Part 61: Private Pilot Checklist – ASEL

Reference	Requirements and Limitations
61.103	Eligibility Requirements • Be at least 17 years of age • Be able to read, speak, write, and understand the English language • Hold a U.S. Student Pilot certificate, Sport Pilot certificate, or Recreational Pilot certificate • Obtain the appropriate logbook endorsements from an authorized instructor • Pass the required knowledge test • Meet the aeronautical experience requirements • Pass a practical test
61.105	Aeronautical Knowledge Received and logged ground training from an authorized instructor or complete a home study course on the aeronautical knowledge areas of 14 CFR 61.105(b)
61.107	Flight Proficiency Received and logged ground and flight training from an authorized instructor on the areas of operation of 14 CFR 61.107(b)(1)
61.109(a) Domingo (2018) Legal Interpretation	Aeronautical Experience At least 40 hours of flight time that includes at least 20 hours of flight training from an authorized instructor and 10 hours of solo flight training in the Areas of Operation listed in 14 CFR 61.107(b)(1) *Note: The 20 hours of flight training from an authorized instructor and the 10 hours of solo flight training are both required to be conducted in a single-engine airplane.*
61.109(a)(1)	Aeronautical Experience (Dual) 3 hours of cross-country flight training in a single-engine airplane
61.109(a)(2)	Aeronautical Experience (Dual) 3 hours of night flight training in a single-engine airplane that includes: • One cross-country flight of over 100 NM total distance • 10 takeoffs and 10 landings to a full stop (with each landing involving a flight in the traffic pattern) at an airport *Note: 14 CFR 61.110 provides night flying exceptions for pilots in the State of Alaska.*
61.109(a)(3)	Aeronautical Experience (Dual) 3 hours of flight training in a single-engine airplane on the control and maneuvering of an airplane solely by reference to instruments, including straight-and-level flight, constant airspeed climbs and descents, turns to a heading, recovery from unusual flight attitudes, radio communications, and the use of navigation systems/ facilities and radar services appropriate to instrument flight
61.109(a)(4)	Aeronautical Experience (Dual) 3 hours of flight training in preparation for the practical test in a single-engine airplane performed within the preceding 2 calendar months from the month of the test
61.109(a)(5)	Aeronautical Experience (Solo) 10 hours of solo flight time in a single-engine airplane, consisting of at least: • 5 hours of solo cross-country time • One solo cross country flight of 150 NM total distance, with full-stop landings at three points, and one segment of the flight consisting of a straight-line distance of more than 50 NM between the takeoff and landing locations • Three takeoffs and three landings to a full stop (with each landing involving a flight in the traffic pattern) at an airport with an operating control tower

Reference	Requirements and Limitations
61.109(k)	<u>Use of Flight Simulators and Flight Training Devices</u> • A maximum of 5 hours may be performed in a full flight simulator or flight training device if the training was accomplished in accordance with 14 CFR Part 142 by an authorized instructor • A maximum of 2.5 hours may be performed in a full flight simulator or flight training device if the training was not accomplished in accordance with 14 CFR Part 142 by an authorized instructor *Note: The simulator or device must represent the category, class, and type, if applicable, of aircraft appropriate to the rating sought.*

Day VFR Required Equipment

A TOMATO FLAMES

- Altimeter
- Tachometer
- Oil pressure
- Magnetic compass
- Airspeed indicator
- Temperature sensor (if liquid-cooled)
- Oil temperature (if air cooled)
- Fuel gauge
- Landing gear position (if retractable)
- Anticollision lights (if certificated after March 11, 1996)
- Manifold pressure (if turbocharged or supercharged)
- ELT (if required by 14 CFR 91.207)
- Safety belts

Night VFR Required Equipment

Day VFR Equipment + FLAPS

- Fuses (spares) or circuit breakers
- Landing light (if for hire)
- Anticollision lights
- Position lights
- Source of electricity

IFR Required Equipment

Day (or Night) VFR Equipment + GRAB CARD

- Generator or alternator
- Radios
- Attitude indicator
- Ball
- Clock
- Adjustable altimeter
- Rate-of-turn indicator
- Directional gyro

Engine Run-Up

CIGAR

- Controls (free and correct, trim and flaps set)
- Instruments (checked and set)
- Gas (fuel level, pumps, and tank selector)
- Airplane secure, annunciators, autopilot test
- Run-up and radios

Before Takeoff

LIGHTS, CAMERA, ACTION

- Lights: ON
- Camera: Transponder set to ALT
- Action: Critical items checked

Before Landing (Downwind)

CGUMPS

- Carburetor heat: ON
- Gas: SET to the proper tank(s)
- Undercarriage: DOWN
- Mixture: SET for a go-around
- Power: AS REQUIRED
- Seatbelts and switches: ON

Preflight Action (14 CFR 91.103)

WEALTH (of Information)

- Weather reports and forecasts*
- Expected takeoff and landing performance
- Alternatives available*
- Length of runways to be used
- Traffic delays*
- How much fuel is required*

** = Required on flights under IFR or not in the vicinity of an airport*

Required Inspections

AV1ATE

- Annual: 12 calendar months
- VOR (IFR): 30 days
- 100 Hour (if for hire): 100 hours
- Altimeter and pitot-static system (IFR): 24 calendar months
- Transponder: 24 calendar months
- ELT: 12 calendar months

