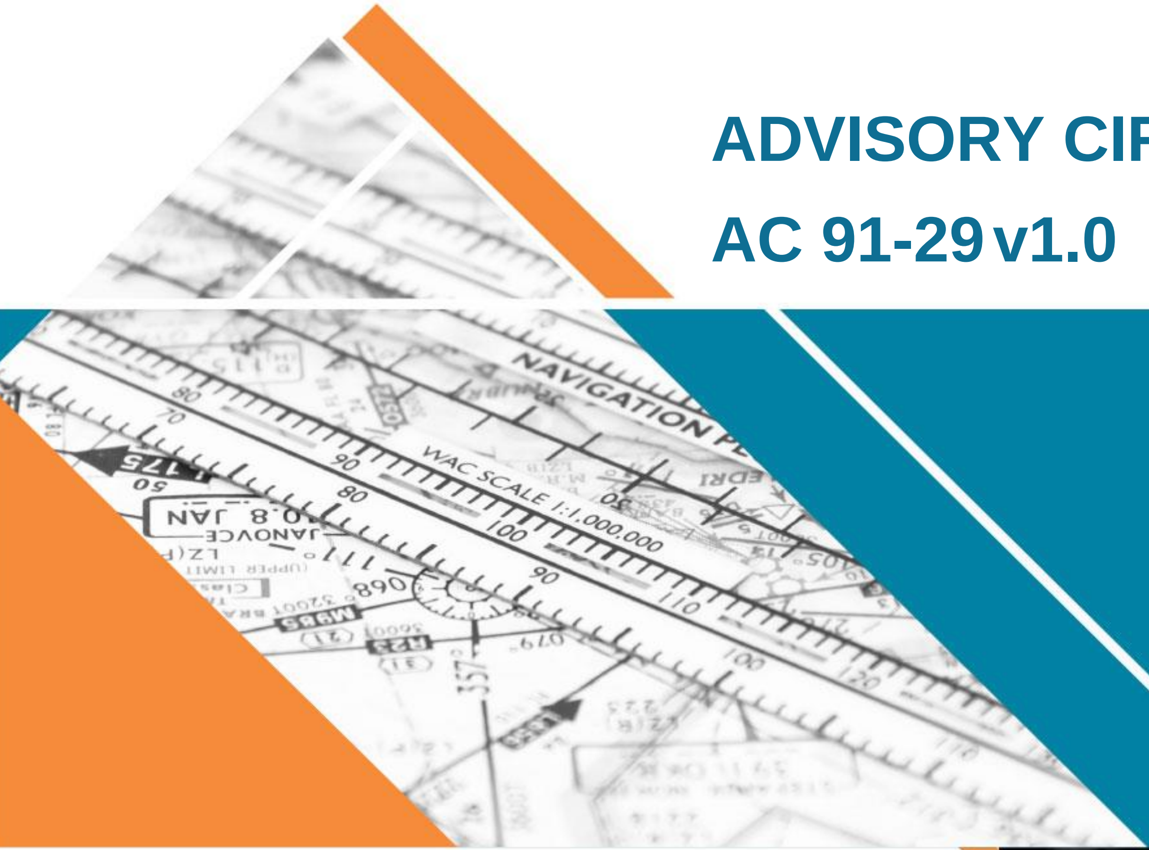
Australian Government
Civil Aviation Safety Authority



ADVISORY CIRCULAR
AC 91-29 v1.0

Guidelines for helicopters - suitable places to take off and land

Date	October 2021
Project number	OS 99/08
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For Flight Operations Regulations commencing on 2 December 2021

Audience

This advisory circular (AC) is for pilots and operators of helicopters.

Purpose

This AC provides guidance to assist pilots in assessing the suitability of a place for a helicopter to safely take off and land. It provides an overview of the pilot's responsibilities and discusses some, but not all, circumstances, including prevailing weather conditions, that are recommended to be considered. It also provides general information and advice to enhance the safety of taking off and landing at any place.

While this AC primarily highlights general principles related to the selection and use of places for helicopters to take-off and land, it does not cover the application of the rotorcraft performance class rules required to be used by an Australian air transport operator under Part 133 or able to be used by a person conducting an aerial work operation under Part 138.

For locations that are not certified aerodromes, the pilot may not be able to solely rely on published information and may need to seek information from the owner or operator of the land in question to ensure a safe outcome.

The pilot in command (PIC) is ultimately responsible for the safe conduct of their flight. In some circumstances, the responsibility is shared with the aircraft operator, particularly in air transport operations. CASA recommends that pilots and operators (where applicable) consider the advice in this AC when determining whether it is safe to take off from or land at any place/aerodrome.

For further information

For further information, contact CASA’s Flight Standards Branch (telephone 131 757 or email flightstandards@casa.gov.au).

Unless specified otherwise, all subregulations, regulations, Divisions, Subparts and Parts referenced in this AC are references to the *Civil Aviation Safety Regulations 1998 (CASR)*.

Status

This version of the AC is approved by the Branch Manager, Flight Standards.

Version	Date	Details
v1.0	October 2021	Initial AC. This AC supports 91.410 and replaces helicopter operational information in CAAP 92-2(2) from 2 December 2021 when the CAAP will be repealed.

Contents

1 Reference material

1.1 Acronyms

The acronyms and abbreviations used in this AC are listed in the table below.

Acronym	Description
AC	advisory circular
AFM	aircraft flight manual
AGL	above ground level
AWIS	Aerodrome Weather Information Service
CASR	*Civil Aviation Safety Regulations 1998*
D	D (see Definitions)
DLB	Dynamic Load Bearing
EASA	European Aviation Safety Agency
FAR	*Federal Aviation Regulations* of the United States of America
FATO	final approach and take-off area
HIGE	hover in ground effect
HLS	helicopter landing site
HOGE	hover over ground effect
ISA	International Standard Atmosphere
ICAO	International Civil Aviation Organization
LDR	landing distance required
LSALT	Lowest Safe Altitude
MLW	maximum landing weight
MOS	Manual of Standards
MTOW	maximum take-off weight
NAA	National Aviation Authority
OEI	one engine inoperative
PA	pressure altitude
PIC	pilot in command
POH	pilot operating handbook
QNH	regional or airfield pressure setting
RD	Rotor Diameter

Acronym	Description
TD/PM	touchdown/positioning marking
TLOF	touchdown and lift-off area
TODR	take-off distance required
VMC	visual meteorological conditions

1.2 Definitions

Terms that have specific meaning within this AC are defined in the table below. Where definitions from the Regulations have been reproduced for ease of reference, these are identified by grey shading. Should there be a discrepancy between a definition given in this AC and the Regulations, the definition in the Regulations prevails.

Term	Definition
Basic HLS	a place that may be used as an aerodrome for infrequent, opportunity and short-term operations other than Air Transport operations by day under helicopter Visual Meteorological Conditions (VMC).
D	for a rotorcraft, means the maximum dimensions of the rotorcraft
Final approach and take-off area (FATO)	for the operation of a rotorcraft at an aerodrome, means the area of the aerodrome: a. from which a take-off is commenced; or b. over which the final phase of approach to hover is completed
Helicopter Landing Site (HLS)	means an aerodrome, including a heliport, intended for use wholly or partly for the arrival, departure or movement of helicopters and where designed to and capable of accommodating them, other rotorcraft.
Heliport	An area that is: a. intended for use wholly or partly for the arrival or departure of helicopters, on: i land, or ii a building or other raised structure on land; and b. meets or exceeds the heliport standards set out in Volume II of Annex 14 to the Chicago Convention.
Lift-off	in relation to a helicopter, means to raise the helicopter from a position of being in contact with the surface of the HLS into the air.
Secondary HLS	A place suitable for use as an aerodrome for helicopter operations by day or night that does not conform fully to the standards for a heliport set out in Volume II of the Annex 14 to the Chicago Convention.
Take-off	in relation to a flight of a helicopter from a HLS, means the phase of flight where the helicopter accelerates into forward flight and commences climb at the relevant climb speed, or if not intending to climb, enters level flight for the purposes of departure from the helicopter landing site.
RD	means the diameter of the main rotor with the engine/s running.

Term	Definition
Touchdown	means lowering the helicopter from a flight phase not in contact with the surface of the HLS into a position which is in contact with the surface of the HLS for a landing.
Touchdown and Lift-off Area (TLOF)	touchdown and lift-off area and is the surface over which the touchdown and lift-off is conducted. .
R	for a rotorcraft, means the largest radius of the rotorcraft's main rotor disc, as mentioned in the rotorcraft's flight manual.
V_{TOSS} (FAA)	means take-off safety speed for a category A rotorcraft
V_{TOSS} (Part 133)	V_{TOSS}, for a rotorcraft, means the minimum speed at which climb of the rotorcraft is achieved with 1 engine inoperative and the remaining engines operating within the operating limits mentioned in the rotorcraft's flight manual for a take-off.
V_X	best angle of climb speed the airspeed at which the aircraft gains the greatest amount of altitude in a given distance.
V_Y	best rate of climb speed–the airspeed that provides the most altitude gain in a given period of time.

