

1 Performance & Limitations

Key speeds

- V_{NE} — never exceed; decreases with DA
- V_Y — best rate of climb
- $V_{AUTOROT}$ — best glide in autorotation

Hover performance

- **IGE** — ground effect ≤ 1 rotor diameter; lower power req.
- **OGE** — no ground effect; significantly more power
- High DA / OAT / mass \rightarrow reduced margin for OGE
- Headwind improves hover; tailwind degrades it

Translational lift & transverse flow

Effective Translational Lift (ETL) occurs at approximately 16–24 kt IAS when the helicopter moves into undisturbed air. The rotor disc becomes more aerodynamically efficient \rightarrow noticeable increase in lift and performance. Felt as a vibration followed by a “surge” and nose-up pitch.

Transverse flow effect is a vibration at the onset of ETL caused by the difference in induced flow between the front and rear of the rotor disc. The air flowing through the rear half of the disc has a higher downwash angle than the front half. This causes unequal lift across the disc and a lateral vibration. Correction: apply lateral cyclic toward the retreating side to counter the roll (right cyclic for CCW rotors, left cyclic for CW rotors like Cabri G2).

Factors reducing performance

- \uparrow Density Altitude (high elev., high OAT, low QNH)
- \uparrow Mass / aft CG
- \uparrow Humidity (minor but real)
- Tailwind / downslope wind

Power curves

- **Power required** = parasite + induced + profile
- **Power available** decreases with DA
- Bucket of Pr curve $\approx V_Y$
- Excess power = climb capability

To determine OGE hover capability at a given location: enter OAT and pressure altitude into the RFM hover ceiling chart, read the maximum mass for OGE. If the current mass exceeds it, OGE hover is not possible. Options: reduce mass, wait for cooler conditions, or plan an IGE departure only.

2 Aerodynamic Hazards

Loss of Tail Rotor Effectiveness (LTE)

Three distinct phenomena cause LTE. The critical wind azimuths depend on main rotor rotation direction — for CCW rotors (e.g. R22/R44) the dangerous wind comes from the left rear; for CW rotors (Cabri G2, some Airbus) it mirrors to the right rear. The underlying aerodynamics are the same, only the geometry flips.

- **Main rotor disc vortex interference** — wind from the rear quarter pushes the MR tip vortex into the tail rotor disc, disrupting its airflow. The TR must work against disturbed, swirling air \rightarrow sudden loss of anti-torque. Onset is abrupt with little warning.

- **Weathercock instability (tailwind)** — wind from the rear acts on the fuselage like a weather vane, pushing the nose away from wind. If the yaw rate exceeds TR authority, the pilot cannot stop the rotation. Worst with direct tailwind or quartering tailwind from the side opposite to TR thrust.
- **Tail rotor vortex ring state** — crosswind from the TR thrust side (the direction TR blows air) causes the TR to operate in its own recirculating wake, similar to main rotor VRS. TR thrust collapses \rightarrow uncommanded yaw. Insidious because it builds gradually.

Common to all: low IAS + high power + hovering/slow flight.

Recovery: full opposite pedal, lower collective (reduce torque demand), gain forward airspeed to restore clean airflow over TR.

Retreating Blade Stall

- High IAS + high load factor + high DA + turbulence
- Retreating blade AoA exceeds critical angle
- Symptoms: vibration, pitch-up, roll to retreating side
- **Recovery:** reduce IAS, reduce load factor, descend

Settling with power

Helicopter descends despite power applied. Broad term covering multiple causes:

- Insufficient power margin (high DA, heavy, hot)
- Operating behind the power curve (too slow)
- Downdraft or lee-side sink exceeding climb capability
- Attempting OGE hover beyond performance limits

The pilot pulls more collective but the helicopter keeps sinking — power required exceeds power available.

Prevention:

- Always know your power margin before committing — perform a hover check
- Plan approaches that maintain translational lift as long as possible
- Monitor rate of descent vs. power available; react early
- Avoid slow, steep approaches at high density altitude
- In mountain flying, anticipate downdrafts on the lee side

Vortex Ring State (VRS)

A specific, more dangerous form of settling with power. The rotor descends into its own downwash and re-ingests the air, forming a toroidal (doughnut-shaped) vortex around the disc. Lift collapses because the rotor is working recirculated air, not clean air.

- **Conditions:** low IAS (<30 kt) + high RoD (>300 ft/min) + significant power applied
- **Symptoms:** severe vibration, buffeting, erratic pitch/roll, very high sink rate (up to $3000+$ ft/min) that does *not* respond to more power
- **Adding power makes it worse** — it increases the vortex strength

Settling with power is the broad symptom; VRS is the specific aerodynamic mechanism. You can settle with power without VRS (e.g. simply exceeding power available in a

downdraft), but in VRS, adding power feeds the vortex and worsens the situation.