Required Aircraft Documents

ARROW

- Airworthiness Certificate
- Radio Telephone License (if international)
- Registration Certificate
- Operator's handbook (AFM/POH)
- Weight and balance data

Standard AFM/POH Contents

(MR.) GLEN P. WAHS

- General
- Limitations
- Emergency Procedures
- Normal Procedures
- Performance
- Weight and Balance/Equipment List
- Airplane and System Description
- Handling, Service, and Maintenance
- Supplements

Before Each Maneuver

CHAPS

- Clear the area (clearing turns)
- Heading established and noted
- Altitude established
- Position near an emergency landing area
- Set power and aircraft configuration

Before Landing (Short Final)

PUFFS

- Propellers: FORWARD
- Undercarriage: DOWN
- Flaps (Wing): EXTENDED
- Flaps (Cowl): CLOSED
- Seatbelts and switches: ON

Go-Around

The 5 C's

- Cram: Full power (smoothly)
- Climb: Pitch for V_X or V_Y
- Clean: Flaps and gear UP
- Cool: Cowl flaps OPEN
- Call: Make a radio call

Engine Failure [ASEL]

ABCDEFG

- **Airspeed:** Pitch for best glide speed
- **Best Landing Option:** Establish and turn if necessary
- **Checklists or Configure:** As the situation dictates
- **Declare an Emergency:** Make a radio call (121.5)
- **Execute an Emergency Landing:** "Aviate" first
  - **Fire Prevention:** Fuel and electrical OFF
  - **Ground Plan:** Exit with safety equipment

Engine Restart Criteria

VFR

- **Vibration?** None observed
- **Rotation?** Possible if no visible damage
- **Fire?** No smoke, fire, or fluid leaks

Emergency Transponder Codes

- **7500:** "Hi, Jack."
- **7600:** "Can't talk now."
- **7700:** "I'm on Fire!"

Wind Reports

"If written it's true. If spoken it's magnetic."

METARs, TAFs, and winds aloft are in reference to true north. ATIS, PIREPs, and automated weather reports are in reference to magnetic north.

Weather Minimums

3 152's

- 3 SM visibility
- 1,000' above clouds
- 500' below clouds
- 2,000' horizontally from clouds

5 F-111's

- 5 SM visibility
- 1,000' above clouds
- 1,000' below clouds
- 1 SM horizontally from clouds

Class E Airspace Types

FEET SO 14-50

- Federal airway (1,200' AGL up to 18,000' MSL)
- Extension to a surface area
- En route domestic area
- Transition area (700' or 1,000' AGL)
- Surface area designated for an airport
- Offshore airspace area (beyond 12 NM)
- 14,500' everywhere else

Special Use Airspace Types

McPRAWN

- Military Operation Areas (Nonregulatory)
- Controlled Firing Areas (Nonregulatory)
- Prohibited Areas (Regulatory)
- Restricted Areas (Regulatory)
- Alert Areas (Nonregulatory)
- Warning Areas (Nonregulatory)
- National Security Areas (Nonregulatory)

Airport Sign Types

MIDDLR

- Mandatory instruction
- Information
- Destination
- Direction
- Location
- Runway distance remaining

Determination of V_{MC} [AMEL]

SMACFUM

- Standard day
- Most unfavorable weight (light)
- And most unfavorable CG (aft)
- Critical engine windmilling
- Flaps set for takeoff, gear UP, trim for takeoff
- Up to 5° of bank
- Maximum power on the operating engine

Determination of Critical Engine [AMEL]

PAST

- P-Factor
- Accelerated slipstream
- Spiraling slipstream
- Torque

Standard Flight Manual Format

1. General
2. Limitations
3. Emergency Procedures
4. Normal Procedures
5. Performance
6. Weight and Balance/Equipment List
7. Airplane and System Description
8. Handling, Service, and Maintenance
9. Supplements
10. Optional information (e.g., Safety and Operational Tips)

Barometric Pressure

Pressure decreases at a rate of 1" Hg per 1,000' of altitude gain. The standard surface pressure at sea level is 29.92" Hg.

Pressure Altitude

The pressure altitude can be determined by:

- Setting the barometric scale of the altimeter to 29.92 and reading the indicated altitude.
- Applying a correction factor to the indicated altitude according to the reported altimeter setting.

Example:

- Field Elevation = 300'
- Altimeter Setting = 30.02" Hg
- Pressure Altitude = 200'

If the local altimeter setting is greater than 29.92 inches, pressure altitude is lower than field elevation.

Density Altitude

A normally aspirated engine produces 3% less power for every 1,000' of density altitude.

For every 10°F above (or below) standard temperature at an airport's elevation, add (or subtract) 600' to (or from) the field's elevation.

Density altitude increases (or decreases) 102' for every 1°C the temperature varies from standard.

Correct Density Altitude for Humidity

If the temperature is greater than 5°C, double the dew point in degrees Celsius and add a zero. Add the result to the density altitude.

Example: 24°C + 24°C = 480' Correction

Altimeter Errors

"From hot to cold, look out below."

When the air temperature is warmer than standard, the altimeter will indicate a lower altitude than actually being flown. When the air temperature is colder than standard, the altimeter will indicate a higher altitude than actually being flown.

"From high to low, look out below."