1.3 References

Regulations

Regulations are available on the Federal Register of Legislation website https://www.legislation.gov.au/

Document	Title
Civil Aviation Act 1988	
Part 91	General operating and flight rules
Part 133	Australian air transport operations – rotorcraft
Part 139	Aerodromes

Advisory material

CASA's advisory circulars are available at http://www.casa.gov.au/AC

Document	Title
EASA	Off Airfield Landing Site Operations
FAA-H	Helicopter Flying Handbook
FAR	Part 27 and 29 of the Federal Aviation Regulations
ICAO	Annex 14 Volume II Heliports

Other

Document	Title
AIP	Aeronautical Information Publication

2 Introduction

2.1 Definition of aerodrome in the Civil Aviation Act

2.1.1 The *Civil Aviation Act 1988* defines an *aerodrome* as 'an area of land or water (including any buildings, installations and equipment), the use of which as an aerodrome is authorised under the regulations, being such an area intended for use wholly or partly for the arrival, departure or movement of aircraft'.

2.1.2 This means any place able to be taken off from, or landed at, in accordance with the regulations, is an aerodrome if authorised by the legislation for use as an aerodrome. Terms such as *landing place* or *authorised landing area* are not used in the regulations. For a place that is not a certified or registered aerodrome, a place is authorised for use as an aerodrome by regulation 91.410 if it is suitable for the landing and taking-off of aircraft.

2.1.3 For example:

- A body of water used by a float equipped helicopter is an aerodrome if it is a place that is suitable for the landing and taking-off of aircraft.
- A carpark or football oval used by a helicopter is an aerodrome if it is a place that is suitable for the landing and taking-off of the helicopter.
- The side of the road at a car accident site used by a medical transport helicopter is a specifically defined aerodrome, known as a medical transport operating site, if it is a place that is suitable for the landing and taking-off of aircraft.

2.2 Use of aerodromes

2.2.1 Regulation 91.410 authorises a place for use as an aerodrome if it is suitable for the landing and taking-off of aircraft and that the aircraft can land at or take off from the place safely, having regard for all of the circumstances of the proposed landing or take-off including the prevailing weather conditions.

2.2.2 Because helicopters are operationally extremely versatile compared to aeroplanes, not every departure or arrival location will be from either an ICAO Annex 14 volume II compliant surface level, elevated heliport, helideck, or a normal aerodrome based on a runway with a protected obstacle environment.

2.2.3 The generic term for an aerodrome for helicopter operations is a helicopter landing site (HLS). Operations to HLS that are not purpose-built present safety challenges to the (PIC) which have to be considered, risk assessed and managed by the PIC for safe operations.

2.2.4 When taking off or landing, different helicopters often have similar generic operational considerations although the specific requirements may differ for particular designs, such as single engine verses multi-engine capability. For example, final approach and take-off area (FATO) length and width and obstacles in the take-off and initial climb phase or the approach and landing phase are common considerations, but what specifically constitutes a safe FATO length and width is usually different for different helicopter types, especially when other circumstances are taken into account (such as category A capability or the need for avoidance of the avoid area of the HV diagram). Transport/large helicopters often have more stringent requirements in their aircraft flight manual (AFM) compared to normal/small helicopter types.

2.2.5 On any day, a place previously considered suitable may become unsuitable due to changes in prevailing weather conditions.

2.2.6 There is no legal obligation on helicopter pilots operating solely under Part 91 to apply safety margins to the take-off or landing distance, take-off performance and obstacle avoidance ability which has been determined when using the helicopter manufacturer's data.

2.2.7 A safety margin can be applied by ensuring required distances are greater than required by a set distance, or the take-off weight is limited to a percentage less than the MTOW for the requirements of the day and location, or power requirements and ensuring performance is available to allow obstacles to be avoided by an adequate vertical margin appropriate for the helicopter.

2.2.8 Pilots are required under regulation 91.055 to operate the aircraft in a manner that does not create a hazard to another aircraft, a person or property. Therefore, pilots should remain cognisant that, due to various circumstances, the aircraft may not meet the manufacturer's optimum performance standards during normal operations.

2.2.9 It is recommended that reasonable safety margins be applied to a helicopter’s performance requirements that make allowance for the potential for degraded performance or degraded pilot reaction time and which allow enhanced manoeuvrability of the aircraft, particularly where there is potential for a hazard to be created to third parties not associated with the operation.

Note: See the standard safety margins recommended for smaller helicopter below in Table 1, Section 8.

Note: For smaller helicopters, where the information available to the pilot can sometimes be quite non-specific or not fully available, the use of reasonable safety margins is extremely important.

2.3 HLS size characteristics

2.3.1 The helicopter is one of the more versatile kinds of aircraft and can, if required under special and rare circumstances, operate to and from a space little larger than its overall D. The smaller the HLS, and the less knowledge a pilot / operator has about the hazards presented by obstacles and surface conditions, the greater the risk associated with its use. The risk presented by such hazards can be reduced when:

- the size of the defined areas of the HLS are greater than the minimum required size
- the pilot-in-command has access to accurate, up-to-date information about the site, which is presented in a suitable and easily interpretable form
- visual information, cues and positional markings are present for the defined areas at the site.

2.3.2 Defined areas are the basic building blocks of a HLS. They are based on the basic design requirements of a compliant ICAO Annex 14 volume II heliport but can be applied to any place to be used as a HLS from the perspective of the applicability of their attributes. Defined areas have a set of attributes that persist even when co-located or coincidental with another defined area. In such cases, the defined area with the more limiting standard would apply.

2.3.3 Defined areas belong to one of four main categories:

- FATO – the area over which the final approach is completed, and the take-off conducted.
- Touchdown and lift-off area (TLOF) – the surface over which the touchdown and lift-off is conducted.
- Stand(s) – the area for parking and within which positioning takes place.
- Taxiways and associated taxi routes – the surfaces and areas for ground or air taxiing.

2.3.4 A defined area on a landing site may have one or more of three basic attributes:

a. **Containment** – an attribute that affords protection to the overall helicopter and its undercarriage and permits clearance from obstacles to be established. Containment is of two types: undercarriage containment and helicopter containment. Where a defined area (such as a TLOF or taxiway) provides only undercarriage containment, it should be situated within, or co-located with, another defined area (i.e., a FATO, stand or taxi-route). This additional defined area will provide protection to the overall helicopter.

b. An **additional safety/protection area**:
   i. for a FATO – a safety area surrounds the FATO and compensates for errors in manoeuvring, hovering and touchdown
   ii. for a stand – a protection area surrounds the stand and compensates for errors of manoeuvring
   iii. for a taxiway – a protection area incorporated in the taxi-route, which compensates for errors of alignment and/or manoeuvring.

c. **Surface loading capability** – this attribute ensures adequate surface strength to permit a helicopter to touchdown, park or ground taxi without damage to the surface of the HLS or helicopter. Surface loading is either:
   i. static – where only the mass of the helicopter is considered, although elevated heliports/helidecks may include additional factors to protect the building/structure

   or

   ii. dynamic – where the apparent weight (i.e., a force comprised of multiples of gravitational force) of the helicopter is used. Two types of dynamic loading need to be considered:
      A. dynamic loading due to normal operations.

B. dynamic loading due to a heavy landing, determined by an 'ultimate limit state' test (i.e., touchdown at a rate of descent of 12 ft/s for surface-level heliports).

2.4 Types of aerodromes for use of helicopters

2.4.1 From a high-level perspective, from highest level of safety assurance to lowest level of safety assurance, these are the common kinds of HLS:

- ICAO Annex 14 Volume II compliant heliport
- Secondary HLS: a HLS that does not fully conform to ICAO Annex 14 Volume II standards but meets the recommended standards outlined in section 2.4.2 below

  Note: The specific lack of conformance is normally individual to the specific location, but could include matters such as a lack of, or different, markings, different lighting specifications or different limited obstacle environments.

- Basic HLS: a HLS that does not meet the Secondary HLS recommended standards.

