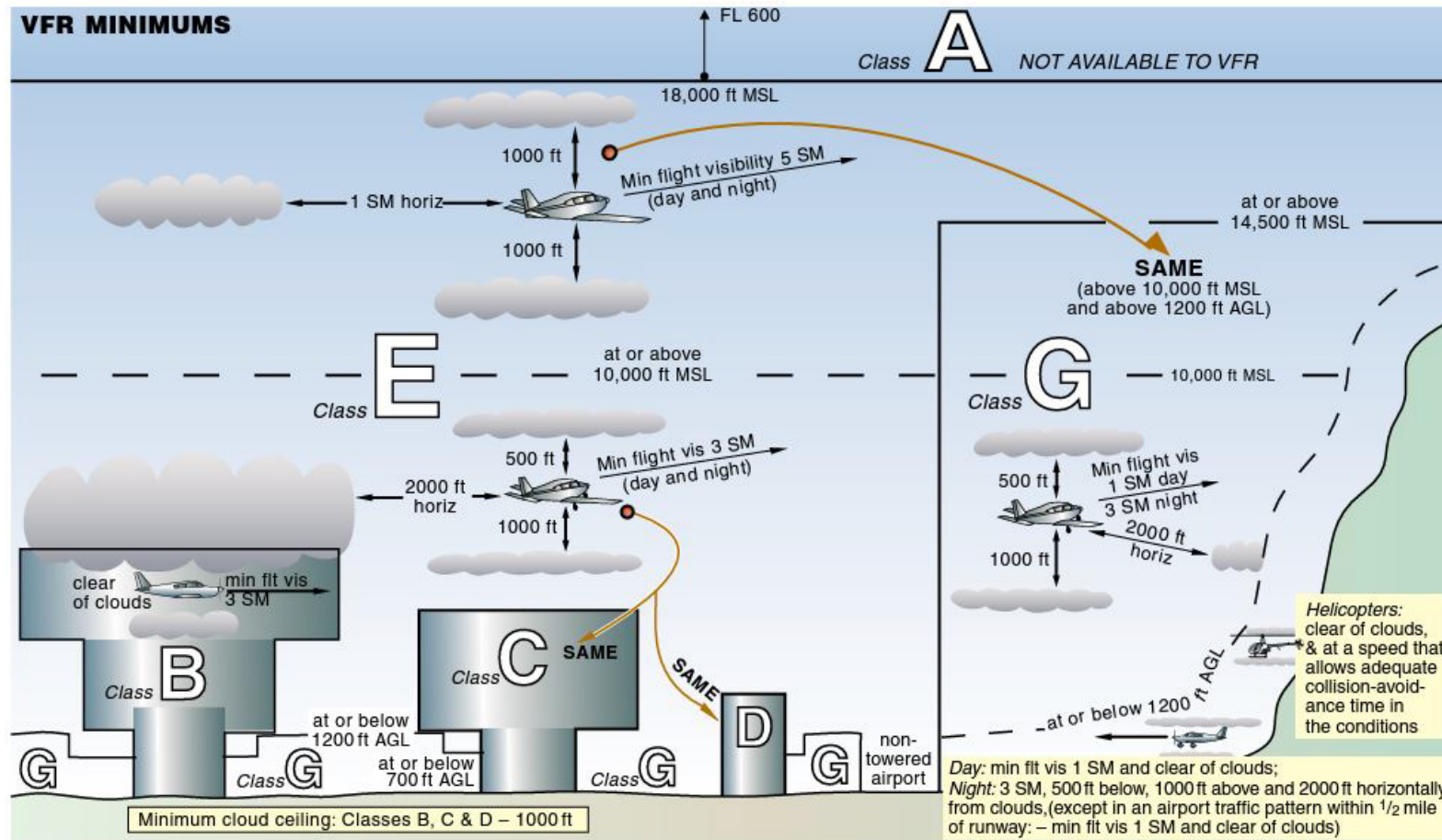
5 SM
Visibility



Table

<u>Class</u>	<u>Day/Night</u>	<u>AGL (ft)</u>	<u>MSL (ft)</u>	<u>Visibility (SM)</u>	<u>Above Clouds (ft)</u>	<u>Below Clouds (ft)</u>	<u>Horizontal (ft)</u>	<u>Nickname</u>
B				3	clear	clear	clear	
C				3	1000	500	2000	3-152
D				3	1000	500	2000	3-152
E			under 10000	3	1000	500	2000	3-152
			10000+	5	1000	1000	1 SM	5-1-1-1
G	Day	under 1201	Any	1	clear	clear	clear	
	Night	under 1201	Any	3	1000	500	2000	3-152
	Day	1201+	under 10000	1	1000	500	2000	
	Night	1201+	under 10000	3	1000	500	2000	3-152
	Day & Night	1201+	10000+	5	1000	1000	1 SM	5-1-1-1

Diagram



Class E and G Cloud Clearances

E	Day	G Night	
5-111	5-111	5-111	
			10000 MSL
3-152	1-152	3-152	
			1200 AGL
3-152	1, clear	3-152	

SETVODA

Surface area (looks like a D but with magenta dashed)

Extension to a surface area

Transition area (the 700')

Victor Airway

VOR Airways 1200 AGL to 17999 MSL

8 NM Wide

Offshore (controlled airspace beyond 12 NM from the coast of the US)

'Blue zipper'

Domestic Enroute areas ('everywhere else')

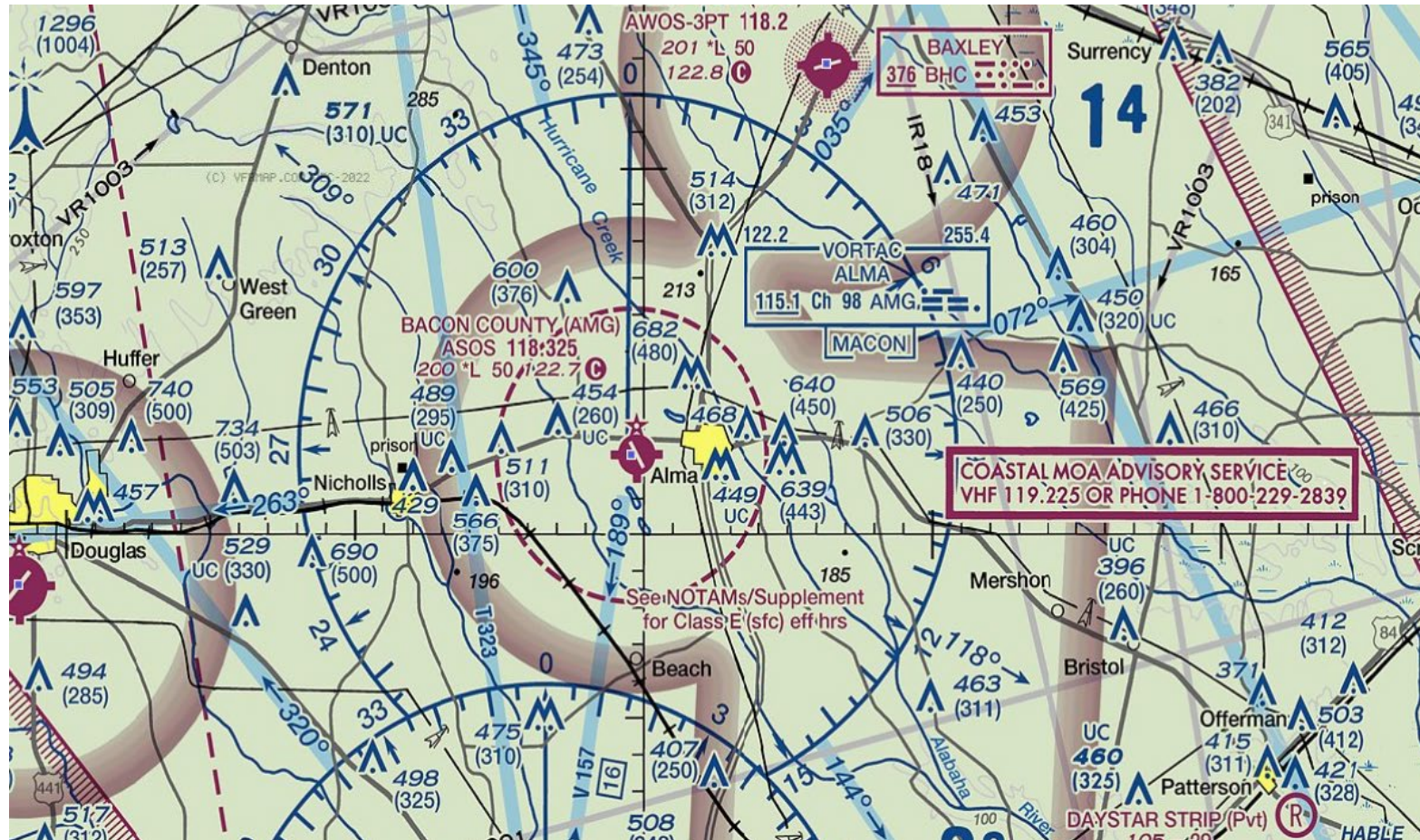
ATC Services are available

Above

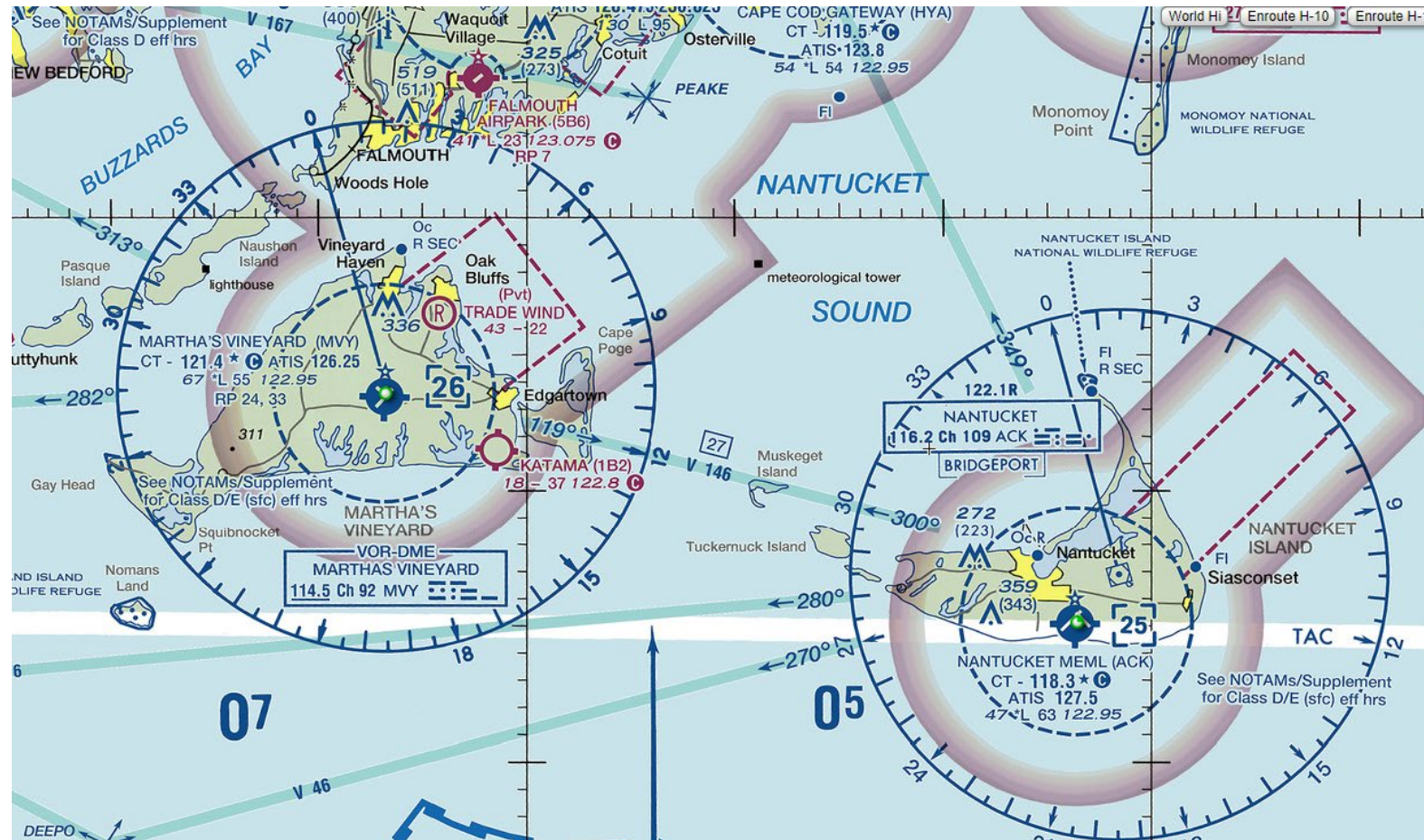
14500 MSL to 17999 MSL

Class A (above FL600)

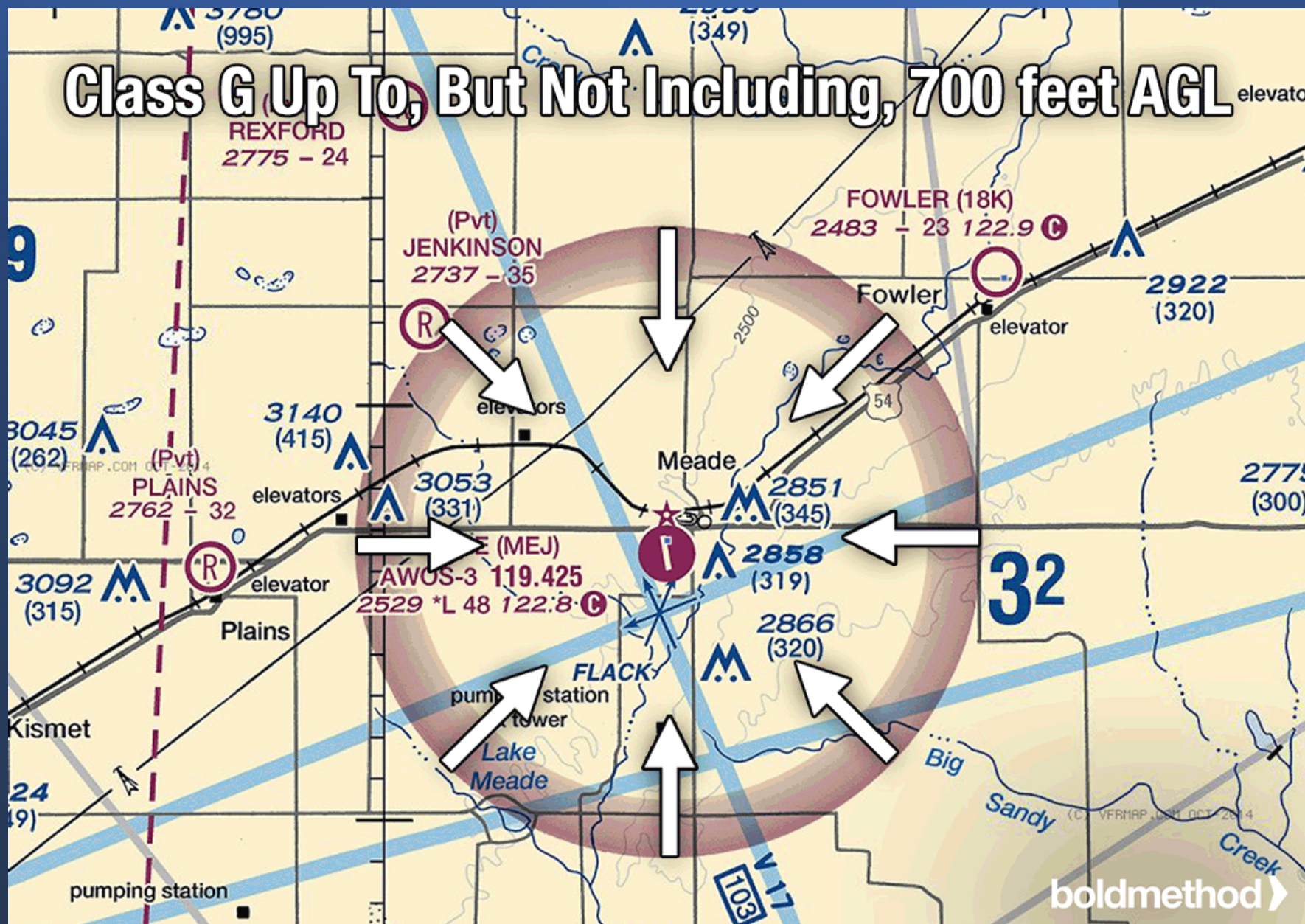
Class E Airport-Controlled Airspace Uncontrolled Field



Class E Surface Extension



Class G Up To, But Not Including, 700 feet AGL



Transition Areas Class G Meets Class E

G is 700 feet tall inside magenta...1200 outside...why? Approaches

JO 7400.2N - Procedures for Handling Airspace Matters

18-2-3. 700-FOOT CLASS E AIRSPACE

A Class E-5 airspace area with a base of 700 feet above the surface must be designated to accommodate arriving IFR operations below 1,500 feet above the surface and departing IFR operations until they reach 1,200 feet above the surface.

18-2-4. 1,200-FOOT CLASS E AIRSPACE

Where sufficient controlled airspace does not exist, designate a 1,200 foot Class E-5 airspace area to accommodate arriving IFR operations at 1,500 feet and higher above the surface and departing IFR operations from the point they reach 1,200 feet above the surface until reaching overlying or adjacent controlled airspace.

Magenta
around KFFC
and KCCO
means class E
above 700 AGL



Magenta around 6A2 means class E above 700 AGL but class E starts at 1201 AGL at many private ones



My home area
has been
changed since I
made the
previous slide

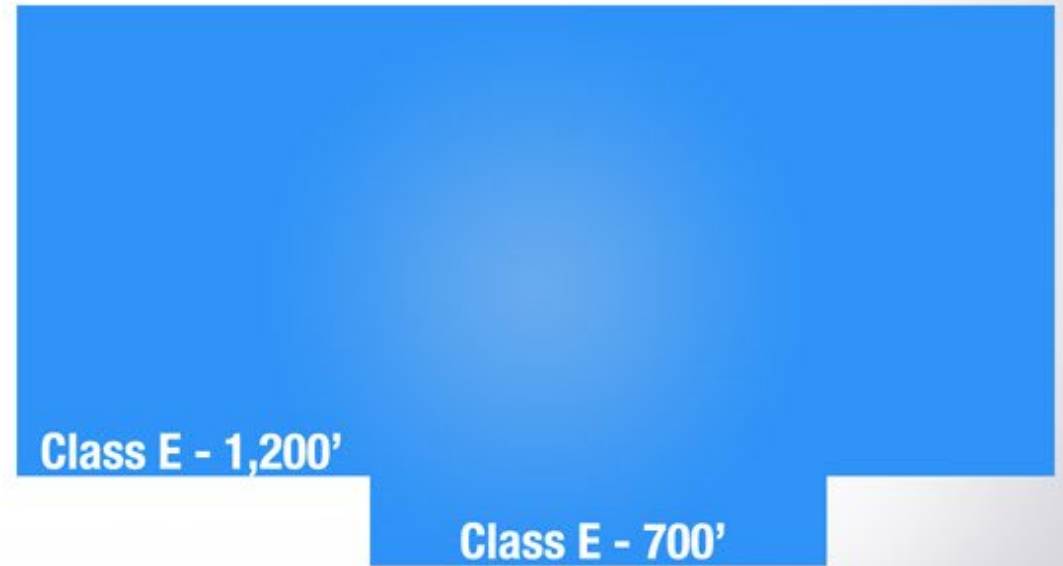


Class B vs. Class E

Class B



Class E



Pattern Altitudes

Our first source for pattern altitude information in the US is the FAA.
If not specified...

AIM 4-3-3.

Standard traffic pattern altitude is defined by AIM 4-3-3 as:

1. 1,000 feet above ground level (AGL) for Propeller-driven aircraft.
2. Large and turbine-powered aircraft enter the traffic pattern at an altitude of not less than 1,500 feet AGL or 500 feet above the established pattern altitude.
3. Helicopters operating in the traffic pattern may fly a pattern similar to the fixed-wing aircraft pattern, but at a lower altitude (500 AGL) and closer to the runway. This pattern may be on the opposite side of the runway from fixed-wing traffic when airspeed requires or for practice power-off landings (autorotation) and if local policy permits. Landings not to the runway must avoid the flow of fixed-wing traffic.

Speed Limits

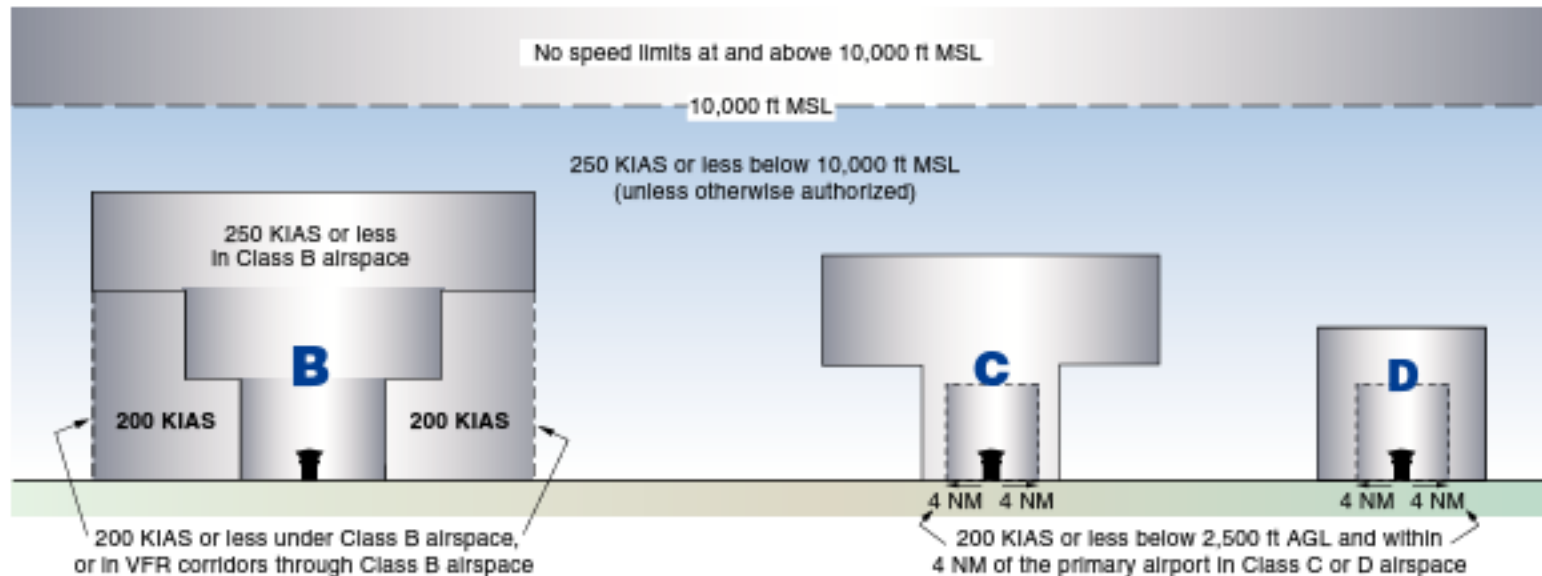
Maximum indicated airspeed below 10,000 feet MSL is 250 KIAS, or 288 mph (unless otherwise authorized).

Maximum indicated airspeed in Class B airspace is 250 KIAS, or 288 mph (unless otherwise authorized).

Maximum indicated airspeed at or below 2,500 feet AGL within 4 nautical miles of the primary airport of a Class C or Class D airspace area is 200 KIAS, or 230 mph (unless otherwise authorized or required by ATC, or unless the operation is within Class B airspace, in which case 250 KIAS applies).

A maximum indicated airspeed limit of 200 KIAS also applies to the airspace underlying Class B airspace, or in a VFR corridor through Class B airspace.

If minimum safe airspeed for your airplane exceeds these speeds, ATC should be notified and the aircraft should be operated at the minimum safe speed.



FAA UAS PDF

Has some great diagrams

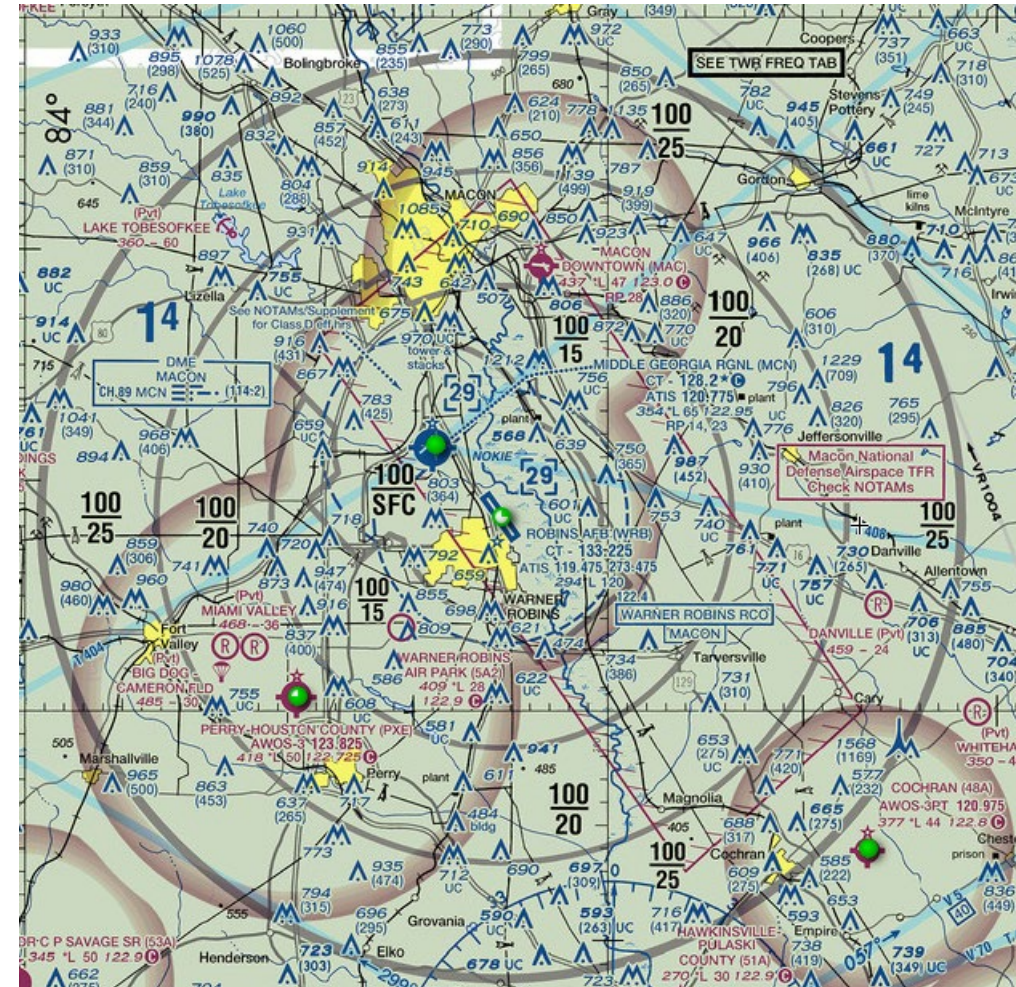
[https://www.faa.gov/sites/faa.gov/files/uas/resources/events_calendar/archive/How To Understand and Operate in Class E.pdf](https://www.faa.gov/sites/faa.gov/files/uas/resources/events_calendar/archive/How_To_Understand_and_Operate_in_Class_E.pdf)

Terminal Radar Service Area (TRSA)

Long before the days of lettered airspaces...

Radar and air traffic control services are made available to pilots flying under instrument flight rules or (optionally) visual flight rules, to maintain aircraft separation

For the Macon TRSA, use Atlanta Approach on 124.2



Special Use Airspaces

MCPRAWN =

MOA

Controlled Firing Area (CFA)

Prohibited

Restricted

Alert

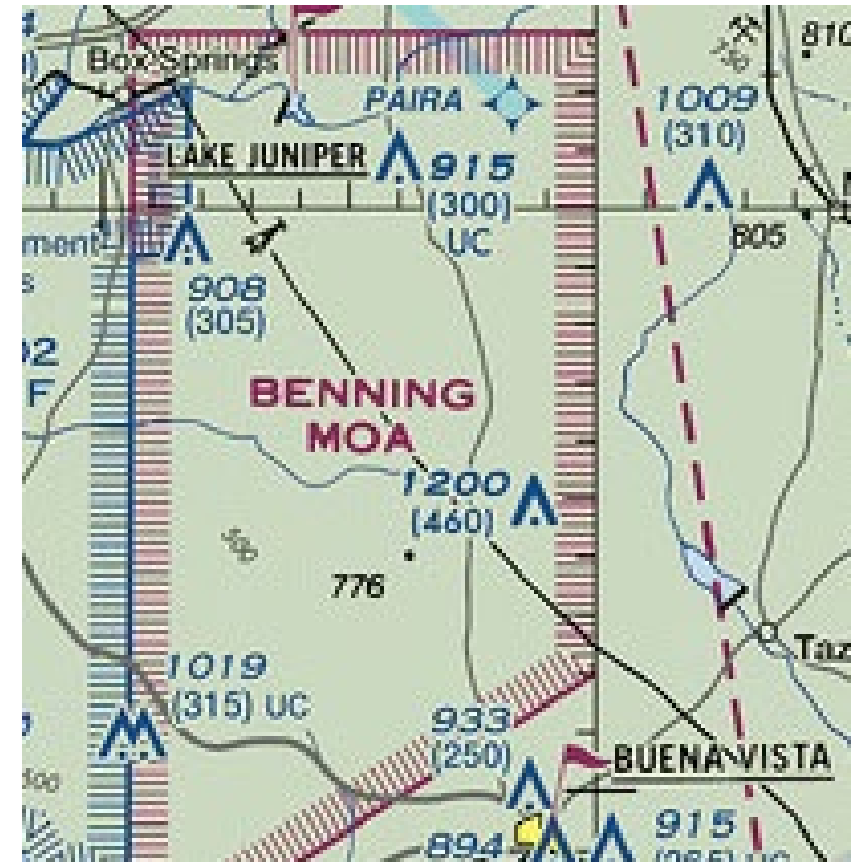
Warning

NSA

Military Operations Area (MOA)

A military operations area (MOA) is "airspace established outside Class A airspace to separate or segregate certain nonhazardous military activities from IFR Traffic and to identify for VFR traffic where these activities are conducted."

These are designed for routine training or testing maneuvers.

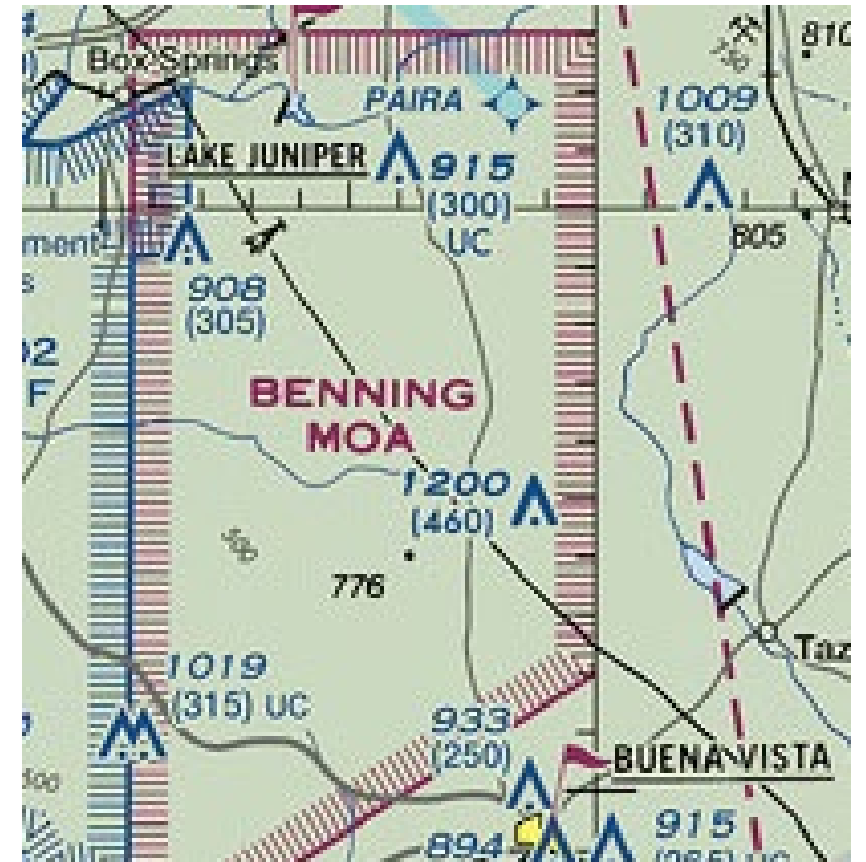


Military Operations Area (MOA)

A MOA is a type of special use airspace (SUA), other than restricted airspace or prohibited airspace, where military operations are of a nature that justify limitations on aircraft not participating in those operations.

The designation of SUA's identifies for other users the areas where military activity occurs, provides for segregation of that activity from other fliers, and allows charting to keep airspace users informed.

Local flight service facilities maintain current schedules and contacts for the agency controlling each MOA.

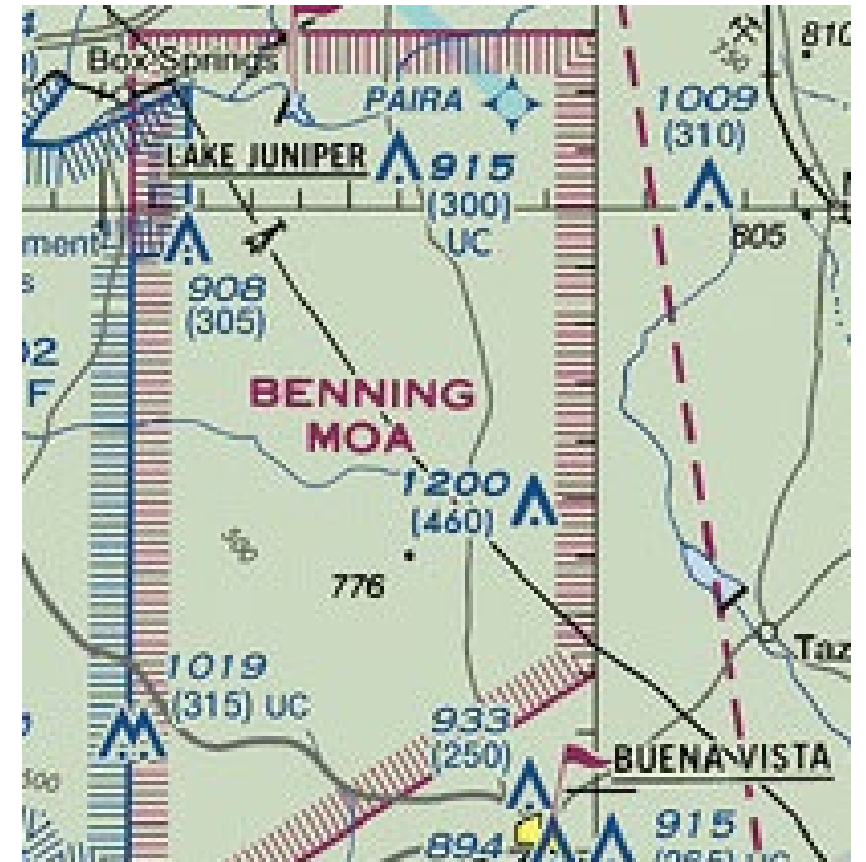


Military Operations Area (MOA)

Whenever an MOA is active, nonparticipating IFR traffic may be cleared through the area provided ATC can ensure IFR separation; otherwise, ATC will reroute or restrict nonparticipating IFR traffic.

Although MOA's do not restrict VFR operations, pilots operating under VFR should exercise extreme caution while flying within, near, or below an active MOA.

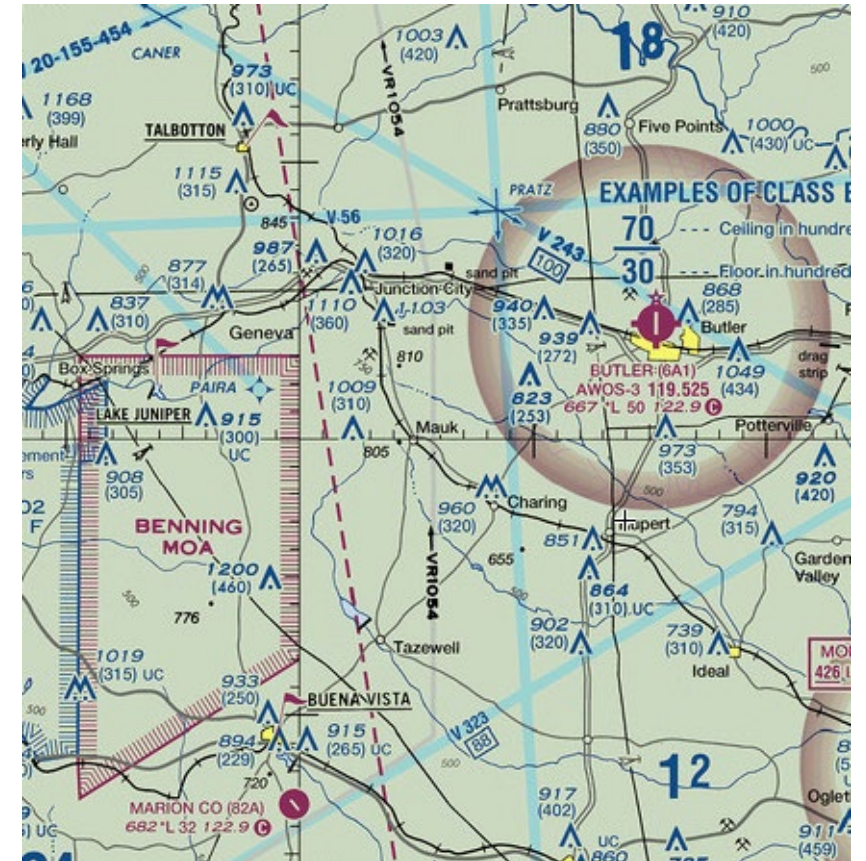
Additionally, prior to entering an active MOA, pilots are encouraged to contact the controlling agency for traffic advisories due to the frequently changing status of these areas.



Military Training Routes (MTRs)

Military training routes are aerial corridors across the United States in which military aircraft can operate below 10,000 feet faster than the maximum safe speed of 250 knots that all other aircraft are restricted to while operating below 10,000 feet.

The routes are the result of a joint venture between the Federal Aviation Administration and the Department of Defense to provide for high-speed, low-altitude military activities.



Military Training Routes (MTRs)

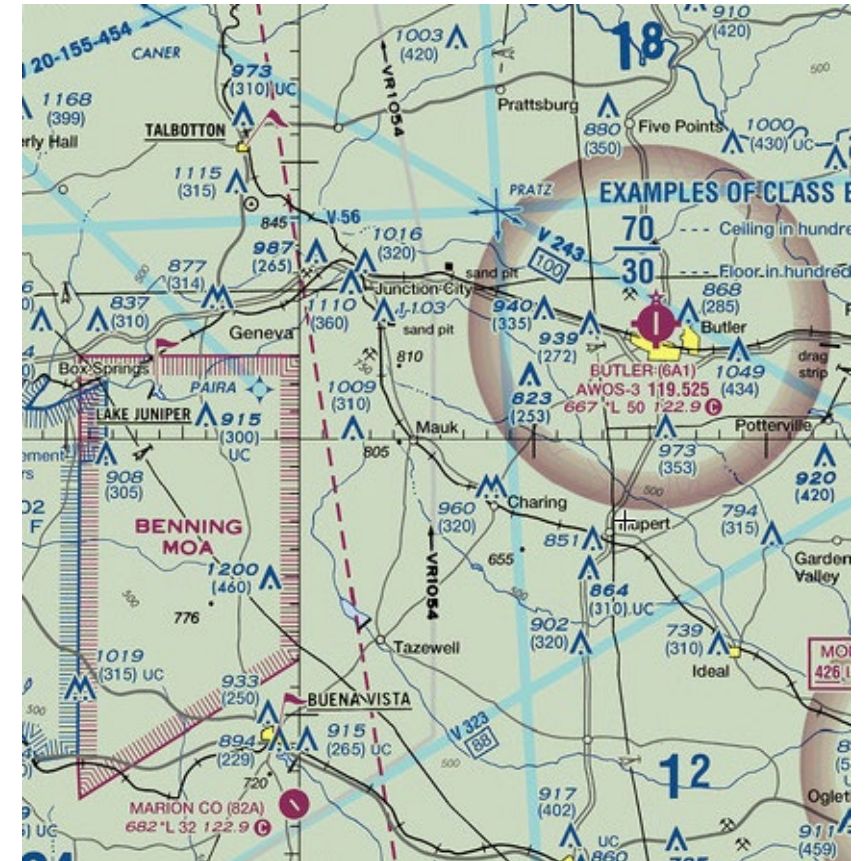
Military Training Routes are divided into Instrument Routes (IR), and Visual Routes (VR).

Each route is identified by either of these two letters, followed by either four digits for routes below 1,500 feet above ground level, or three digits for routes extending for at least one leg above 1,500 ft AGL. (i.e., VR-1056).

The difference between the IR and VR routes is that IR routes are flown under Air Traffic Control, while VR routes are not.

VRxxxx / IRxxxx are less than 1500 AGL

VRxxx / IRxxx 1500+ AGL



Class E Airport inside a MOA



Controlled Firing Areas

AIM 3-4-7

CFAs contain activities which, if not conducted in a controlled environment, could be hazardous to nonparticipating aircraft.

The distinguishing feature of the CFA, as compared to other special use airspace, is that its activities are suspended immediately when spotter aircraft, radar, or ground lookout positions indicate an aircraft might be approaching the area.

There is no need to chart CFAs since they do not cause a nonparticipating aircraft to change its flight path.

What does a CFA look like on a VFR Sectional?

Trick question – they're not on there!

You really shouldn't have to worry about these areas while you're flying. CFAs are generally used for small arms target practice or mortar practice.

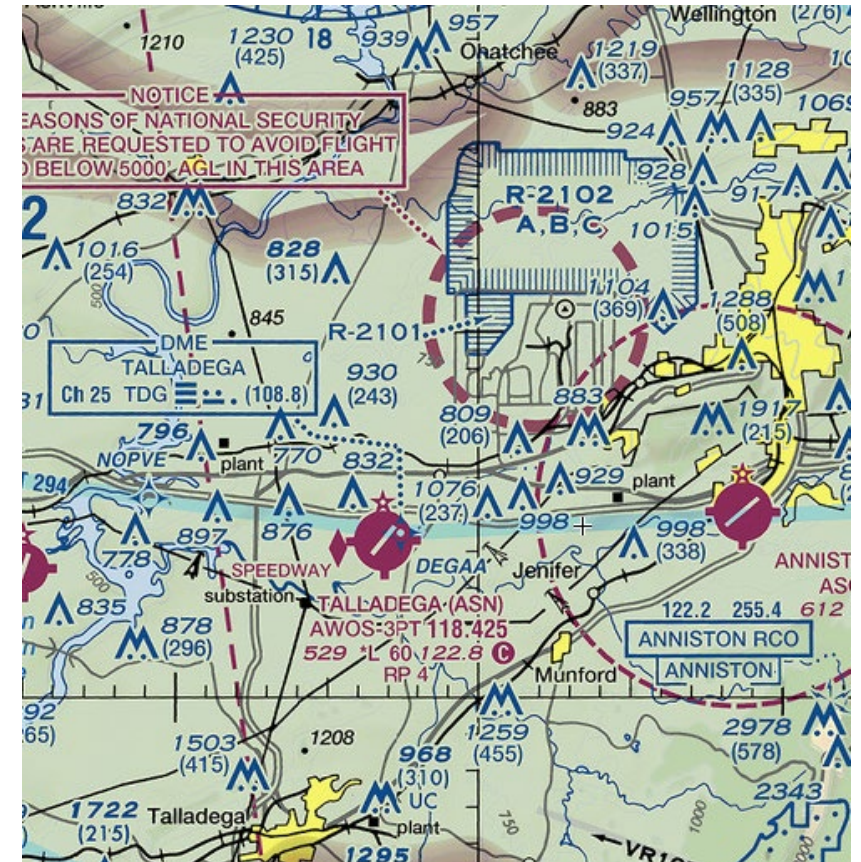
There are always spotters and/or radar that will detect you approaching the area.

