pilotinstitute

Private Pilot

Study Sheet

Table of Contents

Pilot Qualifications

Requirements

FAR 61.103

- Minimum Age- 17 years old.
- Read, speak, write, and understand English.
- Receive flight training and logbook endorsement from authorized instructor.
- Pass Private Pilot Knowledge Test.
- Meet aeronautical experience. requirements (FAR 61.109).
- Hold U.S. student, sport, or recreational pilot certificate.
- Hold at least a third-class medical certificate or comply with BasicMed requirements (FAR 61.23).

Privileges

FAR 61.113

- Act as PIC of an aircraft.
- Act as PIC of an aircraft for compensation or hire in connection with business if the flight is incidental to the business and doesn't carry passengers or cargo for hire.
- Reimbursed for search and location operating expenses.
- PIC for charity.
- Demonstrate aircraft to potential buyer (with at least 200 hours flight time).
- Test fly aircraft after major alteration.

Limitations

FAR 61.113

- Cannot act as PIC or SIC for an aircraft that carries passengers or cargo for hire.
- Cannot pay less than the pro-rata share.

Special Endorsement Required

FAR 61.31

- **Tailwheel**.
- **Complex**: Has flaps, retractable gear, and variable pitch propeller.
- **High performance**: One engine has more than 200 horsepower.
- **High altitude**: Service ceiling above 25,000'.

Responsibilities of PIC

- Carry pilot's license, government-issued photo ID, and medical certificate (FAR 61.3).
- Responsible for and the final authority over the operation of the aircraft (FAR 91.3(a)).
- Ensure the aircraft is airworthy before flight (FAR 91.7).
- In an in-flight emergency, the PIC may deviate from any FAR as necessary to meet the emergency (FAR 91.3(b)).

Currency

Definition: Minimum legal requirements to act as PIC under specified conditions. Must be completed in the same category, class, and type (if type rating is required) of aircraft.

To act as PIC

FAR 61.56

Every 24 calendar months:

- Flight Review, OR
- Obtain another certificate or rating, OR
- Complete at least one FAA WINGS phase.

To carry passengers

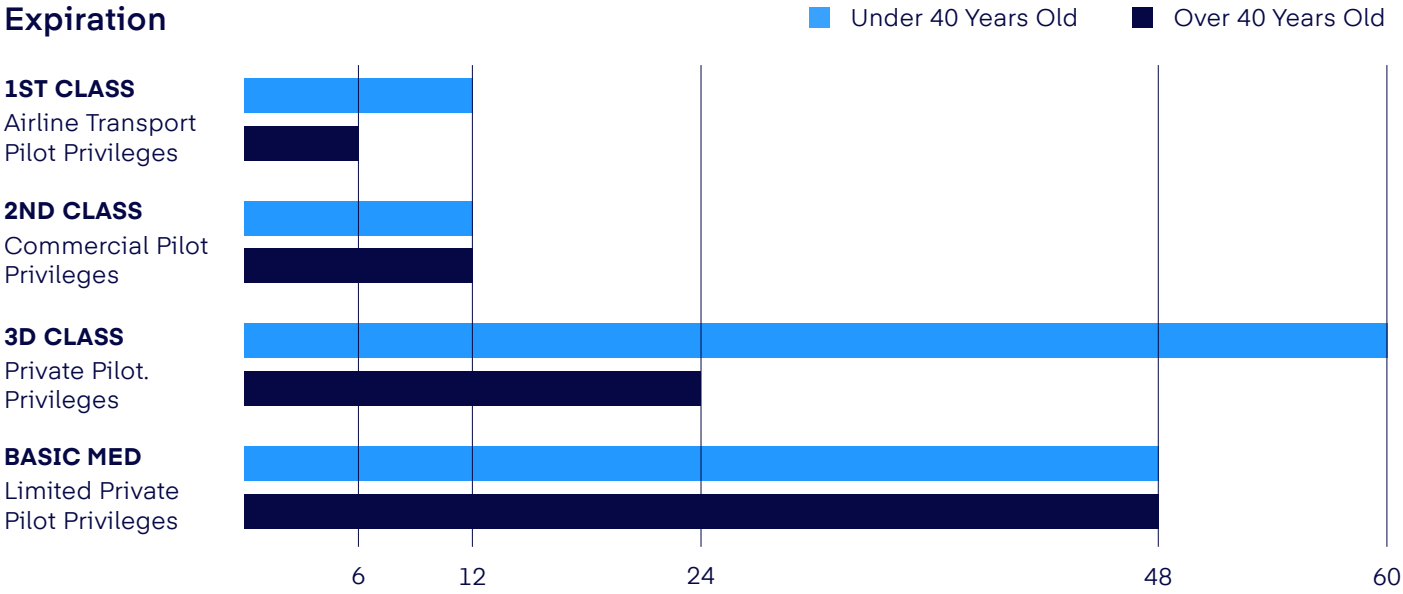
FAR 61.57

- Day: 3 takeoffs and landings within the preceding 90 days.
- Night (or tailwheel): 3 takeoffs and landings to a full stop within the preceding 90 days.

MEDICAL CERTIFICATES

FAR 61.23

Expiration



For operations requiring the following classes of medical (Privileges)	Types of medical certificate that can be used	How long your medical certificate is valid for	
		Under 40 years old	40 years old and over
1st Class (ATP)	1st class only	12 calendar months	6 calendar months
2nd Class (Commercial)	1st or 2nd class	12 calendar months	12 calendar months
3rd Class (Private or CFI)	1st, 2nd or 3rd classes	60 calendar months	24 calendar months

BasicMed

FAR Part 68

- Available to pilots who held a valid medical certificate after July 14, 2006.
- Requires a physical exam every 48 months and an online course every 24 months.
- Not valid for operations requiring compensation or hire.

If unable to obtain a medical

- **Special Issuance** (FAR 67.401): A limited medical certificate issued for pilots with disqualifying conditions such as mental, neurological, or cardiovascular disorders. Requires case-by-case evaluation.
- **SODA (Statement of Demonstrated Ability):** Allows a pilot with non-progressive medical conditions (e.g.,color vision deficiency, missing limb) to obtain a medical certificate after demonstrating the ability to safely operate an aircraft.

Airworthiness Requirements

Equipment Required

FAR 91.205

VFR day (ATOMATOFLAMES)

- **A** **A**irspeed indicator.
- **T** **T**achometer.
- **O** **O**il pressure gauge.
- **M** **M**agnetic compass.
- **A** **A**ltimeter.
- **T** **T**emp gauge (for each liquid-cooled engine).
- **O** **O**il temp gauge (for each air-cooled engine).
- **F** **F**uel quantity gauge.
- **L** **L**anding gear position indicator- if landing gear can retract.
- **A** **A**nti-collision lights.
- **M** **M**anifold pressure gauge- only if aircraft has turbocharger or a variable pitch prop.
- **E** **E**LT.
- **S** **S**eat belts.

VFR night (FLAPS)

- **F** **F**uses (spare set or 3 of each) if accessible during flight.
- **L** **L**anding light (if operating for hire).
- **A** **A**nti-collision light system.
- **P** **P**osition (navigation) lights.
- **S** **S**ource of electricity.

Unairworthy and Still Needs to Fly?
FAR 21.197

Get a special Flight Permit: For when aircraft is NOT airworthy but safe for flight.

Flying With Inoperative Instruments And Equipment

FAR 91.213

With MEL	Without MEL	
	Things to check	Things to do
Minimum Equipment List: What can be inoperative and still legal to fly.	• VFR-day type certification (Part 23). • KOEL (Kinds of Operations Equipment List). • 14 CFR Part 91.205. • ADs (Airworthiness Directives).	• Deactivate/ remove. • Placard inop in accordance with 91.213. • Log maintenance in accordance with 91.213.

INSPECTIONS AND DOCUMENTS

Inspections (AAV1ATE)

Annual Inspection (FAR 91.409).
- Every 12 calendar months.
- Can count for 100-hour.

Airworthiness Directives (FAR 91.403).

VOR Equipment Check (FAR 91.171). Every 30 days; IFR-only.

100-hour Inspection (FAR 91.409).
- If flying for hire or instruction.
- Cannot count for annual.

Altimeter (FAR 91.411). Every 24 calendar months; IFR-only.

Transponder (FAR 91.413). Every 24 calendar months.

