CPL PERFORMANCE EXTRACTS

PART 91 MOS

PART 135 MOS

AC 91-02 v1.2

IMPORTANT INFORMATION

The use of these ‘selected extracts’ in CASA PEXO exams is subject to the following conditions:

1. The ‘selected extracts’ must be as provided without any additional pages, training notes, cross references or indexes added to them.

2. Candidates may choose to take into their exams either:

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- The normal set of PART 91 & PART 135 MOS and AC 91-02 documents,
- but NOT both.

3. Should a candidate, as a result of using ‘selected extracts’, find that they cannot answer a question(s) or choose an incorrect answer(s), are not permitted to use this to request a re-marking of their exam.

4. Candidates may only take ‘selected extracts’ into those exams where each of those

documents (PART 91 MOS OR PART 135 MOS and AC 91-02) are part of the ‘permitted materials’ for that subject.

5. A divider page, used to separate the different sections, i.e. separating PART 91 MOS from PART 135 MOS and from the AC 91-02 portions of ‘selected extracts’, is approved.

6. As per the normal CASA requirements stated on page https://www.casa.gov.au/standard-page/permitted-material-under-part-61 of the CASA web

site, **no tagging of these pages is permitted, however candidates may choose to underline or highlight sections of the text if they wish** (also as stated on that same page of the CASA web site).

EXTRACTS FROM

CASR PART 91 MOS

CHAPTER 19 FUEL REQUIREMENTS

19.01 Purpose

For subregulation 91.455 (1), this Chapter prescribes requirements relating to fuel for aircraft.

19.02 Definitions of *final reserve fuel* and *contingency fuel*

The final reserve fuel and contingency fuel that must be carried on board an aircraft for a flight must conform to the requirements set out in Table 19.02 (2) so that, for an aircraft mentioned in an item of column 1 of the Table, in the kind of flight mentioned for the aircraft in column 2, the final reserve fuel flight time, and the contingency fuel amount, must be as mentioned in columns 3 and 4 respectively for the item.

Table 19.02 (2) — Final reserve fuel and contingency fuel requirements

	Column 1	**Column 2**	**Column 3**	**Column 4**
Item	**Aircraft (by aircraft category)**	**Kind of flight (by flight rules)**	**Final reserve fuel flight time**	**Contingency fuel amount**
1	Aeroplane with MTOW <= 5 700 kg (piston engine or turboprop)	VFR	30 minutes	N/A
2	Aeroplane with MTOW <= 5 700 kg (piston engine or turboprop)	Night VFR	45 minutes	N/A
3	Aeroplane with MTOW <= 5 700 kg (piston engine or turboprop)	IFR	45 minutes	N/A
4	Turbojet engine aeroplane, or aeroplane with MTOW > 5 700 kg (turboprop engine)	IFR or VFR	30 minutes	5% of trip fuel
5	Aeroplane with MTOW > 5 700 kg (piston engine)	IFR or VFR	45 minutes	5% of trip fuel
6	Rotorcraft	VFR	20 minutes	N/A
7	Rotorcraft	IFR	30 minutes	N/A

Note Table 19.02 (2) describes the required final reserve fuel and contingency fuel by aircraft type and flight rules.

19.03 General requirements

Fuel consumption data

(1) When determining the amount of usable fuel required under this Chapter for a flight of an aircraft, the pilot in command must use 1 of the following fuel consumption data sources:

(a) the most recent aircraft specific fuel consumption data derived from the fuel consumption monitoring system used by the operator of the aircraft (if available);

(b) the aircraft manufacturer's data for the aircraft.

Note The aircraft manufacturer's data includes electronic flight planning data. The manufacturer's data may be in the AFM, cruise performance manuals or other publications.

Operational requirements etc.

(2) In determining the amount of usable fuel required under this Chapter, the pilot in command must take into account the effect of the following matters:

(a) the operating conditions for the proposed flight, including the following:

(i) the actual weight (if known or available), or the anticipated weight, of the aircraft;

(ii) relevant NOTAMs;

(iii) relevant authorised weather forecasts and authorised weather reports;

(iv) relevant air traffic service procedures, restrictions and anticipated delays;

(v) the effects of deferred maintenance items and configuration deviations;

(b) the potential for deviations from the planned flight because of unforeseen factors.