2.4.2 Secondary HLS

2.4.2.1 The term 'secondary HLS' is not defined in the regulations.

2.4.2.2 For a HLS to be categorised as a secondary HLS, it is recommended that it meet the following standards:

- The FATO should, at a minimum, be:
  - o capable of enclosing a circle with a diameter equal to one-and-a-half times the D-value (1.5 x D) of the largest helicopter intended to use the site
  - o capable of including a safety area extending a distance of at least 0.25 x D or 3 m around the FATO, whichever is larger
  - o free of obstacles
  - o provide ground effect
  - o capable of at least dynamic load bearing (DLB) for the helicopters being operated.
- The TLOF, being a clear and stable area capable of bearing the dynamic loads which may be imposed by the helicopter on the site by a heavy landing, should, at a minimum, be an area at least 0.83 x D and may or may not be located within the FATO.
- Stands should be of sufficient size to contain a circle with a diameter of at least 1.2 x D, plus a 0.4 x D protection area for the largest helicopter that the stand Is intended to serve.
- No fixed objects should be permitted within the stand and protection area and all non-essential moveable objects should be removed, so as to not present a hazard.
- Approach and departure paths should be in accordance with the ICAO Annex 14 recommendations and take into account matters such as, but not limited to, approach and take-off climb surfaces lengths and slopes.

- There should be a minimum of two approach and departure paths.

Note: CASA does not recommend operations to mobile platforms on land as this is an operator-based aircraft manoeuvring decision, and guidance on operations to these appliances is not given in this AC. The use of ground handling appliances should normally be limited to pre-start and post-shutdown actions and comply with AFM requirements.

2.4.2.3 From an operational perspective, unlike a basic HLS, a secondary HLS:

- is recommended for use in night operations in addition to day operations
- is recommended for use in air transport operations
- includes touchdown/positioning markings (TD/PM) which provide the visual cues that permit a helicopter to be placed in a specific position and, when necessary, orientated such that, when the pilot's seat is above the marking the undercarriage will be inside the load-bearing area and all parts of the helicopter will be clear of any obstacles by a safe margin.

2.4.3 Basic HLS

2.4.3.1 The term 'basic HLS' is not defined in the regulations.

2.4.3.2 For the purposes of this AC, it is a HLS that, by its lack of design elements, or its lack of operational information, does not provide the safety margins of a secondary HLS and therefore increases operational risk. It is recommended that pilots and helicopter operators carry out thorough risk and hazard assessments for a proposed operation to a basic HLS and apply appropriate controls to any hazards identified during this process.

2.4.3.3 It is recommended that passengers, crew and operational personnel carried into a basic HLS should be briefed on the hazards of the site and any site-specific safety procedures needed to ensure safe loading and unloading at the HLS.

2.4.3.4 To use a basic HLS, it is recommended that the HLS:

- be large enough to incorporate a safety margin, on top of the absolute minimum size required to accommodate the helicopter, sufficient to enable the safe conduct of the proposed operation

Note: The size of the safety margin is recommended to be determined via a specific risk assessment conducted by the PIC or the operator.

- have a TLOF with surface characteristics that are strong enough to withstand the dynamic loads imposed by the helicopter

Note: Dynamic load bearing capability assumes all static load limits imposed by the helicopter and any other structure or vehicle will also be met. Operators and pilots should ensure this is the case prior to using the site.

- have sufficient obstacle free approach and departure gradients to provide for safe helicopter operations into and out of the site under all expected operational conditions
- have approach and departure paths that:

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  - o minimise the exposure of the helicopter to meteorological phenomena which may endanger the aircraft, and
  - o provide escape flight paths that, if a non-normal situation arises, maximise the potential for using suitable forced landing areas
- – only be used for day operations where the weather is VMC.

3 Explanation of aerodrome suitability considerations

3.1 Overview

3.1.1 The suitability of an aerodrome (which is a helicopter landing site (HLS) however defined) depends on many factors, including its characteristics, the surrounding terrain and obstacles, the helicopter being used, as well as the pilot's formal qualifications and personal skills.

3.1.2 A pilot is authorised by virtue of their licence to assess these factors before deciding whether a particular flight or movement should take place. If a pilot fails to discover or consider any significant factor affecting the safety of a take-off or landing, they may contravene regulation 91.410.

3.1.3 For helicopters, there are many aerodromes all around Australia whose information is not published in any guide. Obtaining information about these aerodromes can be difficult, and pilots should take every available step to satisfy themselves of the suitability of the aerodrome.

3.1.4 Some aerodromes may be managed by persons who have limited ability to assess the aerodrome's operational status. A pilot could obtain information from the manager of such an aerodrome but not have full confidence in the quality of the information received.

3.1.4.1 HLS surfaces can be highly variable. Some examples are concrete, bitumen, coral, gravel, soil, grass on soil or sand, hard-packed sand or a dry salt-lake. Each of these kinds of surfaces has its own characteristics, many of which vary with the weather and season.

3.1.4.2 In the case of natural surfaces, the soil's moisture content could give rise to subsurface softness and inability to sustain dynamic loads. Except for beach sand, a very wet surface almost invariably gives rise to an unsatisfactory surface. Grass density and length will have a significant effect on the pilot's ability to detect obstructions, holes, water, stones, anthills, erosion trenches or loose objects that could cause damage to engines or rotor systems. Landing on dry grass or vegetation in some helicopters can be a serious fire hazard.

3.2 Legal considerations

3.2.1 Performance

3.2.1.1 The rules relating to take-off and landing performance are contained in Chapters 24 and 25 of the Part 91 Manual of Standards (MOS). A closely related requirement are the rules associated with take-off and landing minima which are contained in Chapter 15 of the Part 91 MOS.

3.2.1.2 It should also be noted that if a HLS is located in a populous area and the HLS is not a certified aerodrome or a place used for the regular take-off and landing of aeroplanes, then specific take-off performance and landing performance requirements apply which can be found in sections 24.04, 24.05, 25.04 and 25.05 of the Part 91 MOS.

3.2.2 Local Rules

3.2.2.1 There may be other local legislation that also applies to operations at a HLS. It is the responsibility of pilots and operators to check and adhere to any local rules.

3.2.3 Noise or environmental considerations

3.2.3.1 Where noise or other environmental considerations make helicopter operations undesirable, the proposal may be subject to the provisions of the Commonwealth Environment Protection (Impact of Proposals) Act 1974 and parallel State legislation.

3.3 Ambient conditions

3.3.1 Overview

3.3.1.1 There is a strong correlation between satisfactory helicopter performance and the correct assessment and application of environmental factors. It should be of utmost importance when planning to operate to or from an area, whether the area is prepared or unprepared, that careful performance consideration is given in relation to the MTOW of the rotorcraft and the accurate assessment of prevailing ambient conditions.

3.3.2 Wind speed and direction

3.3.2.1 Regulation 91.380 requires the pilot to take off and land into wind to the extent practicable unless the aircraft flight manual/pilot operating handbook (AFM/POH) allows the aircraft to land or take off downwind or crosswind, and the pilot is satisfied that traffic conditions at the aerodrome enable such a landing or take-off to be carried out safely. Even if downwind operations are permitted by the AFM CASA does not recommend operations with a downwind component for take-off or landing. Pilots must at all times remain aware of the impacts on performance of downwind operations and in particular the effect of turn from into wind to downwind operations at low airspeed and low level.

3.3.2.2 Pilots should be aware that wind affects hover, take-off and climb performance. Headwinds are most desirable as they contribute to the greatest increase in performance. Crosswinds and tailwinds require more tail rotor thrust to maintain directional control. This increased tail rotor thrust means there is less power available to the main rotor to produce lift. When taking off into a headwind, effective translational lift is achieved earlier, resulting in more lift and a steeper climb angle. When taking off with a tailwind, more distance is required to accelerate through translation and results in a faster run-on speed in the event of an engine failure on take-off. Therefore, downwind operations are not recommended.

3.3.2.3 For non-controlled aerodromes, and aerodromes without an Aerodrome Weather Information Service (AWIS), pilots will need other visual cues to determine the take-off and landing direction. The windsock has, for many years provided pilots with wind direction and strength at the aerodrome surface.

3.3.2.4 While other systems are now routinely available to pilots that provide wind information, considerable useful information can be obtained by observing the windsock(s) before taking off or landing.

Note: It is recommended that, where possible, pilots observe and interpret the behaviour of a relevant windsock prior to taking off or landing.

3.3.2.5 Windsock interpretation:

a. A windsock at a 45º angle to the horizontal indicates a windspeed of approximately 15 kts.
b. A windsock that is horizontal indicates a windspeed of 25–30 kts.
c. A windsock at a 30º angle to the direction of the runway indicates that half of the total windspeed will be crosswind.
d. A windsock at a 45º angle to the runway indicates at least a 15 kt crosswind.
e. Gusting conditions will be indicated by the windsock varying rapidly in direction or angle. These conditions should be treated with caution.

Note: Pilots are recommended to consider both the possibility and effects of wind shear, and whether the conditions remain within the maximum crosswind limit of the aircraft.