ELT (FAR 91.207).
- Every 12 calendar months.
- Battery replaced/recharged after 1 hour cumulative use or ½ useful life.

Preventive Maintenance

Appendix A part 43.

Must be performed by owner of the aircraft who holds a certificate of competency (e.g., private pilot certificate) for that aircraft.

Documents (ARROW)

FAR 91.203, 91.9, 23.2620.

- **A**irworthiness Certificate.
- **R**egistration.
- **R**adio Operators License (if international).
- **O**perating Limitations (AFM/ POH, supplements, placards, markings).
- **W**eight and Balance.

Weather Information

WEATHER PRODUCTS

METAR

Aviation routine weather report; issued hourly.

```
METAR KJFK 121651Z
22015G25KT -RA 10SM FEW020
OVC050 25/17 A2985 RMK AO2
```

CODE	MEANING
KJFK	Airport code
121651Z	**Date/Time Issued**: 12th day of the month at 1651 Zulu
22015G25KT	**Wind** from 220° at 15 knots, gusting to 25 knots
10SM	**Visibility**: 10 statute miles
-RA	**Wx**: Light rain
FEW020 OVC050	**Sky**: Few clouds at 2,000'; overcast at 5,000' (AGL)
25/17	**Temp** 25°C, Dew point 17°C
A2985	**Altimeter** setting 29.85 inHg
RMK AO2	**Remarks**: Automated station with precip sensor

TAF

Terminal Aerodrome Forecast; valid for 24 or 30 hours; issued 4 times daily.

```
TAF KJFK 121720Z 1218/1324
22015G25KT P6SM FEW020
FM122200 22012KT P6SM
SCT050
TEMPO 1300/1304 5SM SHRA
```

CODE	MEANING
KJFK	Airport code
121720Z	**Date/Time Issued**: 12th day of the month at 1720 Zulu
1218/1324	**Valid** from 12th at 1800Z to 13th at 2400Z
22015G25KT P6SM FEW020	**Initial forecast** (P6SM: Visibility > 6 SM)
FM122200	**From** 12th at 2200Z
22012KT P6SM SCT050	**FM forecast**
TEMPO 1300/1304	**Temporary**, from 13th 0000Z to 0400Z
5SM SHRA	**TEMPO forecast**

Common TAF Codes

FM	From a specific time [DDHHmm] (rapid change).
BECMG	Becoming (gradual change).
TEMPO	Temporary conditions [DDHH/DDHH].
PROB30	30% probability.

PIREP

Pilot weather report; provides actual inflight conditions. Either Routine (UA) or Urgent (UUA).

```
UA /OV KXYZ 090025 /TM 1520 /FL060 /TP C172 /SK BKN050-TOP070 /WX RA /TA 05
/WV 280030 /TB LGT /IC NEG /RM LLWS ±10KT SFC-030
```

UA or UUA	/OV	/TM	/FL	/TP	/SK
Type	Location*	Time (Z)	Altitude	Aircraft Type	Sky Condition
/WX	**/TA**	**/WV**	**/TB**	**/IC**	**/RM**
Weather	Temp	Wind	Turbulence	Icing	Remarks

* Radial/Distance

Notes

Altitudes: Reported in hundreds of feet MSL.
Wind Direction: In degrees true.
Temperature: Celsius. Prefix M for negative temps.
Visibility: Statute miles (SM).
Wind Speed: Knots.

Winds and Temperatures Aloft Forecast (FB)

Winds not forecasted within 1,500 ft of station elevation.
Temps not forecasted for 3,000' level or within 2,500' of station elevation.
Temps above 24,000 ft are always negative (no minus sign).

```
FD1US1
DATA BASED ON 071200Z
VALID 071800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000
```

FT	3000	6000	...	24000	39000
KJFK	6000	2512+02		2945-45	771152

Fb Encoding Format

DD	Wind direction (10s of degrees, true)
SS	Wind speed (knots)
TT	Temperature (°C)

Winds < 5 kts: 9900±TT.
Winds < 100 kts (but > 5 kts): DDSS±TT.
Winds > 100 kts (but < 200 kts): [DD+50][SS-100]±TT

Decoded Examples

Code	Meaning
9900	Light and variable winds (<5 knots).
2512+02	Wind from 250° at 12 knots. Temp plus 2°C.
2945-45	Wind from 290° at 45 knots. Temp minus 45°C.
771152	Wind from 270° (77-50) at 111 knots (11+100). Temp minus 52°C.

Essential Weather Abbreviations

Weather Phenomena

Code	Meaning
RA	Rain
SN	Snow
FG	Fog
BR	Mist
HZ	Haze
TS	Thunderstorm
SH	Showers
DZ	Drizzle
FZ	Freezing
GR	Hail
UP	Unknown Precipitation*
DU	Dust
SA	Sand
FU	Smoke

Sky Condition

Code	Meaning	Code	Meaning
SKC/ CLR	Sky Clear	BKN	Broken Clouds (5/8 to 7/8 coverage)
FEW	Few Clouds (1/8 to 2/8 coverage)	OVC	Overcast (8/8 coverage)
SCT	Scattered Clouds (3/8 to 4/8 coverage)	VV	Vertical Visibility**

Intensity or Proximity

Code	Meaning	Code	Meaning
-	Light intensity	+	Heavy intensity
(No sign)	Moderate intensity	VC	In the vicinity (5-10 SM)

Other Abbreviations

Code	Meaning	Code	Meaning
RVR	Runway Visual Range	CIG	Ceiling
WS	Wind Shear	VIS	Visibility
LLWS	Low-Level Wind Shear	WX	Weather
VRB	Variable wind direction	SLP	Sea Level Pressure

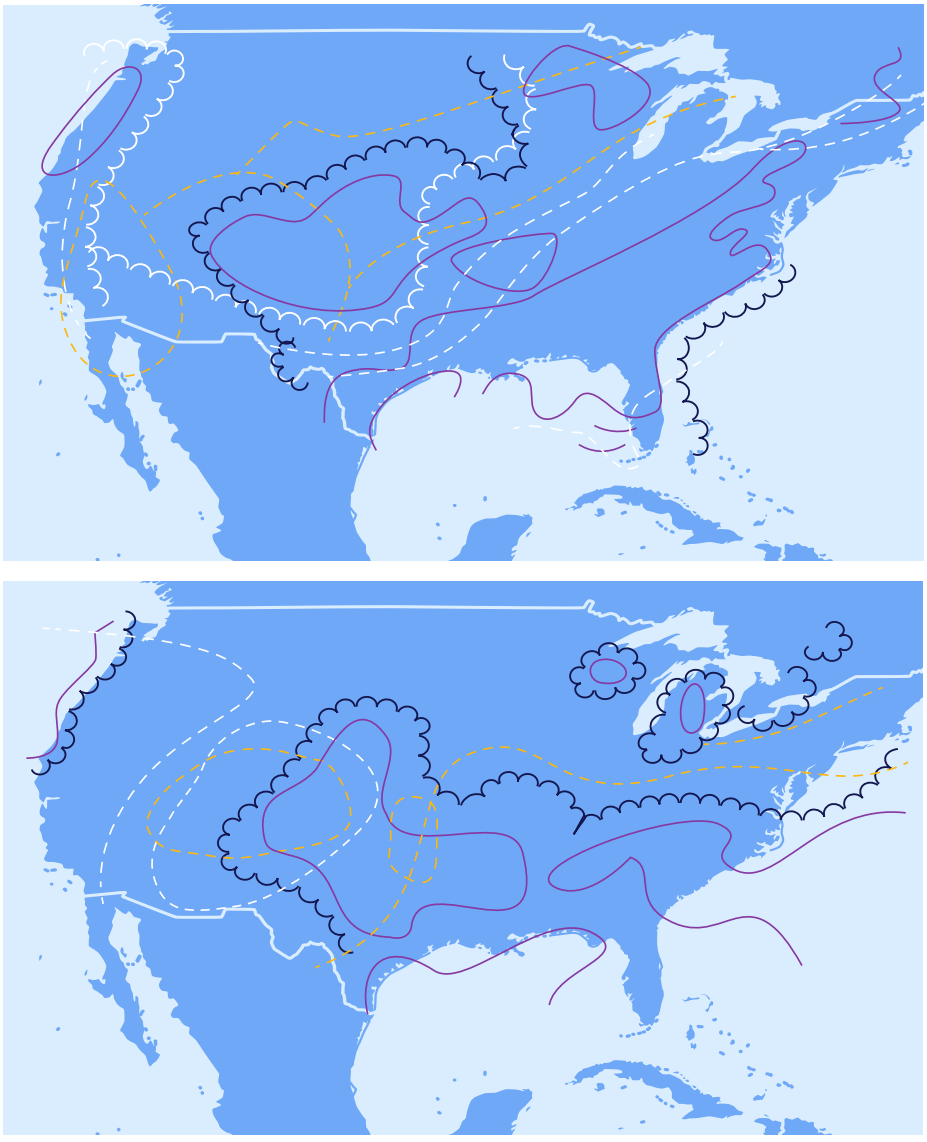
* Automated stations.
** Indefinite ceiling.