19.04 Amount of fuel that must be carried for a flight

(1) The pilot in command of an aircraft must ensure that, when a flight of the aircraft commences, the aircraft is carrying on board at least the following amounts of usable fuel:

(a) taxi fuel;

(b) trip fuel;

(c) destination alternate fuel (if required);

(d) holding fuel (if required);

(e) contingency fuel (if applicable);

(f) final reserve fuel;

(g) additional fuel (if applicable).

(2) The pilot in command must ensure that, at any point of in-flight replanning, the aircraft is carrying on board at least the following amounts of usable fuel:

(a) trip fuel from that point;

(b) destination alternate fuel (if required);

(c) holding fuel (if required);

(d) contingency fuel (if applicable);

(e) final reserve fuel;

(f) additional fuel (if applicable).

(3) The pilot in command must ensure that the aircraft is carrying on board at least the following amounts of usable fuel, required at any time to safely continue the flight:

(a) trip fuel from that time;

(b) destination alternate fuel (if required);

(c) holding fuel (if required);

(d) final reserve fuel;

(e) additional fuel (if applicable).

(4) If, after commencement of the flight, fuel is used for a purpose other than that originally intended during pre-flight planning, the pilot in command must reanalyse the planned use of fuel for the remainder of the flight, and adjust the parameters of the

flight in so far as is necessary to remain in compliance with the requirements of this Chapter.

(5) Subsection (6) applies if an aircraft for a flight:

(a) is unable to land at the planned destination aerodrome; and

(b) diverts to the planned destination alternate aerodrome that was required for the flight.

(6) Despite subsection (3), the pilot in command must ensure that the aircraft is carrying at least the following amounts of usable fuel:

(a) destination alternate fuel from the time of commencing the diversion;

(b) holding fuel (if required);

(c) final reserve fuel.

19.05 Procedures for determining fuel before flight and fuel monitoring during a flight

(1) The pilot in command of an aircraft for a flight must ensure that the amount of usable fuel on board the aircraft is determined before the flight commences.

(2) The pilot in command must ensure that the amount of fuel is checked at regular intervals throughout the flight, and that the usable fuel remaining is evaluated to:

(a) compare planned fuel consumption with actual fuel consumption; and

(b) determine the amount of usable fuel remaining; and

(c) determine whether the remaining usable fuel is sufficient to satisfy:

(i) if a point of in-flight replanning has been specified by the pilot in command for the flight and the flight has not proceeded past the point — the requirements of subsection 19.04 (2); and

(ii) otherwise — the requirements of subsection 19.04 (3); and

(d) determine the amount of usable fuel expected to be remaining when the aircraft lands at the destination aerodrome.

19.06 Procedures if fuel reaches specified amounts

(1) If, at any time during a flight, the amount of usable fuel remaining in the aircraft on landing at the destination aerodrome will be, or is likely to be, less than the fuel required under subsection 19.04 (3), then the pilot in command must:

(a) take into account the likely air traffic and operational conditions on arrival at:

(i) the destination aerodrome; and

(ii) if a destination alternate aerodrome is required for the flight — the destination alternate aerodrome; and

(iii) any en route alternate aerodrome; and

(b) proceed to an aerodrome mentioned in paragraph (a) that enables the pilot in command to continue to meet the requirements in section 19.04.

(2) The pilot in command must request from ATS the duration of any likely delay in landing if unforeseen factors could result in the aircraft landing at the destination aerodrome with less than the following amounts of fuel remaining:

(a) the final reserve fuel;

(b) the destination alternate fuel (if required).

EXTRACTS FROM

PART 135 MOS

Part 135 (Australian Air Transport Operations—Smaller Aeroplanes) Manual of Standards 2020

made under the *Civil Aviation Safety Regulations 1998*.

Compilation No. 1

Compilation date: 2 December 2021

Includes amendments up to: F2021L01687

Prepared by the Advisory and Drafting Branch, Legal, International and Regulatory Affairs Division, Civil Aviation Safety Authority, Canberra.

Chapter 7 — Fuel requirements

7.01 Purpose of Chapter 7

This Chapter prescribes requirements for subregulation 135.215(1) of CASR.