3.3.2.6 Where two windsocks are available, a difference in direction or speed between them can show a transient change or the influence of mechanical interference, such as trees or buildings. It is not unusual during the passage of frontal weather to have windsocks at either end of the runway showing completely opposite wind directions.

3.3.2.7 At uncertificated aerodromes, it is recommended that, prior to flight, pilots establish whether there are any windsocks and whether they are functional. Windsocks at uncertificated aerodromes do not need to meet Part 139 standards; therefore, they may not be able to be interpreted in accordance with the guidance in these paragraphs.

3.3.2.8 When operating into unfamiliar uncertificated aerodromes or HLSs, it is recommended that, in addition to windsocks, pilots use secondary methods to judge the windspeed and direction, such as observing aircraft drift, tree movements, glassy water on dams, directions of windmills, blowing dust or smoke.

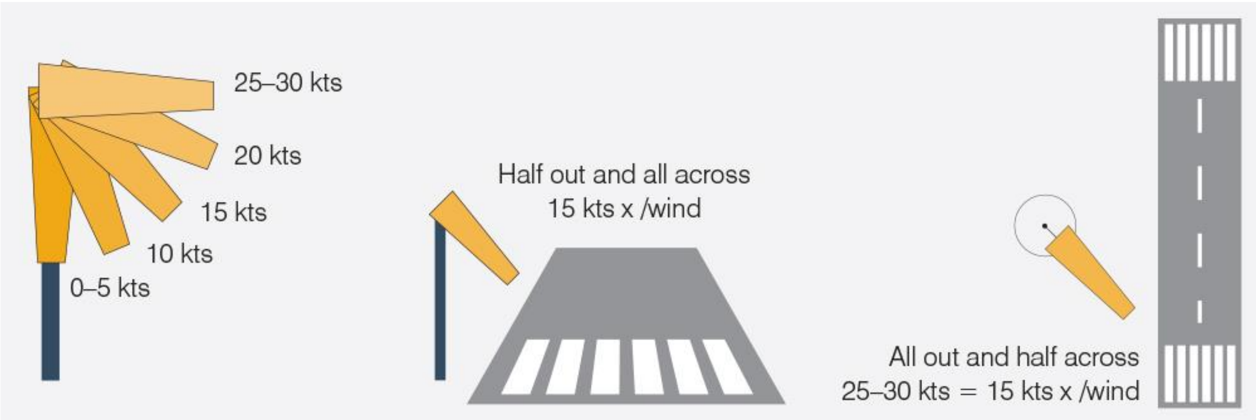

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Figure 1: Windsock interpretation

3.3.3 Pressure altitude considerations

3.3.3.1 Pressure altitude (PA) is the height above a standard datum, which is a theoretical level where the pressure of the atmosphere is 1013.2 hectopascals (hPa) as measured by a barometer. An altimeter is essentially a barometer calibrated to indicate altitude in the International Standard Atmosphere (ISA). As the atmospheric pressure changes, the standard datum may be below, at or above sea level. Pressure altitude is important as a basis for determining aircraft performance.

3.3.3.2 The reduction of ambient air pressure with height increases the true air speed (TAS) required for a given indicated air speed (IAS), which affects take-off and landing distance requirements.

3.3.3.3 The pressure altitude for an aerodrome can be determined using two methods:

a. With the aircraft parked on the aerodrome, set the barometric scale of the altimeter to 1013 hPa. The indicated altitude read is the pressure altitude.
or

b. Applying a correction factor to the aerodrome altitude above sea level according to the reported sea level pressure.

3.3.3.4 Put simply, pressure altitude is the height above the ISA datum of 1013 hPa.

3.3.3.5 To determine pressure altitude at a sea level aerodrome, apply the regional or airfield pressure setting (QNH) to the aerodrome elevation as compared to 1013h Pa. A 1 000 ft aerodrome elevation with a QNH of 1003 hPa would be 10 hPa above 1013. Where 1hPa is equal to approximately 30 ft, 10h Pa x 30 ft gives a pressure altitude of 300 ft above the aerodrome elevation (or 1 300 ft above 1013 hPa). Refer to Figure 3 below.

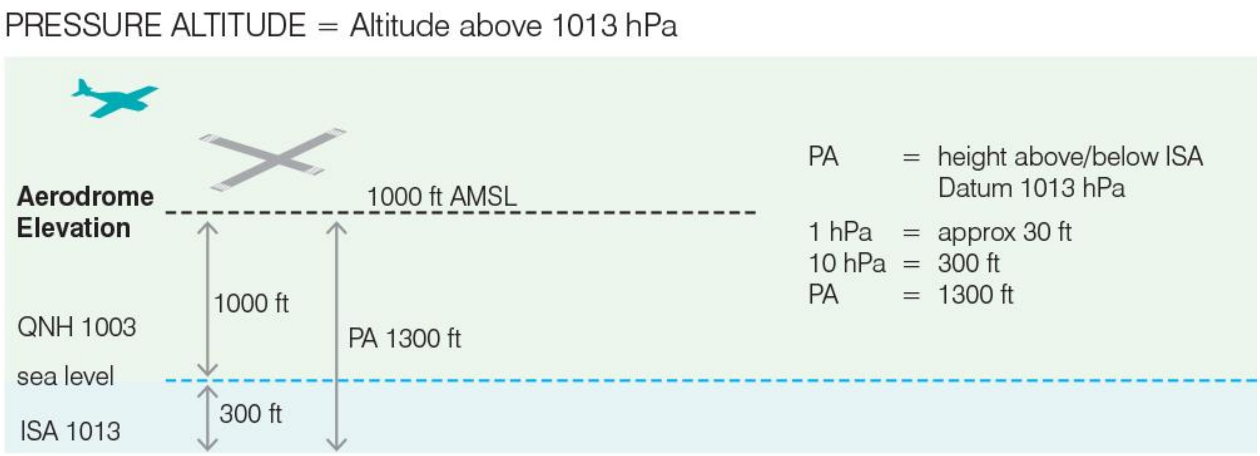

Figure 2: Pressure altitude calculation

3.3.3.6 As stated above, without making the above calculation, a pilot is also able to read pressure altitude on the altimeter for the aerodrome (1 300 ft) of the aircraft at the aerodrome directly by setting standard pressure 1013 hPa on the altimeter subscale.

3.3.4 Density altitude considerations

3.3.4.1 It is imperative pilots are aware that the hotter the day gets, the greater the decrease in air density. This decrease in air density markedly reduces engine power output, and aerodynamic performance. This effect can be delayed if an aircraft is fitted with a turbocharger or by using derated engines, which can maintain performance to higher density altitudes. However, in all cases with an increase in temperature, not only is engine power reduced, but the volume or density of the air over the aerofoil that generates lift is reduced.

3.3.4.2 The term for correlating aerodynamic performance in the non-standard atmosphere is density altitude. That is, the altitude in the standard atmosphere corresponding to a particular value of air density.

3.3.4.3 Density altitude can be determined by correcting the outside air temperature (OAT) compared to the ISA temperature value against the aerodrome elevation. With a higher than normal ambient temperature, the aircraft performance will be less than that of a standard ISA temperature. Conversely, if it is colder, the performance will be improved.

3.3.4.4 Determining the aircraft take-off or landing performance is predicated on knowing the density altitude. The pilot does not always have to make a separate density altitude calculation because take-off and landing performance charts normally provide integral solutions for density altitude through entries of pressure altitude and temperature.

3.3.4.5 However, experimental aircraft do not always have performance charts that allow for the of performance when operating in other than ISA conditions. Although some pilot operating handbook (POH) suggest corrections are to be made, the pilot is often left with scant information to make such determinations. Pilots should be acutely aware of the performance loss at high-density altitudes and apply factors to make allowance for the variation to the take-off and landing performance in these conditions when compared to ISA conditions.

3.3.4.6 Density altitude can be determined by applying an ambient temperature correction to the pressure altitude. Each 1°C variation from ISA is equivalent to a 120 ft variation in density altitude. Thus, for a 1 000 ft aerodrome elevation in the example above having a 1 300 ft PA, ISA equals approximately 12°C. If the aerodrome has a 30°C outside air temperature, this is 18°C hotter than ISA. Therefore, 120 x 18 equals 2 160 ft, plus PA 1 300 ft, equals a density altitude of 3 460 ft. So, the performance of the aircraft will be degraded. It will perform as if the aircraft were at 3 460 ft and not at 1 000 ft aerodrome level.