VRS recovery

- **Classic:** lower collective (reduce vortex energy) + cyclic forward (gain IAS to fly out of the recirculation) — needs altitude
- **Vuichard:** simultaneous power + lateral cyclic + opposite pedal to fly sideways out of the vortex column — works with less altitude loss
- **Key:** **never** respond with more collective alone — it deepens the VRS

3 EFATO — Engine Failure After Take-Off

Why EFATO is critical

Take-off combines low altitude + low airspeed + high power — the worst combination for an engine failure. Options are severely limited by energy state (speed + height). Every EFATO decision must be pre-planned before you lift off.

Decision framework by altitude

Below safe forced landing height (<200 ft AGL):

- Immediately lower collective to maintain Nr
- Land essentially **ahead** — slight turn ($\pm 30^\circ$) is the maximum
- No time to select ideal area — take what is in front of you
- **Never** attempt a turn-back (180°) — insufficient energy, high risk of rotor RPM decay in the turn

Above safe forced landing height (>200 ft AGL):

- More energy available → wider choice of landing areas
- Can make turns (up to 180° if altitude permits)
- Still: lower collective first, establish autorotative glide, then manoeuvre
- Choose into-wind landing if possible

Above 500 ft AGL:

- Full range of options — turns, area selection, even return to departure point if within glide range
- Standard autorotation procedure applies

Immediate actions — any height

1. **Lower collective** — maintain Nr (rotor RPM decays in ~ 2 sec without action)
2. **Establish V_{AUTOROT}** — best glide speed for your type
3. Select landing area (pre-planned below safe height)
4. Flare to reduce groundspeed, then cushion with collective

Without engine torque, the rotor decelerates immediately. Lowering collective reduces blade pitch angle → the upward airflow through the disc (autorotative force) keeps the rotor spinning. A delay of even 1–2 seconds at high collective means Nr drops below recoverable range.

Pre-flight planning

- Before every take-off: identify forced landing area ahead
- Know the H-V diagram (“dead man’s curve”) for your type — it shows height/speed combinations where a

safe autorotation landing is not possible. At low height + low speed there is insufficient time to accelerate; at low height + high speed, insufficient time to flare. Pass through these zones quickly during take-off.

- Brief yourself: “If engine fails before translational lift / below 200 ft / above 500 ft, I will...”
- Consider wind direction — tailwind EFATO is worst case

4 Air Law — CPL Privileges

CPL(H) holder may:

- Exercise all PPL(H) privileges
- Act as PIC on commercial ops (VFR)
- Aerial work, passenger transport (single-pilot)

VFR minima by airspace (SERA.5001)

Class A: VFR not permitted.

Class B (above FL 100):

- 8 km visibility
- Cloud: 1500 m horizontal, 1000 ft vertical
- ATC clearance required

Class C/D/E (below FL 100, above 3000 ft AMSL or 1000 ft AGL):

- 5 km visibility
- Cloud: 1500 m horizontal, 1000 ft vertical
- Class C/D: ATC clearance required; Class E: no clearance

Class F/G (at/below 3000 ft AMSL or 1000 ft AGL):

- **Standard:** 5 km vis, clear of cloud, sight of surface
- **Reduced** (≤ 140 kt IAS): 1500 m vis, clear of cloud, sight of surface
- The 1500 m rule is not helicopter-specific — any aircraft ≤ 140 kt qualifies (helis benefit because they typically fly below 140 kt)

Special VFR (inside CTR only — class C/D):

- Requires **ATC clearance**; only within a CTR
- **Aeroplanes:** vis ≥ 1500 m, clear of cloud, sight of surface
- **Helicopters:** vis ≥ 800 m, clear of cloud, sight of surface
- Day only (night SVFR needs specific national approval)
- 800 m is **only** for helicopters, **only** SVFR, **only** inside CTR

Night VFR — EASA (SERA)

Night VFR requires national approval and/or type supplement (e.g. Cabri G2: J40-901). SERA defers night VFR conditions to each state. Key SERA-level principles:

- No reduced visibility (≤ 140 kt / 1500 m) rule at night
- Must maintain 1500 m / 1000 ft from cloud (“clear of cloud” not sufficient)
- Surface or surface lights must be visible
- Helicopter SVFR 800 m reduction generally **does not** apply at night

Night VFR — Czech Republic (AIP ENR 1.2)

Czech rules distinguish **aerodrome** (circuit / CTR / ATZ) and **en-route** night flights:

Aerodrome night flights:

- Visibility: **5 km** (flight and ground)
- Min height: **1000 ft AAL/AGL** (circuit), 1300 ft AGL (cruise)
- Min cloud base: 2300 ft AGL (circuit: 2000 ft)
- Cloud separation: 1500 m horiz, 1000 ft vert

En-route night flights:

- Visibility: **8 km** (flight)
- Min height: **2000 ft AGL**
- Min cloud base: **3000 ft AGL**
- Alternate aerodrome required
- Transponder SSR Mode A / C or S required
- At least one radio nav aid (ADF / VOR / GPS)
- Fuel: **IFR-equivalent** navigation reserve (more than standard VFR 20 min)
- Flight plan must be submitted before flight

Airspace structure — services provided

Class A: IFR only. Full ATC separation for all traffic. No VFR.