When they see you coming, they'll stop all firing even though you're most likely higher than any of their shells will reach.

Restricted airspace

Restricted airspace zones may not be active ("hot") at all times; in such cases there are typically schedules of local dates and times available to aviators specifying when the zone is active, and at other times, the airspace is subject to normal VFR/IFR operation for the applicable airspace class.

It is not illegal to fly through restricted airspace while VFR and not talking to ATC...but again 'may be extremely hazardous'. A missile strike would be a major issue...



Prohibited airspace

Prohibited airspace refers to an area (volume) of airspace within which flight of aircraft is not allowed, usually due to security concerns.

It is one of many types of special use airspace designations and is depicted on aeronautical charts with the letter "P" followed by a serial number.

It differs from restricted airspace in that entry is typically forbidden at all times from all aircraft and is not subject to clearance from ATC or the airspace's controlling body.



Prohibited airspace

Part of a Terminal Area Chart, showing the prohibited/restricted airspace surrounding Camp David.

Some prohibited airspace may be supplemented via NOTAMs.

Prohibited Area 40 (P-40) and Restricted Area 4009 (R4009) often will have additional restricted airspace added via a NOTAM when the President of the United States visits Camp David in Maryland, while normally the airspace outside of P-40 and R4009 is not prohibited/restricted.

Violating prohibited airspace established for national security purposes may result in military interception and/or the possibility of an attack upon the violating aircraft.

Aircraft violating or about to violate prohibited airspace will often be warned beforehand on 121.5 MHz, the emergency frequency for aircraft.



Warning Areas

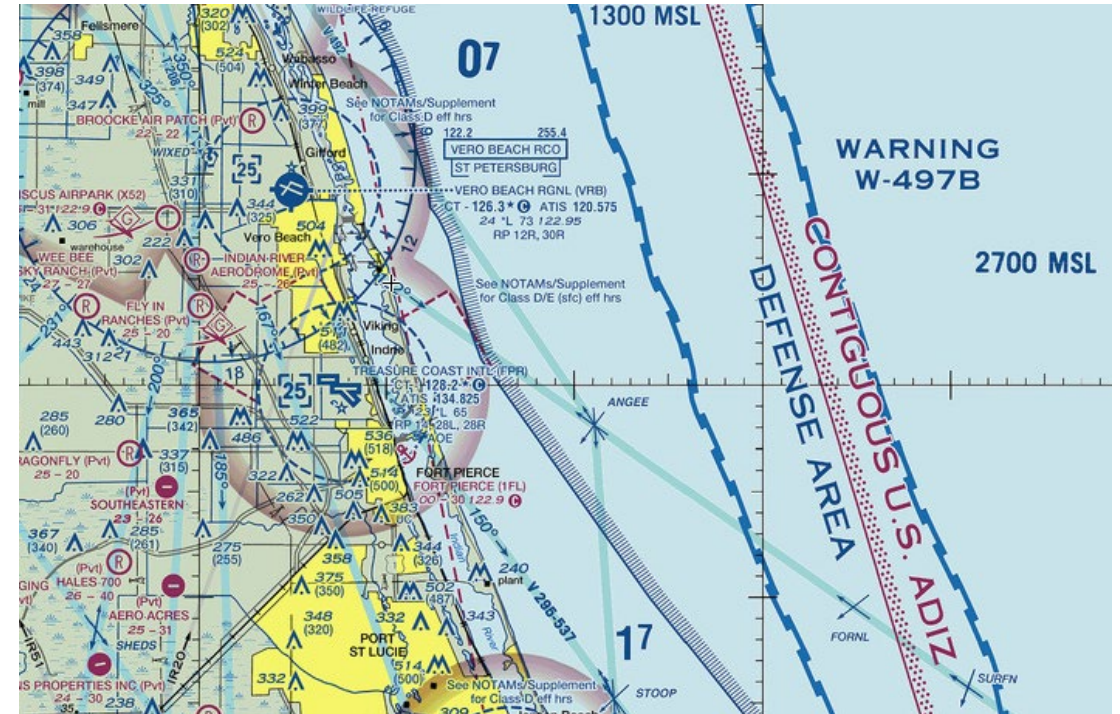
Warning areas are similar in nature to restricted areas; however, the United States government does not have sole jurisdiction over the airspace.

A warning area is airspace of defined dimensions, extending from 3 NM outward from the coast of the United States, containing activity that may be hazardous to nonparticipating aircraft.

The purpose of such areas is to warn nonparticipating pilots of the potential danger.

A warning area may be located over domestic or international waters or both.

The airspace is designated with a “W” followed by a number.

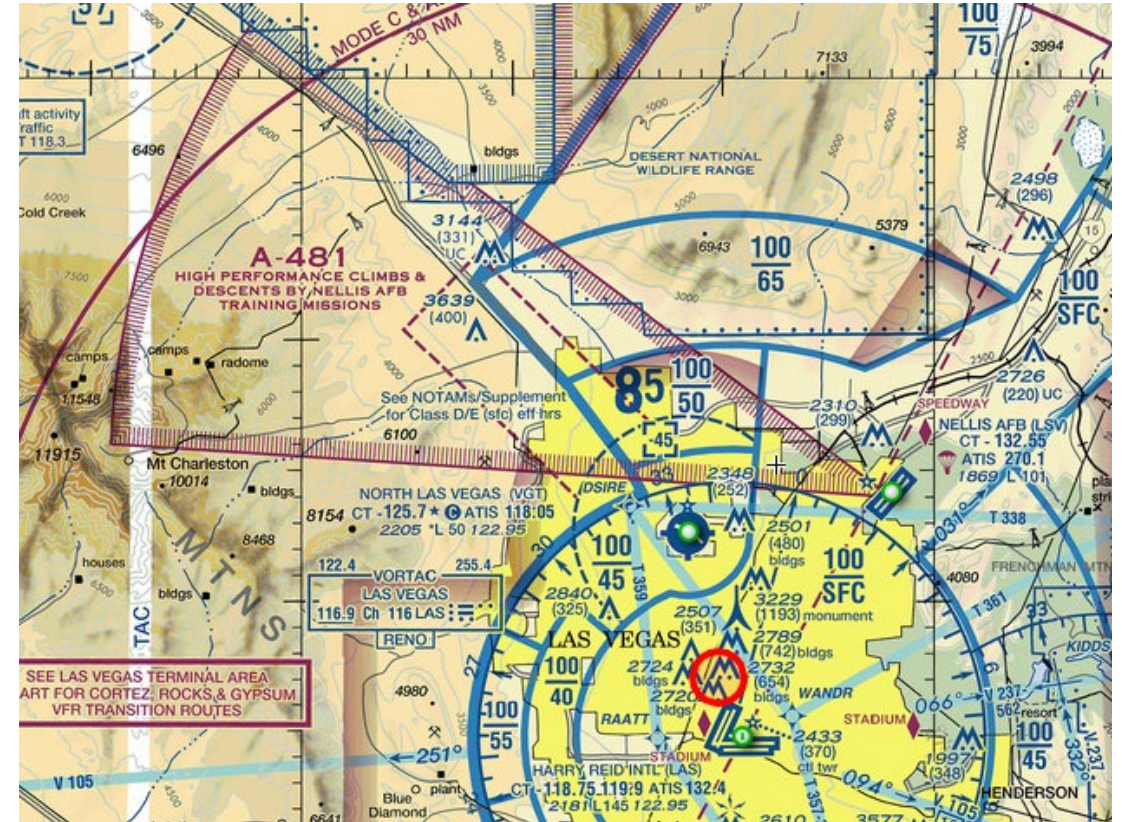


Alerts Areas

Alert areas are depicted on aeronautical charts with an “A” followed by a number (e.g., A-211) to inform nonparticipating pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity.

Pilots should exercise caution in alert areas.

All activity within an alert area shall be conducted in accordance with regulations, without waiver, and pilots of participating aircraft, as well as pilots transiting the area, shall be equally responsible for collision avoidance.



NOTAMs/TFRs

See separate lesson called NOTAMs



NSA

An NSA may sound like a Prohibited Area, but it's not.

It's just a place where, for security and safety, pilots are requested to avoid overflight as depicted on the chart.

For example, Livermore Labs has an NSA requesting pilots don't overfly below 800'.

Further restrictions can always be put in place by NOTAM, so make sure you check them.

SATR & SFRA

AIM 2.4 Special Air Traffic Rules (SATR) and Special Flight Rules Area (SFRA)

2.4.1 Background. The Code of Federal Regulations (CFR) prescribes special air traffic rules for aircraft operating within the boundaries of certain designated airspace. These areas are listed in 14 CFR Part 93 and can be found throughout the NAS. Procedures, nature of operations, configuration, size, and density of traffic vary among the identified areas.

2.4.2 SFRAs. Airspace of defined dimensions, above land areas or territorial waters, within which the flight of aircraft is subject to the rules set forth in 14 CFR Part 93, unless otherwise authorized by air traffic control. Not all areas listed in 14 CFR Part 93 are designated SFRA, but special air traffic rules apply to all areas described in 14 CFR Part 93.

2.4.3 Participation. Each person operating an aircraft to, from, or within airspace designated as a SATR area or SFRA must adhere to the special air traffic rules set forth in 14 CFR Part 93, as applicable, unless otherwise authorized or required by ATC.

2.4.4 Charts. SFRAs are depicted on VFR sectional, terminal area, and helicopter route charts. (See FIG ENR 5.1-1.)

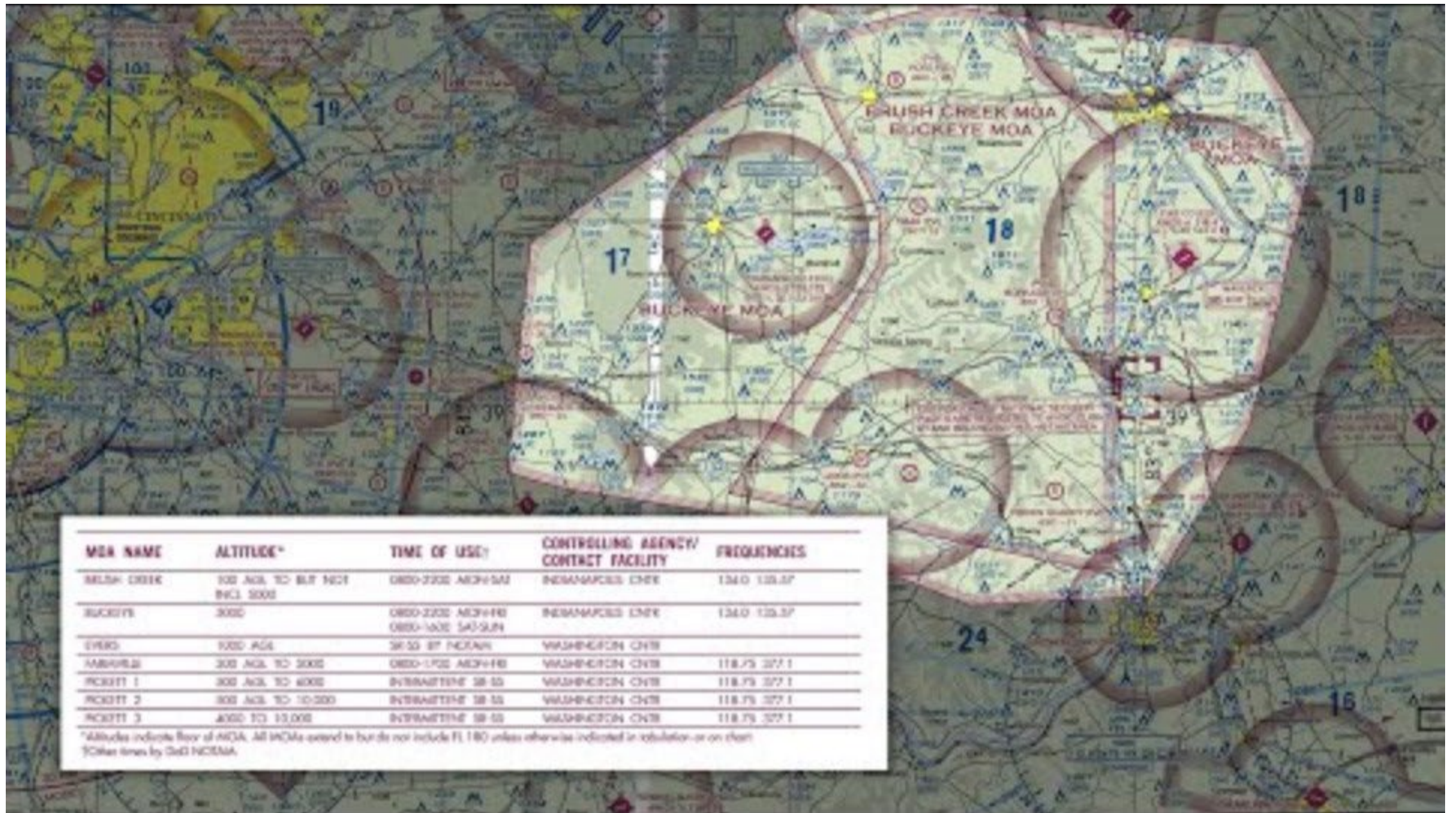
Some SFRAs

Special Flight Rules Areas

Washington, DC Special Flight Rules Area

Los Angeles Special Flight Rules Area

Hudson River Special Flight Rules Area





Any questions I can answer or
follow up later on?

Navigation and Flight Planning



Lesson Objective

To develop understanding of what goes into flight planning...which is a lot...we don't always go direct

Gary's Overall Rules to Navigation

- #1 Know where you are
- #2 Know where to go next
- #3 Know how much fuel is left
- #4 Don't end up in a storm
- #5 Do your best not to get lost
- #6 Know how to get back on track

Terms used in navigation

True course—the intended/desired direction of flight as measured on a chart clockwise from true North.

True heading—the direction of the longitudinal axis of the airplane with respect to true North.

Magnetic course—true course corrected for magnetic variation.

Compass heading—aircraft heading read from the compass. Derived by applying correction factors for variation, deviation, and wind to true course.

Deviation—compass error due to magnetic disturbances from electrical/metal parts in the airplane.
Correction displayed on compass correction card near magnetic compass.

Variation—angular difference between true north and magnetic north, shown by isogonic lines on sectional charts.

Standard pressure—29.92" Hg

Standard temperature—15°C

Terms used in navigation

Indicated Altitude—altitude read directly from the altimeter after it is set to the current altimeter setting.

Pressure Altitude—height above the standard pressure level of 29.92" Hg

$1,000 \times (29.92 - \text{Alt}) + \text{Elevation}$

Can be obtained by setting 29.92" Hg in the barometric pressure window and reading the altimeter.

Density Altitude—pressure altitude corrected for nonstandard temperatures $120(T - 15^\circ\text{C}) + \text{PA}$.

True Altitude—true vertical distance of the aircraft above sea level. Airport, terrain, obstacle elevations all shown in true altitudes on charts.

Absolute Altitude—vertical distance of the aircraft above the surface of the earth (water or terrain).

Terms used in navigation

Indicated Airspeed (IAS)—the speed of an aircraft as shown on the airspeed indicator.

Calibrated Airspeed (CAS)—indicated airspeed of an aircraft, corrected for installation and instrument errors.

True Airspeed (TAS)—the speed at which an aircraft is moving relative to the surrounding air. CAS corrected for density altitude.

Groundspeed Airspeed (GS)—the speed of an aircraft in relation to the ground.

§ 91.103 Preflight action

Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight. This information must include—

(a) For a flight under IFR or a flight not in the vicinity of an airport, weather reports and forecasts, fuel requirements, alternatives available if the planned flight cannot be completed, and any known traffic delays of which the pilot in command has been advised by ATC;

§ 91.103 Preflight action

(b) For any flight, runway lengths at airports of intended use, and the following takeoff and landing distance information:

(1) For civil aircraft for which an approved Airplane or Rotorcraft Flight Manual containing takeoff and landing distance data is required, the takeoff and landing distance data contained therein; and

(2) For civil aircraft other than those specified in paragraph (b)(1) of this section, other reliable information appropriate to the aircraft, relating to aircraft performance under expected values of airport elevation and runway slope, aircraft gross weight, and wind and temperature.

§ 91.103 Preflight action – NW KRAFT

N - NOTAMs

W - Weather reports and forecasts

K - Known traffic delays

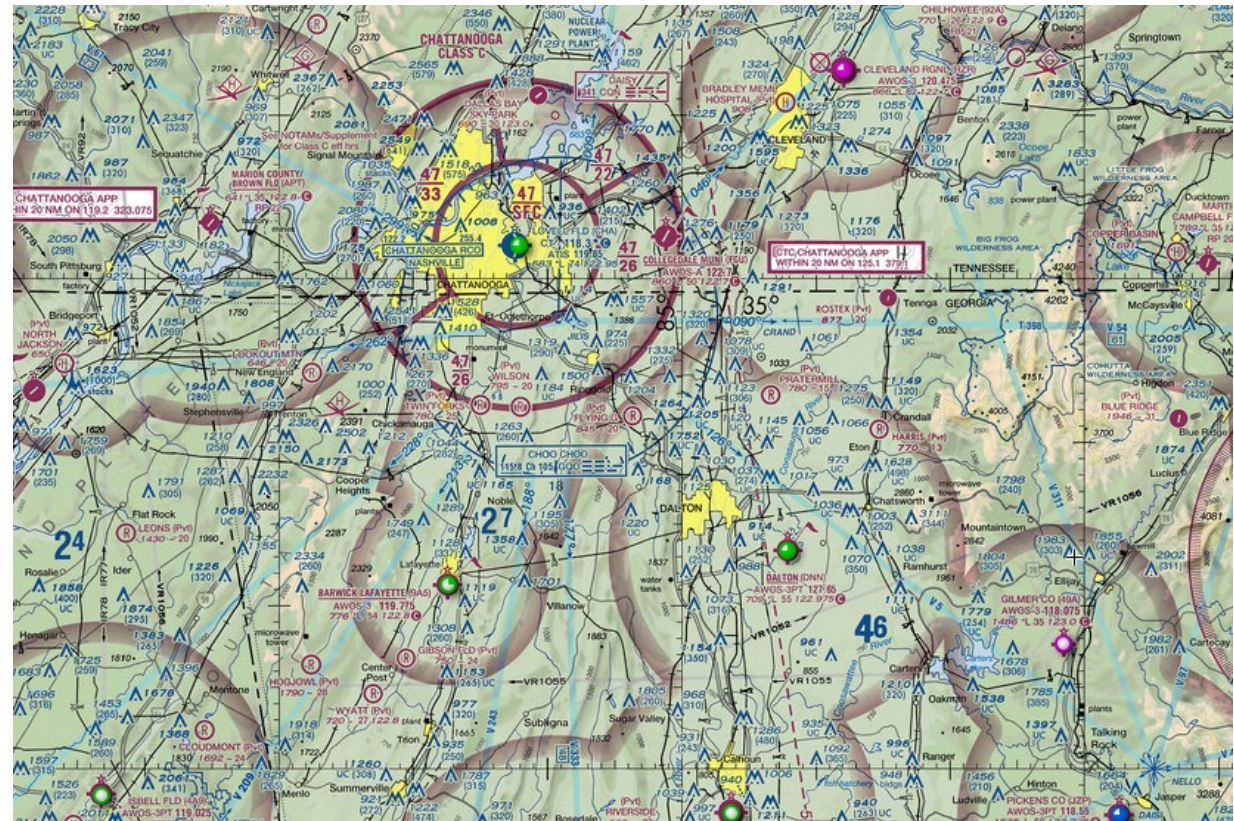
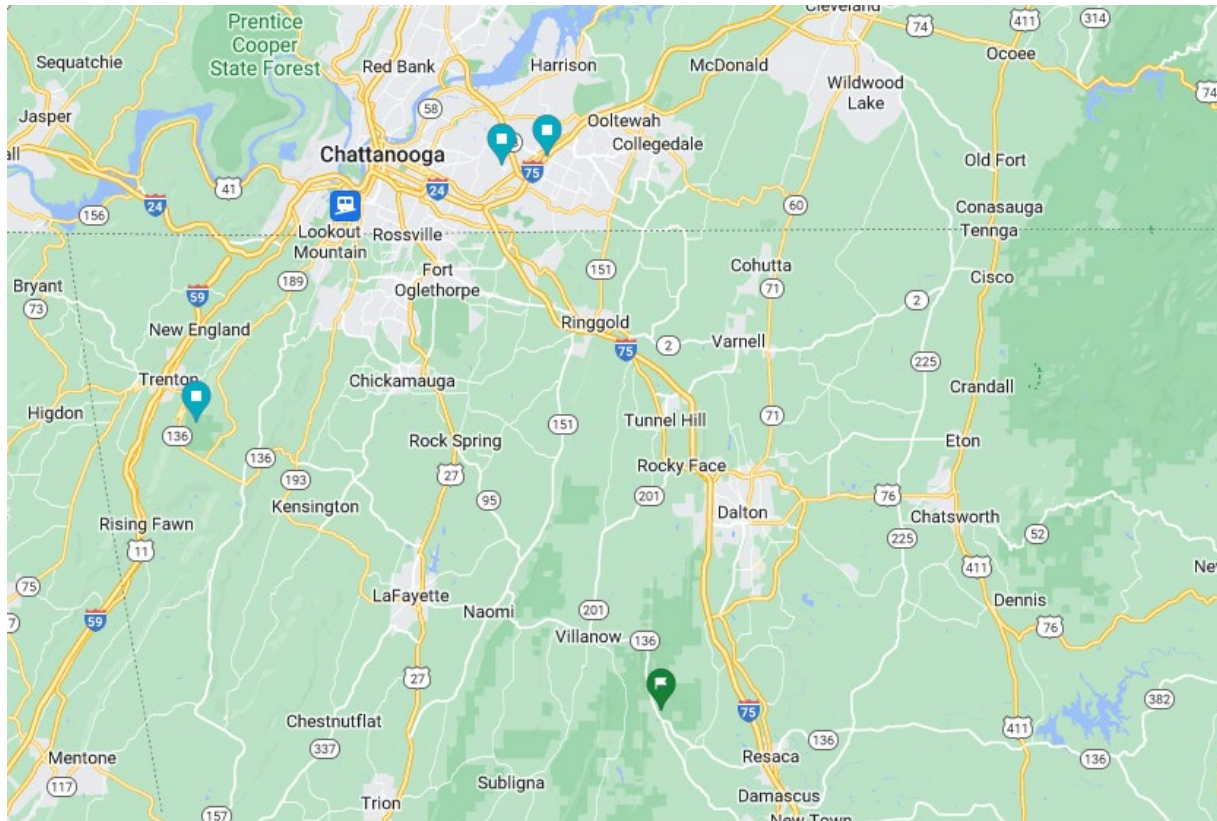
R - Runway length of intended use

A - Alternatives

F - Fuel Requirements

T - Takeoff and landing performance data

Street Map vs Sectional



AIRPORTS

Airports in the following categories are charted as indicated (additional symbols are shown later in this Section).
Public use airports:



Hard-surfaced runways greater than 8069' or some multiple runways less than 8069'



Hard-surfaced runways 1500' to 8069'



Other than hard-surfaced runways



Seaplane bases

AIRPORTS

Landplane: Civil

Airports having control towers (CT) are shown in blue, all others are shown in magenta.

All recognizable runways, including some which may be closed, are shown for visual identification purposes. Fuel available.

Runway patterns will be depicted at airports with at least one hard surfaced runway 1500' or greater in length.

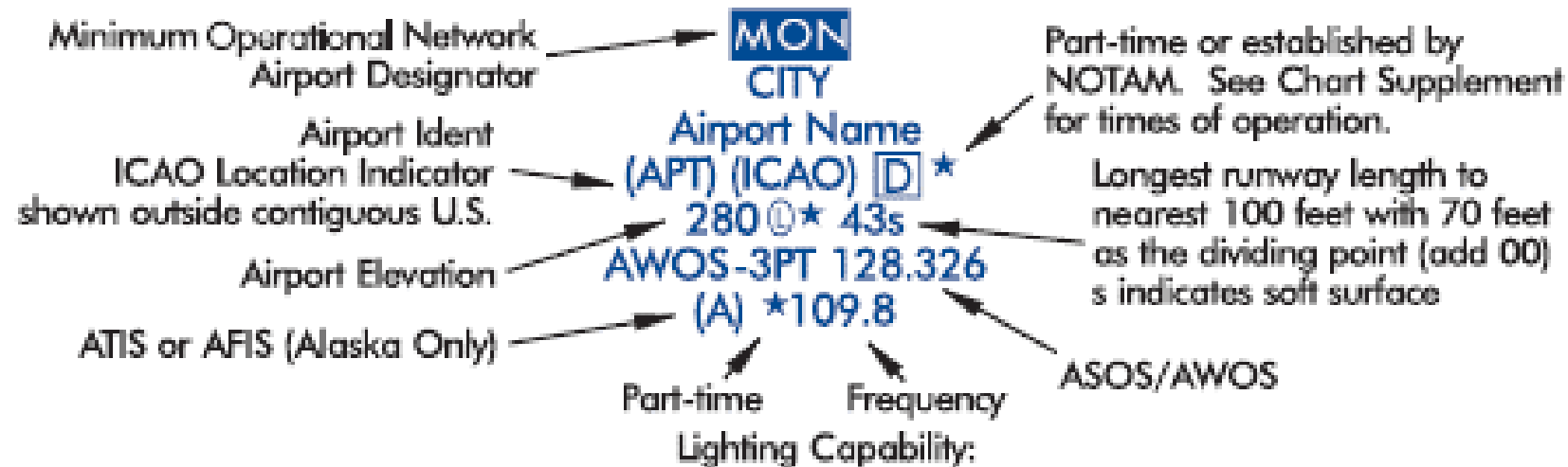
Non-Towered Towered



Landplane: Civil-Military

Non-Towered Towered





Obstruction

Above 200' & below 1000' AGL
(above 299' AGL in urban area)



Under Construction (UC) or reported and
position/elevation unverified



1000' and higher (AGL)



Wind Turbine



High-Intensity Obstruction Lights

Less than 1000' (AGL)



1000' and higher (AGL)



Wind Turbine



Group obstruction



Wind Turbines



High-intensity lights may operate part-time
or by proximity activation.

Group Obstruction

Above 200' & below 1000' AGL
(above 299' AGL in urban area)



1000' and higher (AGL)



At least two in group
1000' and higher (AGL)



Wind Turbines



Wind Turbine Farms

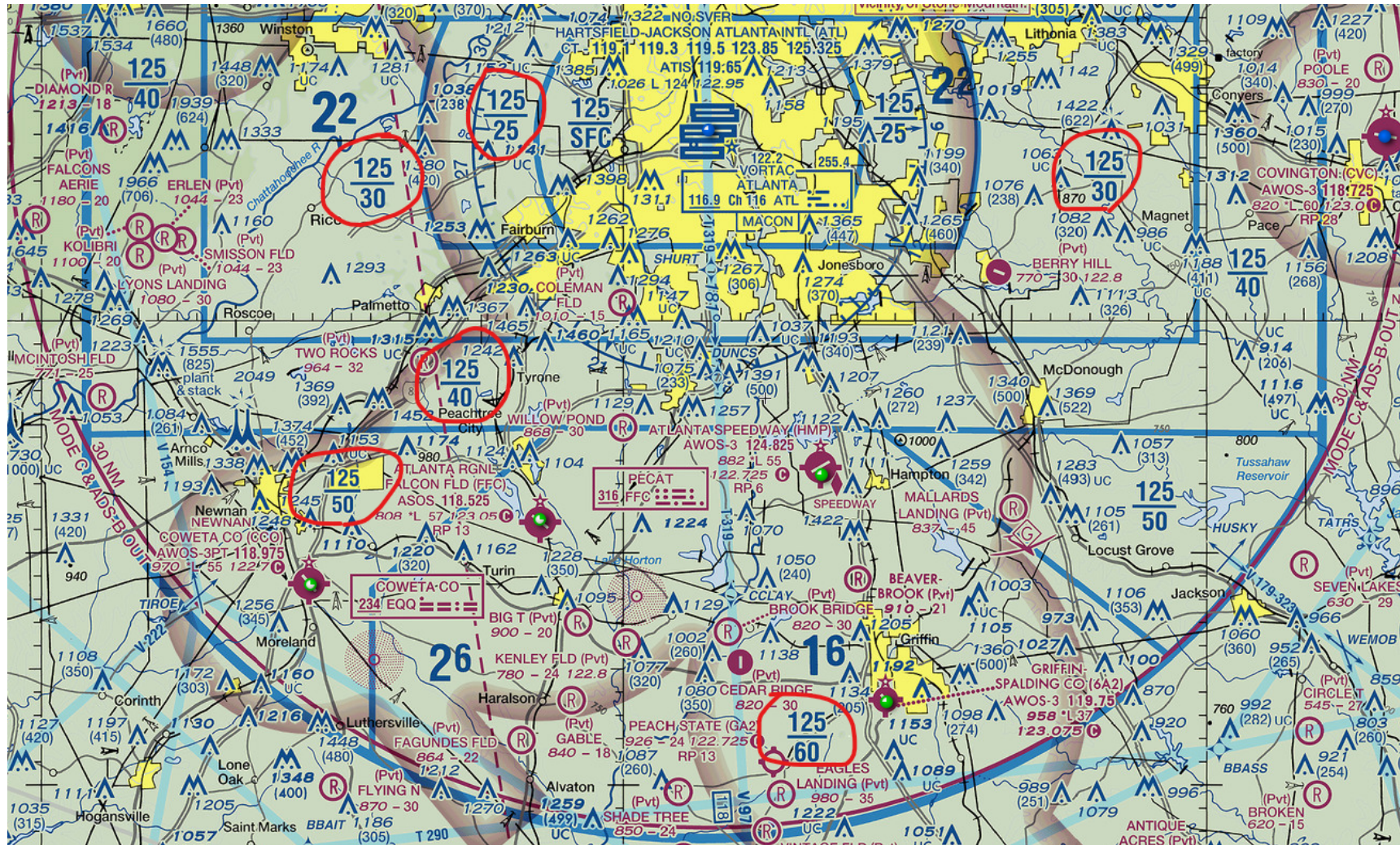
When highest wind turbine is unverified,
UC will be shown after MSL value.



RMG, POLLL, CHERO



125 / 30



LAT LON

Why degrees?

Because someone thought up the system and the rest of the world adopted it...just like inches, feet, yards, miles

In 1884, the United States hosted the International Meridian Conference, attended by representatives from twenty-five nations. Twenty-two of them agreed to adopt the longitude of the Royal Observatory in Greenwich, England as the zero-reference line. The Dominican Republic voted against the motion, while France and Brazil abstained. France adopted Greenwich Mean Time in place of local determinations by the Paris Observatory in 1911.

Latitude - degrees from equator north or south

Longitude - degrees from the prime meridian east or west

(they are all long)

Prime Meridian, which passes through the Royal Observatory, Greenwich

There are two formats of degrees

NMs and Grids

Each degree is broken into 60 minutes

$$1' = 1 \text{ NM}$$

$$1 \text{ NM} = 1.15 \text{ SM}$$

$$\rightarrow 1 \text{ degree} = 60 \text{ NM} = 69 \text{ SM}$$

$$90 \text{ knots} = 90 \text{ NM} / \text{hour} = 90 \text{ NM} / 60 \text{ min}$$

$$\rightarrow 7.5 \text{ NM @ } 90 \text{ kts} = 5 \text{ min}$$

Magnetic Heading, True Heading, Variation, Deviation

See my lesson called Degrees Compasses and Heading Indicators

Importance of using the proper and current aeronautical charts

For example, there was an accident at West Georgia years ago right after they changed the CTAF frequency

Plotting a course, selection of fuel stops and alternates, and unforeseen situations

Before I give multiple specific examples...there are many factors:

Airspaces

Airways

Is it day or night

Cheap Fuel

Do you need a car?

Terrain

Weather

Approaches

Restricted Airspaces

TFRs

NOTAMs

Equipment installed

Airspaces

Do you go under, above, around, or through?

Class B

Under or through?

It will be too tall to go above

Atlanta north to south on V97...but not east & west

Don't do KFFC to KRYV direct

Class C

Best to plan to go over or if you are going to hit an outer edge

Good idea to contact their approach control

Class D

Airspace is not that tall you can easily go over it.

Airways

Are there any airways that are established that you could use?

If you fly them correctly you will not have to worry about terrain or communications.

Be aware there might be more traffic to be cautious of.

Stay above the MEA whenever possible...at least above the MOCA.

There are now more GPS airways being established but most airways were made using VORs.

Using VORs adds another layer of safety in case there is a GPS issue.

91.159 VFR cruising altitude or flight level.

Except while holding in a holding pattern of 2 minutes or less, or while turning, each person operating an aircraft under VFR in level cruising flight more than 3,000 feet above the surface shall maintain the appropriate altitude or flight level prescribed below, unless otherwise authorized by ATC:

(a) When operating below 18,000 feet MSL and -

(1) On a magnetic course of zero degrees through 179 degrees, any odd thousand foot MSL altitude + 500 feet (such as 3,500, 5,500, or 7,500); or

(2) On a magnetic course of 180 degrees through 359 degrees, any even thousand foot MSL altitude + 500 feet (such as 4,500, 6,500, or 8,500).

(b) When operating above 18,000 feet MSL, maintain the altitude or flight level assigned by ATC.

(Magnetic course—true course corrected for magnetic variation)



Altitudes

VFR east – 5500, 7500, 9500

VFR west – 4500, 6500, 8500

IFR east – 5000, 7000, 9000

IFR west – 4000, 6000, 8000

MEF

The Maximum Elevation Figure (MEF) represents the highest elevation within a quadrant, including terrain and other vertical obstacles (towers, trees, etc.).

A quadrant on Sectionals is the area bounded by ticked lines dividing each 30 minutes of latitude and each 30 minutes of longitude.

MEF figures are rounded up to the nearest 100' value and the last two digits of the number are not shown.

MEFs over land and open water areas are used in areas containing manmade obstacles such as oil rigs.

12⁵

*In this example the
MEF represents
12,500'.*

MEF

Pilots should be aware that while the MEF is based on the best information available to the Specialist, the figures are not verified by field surveys.

Also, users should consult the Aeronautical Chart Bulletin in the A/FD or AeroNav Products website to ensure that your chart has the latest MEF data available.

Unlike the Minimum safe altitude used for IFR flight, the MEF **does not include any margin** for aircraft clearance above the terrain nor for altimeter error.

12⁵

*In this example the
MEF represents
12,500'.*

91.119 — Minimum safe altitudes: General.

Except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes:

- (a) Anywhere. An altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.
- (b) Over congested areas. 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.
- (c) Over other than congested areas. 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.

OROCA

The Off Route Obstruction Clearance Altitude (OROCA) is represented in thousands and hundreds of feet above mean sea level.

The OROCA represents the highest possible elevation including both terrain and other vertical obstructions (towers, trees, etc.) bounded by the ticked lines of latitude and longitude.

OROCA is computed just as the Maximum Elevation Figure (MEF) found on Visual charts except that it provides an additional vertical buffer of 1,000 feet in designated non-mountainous areas and a 2,000 foot vertical buffer in designated mountainous areas within the United States.

OROCA

Unlike a MEF, when determining an OROCA the area 4 NM around each quadrant is analyzed for obstructions.

OROCA does not provide for NAVAID signal coverage, communication coverage and would not be consistent with altitudes assigned by Air Traffic Control. OROCA's can be found over all land masses and open water areas containing man-made obstructions (such as oil rigs).

OROCA's are shown in every 30 x 30 minute quadrant on Area Charts, every one degree by one.

It is a good value to determinate obstacle clearance whenever the pilot has to, or would like to divert from the airway, e.g. during an emergency descent or when flying direct to a point away from an airway.

Attention

MEF on VFR sectionals do not include the buffer.

OROCA on IFR low enroute charts do include the +1000/+2000 buffer.

Therefore, whatever the conditions the OROCA will keep you the safest.

You are best not to fly exactly at the MEF.

Overall Altitude Considerations

- Terrain/MEF
- Congested or Not
- Airspaces
- Clouds
- East or West (odd or even)
- Winds Aloft
- Climb Performance
- Oxygen availability
- How far are you going

Day or Night

If you fly over a lot of farmland during the day for example there are many places you might be able to make an unexpected landing

If you fly over the same areas at night, it's just total dark

Moonlight?

Caution!

Miscellaneous Activity Areas

Aerobatic Practice Area



Glider Operations



Hang Glider Activity



Ultralight Activity



Unmanned Aircraft Activity



Parachute Jumping Area with Frequency



Space Launch Activity Area



Fuel prices

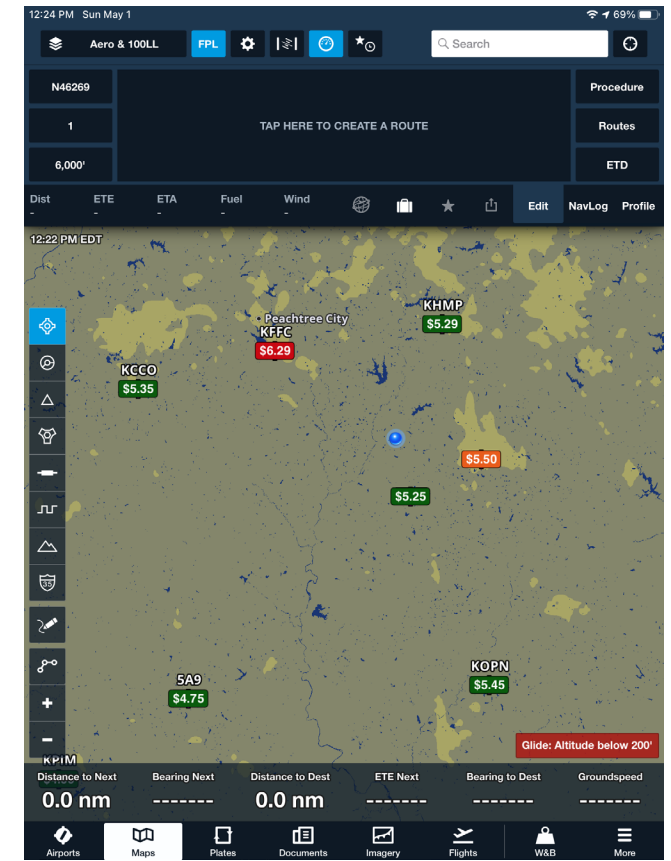
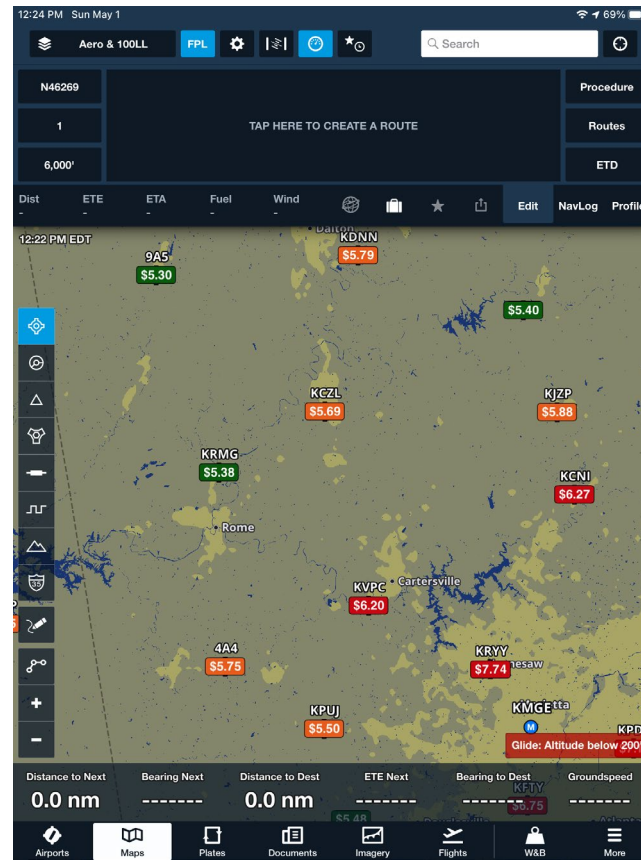
Most important you need to make sure you have enough fuel to fly plus the required extra.

Fuel prices are all over the place.

If you can save \$2/gallon plan to stop some place to buy gas.

If you plan to stop, remember it takes gas to go out of the way and to climb back up.

In CAP KRYYY -> KPUJ -> KRYYY requires two sorties to get cheaper fuel.



Do It Yo Self Service

If you don't mind pumping the gas yourself, you can save a fortune in northwest Georgia

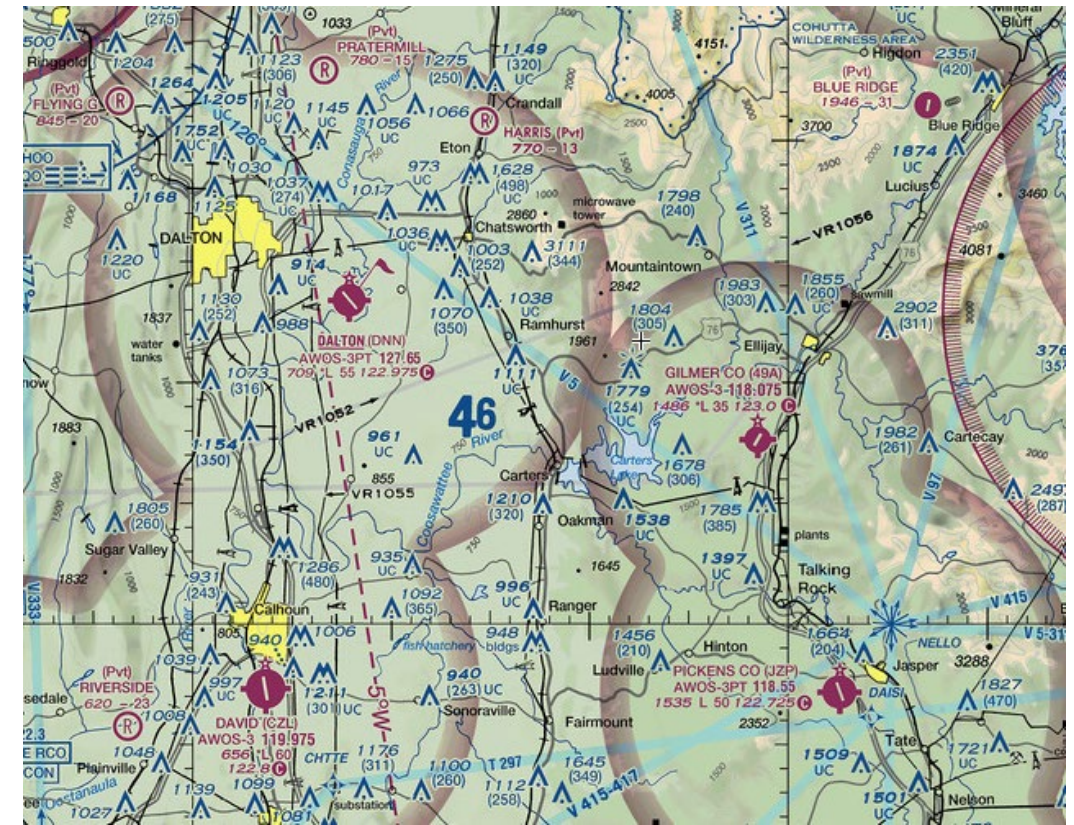
If you or someone you know owns a tank you can but it when prices are low to 'weather' our price hikes.