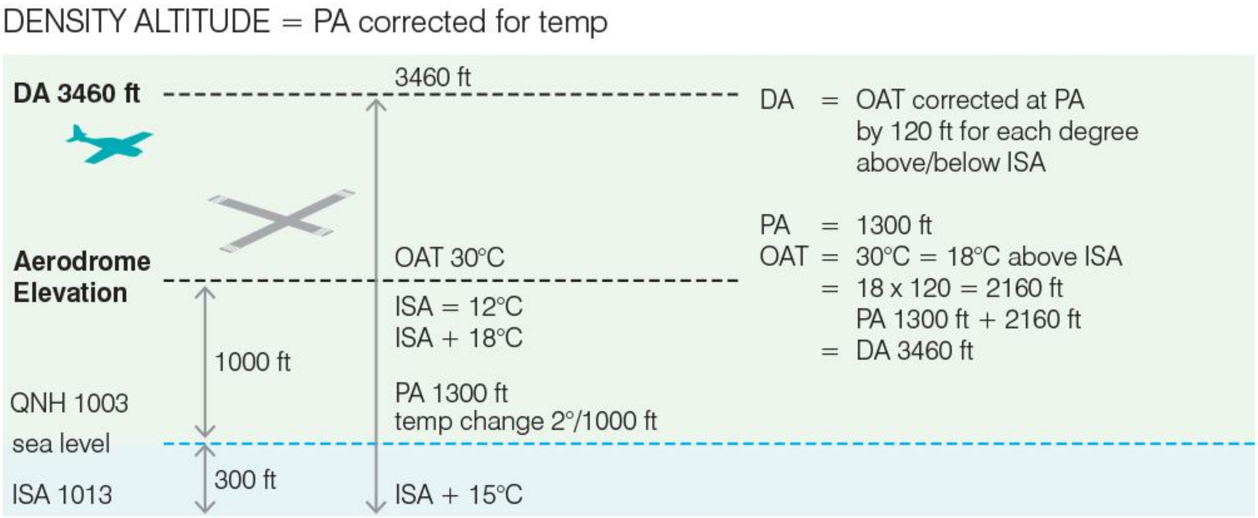

Figure 3: Density altitude calculation

3.3.5 Humidity

3.3.5.1 Performance data for smaller aircraft does not usually include a humidity correction, but pilots should be aware that all engines are adversely affected to some degree by high humidity. This is due to water vapour displacing oxygen, thus reducing the temperature rise during combustion. If a helicopters documentation provides relevant information related to humidity, the pilot should allow for the effects of humidity during operation.

3.3.5.2 Remember that, when operating at high density altitudes and weights, the ‘four Hs’ (High, Hot, Heavy, and Humid) all combine to reduce helicopter performance.

3.3.6 Light conditions

3.3.6.1 Pilots should not underestimate the difficulties associated with taking off or landing directly into a low sun and should take into consider, haze, smoke or low light when manoeuvring in the vicinity of an aerodrome or looking for other traffic. If a take-off or landing into the sun is known to be likely, it is recommended that the pilot ensure the windscreen is clean for all operations.

3.4 Weight altitude temperature (WAT) limitations

3.4.1 It is important to remember there is more to performance than the ability to take off and land within the space available. Terrain and obstacles must be cleared after take-off and during the approach to land.

3.4.2 For FAR Part 27certified helicopters, the take-off distance in the AFM has been determined from the commencement of the take-off to climb over a 50 ft obstacle. For landing, the horizontal distance required to land and come to a complete stop from 50 ft above the landing surface. For a helicopter certified under FAR Part 29, the normal take-off distance is the horizontal distance along the take-off path from the start of the take-off to the point at which the helicopter attains and remains at least 35 ft above the take-off surface, attains and maintains a speed of at least V_{TOSS}, and establishes a positive rate of climb, whilst landing distance is the same for Part 27.

3.4.3 To ensure that climb performance does not fall below prescribed certification minimums, most AFMs give take-off and landing weights that should not be exceeded at the prevailing altitude and temperature. For multi-engine aircraft, climb performance is predicated on meeting the weight limitations specified under the aircraft's certification status.

3.5 Obstacles on and in the vicinity of an aerodrome

3.5.1 It is recommended that pilots have a thorough awareness of the obstacles in the approach and climb-out flight paths. Where a pilot does not have experience with non-standard approach and departure angles, it is recommended the pilot consider alternative aerodrome options, or receive training in the special techniques necessary for these kinds of circumstances.

3.5.2 Aerodromes where there is an extended surface beyond the normal runway length provide additional margins of safety. Even where the surface of the obstacle-free area is not sound enough to permit normal operation of a helicopter, it may, nevertheless, minimise structural damage if a forced landing is required.

3.5.3 For low-powered twin-engine helicopter, where an engine failure just after take-off would result in a significantly reduced rate of climb, runways that have obstacle-free, low-angle departure areas will significantly lower the risk of the aircraft striking obstacles in the climb-out flight path.

3.6 Emergency alighting areas and climb – engine failure during take-off

3.6.1 It is recommended that before conducting a take-off from any aerodrome, pilots of single-engine helicopters make themselves aware of the areas that would be suitable, from the lift-off point to a safe manoeuvring height, to conduct a forced landing in the event of engine failure after take-off. These are known as suitable forced landing areas in the CASR -see Part 1 of the CASR dictionary and section 1.06 of the Part 138 MOS.

3.7 Foreign object damage, gravel and dust

3.7.1 Foreign object damage (FOD) to a turbine engine may cause loss of power or complete failure. FOD frequently arises when gravel is sprayed into the engine intake by the rotor downwash.

3.7.2 Dust will damage both piston and turbine engines but can be reduced in piston engines by use of filtered air or using particle separators or FOD screens in turbine engines.

4 Aircraft certification and performance

4.1 Basics of certification

4.1.1 The performance of every certificated aircraft has been evaluated as part of the certification process. This process allows the manufacturer to determine the take-off and landing performance under average conditions. There are two different classifications of airworthiness certificate: Standard Airworthiness Certificate and Special Airworthiness Certificate.

4.1.2 Standard Airworthiness certification falls under either:

- FAR Part 27 – Airworthiness Standards: Normal Category Rotorcraft, and specifies fewer comprehensive take-off, flight and landing performance standards than FAR Part 29. (EASA CS-27 is the European equivalent).
- FAR Part 29 - Airworthiness Standards: Transport Category Rotorcraft, includes certification categories A and B. (EASA CS-29 is the European equivalent). Most helicopter above 3175 kg MTOW, are certified under Part 29.

4.1.3 Special Airworthiness certification encompasses, primary, intermediate, restricted, limited or amateur built rotorcraft. Special certificates of airworthiness often have strict conditions regarding operation of the aircraft.

4.1.4 The performance data required for type certification allows the pilot to understand how the aircraft will perform through a range of conditions and plan accordingly. Performance figures in the AFM are derived from flight test averages of many flights, must be able to be achieved by a pilot of average ability without exceptionally favourable conditions, throughout the ranges of altitude from standard sea level conditions to the maximum altitude for which take-off and landing certification is requested for the aircraft. Average ability means, a pilot, capable of conducting each task correctly and at the appropriate time. Certain other assumptions are made, such as, calm wind, the engine is developing its rated power, normal operating procedures are being followed and the helicopter is in good condition.

4.2 Aircraft flight manual/pilot operating handbook

4.2.1 Each certification standard specifies what operational information and limitations must be provided in the AFM/POH.

4.2.2 Amateur-Built Experimental aircraft are not required to be certified to specific airworthiness standards and may operate without NAA or manufacturer approved AFM/POHs. The owners of these aircraft are responsible for establishing the aircraft limitations during tests, and they must show not only that the aircraft is controllable throughout its normal range of speeds and throughout all the manoeuvres to be executed, but that it also has no hazardous operating characteristics or design features.

Note: Regulation 91.095 requires the pilot to operate in accordance with the AFM instructions (this is a defined term in the CASR dictionary).

4.3 Performance information

4.3.1 The AFM/POH, owner's manual, or placarding should provide relevant performance information, but presentations are not standardised. Learning how to find and interpret a particular aircraft's performance information should be part of a pilot's familiarisation with the helicopter.

4.3.2 Regulations 91.795 and 91.800 stipulate that an aircraft must not take off or land above the maximum all up weight of the aircraft from the AFM (or equivalent), or a more limiting weight due to the aircraft performance requirements specified in the Part 91 MOS.

4.3.3 Although helicopters manufactured under the special certification process, are required to provide performance information in the AFM/POH, it can be limited in detail and may lack the rigour and accuracy of tests required for a helicopter under FAR Part 27 certification. It may contain a proviso advising, 'performance can depend on aircraft condition, environment and pilot skill'.

4.3.4 Although not within the scope of this AC, regardless of whether the helicopter has been certified under Part 27 or 29, helicopters operated under Part 133 require performance data to provide appropriate safety margins. Even if the requirements are already reflected in their take-off and landing performance charts, pilots must be familiar with any additional safety margins applicable to their operation.