Standard Brief Elements

Adverse Conditions: Significant weather that may affect flight.
VFR Flight Not Recommended: When conditions are below VFR minimums.
Synopsis: Big-picture weather patterns.
Current Conditions: METARs along route.
En Route Forecast: Expected weather along route.
Destination Forecast: TAF for arrival area.
Winds Aloft: Forecast winds at various altitudes.
NOTAMs: Notices to Airmen about changes or hazards.

Low-Level Significant Weather Prognostic (SIGWX)

Significant weather forecast at the surface and low altitudes (up to 24,000 feet MSL).
Shows areas of VFR, MVFR, and IFR conditions, as well as turbulence, icing, and freezing levels.



Flight planning only. See TAFs for specific terminal forecast:

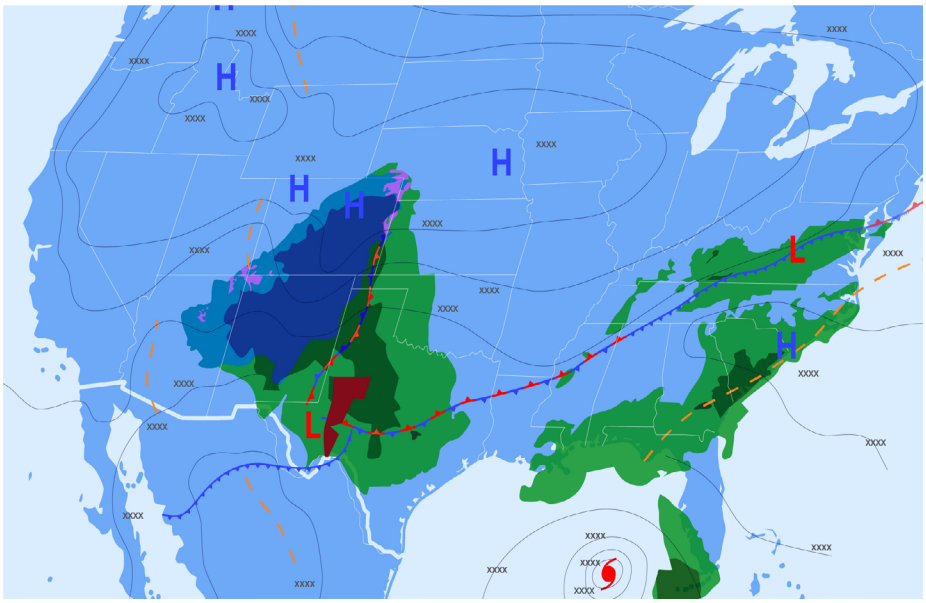
Ceiling less than 1000ft and/or visibility less than 3 miles

Ceiling 1000-3000ft inclusive and/ or visibility 3-5 miles inclusive

Moderate or greater turbulence

Freezing level above mean sea level

Freezing level at surface



Surface Prognostic

Depicts forecasted weather patterns at the surface for a specified future time period. Includes information on **pressure systems, fronts, precipitation,** and **general weather conditions.** Closely spaced **isobars** indicate a steeper pressure gradient (more wind).

Weather Briefing Types

Standard: Complete weather picture.
Abbreviated: Update or supplement.
Outlook: For departures ≥6 hours away.

AIRMET

Issued for moderate weather that may affect small aircraft.

Types:

- AIRMET Sierra: IFR conditions and mountain obscuration.
- AIRMET Tango: Moderate turbulence, sustained surface winds ≥30 knots, low-level wind shear.
- AIRMET Zulu: Moderate icing and provides freezing level information.

Issued: Every 6 hours (or as needed).

SIGMET

Advises of severe weather conditions (not associated with thunderstorms) hazardous to all aircraft.

Conditions:

- Severe icing.
- Severe or extreme turbulence.
- Dust storms, sandstorms, volcanic ash reducing visibility to < 3 miles.

Duration: Valid for up to 4 hours.

Convective SIGMET

Issued for convective weather hazards like thunderstorms.

Conditions:

- Embedded thunderstorms.
- A line of thunderstorms.
- Thunderstorms with heavy precipitation affecting 40%+ of an area at least 3,000 square miles.
- Surface winds ≥ 50 knots due to severe thunderstorms.
- Hail ≥ ¾ inch in diameter.
- Tornadoes.

Issued: Hourly, valid for up to 2 hours.

THE ATMOSPHERE

Pressure Systems

High Pressure: Clockwise rotation, sinking air. Typically brings clear skies and stable conditions.
Low Pressure: Counterclockwise rotation, rising air. Associated with clouds, precipitation, and unstable weather.

Dew Point

The temperature at which air must be cooled to become saturated and form clouds. A small temperature/dew point spread increases the likelihood of fog, low clouds, or carburetor icing.

Stability

Cool, dry air resists vertical movement (stable).
Warm, moist air is unstable and can form thunderstorms.

Temperature Inversion

Temperature increases with altitude (opposite of normal lapse rate).
Stable air, poor visibility, risk of wind shear at inversion layer.

Standard Lapse Rate

Temperature decreases **2°C per 1,000′.**
Pressure decreases **1" Hg per 1,000′.**

Fronts

Warm	Cold	Stationary	Occluded
Stratiform clouds, poor visibility	Towering cumulus, thunderstorms, good visibility	Hardly moves, a combination of cold and warm front weather	Severe weather

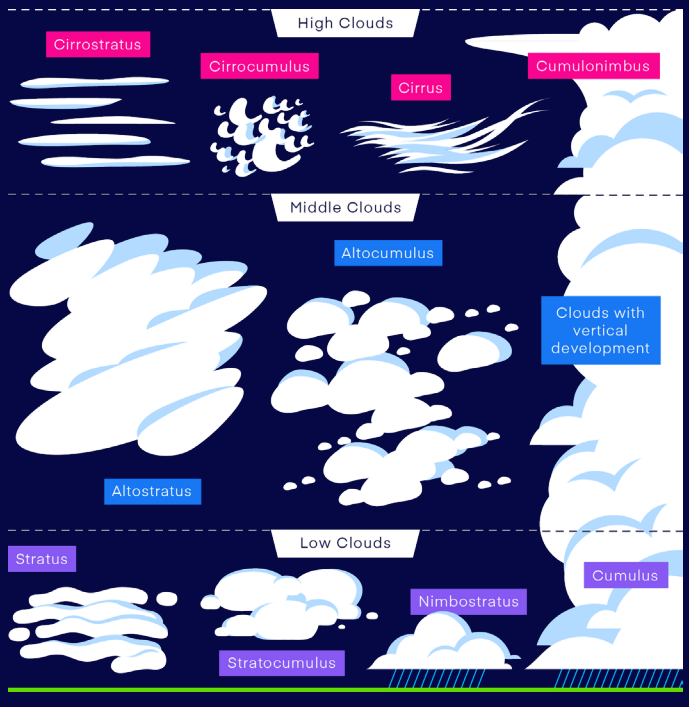
Clouds

Cloud names combine a height prefix (like cirro- or alto-) with a form type (like cumulus or stratus).

Cloud Base Height Ranges:
Low: Bases below 6,500′ AGL (no prefix).
Middle: Bases 6500-20,000′ AGL (prefix **"alto-"**).
High: Bases above 20,000′ AGL (prefix **"cirro-"**).

Extensive Vertical Development: Towering clouds indicate instability.