Need a Car?

Then you might be willing to pay more for fuel

All cars are not created equal but as long as they work...



Terrain

Weather

You could plan flights right now for any place you might go within 2 years.

As for weather, you better start checking forecasts 2 days from your flight. Weather will determine if you need to alter your route of flight, change your altitude, determine VFR vs IFR, or drive instead.

→ See my slides on Weather Current Info and Forecasts

Weather



What if there is no weather reporting where you are or where you are going? Just look at the windsocks & flags. If you need to call to ask someone.

<https://youtu.be/pa89-M4wHhQ>

Weather

What if there is no weather reporting where you are or where you are going? Just look at the windsocks & flags. If you need to call to ask someone.



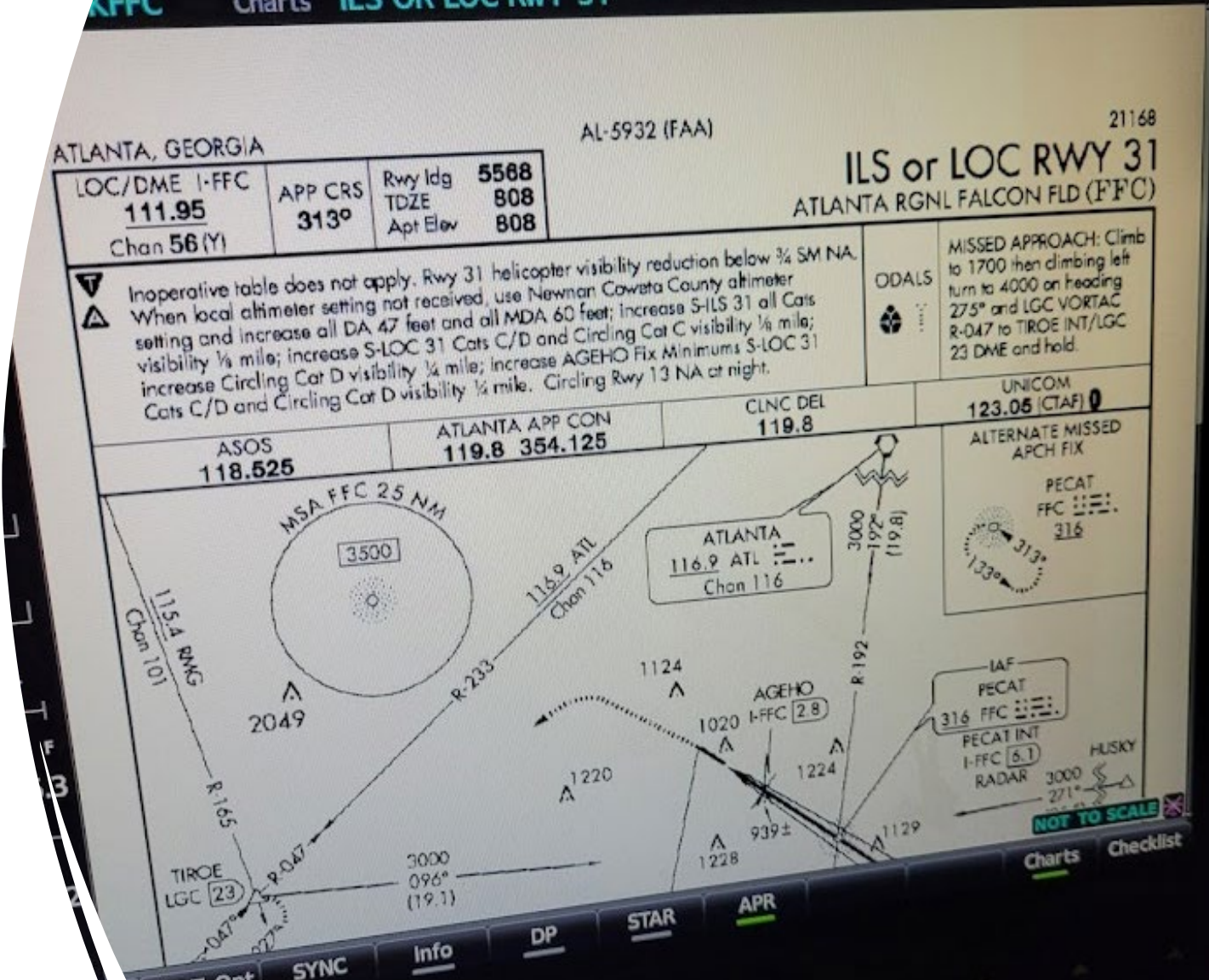
Approaches

Review all the approaches for the airport you are going to especially if you have never been there before. The approaches safely lead you from the enroute environment to the airport. You can incorporate one of the initial fixes into your route plan. I strongly suggest printing the approach in case something happens to your tablet in flight.

Remember that the approaches have all the necessary info for that airport that you will need including, runway numbers, runway lengths, elevation for touchdown zones, coordinates, and frequencies.

But what if the approach I choose does not make sense because the winds do not favor it? You can either come up with a plan to approach from the other side or do a circle to land.

Good idea to file to a fix that is included in the approach. That will give ATC info on your thoughts.



Special Use Airspaces

See lesson on National Airspace System

Notice to Air Missions (NOTAMs)

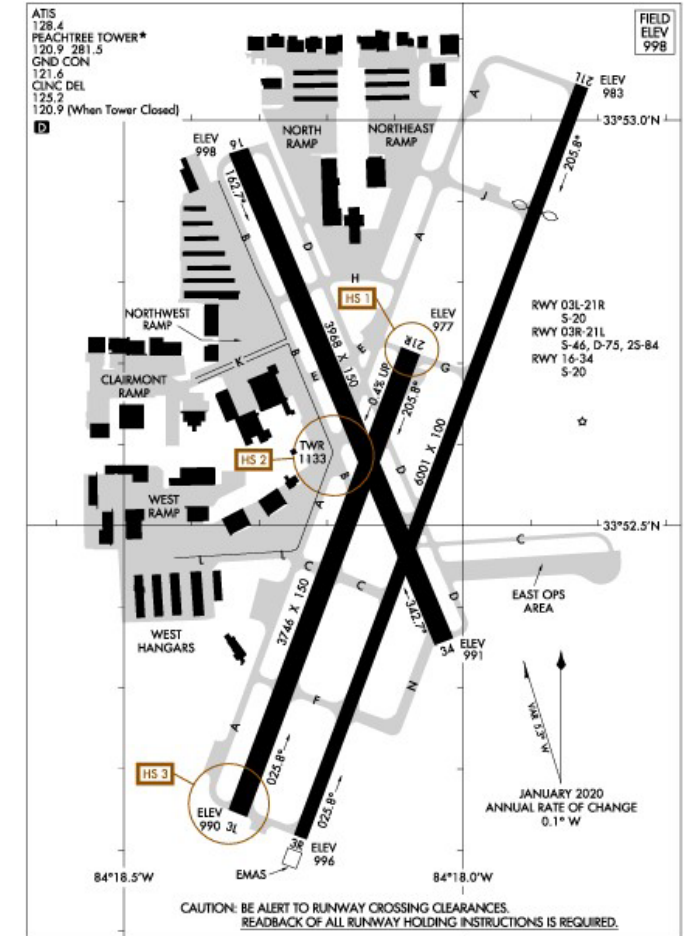
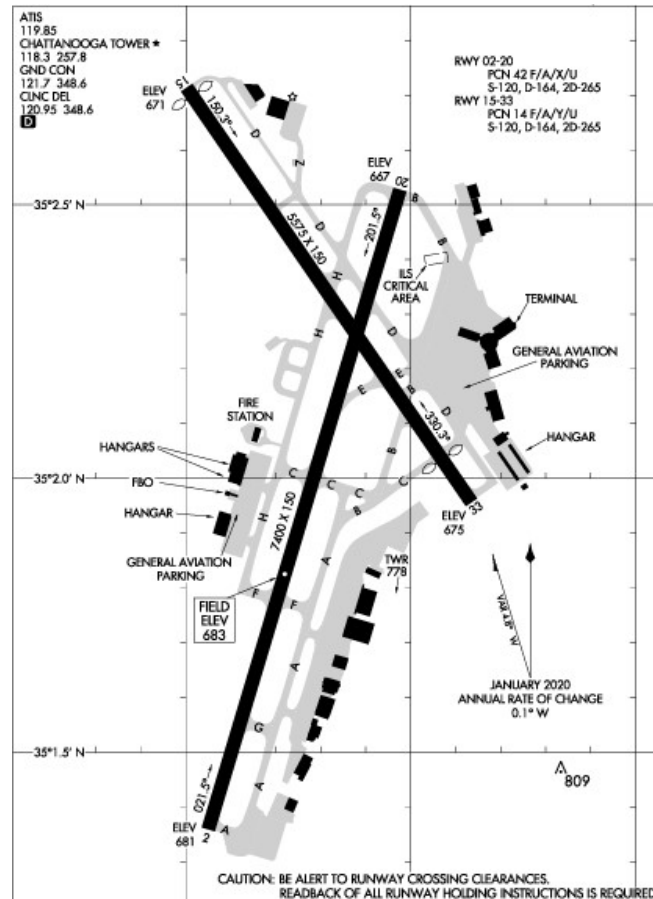
See separate lesson

Equipment installed

Simply put if you don't have the equipment needed that will restrict your options

My C150 is VFR only...so if weather could be bad...I need to wait, find a way around, or not fly

We landed
safe...into a
maze



FBOs

You know how to get to the runway...now where are you going after you land?

KFFC = The main building

KCCO = The building on the south side

KRYY = Hawthorne

KECP = Sheltair

KCHA = Wilson Air

KPDK = Your choice of Atlantic, Signature, or Epps

KBHM = Atlantic West or Atlantic East

KJZP, 4A4, others = A little building

From
GA62/KHMP/GA2
to either
KCXU or KMGR

KMGR has:

- Full service gas cheaper than KCXU has self service gas
- Two runways
- Cars
- A building to cool down in summer or warm up in the winter
- Bathrooms
- 10 minutes closer drive for my family
- Internet
- Free refreshments daily (Free hot dogs every Saturday)



Sometimes you are the only humans there

Remember what Maslow said?

Do you prefer burgers, seafood, chicken, or BBQ?

KAHN = Raising Cane's Chicken Fingers when we used to visit my wife's grandma

KJZI = Charleston Crab House

KCHA= Rib & Loin or Sticky Fingers

KSSI = Southern Soul Barbeque (so I heard)

Prep

Sunglasses

Prescription glasses

Water and a snack

Remember to charge everything you would need. Tablets, Stratus, etc.

Anything you might need for the kids

File

You can electronically file the plan before you leave for the airport or at the airport during pre-flight.

You do not have to call 1-800-WXBRIEF anymore but you can if you wish or do not have internet.

ForeFlight is the easiest for me.

Just know your times better be right if you activate and if you have an unexpected stop that you better let them know.

Remember to Cancel

Filing flight plans enhances safety. You can cancel in the air or you can also cancel upon reaching destination.

AIM 7-1-2 OVERDUE AIRCRAFT ON FLIGHT PLAN

Consider an aircraft on a VFR or DVFR flight plan overdue:

When it fails to arrive 30 minutes after its ETA and communications or location cannot be established.

When notified by a commercially available tracking service, begin search and rescue activities most appropriate for the circumstances, i.e., a communications search followed by an ALNOT.

ALERT NOTICE (ALNOT) = A request originated by a flight service station (FSS) or an air route traffic control center (ARTCC) for an extensive communication search for overdue, unreported, or missing aircraft.

When is a plan required

- IMC (IFR Conditions)
- Through some TFRs such as President or VP
- Class A airspace
- Crossing the ADIZ (Air Defense Identification Zone)
- Flying to another country
- A DC FRZ flight plan is required to fly VFR in the DC FRZ
- A DC SFRA flight plan is required to fly VFR in the DC SFRA

When should I file

- Any time you are on a cross country trip
- When you plan to use flight following
- When you are doing practice approaches over a long area
- Since it is used for SAR, to give first responders/CAP and idea where to look for you

Kennesaw to Gadsden KRYY -> KGAD

First I go to [SkyVector.com/ForeFlight](https://skyvector.com/ForeFlight) and put in KRYY to KGAD direct.

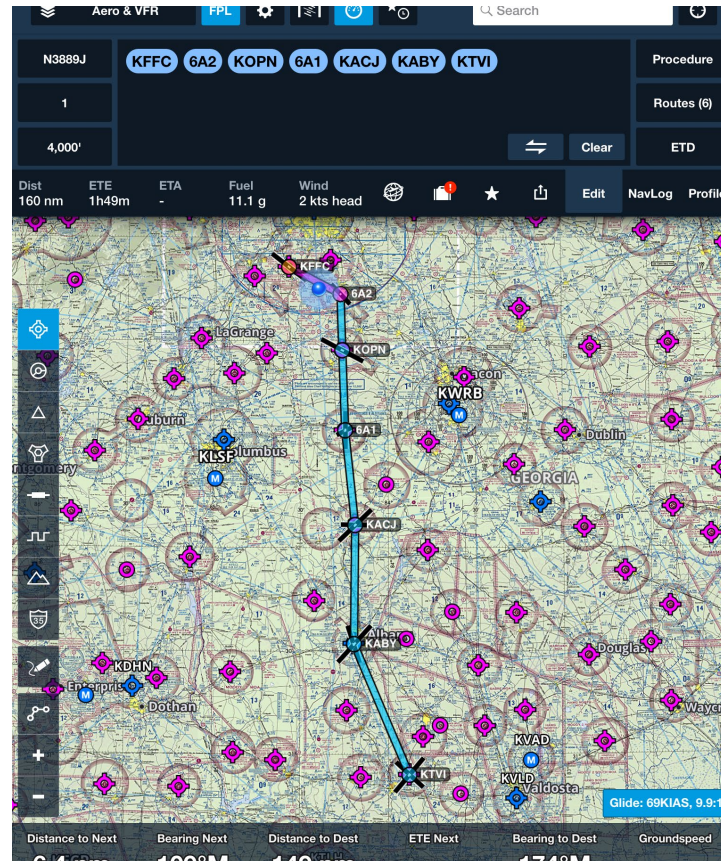
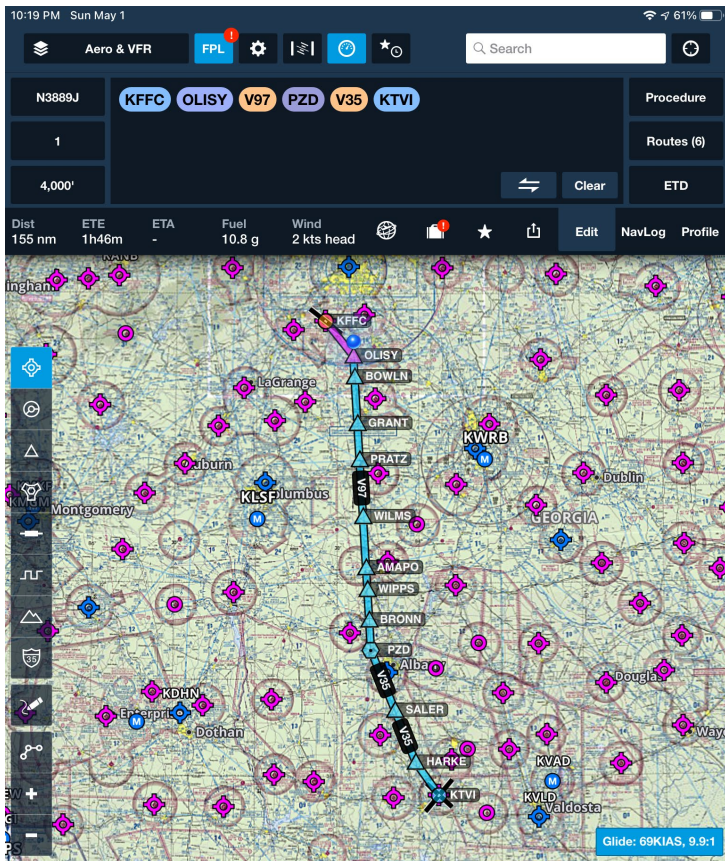
In clear day conditions this might be fine but first thought is that would put us dangerous close to a 'human strike' at Cedartown. Direct is 74 NM.

You can see the V325 airway is near the direct line so using that will not take up extra time and will give assurances for navigation, radios, and terrain. I am going to add DALAS FELTO MAYES as waypoints.

Now looking at the airport I try to figure which would be the best runway to use. You want to consider length and winds. For KGAD runway 24 makes the most sense if the winds agree. This path would put you right into the left pattern for 24.

So now what altitude to plan? Looking at the low enroute chart I see the MEA for V325 is 5000 but 5000 is an odd number so I would plan for 6000. At MAYES I would start descending to 3600. If I am too high at HUBJU I would do the hold till I get to 3600.

Peachtree City to Thomasville KFFC -> KTVI



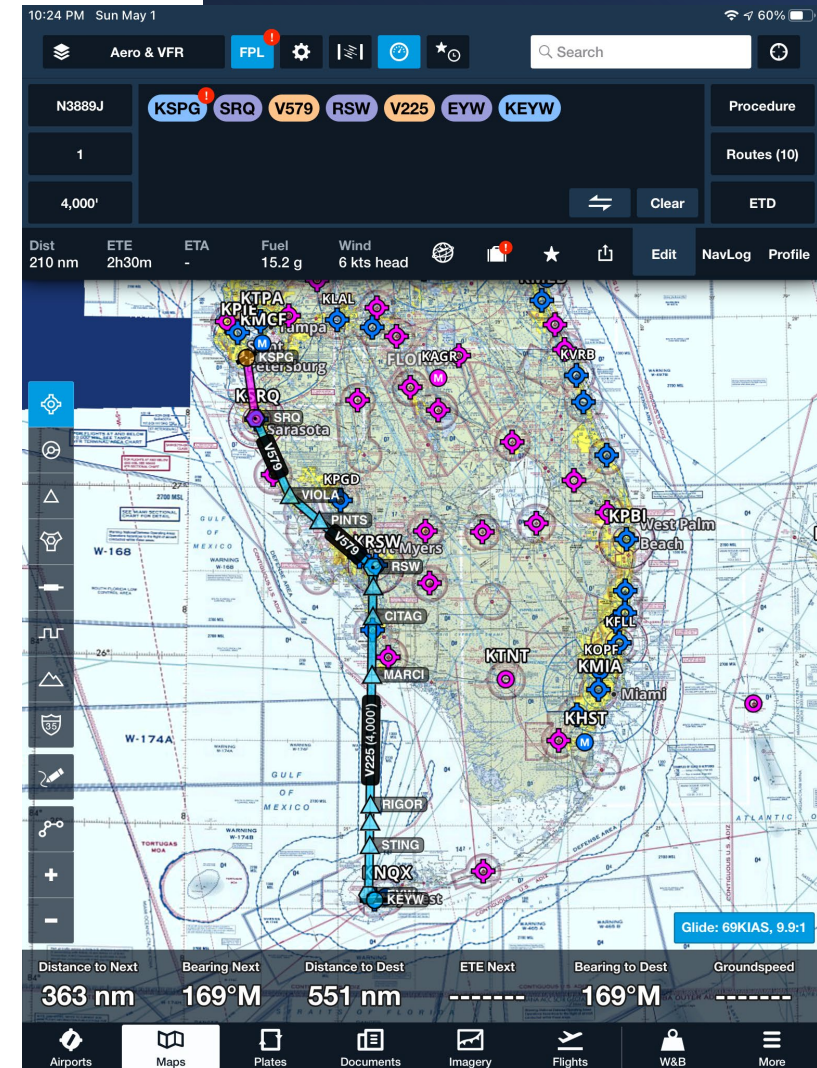
Option 1: use airways
OLISY V97 PZD V35 HARKE
151 NM

Option 2: over airports
(night)
6A2 KOPN 6A1 KACJ KABY
KTVI
160 NM

Tampa Bay to Key West

Using the Route Advisor says to basically take V579 to V225

If you are not comfortable going over that much water you could fly to Homestead then follow the highway





Pilots N Paws Trip

GA62 -> KCSG -> KMNV

then

KMNV -> KATL/ATL -> GA62

With a retired Delta pilot

Pilotage vs Dead Reckoning

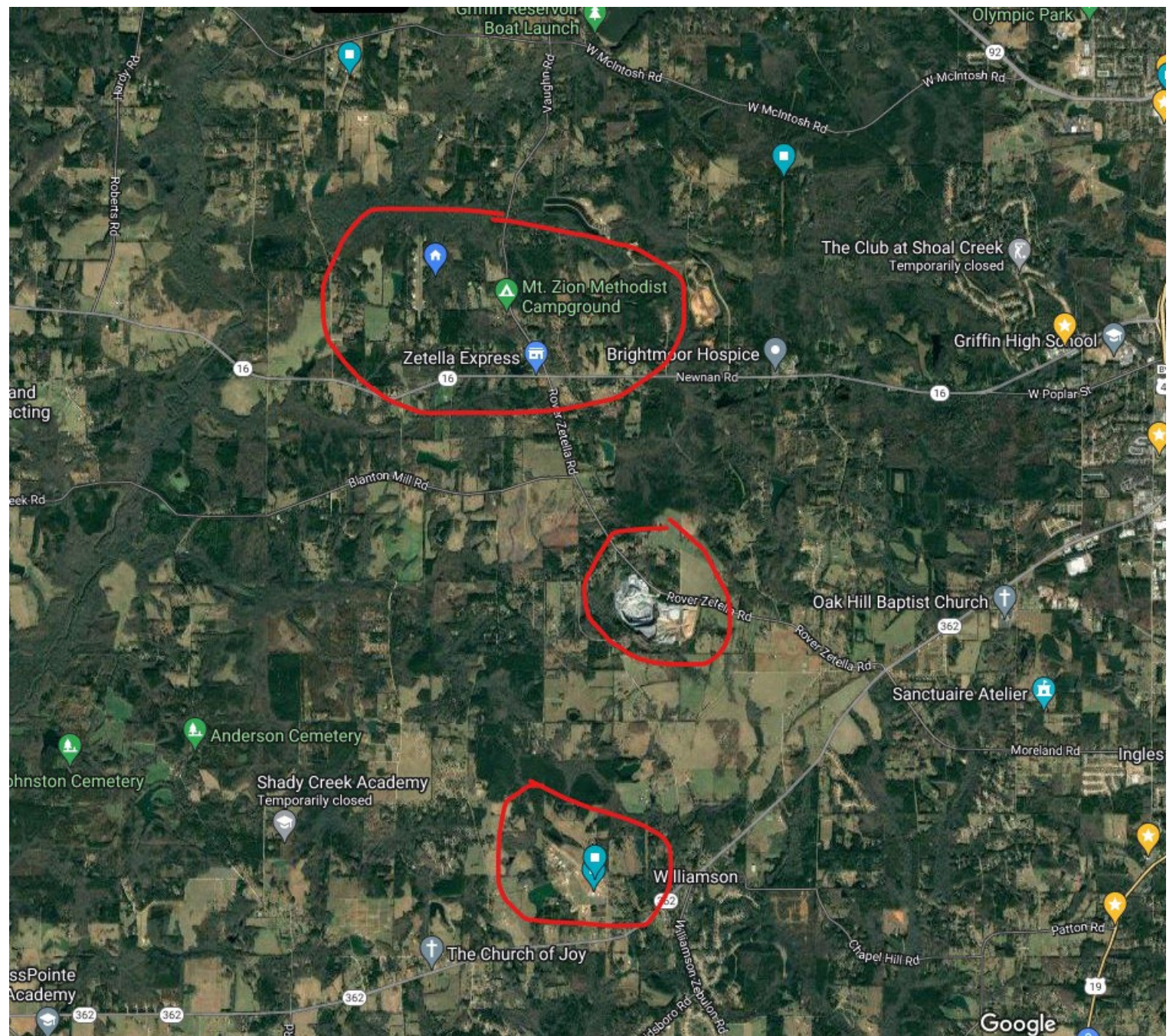
Pilotage is navigation by reference to landmarks or checkpoints. It is a method of navigation that can be used on any course that has adequate checkpoints, but it is more commonly used in conjunction with dead reckoning and VFR radio navigation.

= Just use your eyes...no GPS, no ipad, no paper

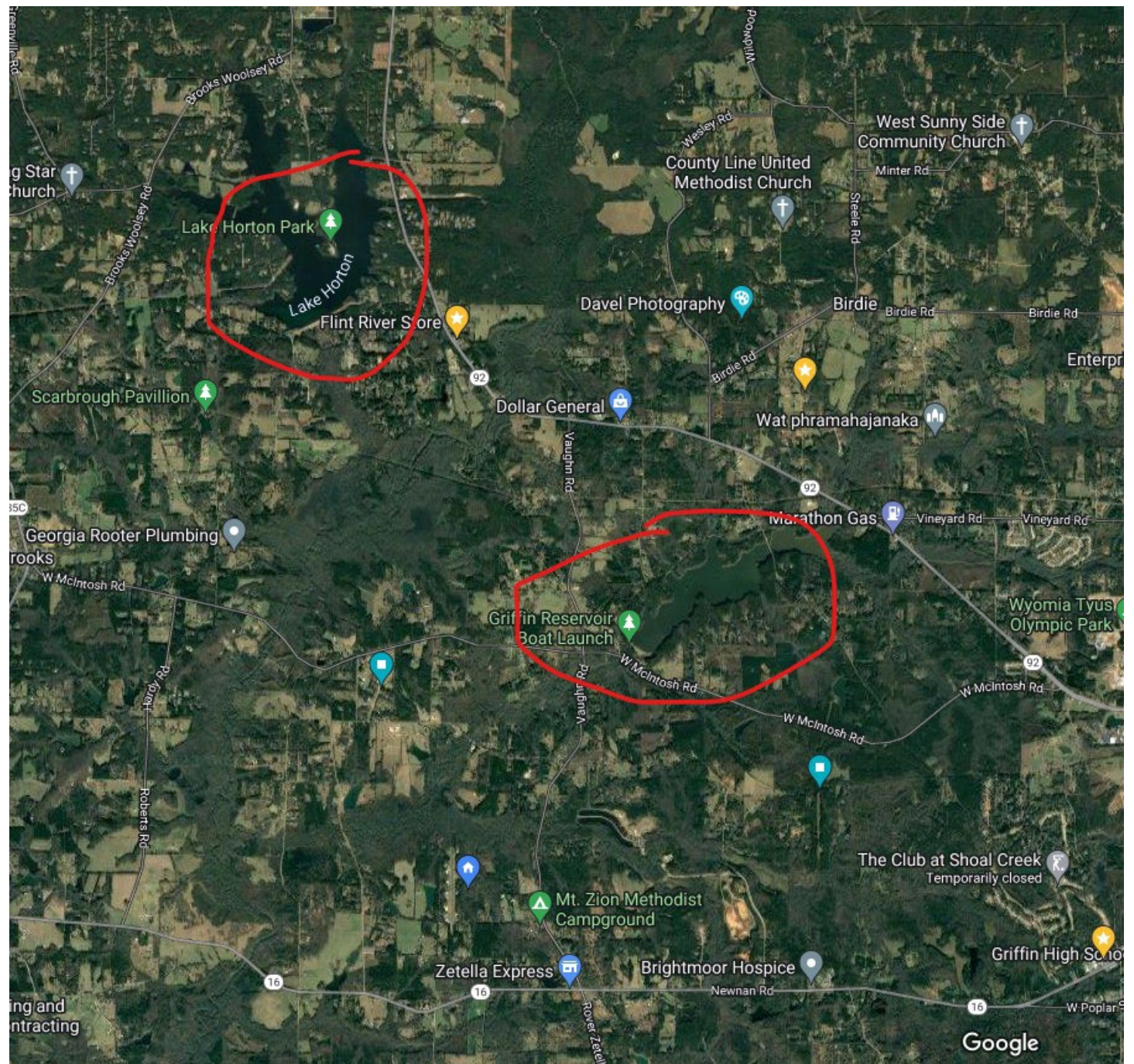
Dead reckoning is navigation solely by means of computations based on time, airspeed, distance, and direction. The products derived from these variables, when adjusted by wind speed and velocity, are heading and GS. The predicted heading takes the aircraft along the intended path and the GS establishes the time to arrive at each checkpoint and the destination. Except for flights over water, dead reckoning is usually used with pilotage for cross-country flying. The heading and GS, as calculated, is constantly monitored and corrected by pilotage as observed from checkpoints.

= Checking versus a log with calculated checkpoints

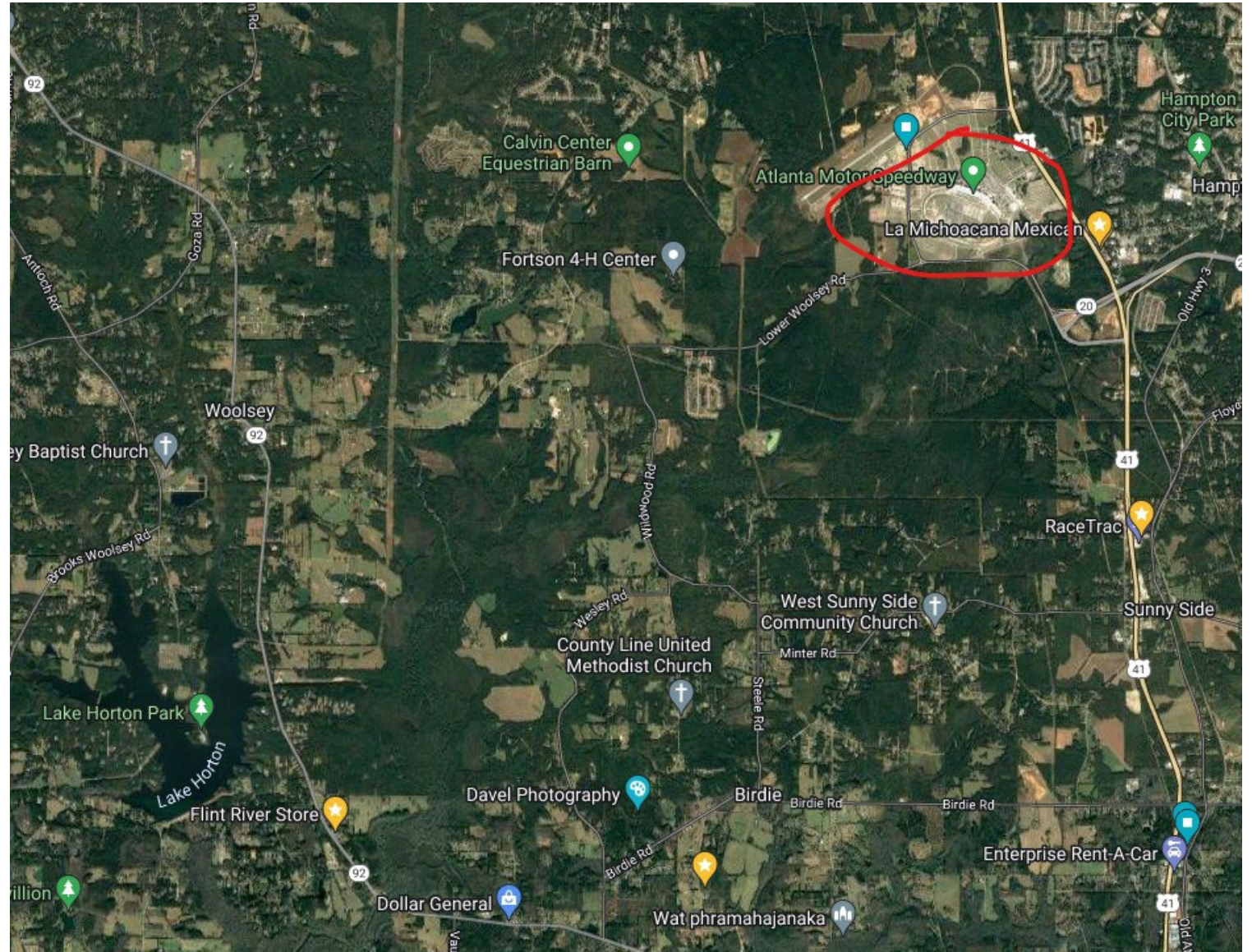
Pilotage from Peach State to Hampton



Pilotage from Peach State to Hampton



Pilotage from Peach State to Hampton

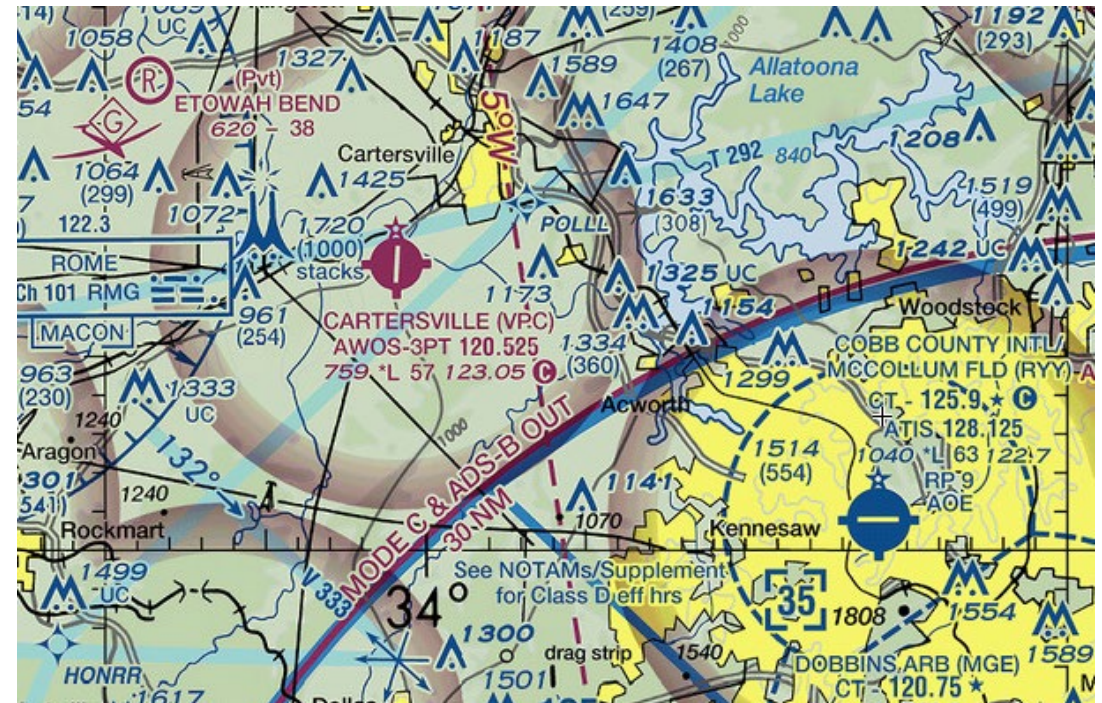


Fundamentals of pilotage and dead reckoning

Know your area

- Interstate highways
- State highways
- IFR (I Follow Roads)
- Power lines
- Lakes
- Walmart store
- Target stores
- Kroger stores
- Publix stores
- Home Depot (always orange)
- Lowes

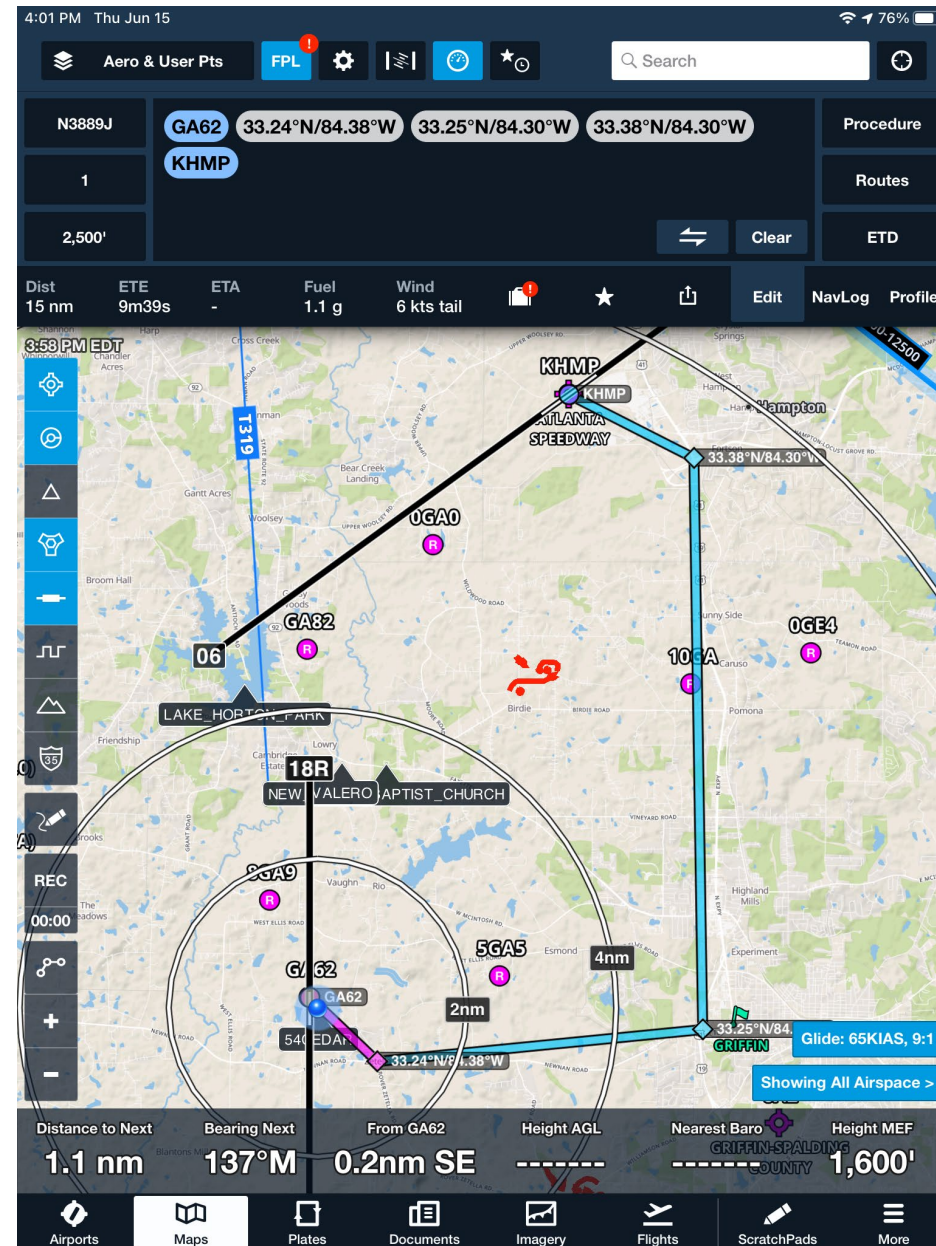
Plant Bowen



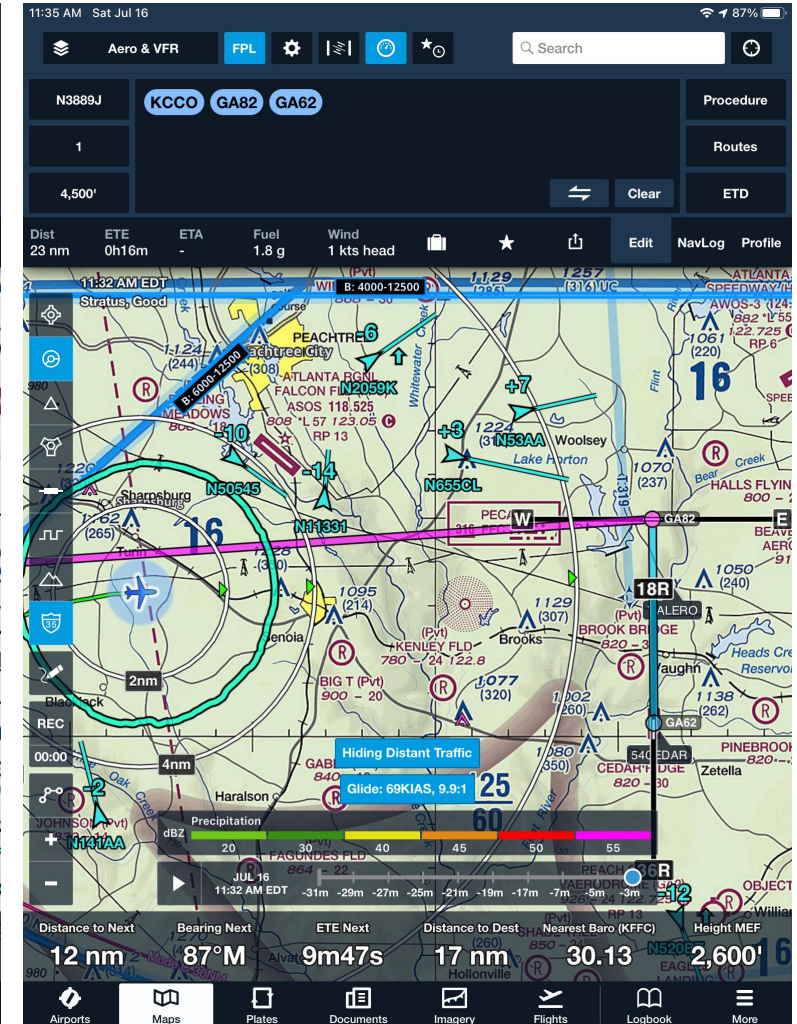


Kennesaw Mountain

IFR — I Follow Roads



IFPL – I Follow Power Lines



If you can find
the Bay...



Fundamentals of radio navigation

See Lesson on VORs

Fuel Stops

Let's talk about fuel stops...

1 hour reserve

Wind factors

Fuel pricing

Full serve or self serve

Runways vs wind

Top of Descent (TOD)

TOD in miles away from the airport =
 $(\text{Ground Speed} / 60) * (\text{Altitude above pattern} / 500)$

Example:

GS = 90 kts

Airport elevation = 1000

Pattern altitude = 2000

Cruise altitude = 4500

$(90 / 60) * (2500 / 500)$

$1.5 \times 5 = 7.5$ miles

Diversion to an alternate

My real life diversions

On the way to the first scheduled
Commercial checkride from Cobb County to
Collegedale

On the way from Cedar Ridge to Panama City
...while a mile up

Weather diversions while training

Radio issues

- Check all the wires
- Check the comm panel
- Check the headset volume
- Check the radio volume
- If you are alone, try to plug in the other side
- Make sure you are on the right frequency
- Try other frequencies in the area
- Get higher
- Try the guard channel 121.5
- Try the closest FSS
- Turn the transponder to 7600
- Try calling the nearest facility if you can with your phone
- I could try using the Zoleo to reach ATC or send a message to someone I know to have them contact ATC
- Brush up on light signals if going to a towered airport

Lost procedures

If Lost First Don't Panic

The Five C's

- Climb – This will allow you to see more ground, increasing chances of spotting a landmark...This improves radio reception, extends the transmitter range and increases radar coverage
- Communicate – use the frequencies on the chart...A controller can provide radar vectors...Use 121.5 if the situation becomes threatening and squawk 7700
- Confess – Tell any ATC facility the situation
- Comply – Comply with any ATC suggestions
- Conserve – Reduce power/airspeed for max endurance or range (whichever is appropriate)

Lost procedures

- Use GPS in the dash
 - ForeFlight
 - Garmin Pilot
 - Two VORs
 - Google Maps
 - Paper Sectional
 - Paper street maps
-
- Look for large landmarks such as Cartersville power plant, Kennesaw Mountain, Stone Mountain

If in unfamiliar areas, try different common frequencies
Try 121.5 asking for nearest ATC approach/center

High School Football Fields

They will usually have the name of the school and/or town in the end zones.

Many times the schools are on the sectionals.

They are also on Google Maps/street maps



Computation of fuel consumption

Assume the highest fuel burn of the model

Importance of preparing and properly using a flight log

You can make a flight log ahead of time and print it out from a variety of sources.

You can cross off or check off a leg after done.