Class B: IFR and VFR. ATC clearance required. Full separation provided between all traffic (IFR–IFR, IFR–VFR, VFR–VFR). Speed limit: none.

Class C: IFR and VFR. ATC clearance required. Separation: IFR from IFR and VFR. VFR receives traffic information about other VFR. Speed limit: 250 kt below FL 100.

Class D: IFR and VFR. ATC clearance required. Separation: IFR from IFR only. All traffic receives traffic information about other flights. Speed limit: 250 kt below FL 100.

Class E: IFR and VFR. ATC clearance required for IFR only; VFR does not need clearance. Separation: IFR from IFR only. Traffic information where practicable. Speed limit: 250 kt below FL 100.

Class F: IFR and VFR. Advisory service for IFR. No ATC clearance. Flight information service on request. Speed limit: 250 kt below FL 100.

Class G: Uncontrolled. No ATC clearance. Flight information service on request. No separation. Speed limit: 250 kt below FL 100.

Fuel reserves — EASA (NCO.OP.125/126)**Aeroplanes (NCO.OP.125):**

- Day VFR: final reserve = **30 min** at cruise consumption
- Night VFR: final reserve = **45 min** at cruise consumption

Helicopters (NCO.OP.126):

- VFR (day and night): final reserve = **20 min** at best range speed
- No day / night distinction in NCO.OP.126 itself

Total = taxi + trip + contingency (10%) + alternate (if req.) + final reserve + additional (PIC discretion).

Czech night en-route (AIP ENR 1.2, §2.5.3.2): “the aircraft shall have navigational reserve of fuel and oil as for an IFR flight.” — effectively IFR fuel planning rules apply, exceeding the standard VFR 20 min reserve.

PIC responsibilities

- Go/no-go decision
- Airworthiness check, W&B within limits
- Required documents on board (A-R-R-O-W / national)
- POB notification

5 Meteorology & Go/No-Go**METAR/TAF — key items**

- Wind (dir, strength, gusts), Visibility, RVR
- Cloud: FEW/SCT/BKN/OVC + height
- TEMPO / BECMG / PROB, QNH

When evaluating a go/no-go: check ceiling vs MSA, visibility vs VFR minima for your category, wind vs helicopter limits and terrain effects. For example, BKN at 800 ft with vis 4 km and gusting 25 kt meets helicopter reduced minima technically, but gusty conditions near terrain mean turbulence risk — not ideal for commercial ops.

Mountain / hilly terrain

- Lee-side turbulence, rotor clouds
- Valley wind convergence
- Reduced performance at altitude
- Plan MSA carefully — add margin

On the lee side of a ridge, expect turbulence, downdrafts, and possible rotor streaming. Wind accelerates over the crest and creates eddies on the lee side. Strong downdrafts can exceed climb capability. Fly with margin above ridgelines, approach from the upwind side, and avoid the lee side at low level.

6 Navigation & Fuel Planning**Route planning**

- Select route: terrain, airspace, alternates
- **MSA:** highest obstacle within 5 NM + 1000 ft (2000 ft mountainous)
- Check NOTAMs, restricted / danger areas

Fuel calculation

Component	Detail
Taxi fuel	As required
Trip fuel	Planned route
Contingency	10% of trip (or 5 min)
Alternate fuel	If required
Final reserve	30 min (day VFR) / 20 min (heli)
Additional	PIC discretion

Calculate from POH fuel burn at planned power setting and altitude. Total = taxi + trip + contingency + alternate (if required) + final reserve + additional at PIC discretion.

7 Systems — General

- **Governor / FADEC:** maintains Nr by adjusting fuel flow
- Governor failure → manual throttle correlation
- **Clutch / belt system:** engagement procedure, limits
- **Hydraulics:** servo-assisted; failure = heavy controls
- **Rotor brake:** use only below specified Nr
- Know: engine limits (TQ, TOT / EGT, Nr), emergency

procedures from memory, fuel system, electrical system

After governor failure, the governor no longer adjusts fuel flow to maintain Nr. The pilot must immediately take over manual throttle correlation — hold the twist grip firmly and regulate Nr in the green arc. Throttle must be adjusted with every collective change. Workload increases significantly. Land as soon as practicable.