4.3.5 An example of a factoring requirement applicable to large or commercial helicopter is:

> In pre-flight calculation of performance for take-off and landing, the pilot must factor for a headwind or a tailwind. If the headwind is more than 5 knots, then only 50% of the headwind component may be used. If the AFM allows a tailwind component for take-off or landing, then a 150% of the tailwind component must be factored into the calculation

4.4 Take-off and landing distances in the AFM/POH

4.4.1 Each helicopter operation calls for an aerodrome of certain dimensions. The AFM/POH normally shows the dimensions required for a take-off at a given combinations of weight, altitude and temperature.

4.4.2 Pilots should be aware that AFM/POH helicopter performance is tested and calculated under strict criteria. For example, landing certification for a single-engine rotorcraft requires that:

- it must be able to land with no excessive vertical acceleration, no tendency to bounce, nose over, ground loop, porpoise, and without exceptional piloting skill or exceptionally favourable conditions; with approach or autorotation speeds appropriate to the type of rotorcraft and selected by the applicant,
- the approach and landing made with, power off, and entered from steady state autorotation.

4.4.3 When landing at an aerodrome with minimum dimensions, it is recommended that appropriate safety margins be applied before attempting the take-off or landing. See Table 1 in Section 8.

4.5 What must a rotorcraft flight manual contain as a minimum

4.5.1 FAR §27.1587 sets out the information required in the Rotorcraft Flight Manual for a normal category, small rotorcraft, determined in accordance with §§27.49 through 27.87 and 27.143(c) and (d). This information includes:

- The hover in ground effect (HIGE) ceiling, determined over the ranges of weight, altitude, and temperature for which certification is requested, with:
  - Take-off power and landing gear extended.
  - For reciprocating engine powered helicopters at maximum weight, with a standard atmosphere, the ceiling must be at least 4000 ft.
  - For turbine engine powered helicopters at maximum weight, with a standard temperature plus 22° C, the ceiling must be at least 2500 ft pressure altitude.
- The hover out of ground effect (HOGE) performance, determined over the ranges of weight, altitude, and temperature for which certification is requested, with:
  - Take-off power and landing gear extended.
- Take-off weight maximum at sea level through to the highest altitude requested for certification at:
  - Take-off power and r.p.m;
  - The most critical centre of gravity; and
  - Must not require exceptional pilot skill or exceptionally favourable conditions; and
  - Must be able to safely land after engine failure at any point, up to a minimum of 7000 ft DA.
- V_Y must be determined in standard sea level conditions at:
  - Maximum continuous power on each engine
  - Maximum weight.
  - Steady rate of climb on both engines with maximum continuous power, at selected speeds from sea level to maximum altitude with corresponding weights and temperatures.
  - Steady rate of climb or descent on one engine at V_Y with maximum weight; and
  - The critical engine inoperative and the remaining engine at 30 minute one engine inoperative (OEI) maximum continuous power, or continuous OEI power depending on certification request.
- Autorotational performance for single-engine helicopters and multi-engine helicopters that don't meet the Category A engine isolation requirements of Part 29, that determines minimum rate of descent and the best angle-of-glide speed at:
  - Maximum weight; and
  - Rotor speeds selected by the applicant.

- Landing must be demonstrated with no excessive vertical acceleration, no tendency to bounce, nose over, ground loop, porpoise, or water loop, and without exceptional piloting skill or exceptionally favourable conditions at:
  - approach or autorotation speeds appropriate to type
  - for single-engine rotorcraft, power off, from steady autorotation
  - for multi-engine rotorcraft OEI, the operating engine within approved operating limits from an established OEI approach, or from complete power failure.
- A height and forward speed envelope must be established to indicate which combinations would prevent a safe landing, from sea level to the maximum altitude capability of the rotorcraft or 7000 ft, whichever is less; and from the maximum weight at sea level to selected weights at the maximum altitude. This weight may not be less than the maximum weight that allows HOGE. The applicable power failure conditions are:
  - For single-engine helicopters, full autorotation.
  - For multiengine helicopters, OEI (where engine isolation features ensure continued operation of the remaining engines) and the remaining engine(s) within approved limits and at the minimum installed specification power available for the most critical combination of approved ambient temperature and pressure altitude resulting in 7000 ft density altitude or the maximum altitude capability of the helicopter, whichever is less.
- Demonstrated controllability in winds from all azimuths up to 17 ks in any manoeuvre close to the ground, or out-of-ground effect, through the range from sea level to 7000 ft or maximum altitude capability with:
  - critical weight (HIGE) or applicant select weight (HOGE)
  - critical centre of gravity
  - critical r.p.m. (HIGE) or applicant selected r.p.m. (HOGE)

4.5.2 The powerplant cooling system must demonstrate the ability to maintain components within the established limits under critical surface and flight operating conditions for which certification is required, and after normal shutdown. Powerplant components to be considered include, but may not be limited to engines, rotor drive system components, auxiliary power units, and the cooling or lubricating fluids used with these components. The components must be tested in maximum ambient atmospheric temperature, corresponding to sea level conditions of at least 100^{o} F, (38^{o} C). For reciprocating engines, the fuel used during the cooling tests must be of the minimum grade approved for the engines, and the mixture settings must be those normally used. The temperature must be stabilised (rate of change, less than 2^{o} F) before commencing the next stage of flight to be investigated. (FAR Part 27.1041 to 27.1045).

5 Information about aerodromes publications

5.1 Aerodrome standards

5.1.1 Standards that apply for certified aerodromes can be found in Part 139.

5.1.2 Standards for military aerodromes have a number of commonalities with the civil rules and are contained in the Defence Aviation Safety Regulations (DASR).

5.1.3 There are no standards for aerodromes that are not certified (listed in En-route Supplement Australia (ERSA) as an uncertified aerodrome). CASA has published recommended criteria for landowners or operators of these aerodromes, but these recommended guidelines are not required to be followed.

5.1.4 Similarly, there are no mandatory standards for heliports. CASA has published recommended criteria for landowners or operators of heliports, but these recommended guidelines are not required to be followed.

5.2 Publications containing aerodrome data

5.2.1 All aerodromes that are certified (CERT) under Part 139 are listed in the ERSA. The ERSA also contains all military aerodromes (MIL) and a significant number of uncertified (UNCR) aerodromes. A certified aerodrome must meet certain criteria and is required to provide full information in the ERSA. An aerodrome must be certified if there is an instrument approach at that aerodrome. Certified aerodromes are subject to inspection and NOTAM action.

5.2.2 The ERSA only provides limited information for uncertified aerodromes and these aerodromes are not subject to NOTAM action except in certain circumstances (refer to ERSA for further details).

5.2.3 Take-off and landing guides are also commercially available which provide information for pilots about many aerodromes not included in the ERSA. Pilots should note that the information in these guides may not be subject to regular updating, and these aerodromes are not supported with NOTAM information. Pilots should therefore consider ways of mitigating the risk of such a document's information being out of date or inaccurate.

5.2.4 The examples below are two of the many possible considerations to be made. A pilot should consider whether:

- the obstacles surrounding the aerodrome have been accurately described and are still up to date (e.g., have the trees on final grown taller since last reported), and
- the information provided enables the pilot to judge whether a landing approach can be made from both runway directions.

6 Permission to operate

6.1 Ownership and management

6.1.1 Pilots and operators must consider ownership and management requirements for aircraft operations into any aerodrome. Unless a landing place is unambiguously open to public use for aviation, the pilot should assume that approval is required before using land or water for take-off and landing. General examples of places where approval is required are:

- an uncertified aerodrome managed by local council or private organisation/landowner (check if published in ERSA in the first instance)
- private farmland
- roads, parks or fairways owned by local authorities or private interests
- water, land or dry lakes managed by a state authority such as National Parks, Waterways Authority, Lands Department etc.

6.2 Penalties and liability

6.2.1 Use of a public facility, such as a road or park, for landing may be an offence under State or territory legislation even if the physical requirements for a landing area are satisfied. An unauthorised landing on property might also be a trespass.

6.2.2 While the law generally recognises a person's right to take any reasonable action to save themselves in an emergency, pilots should remember that nothing in the CASR provide immunity against civil liability in the case of damage to persons or property.

7 Pilot responsibilities

7.1 Compliance with the flight manual

Note: Regulation 91.095 requires the pilot to operate in accordance with the 'aircraft flight manual instructions'. This is a legally defined term in the CASR dictionary and is effectively an umbrella term to encompass 'aircraft flight manual' plus placards and other documents that might not be legally part of the AFM.

