

## VFR tougher than IFR

16.687

- Weather is difficult to understand and forecast
- Weather can change rapidly
- As a competent IFR pilot, only the crazy bad stuff matters: icing, thunderstorms, ground fog
- While you're a VFR-only pilot, the main risk of a non-local flight will be weather

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# Airspace Diagram

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The diagram, titled "Airspace-at-a-Glance" from the Air Safety Institute, illustrates the vertical structure of airspace classes. At the top, Class A airspace is shown in red, extending from FL 600 to 18,000 msl. Below it is Class E airspace in green, extending from 14,500 msl down to the surface. Class B (blue), Class C (purple), and Class D (light blue) are depicted as cylindrical volumes. Class G (orange) is the uncontrolled airspace at the bottom. Altitudes are marked at 700 agl, 1200 agl, and 14,500 msl. The Air Safety Institute logo and contact information (800-USA-AOPA, www.airsafetyinstitute.org) are also present.

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# 91.155 - Basic VFR Weather Minimums

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Goal: make sure that an IFR plane coming out of a cloud will have time to see and avoid you.

- Visibility and cloud clearances
  - Class A: not applicable (IFR only)
  - Class B: 3 SM and clear of clouds
  - Class C: 3 SM and 500 feet below, 1000 feet above, 2000 feet horizontal
  - Class D: 3 SM and 500/1000/2000

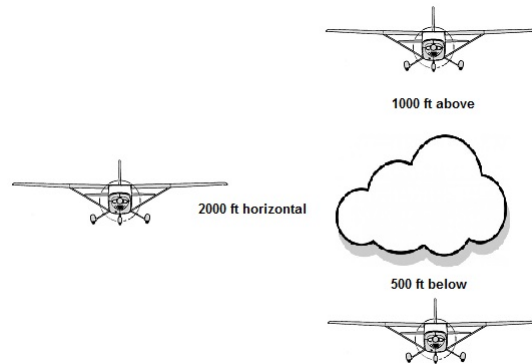
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## 91.155 - Basic VFR Weather Minimums

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- Class E:
  - Below 10,000 MSL: 3 SM and 500/1000/2000
  - At/Above 10,000 MSL: 5 SM and 1000/1000/1 SM



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## 91.155 - Basic VFR Weather Minimums

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- Class G:
  - $\leq 1200$  feet AGL:
    - Day: 1 SM and clear of clouds
    - Night: 3 SM and 500/1000/2000

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## 91.155 - Basic VFR Weather Minimums

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- Class G:
  - > 1,200 feet AGL and < 10,000 feet MSL
    - Day: 1 SM and 500/1000/2000
    - Night: 3 SM and 500/1000/2000
  - > 1,200 feet AGL and  $\geq$  10,000 feet MSL
    - 5 SM and 1000/1000/1 SM

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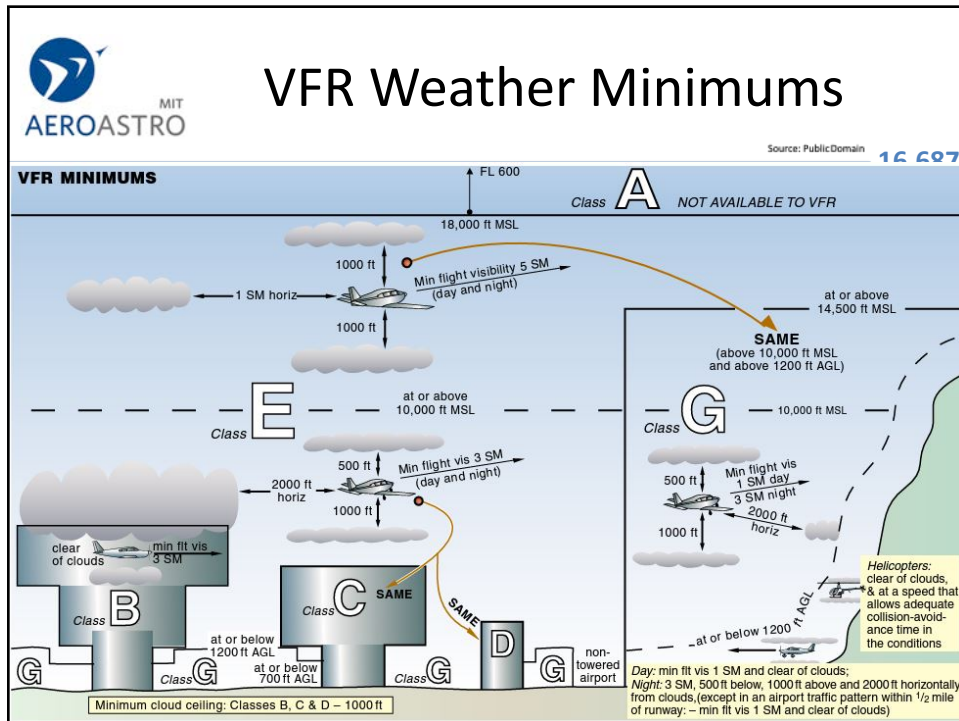
## 91.155 - Basic VFR Weather Minimums