When flying from an area of higher pressure to an area of lower pressure without resetting the altimeter, the aircraft is flying at a lower altitude than indicated. If flying from an area of low pressure to an area of high pressure without resetting the altimeter, the aircraft is flying a lower altitude than indicated.

Temperature Lapse Rate

Temperature decreases at a rate of 3.5°F (2°C) per thousand feet.

True Airspeed

True airspeed increases by 2% for every 1,000' of altitude.

Clouds and Weather

When flying over the top of a severe thunderstorm, the cloud should be over-flown by at least 1,000' for every 10 knots of wind speed.

To find the height of the cloud bases, use the following formula (the temperature is in degrees Fahrenheit).

((Temperature – Dew Point) / 4.4) × 1,000

Airspeed Calculations

$$\text{Maneuvering Speed} = V_{S1} \times \sqrt{\text{Positive Limit Load Factor}}$$

Maneuvering speed (V_A/V_O) decreases 2 knots for every 100 pounds below max gross weight.

Best rate of climb speed (V_Y) decreases 1/2 knot for every 1,000' of density altitude gained.

Best angle of climb speed (V_X) increases 1 knot for every 1,000' of density altitude gained.

Best glide speed (V_{BG}) decreases 1/2 to 1 knot for every 100 pounds under max gross weight.

$$\text{Rotation Speed } (V_R) = 1.15 \times V_{SO}$$

$$\text{Dynamic Hydroplane Speed} = 8.6 \times \sqrt{(\text{Tire Pressure})}$$

Airspeeds at Reduced Weights

Speeds published in the AFM/POH at max gross weight (e.g., maneuvering, stall, and approach) can be reduced for the current weight using the following formula or rule of thumb.

$$V_{NEW} = V_{OLD} \times \sqrt{(\text{Current Weight / Max Gross Weight})}$$

- V_{NEW} is the calculated speed for the current weight.
- V_{OLD} is the AFM/POH speed at the max gross weight.

As a rule of thumb, these speeds decrease 1% for every 2% reduction in gross weight.

Defined Minimum Maneuvering Speed

A defined minimum maneuvering speed (DMMS) provides a margin above stall speed during turning flight. It is essentially a 30% buffer above the clean stall speed (V_{S1}) in a 30° bank.

$$\text{DMMS} = V_{S1} \times 1.4$$

Attitude Flying

The Primary Rule of Attitude Flying
Attitude + Power = Performance

Use one-half of the bank angle to begin a rollout to a heading. For a 30° bank, begin the rollout 15° early.

Lead a level off from a climb or descent by 10% of the vertical speed. If the climb rate is 500 FPM, initiate the level-off 50' early.

For altitude deviations of less than 100', use a half-bar-width correction. For errors over 100', use a full-bar-width. An alternate method is to establish a change rate of twice the altitude deviation, not to exceed 500 FPM. If the altitude is off by 100', the rate of return should be 200 FPM.

Reciprocal Headings

To find a reciprocal heading, add 200 and subtract 20, or subtract 200 add 20.

Takeoff Distance

Takeoff distance increases by 10% for every 1,000' of density altitude above sea level.

A runway upslope increases takeoff distance by 7% per degree. A runway downslope reduces takeoff distance by 5% per degree.

Increase the takeoff distance required by 10% for every two knots of tailwind.

Abort the takeoff if no more than 70% of the takeoff speed is reached by 50% of the runway length.

Add at least 15% (50% recommended) to the planned takeoff distance as a safety margin.

Climb Gradients

Climb Rate in FPM = (Ground Speed / 60) × Climb Gradient

Climb Gradient as a Percentage = (Rise / Run) × 100

Note: The "rise" and the "run" are in feet. There are approximately 6,076 feet in one nautical mile.

Approach and Landing

3° Rate of Descent = Ground Speed × 5

For every knot above the recommended approach airspeed at the runway threshold, the touchdown point will be 100' further down the runway.

For every 10' above the standard 50' threshold crossing height, increase the landing distance required by 200'.

For every 10% reduction in weight, reduce the approach speed published at the max gross weight by 5%.

Increase the landing distance by 50% for a wet runway.

Increase the approach speed by 20% if ice is on the wings.

Increase the landing distance required by 21% for every 10 knots of tailwind.

Add at least 15% (50% recommended) to the planned landing distance as a safety margin.

Mixture Settings

- **Engine Start:** Full-rich, unless the engine is flooded.
- **Taxi:** Lean for max RPM.
- **Takeoff < 4,000' Density Altitude:** Full-rich.
- **Takeoff > 4,000' Density Altitude:** Lean for max RPM.
- **Climb > 4,000' Density Altitude:** Lean for max RPM.
- **Cruise:** Lean as desired within the temperature limits.
- **Descent:** As necessary to produce a smooth running engine.
- **Landing:** Appropriate setting for a go-around.

Maximum Range and Endurance

Max Endurance Speed (Fixed Gear) = 1.2 × V_S
Max Endurance Speed (Retractable Gear) = 1.3 × V_S
Max Range Speed (Fixed Gear) = 1.5 × V_S
Max Range Speed (Retractable Gear) = 1.8 × V_S

Maximum range speed changes with wind:

- Increase the speed by half of the headwind.
- Decrease the speed by half of the tailwind.

Standard Rate Turn

Bank Angle = (TAS / 10) + 5

Sectional Charts

The width of a finger equals 5 NM on a Sectional Chart for the average person.