When I did my private pilot checkride, I had a complicated Excel spreadsheet I made.

(ForeFlight and Garmin Pilot did not exist)

Importance of a weather check and the use of good judgment in making a “go/no- go” decision

Once you take off it might be hard to outrun a storm

It is better to be on the ground wishing you were flying than to be flying and praying you can make it back safely to the ground.

Purpose of and procedure used in filing a flight plan

It helps if you use flight following or need a 'pop up' IFR
If you disappear then they will know where to send SAR

Why use flight following?

I like to use the words Terrain Weather Traffic Wildlife (TWTW)...ATC can help you with 3 of the 4

- If you do not realize there is a good size mountain coming up as you travel from the Atlanta area north, they will remind you
- They can warn you of upcoming weather and the best way to get around it
- Traffic they can tell you what aircraft could be a factor in your area
- If you did not realize there was a TFR they can warn you, but they can also permit you to fly through some such as being near a concert

Why use flight following?

Sounds great but I have ForeFlight with ADSB in...

- If the other traffic is also talking to ATC then ATC will give instructions how to avoid each other instead of you going right and they go the same way for some reason
- If you have an emergency, they will know where to send the first responders
- You can ask them to let you fly through Class B airspaces and other airspaces that you would normally have to avoid
- They allowed me to fly right over Epcot Center before
- It is free

Do not be afraid of them they are there to help



Flight Following

Pilot: “Atlanta Approach Cessna 2739C is a 182RG slash Golf 3 miles north of Cobb County Airport Romeo Yankee Yankee at 3000 enroute to Chattanooga request flight following”

Even better...have the tower arrange for VFR traffic advisories before takeoff

Pilot: “Atlanta Approach Cessna 442KS is a 172 slash Golf 3 miles southeast of Atlanta Regional Falcon Field Foxtrot Foxtrot Charlie at 3000 climbing to 5500 enroute to KRYV Romeo Yankee Yankee request flight following”

Who I am calling:

Who I am:

Where now (x miles & altitude from blah):

Where going:

What needed:

Passed to another control

“Atlanta Center 2739C at 6200 for 7000”



The Fun Part

While training, you can stop places

#5 MARKET STREET DOCK
Alaskan snow crab / lobster tail
king crab / corn / potatoes

CRAB HOUSE SPECIALTIES

"YOU HOOK IT...WE'LL COOK IT" 12

Bring us your **cleaned** fresh catch, we will cook it!

CHARLESTON SHRIMP & GRITS 19

Shrimp / sausage / Carolina grits / mushrooms
brown gravy / scallions

GRILLED SHRIMP 19

White wine / garlic butter / Carolina grits / veg of the day

BROAD STREET SEAFOOD PASTA 19

Sautéed shrimp / crabmeat / mussels*
tomato basil sauce

GRILLED SALMON* 22

Asian slaw / ginger soy glaze / Carolina grits / collard greens

STEAMIN' TAILS & LEGS 22

Steamed peel n' eat shrimp / Alaskan snow crab legs
veg of the day / smashed potatoes

LOWCOUNTRY CRAB CAKES 23

Pan sautéed / roasted red pepper corn relish / remoulade
sauce / smashed potatoes / veg of the day

GRILLED SEAFOOD TRIO 24

Mahi-mahi / sea scallops / shrimp / white wine
garlic butter / Charleston red rice / veg of the day

FRIED SOFT SHELL BLUE CRABS 25

Legs, claws, shell & all / roasted red pepper corn relish
remoulade sauce / Charleston red rice / cole slaw

FRIED LOBSTER TAILS 27

The Fun Part

Getting some place quicker than driving...while listening to music or audio books



The Fun Part

Taking the family to see the ocean for the afternoon

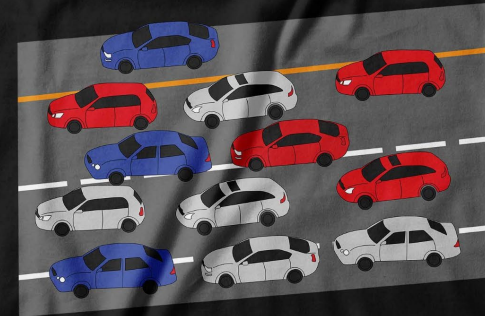


**A SLOW PLANE IS BETTER
THAN A FAST CAR**



**NO TRAFFIC...NO STOP SIGNS..
NO SPEED TRAPS UP HERE**

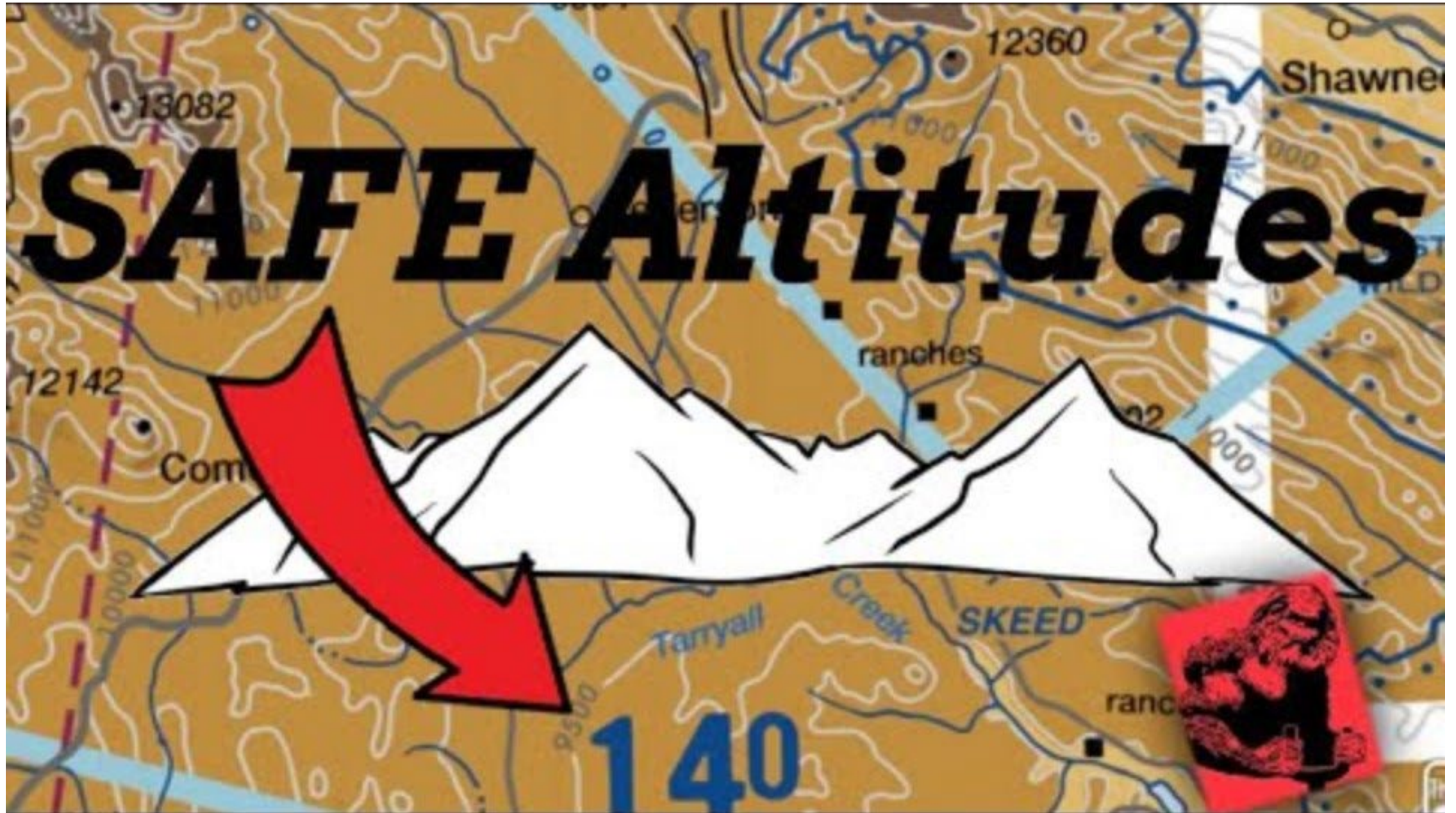
NO TRAFFIC UP HERE











VFR NAVIGATION LOG



JEPPESSEN



Check Point From	VOR Freq	Course To	Altitude	Wind		TC	TH	MH	CH	LWC	SST	Time On		C/P		Departure		Destination	
				Dir	Spd							ETA	Alt	ETA	Alt				
SKVV	VVC 116.7	053°	CLB	080 10	36	055°	056°	065°	061°	5	67	5	14:00	7.8	14:00	7.8	021/000	004/000	040/12
TOC		053°	3500	090 20	110	055°	058°	065°	063°	5	92	5	14:00	47	14:00	47	1012	1009	1009
CUMARAL	VVC 116.7	060°	3500	080 20	110	060°	065°	072°	070°	5	92	5	14:00	47	14:00	47	05	05	05
VELLANUEVA	EYP 116.7	039°	3500	080 20	110	039°	044°	051°	048°	5	92	5	14:00	47	14:00	47	14:00	14:00	14:00
TOC		039°	DES	080 15	110	039°	040°	047°	045°	5	92	5	14:00	47	14:00	47	14:00	14:00	14:00
SKYP	EYP 116.6																		
Total H 102												04:00	10.8						

Airport & XPS Advisories			
Departure	ATIS Code	Altitude	Destination
021/000	004/000	040/12	1009
1012	1009	05	05
14:00	14:00	14:00	14:00

Airport Frequencies			
Departure	Destination	SKVV	SKYP
ATIS	127.675	ATIS	127.7
Ground	-	Ground	126.6
Tower	118.7	Tower	118.3
Unicom	119.3	Unicom	-
CTAF	-	CTAF	-
FDIS	127.0	FDIS	126.8
UNICOM	122.9	UNICOM	122.9
Field Freq	136.05	Field Freq	102.71
Back In	15:10	Log Time	13:20
Arrive Out	13:40	01:20	



Flight Plan and Weather Log on Reverse Side

LEARN TO FLY!

GET THIS

FREE NAVLOG

Log

Clearance Limit _____ Route _____
Altitude _____ Departure Frequency _____ Transponder
Code _____

Weight and balance; Chart Supplement; OBS - Omni Bearing Selector
Direction Angle TH = True Heading VAR = Variation MH = Mag Heading

Time Off _____

TAS

TC
WCA

TH
VAR

MH
DEV

Compass
Heading

Leg
Dist

GS
Est
Act

75

217
16

233
12

245
0

245°

10

66

290

108

217
11

228
12

240
0

240°

17

99

22

217
1

228
12

240
0

240°

9

99

217
1

228
12

240
0

240°

14

99



The image is a composite featuring a man in a headset and sunglasses, a flight log, a flight computer, and a green arrow pointing to a flight log entry.

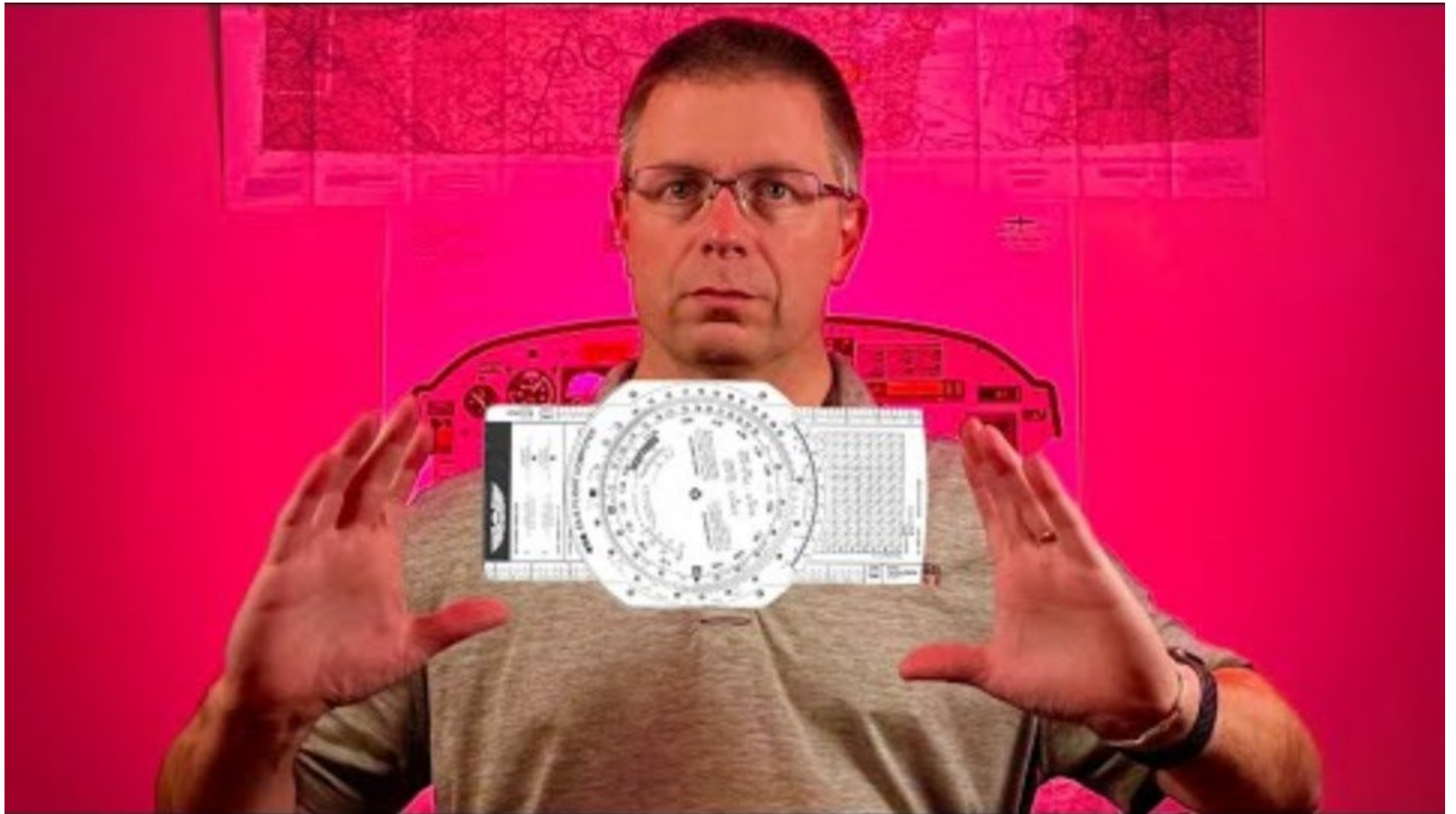
Flight Log:

Altitude	Speed	Time	Distance	Fuel	Remarks
1000	100	00:00	0.0	0.0	Start
1500	150	00:05	0.5	0.5	Climb
2000	200	00:10	1.0	1.0	Climb
2500	250	00:15	1.5	1.5	Climb
3000	300	00:20	2.0	2.0	Climb
3500	350	00:25	2.5	2.5	Climb
4000	400	00:30	3.0	3.0	Climb
4500	450	00:35	3.5	3.5	Climb
5000	500	00:40	4.0	4.0	Climb
5500	550	00:45	4.5	4.5	Climb
6000	600	00:50	5.0	5.0	Climb
6500	650	00:55	5.5	5.5	Climb
7000	700	01:00	6.0	6.0	Climb
7500	750	01:05	6.5	6.5	Climb
8000	800	01:10	7.0	7.0	Climb
8500	850	01:15	7.5	7.5	Climb
9000	900	01:20	8.0	8.0	Climb
9500	950	01:25	8.5	8.5	Climb
10000	1000	01:30	9.0	9.0	Climb
10500	1050	01:35	9.5	9.5	Climb
11000	1100	01:40	10.0	10.0	Climb
11500	1150	01:45	10.5	10.5	Climb
12000	1200	01:50	11.0	11.0	Climb
12500	1250	01:55	11.5	11.5	Climb
13000	1300	02:00	12.0	12.0	Climb
13500	1350	02:05	12.5	12.5	Climb
14000	1400	02:10	13.0	13.0	Climb
14500	1450	02:15	13.5	13.5	Climb
15000	1500	02:20	14.0	14.0	Climb
15500	1550	02:25	14.5	14.5	Climb
16000	1600	02:30	15.0	15.0	Climb
16500	1650	02:35	15.5	15.5	Climb
17000	1700	02:40	16.0	16.0	Climb
17500	1750	02:45	16.5	16.5	Climb
18000	1800	02:50	17.0	17.0	Climb
18500	1850	02:55	17.5	17.5	Climb
19000	1900	03:00	18.0	18.0	Climb
19500	1950	03:05	18.5	18.5	Climb
20000	2000	03:10	19.0	19.0	Climb
20500	2050	03:15	19.5	19.5	Climb
21000	2100	03:20	20.0	20.0	Climb
21500	2150	03:25	20.5	20.5	Climb
22000	2200	03:30	21.0	21.0	Climb
22500	2250	03:35	21.5	21.5	Climb
23000	2300	03:40	22.0	22.0	Climb
23500	2350	03:45	22.5	22.5	Climb
24000	2400	03:50	23.0	23.0	Climb
24500	2450	03:55	23.5	23.5	Climb
25000	2500	04:00	24.0	24.0	Climb
25500	2550	04:05	24.5	24.5	Climb
26000	2600	04:10	25.0	25.0	Climb
26500	2650	04:15	25.5	25.5	Climb
27000	2700	04:20	26.0	26.0	Climb
27500	2750	04:25	26.5	26.5	Climb
28000	2800	04:30	27.0	27.0	Climb
28500	2850	04:35	27.5	27.5	Climb
29000	2900	04:40	28.0	28.0	Climb
29500	2950	04:45	28.5	28.5	Climb
30000	3000	04:50	29.0	29.0	Climb
30500	3050	04:55	29.5	29.5	Climb

<https://youtu.be/PAGrRVsGPsM>



<https://youtu.be/mBvoiDJ5W3U>





Any questions I can answer or
follow up later on?

Notice to Airmen (NOTAMs)



NOTAMs

A NOTAM is a notice containing information essential to personnel concerned with flight operations but not known far enough in advance to be publicized by other means. It states the abnormal status of a component of the National Airspace System (NAS) – not the normal status.

NOTAMs indicate the real-time and abnormal status of the NAS impacting every user.

NOTAMs concern the establishment, condition, or change of any facility, service, procedure or hazard in the NAS.

NOTAMs have a unique language using special contractions to make communication more efficient.

NOTAMs

FDC NOTAMs: Flight Data Center NOTAMs are NOTAMs that are regulatory in nature such as changes to an instrument approach procedure or airway. Temporary Flight Restrictions (TFRs) are also issued as FDC NOTAMs. Also includes amendments to published instrument approach procedures and other current aeronautical charts.

Center Area NOTAMs: An FDC NOTAM issued for a condition that is not limited to one airport, therefore it is filed under the Air Route Traffic Control Center (ARTCC) that controls the airspace involved. TFRs, airway changes and laser light activity are examples of this type of NOTAM. This becomes very important to know when looking for NOTAMs on your own.

NOTAMs

Domestic NOTAMs: NOTAMs that are primarily distributed within the United States although they may also be available in Canada. Domestic NOTAMs stored in the USNS are coded in a domestic format rather than an ICAO format.

Includes:

Visual Navigation Aids

Radio Nav aids

NOTAMs

NOTAM (D): A NOTAM given (in addition to local dissemination) distant dissemination beyond the area of responsibility of the Flight Service Station. This type of NOTAM now includes (U) NOTAMs and (O) NOTAMs. (U) NOTAMs are unverified NOTAMs which are those that are received from a source other than airport management and have not yet been confirmed by management personnel. This is allowed only at those airports where airport management has authorized it by Letter of Agreement. (O) NOTAMs are other aeronautical information which does not meet NOTAM criteria but may be beneficial to aircraft operations.

Usually not included in a weather briefing unless specifically requested, NOTAM (D) outlines all local and distant (D) NOTAMs for all navigational facilities, public use airports, seaports, and heliports in the U.S. Chart supplement. For example, information regarding runway closures or obstructions can be found in this NOTAM.

NOTAMs

→ Location search on location(s) PDK. 27 NOTAM(s) found.						
ListTableMapBeta FiltersSortCount27 13						
	Location	Number	Class	Start Date UTC	End Date UTC 1	Condition
	PDK	N/A	Aerodrome	06/27/2023 1327		ON AIRPORT - SEE CONSTRUCTION GRAPHIC
	PDK	3/9321	Procedure	05/02/2023 1000	02/25/2024 2119EST	IAP DEKALB-PEACHTREE, ATLANTA, GA. ILS OR LOC RWY 21L, AMDT 9... S-ILS 21L DA 1432/HAT 441 ALL CATS, VIS ALL CATS RVR 5500. CIRCLING CAT A/B MDA 1600/HAA 602. CHANGE NOTE TO READ: FOR INOP ALS, INCR...
	PDK	3/9322	Procedure	05/02/2023 1000	02/25/2024 2119EST	IAP DEKALB-PEACHTREE, ATLANTA, GA. RNAV (GPS) Y RWY 21L, AMDT 2... LNAV MDA 1540/HAT 549 ALL CATS, VIS CATS C/D 1 3/8. CIRCLING CAT A/B MDA 1600/HAA 602. TEMPORARY CRANES 1238 MSL BEGINNING 1672FT N...
	PDK	3/9323	Procedure	05/02/2023 1000	02/25/2024 2119EST	IAP DEKALB-PEACHTREE, ATLANTA, GA. RNAV (GPS)-A, ORIG-A... CIRCLING CAT A/B MDA 1600/HAA 602. TEMPORARY CRANES 1238 MSL BEGINNING 1672FT NW OF RWY 21L (2022-ASO-18390 THRU 18397-OE). 2305021000-24022...
	PDK	01/015	Airspace	01/09/2023 0000	01/07/2024 2359	AIRSPACE UAS WI AN AREA DEFINED AS 1.1NM RADIUS OF 334959.20N0842024.40W (3.2NM SW PDK) SFC-300FT AGL DLY 0000-2359 2301090000-2401072359
	PDK	01/016	Airspace	01/09/2023 0000	01/07/2024 2359	AIRSPACE UAS WI AN AREA DEFINED AS 1.2NM RADIUS OF 335139N0842022W (2.1NM WSW PDK) SFC-300FT AGL DLY 0000-2359 2301090000-2401072359
	PDK	06/028	Obstruction	06/30/2023 1547	09/30/2023 2359	OBST TOWER LGT (ASR 1230498) 335143.70N0842316.40W (4.4NM W PDK) 1139.8FT (212.9FT AGL) U/S 2306301547-2309302359
	PDK	3/4296	Procedure	07/11/2023 1611	09/14/2023 1611EST	ODP DEKALB-PEACHTREE, ATLANTA, GA. TAKEOFF MINIMUMS AND (OBSTACLE) DEPARTURE PROCEDURES AMDT 3A... ADD TAKEOFF OBSTACLE NOTE: RWY 3R, TEMPORARY CRANES BEGINNING 1058FT FROM DER, BEGINNING 691FT LEFT O...
	PDK	06/022	Obstruction	06/25/2023 2349	09/04/2023 2359	OBST TOWER LGT (ASR 1021964) 334631.00N0841433.00W (6.7NM SSE PDK) 1603.7FT (599.7FT AGL) U/S 2306252349-2309042359
	PDK	06/023	Obstruction	06/25/2023 2351	09/04/2023 2359	OBST TOWER LGT (ASR 1021963) 334557.00N0840820.00W (10.4NM SE PDK) 1319.9FT (440.0FT AGL) U/S 2306252351-2309042359
	PDK	06/018	Obstruction	06/23/2023 2118	08/31/2023 2359	OBST TOWER LGT (ASR 1033743) 335500.00N0841204.00W (5.6NM ENE PDK) 1537.4FT (467.5FT AGL) U/S 2306232118-2308312359
	PDK	04/020	Aerodrome	05/01/2023 1200	08/31/2023 2100	RWY 16/34 CLSD 2305011200-2308312100
	PDK	04/022	Aerodrome	05/01/2023 1200	08/31/2023 2100	TWY B BTN APCH END RWY 16 AND TWY H CLSD 2305011200-2308312100
	PDK	05/026	Aerodrome	05/11/2023 2300	08/31/2023 2100	TWY H BTN TWY B AND TWY D CLSD 2305112300-2308312100
	PDK	06/026	Aerodrome	06/27/2023 1351	08/31/2023 1030	TWY D BTN APCH END RWY 34 AND RWY 03R/21L CLSD 2306271351-2308311030

NOTAMs

	PDK	07/015	Aerodrome	07/17/2023 1254	07/31/2023 2300	TWY E BTN TWY B AND TWY D CLSD 2307171254-2307312300
	PDK	07/017	Aerodrome	07/18/2023 0029	07/28/2023 1130	TWY D LGT BTN APCH END RWY 16 AND APCH END RWY 34 U/S 2307180029-2307281130
	PDK	07/018	Aerodrome	07/18/2023 0030	07/28/2023 1130	TWY H LGT BTN TWY A AND TWY B U/S 2307180030-2307281130

NOTAMs

https://www.faa.gov/air_traffic/publications/atpubs/notam_html/chap1_section_2.html

RWY (Runway). Keyword used to describe a temporary change or hazard associated with landing and takeoff surfaces to include runway lighting, markings, signage, and other airport services or attributes associated with a specific runway.

TWY (Taxiway). Keyword used to describe a temporary change or hazard associated with a taxiway, taxiway lighting, markings, helipads, signage and other attributes associated with a specific taxiway.

APRON (Apron/Ramp). Keyword used to describe a temporary change or hazard associated with an apron, ramp, or taxilane, lighting, markings, helipad, signage and other attributes associated with a specific apron.

AD (Aerodrome). Keyword used to describe a temporary change or hazard or potential hazard on or within 5 statute miles of an airport, heliport, or maneuvering area that is not associated with a specific movement area surface. Such hazards may include, (but are not limited to), aerodrome closures, lighting not associated with a specific movement area surface, aerodrome services (fuel, customs, ARFF), helicopter platforms, meteorological equipment (wind indicators) or services, and wildlife hazards.

OBST (Obstructions). Keyword used to describe a temporary change or hazard. Such hazards may include, (but are not limited to), moored balloon, kite, tower, crane, stack, obstruction, wind turbine, obstruction lighting outage, obstruction status, or telecommunication tower light outage.

NOTAMs

NAV (Navigation Aids). Keyword used to describe a temporary change or hazard caused by the changes in the status of ground-based radio navigational aids and Global Navigation Satellite Systems (GNSS) (except for area navigation (RNAV) approach anomalies).

COM (Communications). Keyword used to describe a temporary change or hazard caused by or related to communication outlets and air-to-ground frequencies due to commissioning, decommissioning, outage, or unavailability.

SVC (Services). Keyword used to describe a temporary change or hazard associated with change in service levels, such as operating hours, air traffic management services, or airport services. The ICAO contraction for service (SER) is an allowable contraction in the body of the NOTAM. "SVC" is only used as the keyword contraction for Service NOTAMs.

AIRSPACE (Airspace). Keyword used to describe an airspace restriction or activity warning which impacts, restricts, or precludes use of airspace. Such restrictions and activities may include, (but are not limited to), parachute jumping, unmanned aircraft, etc.

ODP (Obstacle Departure Procedure). Keyword used when a NOTAM applies to a textual or graphic obstacle departure procedure.

NOTAMs

SID (Standard Instrument Departure). Keyword used when a NOTAM applies to a published standard instrument departure.

STAR (Standard Terminal Arrival). Keyword used when a NOTAM applies to a published standard terminal arrival.

CHART (Chart). Keyword used to describe a U.S. Government chart correction, followed by name of chart and word “CORRECT” that becomes effective before the next publication cycle.

DATA (Data). Keyword used to describe a temporary change or hazard associated with a data set change followed by the name of the data set to be changed; for example, U.S. DOD DAFIF, DACS, or NFD.

IAP (Instrument Approach Procedure). Keyword used when a NOTAM applies to a published instrument approach procedure.

VFP (Visual Flight Procedure). Keyword used when a NOTAM applies to visual flight procedures such as Charted Visual Flight Procedure and RNAV Visual Flight Procedure.

NOTAMs

DVA (Diverse Vector Areas). Keyword used to describe a temporary change or hazard associated with a Diverse Vector Area.

ROUTE (Route). Keyword used to describe a temporary change or hazard or change associated with published Air Traffic Services (ATS) routes and related information.

SPECIAL (Special). Keyword used when a NOTAM applies to a special instrument flight procedure.

SECURITY (Security). Keyword used for Department of State advisories, Special Federal Aviation Regulations (SFARs), advisories of national emergency, national security actions, special security instructions, Air Defense Identification Zone (ADIZ) procedures.

Temporary Flight Restrictions (TFR)

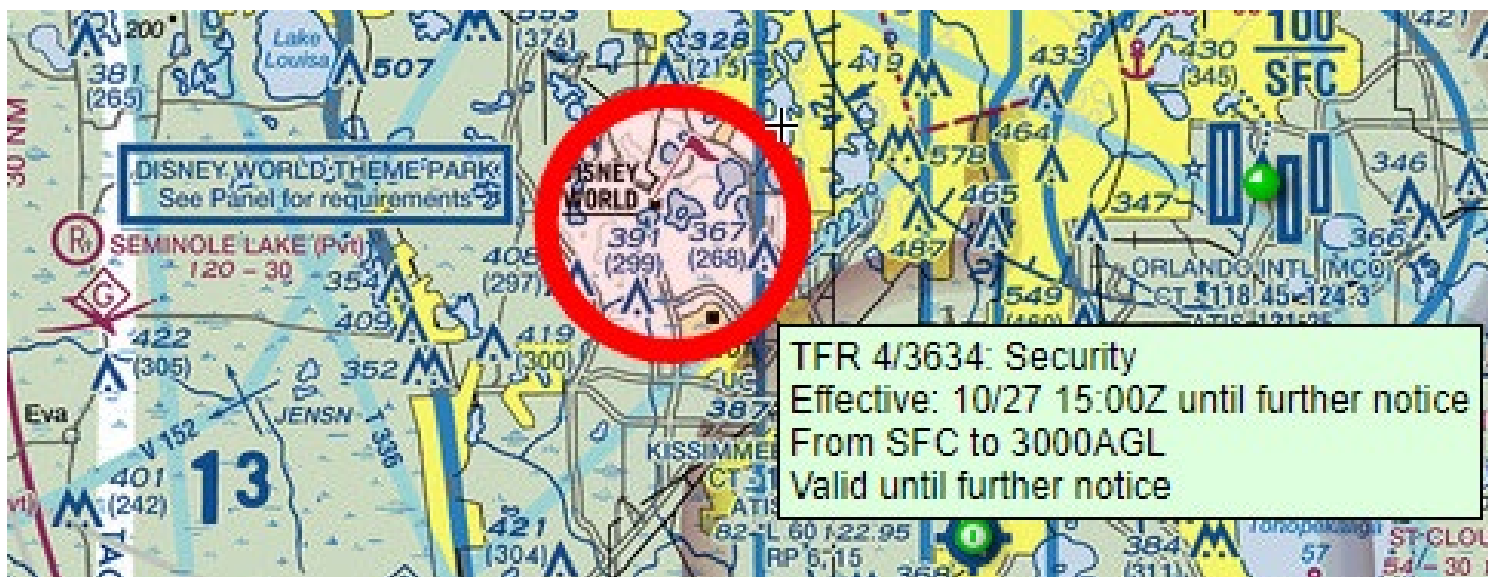
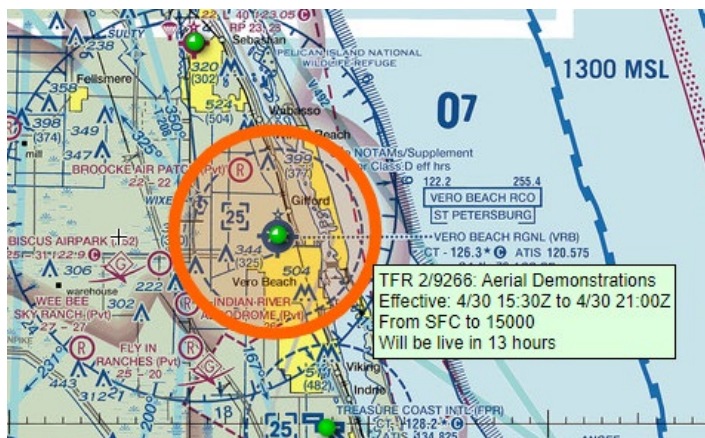
A flight data center (FDC) Notice to Airmen (NOTAM) is issued to designate a TFR. The NOTAM begins with the phrase “FLIGHT RESTRICTIONS” followed by the location of the temporary restriction, effective time period, area defined in statute miles, and altitudes affected. The NOTAM also contains the FAA coordination facility and telephone number, the reason for the restriction, and any other information deemed appropriate. The pilot should check the NOTAMs as part of flight planning.

Some of the purposes for establishing a TFR are:

- Protect persons and property in the air or on the surface from an existing or imminent hazard.
- Provide a safe environment for the operation of disaster relief aircraft.
- Prevent an unsafe congestion of sightseeing aircraft above an incident or event, that may generate a high degree of public interest.
- Protect declared national disasters for humanitarian reasons in the State of Hawaii.
- Protect the President, Vice President, or other public figures.
- Provide a safe environment for space agency operations.

It is a pilot’s responsibility to be aware of TFRs in their proposed area of flight. One way to check is to visit the FAA website, www.tfr.faa.gov, and verify that there is not a TFR in the area.

Different Types of TFRs



<https://notams.aim.faa.gov/notamSearch/>



Best Rwy

HARD SURFACE

5768 X 100

31: Calm

Sunrise / Sunset: 06:51 EDT / 20:20 EDT

A/FD

NEARBY

SAFETAXI

NOTAMs

AIRPORT (3)

OBSTACLE (0)

FDC (1)

Upcoming



Radio Altimeter Unreliable

Apr 30, 00:01 - Apr 30, 2024, 00:01 EST

Effective in 36m, Surface - Unlimited

AD AP RDO ALTIMETER UNREL. AUTOLAND, HUD TO TOUCHDOWN, ENHANCED FLT VISION SYSTEMS TO TOUCHDOWN, HEL OPS REQUIRING RDO ALTIMETER DATA TO INCLUDE HOVER AUTOPILOT MODES AND CAT A/B/PERFORMANCE CLASS TKOF AND LDG NOT AUTHORIZED EXC FOR ACFT USING APPROVED ALTERNATIVE METHODS OF COMPLIANCE DUE TO 5G C-BAND INTERFERENCE PLUS SEE AIRWORTHINESS DIRECTIVES 2021-23-12, 2021-23-13

NOTAM ID: 04/006, Source: Internet



Any questions I can answer or
follow up later on?

Benefits

Traffic advisories

Navigational assistance

Weather advisories

Pass on PIREPs

MOA/SUA advisories

Emergency assistance

Even if they are too busy for you:

Listen for traffic

Listen for ride reports

Ready to mayday

Put phone number in remarks...they can't see pilot information

You can get flight following to practice areas

They can now see ADS-B so they already know if you are naughty or nice

They would rather talk to you so they know what you are doing

If they say turn or descend early there is probably a reason

If you have an emergency you can keep your current code

Military can shut off ADS-B so if you say well I already have ADS-B in

Say you are going to John Tune Airport outside of KBNA...if they say radar services terminated use 1200...if you are about to pass through the class C get verification you can

Night Operations



Lesson Objective

To develop understanding of what makes night flying more challenging...but it is fun to me



Intro

The mechanical operation of an airplane at night is no different than operating the same airplane during the day.

The airplane does not know if it is being operated in the dark or in bright sunlight.

It performs and responds to control inputs by the pilot.

The pilot's interpretation of the world outside of the plane is different.

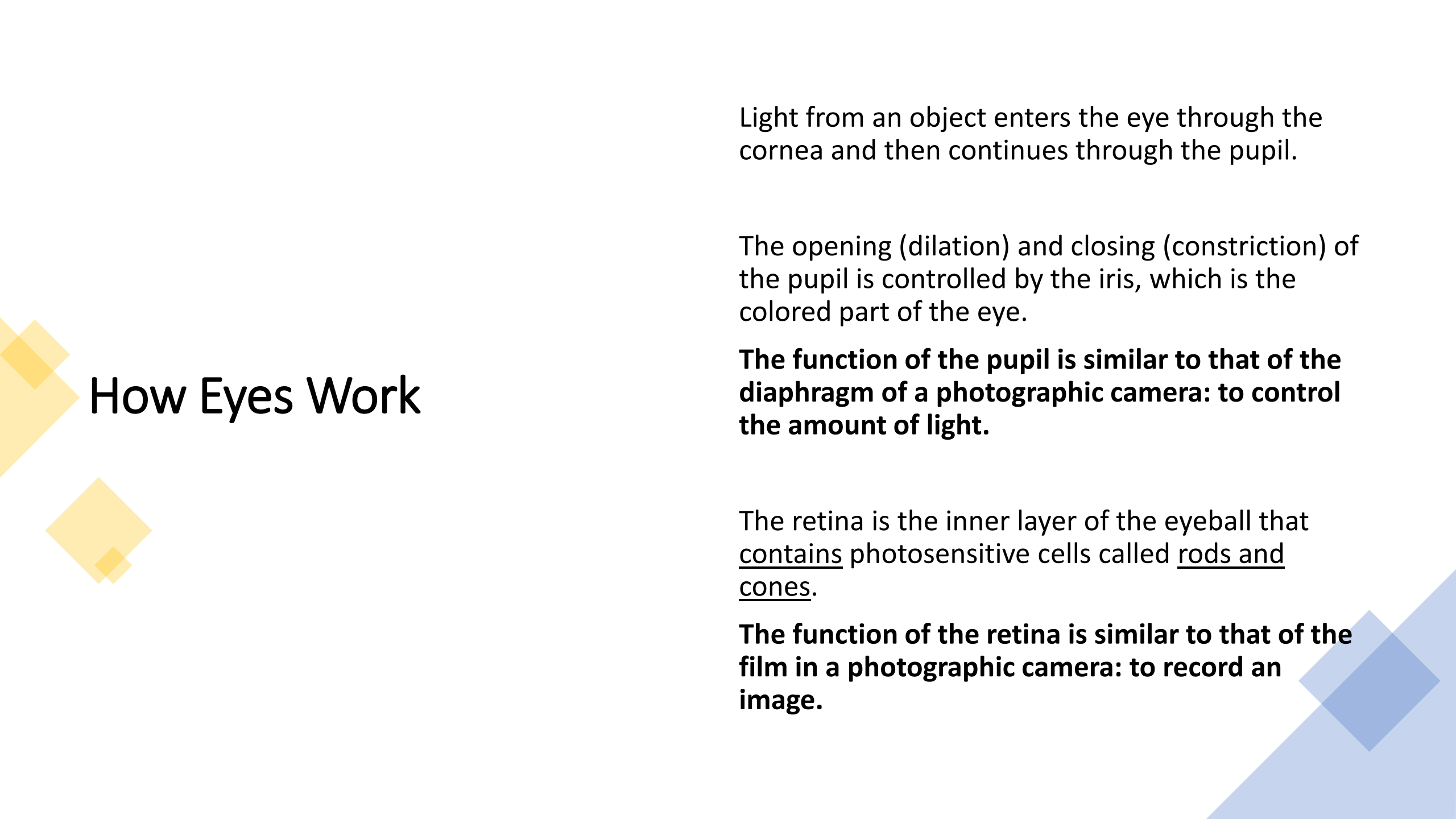


Intro

The pilot is affected by various aspects of night operations and should take them into consideration during night flight operations.

Some are human physical limitations affecting all pilots.

Others limitations, such as equipment requirements, procedures, and emergency situations, should also be considered.



How Eyes Work

Light from an object enters the eye through the cornea and then continues through the pupil.

The opening (dilation) and closing (constriction) of the pupil is controlled by the iris, which is the colored part of the eye.

The function of the pupil is similar to that of the diaphragm of a photographic camera: to control the amount of light.

The retina is the inner layer of the eyeball that contains photosensitive cells called rods and cones.

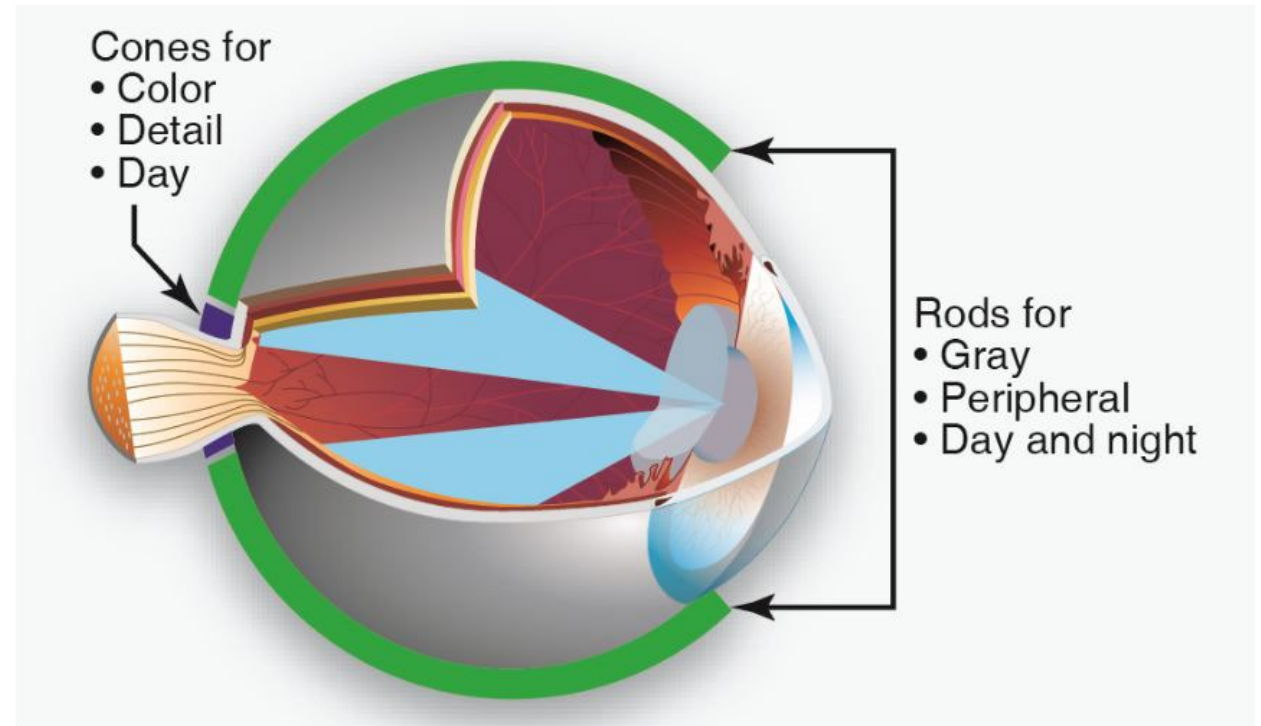
The function of the retina is similar to that of the film in a photographic camera: to record an image.

Cones and Rods

Cones are located in the center of the retina, the layer upon which all images are focused.

The cones are used for day or high-intensity light vision.