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- Class G Exceptions!
  - At night within 1/2 mile of runway, allowed to operate with 1 SM and clear of clouds
- In controlled airspace around an airport, must have  $\geq$  1,000 foot ceiling and  $\geq$  3 SM visibility

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 **91.157 - Special VFR Weather Minimums**

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- With ATC Clearance
- 1 SM visibility
- Clear of clouds
- At night, aircraft and pilot are IFR equipped and rated
- ATC cannot offer; you must request

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## Cirrus Personal Minimum Matrix

Source: Public Domain **16.687**

GENERAL PILOT MINIMUMS				INSTRUMENT FLIGHT MINIMUMS	
CURRENT PILOT CAPABILITY CATEGORY	WIND LIMITS	VFR MINIMUMS		CURRENT PILOT CAPABILITY CATEGORY	IFR MINIMUMS
●	Wind: 15kts X-wind: 5kts Max Gust: 5kts	Day 8000' Ceilings 10 SM Visibility	Night 5000' Ceilings 10 SM Visibility	●	1500' / 3 SM Current Reported Weather
■	Wind: 20kts X-wind: 10kts Max Gust: 10kts	Day 3000' Ceilings 10 SM Visibility	Night 5000' Ceilings 10 SM Visibility	■	500' / 2 SM Above Published Approach Minimums
◆	Wind: 35kts X-wind: 20kts Max Gust: 15kts	Day 3000' Ceilings 5 SM Visibility	Night 5000' Ceilings 10 SM Visibility	◆	Published Approach Minimums