Form Classification
Cumulus: Heaped or piled (puffy).
Stratus: Layered.
Cirrus: Wispy, thin, high.
Nimbus: Rain-bearing.
Lenticular: Lens-shaped, forms over mountains.



WEATHER HAZARDS

Icing

Dangers
Increased weight: More lift is needed to maintain altitude.
Reduced lift: Disrupted airflow decreases wing efficiency.
Increased drag: More resistance slows the aircraft.
Decreased thrust: Ice on the propeller reduces engine efficiency.

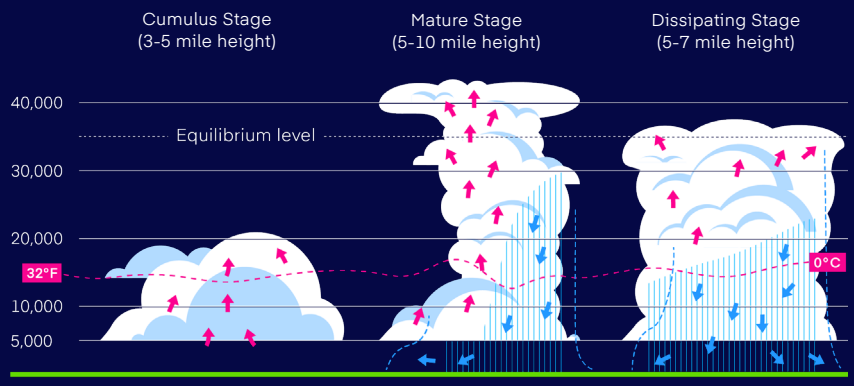
Intensity
Trace: Perceptible, not hazardous.
Light: Occasional use of deicing/anti-icing systems needed.
Moderate: Hazardous accumulation; frequent deicing required.

Severe: Rapid buildup overwhelms deicing systems; immediate diversion required.

Types
Clear Icing: Smooth, transparent ice from large droplets, spreading over surfaces. Forms between 0°C and -10°C.
Mixed Icing: A blend of rime and clear, creating uneven, rough buildup. Forms between -10°C and -15°C.
Rime Icing: Opaque, rough ice from small droplets, usually on leading edges. Forms between -15°C and -20°C.
Frost: Thin ice layer forming when a surface is below freezing and dew condenses.

Thunderstorms

Requirements to form: sufficient **moisture**, an **unstable lapse rate**, and a **lifting action**.



Stages

Cumulus: Warm, moist air rises, forming strong updrafts and vertical cloud growth (instability).

Mature: The most intense stage, with strong updrafts and downdrafts, heavy rain, turbulence, and lightning.

Dissipating: Downdrafts dominate, rain weakens, but microburst potential remains.

Hazards

Turbulence: Severe, especially in the mature stage.
Microbursts: Powerful downdrafts causing dangerous wind shear.
Hail: Can cause structural damage to the aircraft.
Lightning: A strike can affect instruments or cause structural damage.
Icing: Can form within clouds and severely impact performance.
Wind Shear: Rapid wind shifts that can cause sudden airspeed and altitude changes.

Fog

Radiation (Ground Fog): Ground cools rapidly, air reaches dew point. Risk of ice fog in very cold temperatures.
Advection Fog: Warm, moist air moves over cold surface (e.g., coastal fog like in San Francisco).
Steam Fog: Cold, dry air moves over warm water. Associated with turbulence and icing.
Upslope Fog: Moist air mass forced up sloping land, like mountains.

Wind Shear

Sudden change in wind speed and/or direction over a short distance.
Low-level: Near frontal boundaries, thunderstorms, temperature inversions.
High-level: Associated with jet streams, clear air turbulence.

REGULATIONS

Preflight Action

FAR 91.103

Items to become familiar with before flight:

- **N** **N**OTAMs.
- **W** **W**eather conditions.
- **K** **K**nown traffic delays.
- **R** **R**unway lengths of intended landing.
- **A** **A**lternates in case of diversion.
- **F** **F**uel requirements (FAR 91.151).
  - Day: Fly to the first point of intended landing, then cruise 30 minutes.
  - Night: Fly to the first point of intended landing, then cruise 45 minutes.
- **T** **T**akeoff and landing distances.

Right-of-Way Rules

FAR 91.113

Aircraft in Distress: Has right-of-way over all other aircraft.
Converging (Same Category): Aircraft on the right has ROW.
Different Categories (Priority Order):

```
Balloon > Glider > Airship > Airplane/Rotorcraft
```

Approaching Head-On: Both aircraft alter course to the right.
Overtaking: Aircraft being overtaken has ROW; overtaking aircraft passes on the right.
Landing: Aircraft on final or landing has ROW; lower aircraft has ROW.

Night Definitions

Logging Night Time (FAR 1.1): Between the end of evening civil twilight and the beginning of morning civil twilight.
Night Pax Currency (FAR 61.57): Period beginning 1 hour after sunset and ending 1 hour before sunrise.
Aircraft Lights (FAR 91.209): From sunset to sunrise, nav and anticollision lights on.

NTSB Accident/Incident Reporting

NTSB 830

Accident: Death, serious injury, or substantial aircraft damage.
Serious Injury: Hospital >48 hrs within 7 days; bone fractures (except fingers, toes, nose); severe bleeding; nerve/muscle/tendon damage; internal organ injury; burns over 5% body.
Substantial Damage: Affects structural strength, performance, flight characteristics; excludes minor damage (e.g., engine failure, bent fairings, small dents).
Immediate Notification Required for:

- **Accident**.
- **Serious Incident:** Flight control malfunction; crew incapacitation; in-flight fire; collision in flight; property damage >$25,000; overdue aircraft believed in accident.

Reporting: Operator to submit written report within 10 days for accidents, 7 days for overdue aircraft.
Preserve Wreckage: Don't move wreckage unless necessary to protect from further damage, rescue persons, or protect the public.

Seatbelt Regulations

FAR 91.105 & 91.107

Pilot: Seatbelt worn when at station; harness during takeoff & landing (unless not equipped or duties prevent).
Passengers: Seatbelts & harness worn during surface movement, takeoff, landing.
PIC Duties: Before takeoff, brief passengers on belts/harnesses; notify them to fasten before movement.

Minimum Safe Altitudes

FAR 91.119

Anywhere: Altitude allowing emergency landing without undue hazard if power fails.
Congested Areas: 1,000’ above the highest obstacle within 2,000’ radius.
Other Than Congested Areas: 500’ above the surface.
Sparsely Populated Areas: 500' away from any person, vessel, vehicle, structure.

NAVIGATION

Navigation Techniques

Pilotage: Navigation using visual landmarks (map + eyes).
Dead Reckoning: Navigation by calculating heading, time, speed, wind, and distance.

Navigation Definitions

True Course (TC): Ground track relative to true north.
Magnetic Course (MC): TC corrected for variation. East is Least (Subtract). West is Best (Add).
Wind Correction Angle (WCA): The angle added/subtracted to account for wind drift.
Magnetic Heading (MH): MC corrected for wind.
Compass Heading (CH): MH adjusted for compass deviation.

```
TC ± Var. = MC ± WCA = MH ± Dev. = CH
```

Magnetic Compass Errors

Deviation: Magnetic interference from aircraft (use compass correction card).
Magnetic Dip: Compass tilts toward magnetic poles; stronger near poles.
Acceleration Error (ANDS): Accelerate North, Decelerate South (E/W headings).
Turning Error (UNOS): Undershoot North, Overshoot South.
Oscillation Error: Erratic readings due to turbulence.
Variation: Diffverence between true and magnetic north; found using isogonic lines on charts.

GPS

GPS: 24 satellites orbiting Earth; need signals from 4+ satellites for 3D fix.
RAIM: Receiver monitors GPS signal integrity; alerts pilot to errors.
WAAS: Enhances GPS accuracy using ground stations; provides correction data.

Elements of a VFR Flight Plan

1. **Aircraft Information:** Aircraft type, registration number, and equipment codes.
2. **Pilot Information:** Pilot's name and contact details.
3. **Departure and Destination:** Airport identifiers and estimated departure time.
4. **Route of Flight:** Planned route, including waypoints, headings, and altitudes.
5. **Estimated Time En Route (ETE):** Expected flight duration.
6. **Fuel on Board:** Amount of fuel in hours and minutes.
7. **Alternate Airports:** Optional; other airports nearby in case of diversion.
8. **Number of Souls on Board:** Total people onboard for emergency purposes.
9. **Remarks:** Any additional relevant details, such as equipment issues or special requests.