7.02 Definitions for Chapter 7

In this Chapter:

additional fuel means the supplementary amount of fuel required to allow an aeroplane that suffers engine failure or loss of pressurisation at the critical point along the route (whichever results in the greater subsequent fuel consumption) to:

(a) proceed to an alternate aerodrome for the flight of the aeroplane; and
(b) fly for 15 minutes at the holding speed, for the aeroplane, at 1 500 ft above the aerodrome elevation in ISA conditions; and
(c) make an approach and landing.

contingency fuel, for an aeroplane and flight, means the amount of fuel required to compensate for unforeseen factors, which must not be less than the greater of the following amounts:

(a) if:
  (i) the aeroplane is a piston-engine aeroplane — 10% of the trip fuel amount for the flight; or
  (ii) the aeroplane is a turbine-engine aeroplane — 5% of the trip fuel amount for the flight;
(b) an amount of fuel required to fly, in ISA conditions, for 5 minutes at the holding speed, for the aeroplane, at 1 500 ft above the planned destination aerodrome.

destination alternate fuel means the amount of fuel required to enable an aeroplane to do the following in a sequence:

(a) perform a missed approach at the destination aerodrome;
(b) climb to the expected cruising altitude;
(c) fly the expected routing to the destination alternate aerodrome;
(d) descend to the point where the expected approach is initiated;
(e) conduct the approach;
(f) land at the destination alternate aerodrome.

established, for the definition of ***holding fuel*** in this section, means any of the following:

(a) established by the aeroplane's manufacturer, and published in the aeroplane's flight manual;
(b) established by the use of a fuel consumption monitoring system;
(c) established by the aeroplane's operator and published in the operator's exposition, along with:
  (i) the relevant data and methodology used; or

(ii) references to another accessible location of the data and methodology used.

final reserve fuel means the calculated amount of fuel:

(a) that is required to fly an aeroplane mentioned in column 1 of an item in the following table, calculated as follows:

(i) for the kind of flight mentioned in column 2 of the item—for the period of the flight mentioned in column 3 of the item; and

(ii) at 1 500 ft above aerodrome elevation in ISA conditions; and

(iii) at holding speed; and

(iv) at the aeroplane's estimated weight on arrival at the destination alternate aerodrome, or planned destination aerodrome if no destination alternate aerodrome is required for the flight; and

(b) that is usable fuel remaining on completion of the final landing at the aerodrome.

Table—Final reserve fuel requirements

Item	**Column 1**	**Column 2**	**Column 3**
	Aeroplane	**Kind of flight**	**Final reserve fuel flight time**
1	A piston-engine aeroplane	IFR flight or VFR flight	45 minutes
2	A turbine-engine aeroplane	IFR flight or VFR flight	30 minutes

holding fuel means the amount of fuel required by an aeroplane to fly for the period anticipated for holding (taking into account the operating conditions), calculated at the holding fuel consumption rate established for the aeroplane for the anticipated meteorological conditions, or ISA conditions.

Note: See the definition of ***established*** in this section.

point of in-flight replanning means a point en route during a flight of an aeroplane, determined by the operator or pilot in command for the flight before the flight commences, at which an aeroplane can:

(a) if the flight arrives at the point with adequate fuel to complete the flight to the planned destination aerodrome while maintaining the fuel required by subsection 7.04(2) —continue to that aerodrome; or

(b) otherwise — divert to an en route alternate aerodrome while maintaining the fuel required by subsection 7.04(3).

taxi fuel means the amount of fuel expected to be used by an aeroplane before take-off, taking into account:

(a) local conditions at the departure aerodrome; and

(b) APU consumption, if applicable.

trip fuel means the amount of fuel required to enable an aeroplane to fly from any point along the route until landing at a destination aerodrome, including (as applicable) the following:

(a) fuel for take-off and climb from the departure aerodrome to initial cruising level or altitude, taking into account the expected departure routing;

(b) fuel for cruise from top of climb to top of descent, including any step climb or descent;

(c) fuel from top of descent to the point where the approach is initiated, taking into account the expected arrival procedure;

(d) fuel for executing an approach and landing.

unforeseen factors means factors that could have an influence on an aeroplane's fuel consumption to the planned destination aerodrome, including:

(a) the aeroplane's deviation from the expected fuel consumption data for an aeroplane of that type; and

(b) extended delays and deviations from planned routings or cruising levels.