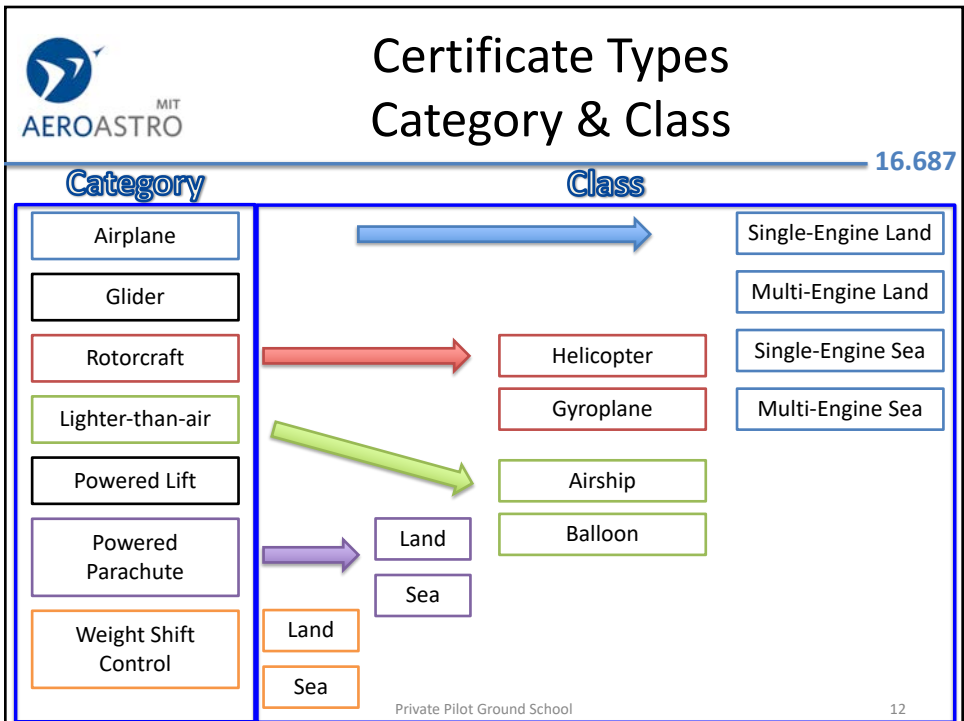
<b>INFREQUENT FLYER</b> 	<b>AVERAGE PILOT</b> 	<b>ELITE AVIATOR</b> 
<b>General</b> 12-24 mo since last training <60 hrs last 12 mo 10 hrs last 90 days  <b>Instrument</b> <5 IFR hrs last 90 days <1 hr IMC last 90 days No approaches last 90 days	<b>General</b> 6-12 mo since last training 100-180 hrs last 12 mo 25-30 hrs last 90 days  <b>Instrument</b> 10-25 IFR hrs last 90 days 1-3 hrs IMC last 90 days 1-4 AP approaches last 90 days 1 Non-AP approaches last 90 days	<b>General</b> <6 mo since last training >200 hrs last 12 mo >50 hrs last 90 days  <b>Instrument</b> >35 IFR hrs last 90 days >3 hrs IMC last 90 days >4 AP approaches last 90 days >2 Non-AP approaches last 90 days

**NIGHT OPERATIONS**  
 Decrease Wind Limits by 5 kts  
Increase Vigilance When Conducting Instrument Approach Procedures

**ICING CONDITIONS**  
 Flight Into Icing Conditions is Hazardous  
Refer to Airplane Flight Manual Limitations

Flying within the Envelope of Safety will not guarantee a safe flight. Pilots must comply with regulations, exercise sound judgment, and maintain a high level of flying proficiency to minimize the risks associated with flight. Cirrus Aircraft company pilots comply with and endorse the Envelope of Safety.



## Categories and Classes

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- With respect to certification of AIRCRAFT

- Category

- Normal (+3.8/-1.52g)
- Utility (+4.4/-1.76g)
- Acrobatic (+6/-3g)
- Commuter and Transport



- Class

- Airplane
- Rotorcraft
- Glider
- Balloon
- Powered Lift



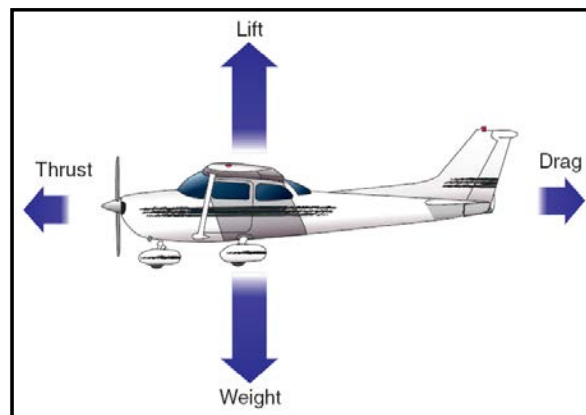
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## Four Forces of Flight

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- Lift
- Weight
- Thrust
- Drag



Source: Public Domain

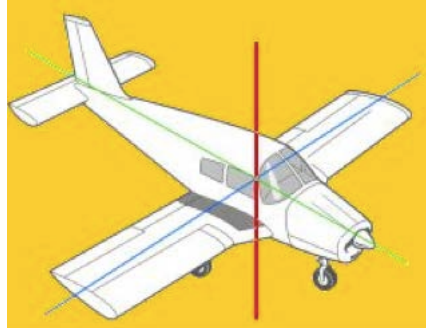
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## Three Axes of Flight

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- Longitudinal (green)
  - Nose to tail
- Lateral (blue)
  - Wingtip to wingtip
- Vertical (red)
  - Top to bottom