Lost Procedures (5 C's)

Confess: Admit you're lost; no shame in safety.
Climb: Increase altitude for better communication and visibility.
Conserve: Throttle back and circle to save fuel.
Communicate: Call ATC or FSS for assistance.
Comply: Follow instructions from ATC.

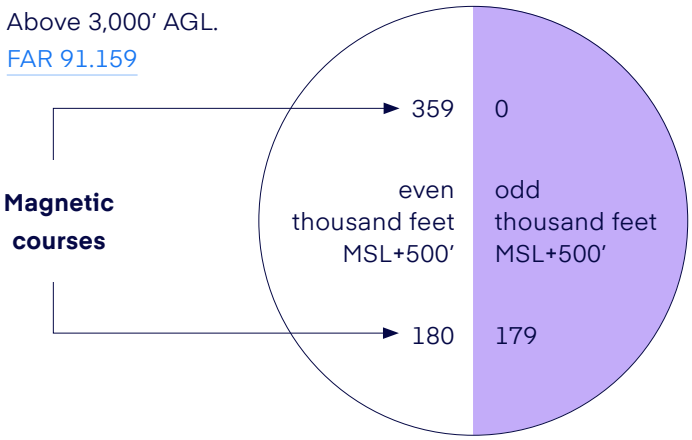
NOTAMs (Notices to Airmen)

Time-critical information not found on charts that may affect your flight.
Where to Find: FAA NOTAM system, flight service briefings, or online weather services.

Types
NOTAM (D): (Distant) Info on airports, runways, taxiways, lighting, and other facilities.
FDC NOTAM: (Flight Data Center) Regulatory info like TFRs, changes to instrument procedures, or airspace.
SAA NOTAM: Alerts when special activity airspace (like restricted areas) is active outside normal hours.
Pointer NOTAM: Highlights another NOTAM to make sure it's not missed.
Military NOTAM: Relates to military airports, airspace, or operations.

VFR Cruising Altitudes

Above 3,000' AGL.
FAR 91.159



COMMUNICATION

Radio Communications

ATIS: Weather/airport info.
AWOS / ASOS: Automated weather info.
Ground: Controls movement areas (taxiways).
Tower: Controls takeoff/landing on runways.
Center: Radar coverage and traffic advisories for IFR and VFR.
FSS: Flight Service Station for opening/closing flight plans and enroute weather.
Unicom: Airport services and general info (not always attended).
CTAF: Common traffic frequency for non-towered airports or when tower is closed.

Lost Comms (Radio Failure)

1. **Aviate, navigate, communicate:** Fly the airplane first.
2. **Stay clear of towered airspace** unless required to enter (e.g., emergencies).
3. **Troubleshoot** and try to fix the failure.
4. **Squawk 7600** for lost comms and monitor 121.5 if you can still receive.
5. **Look for light gun signals** if landing at a towered field.

Transponder Codes

1200: VFR.
7500: Hijack.
7600: Lost comms.
7700: Emergency.

Light Gun Signals

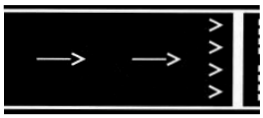
Signal	Ground	In-Flight
Steady Green	Cleared for Takeoff	Cleared to Land
Flashing Green	Cleared for Taxi	Return for Landing
Steady Red	Stop	Continue Circling
Flashing Red	Taxi Clear of Runway	Airport unsafe, don't land
Flashing White	Return to starting point on airport	N/A
Alternating green/red	Caution	Caution

AIRPORT OPERATIONS

Airport Signs

Sign Type	Description	Example
Mandatory Instruction	Indicates areas like runway entrances or prohibited zones. Red signs are always mandatory.	
Location	Shows your current location (e.g., taxiway or runway).	
Direction	Points to the direction of runways or taxiways.	
Destination	Lead you to a specific location (e.g., runway or terminal), works like direction signs.	
Information	Provide info such as radio frequencies or noise abatement procedures.	
Runway Distance Remaining	Show remaining runway distance in thousands of feet.	
ILS Critical Area Holding Position	Indicates where aircraft must stop to protect ILS signal integrity (during low-vis conditions).	
Runway Safety Area Boundary	Marks the boundary of the runway safety area.	

Airport Markings

Marking Type	Description	Example
Displaced Threshold	Marks a section usable for takeoff but not for landing.	
Blast Pad/Stopway	Indicates areas not suitable for landing, takeoff, or taxiing.	
Runway Hold Short Lines	Indicates runway entrance from taxiway.	
Taxiway Edge (Continuous)	Indicates taxiway edges where crossing is not allowed.	
Taxiway Edge (Dashed)	Indicates taxiway edges where crossing is permitted.	
ILS Critical Area Boundary	Indicates protected areas for ILS operations.	
Non-Movement Area Boundary	Marks the boundary between ATC-controlled movement areas and non-controlled areas.	
Taxiway-Taxiway Hold	Marks location on taxiway or apron where aircraft hold short of another taxiway.	
Enhanced Centerline	Indicates the approach to a runway hold short line.	

Runway & Taxiway Lights

Runway Lights
REIL: (Runway end identifier lights) Two white flashing lights at each runway end.
Edge: White. The last 2000' or 1/2 the runway (whichever is shorter) for instrument runways are amber.
Centerline: White, alternating red and white in the last 3,000', red in the last 1,000'.
LAHSO: (Land and hold short operations) Flashing white lights at the hold-short line.

Taxiway Lights
Edge: Blue.
Centerline: Green.
Lead-on/Lead-off: Alternating yellow/green

Chart Supplement

A directory of all public-use airports, heliports, and seaplane bases in the U.S.
Contents:.

- Airport diagrams, runways, and taxiways.
- Communication frequencies (ATIS, ground, tower, etc.).
- Traffic pattern altitudes (TPA) and lighting information.
- Special notices like noise abatement procedures or hot spots.

Traffic Pattern Altitude (TPA)

Standard TPA: Typically **1,000 feet AGL** unless otherwise published in the **Chart Supplement.**

Hot Spots

Areas on an airport with a history of frequent runway incursions or confusing taxiway/runway layouts.
Key Tip: Increase situational awareness in these areas.
Where to Find: Marked on airport diagrams ("HS").

Wake Turbulence

Results from lift-generated counter-rotating vortices trailing from wingtips. Can cause loss of control if encountered. Worse behind large aircraft that are **heavy, clean,** and **slow**.

Runway Incursion Avoidance

Procedures to prevent unauthorized entry onto a runway by an aircraft or vehicle.

Key Actions

- **Hold Lines:** Always stop at hold short lines. At towered airports, ATC clearance is required to cross.
- **Sterile Cockpit:** No distractions during taxi, takeoff, or landing. No non-essential conversations or tasks. Keep eyes outside.
- **Situational Awareness:** Know your position on the airport. Use airport diagrams and follow taxi clearances carefully. Look out for hot spots.
- **Ask ATC for Help:** Confirm instructions if unsure. Request turn-by-turn guidance from ATC if unclear about taxi routes.
- **Lighting:** Use strobes, landing, and taxi lights to increase visibility, especially in low visibility conditions.

Wake Turbulence Avoidance Tips

- **Wait times:** Allow time for wake turbulence to dissipate, typically 2-3 minutes after larger aircraft departures or landings.
- **Takeoff:** Rotate before their rotation point and climb upwind of their flight path.
- **Landing:** Stay above the flight path of the landing aircraft and land beyond their touchdown point.
- **Crosswinds:** If winds are present, stay upwind of the generating aircraft's path.

REGULATIONS

VFR Weather Minimums

FAR 91.155

Class B: 3 SM visibility; Clear of clouds.
Class C, D, E (<10,000' MSL): 3 SM; Clouds: 500' below, 1,000' above, 2,000' horizontal.
Class E (>10,000' MSL): 5 SM; Clouds: 1,000' below, 1,000' above, 1 SM horizontal.
Class G (<1,200' AGL):.

- **Day:** 1 SM; Clear of clouds.
- **Night:** 3 SM; 500' below, 1,000' above, 2,000' horizontal.

Class G (>1,200' AGL & <10,000' MSL):.