The distance from the tip of the thumb to the knuckle equals 10 NM on a Sectional Chart for the average person.

Planned Descent Point

The following formula is used to calculate a PDP in NM. The threshold crossing altitude (TCA) is the TDZE plus the TCH (typically around 50'). The resulting distance is the PDP in NM from the runway.

PDP = (MDA – TDA) / 318

To calculate the PDP in minutes and seconds, use the following formula. Subtract the resulting time from the time required to fly the approach.

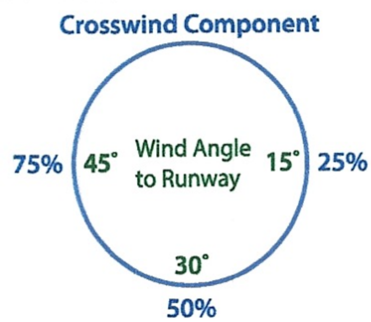
PDP = (MDA – TDA) / 10

3° Glidepath

To find the proper altitude at any point along on a 3° glidepath, multiply the distance in nautical miles from the threshold by 300. At 10 NM the aircraft should be 3,000' above the TDZE, at 5 NM 1,500', and at 1 NM 300'.

To find the proper rate of descent on a 3° glidepath, multiply the groundspeed by 5. At 120 knots, the descent rate should be 600 FPM.

Crosswind Components



Example: A 30° wind results in a crosswind component of 50%.

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All values are approximations. The AFM/POH has precedence.
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Passenger (SAFETY) Briefing

- **S**eatbelts
- **A**ir (environmental controls)
- **F**ire Extinguisher
- **E**xits, emergencies, and equipment
- **T**raffic and talking
- **Y**our questions?

(TENEY) Takeoff Briefing

- **T**hreats
- **E**xpectations
- **N**ormal departure procedures
- **E**mergency procedures
- **Y**our questions?

Takeoff Briefing – Emergency Procedures

Engine Failure or Abnormality Prior to Rotation

Abort the takeoff:

- Maintain directional control
- Throttle Lever(s): IDLE
- Wheel Brakes: APPLY MAX

If insufficient runway remains for a safe stop:

- Maintain directional control and avoid obstacles
- Mixture(s): CUTOFF
- Fuel Selector(s): OFF
- Magnetos: OFF
- Battery Master: OFF

Engine Failure After Liftoff and Sufficient Runway Remains to Stop

- Pitch down and maintain directional control
- Establish the approach speed for the flap setting
- Throttle Lever(s): IDLE
- Land straight ahead
- Wheel Brakes: APPLY MAX

Engine Failure After Liftoff and Below the Turnback Altitude [ASEL]

- Pitch down and maintain directional control
- Establish the final approach speed
- Pick the most suitable area within 30° from the heading
- Flaps: FULL (before landing)
- Mixture(s): CUTOFF
- Fuel Selector(s): OFF
- Magnetos: OFF
- Battery Master: OFF

Engine Failure After Liftoff and Decision Made to Continue [AMEL]

- Maintain directional control and airspeed (V_{YSE})
- Mixtures: FULL FORWARD
- Propeller Controls: FULL FORWARD
- Throttle Levers: FULL FORWARD
- Flaps: UP
- Landing Gear: UP
- Identify the inoperative engine
- Verify the inoperative engine
- Feather the inoperative engine
- Climb straight ahead to a safe altitude

Crew Resource Management Briefing

- Designation of the PIC defined by 14 CFR 1.1
- Designation of the pilot flying (PF) and the pilot monitoring (PM)
- Review of standard operating procedures
- Proper exchange of the flight controls
- Guidelines for the operation of automated systems
- PF sets a positive tone to promote teamwork and safety:
  - "Bring my attention to anything that looks unusual, confusing, or incorrect."
  - "If you see anything hazardous, take any action that is necessary for our safety."
  - "Feel free to interrupt me if you have any questions about what I am doing or saying."
  - "If you need to be heads-down or off the radio, please let me know."

Visual Approach Briefing

- Field elevation and traffic pattern altitude
- Wind direction and velocity
- Active runway
- Approach type, final approach speed, and configuration
- Planned touchdown and aiming points

Instrument Approach Briefing

- Type of approach
- Airport name and identifier
- Chart number
- ATIS/Weather information
- Localizer/Navigational aid frequency
- FAF and FAF crossing altitude
- Final approach course
- Initial rate of descent
- DH/MDA
- Airport elevation
- Minimum safe altitude(s)
- Fixes and altitude restrictions
- Missed approach point and procedure
- Runway dimensions and visual approach aids
- Direction of runway turnoff
- Taxi hazards (e.g., hot spots and parallel runways)
- Parking location

Callouts During Approach

Instrument Approach

- Glideslope/Localizer/Course alive
- 1/2 dot below glideslope/glidepath
- 500' above minimums
- 100' above minimums
- Minimums
- Runway in sight or approach lights in sight
- Landing or missed approach (PF)