Source: Public Domain

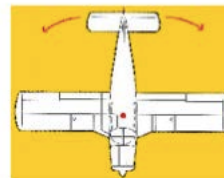
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## The Flight Controls

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- **Elevator** to control **Pitch**
  - Motion about the lateral axis
- **Ailerons** to control **Roll**
  - Motion about the longitudinal axis
- **Rudder** to control **Yaw**
  - Motion about the vertical axis



Source: Public Domain

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# Why Johnny Cessna can't hover

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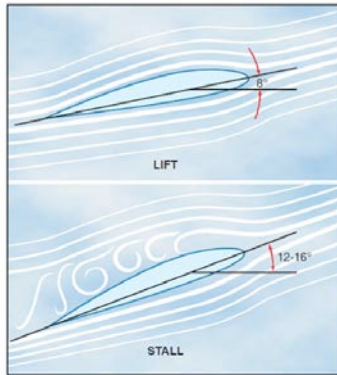
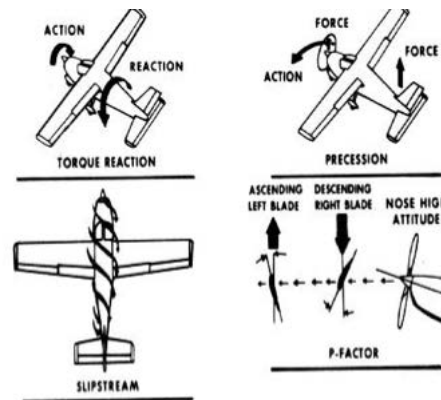


Figure 2-5. As the angle of attack is increased, the separation point starts near the trailing edge of the airfoil and progresses forward. Finally, the airfoil loses its lift and a stall condition occurs.  
Source: Public Domain

# Left Turning Tendencies

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- Torque
- P Factor
- Spiraling Slip Stream
- Gyroscopic Precession
  - This is not always a left turning tendency



Source: Public Domain



# Altitude Definitions

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- True – actual height above sea level
- Indicated – what is shown on altimeter
- Absolute – height above the ground
- Pressure – height above standard datum plane (29.92" Hg), read from altimeter set to 29.92"
- Density – pressure alt. corrected for non standard temperature



# Taxiway and Runway Markings

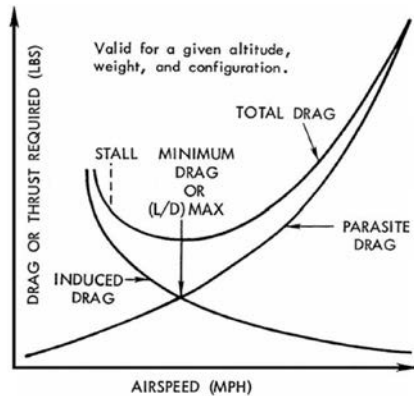
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	<b>ILS critical area holding position sign</b> When the ILS is in use ATC may hold you short of this sign so your aircraft does not interfere with the ILS signal.		<b>Runway boundary sign</b> This sign faces the runway and is visible to pilots exiting the runway. Taxi past this sign to be sure you are clear of the runway.
	<b>Runway approach area holding position sign</b> You must hold at this sign until cleared to cross the runway, to avoid interference with runway operations.		<b>Taxiway ending marker</b> This sign indicates the termination of the taxiway. It is located at the far end of the intersection.
	<b>Taxiway location sign</b> This sign indicates which taxiway you're on. It may be posted next to direction or holding position signs.		<b>Closed runway and taxiway marking</b> Located at both ends of permanently closed runways and at 1,000-foot intervals. It is also placed at taxiway entrances if they are permanently closed.
	<b>Runway holding position sign</b> Until cleared onto the runway you must hold at this sign. In this example, the runway 15 threshold is to the left and the runway 33 threshold is to the right.		<b>Direction sign for runway exit</b> This sign will indicate the approaching taxiway while on the runway. In this example, taxiway Bravo is approaching to the left.
	<b>Destination signs and location sign</b> This sign indicates current position and direction to other taxiways. In this example, you are on taxiway Alpha. Taxiway Charlie passes from right to left and Alpha continues ahead to the right.		<b>ILS critical area boundary sign</b> Indicates when you are safely clear of the ILS critical area. It is located directly beside the ILS holding position markings. While ILS approaches are in use, taxi past the sign before stopping on the taxiway.
	<b>Outbound destination sign</b> This sign indicates directions to common taxi routes. In this example, runway 27 and 33 are to the right. The dot in the middle separates destinations identified on the sign.		<b>Holding position and location signs</b> In this example you are on taxiway Alpha; runway 5-23 passes perpendicular to your position. Runway 9-27 passes at an angle starting ahead and left of your position to behind and right of your position.
	<b>Inbound destination sign</b> This sign directs pilots to destinations on the airport. This example indicates that the military installation is to the right.		<b>Runway location sign</b> This sign identifies the runway on which your aircraft is located.