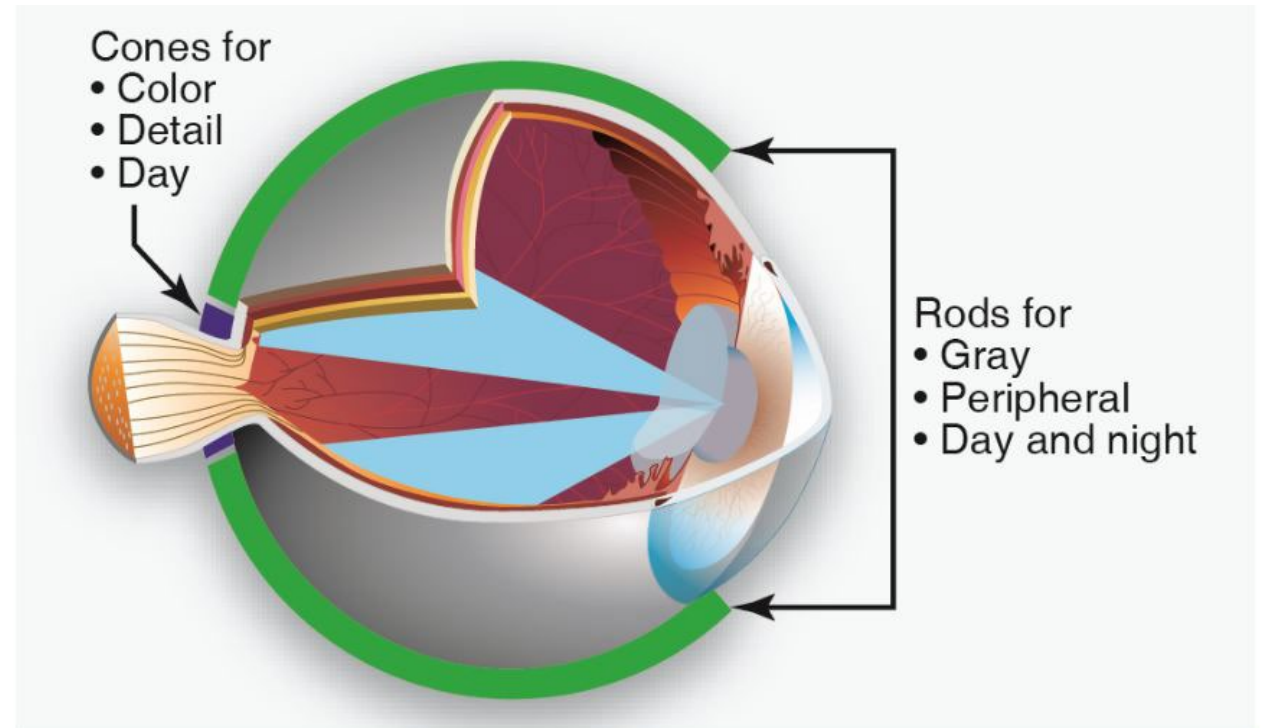
They are involved with central vision to detect detail, perceive color, and identify far-away objects.



Cones and Rods

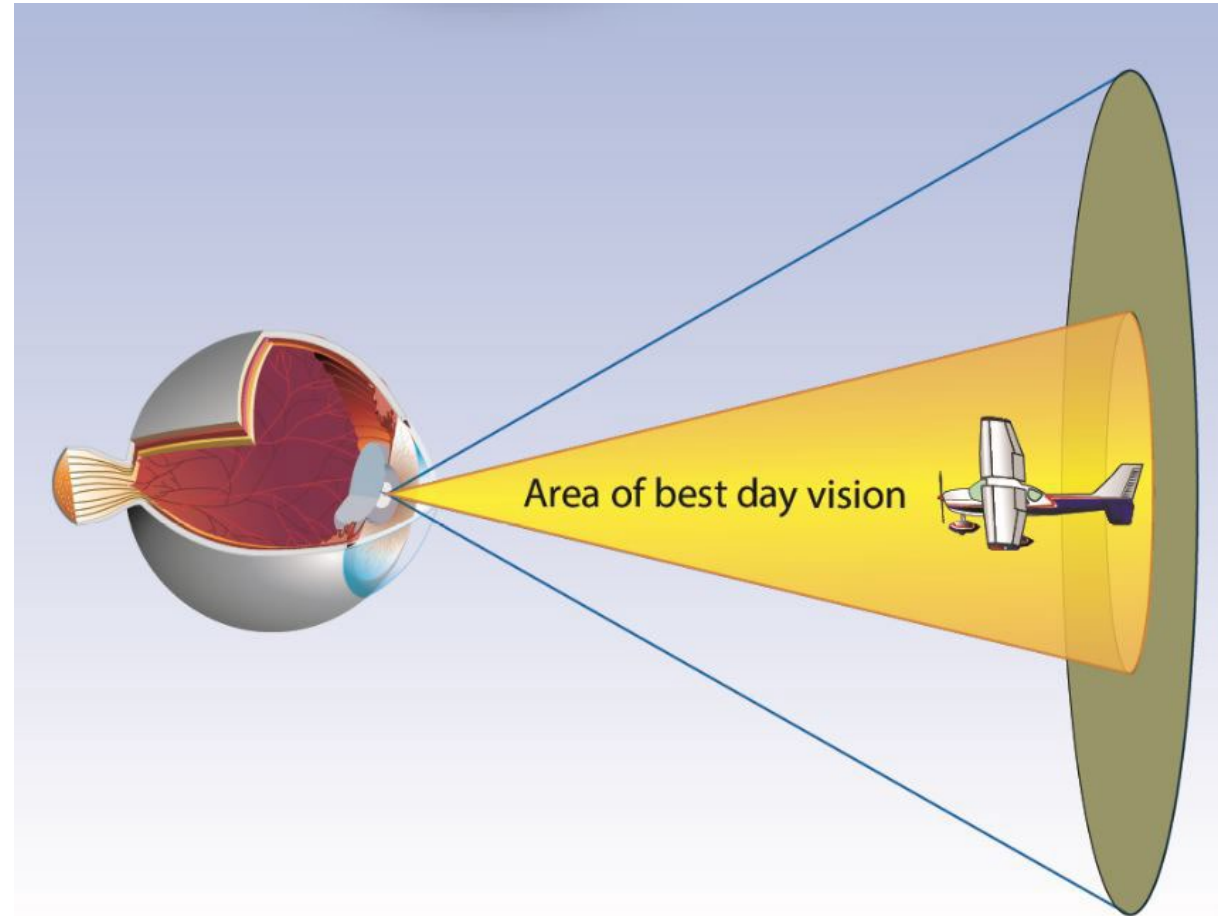
Rods are located in a ring around the cones, function when something is seen in the peripherals and provide vision in dim light.

Rods are used for low light intensity or night vision and are involved with peripheral vision to detect position references, including objects (fixed and moving) in shades of gray, but cannot be used to detect detail or to perceive color.



Photopic Vision

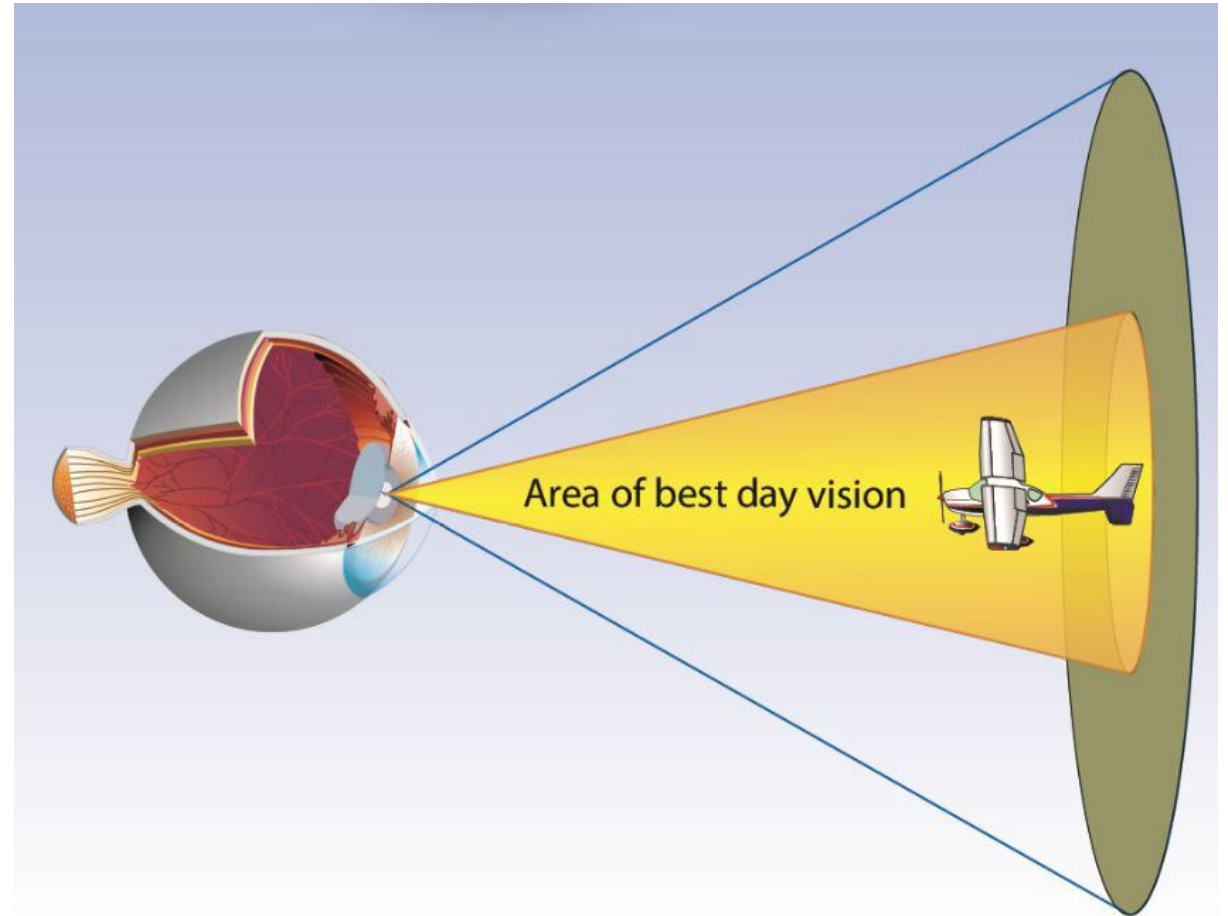
During daytime or high-intensity artificial illumination conditions, the eyes rely on central vision (foveal cones) to perceive and interpret sharp images and color of objects.



Oxygen

Rods consume the most oxygen in the retina due to the high metabolic activity required to maintain the dark current.

Although Pilots are not required to use oxygen below 14,000' msl (or 12,500' msl if you're up there over 30 minutes), the FAA does recommend you use supplemental oxygen when flying at night above 5,000' msl as the oxygen helps the rods in your eyes to work better and you will actually be able to see more if you do use oxygen.



Mesopic Vision and Scotopic Vision

Mesopic Vision

Occurs at dawn, dusk, or under full moonlight levels and is characterized by decreasing visual acuity and color vision.

Under these conditions, a combination of central (foveal cones) and peripheral (rods) vision is required to maintain appropriate visual performance.

Scotopic Vision

During nighttime, partial moonlight, or low intensity artificial illumination conditions, central vision (foveal cones) becomes ineffective to maintain visual acuity and color perception.

Under these conditions, if looking directly at an object for more than a few seconds, the image of the object fades away completely (night blind spot).

Peripheral vision (off center scanning) provides the only means of seeing very dim objects in the dark.

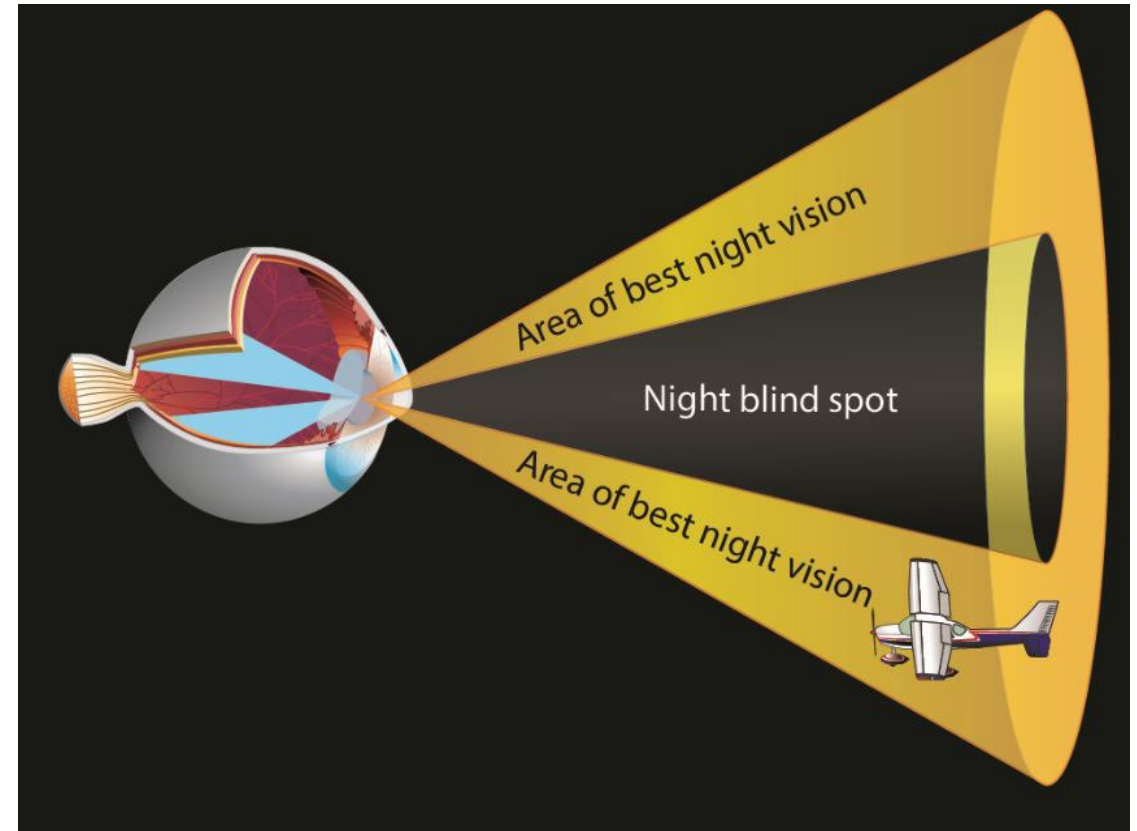
Night Blind Spot

The “Night Blind Spot” appears under conditions of low ambient illumination due to the absence of rods in the fovea.

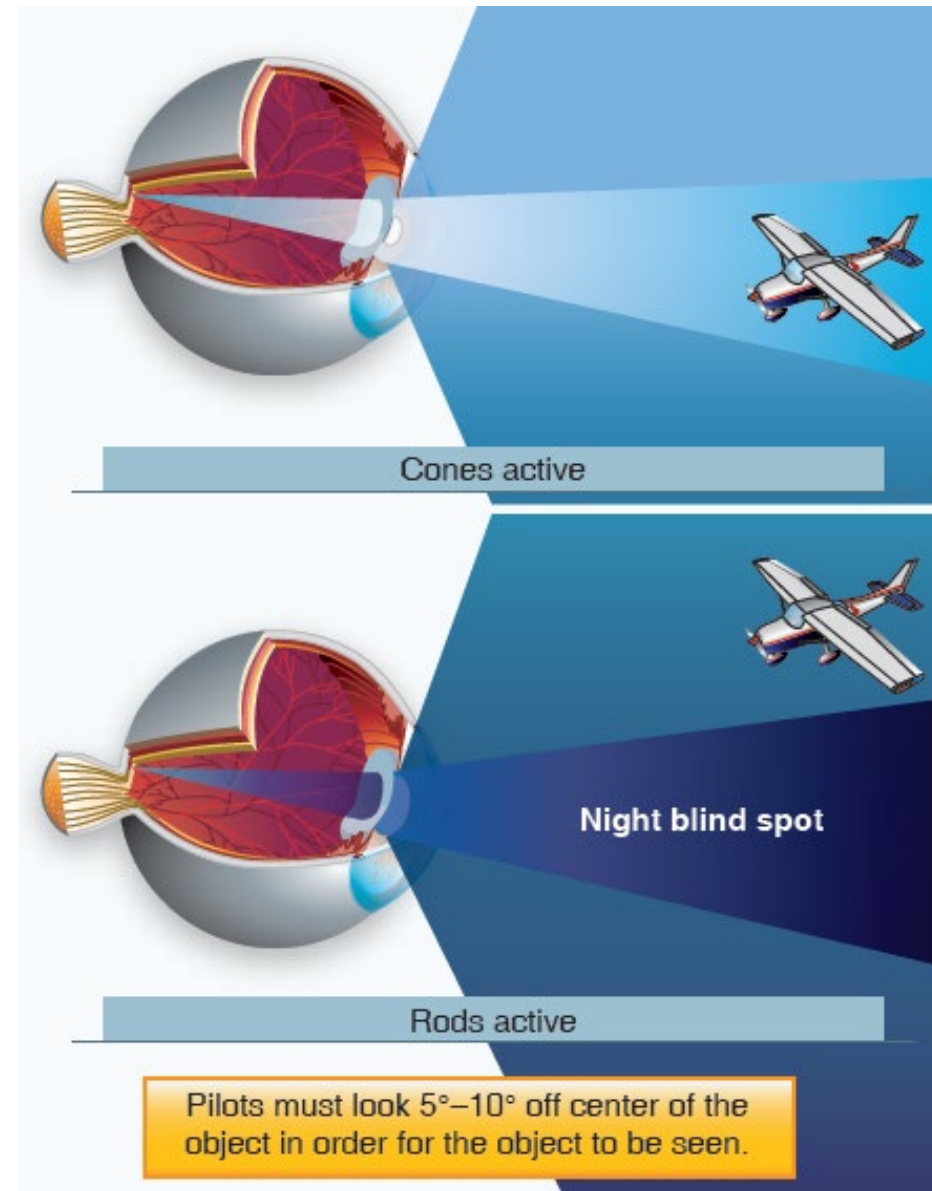
This absence of rods affects the central 5 to 10 degrees of the visual field.

If an object is viewed directly at night, it may go undetected or it may fade away after initial detection.

The night blind spot can hide larger objects as the distance between the pilot and an object increases.



Day vs Night



Vision Under Dim and Bright Illumination

When a dark room is entered, it is difficult to see anything until the eyes become adjusted to the darkness.

In darkness, vision gradually becomes more sensitive to light.

Maximum dark adaptation can take up to 30 minutes.

Exposure to aircraft anti-collision lights does not impair night vision adaptation because the intermittent flashes have a very short duration (less than 1 second).

However, if dark-adapted eyes are exposed to a bright light source (searchlights, landing lights, flares, etc.) for a period of 1 second or more, night vision is temporarily impaired.

FAA Definition of Night

According to 14 CFR part 1, section 1.1, “night” means the time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the Air Almanac.

National Weather Service defines:

Morning civil twilight = begins when the geometric center of the sun is 6 degrees below the horizon and ends at sunrise.

Evening civil twilight = begins at sunset and ends when the geometric center of the sun is 6 degrees below the horizon

Where do I look up these times?

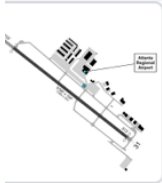
Sunrise and sunset

Times for 29-Apr-202

	Local (UTC-4)	Zulu (UTC)
Morning civil twilight	06:27	10:27
Sunrise	06:53	10:53
Sunset	20:18	00:18
Evening civil twilight	20:44	00:44

3 PM Fri Apr 29

★ ☆

 **KFFC: Atlanta Regional Falcon Field**
Atlanta, Georgia, US
33.36°N/84.57°W
🌅 6:51 AM 🌇 8:19 PM EDT

Latest Weather **VFR**, Variable at 4 kts, 10 sm ☁

I like to use airnav.com

<https://www.airnav.com/airport/KFFC>

ForeFlight and Garmin Pilot also have times

Required Equipment

91.205 is some long verbage so here is the list...start with...

To help remember VFR Day Instrument Requirements we'll use A TOMATO FLAMES.

A – airspeed indicator

T – tachometer (for each engine)

O – oil pressure gauge (for each engine using a pressure system)

M – manifold pressure gauge (for each altitude engine)

A – altimeter

T – temperature gauge (for each liquid cooled engine)

O – oil temperature gauge (for each air cooled engine)

F – fuel gauge

L – landing gear position indicator

A – anti collision lights (for aircraft certified after March 11th 1996)

M – magnetic compass

E – ELT

S – safety belts

Required Equipment

VFR Night Requirements include the above mentioned A TOMATO FLAMES plus FLAPS.

F – fuses (one complete spare set)

(If you use fuses)

L – landing light if you are flying for hire

A – anti collision lights

P – position lights

S – source of electricity (alternator, generator)

The strobe and beacon are both anti-collision lights.

The red and green wingtip lights are position lights (required at night, but not during the day).

Position Lights

If you see a **red** light on left and a white on right of traffic = it is moving to your left

If you see a white on the left and a **green** on the right of traffic = it is moving to your right

If you see a **green** on the left and a **red** on the right of traffic = it is coming at you

See and **Avoid**



Landing Lights

Landing lights provide a means by which airplanes can be seen at night by other pilots.

Pilots are encouraged to turn on their landing lights when operating within 10 miles of an airport and below 10,000 feet.

Operation with landing lights on applies to both day and night or in conditions of reduced visibility.

This should also be done in areas where flocks of birds may be expected.

Beacon Lights

- Lighted civilian land airports—alternating white and green lights
- Lighted civilian water airports—alternating white and yellow lights
- Lighted military airports—alternating white and green lights, but are differentiated from civil airports by dual peaked (two quick) white flashes, then green

Flying to Cobb County International KRYV from the west...be careful as you don't go towards Dobbins by mistake

3 in 3

61.57 (b) Night takeoff and landing experience.

(1) Except as provided in paragraph (e) of this section, no person may act as pilot in command of an aircraft carrying passengers during the period beginning 1 hour after sunset and ending 1 hour before sunrise, unless within the preceding 90 days that person has made at least three takeoffs and three landings to a full stop during the period beginning 1 hour after sunset and ending 1 hour before sunrise, and -

Grounded

If sunset = 1830:

Land before 1930 if pilot is not current (3 in 3) and have passengers

Land before 1830 if plane is not night current (something not working)

Fuel

91.151 Fuel requirements for flight in VFR conditions.

(a) No person may begin a flight in an airplane under VFR conditions unless (considering wind and forecast weather conditions) there is enough fuel to fly to the first point of intended landing and, assuming normal cruising speed -

(1) During the day, to fly after that for at least 30 minutes; or

(2) At night, to fly after that for at least 45 minutes.

VFR Day + 30 min fuel

VFR Night + 45 min fuel

IFR + 45 min fuel + alt apt

My personal minimum is 1 hour reserve no matter what

Engine Start

Day or night, turn the beacon light switch to on before engine start.

At night especially make sure nobody is running up to say hello.

When walking around look at the tails of the planes around you for the beacon lights.

Takeoff and climb-out

Have the landing light on...sometimes taxi light also.

Set heading bug.

If the runway is not more than 3000 ft, treat it as a short field takeoff...hold brakes for a moment.

Climb at V_y and continue to climb at runway heading till at least 500 AGL before making any turns.

We Get High With A Little Help From Our Friends

Make the six pack/G1000 your friend.

Trust your instruments, be sure to use them.



Runway Lighting

The basic runway lighting system consists of two straight parallel lines of runway edge lights.

These lights are aviation white, although aviation yellow may be substituted for a distance of 2,000 feet from the far end of the runway to indicate a caution zone.

At some airports, the intensity of the runway edge lights can be activated and adjusted by radio control.

The control system consists of a 3-step control responsive to 7, 5, and/or 3 microphone clicks.

All lighting is illuminated for a period of 15 minutes from the most recent time of activation and may not be extinguished prior to end of the 15-minute period.

Runway Lighting

Suggested use is to always initially key the mike 7 times; this assures that all controlled lights are turned on to the maximum available intensity.

If desired, adjustment can then be made, where the capability is provided, to a lower intensity by keying 5 and/or 3 times.

Even when lights are on, the pilot should always key the mike as directed when overflying an airport of intended landing or just prior to entering the final segment of an approach.

This assures the aircraft is close enough to activate the system and a full 15-minute lighting duration is available.

Runway Edge Lighting

The length limits of the runway are defined by straight lines of lights across the runway ends.

At some airports, the runway threshold lights are aviation green, and the runway end lights are aviation red.

At many airports, the taxiways are also lighted.

A taxiway edge lighting system consists of blue lights that outline the usable limits of taxi paths.



Airport Lighting Aids - PAPI Lights

PAPI = Precision Approach Path Indicator

The precision approach path indicator (PAPI) uses light units similar to the VASI but are installed in a single row of either two or four light units.

These lights are visible from about 5 miles during the day and up to 20 miles at night.

The visual glide path of the PAPI typically provides safe obstruction clearance within plus or minus 10 degrees of the extended runway centerline and to 3.4 NM from the runway threshold.



Airport Lighting Aids - PAPI Lights

Descent, using the PAPI, should not be initiated until the aircraft is visually aligned with the runway.

The row of light units is normally installed on the left side of the runway and the glide path indications are as depicted.

Lateral course guidance is provided by the runway or runway lights.



Airport Lighting Aids - VASI Lights

VASI = Visual Approach Slope Indicator

VASI installations may consist of either 2, 4, 6, 12, or 16 light units arranged in bars referred to as near, middle, and far bars.

Most VASI installations consist of 2 bars, near and far, and may consist of 2, 4, or 12 light units.

Some VASIs consist of three bars, near, middle, and far, which provide an additional visual glide path to accommodate high cockpit aircraft.

Airport Lighting Aids - VASI Lights

Two-bar VASI installations provide one visual glide path which is normally set at 3 degrees.

Three-bar VASI installations provide two visual glide paths.

The lower glide path is provided by the near and middle bars and is normally set at 3 degrees while the upper glide path, provided by the middle and far bars, is normally $1/4$ degree higher.

This higher glide path is intended for use only by high cockpit aircraft to provide a sufficient threshold crossing height.

Although normal glide path angles are three degrees, angles at some locations may be as high as 4.5 degrees to give proper obstacle clearance.

Pilots of high performance aircraft are cautioned that use of VASI angles in excess of 3.5 degrees may cause an increase in runway length required for landing and rollout.

Airport Lighting Aids - VASI Lights

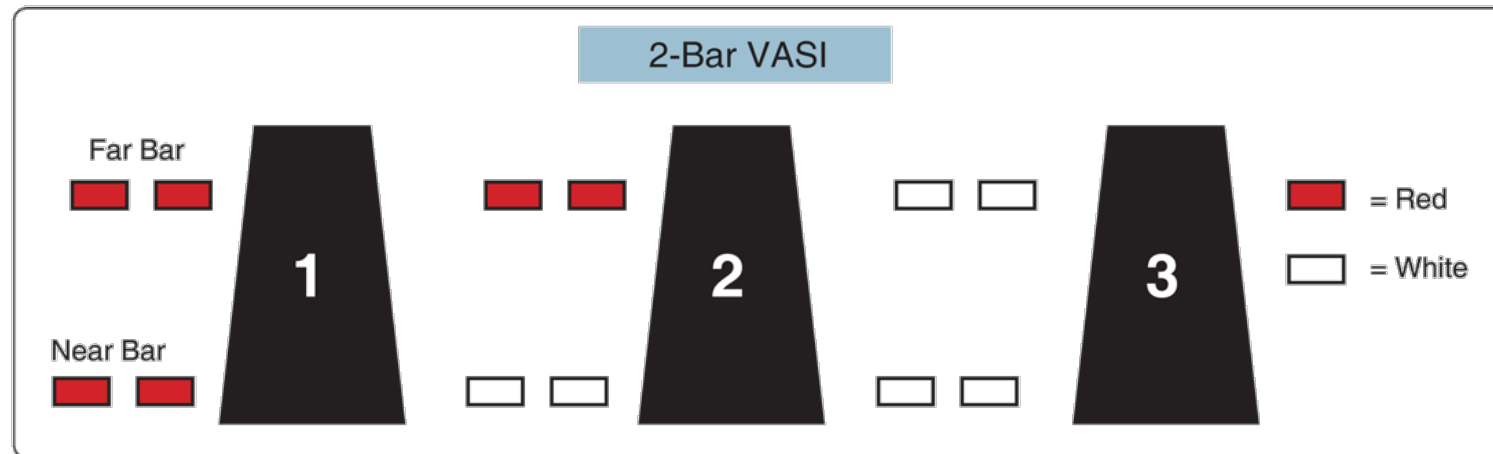


Figure 134. 2-BAR VASI.

©ASA

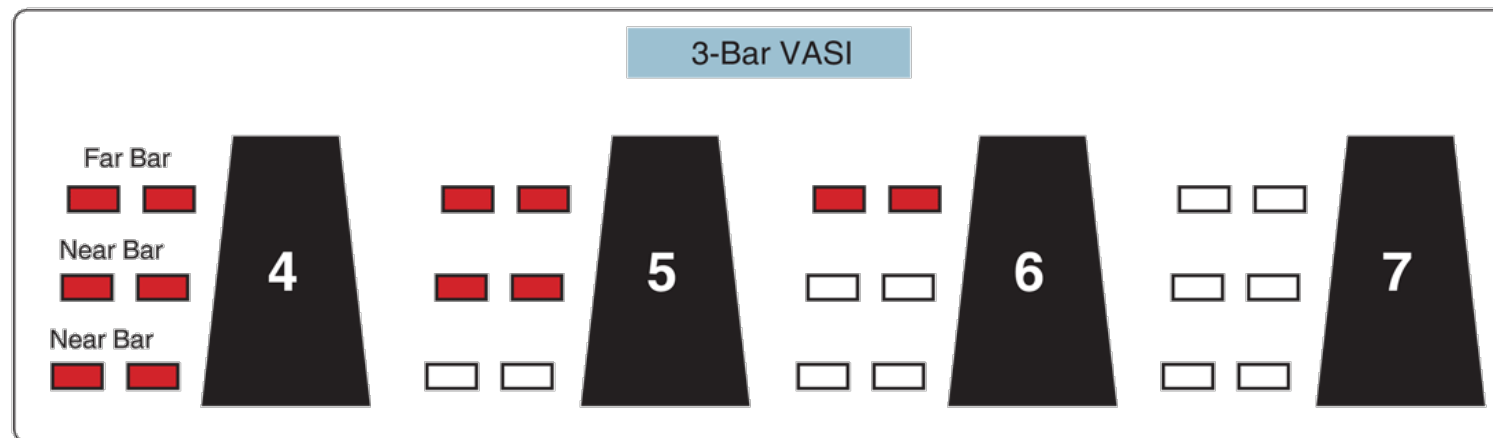


Figure 135. 3-BAR VASI.

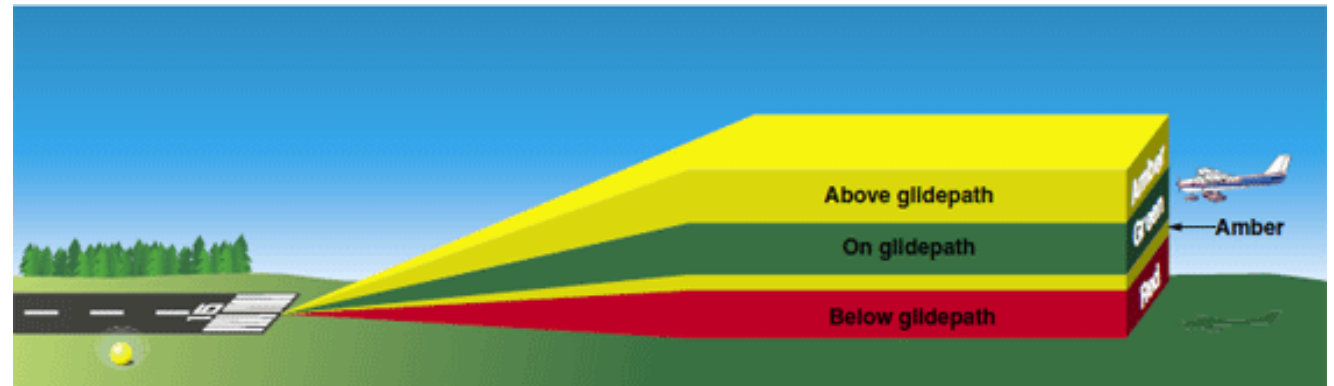
©ASA

Airport Lighting Aids - VASI Lights

Tri-color visual approach slope indicators normally consist of a single light unit projecting a three-color visual approach path into the final approach area of the runway upon which the indicator is installed.

The below glide path indication is red, the above glide path indication is amber, and the on glide path indication is green.

These types of indicators have a useful range of approximately one-half to one mile during the day and up to five miles at night depending upon the visibility conditions.



Taxiway Lights

Simply put, all taxiways are surrounded by blue lights.

Make sure to stay on pavement between blue lights from the runway to the ramp.

Go extra slow.

Do not catch up on email and Facebook.

Leave the GPS alone till stopped.



Approach Light Systems (ALS)

ALS provide the basic means to transition from instrument flight to visual flight for landing. Operational requirements dictate the sophistication and configuration of the approach light system for a particular runway.

ALS are a configuration of signal lights starting at the landing threshold and extending into the approach area a distance of 2400-3000 feet for precision instrument runways and 1400-1500 feet for nonprecision instrument runways. Some systems include sequenced flashing lights which appear to the pilot as a ball of light traveling towards the runway at high speed (twice a second).



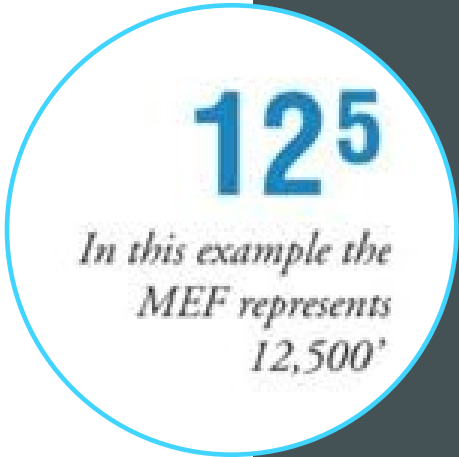
MEF

The Maximum Elevation Figure (MEF) represents the highest elevation within a quadrant, including terrain and other vertical obstacles (towers, trees, etc.).

A quadrant on Sectionals is the area bounded by ticked lines dividing each 30 minutes of latitude and each 30 minutes of longitude.

MEF figures are rounded up to the nearest 100' value and the last two digits of the number are not shown.

MEFs over land and open water areas are used in areas containing manmade obstacles such as oil rigs.



125

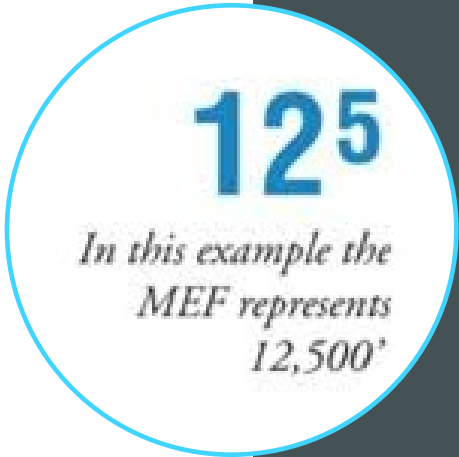
*In this example the
MEF represents
12,500'*

MEF

Pilots should be aware that while the MEF is based on the best information available to the Specialist, the figures are not verified by field surveys.

Also, users should consult the Aeronautical Chart Bulletin in the A/FD or AeroNav Products website to ensure that your chart has the latest MEF data available.

Unlike the Minimum safe altitude used for IFR flight, the MEF does not include any margin for aircraft clearance above the terrain nor for altimeter error.



125

*In this example the
MEF represents
12,500'*

Caution Lights

Beacons producing red flashes indicate obstructions or areas considered hazardous to aerial navigation.

Steady-burning red lights are used to mark obstructions on or near airports and sometimes to supplement flashing lights on en route obstructions.

High-intensity, flashing white lights are used to mark some supporting structures of overhead transmission lines that stretch across rivers, chasms, and gorges.

These high-intensity lights are also used to identify tall structures, such as chimneys and towers.

Orientation and Navigation

Generally, at night, it is difficult to see clouds and restrictions to visibility, particularly on dark nights or under an overcast.

When flying under VFR, pilots should exercise caution to avoid flying into clouds.

Usually, the first indication of flying into restricted visibility conditions is the gradual disappearance of lights on the ground.

If the lights begin to appear surrounded by a halo or glow, further flight in the same direction calls for caution.

Such a halo or glow around lights on the ground is indicative of ground fog.

If a descent occurs through clouds, smoke, or haze in order to land, the horizontal visibility is considerably less when looking through the restriction than it is when looking straight down through it from above.

Pilots should avoid a VFR night flight if expecting conditions below VFR minimums.

If encountering IMC, risk increases dramatically unless both the pilot and aircraft are equipped for flight under IFR, and the pilot has prepared and filed an IFR flight plan that can be activated, if needed.

Orientation and Navigation

Crossing large bodies of water at night in single-engine airplanes could be potentially hazardous, because in the event of an engine failure, the pilot may be forced to land (ditch) the airplane in the water.

Another hazard faced by pilots of all aircraft, due to limited or no lighting, is that the horizon blends with the water.

During poor visibility conditions over water, the horizon becomes obscure and may result in a loss of orientation.

Even on clear nights, the stars may be reflected on the water surface, which could appear as a continuous array of lights, thus making the horizon difficult to identify.

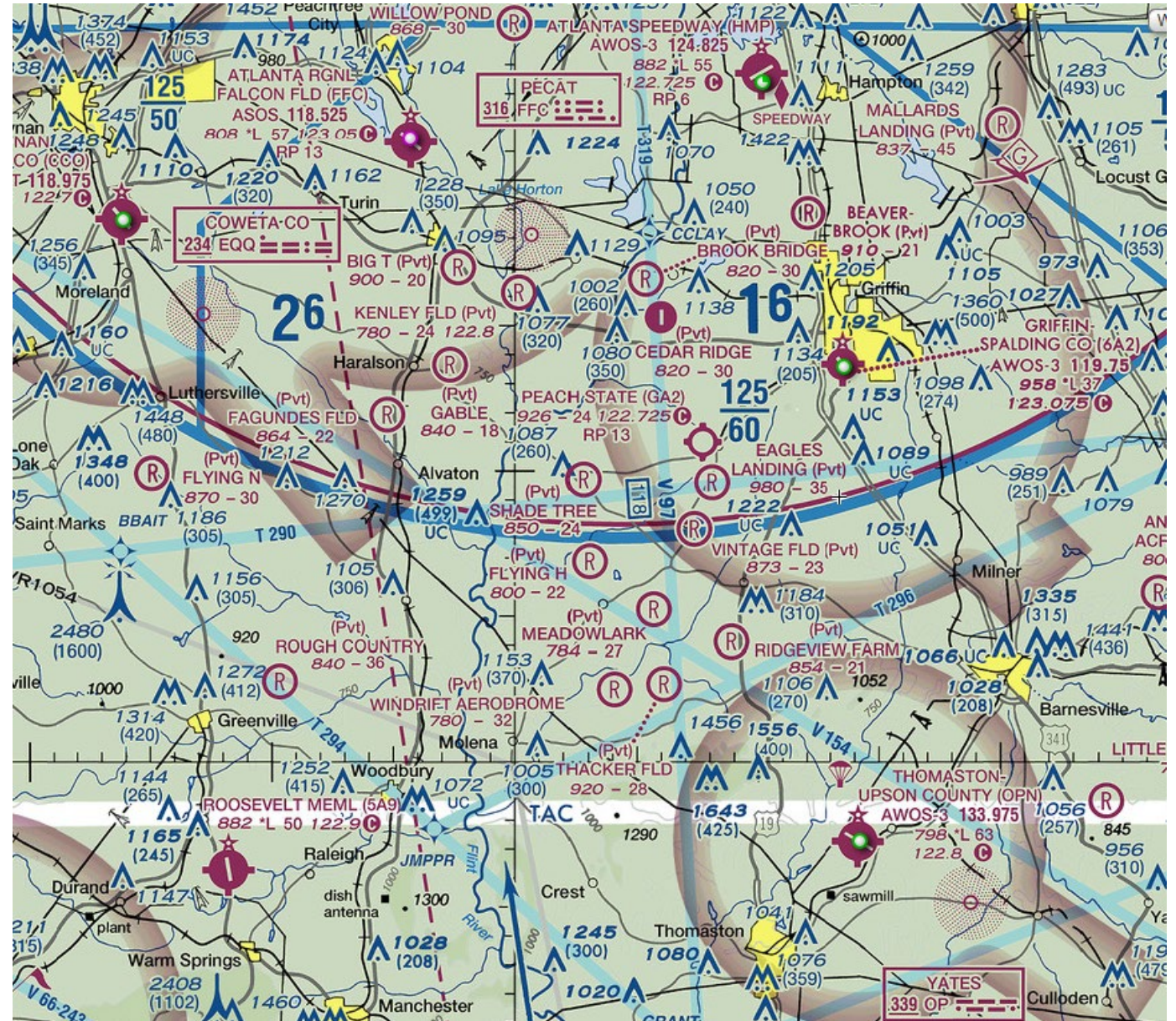
Orientation and Navigation

Lighted runways, buildings, or other objects may cause illusions when seen from different altitudes.

At an altitude of 2,000 feet, a group of lights on an object may be seen individually, while at 5,000 feet or higher, the same lights could appear to be one solid light mass.

These illusions may become quite acute with altitude changes and, if not overcome, could present problems when making approaches to lighted runways.

What is the Yellow on the Sectional?





IFW

I Follow Walmarts

Great for visual landmarks...every town big or small has one well lit too

Approaches and Landings

When approaching the airport to enter the traffic pattern and land, it is important that the runway lights and other airport lighting be identified as early as possible.

If the airport layout is unfamiliar, sighting of the runway may be difficult until very close-in due to the maze of lights observed in the area.

A pilot should normally fly toward the rotating beacon until the lights outlining the runway are distinguishable.

To fly a traffic pattern of proper size and direction, the runway threshold and runway-edge lights need to be positively identified.

Once the airport lights are seen, these lights should be kept in sight throughout the approach.

Approaches and Landings

Monitoring the altimeter prevents flying too low for the distance from the airport.

When entering the traffic pattern, the pilot should allow adequate time to complete the before-landing checklist.

If the heading indicator contains a heading bug, setting it to the runway heading is an excellent reference for the pattern legs.

The pilot maintains the recommended airspeeds and executes the approach and landing in the same manner as during the day.

A low, shallow approach is a very bad idea.

Power lines and trees might be real difficult to judge at night.

The altimeter and VSI should be constantly cross-checked against the airplane's position along the base leg and final approach.

Approaches and Landings

After turning onto the final approach and aligning the airplane midway between the two rows of runway-edge lights, the pilot should note and correct for any wind drift.

Throughout the final approach, proper use of pitch and power helps to maintain a stabilized approach.

Flaps are used as in a normal approach.

Usually, halfway through the final approach, the landing light is turned on.

The landing light is sometimes ineffective since the light beam will usually not reach the ground from higher altitudes.

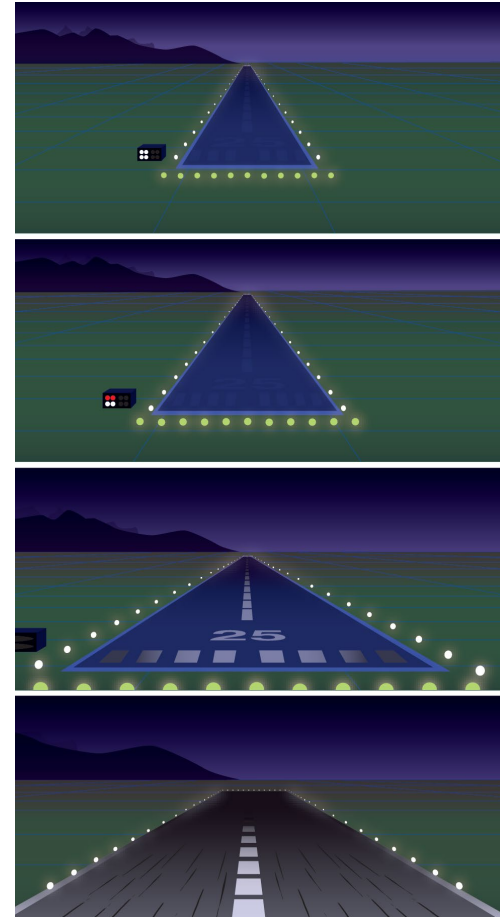
The light may even be reflected back into the pilot's eyes by any existing haze, smoke, or fog.