7.03 General requirements

Fuel consumption data

(1) When determining the quantity of usable fuel required under this Chapter for a flight of an aeroplane, the operator, and pilot in command, must each use the following fuel consumption data sources:

(a) the most recent aeroplane specific fuel consumption data derived from a fuel consumption monitoring system used by the operator, if available;

(b) the aeroplane's manufacturer's data for the aeroplane.

Note: The aeroplane manufacturer's data includes electronic flight planning data. The manufacturer's data may be in the flight manual, cruise performance manuals or other publications.

Operational conditions etc

(2) In determining the quantity of usable fuel required under this Chapter, the operator, and pilot in command, must each consider the effect of the following matters:

(a) the operating conditions for the proposed flight, including the following:

(i) the actual (if known or available), or anticipated, weight of the aeroplane;

(ii) relevant NOTAMs;

(iii) relevant meteorological reports and forecasts;

(iv) relevant ATS procedures, restrictions and anticipated delays;

(v) the effects of deferred maintenance items and configuration deviations;

(b) the potential for deviations from the planned flight because of unforeseen factors.

7.04 Amounts of fuel to be carried on board for a flight

(1) The operator, and pilot in command, of an aeroplane must each ensure that, when a flight of the aeroplane commences, the aeroplane is carrying on board at least the total of the following amounts of usable fuel:

(a) taxi fuel;

(b) trip fuel;

(c) destination alternate fuel, if required;

(d) holding fuel, if required;

(e) contingency fuel;

(f) final reserve fuel;

(g) additional fuel, if applicable.

(2) The operator, and pilot in command, must each ensure, at any point of in-flight replanning, the aeroplane is carrying on board at least the following amounts of usable fuel:

(a) trip fuel from that point;

(b) destination alternate fuel, if required;

(c) holding fuel, if required;

(d) contingency fuel;

(e) final reserve fuel;

(f) additional fuel, if applicable.

(3) The operator, and pilot in command, must each ensure the aeroplane is carrying on board at least the following amounts of usable fuel, required at any time to continue the flight safely:

(a) trip fuel from that time;

(b) destination alternate fuel, if required;

(c) holding fuel, if required;

(d) final reserve fuel;

(e) additional fuel if applicable.

(4) If, after the commencement of the flight, fuel is used for a purpose other than that originally intended during pre-flight planning, the pilot in command must re-analyse the planned use of fuel for the remainder of the flight, and adjust the parameters of the flight if that is necessary to continue to meet the requirements of this Chapter.

(5) Subsection (6) applies if an aeroplane:

(a) has been unable to land at the planned destination aerodrome; and

(b) is diverting to the planned destination alternate aerodrome.

(6) Despite subsection (3), the operator, and pilot in command, must each ensure the aeroplane is carrying at least the following amounts of usable fuel:

(a) destination alternate fuel from that time;

(b) holding fuel, if required;

(c) final reserve fuel.

7.05 Requirements for determining fuel before, and monitoring fuel during, flight

(1) The operator, and pilot in command, of an aeroplane must each ensure that for a flight of the aeroplane*:*

(a) the amount of usable fuel on board the aeroplane is determined before the flight commences, and recorded; and

(b) regular in-flight fuel amount checks are conducted.

Note: Procedures to ensure that a flight of the aeroplane is conducted in accordance with the fuel requirements stated in this Chapter, including procedures for how regular in-flight fuel amount checks will be conducted for a flight, must be included in the operator's exposition: see regulation 135.205, and paragraphs 119.205(1)(h) and (o), of CASR.

(2) The pilot in command must do all of the following at each in-flight fuel amount check:

(a) determine the amount of usable fuel remaining;

(b) compare planned fuel consumption with actual fuel consumption;

(c) determine whether the remaining usable fuel is sufficient to meet:

(i) if a point of in-flight replanning has been specified by the operator for the flight and the flight has not proceeded past the point — the requirements of subsection 7.04(2); and

(ii) otherwise — the requirements of subsection 7.04(3);

(d) calculate the amount of usable fuel expected to be remaining when the aeroplane lands at the destination aerodrome.