## Best Glide Ratio

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- What airspeed would you fly when you lost your engine? Why?
- $L/D_{MAX}$  is the airspeed at which the aircraft covers maximum distance for a given altitude loss



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## Thunderstorms

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- Cumulonimbus = greatest turbulence
  - Conditions for thunderstorm formation:
    - Lifting action
    - Unstable air
    - Moist air
- Squall Line: frontal band of thunderstorms
  - Produce the most intense weather hazards for aircraft!
  - Typically develops in front of a cold front



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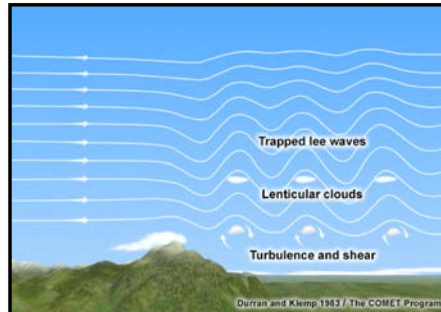
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## Mountain Wave Turbulence

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- Get additional training before flying out West. Cessna v. Mountain is an unequal contest.
- Mountain Wave Turbulence:
  - Expect it when winds across a ridge are 40 knots or greater and the air is stable
  - Crests of mountain waves may be marked by lens-shaped, or lenticular clouds
    - Lenticular clouds can look stationary but may contain winds of > 50 knots!



Source: Public Domain

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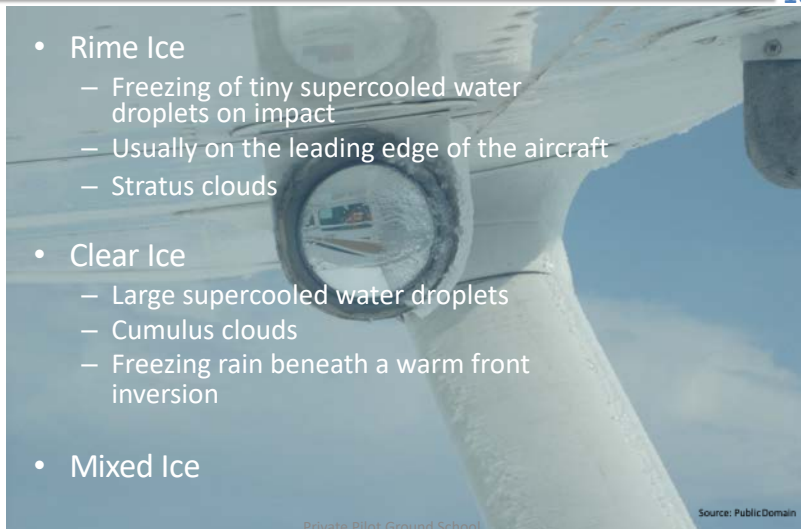
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## Structural Icing

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- Rime Ice
  - Freezing of tiny supercooled water droplets on impact
  - Usually on the leading edge of the aircraft
  - Stratus clouds
- Clear Ice
  - Large supercooled water droplets
  - Cumulus clouds
  - Freezing rain beneath a warm front inversion
- Mixed Ice



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## Aviation Routine Weather Report METAR

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- KPDK 161653Z VRB04KT 10SM OVC060 14/07 A3015 RMK AO2 RAE46 SLP209 T01390072=
- Location: Peachtree Dekalb Airport
- Date: 16<sup>th</sup> of the month
- Time: 16:53 Z
- Time: 12:53 PM EDT
- Wind Direction: Variable
- Wind Speed: 04 knots
- Visibility: 10 Statute Miles
- Clouds/Wx/Remarks: Overcast 6000
- Temperature: 14 C
- Dewpoint: 07C
- Altimeter Setting: 30.15 in Hg
- Remarks ...