7.1.1 Pilots are able to develop their own personal operating minimums that are more conservative than the AFM minimums (for performance or operating limits etc). Pilots should be honest when assessing their own experience, recency and personal skills. If a pilot knows they have not been flying recently or frequently, or that they do not have vast experience conducting landings into smaller congested or confined areas or they have not flown frequently in marginal weather conditions, the pilot should consider using personal limits which are more conservative than the AFM minimums.

7.1.2 Special rules exist for Part 133 or Part 138 operations to, in a particular circumstance, not comply with the AFM. Refer to regulations 133.030 and 138.210.

7.2 Deciding to use an aerodrome or HLS

7.2.1 It is the pilot's responsibility to be satisfied the helicopter is able to take off or land safely. When operating at a certified or other aerodrome authorised by the regulations (such as an HLS), the pilot needs to know not only the location of the aerodrome, but also the features that can be used to positively identify it as the aerodrome intended for landing, and any potential hazards.

7.2.2 Some operational factors that pilots and operators are recommended to consider prior to using a HLS are:

- the FATO and TLOF are clear of all objects and animals likely to be a hazard to the helicopter, other than objects essential to the helicopter operation
- no person is within 30 m of the closest point of a hovering or taxiing helicopter, other than persons who are essential to the safe conduct of the operation or the specific nature of the task and who are trained and competent in helicopter operational safety procedures
- appropriate information from the owners and authorities is obtained to confirm the suitability of the HLS for the proposed operation
- where the performance information in an AFM details greater or additional limitations for defined areas or the approach and departure paths (compared to those set out in these guidelines), then the greater and/or additional requirements are available for the flight.

7.2.3 Section 3 of this AC discusses certain considerations in detail; however, the following is a summary list of matters a pilot may wish to consider when deciding to use an aerodrome.

- aircraft type

- aircraft weight
- prevailing weather conditions
- the kind of operation being conducted
- the means of identifying the boundaries of the manoeuvring area
- the length of (suitable) FATO available
- the width of the FATO
- the nature of the FATO and TLOF surface including its pavement strength
- the FATO elevation
- the FATO direction
- the TLOF and FATO (if solid) slope
- recency and type of usage: e.g., use as agricultural strip, any current fixed-wing, gliding or parachute operations etc.
- surface type: e.g., sealed, broken seal, black soil, sandy loam, naturally soft, naturally hard, gravel, small/larger stones
- surface conditions: e.g., cracked, sandy, soft gravel, muddy, recently ploughed, hardened mud (rutted or stock-pitted), heavily grassed, lightly grassed
- surface moisture levels: e.g., dry, moist, wet, muddy
- ambient conditions: temperature, wind, general conditions
- are people, machines, stock/wildlife likely to be present at the time of movement
- obstructions in the approach, take-off and lateral transition areas
- any other obstacles in the vicinity of the aerodrome (such as power lines)
- any management limits on the use of the landing place
- any special procedures applicable at the landing place (e.g., one-off activities, noise abatement considerations etc.)
- NOTAMs or AIP Supplements applicable to the area
- for night operations: availability, type and means of operating the aerodrome lights
- for IMC or night operations: the terrain in the vicinity of the aerodrome.

7.3 Accuracy of calculations

7.3.1 Given the considerable effect of different aircraft weights on helicopter performance, it is very important that the pilot take into account all relevant information and accurately make the necessary calculations to ensure the helicopter can take off or land safely.

7.4 No-go situations

7.4.1 Every pilot must learn to resist personal and external pressures to proceed without essential safety information, or when evidence suggests safety is not reasonably assured.

7.4.2 It is also important that other persons involved in the operation be made aware that no decision to proceed will be made until all required information has been assessed. Unless and until the operation is potentially safe, both common sense and regulatory requirements mean the take-off or landing must not be attempted.

8 Recommended safety margins

8.1.1 As discussed earlier in section 4 of this AC, performance figures in the AFM are derived from flight test averages of many flights and must be able to be achieved by a pilot capable of conducting each task correctly and at the appropriate time. The manufacturer does not test the helicopter under each, and every condition shown on a performance chart, but mathematically derives the remaining data. Certain other assumptions are made, such as, calm wind, the engine is developing its rated power and normal operating procedures are being followed.

8.1.2 As engine performance can degrade over time, it is important to conduct regular power assurance checks to ensure that the engine is still achieving the manufacturers specifications, and that the AFM performance graphs can be relied on. The AFM will have a section detailing how the power assurance check is to be performed.

8.1.3 Before committing to a take-off or landing, particularly in a confined area, a power check to determine excess power should be conducted. This can be achieved by noting the power required to hover IGE. Confirm the maximum allowable power to be used for the ambient conditions from the placard or AFM. Slowly start a vertical climb until the maximum power is achieved. Note the corresponding MAP or torque reading. The difference represents the power margin available and indicates what type of take-off will be possible, i.e., cushion-creep or towering.

8.1.4 While it is not a legal requirement for Part 91 operations to use safety margins when determining whether an area can be taken off from, or landed at, safely, the use of safety margins is highly recommended. For example, a pilot should always plan an OGE hover when landing in an area that is uncertain or unverified.

8.1.5 Once the AFM/POH helicopter performance is calculated for the prevailing density altitude and wind conditions, it is recommended that a contingency of 10% be factored into your calculations.

8.1.6 It is recommended that minimum standard margins for Part 91 operations in helicopters be applied as shown in the Table 5 below.

8.1.7 After applying the relevant margins in accordance with Table 1, it is recommended that the pilot apply further factors in accordance with guidance given in the AFM.

Table 1: Recommended minimum standard safety margins

Take-off and Landing	Minimum standard safety margins
Headwind components above 5 knots	u**se** no more than 50% of the headwind component
If tailwind component permitted in AFM	use at least 150% of the tailwind
Where excess power requirements are looking marginal	Subtract 10% from MTOW derived from WAT calculations.
Operating to or from a confined area.	Allow at least 2 x D value.
Operating to or from an unverified area.	Plan using HOGE performance.

9 Critical operations

9.1 Obstructions and mechanical turbulence

9.1.1 Local terrain, buildings and trees, will create mechanical turbulence in windy conditions near the ground, and may become marked in the lee of the obstruction. Operating in close proximity to obstructions can lead to recirculation and loss of performance. Aerodromes, geographically situated in hilly, mountainous areas, including certain coastal regions, can be subject to hazardous turbulent conditions in moderate to strong wind conditions. Pilots should be aware that, in certain cases, aircraft performance can be severely affected. History has shown, in extreme cases, that turbulence has prevented the aircraft from climbing or being controlled near the ground and has also caused structural damage.

9.1.2 In winds below 15 kts, the turbulence may be experienced in the lee of an obstruction, vertically to about one third higher than the height of the obstruction. Above 20 kts, turbulence may be experience on the leeward side of an obstruction to a distance of 10-15 times the obstruction height and up to twice the obstruction height above the ground.

9.1.3 During take-off or landing in gusty wind situations where wind shear is likely to be present, may require a greater power margin to deal with varying power demands or an unexpected loss of airspeed and accompanying sink. Large anti-torque pedal inputs to maintain directional control also act to reduce the excess power available.

10 Take-off and approach and landing technique

10.1 General

10.1.1 Take-offs and landings in more constrained areas require practised pilot technique. Take-offs and landings in helicopters from aerodromes that have long runways and open clear areas are generally relatively easy and routine. The take-off or landing performance as prescribed in the AFM/POH is rarely achieved because the aircraft is not flown to the criteria as detailed. When taking off, it is not as critical whether the pilot applies full power slowly, accelerates slowly, maximises hover-in-ground effect or does not position the aircraft to maximise the use of all available area, as there is plenty of runway/clear area ahead and obstacles rarely pose a problem. Likewise, when landing, if the approach is flown faster, or with higher rates of descent that prescribed, the initial aiming point can always be replaced with another whilst trying to arrest the helicopter's inertia.

10.1.2 Prior to approach or departure, to or from an HLS, a thorough 'recce' of the landing area should be undertaken, noting wires, obstacles, wind velocity, sun position, possible safe departure routes and safe forced landing areas.

10.1.3 If a HLS is only just suitable (smaller area, multiple obstructions), then the technique adopted is said to be a confined area take-off or landing. This is where the speeds prescribed in the AFM/POH, such as Vx after take-off and HIGE/HOGE graphs become critical in identifying whether a take-off or landing can be conducted safely. The Height Velocity diagram should also be carefully considered before operating from these areas.

10.1.4 Confined area technique requires demonstration of competency for the issue of a pilot licence. However, following the grant of a pilot licence, this technique may be rarely used or practised because more regularly we operate from long runways or much larger areas.