Approaches and Landings

The round out and touchdown is made in the same manner as in day landings.

At night, the judgment of height, speed, and sink rate is impaired by the scarcity of observable objects in the landing area.

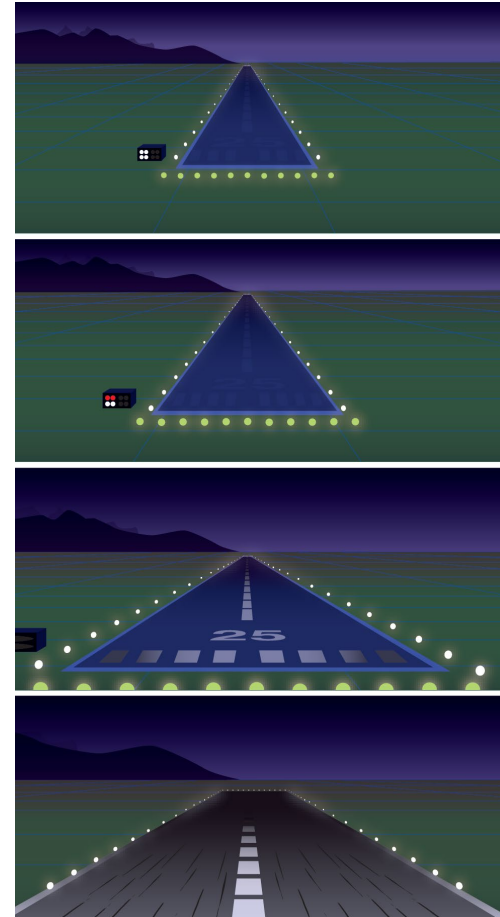
An inexperienced pilot may tend to round out too high.



Approaches and Landings

Continuing a constant approach descent until the landing lights reflect on the runway and tire marks on the runway can be seen clearly helps identify the point to begin the round out.

At this point, the round out is started smoothly and the throttle gradually reduced to idle as the airplane is touching down.



No Landing Light

During landings without the use of landing lights, the round out may be started when the runway lights at the far end of the runway first appear to be rising higher than the nose of the airplane.

This demands a smooth and very timely round out and requires that the pilot feel for the runway surface using power and pitch changes, as necessary, for the airplane to settle slowly to the runway.

Blackout landings should always be included in night pilot training as an emergency procedure.

At some airports no landing light no problem...happened to me at Paulding...some it is a major problem.

Use all available resources:

GPS/G1000 to help you line up on centerline

ForeFlight warns you when you are at 500 feet above

ForeFlight has synthetic vision (not to solely use but for situational awareness)



Moon: 23.1%

Waning Crescent

Moonlight

There is a huge difference between having a full moon with no clouds and having no moonlight.

Clouds and time of year will be the difference makers.

Check this:

<https://www.timeanddate.com/moon/phases/>

Use a tablet to see checklists

SECTION 4
NORMAL PROCEDURES

CESSNA
MODEL 172S NAV III
GFC 700 AFCS

STARTING ENGINE (With Battery)

1. Throttle Control - OPEN 1/4 INCH
2. Mixture Control - IDLE CUTOFF (pull full out)
3. STBY BATT Switch:
 - a. TEST - (hold for 10 seconds, verify that green TEST lamp does not go off)
 - b. ARM - (verify that PFD comes on)
4. Engine Indicating System - CHECK PARAMETERS (verify no red X's through ENGINE page indicators)
5. BUS E Volts - CHECK (verify 24 VOLTS minimum shown)
6. M BUS Volts - CHECK (verify 1.5 VOLTS or less shown)
7. BATT S Amps - CHECK (verify discharge shown (negative))
8. STBY BATT Annunciator - CHECK (verify annunciator is shown)
9. Propeller Area - CLEAR (verify that all people and equipment are at a safe distance from the propeller)
10. MASTER Switch (ALT and BAT) - ON
11. BEACON Light Switch - ON

NOTE

If engine is warm, omit priming procedure steps 12 thru 14 below.

12. FUEL PUMP Switch - ON
13. Mixture Control - SET to FULL RICH (full forward) until stable fuel flow is indicated (approximately 3 to 5 seconds), then set to IDLE CUTOFF (full aft) position.
14. FUEL PUMP Switch - OFF
15. MAGNETOS Switch - START (release when engine starts)
16. Mixture Control - ADVANCE SMOOTHLY TO RICH (when engine starts)

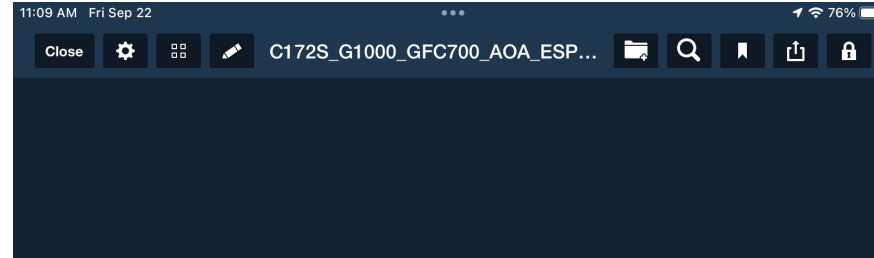
NOTE

If the engine is primed too much (flooded), place the mixture control in the IDLE CUTOFF position, open the throttle control 1/2 to full, and engage the starter motor (START). When the engine starts, advance the mixture control to the FULL RICH position and retard the throttle control promptly.

(Continued Next Page)



Use a tablet to see checklists



Civil Air Patrol
Cessna: C172S (NAVII AoA ESP)
CVD: 13 Jul 20 (G1000 & GFC700)

Preflight Cabin

1. AF...Review at & inspect for Airworthiness
2. Pitot Tube Cover...Remove & Check Clear
3. POH & Garmin G1000™ Cockpit Ref. Guide..... Accessible to Pilot
4. Documents..... AROW in airplane
5. Parking Brake.....Set
6. Control/Avionics Lock.....Remove

WARNING
When the master switch is on, using an external power source, or manually rotating the propeller, treat the propeller as if the magnetos switch were on. Do not stand, nor allow anyone else to stand, within the arc of the propeller since a loose or broken wire, or a component malfunction could cause the engine to start.

7. MAGNETOS Switch.....Off
8. Avionics Switch (BUS 1&2).....Off
9. MASTER Switch (ALT & BAT).....On
10. Primary Fld Display.....Verify On
11. Hobbs & Tach Time.....Record
12. FUEL QTY (L&R).....Check
13. LOW FUEL Annunciator.....Off
14. OIL PRESS Annunciator.....Verify On
15. LOW VAC Annunciator.....Verify On
16. AVIONICS Switch (BUS 1).....On
17. Forward Avionics Fan.....Check On (Listen)
18. AVIONICS Switch (BUS 1).....Off
19. AVIONICS Switch (BUS 2).....On
20. Aft Avionics Fan.....Check On (Listen)
21. AVIONICS Switch (BUS 2).....Off
22. PITOT HEAT Switch.....On
23. Wing Flaps.....Extend
24. Exterior Lights.....On
25. PITOT HEAT/Exterior Lights.....Check
26. PITOT HEAT/Exterior Lights.....Off
27. LOW VOLTS Annunciator.....Check On
28. MASTER Switch (ALT & BAT).....Off
29. Elevator Trim Cntl.....Takeoff position
30. FUEL SELECTOR Valve.....Both
31. ALT STATIC AIR Valve.....Off (Push In)
32. Fire Extinguisher.....Check (Verify green)
33. Carbon Monoxide Detector.....Check

Preflight Right Wing trailing edge

1. Flap.....Check Condition
2. Aileron.....Check Movement
3. Wingtip/Lights.....Check Condition

Preflight Left Wing trailing edge

1. Left Aileron.....Check Movement
2. Left Flap.....Check Condition
3. Baggage Door.....Re-check (Secure)

Before Starting Engine

1. Preflight Inspection.....Complete

PASSENGER BRIEF

1. Seat Belts / Shoulder Harness
2. Personal Electronic Devices off
3. Air Vents / Comfort
4. Fire Extinguisher Location / Operation
5. Emergency Procedures & Exits

MISSION BRIEF

1. Mission Objective
2. Destination, WX, Route, Alt, ETE
3. NOTAMS
4. Crew Coordination & CRM
5. Sterile Cockpit Procedures
6. Cockpit Layout
7. Intercom & Radio Usage
8. Seats, Seatbelts, Doors
9. Emergency Actions & Equipment

Starting Engine (Using Battery)

1. Throttle Control.....Open ¼ inch
2. Mixture Control.....Idle Cut Off
3. Stby Batt Switch.....Test and Arm

See Fuel Contamination Warning in the POH.

Hold for 10 seconds, verify that green test lamp does not go out, then ARM and verify that PFD comes on

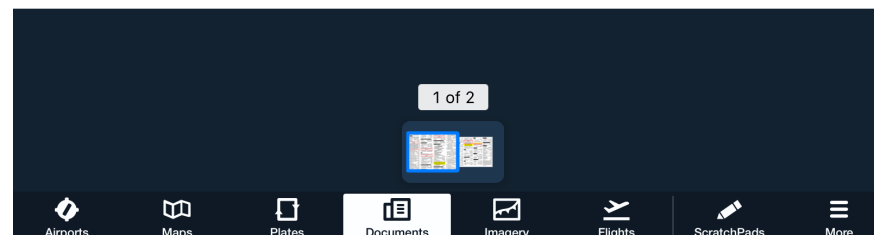
4. Engine Indicating System.....Check. (no red X's through ENGINE indicator)
5. E Bus Volts.....24 volts min
6. M Bus Volts.....Verify 15 volts or less
7. Batt S Amps.....Discharge (neg)
8. Stby Batt Annunciator.....On
9. Propeller Area.....Clear
10. Master Switch (Alt and Batt).....On
11. Beacon Light Switch.....On

Note
If engine is warm, until priming procedure of steps 12, 13 and 14 below.

12. Fuel Pump Switch.....On
13. Mixture Control.....Advance to Full Rich, wait until fuel flow indication is stable, and then return to IDLE CUTOFF position
14. Fuel Pump Switch.....Off
15. Magnetos Switch.....Start
16. Mixture Control.....Advance smoothly to rich (when engine starts)

Note
If the engine floods, place the mixture control in the Idle Cut Off position, open the throttle control ½ to full, and engage the starter motor (Start). When the engine starts, advance the mixture control to the Full Rich position and retard the throttle control promptly.

17. Oil Pressure.....Check
18. Amps (M Batt & Batt S).....Check charge (positive)
19. Low Volts Annunciator.....Verify Off
20. Nav Lights Switches.....On as req
21. Avionics Switch (Bus 1&2).....On
22. Mission Master Switch.....On if inst'd
23. Check MFD for correct A/C type and Navigation database expiration dates, then press ENT
24. Flight Data Logger-Status.....Check
25. ESP.....Enabled/Disabled
26. Fuel Totalizer.....Reset
27. ATIS / AWOS.....Copy
28. Altimeters: PFD & Standby.....Set
29. Cinc Del/Gnd Control.....Contact
30. Transponder.....Code/Flight ID/ALT
31. Wing Flaps.....Retract
32. Flight Plan.....Enter



Night Emergencies

Same as Day VFR:

- **A**ir**s**peed = pitch up to glide speed
- **B**est = flattest, safest
- **C**hecklist = **T**anks **P**ump **M**ix **M**aster **M**ags
- **D**ecclare = Freq you know you can reach someone
7700 (77 heaven)
- **E**xecute = **D**oors **S** turns **S**lips **F**laps

Being Ready for Night Emergencies

Keep the frequency of the closest airport in the radio when possible.

Click 5 times to the closest airport to turn on the runway lights.

Keep the closest ATC frequency or 121.5 on standby or Com2.

Monitor the closest airport direction and runways.

Try to keep a decent height to give good amount of glide distance and time.

Pros and Cons of Night Flying

Pros

The air is usually smoother.

It is usually cooler at night in the summer.

You can actually see traffic much better on cloudless nights.

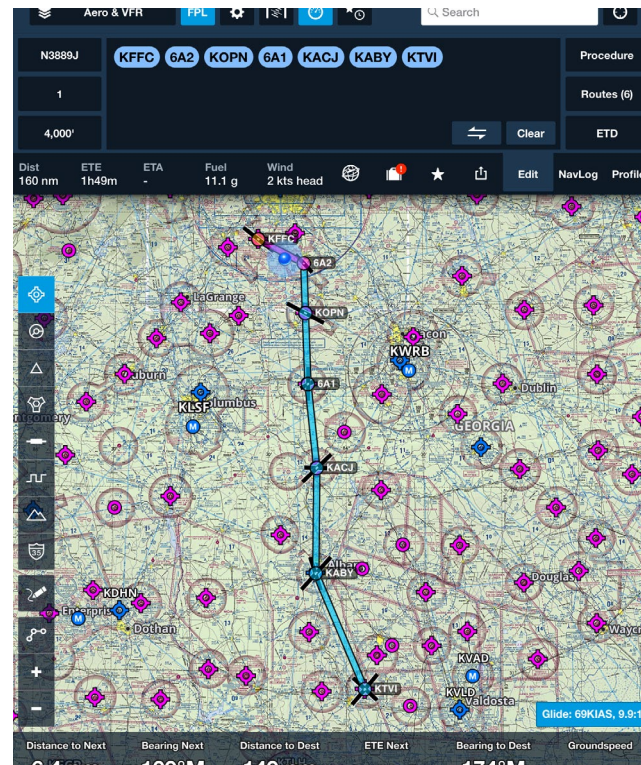
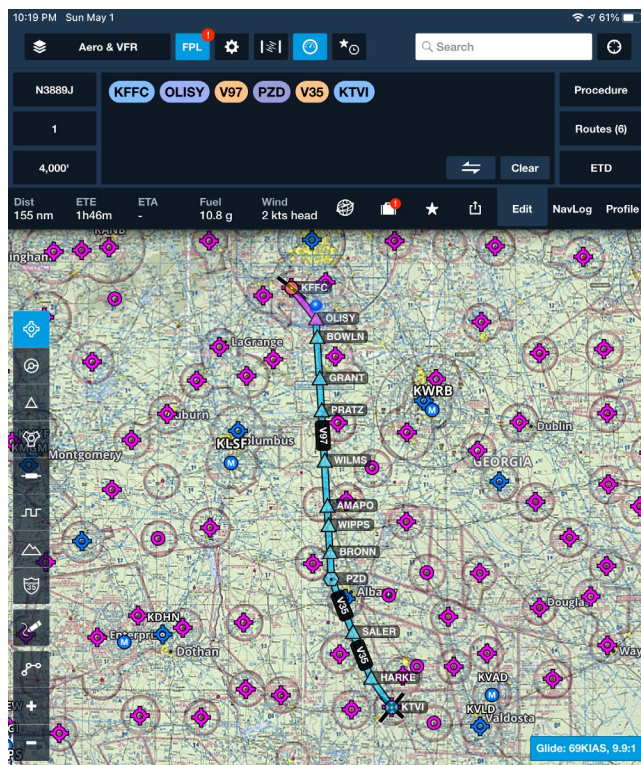
Cons

No horizon for reference

You don't know if you have a nice flat farm to land on or trees below



Peachtree City to Thomasville KFFC -> KTVI



Option 1: use airways

OLISY V97 PZD V35 HARKE

151 NM

Option 2: over airports (night)

6A2 KOPN 6A1 KACJ KABY KTVI

160 NM

Go-around at Dark Country Airports

At a normal airport with a 5000+ foot runway a go around is a normal procedure are not normally a big deal.

At Elijay, GA62 and other airports with shorter runways and low lighting you have to make early decisions.

If you can't make a safe landing, divert to a bigger brighter airport.

Be real tight on your go around procedures...get the extra flaps out quick...and get some height.

Cedar Ridge Night Approach

Where I live, I know to stay at 2000 MSL over GA82 then head south to GA62.

Sometimes you can see below you well, sometimes you can't.

Stay above the trees at 900 MSL till I see the runway numbers...then finish strong.

Ahhh Home
Safe



Danger: False Horizon

The right combination of street lights or clouds can make a false horizon appear.

Bottom line: trust your instruments!



Autokinesis

If you stare at a single light, it can appear to start moving.

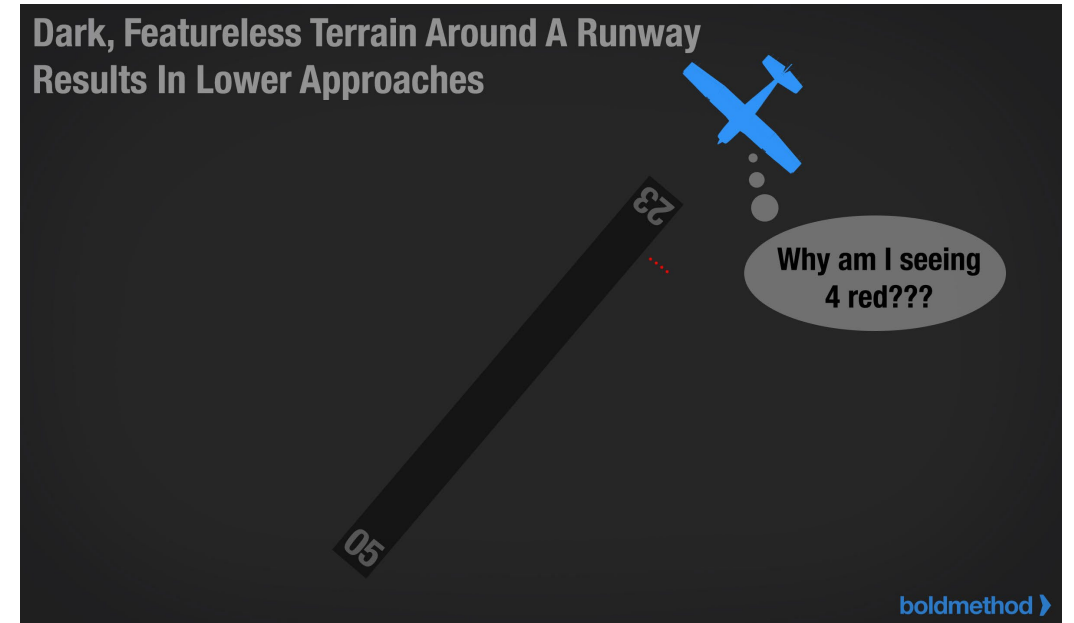
Keep scanning the horizon to prevent it from happening to you.



Featureless Terrain Illusion aka Black-Hole Approach

If you're flying into an airport with few lights around it, it can be incredibly difficult to judge your height and distance from the runway.

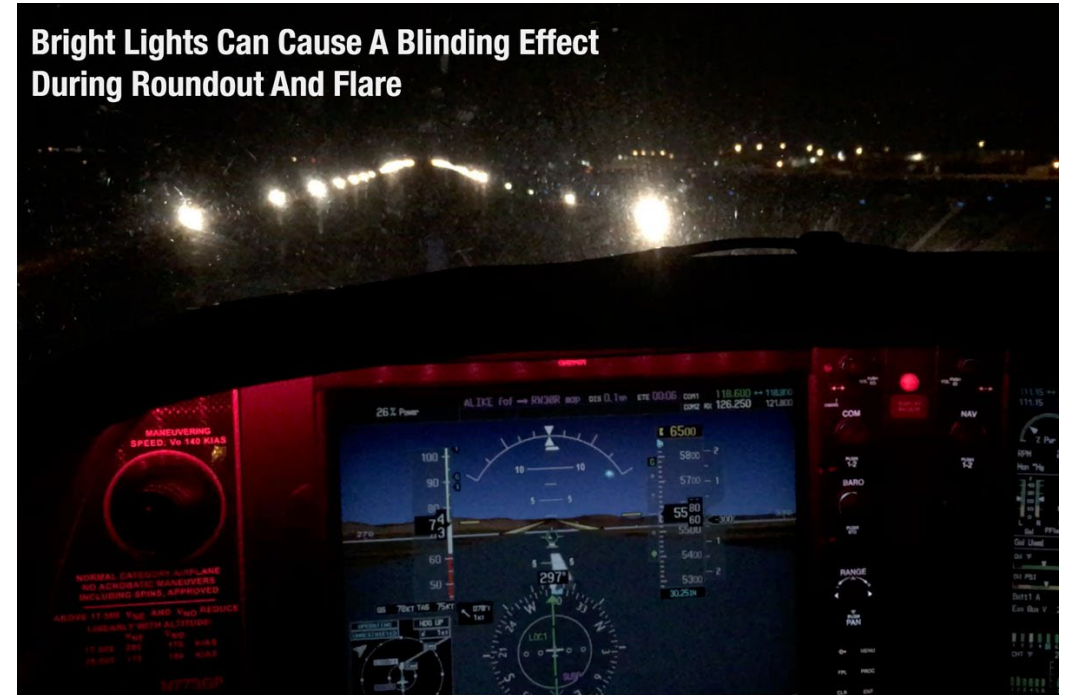
To avoid flying a lower than normal approach, use the VASI/PAPI lights, and if the runway has an ILS, dial in the frequency and follow the glide slope on final.



Ground Lighting Illusions

When you're approaching an airport, use high-intensity runway lighting (HIRL, 7 clicks on the mic) to locate the field.

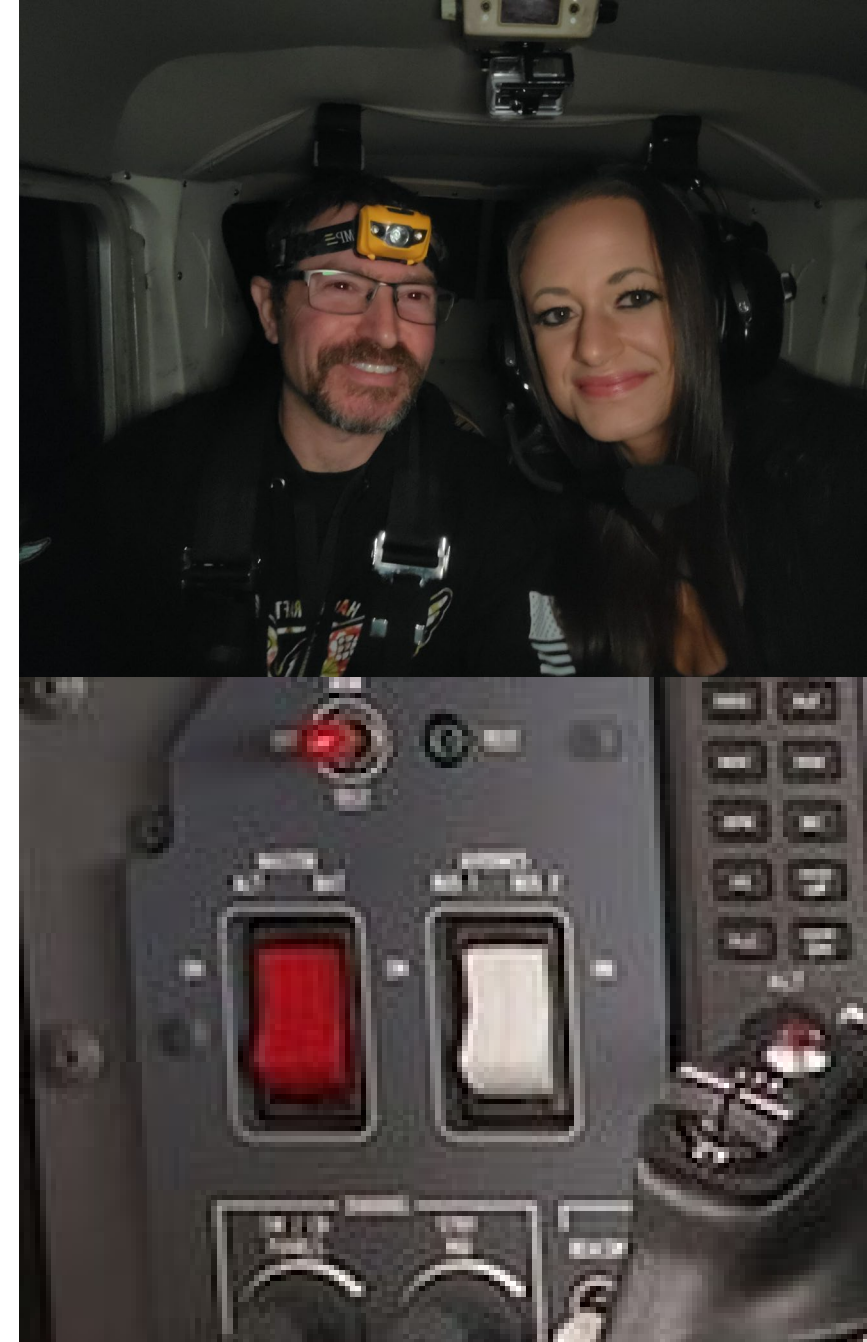
However, once you've found it, turn the lights down to low or medium intensity (3 clicks or 5 clicks) so you don't blind yourself as you're landing.



Proper Adjustment of Interior Lights

Adjust diming enough that you can see what you need to but not so bright that you hinder your night vision.

The newer Cessna 172 and 182s have a perfect diming system.



Importance of Having a Flashlight with a Red Lens

Per FAA-H-8083-3C 11-5:

At least one reliable flashlight is recommended as standard equipment on all night flights.

A reliable LED dimmable flashlight able to produce white/red light is preferable.

Use white for the outside of the plane, use red inside.

Many charts can be displayed on a EFB, which does not require a flashlight.

However, its brightness should be set so as not to seriously impair night vision.

Since the red light is non-glaring, it will not impair night vision.



Any questions I can answer or
follow up later on?

High Altitude Operations



Lesson Objective

To develop understanding of the challenges of flying at higher altitudes

The FARs

91.211 Supplemental oxygen.

(a) General. No person may operate a civil aircraft of U.S. registry—

(1) At cabin pressure altitudes above 12,500 feet (MSL) up to and including 14,000 feet (MSL) unless the required minimum flight crew is provided with and uses supplemental oxygen for that part of the flight at those altitudes that is of more than 30 minutes duration;

(2) At cabin pressure altitudes above 14,000 feet (MSL) unless the required minimum flight crew is provided with and uses supplemental oxygen during the entire flight time at those altitudes; and

(3) At cabin pressure altitudes above 15,000 feet (MSL) unless each occupant of the aircraft is provided with supplemental oxygen.

Now one by one...

12501 ft MSL
to 14000 ft
MSL

Crew needs to use supplemental oxygen if in this area for more than 30 minutes

...and that does not mean cheating by dipping below after 28 minutes

14001 ft MSL
to 15000 ft
MSL

Crew is required to use supplemental oxygen

Passengers must have option

Danger!! Symptoms of Hypoxia

High-altitude flying can place a pilot in danger of becoming hypoxic.

The first symptoms of hypoxia can include euphoria and a carefree feeling.

With increased oxygen starvation, the extremities become less responsive and flying becomes less coordinated.

The symptoms of hypoxia vary with the individual, but common symptoms include:

- Cyanosis (blue fingernails and lips)
- Headache
- Decreased response to stimuli and increased reaction time
- Impaired judgment
- Euphoria
- Visual impairment
- Drowsiness
- Lightheaded or dizzy sensation
- Tingling in fingers and toes
- Numbness



Trust your
instruments...but
can you see them
ok...

As hypoxia worsens, the field of vision begins to narrow and instrument interpretation can become difficult.

Even with all these symptoms, the effects of hypoxia can cause a pilot to have a false sense of security and be deceived into believing everything is normal.

Treatment of Hypoxia

Descend to lower altitudes if there are not terrain issues

OR

Using supplemental oxygen





How Airplane Cabin Pressurization Works

There are four primary goals to keep a comfortable and safe cabin for passengers, maintaining: temperature, humidity, air circulation, and cabin pressure.

Most pressurized cabins are designed for aircraft operating at service ceilings between 25,000 - 50,000 feet.

Inside these aircraft, the pressure of the cabin generally falls somewhere between 6,000 - 8,000 feet in cruise flight at high altitudes.



How Airplane Cabin Pressurization Works

Here are a few important benefits pressurization provides:

Oxygen masks don't need to be worn

Low risk of decompression sickness

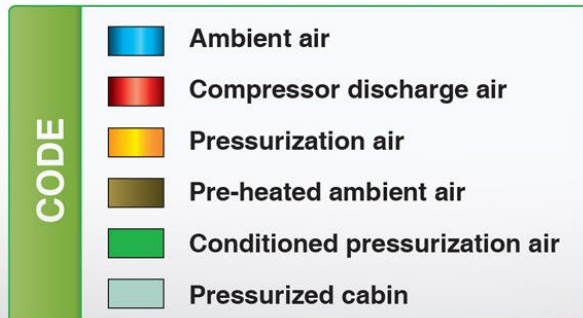
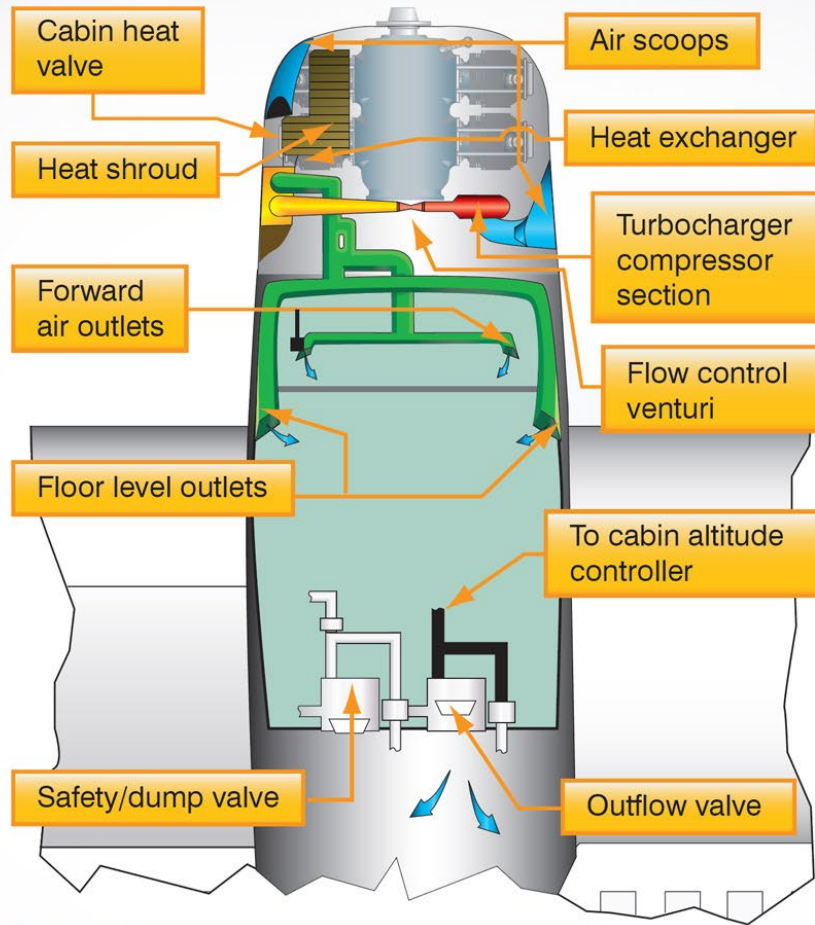
Less noise and vibration

Better control of temperature

Better air ventilation

Fewer trapped gas problems (physiologically)

Pressurization Diagram Of High-Performance Aircraft



Mechanics Of Pressurization

Ambient air is introduced into a compressor, which is usually the airplane's engine.

As the air is compressed, it heats up rapidly.

This heated air is sent through a cooling unit, like a fuel-air heat exchanger.

Through ducting, this air is then introduced into the cabin.

A series of over-flow or outflow valves regulate how quickly air is released from the cabin.

Air comes into the cabin quicker than it's released, creating a high-pressure cabin environment.

Types of Pressurization Systems

Isobaric: The most common system, where cabin pressure is maintained at a constant value regardless of the outside air pressure.

Isobaric Differential: Military fighter aircraft begin pressurization on ascent until the cabin reaches a pre-set altitude. If the altitude is reached, a constant pressure differential is maintained in correlation with the ambient pressure outside the airplane.

Sealed Cabin: Used in spacecraft only, where the vessel carries its own supply of gases.

Importance of “aviator’s breathing oxygen.”

But I work at a medical office and have all these extra tanks...

Aviation oxygen is also pretty specific on not having any moisture content - the thought being that you wouldn't want oxygen lines freezing at higher altitudes because of moisture. Specified at 99.5% pure oxygen. Not more than 0.005mg of water per liter.

Care and storage of high-pressure oxygen bottles

Pilots should be aware of the danger of fire when using oxygen.

Materials that are nearly fireproof in ordinary air may be susceptible to combustion in oxygen.

Oils and greases may ignite if exposed to oxygen and cannot be used for sealing the valves and fittings of oxygen equipment.

Smoking during any kind of oxygen equipment use is prohibited.

Before each flight, the pilot should thoroughly inspect and test all oxygen equipment.

The inspection should include a thorough examination of the aircraft oxygen equipment, including available supply, an operational check of the system, and assurance that the supplemental oxygen is readily accessible.

Care and storage of high-pressure oxygen bottles

The inspection should be accomplished with clean hands and should include:

A visual inspection of the mask and tubing for tears, cracks, or deterioration

The regulator for valve and lever condition and positions

Oxygen quantity

The location and functioning of oxygen pressure gauges, flow indicators, and connections

Problems associated with rapid decompression and corresponding solutions

Physiologically, decompressions fall into the following two categories:

- Explosive decompression—a change in cabin pressure faster than the lungs can decompress, possibly resulting in lung damage.

Normally, the time required to release air from the lungs without restrictions, such as masks, is 0.2 seconds.

Most authorities consider any decompression that occurs in less than 0.5 seconds to be explosive and potentially dangerous.

- Rapid decompression—a change in cabin pressure in which the lungs decompress faster than the cabin.

Problems associated with rapid decompression and corresponding solutions

During an explosive decompression, there may be noise, and one may feel dazed for a moment.

The cabin air fills with fog, dust, or flying debris.

Fog occurs due to the rapid drop in temperature and the change of relative humidity.

Normally, the ears clear automatically.

Air rushes from the mouth and nose due to the escape of air from the lungs and may be noticed by some individuals.

Problems associated with rapid decompression and corresponding solutions

Rapid decompression decreases the period of useful consciousness because oxygen in the lungs is exhaled rapidly, reducing pressure on the body.

This decreases the partial pressure of oxygen in the blood and reduces the pilot's effective performance time by one-third to one-fourth its normal time.

For this reason, an oxygen mask should be worn when flying at very high altitudes (35,000 feet or higher).

It is recommended that the crewmembers select the 100 percent oxygen setting on the oxygen regulator at high altitude if the aircraft is equipped with a demand or pressure demand oxygen system.



Any questions I can answer or
follow up later on?

GPS



Cleared For
the Option!

Lesson Objective

To develop understanding of everything your ever wanted to know about GPS...GPS overload

About

The GPS project was started by the U.S. Department of Defense in 1973.

The first prototype spacecraft was launched in 1978 and the full constellation of 24 satellites became operational in 1993.

Originally limited to use by the United States military, civilian use was allowed from the 1980s following an executive order from President Ronald Reagan after the Korean Air Lines Flight 007 incident.

Advances in technology and new demands on the existing system have now led to efforts to modernize the GPS and implement the next generation of GPS Block IIIA satellites and Next Generation Operational Control System (OCX).

Announcements from Vice President Al Gore and the Clinton Administration in 1998 initiated these changes, which were authorized by the U.S. Congress in 2000.

How It Works

Satellite Navigation is based on a global network of satellites that transmit radio signals from medium earth orbit.

Users of Satellite Navigation are most familiar with the 31 Global Positioning System (GPS) satellites developed and operated by the United States.

Three other constellations also provide similar services.

Collectively, these constellations and their augmentations are called Global Navigation Satellite Systems (GNSS).

The other constellations are GLONASS developed and operated by the Russian Federation, Galileo developed and operated by the European Union, and BeiDou, developed and operated by China.

All providers have offered free use of their respective systems to the international community.

All providers have developed International Civil Aviation Organization (ICAO) Standards and Recommended Practices to support use of these constellations for aviation.

How It Works

The basic GPS service provides users with approximately 7.0 meter accuracy, 95% of the time, anywhere on or near the surface of the earth.

To accomplish this, each of the 31 satellites emits signals that enable receivers through a combination of signals from at least four satellites, to determine their location and time.

GPS satellites carry atomic clocks that provide extremely accurate time.

The time information is placed in the codes broadcast by the satellite so that a receiver can continuously determine the time the signal was broadcast.

The signal contains data that a receiver uses to compute the locations of the satellites and to make other adjustments needed for accurate positioning.

How It Works

The receiver uses the time difference between the time of signal reception and the broadcast time to compute the distance, or range, from the receiver to the satellite.

The receiver must account for propagation delays or decreases in the signal's speed caused by the ionosphere and the troposphere.

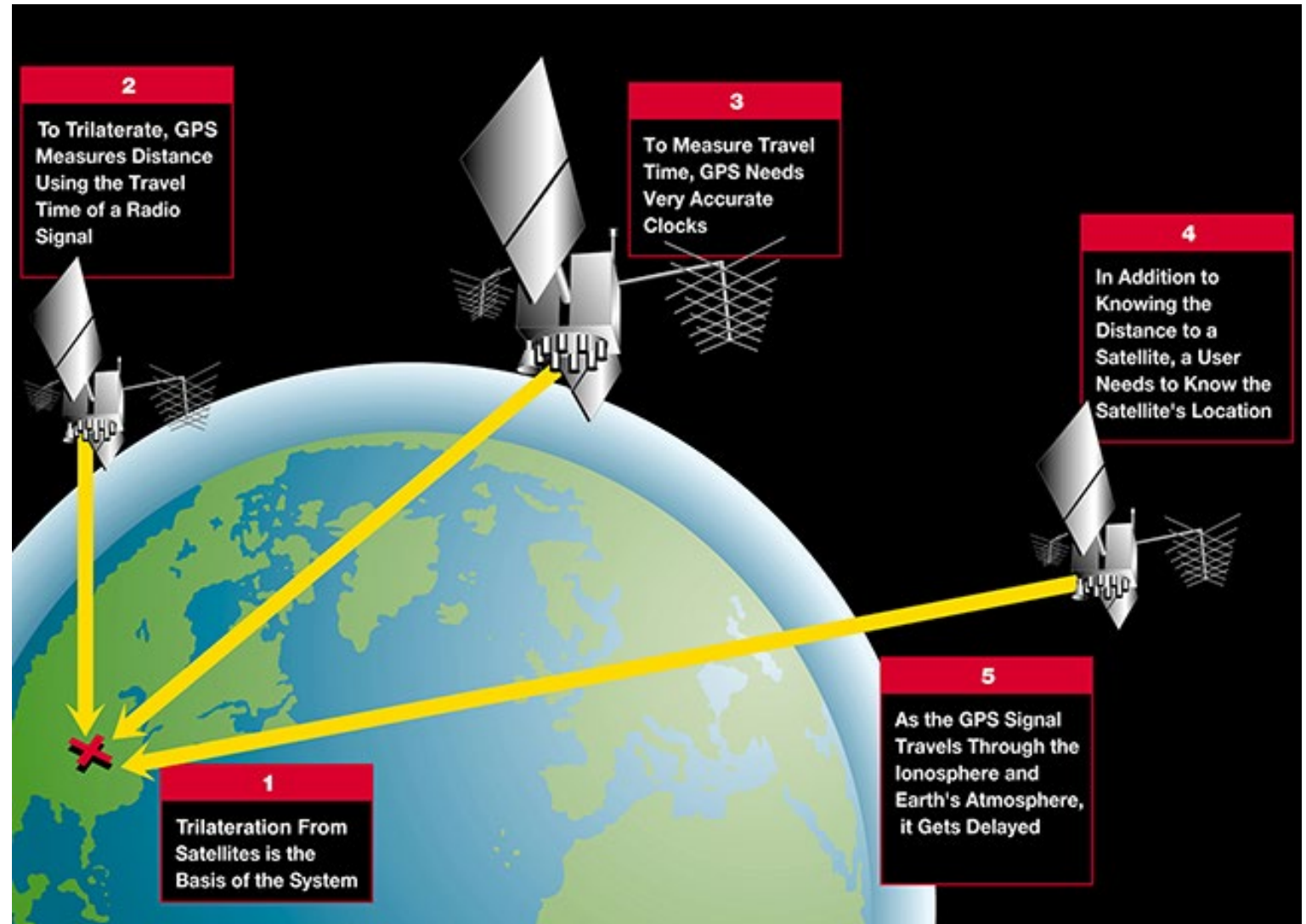
With information about the ranges to three satellites and the location of the satellite when the signal was sent, the receiver can compute its own three-dimensional position.

An atomic clock synchronized to GPS is required in order to compute ranges from these three signals.

However, by taking a measurement from a fourth satellite, the receiver avoids the need for an atomic clock.

Thus, the receiver uses four satellites to compute latitude, longitude, altitude, and time.

How It Works



How It Works

How many satellites does our GPS receiver need to be in contact with?

Calculate a 2D (LAT/LONG) Position = 3

Calculate a 3D (LAT/LONG and Altitude) = 4

Calculate RAIM = 5

Fault Detection and Exclusion = 6

RAIM

Receiver Autonomous Integrity Monitoring. RAIM is the capability of a GPS Receiver to perform integrity monitoring on itself by ensuring available satellite signals meet the integrity requirements for a given phase of flight.

Without RAIM, the pilot has no assurance of the GPS position integrity.

RAIM Prediction can be checked before flight at: <https://sapt.faa.gov/>.

Accuracy

When selective availability was lifted in 2000, GPS had about a five-meter (**16 ft**) accuracy.

GPS receivers that use the L5 band can have much higher accuracy, pinpointing to within 30 centimeters (**11.8 in**), while high-end users (typically engineering and land surveying applications) are able to have accuracy on several of the bandwidth signals to within two centimeters, and even sub-millimeter accuracy for long-term measurements.

Consumer devices, like smartphones, can be as accurate as to within 4.9 m (or better with assistive services like Wi-Fi positioning also enabled).

As of May 2021, 16 GPS satellites are broadcasting L5 signals, and the signals are considered pre-operational, scheduled to reach 24 satellites by approximately 2027.

GPS Fault Detection and Exclusion (FDE)

Fault detection

Purpose: To identify if a GPS signal is inaccurate or unreliable.

How it works: FDE algorithms, like RAIM, compare the position fixes generated from multiple satellites. If the data from one satellite is significantly different from the others, it is flagged as a potential fault.

Requirements: A minimum of 5 satellites are needed for a receiver to detect a fault.

Fault exclusion

Purpose: To remove the faulty satellite data from the navigation solution so the position calculation can continue without interruption.

How it works: Once a fault is detected, the FDE algorithm identifies and excludes the source of the error, allowing the receiver to use the remaining valid satellite data to maintain a correct position.

Requirements: A minimum of 6 satellites are required for a receiver to both detect and exclude a faulty satellite.

Satellite Navigation

The FAA is transforming the NAS to Performance Based Navigation (PBN) to address the shortfalls of conventional ground-based navigation.

PBN allows aircraft to fly flexible point-to-point routes and parallel tracks to reduce en-route chokepoints and delays.

In terminal airspace, PBN enables aircraft to fly precise tracks that are closer together, allowing for more efficient use of the airspace while reducing noise, fuel consumption, and carbon emissions.

The FAA Satellite Navigation Team supports the transition to PBN through development of ground infrastructure and standards that enable use of the Global Positioning System (GPS) using either Aircraft Based Augmentation Systems (ABAS) like Receiver Autonomous Integrity Monitoring (RAIM) or the FAA's Space Based Augmentation System (SBAS) also known as the Wide Area Augmentation System (WAAS).

Satellite Navigation

GPS, WAAS, and ABAS are referred to collectively as Global Navigation Satellite System (GNSS).