Base to Final/FAF Inbound

- Blue-line [AMEL]
- GUMPS check

Short Final

- Gear down, stabilized

Medical Factor	Causes	Symptoms	Prevention and Corrective Actions
Hypoxia	lack of oxygen	euphoria, headache, dizziness, drowsiness, tingling sensations, cyanosis	use supplemental oxygen, descend to a lower altitude
Carbon Monoxide Poisoning	exhaust fumes, cigarette smoke	hypoxia symptoms, muscle weakness, confusion	turn off cabin heater, open fresh air vents, use supplemental oxygen
Hyperventilation	breathing too fast	hypoxia symptoms, muscle spasms	breathe slower, breathe into a bag
Middle Ear and Sinus Problems	trapped gasses (cold, allergies, inflammation)	pain due to pressure differences	valsalva maneuver, slower descent
Spatial Disorientation	loss of horizon or visual references	loss of control, confusion about the airplane's attitude	avoid sudden head movements, focus on (and trust) the flight instruments
Motion Sickness	motion not matching visual clues, turbulence	loss of appetite, sweating, headaches, disorientation, nausea, vomiting	look out to the horizon, avoid rough air and abrupt maneuvers, open fresh air vents, avoid unnecessary head movements
Fatigue	physical exertion, lack of sleep	attention lapses, lack of awareness, error accumulation, low motivation	obtain adequate rest, mitigate the underlying problem
Stress	environmental, physiological, or psychological stressors	fatigue, upset stomach problems sleeping	physical fitness, balanced schedule, set reasonable standards
Dehydration	critical loss of water or electrolytes	fatigue, thirst, headache, abdominal cramps, dizziness	drink plenty of water, avoid diuretic drinks, wear lightweight clothing
Alcohol	consumption, disregard for regulations	impaired judgment, decreased sense of responsibility, reduced coordination	don't fly for at least 8 hours (12–16 hours recommended)
Decompression Sickness	formation of nitrogen bubbles during scuba diving	the bends (pains in the joints), peculiar sensations of the skin, spotty rashes, itching, tingling	follow the recommended waiting time after diving (12 or 24 hours)

General Information

V-speeds are airspeeds defined for specific maneuvers and configurations. They may be stated in MPH or knots, and as calibrated airspeeds (CAS) or indicated airspeeds (IAS). Newer AFM/POHs use knots indicated airspeed (KIAS).

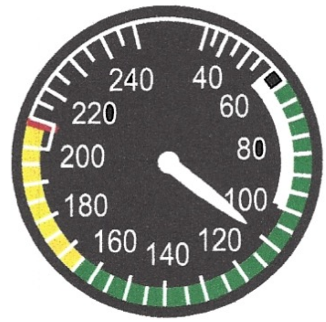
Unless otherwise noted in the AFM/POH, V-speeds apply to sea level, standard day conditions at maximum takeoff weight.

Conditions that can affect the value of V-speeds include:

- Aircraft weight and configuration
- Atmospheric conditions (e.g., altitude and temperature)
- Runway conditions (e.g., contaminated runway)

Did You Know?: The "V" stands for *vitesse*, a French word for speed or rate.

V-Speeds on the Airspeed Indicator



Lower Limit of White Arc – Stall Speed in the Landing Configuration (V_{SO}): In small aircraft, this is the power-off stall speed at the maximum landing weight in the landing configuration (gear and flaps down).

Lower Limit of Green Arc – Stall Speed in a Specific Configuration (V_{S1}): For most airplanes, this is the power-off stall speed at the maximum takeoff weight in the clean configuration (gear up, if retractable, and flaps up).

Note: "Stall speed" can be misleading. A stall can occur at any airspeed, in any attitude, with any power setting.

Related: Stall Awareness: Factors Affecting Stall Speed

Upper Limit of White Arc – Maximum Flap Extended Speed (V_{FE}): The maximum speed for operating with the flaps extended. Some aircraft allow partial flap extensions above the airspeed indication (refer to the AFM/POH limitations).

Upper Limit of Green Arc – Maximum Structural Cruising Speed (V_{NO}): The maximum speed that can be flown safely fly in smooth air. Flight above V_{NO} should only be conducted cautiously. Structural damage can occur if rough air is encountered beyond this speed.

Red Line – Never-Exceed Speed (V_{NE}): The absolute maximum speed. Structural damage or failure can occur beyond this speed.

Other V-Speeds

The following speeds are not shown on the airspeed indicator.

V_R – Rotation Speed: The speed at which the pilot makes a control input, with the intention of lifting the airplane out of contact with the runway or water surface. To prevent an inadvertent stall during takeoff, V_R cannot be less than V_{S1}.

V_{LE} – Maximum Landing Gear Extended Speed: The maximum speed for operating with the landing gear extended. A related speed is V_{LO}, which is the maximum speed for operating (extending or retracting) the landing gear.

V_A – Design Maneuvering Speed: The speed below which the pilot can move a *single flight control*, *one time*, to its *full deflection*, for *one axis* of airplane rotation only (pitch, roll, or yaw), in *smooth air*, without risk of damage to the airplane. V_A decreases as the airplane's weight decreases.

Related: Principles of Flight: Maneuvering Speed

V_X – Best Angle of Climb Speed: The speed that results in the greatest altitude over the shortest distance. Pilots use V_X during a short-field takeoff to clear obstacles in the departure path.

Related: Aircraft Performance: Best Angle of Climb

V_Y – Best Rate of Climb Speed: The speed that results in the greatest altitude gain over the shortest period of time. Pilots use V_Y as the normal climb speed after takeoff.