7.06 Procedures if fuel reaches specified amount

(1) If the pilot in command of an aeroplane for a flight becomes aware that the amount of usable fuel in the aeroplane on landing at the destination aerodrome would be less than the fuel required under subsection 7.04(3), the pilot in command must:

(a) take into account the traffic and operational conditions likely to be prevailing on arrival at:

(i) the destination aerodrome; and

(ii) if a destination alternate aerodrome is required for the flight — the destination alternate aerodrome; and

(iii) any en-route alternate aerodrome; and

(b) proceed to an aerodrome mentioned in paragraph (a) that enables the pilot in command to continue to meet the requirements stated in section 7.04.

(2) The pilot in command must request from ATS the duration of any likely delay in landing if unforeseen factors could result in the aeroplane landing at the destination aerodrome with less than the following amounts of fuel remaining:

(a) final reserve fuel;

(b) destination alternate fuel, if required.

(3) The pilot in command must declare to ATS a “minimum fuel” state if:

(a) the pilot in command is committed to land the aeroplane at an aerodrome in accordance with this section; and

(b) it is calculated that if there is any change to the existing air traffic control clearance issued to the aeroplane in relation to that aerodrome, the aeroplane will land with less than the final reserve fuel remaining.

Note 1: The declaration of “minimum fuel” informs ATS that all planned aerodrome options have been reduced to a specific aerodrome of intended landing and any change to the existing clearance may result in landing with less than final reserve fuel. This is not an emergency situation, but an indication that an emergency situation is possible should any additional delay happen.

Note 2: Pilots in command should not expect any form of priority handling because of a “minimum fuel” declaration. ATS will, however, advise the flight crew of any additional expected delays, and coordinate when transferring control of the aeroplane to ensure other ATS units are aware of the flight’s fuel state.

(4) If the pilot in command of an aeroplane for a flight becomes aware that the amount of useable fuel on board upon landing at the nearest aerodrome where a safe landing can be made would be less than the final reserve fuel, the pilot in command must declare a situation of “emergency fuel” by broadcasting “MAYDAY, MAYDAY, MAYDAY FUEL”.

Note: The emergency fuel declaration is a distress message.

7.07 Operational variations—fuel calculations

(1) Despite sections 7.03 and 7.04, an aeroplane operator may use an operational variation, stated in the operator’s exposition for the purpose of this section, that relates to the calculation of any of the following, if the requirements stated in subsections (3) and (5) are met:

(a) taxi fuel;

(b) trip fuel;

(c) contingency fuel;

(d) destination alternate fuel;

(e) additional fuel.

(2) To avoid doubt, an operational variation mentioned in subsection (1) cannot relate to the calculation of holding fuel or final reserve fuel.

(3) The operator must have submitted to CASA, at least 28 days before using an operational variation:

(a) evidence of at least one of the following, that demonstrates how the operational variation will maintain, or improve, aviation safety:

(i) documented in-service experience;

(ii) the results of a specific safety risk assessment conducted by the operator that meets the requirements of subsection (4); and

(b) details of the operational variation, including procedures in relation to the use of the operational variation, proposed for inclusion in the operator’s exposition.

EXTRACTS FROM

AC 91-02 V1.2

Australian Government
Civil Aviation Safety Authority

ADVISORY CIRCULAR

AC 91-02 v1.2

Guidelines for aeroplanes with MTOW not exceeding 5 700 kg - suitable places to take off and land

Date	November 2022
Project number	OS 99/08
File ref	D22/230926

Advisory circulars are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.

Advisory circulars should always be read in conjunction with the relevant regulations.

Audience

This Advisory Circular (AC) provides guidance for pilots of:

- aeroplanes with maximum take-off weight (MTOW) not exceeding 5 700 kg that are operated under Part 91 of CASR, including experimental aircraft, and
- light sport aircraft (LSA) under Part 103 of CASR.

The AC provides limited guidance for aeroplanes with a MTOW not exceeding 5 700 kg conducting air transport operations operated under Part 135 of CASR. Guidance for these aeroplanes is mainly described in the Part 135 AMC/GM document.