- **Day:** 1 SM; 500' below, 1,000' above, 2,000' horizontal.
- **Night:** 3 SM; 500' below, 1,000' above, 2,000' horizontal.

Class G (>10,000' MSL): 5 SM; 1,000' below, 1,000' above, 1 SM horizontal.

Mode C and ADS-B Required Airspace

FAR 91.215 & 91.225

Within 30 NM of Class B airspace (Mode C veil):
From the surface up to 10,000' MSL.
Within Class B airspace:
Generally, from the surface up to 10,000' MSL, including portions that extend beyond the Mode C veil.
Within Class C airspace:
From the surface up to 4,000' AGL, and above the horizontal boundaries of Class C up to 10,000' MSL.
At and above 10,000' MSL:
Anywhere in the contiguous U.S. and DC, excluding airspace below 2,500' AGL.
Over the Gulf of Mexico: ADS-B required at and above 3,000' MSL within 12 NM of the U.S. coastline.

Airspace VFR Entry Requirements per Class

A	B	C	D	E	G
IFR only; clearance required.	ATC clearance to enter; Mode C transponder & ADS-B Out.	2-way radio comms to enter; Mode C transponder & ADS-B Out.	2-way radio comms to enter.	No VFR requirements.	Uncontrolled; no VFR requirements.

Speed Limits

FAR 91.117

Below 10,000' MSL: 250 KIAS unless:

- Within 4 NM and below 2,500' AGL of Class C/D (200 KIAS).
- Below Class B shelf (200 KIAS).

Above 10,000' MSL: Mach 1.

Special VFR (SVFR)

FAR 91.157

ATC clearance allowing takeoff or landing under VFR in controlled surface airspace when visibility is less than 3 SM and/or the ceiling is below 1,000' AGL.
Weather Minimums: 1 SM visibility, clear of clouds.
Pilot Qualifications:

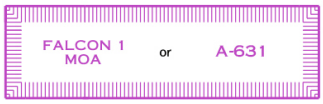
- **Day:** No special requirements.
- **Night:** Pilot must be instrument-rated and aircraft must be IFR-equipped.

Where Prohibited: Not allowed at certain airports (e.g., some Class B/C) where "NO SVFR" is noted on sectional charts or in the Chart Supplement."

AIRSPACE CLASSES

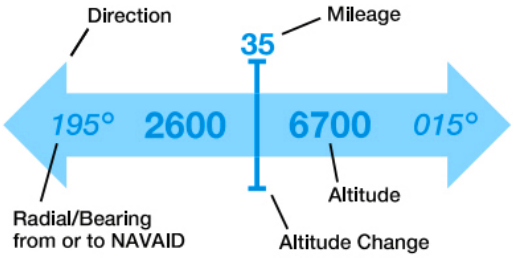
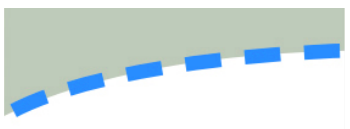
Airspace	Typical Dimensions & Altitudes	Depiction
CONTROLLED AIRSPACE		
Class A	18,000' MSL to FL600 (60,000' MSL). Covers the entire U.S.	Not Depicted
Class B	Core: SFC to 10,000' MSL. Shelves: Various bases to 10,000' MSL. Design tailored to each airport.	
	Mode C & ADS-B Out Veil: 30 NM radius around airport.	
Class C	Core: 5 NM radius; SFC to 4,000' AGL. Shelf: 10 NM radius; various bases to 4,000' AGL.	
Class D	4-5 NM radius; SFC to 2,500' AGL. Minus sign: "ceiling up to but not including".	
Class E	Various base altitudes to 17,999' MSL. Continues above FL600.	
	Starting at 1,200' AGL (Default for Class E).	Not Depicted
	Starting at the SFC.	
	Starting at 700' AGL (transition area).	
	Starting at 14,500' MSL (rare).	
	Starting at specified altitude.	
UNCONTROLLED AIRSPACE		
Class G	SFC to 1,200' AGL in most areas. Can be SFC to 700' AGL or 14,500' MSL.	Not Depicted

SPECIAL USE AIRSPACE

Airspace	Description	Depiction
Military Operations Area (MOA)	Separates high-speed military traffic from IFR traffic. VFR allowed; exercise caution.	
Alert Area	High volume of flight operations; be alert.	
Controlled Firing Area	Gunnery activities. Firing suspended when aircraft detected.	Not Depicted
Prohibited Area	No entry for security or national welfare reasons (e.g., White House).	
Restricted Area	Contains activities like guided missiles. Entry requires permission. Can be “hot” or “cold.”	
Warning Area	Similar to restricted but over international waters.	
National Security Area (NSA)	Requested to avoid for security reasons. May be temporarily prohibited.	

Need to check active times or contact info?
Look in the special use airspace table along the edge of the sectional chart—or tap the area in your EFB.

OTHER AIRSPACE AREAS

Airspace	Description	Depiction
VFR Corridor	VFR route through Class B. Comms or clearance not required.	
VFR Flyway	Suggested VFR routes near Class B airspace to avoid major traffic.	
VFR Transition Route	Specific route through Class B requiring ATC clearance. Depicted on TAC charts.	
Military Training Routes (MTRs)	IR (IFR) and VR (VFR) routes. Four digits = below 1,500' AGL Three digits = above.	
TRSA (Terminal Radar Service Area)	Optional radar services around some Class D airspace.	
ADIZ (Air Defense Identification Zone)	Required for international boundary crossing. Flight plan and two-way comms required.	
Special Flight Rules Area (SFRA)	Special procedures for entry and operation.	
Temporary Flight Restriction (TFR)	Time-limited airspace restrictions. Found in NOTAMs. Sometimes depicted on charts.	

SECTIONAL CHART

Airport Information

PRESCOTT RGNL
ERNEST A LOVE FLD (PRC)
CT - **125.3** ★ Ⓒ ATIS **127.2**
5045 *L 76 *122.95*
RP 3L, 21L, 21R

Text	Meaning
CT - **125.3**	Control tower frequency.
★	Part-time tower operation (see Chart Supplement).
Ⓒ	CT frequency is also CTAF.
ATIS **127.2**	Automated Terminal Information Service frequency.
5045	Airport elevation in feet MSL.
*L	• Lighting limitations exist (often pilot-controlled lighting; see Chart Supplement). • L with no star? Lighting sunset to sunrise.
76	Longest runway length in hundreds of feet (usable length may be shorter).
122.95	Advisory frequency (UNICOM).
RP 3L, 21L, 21R	Right-hand patterns for specified runways.

Maximum Elevation Figure (MEF)

12⁵

- Indicates the highest elevation MSL (plus 100' buffer), including terrain and obstacles, within a specific quadrant.
- Shown with the last 2 zeros omitted (125 = 12,500' MSL).

Performance and Limitations

Aerodynamics Terms

Angle of Attack (AoA): Angle between wing chord line and relative wind.
Critical AoA: AoA where airflow separates; causes stall.
Load Factor: Ratio of lift to weight; increases in turns, raising stall speed.
Adverse Yaw: Tendency to yaw opposite direction of turn due to differential drag.
Wingtip Vortices: Spiraling air from pressure differences at the wingtips
Aspect Ratio: Wingspan divided by average chord; higher values reduce induced drag.

Left-Turning Tendencies

Torque: The propeller spins clockwise, causing a counterclockwise roll.
P-Factor: At high AoA, the descending propeller blade produces more thrust, pulling the nose left.
Spiraling Slipstream: Propeller wash wraps around the fuselage, pushing the tail right and yawing the nose left.
Gyroscopic Precession: When the nose pitches up, the spinning propeller creates a force that causes right yaw.

The Four Forces

Lift: Upward force from air flowing over wings.

Weight: Downward force due to gravity.

Thrust: Forward force produced by engine/propeller.

Drag: Rearward force opposing thrust (parasite and induced).

Stability

Static Stability: Tendency to return to equilibrium after disturbance.

- **Positive:** Returns to original position.
- **Neutral:** Remains in new position.
- **Negative:** Moves further away.

Dynamic Stability: Behavior over time.

- **Positive:** Oscillations decrease.
- **Neutral:** Oscillations constant.
- **Negative:** Oscillations increase.

Lift Generation

Bernoulli's Principle: Faster airflow over the wing's upper surface lowers pressure, creating lift.
Newton's Third Law: The wing pushes air down, and air pushes the wing up, generating lift.