Related: Aircraft Performance: Best Rate of Climb

V_G / V_{BG} – Best Power-Off Glide Speed: The speed that maximizes gliding distance. V_G and V_{BG} are commonly used but are not official V-speeds.

Related: Emergency Approach and Landing: Best Glide Speed

V-Speed List

Speed	Definition
V_1	Maximum speed in the takeoff at which the pilot must take the first action (e.g., apply brakes) to stop the airplane within the accelerate-stop distance. Also the minimum speed in the takeoff, following a failure of the critical engine at V_{EF}, at which the pilot can continue the takeoff and achieve the required height above the takeoff surface within the takeoff distance.
V_2	Takeoff safety speed: The speed at which the aircraft may safely be climbed with one engine inoperative (OEI).
V_A	Design maneuvering speed
V_B	Design speed for maximum gust intensity
V_G / V_{BG}	Best power-off glide speed: Provides the greatest flight distance available (V_G and V_{BG} are not official V-speeds)
V_C	Design cruising speed
V_D	Design diving speed
V_F	Design flap speed
V_{FE}	Maximum flap extended speed
V_H	Maximum speed in level flight with maximum continuous power
V_{LE}	Maximum landing gear extended speed
V_{LO}	Maximum landing gear operating speed
V_{LOF}	Liftoff speed
V_{MC}	Minimum control speed with the critical engine inoperative (commonly used instead of V_{MCA})
V_{MCA}	The minimum speed that the aircraft is still controllable with the critical engine inoperative while the aircraft is airborne
V_{MCG}	The minimum speed that the aircraft is still controllable with the critical engine inoperative while the aircraft is on the ground
V_{MO} / M_{MO}	Maximum operating limit speed (knots or mach)
V_{MU}	Minimum unstick speed
V_{NE}	Never-exceed speed
V_{NO}	Maximum structural cruising speed
V_O	Operating maneuver speed: At or below this speed, the airplane will stall in a nose-up pitching maneuver before exceeding the airplane structural limits.
V_R	Rotation speed
V_{REF}	Reference landing speed
V_S	Stalling speed or the minimum steady flight speed at which the airplane is controllable
V_{S0}	Stalling speed or the minimum steady flight speed in the landing configuration
V_{S1}	Stalling speed or the minimum steady flight speed obtained in a specific configuration
V_{SSE}	Safe, intentional one-engine-inoperative speed: The minimum speed at which to perform intentional engine cuts in flight.
V_X	Best angle of climb speed: The speed that will produce the greatest altitude over the shortest ground distance.
V_{XSE}	Best angle of climb speed with one-engine-inoperative
V_Y	Best rate of climb speed: The speed that will produce the greatest altitude in the shortest time.
V_{YSE}	Best rate of climb speed with one-engine-inoperative

Reference: 14 CFR 1.2

Real-World Training and Authentic Assessment	
Problem-Based Instruction Scenario-Based Training Collaborative Problem-Solving Case Studies	**Collaborative Assessment** Guided Self-Assessment Flight Instructor's Assessment

– – – – – – – – – – *encourages the development of* – – – – – – – – – –

Higher-Order Thinking Skills	**Aeronautical Decision-Making**	**Single-Pilot Resource Management**
The cognitive skills of analysis, synthesis and evaluation.	DECIDE Model: Detect, Estimate, Choose, Identify, Do, Evaluate	5P Model: Plan, Plane, Pilot, Passengers, Programming