Aircraft use GNSS to fly Area Navigation (RNAV) and Required Navigation Performance (RNP) routes and procedures virtually anywhere in the NAS, in all phases of flight.

The FAA Satellite Navigation Team also supports the non-Federal implementation of Ground-Based Augmentation System (GBAS) Landing Systems that provide precision approach capability to airports with installed capability.

Satellite Navigation

Wide Area Augmentation System (WAAS) is a system that monitors the data being generated by the GPS satellites. To combat these errors and provide more reliable GPS information.

Ground based stations that make necessary mathematical corrections for errors detected, then uploads the corrected information to one of two Geo-Stationary Satellites, which then relay the corrected information to our on-board GPS unit.

WAAS greatly increases the accuracy and reliability of GPS Navigation with errors from 6-9 feet.

<https://www.aopa.org/advocacy/advocacy-briefs/air-traffic-services-brief-wide-area-augmentation-system-waas>

Satellite Navigation

“RAIM allows aviation receivers to detect a GPS satellite fault and in many cases isolate the offending satellite and remove it from usage by the receiver,” according to the FAA. For vertical guidance integrity, the FAA's wide-area augmentation system (WAAS) uses ground stations to ensure accuracy of the GPS signals.

At least one satellite, in addition to those required for navigation, must be in view for the receiver to perform the RAIM function; thus, RAIM needs a minimum of 5 satellites in view, or 4 satellites and a barometric altimeter (baro-aiding) to detect an integrity anomaly.

Picture 5 people in a room...all think they are experts...1 is not...

RAIM is where the GPS receiver knows which satellite is wrong and will ignore it

Standards

GPS TSO

Technical Standard Order
Minimum Performance Standards

TSO C129

Non-WAAS GPS
RAIM Required and Confirmed
No Vertical Guidance
Backup Navigation Required
Limitation for
Alternate Airport Selection

*All Phases of Flight,
but Not Primary Navigation*

TSO
C129/C196

TSO
C145/C146

TSO C146

WAAS-capable GPS
May Be Primary Form of Navigation
RAIM not required if WAAS is available
Include Vertical Guidance Approaches
No Restriction on
Alternate Airport Selection

Uses of Suitable RNAV Systems

AIM 1-2-3 (c)

Use of Suitable Area Navigation (RNAV) Systems on Conventional Procedures and Routes

Uses of Suitable RNAV Systems

Subject to the operating requirements, operators may use a suitable RNAV system in the following ways:

- Determine aircraft position relative to, or distance from a VOR (see NOTE 6 below), TACAN, NDB, compass locator, DME fix; or a named fix defined by a VOR radial, TACAN course, NDB bearing, or compass locator bearing intersecting a VOR or localizer course.
- Navigate to or from a VOR, TACAN, NDB, or compass locator.
- Hold over a VOR, TACAN, NDB, compass locator, or DME fix.
- Fly an arc based upon DME.

C129 Limitations

AIM 1-2-3 (d)

Use of Suitable Area Navigation (RNAV) Systems on Conventional Procedures and Routes
Alternate Airport Considerations

For the purposes of flight planning, any required alternate airport must have an available instrument approach procedure that does not require the use of GPS.

This restriction includes conducting a conventional approach at the alternate airport using a substitute means of navigation that is based upon the use of GPS.

For example, these restrictions would apply when planning to use GPS equipment as a substitute means of navigation for an out-of-service VOR that supports an ILS missed approach procedure at an alternate airport.

In this case, some other approach not reliant upon the use of GPS must be available.

C129 Limitations

You can file with the destination or the alternate having only a GPS approach, but not both.
WAAS-equipped aircraft can file for destinations and alternates having only GPS approaches.
If you're going somewhere with a VOR approach, you can use an airport with a GPS approach as an alternate.

IFR TRAINING

RAIM VS

WAAS

GPS Satellites



For More Detailed Info

See
AIM 1-1-17
and

https://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices



Any questions I can answer or
follow up later on?

ADS-B



Cleared For
the Option!

Lesson Objective

To develop understanding of ADS-B



First Let's Discuss the Old Technology

The turning around now I see you now I don't demo

First Let's Discuss the Old Technology

Secondary surveillance radar (SSR) is a radar system used in air traffic control (ATC), that not only detects and measures the position of aircraft, i.e. bearing and distance, but also requests additional information from the aircraft itself such as its identity and altitude.

Unlike primary radar systems that measure the bearing and distance of targets using the detected reflections of radio signals, SSR relies on targets equipped with a radar transponder.

SSR is based on the military identification friend or foe (IFF) technology originally developed during World War II, therefore the two systems are still compatible.

First Let's Discuss the Old Technology

The transponder is a radio receiver and transmitter pair which receives on 1030 MHz and transmits on 1090.

The target aircraft transponder replies to signals from an interrogator by transmitting a coded reply signal containing the requested information.



First Let's Discuss the Old Technology

Both the civilian SSR and the military IFF have become much more complex than their war-time ancestors, but remain compatible with each other, not least to allow military aircraft to operate in civil airspace.

Today's SSR can provide much more detailed information, for example, the aircraft altitude, as well as enabling the direct exchange of data between aircraft for collision avoidance.

Most SSR systems rely on Mode C transponders, which report the aircraft pressure altitude.

The pressure altitude is independent from the pilot's altimeter setting.

Air traffic control systems recalculate reported pressure altitudes to true altitudes based on their own pressure references, if necessary.





First Let's Discuss the Old Technology

The purpose of SSR is to improve the ability to detect and identify aircraft while automatically providing the Flight Level (pressure altitude) of an aircraft.

An SSR ground station transmits interrogation pulses on 1030 MHz (continuously in Modes A, C and selectively, in Mode S) as its antenna rotates, or is electronically scanned, in space.

An aircraft transponder within line-of-sight range 'listens' for the SSR interrogation signal and transmits a reply on 1090 MHz that provides aircraft information.

An aircraft without an operating transponder still may be observed by primary radar but would be displayed to the controller without the benefit of SSR derived data.



First Let's Discuss the Old Technology

Issues:

- The radars have a range
- The radars do not constantly 'see' the plane. If it rotates every 6 seconds then it 'sees' a particular plane every 6 seconds
- Pilot must set a unique code in the transponder when on IFR plans as this system does not give tail number
- Very limited info
- The mode C reply provides height increments of 100 feet, which was initially adequate for monitoring aircraft separated by at least 1000 feet. A slight change of a few feet could cross a threshold and be indicated as the next increment up and a change of 100 feet. Mode S is increments of 25 feet.

<https://photos.app.goo.gl/pxFsxSmje92DCcqv6>

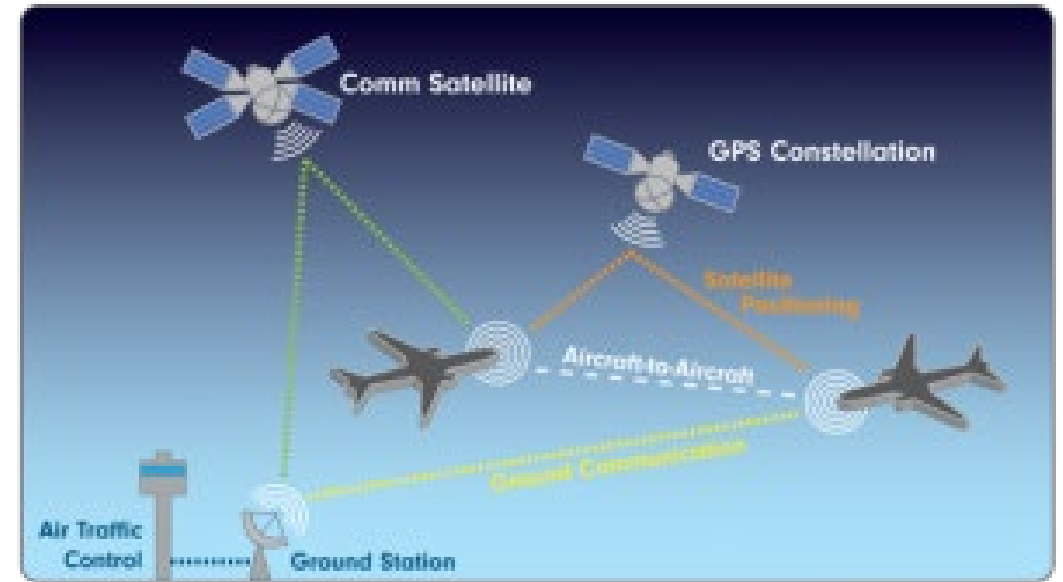
<https://photos.app.goo.gl/CkokYCp71Zd6FP9r6>

Enter ADS-B

Automatic dependent surveillance — broadcast (ADS-B) is a surveillance technology in which an aircraft determines its position via satellite navigation and periodically broadcasts it, enabling it to be tracked.

The information can be received by air traffic control ground stations as a replacement for secondary surveillance radar, as no interrogation signal is needed from the ground.

It can also be received by other aircraft to provide situational awareness and allow self-separation.



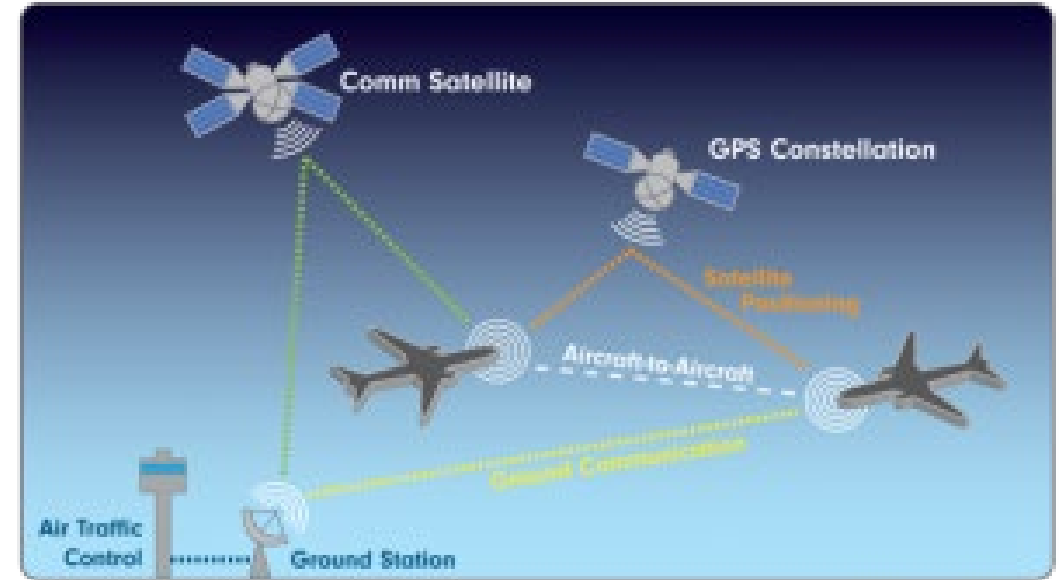
Enter ADS-B

ADS-B is "automatic" in that it requires no pilot or external input.

It is "dependent" in that it depends on data from the aircraft's navigation system.

Aircraft self-report their GPS position in a networked environment, so pilots can see the entire air traffic picture around them.

There is also the added benefit of datalink weather available through ADS-B.



How does it work?

ADS-B enhances safety by making an aircraft visible, real time, to air traffic control (ATC) and to other appropriately equipped ADS-B aircraft with position and velocity data transmitted every second.

ADS-B data can be recorded and downloaded for post-flight analysis. ADS-B also provides the data infrastructure for inexpensive flight tracking, planning, and dispatch.

"ADS-B Out" periodically broadcasts information about each aircraft, such as identification, current position, altitude, and velocity, through an onboard transmitter.

ADS-B Out provides air traffic controllers with real-time position information that is, in most cases, more accurate than the information available with current radar-based systems.

With more accurate information, ATC will be able to position and separate aircraft with improved precision and timing.

How does it work?

"ADS-B In" is the reception by aircraft of FIS-B and TIS-B data and other ADS-B data such as direct communication from nearby aircraft.

The ground station broadcast data is typically only made available in the presence of an ADS-B Out broadcasting aircraft, limiting the usefulness of purely ADS-B In devices.

The system relies on two avionics components—a high-integrity GPS navigation source and a datalink (ADS-B unit).

There are several types of certified ADS-B data links, but the most common ones operate at 1090 MHz, essentially a modified Mode S transponder, or at 978 MHz.

The FAA would like to see aircraft that operate exclusively below 18,000 feet (5,500 m) use the 978 MHz link, as this will alleviate congestion of the 1090 MHz frequency.

ADS-B Enables Improved Safety

- Radar-like IFR separation in non-radar airspace
- Increased VFR flight following coverage
- ATC final approach and runway occupancy, reducing runway incursions on the ground
- Will be easier to find aircraft that have crashed or had an off airport landing
- Helps pilots to see and avoid other aircraft
- VFR-like separation in all weather conditions
- Real-time cockpit weather display

Free Detailed Weather

Since weather and traffic come into play so much during any discussion of ADS-B, let's define some terms: FIS-B and TIS-B.

These are the two products that we can receive via ADS-B In.

Flight Information Services-Broadcast (FIS-B) is just a fancy name for datalink weather.

Only available with a 978 MHz receiver, the end product is very similar to what we're used to seeing with XM Weather.

NEXRAD radar, METARs, TAFs, TFRs, AIRMETs and other information is continuously updated in flight, and all this can be displayed on either a panel-mount MFD or a portable device like an iPad.

There is no monthly subscription fee with FIS-B (your tax dollars paid for it), which is a nice feature.

But unlike XM Weather, ADS-B weather uses the network of ground stations, not satellites

Free Detailed Weather

With a tablet you can look up ATIS/AWOS at any airport without the need for the radio.

This is a big benefit when you are not in radio range. You can look up where storms are.

This was previously not possible in most small planes.

[Back](#)

KRYYCobb County Internation...



[Direct To](#)[Add to Route](#)[Fullscreen](#)[Hold...](#)



Cobb County International/...
Atlanta, Georgia, US
Elevation: 1,040'
🌅 6:34 AM 🌃 8:52 PM EDT

[Taxiways](#)[FBOs](#)[Comments](#)

[Info](#)[Weather](#)[Runway](#)[Procedure](#)[NOTAM](#)

[METAR](#)[TAF](#)[MOS](#)[Daily](#)[Winds](#)

● Low IFR

23m ago

KRYY 090258Z AUTO 10005KT 10SM BKN004 23/22 A3010 RMK AO2 LTG DSNT NE AND SE \$

Time

10:58 PM EDT

Wind

100° at 5 kts

Visibility

10 sm

Clouds (AGL)

Broken 400'

Temperature

23°C (73°F)

Dewpoint

22°C (72°F)

FAA services

ADS-B In pilot cockpit advisory services consist of Flight Information Service-Broadcast (FIS-B) and Traffic Information Service-Broadcast (TIS-B).

These are free services transmitted automatically to aircraft equipped to receive ADS-B In.

FIS-B provides a broad range of textual/graphical weather products and other flight information to the general aviation community.

FIS-B is only available on the 978MHz Universal Access Transceiver (UAT) equipment. FIS-B includes the following:

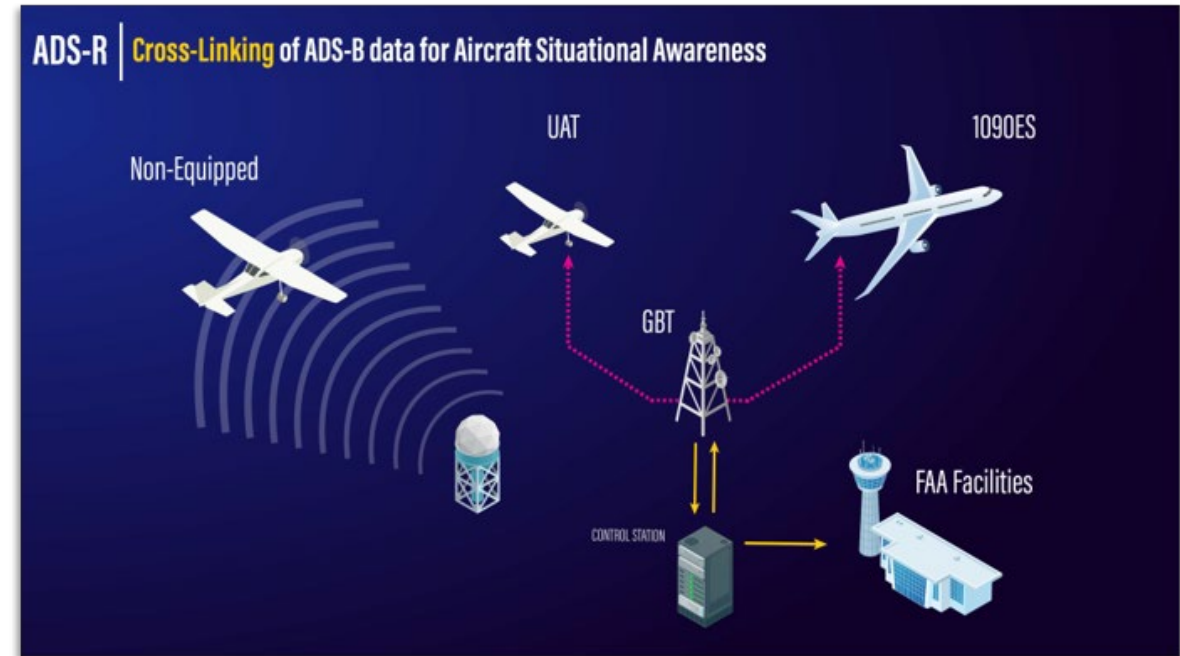
- Aviation Routine Weather Reports (METARs)
- Non-Routine Aviation Weather Reports (SPECIs)
- Terminal Area Forecasts (TAFs) and their amendments
- NEXRAD (regional and CONUS) precipitation maps

FAA services

- Notice to Airmen (NOTAM) Distant and Flight Data Center
- Airmen's Meteorological Conditions (AIRMET)
- Significant Meteorological Conditions (SIGMET) and Convective SIGMET
- Status of Special Use Airspace (SUA)
- Temporary Flight Restrictions (TFRs)
- Winds and Temperatures Aloft
- Pilot Reports (PIREPS)

Automatic Dependent Surveillance - Rebroadcast (ADS-R)

ADS-R is a client-based service that relays ADS-B information transmitted by an aircraft broadcasting on one link to aircraft equipped with ADS-B In on the other link. For example, the information for an aircraft equipped with a 1090MHz ADS-B Out system will be re-broadcasted to an aircraft equipped with ADS-B In on the UAT (i.e. 978MHz) frequency, and vice versa.



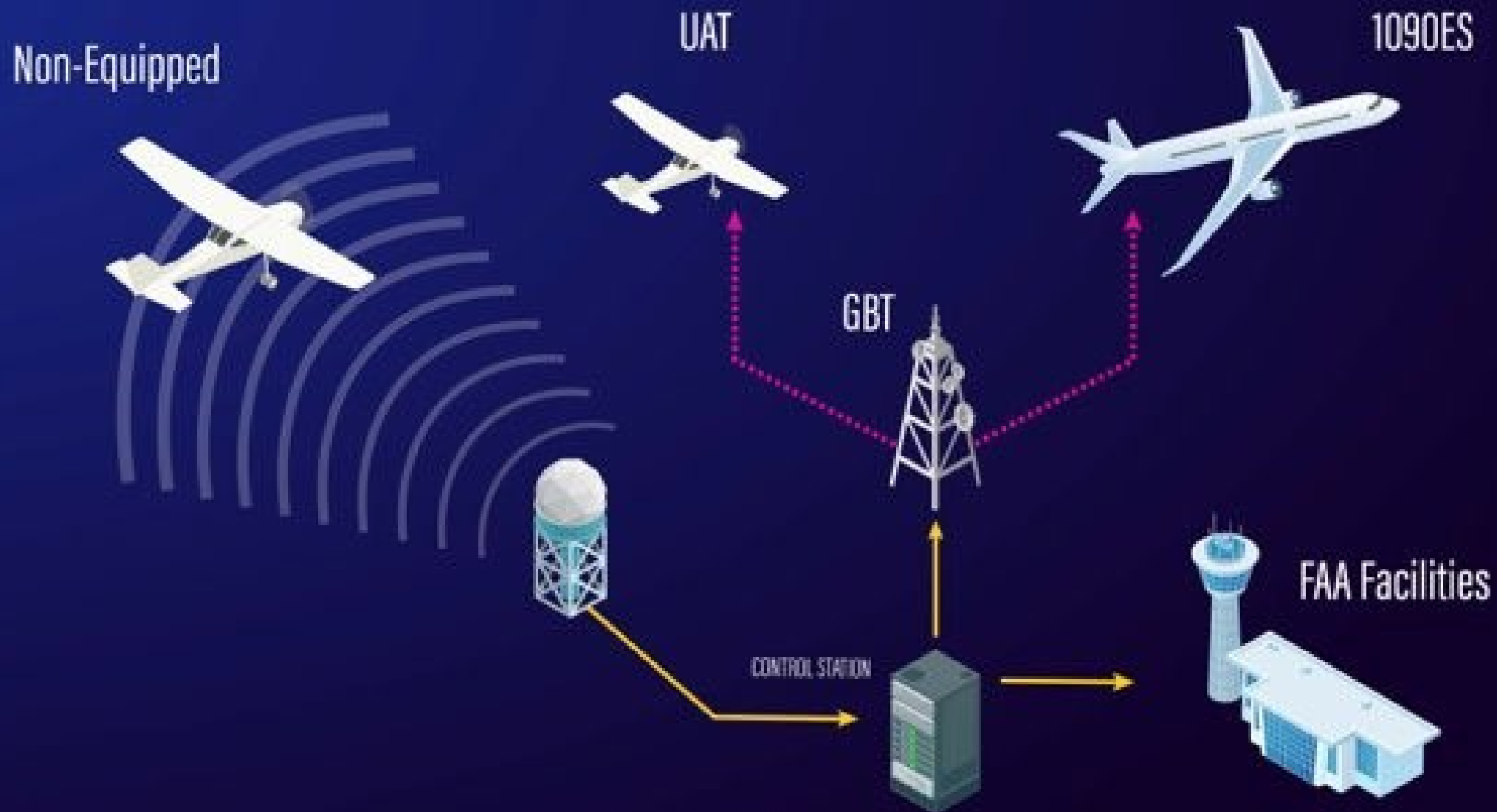
TIS-B vs ADS-B In

TIS-B is an advisory-only service available to both 1090ES and UAT equipment users. TIS-B increases pilots' situational awareness by providing traffic information on all transponder-based aircraft within the vicinity of the ADS-B In equipped aircraft receiving the data.

To qualify as a TIS-B target, an aircraft must be equipped with a transponder, and be **within radar coverage**.

I flew in North Georgia a number of times in a G1000 plane that was not equipped with ADS-B yet with a Stratus 2S suction cupped to the window. There were about 3 times as many planes reported to Foreflight with the Stratus than the G1000 got from ground radar. The weather was also much more detailed.

TIS-B | Uplink of Surveillance Data of Non-ADSB equipped for Aircraft Situational Awareness



Don't have room for a radar tower?

You can set up a monitoring station with a Raspberry Pi with a small antenna or a tall mounted one. There are no houses with a radar.

<https://flightaware.com/adsb/>

<http://stratux.me/>

http://www.dpdproductions.com/page_vhf_air.html#adsbout

Don't have room for a radar tower?

With a small antenna, you
can see aircraft in the
immediate area

With a large antenna, you
can see aircraft for up to
200 miles



§ 91.225 Automatic
Dependent Surveillance-
Broadcast (ADS-B) Out
equipment and use.

Requirements

You must be equipped with ADS-B Out to fly in [most controlled airspace](#).

If you fly in this airspace you must be equipped with ADS-B

Airspace	Altitude
Class A	All
Class B	Generally, from surface to 10,000 feet mean sea level (MSL) including the airspace from portions of Class Bravo that extend beyond the Mode C Veil up to 10,000 feet MSL (e.g. LAX, LAS, PHX)
Class C	Generally, from surface up to 4,000 feet MSL including the airspace above the horizontal boundary up to 10,000 feet MSL
Class E	At and above 10,000 feet MSL over the 48 states and DC, excluding airspace at and below 2,500 feet AGL Over the Gulf of Mexico at and above 3,000 feet MSL within 12 nautical miles of the coastline of the United States
Mode C Veil	Airspace within a 30 NM radius of any airport listed in Appendix D, Section 1 of Part 91 (e.g. SEA, CLE, PHX) from the surface up to 10,000 feet MSL

For More Detailed Info

https://www.faa.gov/air_traffic/technology/adsb/

<https://www.sportys.com/blog/ads-b-101-what-you-need-know/>



Any questions I can answer or
follow up later on?

[All Posts](#)[Private Pilot](#)[Instrument Flight Rules](#)[Instrument Landing System \(ILS\)](#)[IFR Approach Plates](#)[More](#) ▾

Dan George

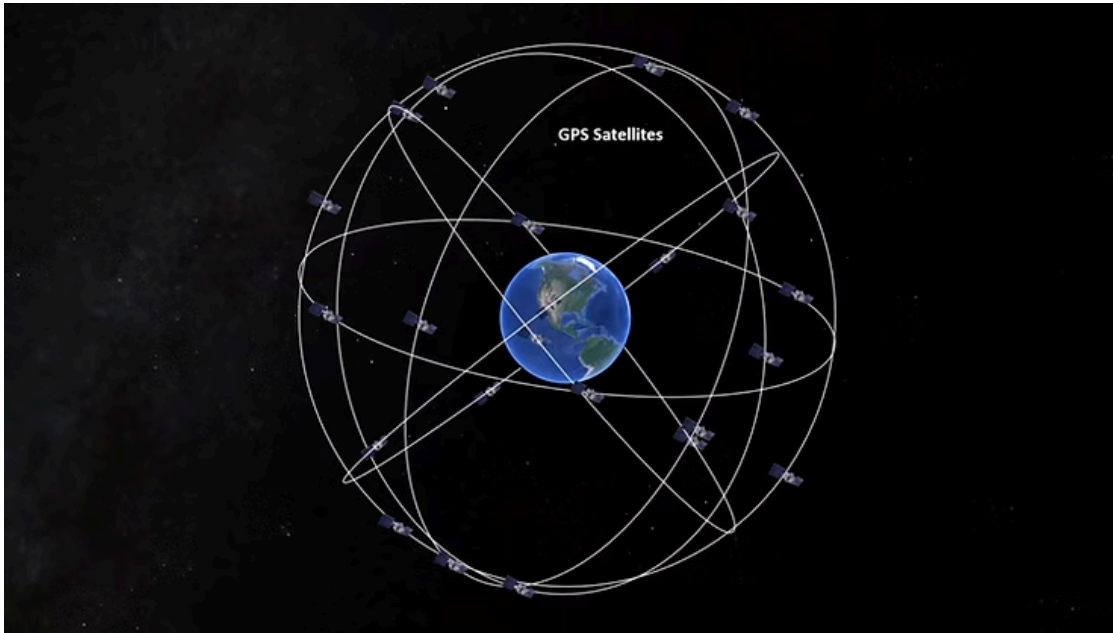
20 hours ago · 4 min read

WHAT IS WAAS? HOW DOES IT IMPROVE GPS FOR IFR FLYING?

UNDERSTANDING GPS: A CLOCK AND RADIO IN SPACE

A GPS satellite can seem like an impossibly sophisticated feat of science, but it helps to think of it as simply a radio and a super precise clock, that we shot up into space. One satellite is part of a constellation of many more, that are in orbit around the Earth. They follow different orbital paths that are set up so that a certain number of these satellites should be visible from any point on Earth. These satellites are at an altitude about 11,000 miles above the planet, which means they are at a speed causing them to circle the globe in 12 hours. They are constantly in motion as observed from our relatively fixed position on the ground or in an aircraft. With a proper receiver on board, signals from these satellites give us a very accurate fix of our position.

**10% OFF
TODAY**



The GPS satellite constellation orbiting Earth

GEOSTATIONARY SATELLITES AND WHY THEY MATTER

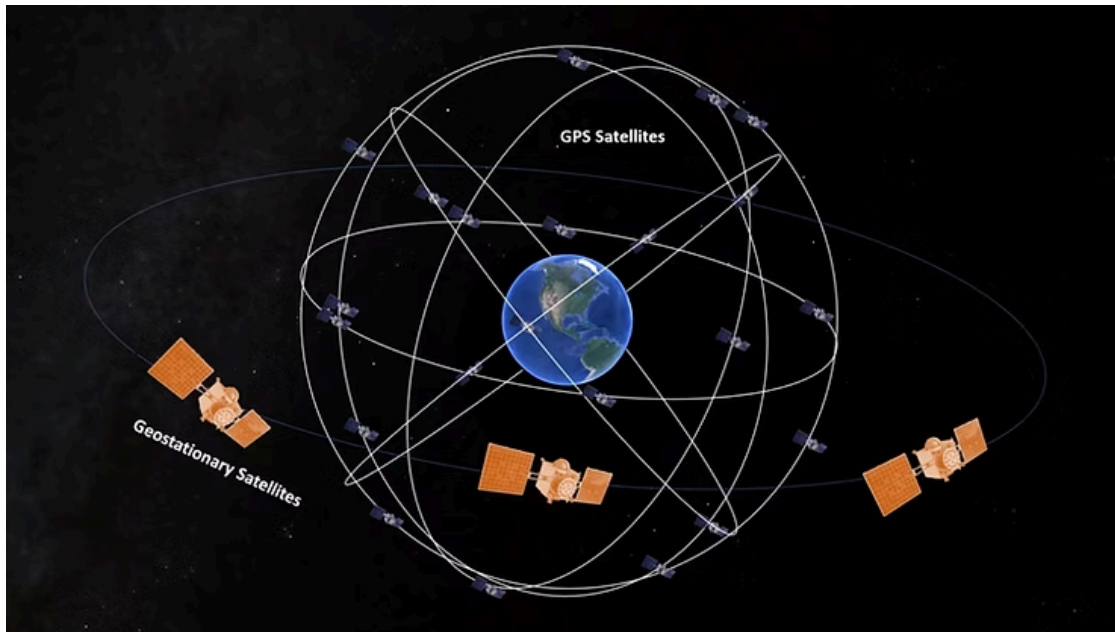
More than three times higher than these satellites, in an orbit around the equator, sit some other hardware. These are geostationary satellites, their high orbit requires a slower speed (the same speed the Earth rotates at) which causes them to appear from the observer on Earth to remain motionless. They are always directly above some fixed point along the equator. Together, all of these satellites make up part of an even more precise navigation aid, called the Wide Area Augmentation System, WAAS for short.

GPS is a US military system and is designed for global usage. WAAS is an FAA program, and is designed for civilian aircraft operating in the National Airspace System, i.e. the United States. Again, the GPS satellites are constantly in motion relative to the ground, while the geostationary satellites hang over a fixed point on the equator, the southern sky as viewed from the Northern Hemisphere in the US.

The GPS satellites, being again very fancy clocks with radios, transmit a signal down towards the ground in all directions. An aircraft equipped with a GPS receiver picks up these signals. As long as a minimum number of satellites, for most purposes this is four, are being received. An aircraft's on-board GPS unit can compute a position for it. But we kind of have to take the receiver's word for it, we aren't positive of our exact location, especially since we're moving over the ground at a decent speed. These signals aren't perfect, and are prone to errors due to position, radio interference, and a number of other factors.

10% OFF
TODAY





Geostationary satellites are higher up, and therefore orbit slower, matching Earth's rotation and so appearing to an observer on the ground to be motionless.

GROUND-BASED WAAS STATIONS: VERIFYING GPS ACCURACY

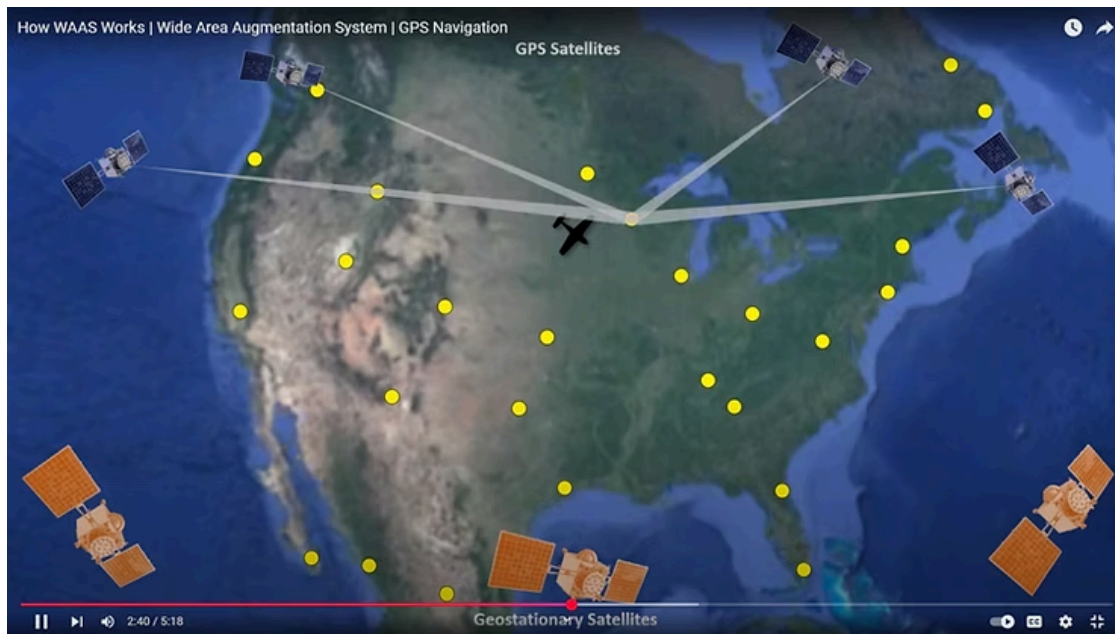
Can we check the accuracy of the system off a known position? We can do so, using a series of 38 ground stations spread out over North America. These are the wide area reference stations, “wide area” being the WA in the WAAS acronym. These stations are surveyed to an exact latitude and longitude position, and elevation above sea level.

The stations receive GPS signals and compute a position the same as our unit does on-board, though unlike us in our aircraft, they know their exact position, and can compare it to the GPS computed position, to determine errors. If the error is due to one satellite not functioning properly, the station will know to ignore it and use a position computed with another series of satellites. This information and other position errors will be transmitted by all stations, by terrestrial link, to master stations; there are three.

The master station is a computer system that collects all the error messages, and generates a user message. The user message is instructions for GPS receivers on how to handle the errors detected by the system. This message is beamed by uplink dishes to the geostationary satellites in the southern sky above the equator. This happens every second. By the way, this error correction principle is similar to what's done with RAIM, Receiver Autonomous Integrity Monitoring, a term you may have heard, but is done continuously and much more accurately, and there are almost never planned outages, so it's a wholly different concept we'll leave for another lesson.

10% OFF
TODAY





Ground stations receive signals from GPS satellites and compare them with its known position. Errors are fed to master computers and uplinked to the geostationary satellites. The error computation is downlinked to the aircraft with a WAAS receive to improve its accuracy

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VORs and Radio Navigation



Lesson Objective

To develop understanding of VORs and why they are still useful in the GPS world. To be able to know where you are at between VORs, to be able to fly to one, and to be able to track yourself away from one.

LAS VOR





Picture This

You are coming back to Kennesaw from north Alabama. You are VFR on top of a heavy blanket of clouds. You forgot to charge your ipad yesterday and it is almost out of power. Now your Garmin 430W is having some sort of issue. At least you have ATC to talk to. Can you find your way home?

NDBs

NDB, or Non-Directional Beacon, is a ground-based radio navigation aid that transmits radio signals in all directions, allowing aircraft to determine their bearing (direction) to the beacon using an Automatic Direction Finding (ADF) receiver.

Function

NDBs transmit a signal of equal strength in all directions, containing a coded element for station identification (usually 1-3 letters in Morse code).

NDBs

Navigation

Pilots use the bearing information received by the ADF to navigate, determine position, and execute non-precision instrument approaches.

Frequency

NDBs typically operate in the low or medium frequency band (190 to 535 kHz).

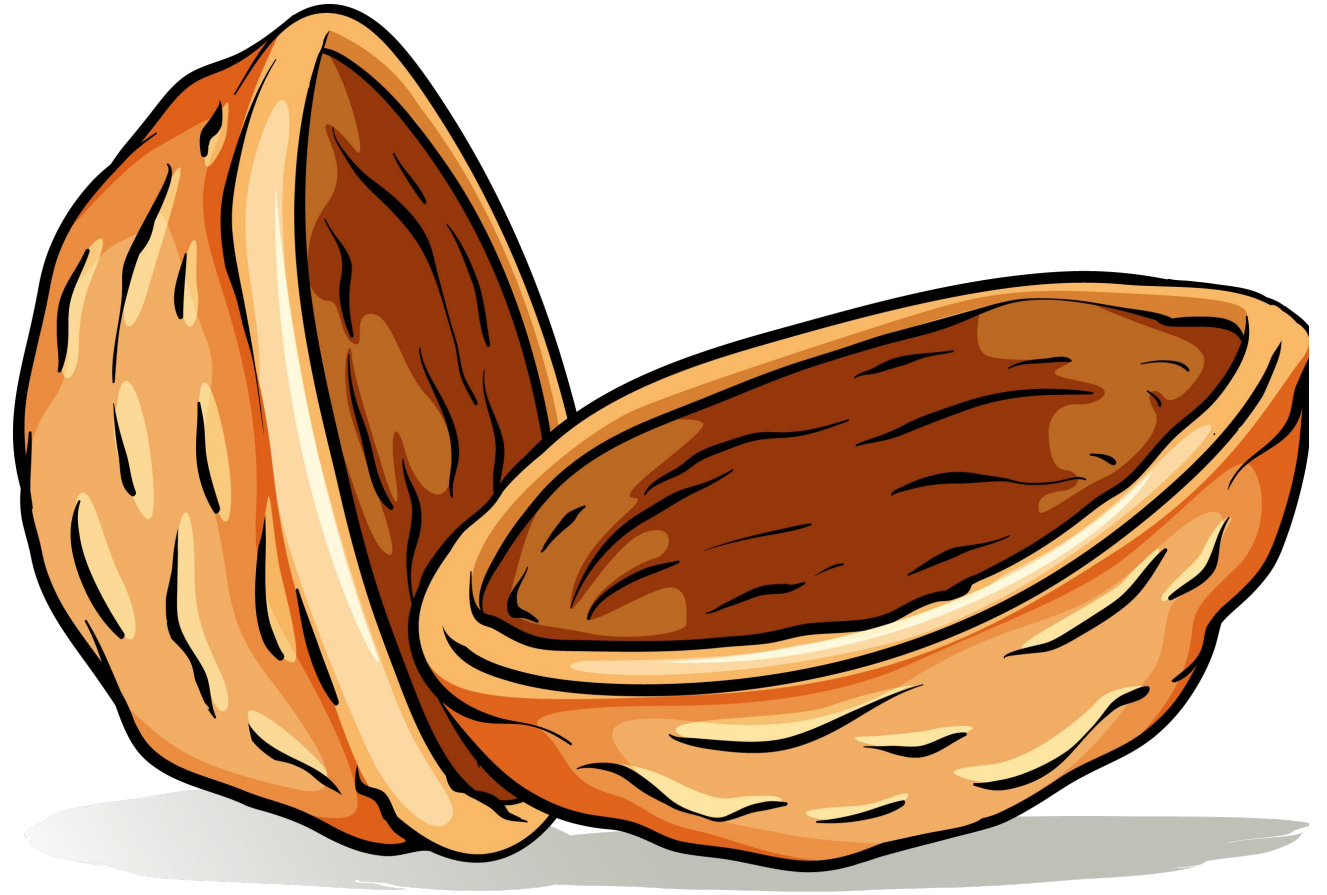
NDBs

In a nutshell...

It's an antenna

Fly to the antenna

The pointer in the dashboard points
to the antenna

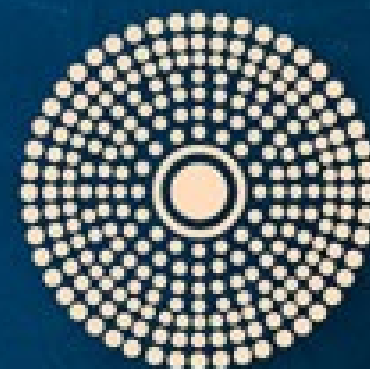




**ADF NEEDLE POINTS
TOWARDS THE NDB**



NDB



VORs

What/How

VOR = Very High Frequency Omnidirectional Range

Very High Frequency means that VORs operate on a frequency range between 108.0 and 117.9 MHz.

You have to tune in a radio frequency just like 'old school' radio stations

Because the equipment is VHF, the signals transmitted are subject to line-of-sight restrictions

Omnidirectional Range means that VORs provide pilots with 360 degrees of Navigational Coverage.

This line of position is called the "radial" from the VOR.

Why Should we Care Any More?