10.2 Take-off

10.2.1 Prior to take-off it is advisable to conduct a power check to confirm the amount of excess power available. As mentioned earlier, conditions at the take-off site may differ from the conditions used when determining performance calculations. Checking the excess power available prior to take-off is a useful tool to indicate a departure from 'expected' performance values. Due consideration of prevailing wind, terrain, forced landing areas and escape routes will assist in selecting an appropriate take-off profile.

10.2.2 A decision point should be nominated where the take-off will be rejected if the helicopter is not accelerating or performing as expected. If the technique described in the AFM/POH is varied, it will affect the take-off performance, hence, the need for safety factors.

10.2.3 Take-off:

- Pre-take-off checks

- Lookout – take-off using sloping ground techniques.
- After-take-off checks to include power check
- Confirm or reselect take-off path.
- Reposition within area if required.
- Select forward and lateral markers as appropriate.
- Lookout above – check for overhead obstructions, overflying aircraft.
- Accelerate to V_X and maintain until clear of obstacles, accelerate to V_Y or recommended climb speed in AFM/POH and continue climb.
- At appropriate time, set max continuous power
- Continue scan for overflying arriving/departing aircraft
- At a safe height, complete the after take-off checks.

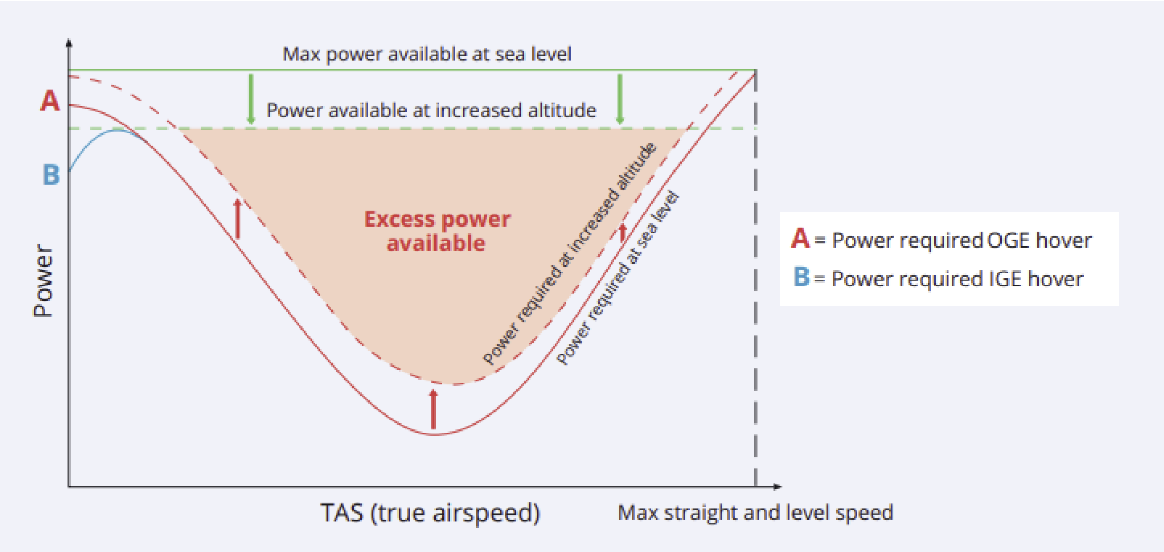

Figure 4: Effect of increasing altitude on HPA/HPR (available horsepower/required horsepower)

10.3 Landing

10.3.1 Most landings are preceded by a hover. Typically, it requires more power to hover than that required for forward flight, therefore, a high degree of care is required when landing, particularly at high gross weights in high density altitudes. Keeping the nose into wind in such circumstances is essential. Due consideration of all the circumstances and prevailing weather conditions is required. Prior to landing at an unfamiliar HLS, a thorough 'recce' of the landing area should be undertaken, noting wires, obstacles, wind velocity, sun position, people or livestock, possible safe approach and go-round routes and safe forced landing areas.

10.3.2 As discussed previously, a power check should be accomplished to assess the power in hand before commencing an approach, as insufficient power could result in a heavy landing. A pilot should always plan an OGE hover when landing in an area that is uncertain or unverified.

10.3.3 As every flight instructor will attest, the execution of a good, safe landing starts with a stabilised approach. This is particularly important when the transition from translational lift to ground effect is made. If too slow too early, the helicopter may develop a high rate of descent, too fast, and large or rapid control inputs may be required to overcome the helicopter inertia, where 'power settling' [1] may occur. It cannot be overly emphasised that a go-around should be carried out as soon as you recognise your landing configuration is not stable.

10.3.4 A stabilised approach occurs when the aircraft is in the landing configuration, all pre-landing checks have been performed, the aircraft is aligned on the final approach path and the pilot maintains a constant rate of descent/speed combination towards the aiming point on the runway or HLS, as determined from the AFM/POH.

10.3.5 Landing:

- prior to commencing the approach, conduct a thorough recce of the area between 300' and 500' agl and a speed of V_Y
- stabilise the configured aircraft on final, maintaining V_Y initially
- monitor ROD/Speed/Power margin and – beware VORTEX RING STATE.
- consider a go-round using planned path if:
  - o the rate of descent becomes excessive
  - o the closing speed becomes excessive (possible downwind component)
  - o the airspeed falls below 30 kts with an excessively high rate of descent
  - o the power 'in hand'/power margin insufficient to safely continue approach.
- check to confirm the information gained in the recce is accurate
- reduce groundspeed in final stages ensuring a safe clearance from obstacles
- at approximately 50 ft, commence a flare, introducing power to establish a hover
- land using sloping ground technique.

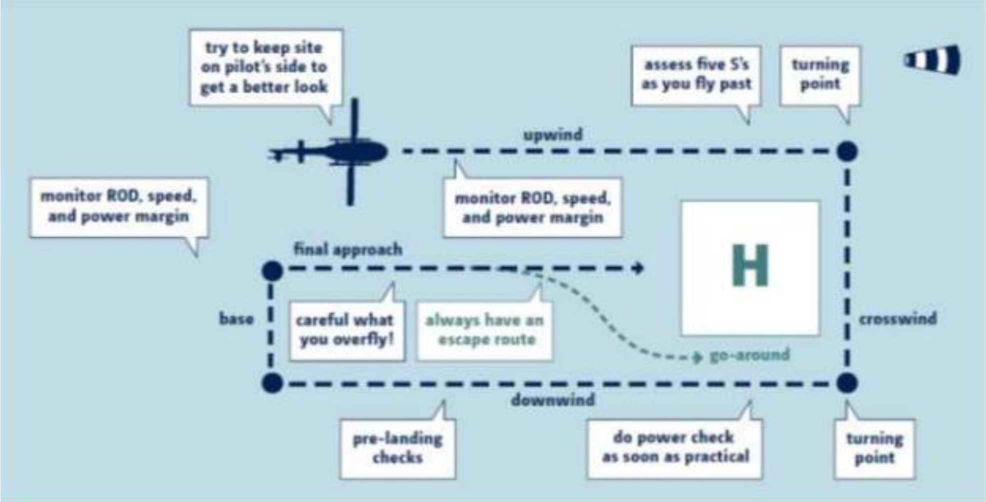

Figure 5: Typical example of a recce to land in an unfamiliar area

[1] Not to be confused with 'settling with power' (vortex ring).

11 Precautionary search and inspection procedure

11.1.1 The helicopter's ability to approach, manoeuvre, land and take-off from an unprepared landing site is one of the most important aspects of helicopter operations. Whilst these sites can vary in their dimensions, approaches, hazards, elevation, and location, the same basic principles should be employed. An unprepared landing site that has obstructions that require a steeper than normal approach, where the manoeuvring space in the ground cushion is limited, or whenever obstructions force a steeper than normal climb-out angle is often defined as 'Confined Area'. While a pilot can land at a Confined Area, they still have to apply all the basic principles.

11.1.2 In the event of unforeseen circumstances, such as a "precautionary or "forced landing" that is made in response to an aircraft malfunction/emergency or deteriorating weather, it will invariably be an unprepared landing site. However, if the pilot is faced with an unplanned landing, the decision to conduct a precautionary procedure/recce and land safely when there is still adequate time, under full control and before conditions deteriorate, is essential and cannot be over-emphasised. An abbreviated format will be required for a "forced landing".

11.1.3 The ability to accurately assess the prevailing environmental conditions, potential obstacles, wires, surface conditions, dimensions and ultimate suitability of a landing area, will be enhanced by utilising a previously practised procedure to maximise the opportunity of a safe landing outcome.

11.1.4 It will be particularly important to consider appropriate heights to be able to conduct such a procedure safely, while cognisant of potential engine failure considerations, especially if the requirement for a precautionary procedure was initially necessitated by an aircraft malfunction, low fuel state, or other related issue.

11.1.5 The private pilot licence syllabus requires training in confined area landing procedures.