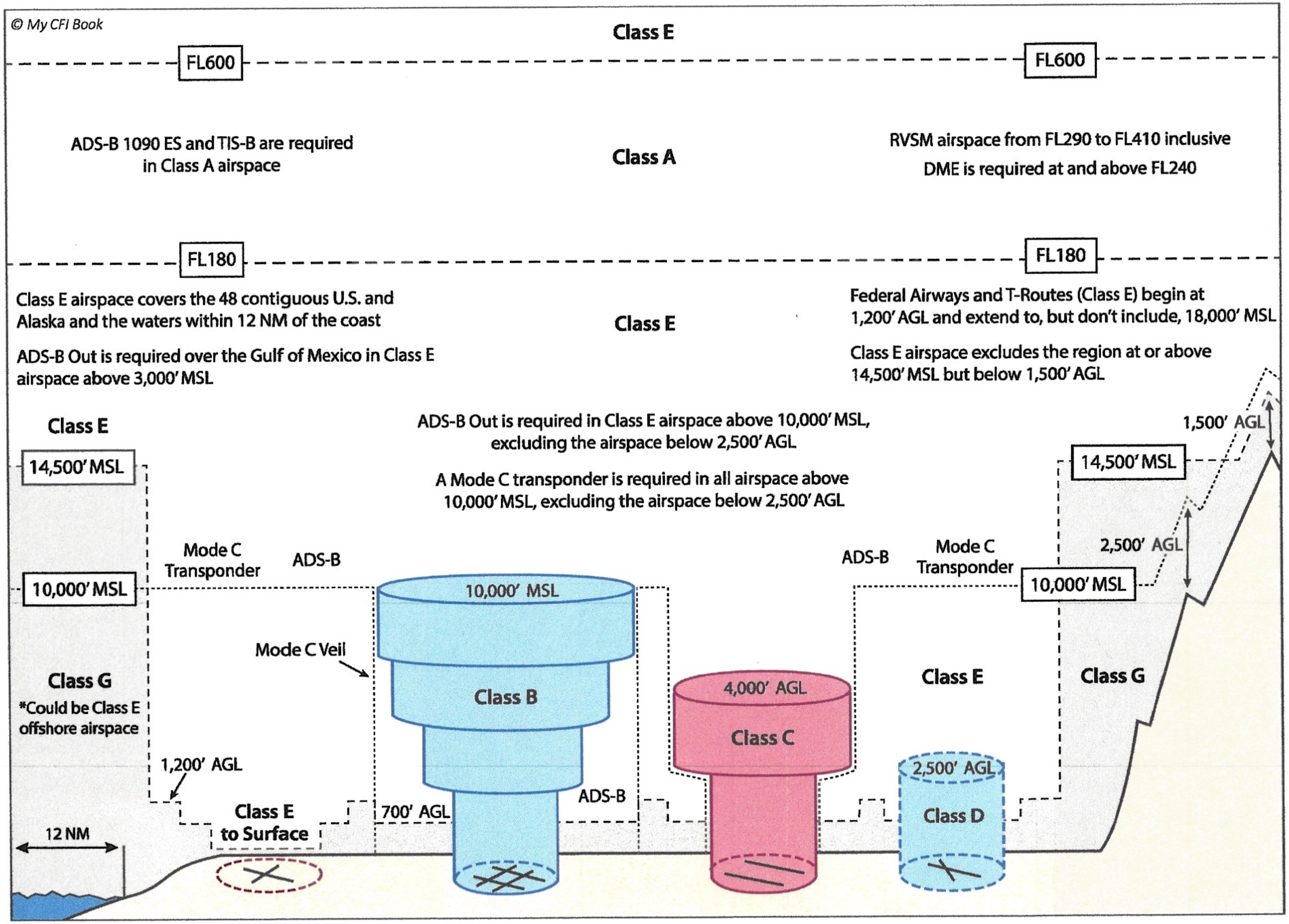
– – – – – – – – – – *which incorporate the elements of* – – – – – – – – – –

Risk Management	***Flight Deck Management***	***Controlled Flight Into Terrain Awareness***
3P Model: Perceive, Process, Perform	Automation Management Sterile Cockpit Checklist Usage	

– – – – – – – – – – *combine to create and maintain* – – – – – – – – – –

Situational Awareness

The accurate perception and understanding of all the factors and conditions within the four fundamental risk elements (Pilot, Aircraft, Environment, External Pressures).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Class E
FL600
FL600
ADS-B 1090 ES and TIS-B are required in Class A airspace
Class A
RVSM airspace from FL290 to FL410 inclusive
DME is required at and above FL240
FL180
FL180
Class E airspace covers the 48 contiguous U.S. and Alaska and the waters within 12 NM of the coast
ADS-B Out is required over the Gulf of Mexico in Class E airspace above 3,000' MSL
Class E
Federal Airways and T-Routes (Class E) begin at 1,200' AGL and extend to, but don't include, 18,000' MSL
Class E airspace excludes the region at or above 14,500' MSL but below 1,500' AGL
Class E
14,500' MSL
ADS-B Out is required in Class E airspace above 10,000' MSL, excluding the airspace below 2,500' AGL
A Mode C transponder is required in all airspace above 10,000' MSL, excluding the airspace below 2,500' AGL
1,500' AGL
14,500' MSL
Mode C Transponder
ADS-B
10,000' MSL
ADS-B
Mode C Transponder
2,500' AGL
10,000' MSL
10,000' MSL
Mode C Veil
Class G
*Could be Class E offshore airspace
Class B
4,000' AGL
Class C
Class E
Class G
1,200' AGL
2,500' AGL
ADS-B
Class D
Class E to Surface
700' AGL
12 NM

Airspace	Class A	Class B	Class C	Class D	Class E	Class G
Operations Permitted	IFR	IFR and VFR	IFR and VFR	IFR and VFR	IFR and VFR	IFR and VFR
Entry Prerequisites	ATC Clearance	ATC Clearance	IFR: Clearance VFR: Two-Way Radio Contact	IFR: Clearance VFR: Two-Way Radio Contact	IFR: Clearance	None
Minimum Pilot Qualifications	Instrument Rating	Student[1] or Private	No Specific Requirement	No Specific Requirement	No Specific Requirement	No Specific Requirement
Equipment	IFR Equipped, Two-Way Radio, Mode C Transponder, ADS-B Out, TIS-B	Two-Way Radio, Mode C Transponder, ADS-B Out	Two-Way Radio, Mode C Transponder, ADS-B Out	Two-Way Radio	Mode C Transponder[2], ADS-B Out[2,3]	Mode C Transponder[2]
VFR Minimum Visibility Below 10,000 MSL	N/A	3 SM	3 SM	3 SM	3 SM	Day: 1 SM[4] Night: 3 SM[4]
VFR Minimum Visibility 10,000 MSL and Above	N/A	3 SM	3 SM	3 SM	5 SM	5 SM
VFR Minimum Distance from Clouds Below 10,000 MSL	N/A	Clear of Clouds	500' Below 1,000' Above 2,000' Horizontal	500' Below 1,000' Above 2,000' Horizontal	500' Below 1,000' Above 2,000' Horizontal	500' Below 1,000' Above 2,000' Horizontal
VFR Minimum Distance from Clouds 10,000 MSL and Above	N/A	Clear of Clouds	500' Below 1,000' Above 2,000' Horizontal	500' Below 1,000' Above 2,000' Horizontal	1,000' Below 1,000' Above 1 SM Horizontal	1,000' Below 1,000' Above 1 SM Horizontal
Aircraft Separation Provided	All	All	IFR/IFR, SVFR/SVFR, SVFR/IFR, VFR/IFR, and Runway Operations	IFR/IFR, SVFR/SVFR, SVFR/IFR, and Runway Operations	IFR/IFR, SVFR/SVFR, SVFR/IFR	None