- What if you GPS has problems...it happens...
- What if you fly in a plane that doesn't have a GPS made in the past 25-30 years
- The same concepts apply to GPS OBS mode

The Radials

VORs have 360 radials...one each for each degree on a compass

R0/R360 = Radial pointing north

Aligned to magnetic north

R90 = east

R180 = south

R270 = west

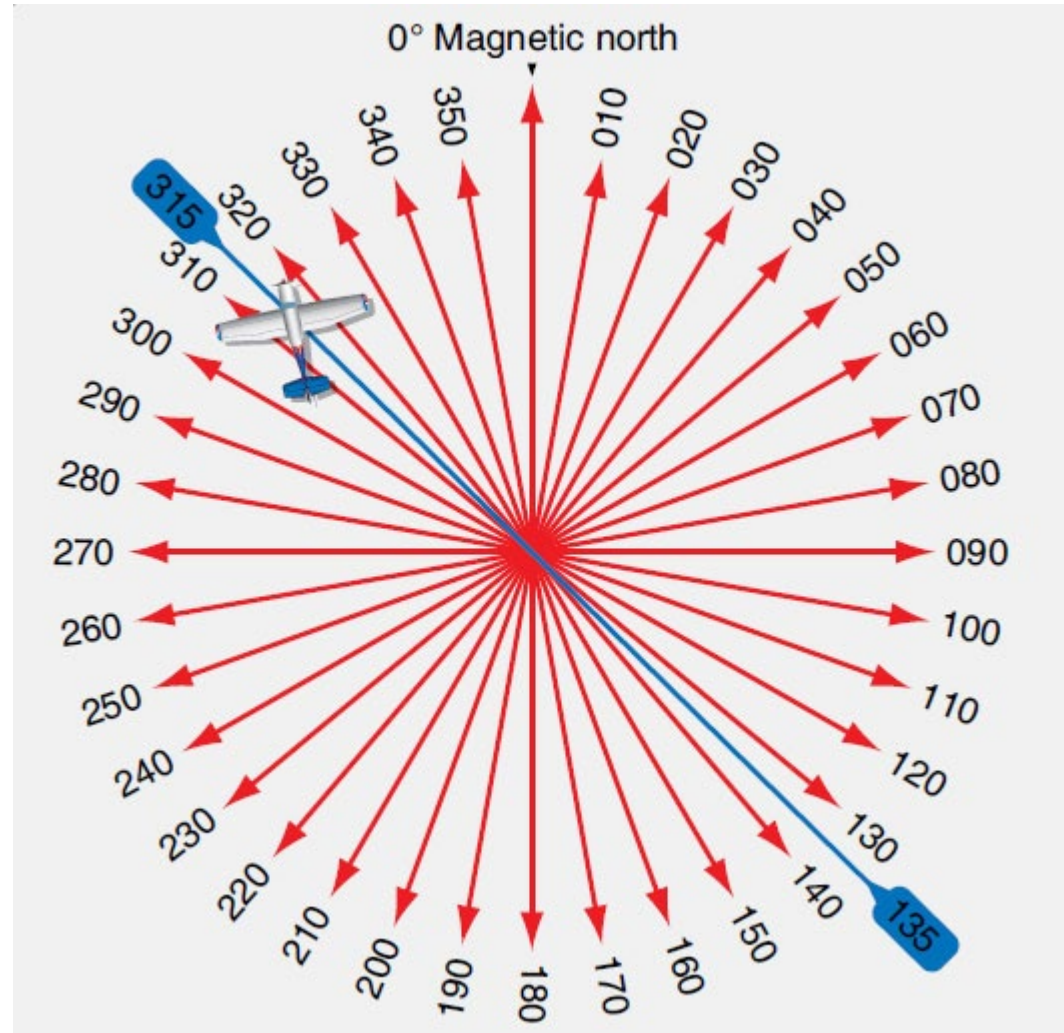
FROM = on a particular radial

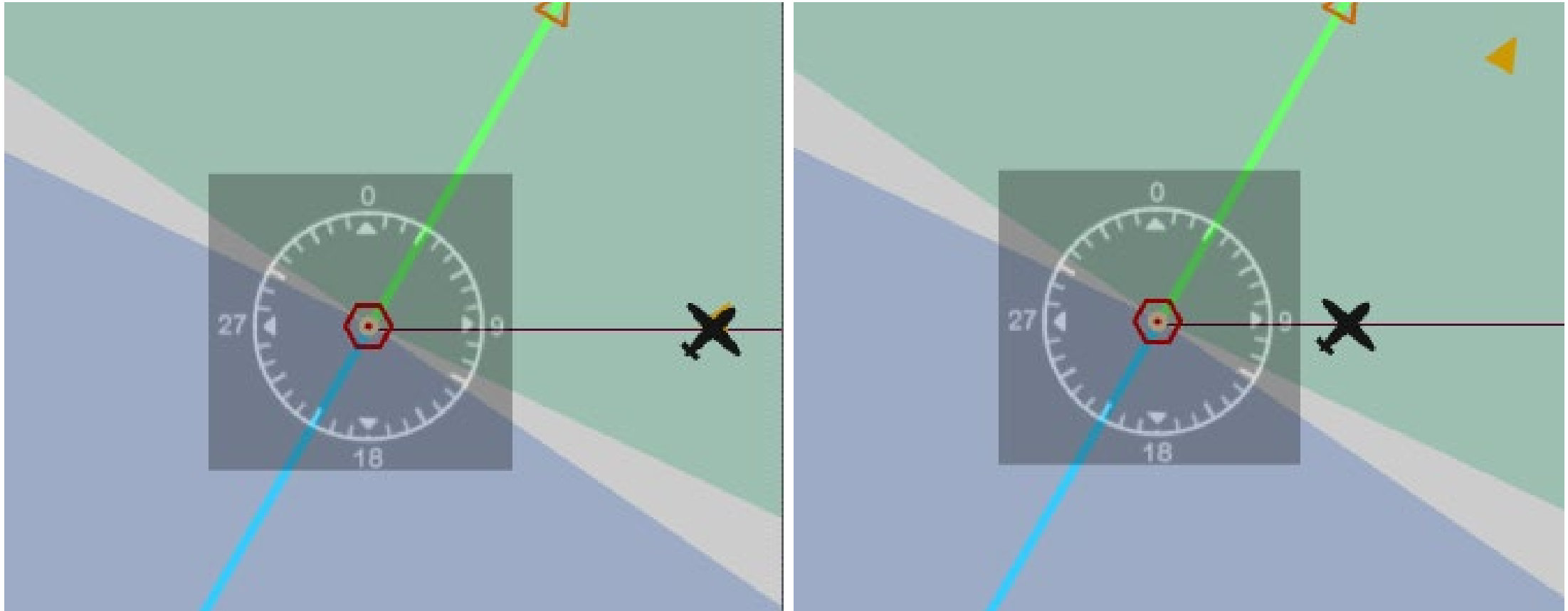
TO = FROM radial + 180

FROM R90 = TO R270 (you are east of the VOR)



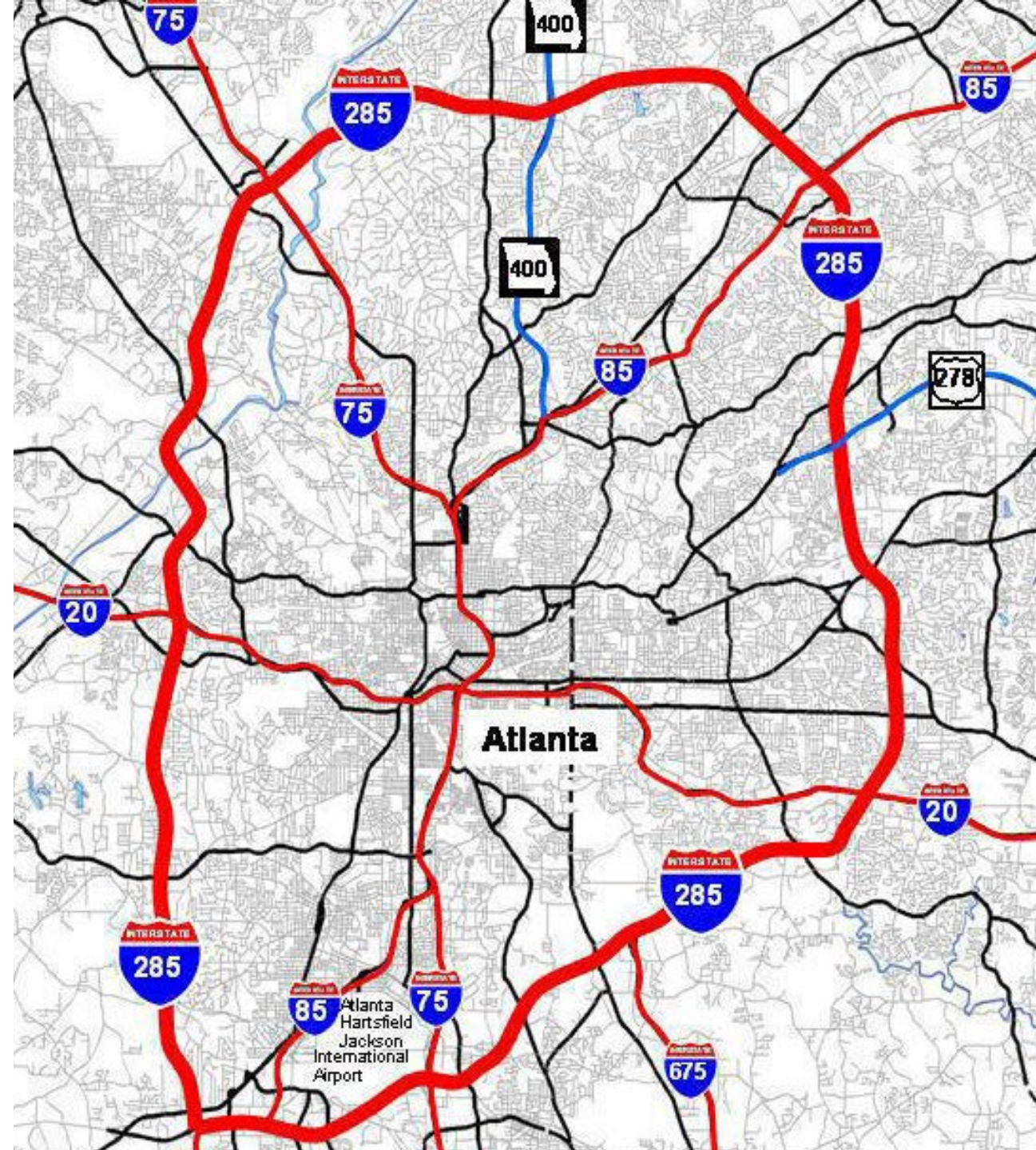
Radials





Where Are You on the Radial?

Let's play the
heading and
radial game



Let's play the heading and radial game

- Pick a spot in the room on the floor...that becomes your VOR
- Which way is N, S, E, W?
- Stand east facing the station

What is your heading and radial?

- Fly 'over' the station

What is your heading and radial?

- Turn left 90 degrees

What is your heading and radial?

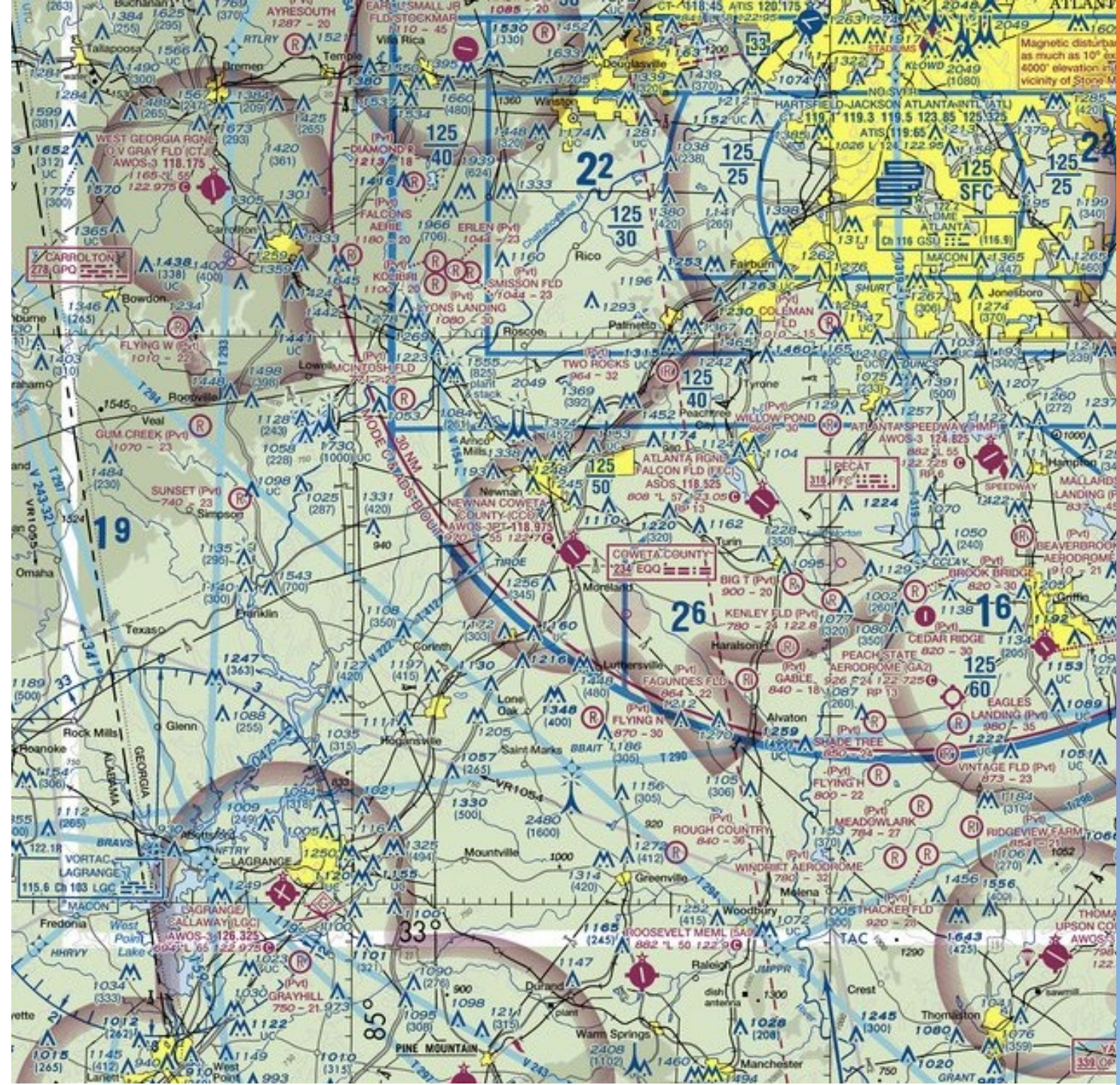
Intersection of Two Radials

The intersection of radials from two different VOR stations can be used to fix the position of the aircraft.

KFFC Atlanta Falcon Field

PDK R209 34NM

LGC R59 36.8NM

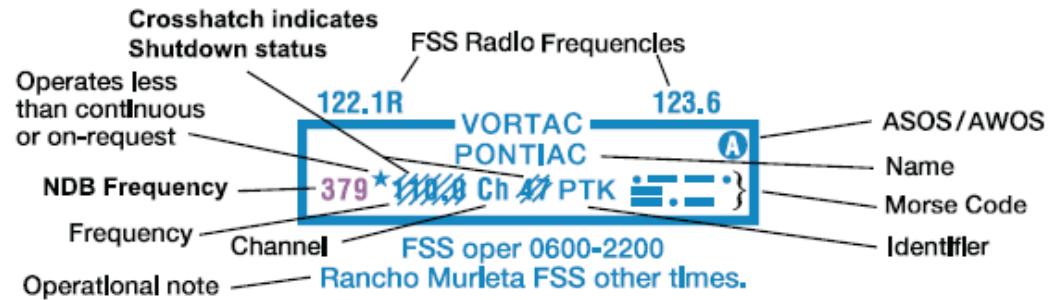


Intersection of Two Radials

KHEF Manassas Regional Airport/Harry P. Davis Field

Pick two...

AML	R198	13.0NM
CSN	R080	17.1NM
DCA	R259	23.9NM
BRV	R351	24.3NM
ADW	R270	30.8NM
LDN	R110	33.3NM



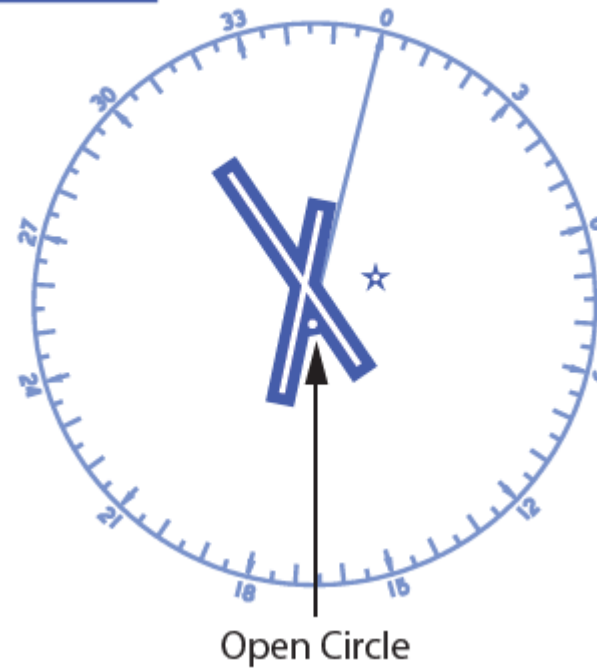
Operates less than
continuous or On-Request



Underline indicates no
voice on this frequency

Open circle symbol
shown when NAVAID
located on airport. Type
of NAVAID shown in top
of box.

Compass Rose is
“reference” oriented to
magnetic north.



Declination

VOR declination is the angular difference between true north and the zero bearing of a VOR station. It's recorded when the station is calibrated and realigned.

The zero bearing can be magnetic north or true north.

The declination is recorded when the station is installed.

The station alignment is not readjusted until it exceeds five degrees.

The magnetic declination of a VOR may differ from the actual declination in a given area. This is because the magnetic poles move over time.

Types

Types

VOR: Provides magnetic bearing information to and from the station.

VOR/DME: VOR co-located with a DME (Distance Measuring Equipment) station to provide distance information to the pilot.

TACAN: The military version

VORTAC: VOR co-located with TACAN. TACAN is reserved for military use only, but these also give distance information to civilian pilots as well.

(VOR-TACAN doesn't roll off the tongue)

Range

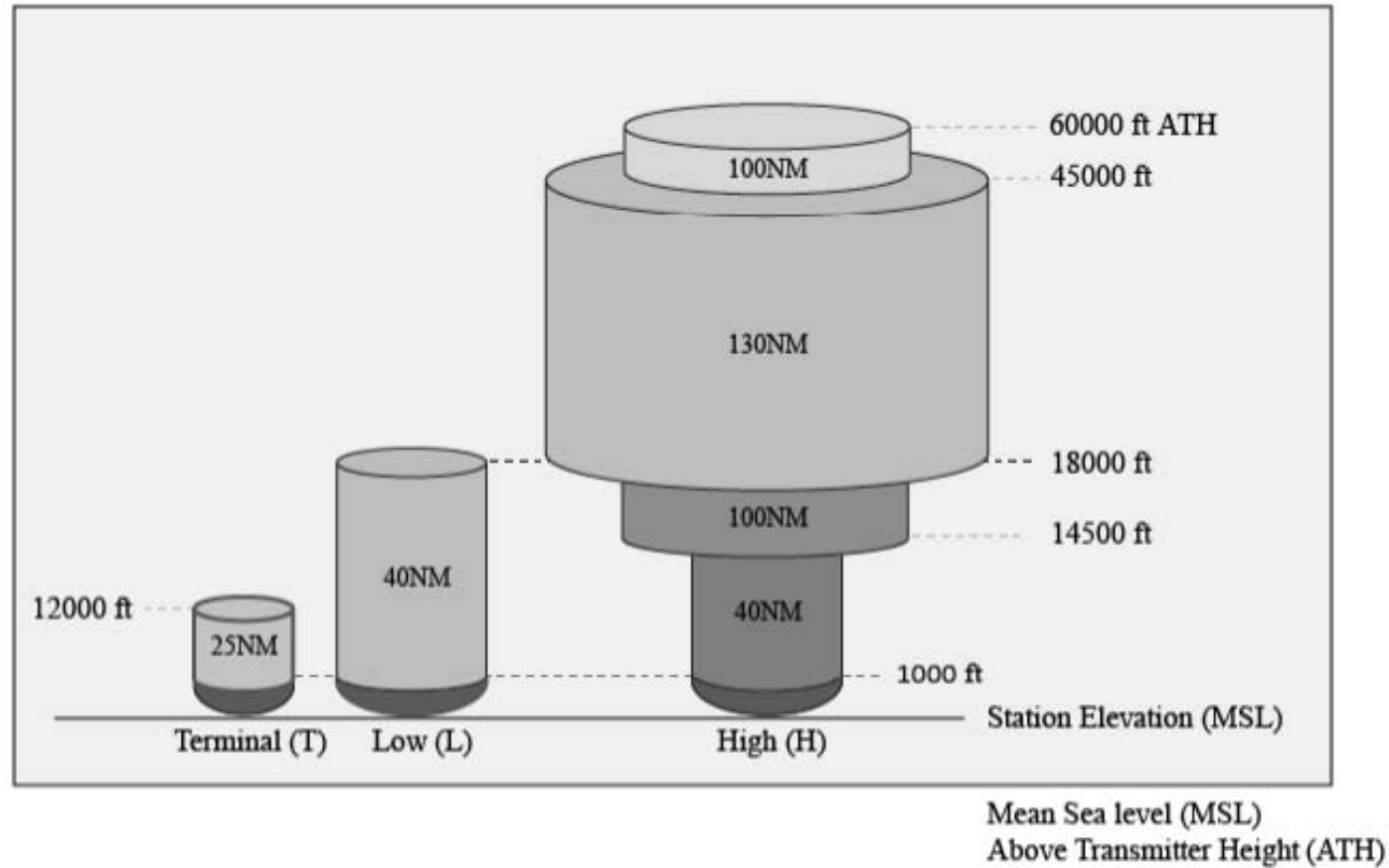
T (Terminal)

L (Low Alt)

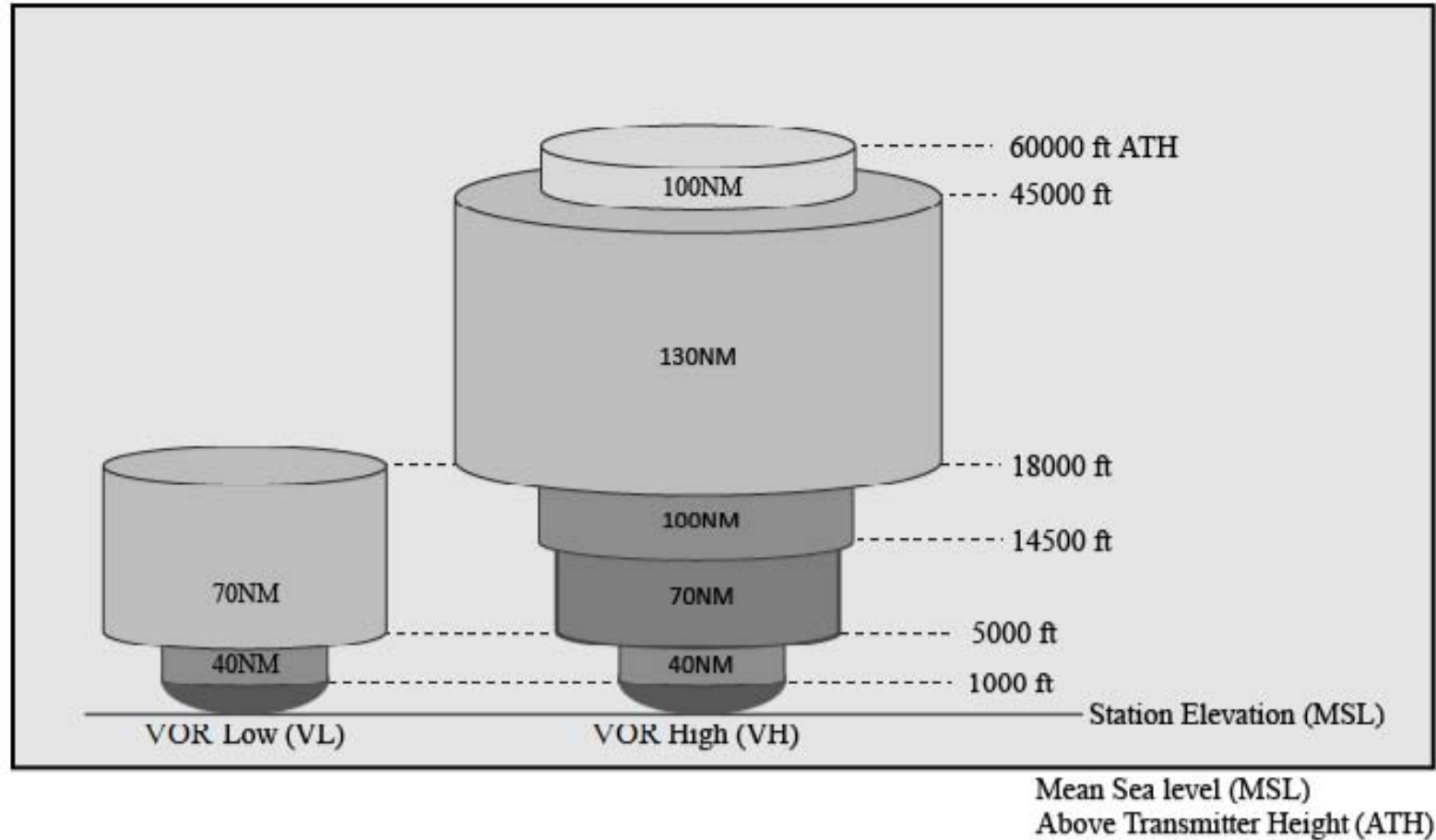
H (High Alt)

Class	Altitudes	Radius (Miles)
T	12,000' and Below	25
L	Below 18,000'	40
H	Below 14,500'	40
H	14,500 – 17,999'	100
H	18,000' – FL 450	130
H	FL 450 – 60,000'	100

Original VOR Service Volumes



New VOR Service Volumes





Tracking a Radial

CDI in the diagram is set for the 270 radial

You always fly **towards** the needle. In this figure, if are set to the 270 radial and you are flying from the VOR you would need to turn the plane more to the right to get back on course.

Each dot on a CDI or HSI represents 2°. A 'full deflection' is 5 dots = 10°. Anything worse than 10° off will still show as 5 dots.



Little or a lot off course

One dot is 2NM off course @ 60NM distance from the VOR.

Example:

3 dots off, 30 NM from VOR

$(200 \text{ ft} * 3 \text{ dots} * 30 \text{ NM}) / 6076 = 3 \text{ NM}$

FROM/TO

The magnetic course TO or FROM the station can be determined.

When the OBS is rotated, the CDI moves to show the position of the radial relative to the plane.

If TO is displayed, the course on the course selector must be flown to the Station.

If FROM is displayed and the course shown followed, the plane flies away from the Station.

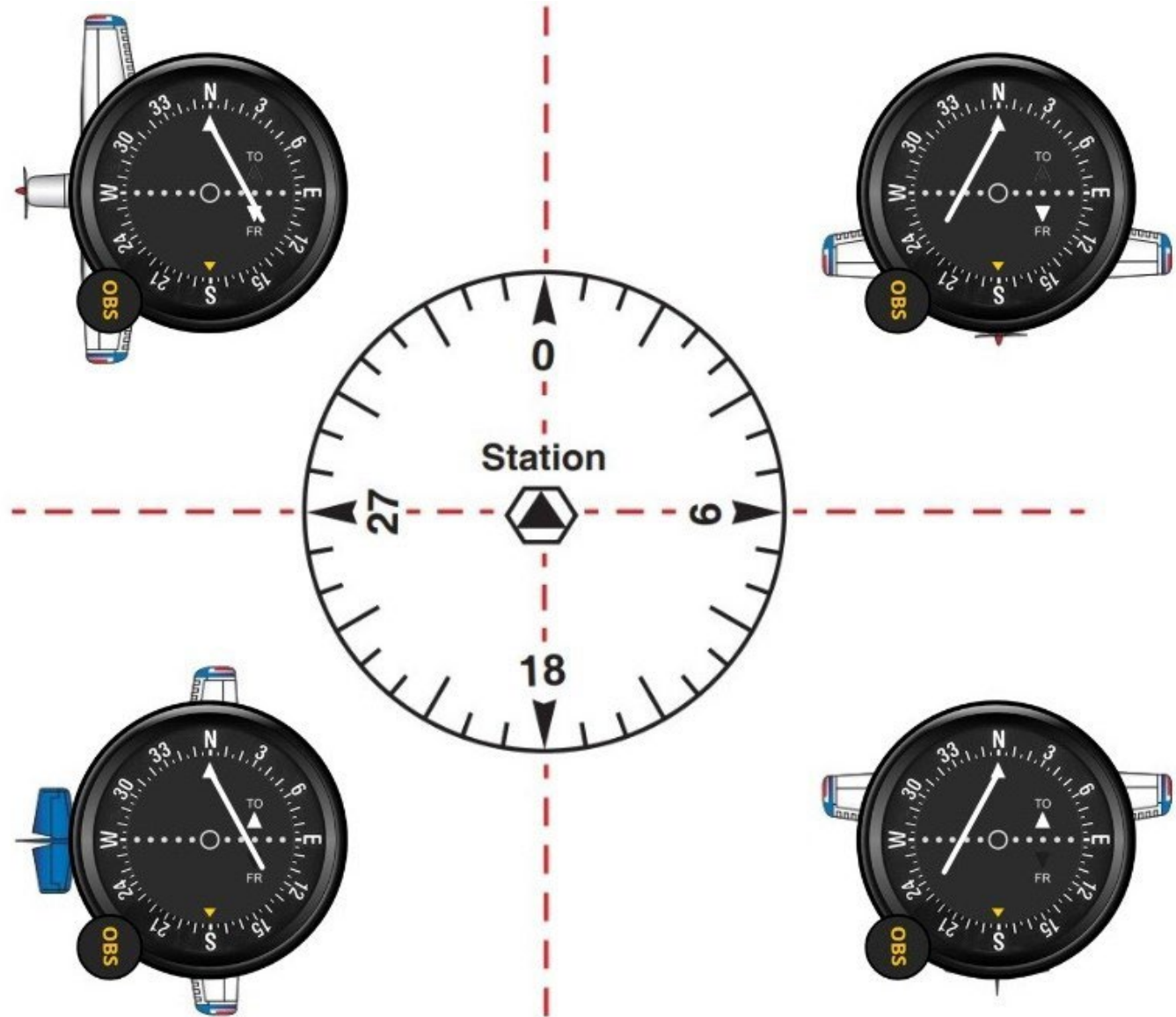
FROM/TO

If your GPS/radios do not have a way to quickly show you what radial you are on, you can turn the CDI/HSI till the needle is centered and it indicates FROM.

Do not worry what the current heading is.

It simply makes no difference at all except whether you will get back on track or end up lost.

FROM/TO



Quiz...What
radial?



Quiz...What
radial?





My Trick/Quick Math

FROM R -, FROM L +, TO R +, TO L -
Huh??

Example

TO/FROM = FROM

Needle is to the right (R)

Since it is set for 270 and it is deflected two dots then
-> $270 - 4 = 266$

You are on R266



CDI Where Am I? #1

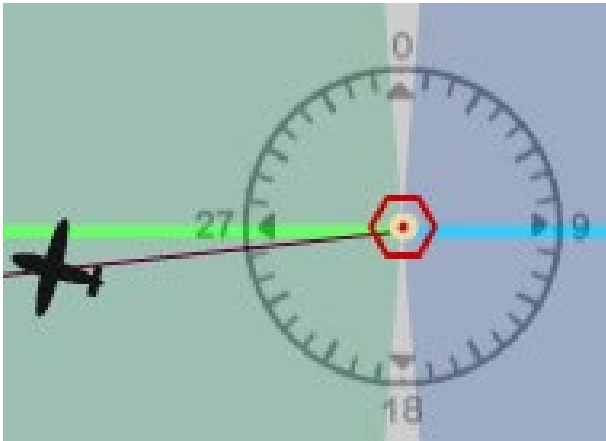
CDI set for 270, showing FROM, needle deflected right.

FROM R –

$$270 - 6 = 264$$

You are on R264.

You need to fly to the right to get back on course.





CDI Where Am I? #2

CDI set for 270, showing FROM, needle deflected to left.

FROM R+

$$270+2=272$$

You are on R272.

You need to fly to the left to get back on course.





CDI Where Am I? #3

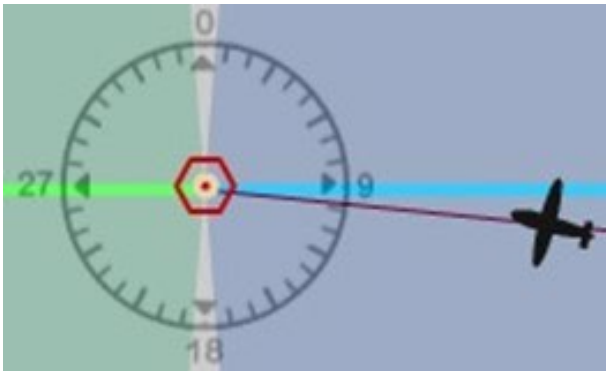
CDI set for 270, showing TO, needle deflected to right.

TO R+

$270 - 180 \Rightarrow 90 + 6 = 96$

You are on R96.

You need to fly to the right to get back on course.





CDI Where Am I? #4

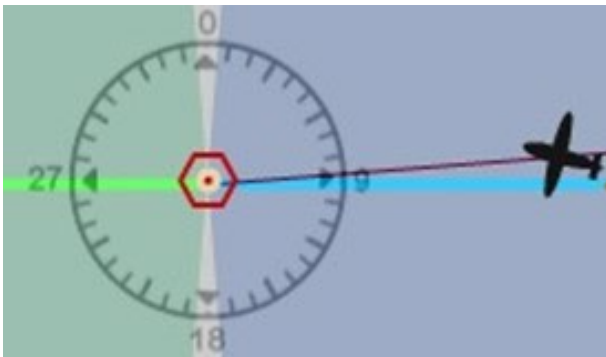
CDI set for 270, showing TO, needle deflected to left.

TO L-

$270 - 180 \Rightarrow 90 - 5 = 85$

You are on R85.

You need to fly to the left to get back on course.





HSI Where Am I? #1

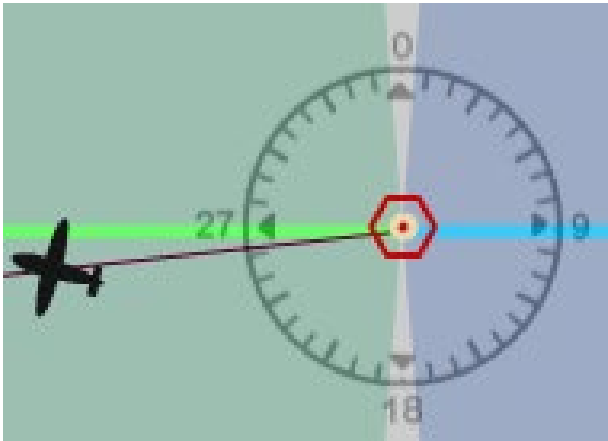
CDI set for 270, showing FROM, needle deflected right.

FROM R-

$270 - 5 = 265$

You are on R265.

You need to fly to the right to get back on course.





HSI Where Am I? #2

CDI set for 270, showing FROM, needle deflected to left.

FROM L+

$270+4=274$

You are on R274.

You need to fly to the left to get back on course.





HSI Where Am I? #3

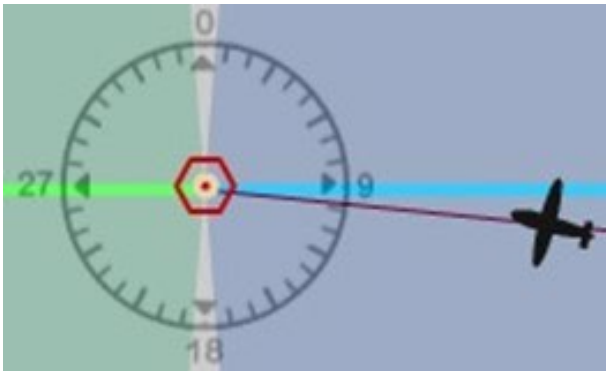
CDI set for 270, showing TO, needle deflected to right.

TO R+

$270 - 180 \Rightarrow 90 + 6 = 96$

You are on R96.

You need to fly to the right to get back on course.



Where?

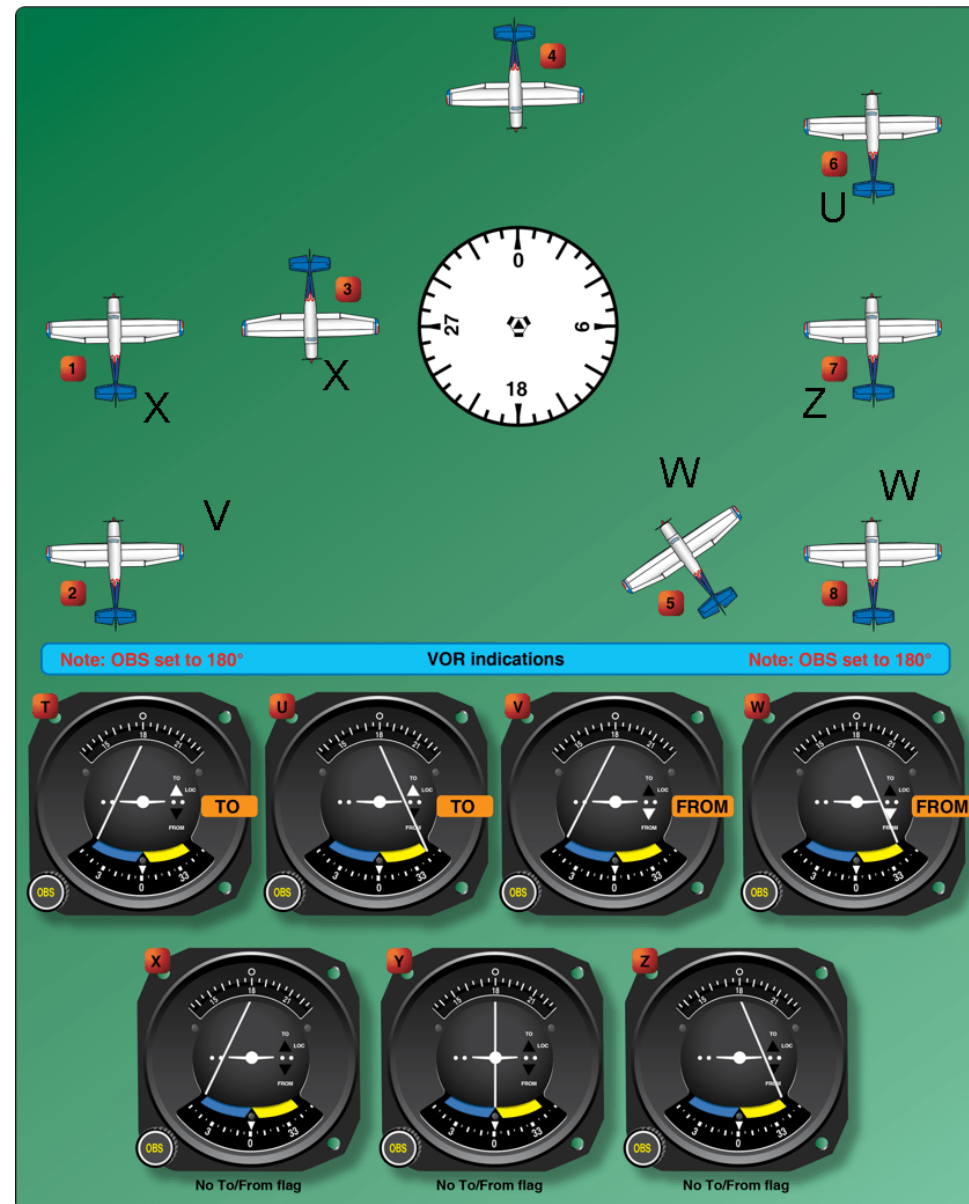


Figure 42. VOR Indicators

©ASA

Same concepts with GPS

Now that you have a better understanding of how to use the CDI or HIS as a primary navigation tool...

You can use the same concepts flying to GPS waypoints

You can use GPS OBS mode to fly to a radial terminating at a waypoint

When you are flying RNAV/GPS approaches you will use the CDI/HIS in the same respects...knowing if you are right or left of the invisible line in the sky

Time and Distance Checks

Tune and identify the VOR station.

Determine the radial on which you are located.

Then turn inbound and re-center the needle if necessary.

Turn 90° left or right, of the inbound course, rotating the OBS to the nearest 10° increment opposite the direction of turn.

Maintain heading and when the CDI centers, note the time.

Time and Distance Checks

Time to VOR = $60 * (\# \text{ minutes} / \# \text{ degrees})$

example: 5 minutes to cross 10 degrees would be 30 minutes

Distance to VOR = $GS * (\# \text{ minutes} / \# \text{ degrees})$

example: 5 minutes to cross 10 degrees going 120 kts would be 60 NM

Testing

According to 91.171, VOR receivers must be checked within 30 days. If you are using a single VOR receiver in the air it must be $\pm 6^\circ$. If you are using dual (one vs other) VOR receivers in the air it must be $\pm 4^\circ$. Log location, error, and date then sign.

VOT (VOR Test) check $\pm 4^\circ$. A VOT differs from a VOR in that it replaces the variable directional signal with another omnidirectional signal, in a sense transmitting a 360° radial (FROM 360 / TO 180) in all directions. Remember: "They are all from the north"

Record the date, place, bearing error, and sign the aircraft log or other record. No signature req.

SLED

Signature (of the pilot performing the check).

Location (of where the check took place).

Error (amount of error detected during the check).

Date (that the check took place).

VOR MON

AIM 1-1-3

f. The VOR Minimum Operational Network (MON). As flight procedures and route structure based on VORs are gradually being replaced with Performance-Based Navigation (PBN) procedures, the FAA is removing selected VORs from service.

During a GNSS disruption, the MON will enable aircraft to navigate through the affected area or to a safe landing at a MON airport without reliance on GNSS.

Navigation using the MON will not be as efficient as the new PBN route structure, but use of the MON will provide nearly continuous VOR signal coverage at **5,000 feet AGL** across the NAS, outside of the Western U.S. Mountainous Area (WUSMA).

VOR MON

Distance to a MON airport. The VOR MON will ensure that regardless of an aircraft's position in the contiguous United States (CONUS), a MON airport (equipped with legacy ILS or VOR approaches) will be within 100 nautical miles.

These airports are referred to as “MON airports” and will have an ILS approach or a VOR approach if an ILS is not available.

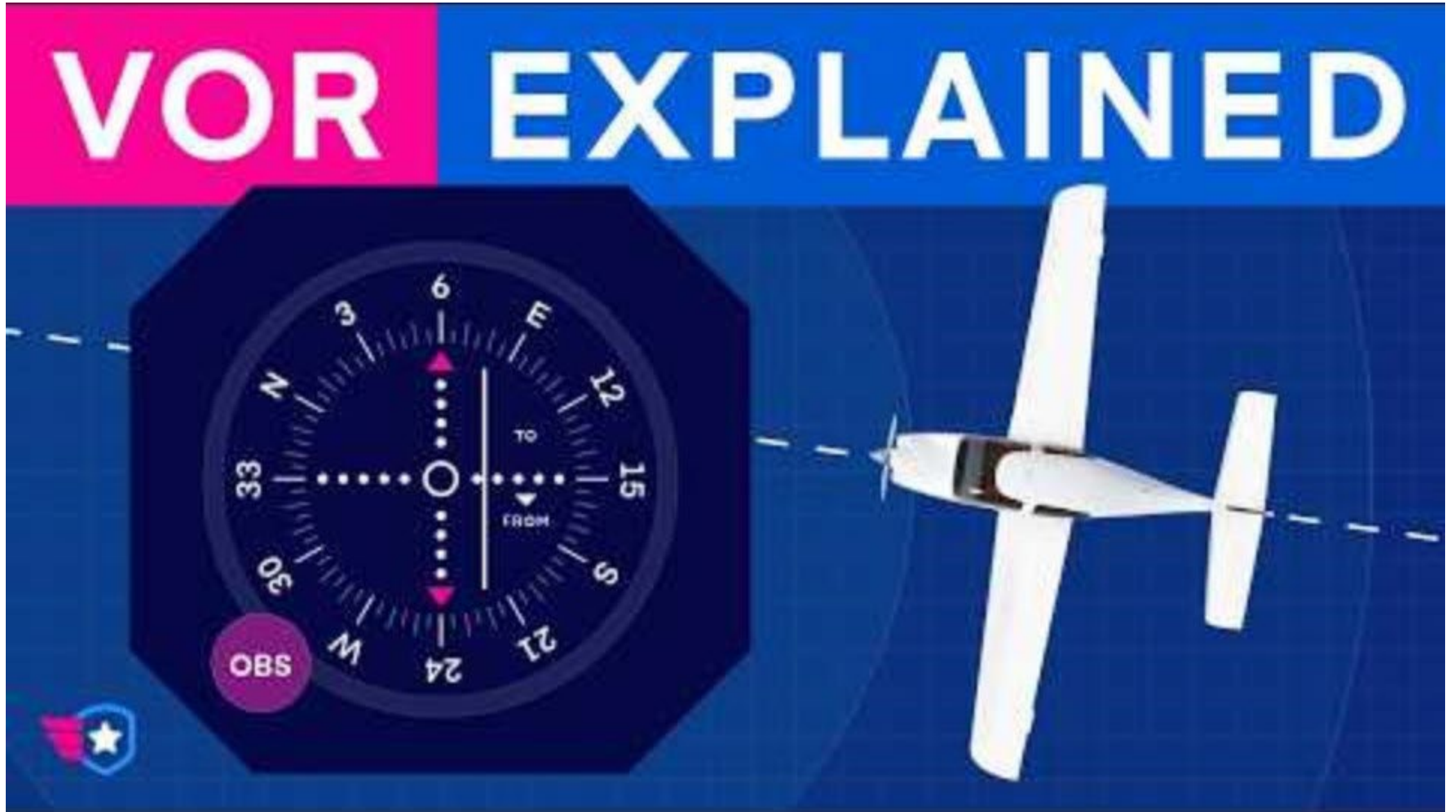
VORs to support these approaches will be retained in the VOR MON. MON airports are charted on low-altitude en route charts and are contained in the Chart Supplement U.S. and other appropriate publications.

IFR TRAINING

DME SLANT

RANGE ERROR







Any questions I can answer or
follow up later on?