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## Our Human Factors Summary

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- The newest airplanes are essentially products of the 1950s.
- Therefore, you are the weakest link.
- Personal minimums should be a function of recent experience.
- If you know that you won't be at your best, grab a co-pilot or CFI!

## Magnetic Variation

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- Isogonic Lines (correction factor to convert **from True to Magnetic**)
  - Dashed magenta lines on sectional charts
  - Memory aid: east is least, west is best (subtract east, add west)

*Deviation* is the compass card!

VORs are magnetic headings. If you forget the above, derive it from a Sectional chart.



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## Flight Planning Tip

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- FAR 61/91 allow for a lot of dangerous stuff, e.g.:
- flying at night with no instrument rating
  - flying single-pilot IFR with no autopilot
  - planning to land on a minimum-length runway

Consider adopting FAR 135 (charter) and FAR 121 (airlines) operating limitations as personal minimums, e.g., land in 60 percent of runway.

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## Night flying advice

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- Try to take off before civil twilight; gives you time to adjust to the world of darkness
- Americans are not smarter than Mexicans: Treat any non-local night flight as an instrument flight. Use IFR approach to find the correct runway at the correct airport ([alternative](#))
- Choose a big airport as your destination
- Ballistic parachute is comforting at night

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## Owner/Operator is Responsible

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- “The owner or operator of an aircraft is primarily responsible for maintaining that aircraft in an **airworthy** condition” (91.403)
- 91.405: “Each owner or operator of an aircraft
  - “Shall have that aircraft inspected...”
  - “Shall ensure that maintenance personnel make appropriate entries in the aircraft maintenance records...”
  - Must fix or placard INOP anything broken

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## 91.3 - Responsibility and Authority of PIC

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- Pilot in command is directly **responsible** for, and is the **final authority** as to, the operation of the aircraft
- Allowed to deviate from rules in an emergency
- Report deviation *if requested to*

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## Safety is not high-tech

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- Well, if the fanciest airplanes were as smart as the cheapest DJI drones, maybe it would be...
- Airline safety can be adapted to GA:
  - Recurrent training
  - Develop and practice instrument flying skills
  - Two-pilot crew
  - Checklists

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## All of those regulations

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Code of Federal Regulations *http://www.ecfr.gov*

```

graph TD
    CFR[Code of Federal Regulations] --> Title14[Title 14 – Aeronautics and Space]
    CFR --> Title49[Title 49 – Transportation]
    Title14 --> Relevant[Most relevant parts:]
    Title49 --> Part830[Part 830 – Notification and Reporting of Accidents]
  
```

**Most relevant parts:**

- Part 1 – Definitions and Abbreviations
- Part 39 – Airworthiness Directives
- Part 43 – Maintenance
- **Part 61 – Pilot Certification**
- Part 67 – Medical Certification
- **Part 91 – General Operating Rules**

Part 830 – Notification and Reporting of Accidents

<Title #> CFR <Part #>.<Regulation #>  
e.g. 14 CFR 61.56

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## Study Guide

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To get close to 100 on the FAA Knowledge test:

- Re-read the FAA textbooks
- Read FAR/AIM
- Read an ASA or Gleim test-prep book (or use the online equivalents)
- To finish this class:  
<https://www.kingschools.com/free-faa-exam/private-pilot>

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## Next Steps

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- Join the MIT Flying Club
- Visit a flight school...
  - Hanscom Field (East Coast Aero Club)
  - Norwood (ECAC, Horizon, or Blue Hill Helicopters)
  - Beverly (Avier)
  - Lawrence (Eagle East)



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## Thanks

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Thanks for spending this week with us.

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