1. Student pilot operations at some Class B airports are prohibited (Ref: 14 CFR Part 91 Appendix D)
2. Required above 10,000' MSL, excluding the airspace at and below 2,500' AGL (Ref: 14 CFR 91.215)
3. Required in Class E airspace at and above 3,000' MSL over the Gulf of Mexico from the coastline to 12 NM (Ref: 14 CFR 91.225)
4. When flying in Class G airspace at 1,200' AGL or below:
   - **Day:** 1 SM visibility, clear of clouds (Ref: 14 CFR 91.155)
   - **Night:** 3 SM visibility, 500' below, 1,000' above, 2,000' horizontal (Ref: 14 CFR 91.155)

Notes:

- *14 CFR 91.155(b) states that in class G airspace below 1,200' AGL during night hours, when the visibility is not less than 1 SM, an airplane may be operated clear of clouds if operated in an airport traffic pattern within 1/2 mile of the runway.*
- *14 CFR 91.155(c) prohibits pilots from operating beneath the ceiling under VFR within the lateral boundaries of controlled airspace designated to the surface for an airport when the ceiling is less than 1,000'.*

Stabilized Approach Concept

A stabilized approach is characterized by a constant-angle, constant-rate of descent approach profile ending near the touchdown point, where the landing maneuver begins. Slight and infrequent adjustments are all that's needed to maintain a stabilized approach.

Stabilized Approach Criteria

An approach is considered stabilized when:

- All briefings and checklists are complete.
- The aircraft is in the landing configuration.
- The approach is programmed and activated in the GPS, if applicable.
- The autopilot and flight director are in the correct mode, if applicable.
- The aircraft is on the lateral and vertical flightpath, ±1 dot of deflection.
- The sink rate is no greater than 1,000 FPM.
- The target approach speed is established, +10/-5 knots.
- The proper wind drift correction is established.
- Only small changes in heading, pitch, and power are required.

Notes:

- *These parameters should be adjusted for the aircraft type and include all manufacturer guidance.*
- *Any approach that requires deviations from the parameters should be addressed in a special briefing.*

Minimum Stabilization Heights

The recommended minimum stabilization heights are:

- 500' above the airport elevation in VMC.
- 1,000' above the airfield elevation in IMC.
- For a circling approach, MDA or 500' above the airport elevation, whichever is lower.

Go-Around for Safety

The objective is to be stabilized before reaching the predetermined minimum stabilization height. If the aircraft is not stabilized at the minimum stabilization height or becomes unstabilized below the minimum stabilization height, a go-around should be initiated.

MANEUVER	BANK		PITCH		POWER	
	PRIMARY	SUPPORTING	PRIMARY	SUPPORTING	PRIMARY	SUPPORTING
Straight-and-Level Flight	DG	AI, TC	ALT	AI, VSI	ASI	TACH/MP
Airspeed Changes in Straight-and-Level Flight	DG	AI, TC	ALT	AI, VSI	TACH/MP	–
Level Turns to Headings	TC	AI	ALT	AI, VSI	ASI	TACH/MP
Establishing Level Turns to Headings	AI	TC	ALT	AI, VSI	ASI	TACH/MP
Constant Airspeed Climbs and Descents	DG	AI, TC	ASI	AI, VSI	TACH/MP	–
Establishing Constant Airspeed Climbs and Descents	DG	AI, TC	AI	ASI, VSI	TACH/MP	–

Legend:

- AI = Attitude Indicator
- ALT = Altimeter
- ASI = Airspeed Indicator
- DG = Directional Gyro (Heading Indicator)
- VSI = Vertical Speed Indicator
- TACH/MP = Tachometer/Manifold Pressure Gauge

Flight Computer Practice Problems

Density Attitude

Pressure Altitude	OAT (°C)	Density Altitude
3,000'	20	
10,000'	-20	
4,000'	-25	

True Airspeed

CAS	TAS	OAT (°C)	Press. Altitude
125		15	5,000
110		0	8,000
149		-5	12,000

True Altitude

Pressure Altitude	OAT (°C)	True Altitude
12,500'	-20	
7,000'	-10	
9,000'	-20	

True Heading and Groundspeed

TC	TAS	Wind	TH	GS
30°	170kt	080°/20kt		
310°	120kt	180°/16kt		
095°	112kt	360°/10kt		

Time, Speed, & Distance

Time	Speed (kts)	Distance (nm)
	180	240
	110	33
2:00	110	
1:30	100	
0:43		90
0:19		35

Converting NM to SM

Nautical Miles	Statute Miles
	161
	77
20	
12	

Fuel Consumption

Time	Burned (gal)	Rate (GPH)
	30	12
	24	11
0:40	7	
4:11	36	
0:15		14
0:28		11