Load Factor Limits

Normal Category: +3.8 to -1.52 Gs.
Utility Category: +4.4 to -1.76 Gs.

Slip vs Skid

Slip: Insufficient turn rate for bank; ball inside turn.
Skid: Excessive turn rate for bank; ball outside turn.

Spins

Stall with yaw from uncoordinated flight.
Recovery (PARE): Power idle, Ailerons neutral, Rudder opposite spin, Elevator forward.

Types of Drag

Parasite Drag: Drag from the aircraft's structure (form, skin friction, interference) moving through the air, increasing with speed.

Induced Drag: Byproduct of lift; increases at low speeds/high AoA.

Airspeed Types

Indicated (IAS): Read from airspeed indicator; uncorrected.

Calibrated (CAS): IAS corrected for instrument and position errors.

Equivalent (EAS): CAS corrected for compressibility effects (high speed).

True (TAS): EAS corrected for non-standard temperature and pressure.

Groundspeed (GS): TAS corrected for wind; actual speed over ground.

Altitude Types

Indicated: Read directly from altimeter (when set to local pressure).

Pressure: Altitude above standard datum plane; shown when altimeter set to 29.92.

Density: Pressure altitude corrected for non-standard temperature; "performance altitude".

True: Height above mean sea level (MSL).

Absolute: Height above ground level (AGL).

V-Speeds

V_{s0}	Stall speed in landing config.
V_{s1}	Stall speed in specified config (usually clean).
V_x	Best angle of climb speed (max altitude over shortest distance).
V_y	Best rate of climb speed (max altitude over shortest time).
V_{fe}	Max flap extended speed.
V_{le}	Max landing gear extended speed.
V_a	Maneuvering speed (max speed for full control inputs; decreases with weight).
V_{no}	Max structural cruising speed (do not exceed except in smooth air).
V_{ne}	Never exceed speed (red line).
V_{ref}	Landing reference speed.
V_r	Rotation speed.
V_g	Best glide speed (L/D Max).

Density Altitude and Performance

The altitude the airplane "feels" it's at, based on air density rather than actual elevation.

Impact on Performance: Higher density altitude (due to high temperature, altitude, or humidity) reduces engine power, propeller efficiency, and wing lift, leading to longer takeoff distances, reduced climb rates, and decreased overall performance.

Rule of Thumb: As density altitude increases, aircraft performance decreases.

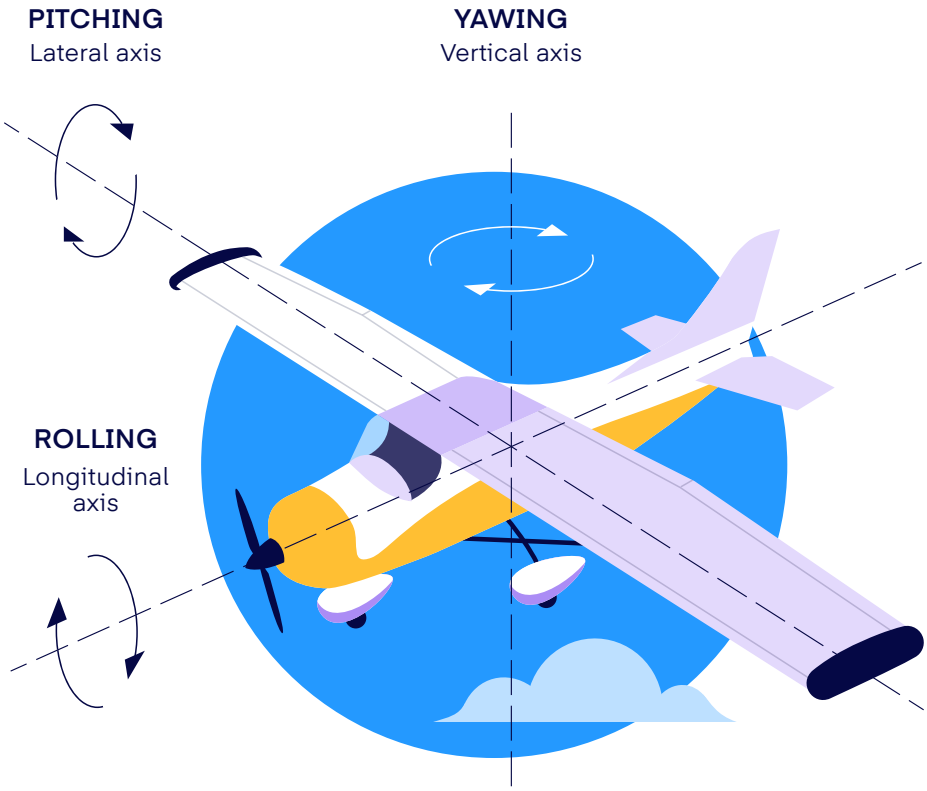
FLIGHT CONTROLS

Primary Controls

Ailerons: Control roll (bank) around longitudinal axis.
Elevator/Stabilator: Controls pitch around lateral axis.
Rudder: Controls yaw around vertical axis.

Secondary Controls

Flaps: Increase lift/drag; allow slower speeds for takeoff/landing and steeper approach.
Trim Tabs: Reduce control pressures; maintain steady flight without constant input.
Leading-Edge Devices: Slots or slats to delay airflow separation at high AoA.
Spoilers: Reduce lift; used for descent or roll control (less common in light aircraft).



ENGINE

Carburetor Icing

Occurs in high humidity, temps -5°C to 20°C (23°F to 70°F).
Signs: Drop in RPM (fixed-pitch prop) or manifold pressure (constant-speed prop), engine roughness.
Action: Apply carb heat to melt ice; expect initial drop in power, then increase.

Preignition

Fuel/air mixture ignites before spark plug fires.
Causes: Hot spots in cylinder, glowing carbon deposits.
Signs: Engine roughness, loss of power, high operating temperatures.
Action: Reduce power, enrich mixture, lower nose to increase cooling, land ASAP.

Detonation

Uncontrolled, explosive combustion in cylinder.
Causes: Using lower octane fuel, high power with lean mixture, extended ground ops.
Signs: Engine overheating, roughness, loss of power.
Action: Reduce power, enrich mixture, open cowl flaps if available, avoid high power settings.

INSTRUMENTS AND EQUIPMENT

Pitot-Static System

Pitot Tube: Measures ram air pressure for Airspeed Indicator (ASI).
Static Port: Provides ambient air pressure for ASI, Altimeter, and Vertical Speed Indicator (VSI).
Pitot Tube Blocked:.

- Ram air blocked, drain hole open: ASI reads zero.
- Both blocked: ASI freezes, acts like altimeter.

Static Port Blocked:.

- ASI inaccurate (reads lower at higher altitudes).
- Altimeter freezes.
- VSI reads zero.

Alternate Static Source

- Provides backup static pressure.
- Readings may be slightly higher due to lower cabin pressure.

Airspeed Indicator Markings

Red Line: (V_{ne}) Never exceed.

Yellow Arc: (V_{no} to V_{ne}) Caution range.

White Arc: (V_{so} to V_{fe}) Flap operating range.

Green Arc: (V_{s1} to V_{no}) Normal operating range.

Vacuum System

Powers gyroscopic instruments: Attitude Indicator (AI), Heading Indicator (HI).
Turn Coordinator often electrically powered; provides redundancy.

Glass Cockpit Systems

AHRS (Attitude and Heading Reference System)
Provides attitude (pitch, bank), heading, rate of turn, slip/skid info.
Uses solid-state gyros, accelerometers, magnetometers.
ADC (Air Data Computer)
Calculates airspeed, altitude, vertical speed.
Uses inputs from pitot tube, static port, temperature probe.
PFD (Primary Flight Display)
Displays flight instruments digitally (airspeed, attitude, altitude, VSI, heading).
MFD (Multi-Function Display)
Shows navigation maps, engine data, weather, traffic, terrain.

Deicing Equipment
Removes ice after formation

Example: Pneumatic boots inflate to break ice on wing leading edges.

Anti-Icing Equipment
Prevents ice formation

Examples: Pitot heat, carb heat, heated propeller blades, heated windshields.

Human Factors

AERONAUTICAL DECISION-MAKING (ADM)

DECIDE Model

- **D** — **Detect:** Identify changes or potential issues in the environment or flight.
- **E** — **Estimate:** Assess the significance and impact of the detected change.
- **C** — **Choose:** Select the best course of action from available options.
- **I** — **Identify:** Determine the specific actions needed to implement the chosen solution.
- **D** — **Do:** Execute the identified actions promptly and efficiently.
- **E** — **Evaluate:** Review the outcome of the actions to ensure the problem is resolved.

IMSAFE Checklist

- **I** — **Illness:** Am I suffering from any illness or symptoms?
- **M** — **Medication:** Am I taking any medications that could affect my performance?
- **S** — **Stress:** Am I under psychological pressure or anxiety?
- **A** — **Alcohol:** Have I consumed alcohol within the last 8 hours, is my BAC over 0.04%, or am I hungover?
- **F** — **Fatigue:** Am I well-rested and alert?
- **E** — **Emotion/Eating:** Am I emotionally stable and properly nourished?

5P Model

Plan: Assess weather, route, fuel, and regulations for changing risks.

Plane: Monitor aircraft condition, performance, and system status.

Pilot: Evaluate fitness, workload, and situational awareness.

Passengers: Consider distractions, experience level, and expectations.

Programming: Manage avionics, automation, and potential tech failures.

Hazardous Attitudes

Type	Attitude	Antidote
Anti-authority	"Don't tell me what to do!"	Follow the rules—they're usually right.
Impulsivity	"Do something quickly!"	Not so fast—think first.
Invulnerability	"It won't happen to me."	It can happen to me.
Macho	"I can do it!"	Taking unnecessary risks is foolish.
Resignation	What's the use?"	I'm not helpless—I can make a difference.

PAVE Checklist

- **P** — **Pilot** Am I physically and mentally fit to fly? (IMSAFE checklist)
- **A** — **Aircraft** Is the aircraft airworthy, fueled, and equipped for the flight?
- **V** — **enVironment** Consider weather, terrain, airports, and airspace.
- **E** — **External Pressures** Am I being pressured by time, passengers, or personal goals?

AEROMEDICAL FACTORS

Hypoxia

Cause: Insufficient oxygen reaching the body's tissues.
Symptoms: Headache, dizziness, euphoria, impaired judgment, cyanosis (blue fingernails/lips).
Action: Descend to lower altitude; use supplemental oxygen.

Types
Hypoxic: Insufficient oxygen available to the body (e.g., high altitude).
Hypemic: Blood can't carry enough oxygen (e.g., due to CO poisoning).
Stagnant: Poor circulation of oxygen in the body (e.g., G-forces).
Histotoxic: Cells unable to use oxygen (e.g., alcohol, drugs).

Supplemental Oxygen Requirements
(Non-Pressurized Aircraft – FAR 91.211)

Altitude (MSL)	Oxygen Required
12,500' - 14,000' (MSL)	Crew must use oxy after 30+ minutes (cumulative).
Above 14,000' (MSL)	Crew must use oxy for the entire duration.
Above 15,000' (MSL)	Oxy must be available for all occupants (pax not required to use it).

Hyperventilation

Cause: Low CO2 levels from excessive breathing due to stress or anxiety.
Symptoms: Dizziness, light-headedness, tingling in extremities, shortness of breath.
Action: Slow breathing, talk/sing aloud, or breathe into a bag to restore CO2 balance.

Hypothermia

Cause: Exposure to cold temperatures.
Symptoms: Shivering, numbness, confusion, slurred speech.
Action: Dress for the environment (layers), limit exposure, and use cabin heat.

Spatial Disorientation

Cause: Inability to correctly interpret flight attitude due to conflicting sensory inputs.
Symptoms: Feeling of turning, climbing, or descending when straight and level.
Action: Trust instruments, avoid abrupt head movements, maintain proper scanning.

Systems for Determining Orientation
Vestibular: Inner ear (balance).
Somatosensory: Sensations from muscles and skin (feeling of motion).
Visual: Eyes (what you see).

CO Poisoning

Cause: Inhalation of carbon monoxide from exhaust leak.
Symptoms: Headache, nausea, drowsiness, impaired judgment.
Action: Turn off cabin heat, open windows, use supplemental oxygen, and land ASAP.

Motion Sickness

Cause: Conflicting sensory inputs (inner ear vs. visual).
Symptoms: Nausea, dizziness, sweating, vomiting.
Action: Focus on the horizon, open vents, avoid unnecessary head movement.

Stress

Cause: Physical or emotional strain.
Symptoms: Irritability, poor decision-making, decreased performance.
Action: Use relaxation techniques, get adequate rest; medical help for chronic stress.

Types
Acute Stress: Short-term, immediate reactions (e.g., emergencies).
Chronic Stress: Long-term strain that can degrade performance over time.

Fatigue

Cause: Lack of sleep, long flights, stress.
Symptoms: Drowsiness, slow reaction times, poor concentration.
Action: Rest, exercise, stay hydrated/fed; medical help for chronic fatigue.

Alcohol/Drugs

FAR 91.17

Cause: Alcohol or drug consumption (including prescription meds).
Symptoms: Impaired judgment, slow reactions, dizziness, nausea.
Action: 8 hours from "bottle to throttle," BAC below 0.04%, no flying under the influence (hangover), no meds unless AME-approved, no intoxicated pax (unless medically supervised).

Decompression Sickness

Cause: Rapid ascent after diving.
Symptoms: Joint pain, dizziness, paralysis (severe cases).
Action: Wait at least 12 hours after a dive before flying below 8,000' MSL; 24 hours for higher altitudes.

Scuba Diving Wait Times	≤ 8,000' MSL	> 8,000' MSL
Without decompression stop (uncontrolled ascent)	12 hours	24 hours
With decompression stop (controlled ascent)	24 hours	24 hours

ILLUSIONS

Vestibular Illusions

Leans
After a prolonged, unnoticed turn, returning to level flight feels like banking in the opposite direction.
Result: Pilot may roll back into the original turn, risking disorientation.

Graveyard Spiral
In a prolonged turn, the sensation of turning is lost, and altitude decreases. The pilot believes they are in level flight and pulls back on the controls.
Result: Tightens the spiral, increasing the rate of descent and risking structural failure.

Graveyard Spin
After spin recovery, the absence of turning sensation makes the pilot feel like they are in a new spin in the opposite direction.
Result: Overcorrection may cause re-entry into the original spin.

Coriolis
Head movement during a prolonged turn causes a false sensation of movement on a different axis.
Result: Pilot may try to correct the perceived attitude, leading to disorientation.

Elevator Illusion
Rapid upward acceleration (updraft) feels like a climb, and rapid downward acceleration (downdraft) feels like a descent.
Result: Pilot may unnecessarily alter pitch.

Somatogravic Illusion
Acceleration feels like a nose-up attitude, and deceleration feels like a nose-down attitude.
Result: Pilot may incorrectly pitch the aircraft, leading to altitude changes.

Inversion
After climbing and leveling off, the pilot feels like they are tumbling backward.
Result: Pilot may push the nose down, causing a dive.

Visual Illusions

Runway Width Illusion
A narrow runway makes you feel too high; a wide runway makes you feel too low.
Result: Can lead to a too-steep or too-shallow approach.

Runway Slope Illusion
An uphill runway makes you feel too high; a downhill runway makes you feel too low.
Result: Can cause improper approach angle (too steep or too shallow).

False Horizon
Sloping clouds, ground lights, or stars are misinterpreted as the horizon.
Result: Pilot aligns the aircraft with the false horizon, creating an unsafe attitude.

Night Visual Illusions

Auto-Kinesis
A stationary light appears to move after prolonged staring.
Result: Pilot may align the aircraft with the perceived moving light, leading to disorientation.

Vertigo (Flicker Vertigo)
Flickering lights (e.g., beacons or strobes) cause dizziness or disorientation.
Result: Pilot experiences imbalance, nausea, or confusion.

Black-Hole Approach
Occurs over dark, featureless terrain or water, causing the pilot to misjudge the descent angle.
Result: Pilot may fly a dangerously low approach, risking landing short.

Ground Lighting Illusion
Rows of lights (e.g., highways) may be mistaken for runway lights, or bright runway lights may cause the pilot to feel lower on approach.
Result: Pilot may align with a road or fly a too-high approach.

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