Note: One acceptable means of compliance with the Part 91 aeroplane performance rules for aeroplanes with a MTOW greater than 5 700 kg is to comply with the requirements of Divisions 1 and 2 of Chapter 9 of the Part 121 Manual of Standards (MOS).

Purpose

This AC provides guidance to assist aeroplane pilots when determining the suitability of a place to safely take off and land. It provides an overview of pilot responsibilities, discusses the relevant circumstances recommended to be considered and includes general information and advice to enhance the safety of taking off and landing at any place.

This AC does not aim to provide detailed technical advice to the operators of aeroplanes certified under Part 25 of the Civil Aviation Safety Regulations (CASR), or under the Federal Aviation Regulations (FAR), or the equivalent European Aviation Safety Agency (EASA) rules (refer to section 3 of this AC).

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

The pilot in command 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.

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

For further information

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

Status

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

Note: Changes made in the current version are annotated with change bars.

Version	Date	Details
v1.2	November 2022	Additional references in section 1.3. New section 6.2.3 to include floatplane aerodrome guidance. Updated recommended safety factors in Table 3 of Chapter 7.
v1.1	November 2021	Updated certification explanation, corrected Table 2 and 3 notes, added explanation of surface uniformity and assessment.
v1.0	October 2021	This AC supports regulation 91.410 of CASR.

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
AMC	acceptable means of compliance
AFM	aircraft flight manual
AWIS	aerodrome weather information service
CASR	*Civil Aviation Safety Regulations 1998*
ERSA	En Route Supplement Australia
FAR	Federal Aviation Regulations
ISA	international standard atmosphere
LDR	landing distance required
LSA	light sport aircraft
MTOW	maximum take-off weight
NAA	national aviation authority
POH	pilot operating handbook
QNH	regional or airfield pressure setting
TODR	take-off distance required

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
V_{ref}	The landing speed at a point 50 ft above the landing threshold. It is not less than 1.3 times the stall speed in the normal landing configuration (V_{so}).
V_S	Stall speed in the clean configuration, i.e. no flaps extended.
V_{S0}	The stall speed or the minimum steady flight speed in the landing configuration. In aeroplanes with MTOW not exceeding 5 700 kg, this is the power off stall speed at the maximum landing weight in the landing configuration, i.e. flaps and landing gear extended.
V_X	Best angle of climb speed, i.e. the airspeed at which the aircraft gains the

Term	Definition
	greatest amount of altitude in a given distance.
V_y	Best rate of climb speed, i.e. the airspeed that provides the most altitude gain in a given period of time.

1.3 References

Legislation

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

Document	Title
Part 91 of CASR	General operating and flight rules
Part 91 MOS	Part 91 (General Operating and Flight Rules) Manual of Standards 2020
Part 135 of CASR	Australian air transport operations—smaller aeroplanes
Part 135 MOS	Part 135 (Australian air transport operations—smaller aeroplanes) Manual of Standards 2020
Part 139 of CASR	Aerodromes

Advisory material

CASA's advisory material is available at https://www.casa.gov.au/publications-and-resources/guidance-materials

Document	Title
Part 91 AMC/GM	Acceptable Means of Compliance / Guidance Material (General Operating and Flight Rules)
Part 135 AMC/GM	Acceptable Means of Compliance / Guidance Material (Australian air transport operations—smaller aeroplanes)

Other material

International Civil Aviation Organization (ICAO) documents are available for purchase from http://store1.icao.int/

Document	Title
AIP	Aeronautical Information Publication
FAA AC 91-79A	Mitigating the Risks of a Runway Overrun Upon Landing
FAA-H-8083-3C	Airplane Flying Handbook
FAA-H-8083-25B	Pilots Handbook of Aeronautical Knowledge

2 Introduction

2.1 Definition of aerodrome in the Civil Aviation Act 1988

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 that 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.

2.2 Use of aerodromes

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

2.2.2 When considering all the circumstances of a landing or take-off, different aeroplane types often have similar considerations although the specific requirements may differ. For example, runway length and width are common considerations, but what constitutes a safe runway length and width is usually different for different aeroplane types, especially when other circumstances are taken into account (such as wind conditions).

2.2.3 When determining what makes a place suitable, large or heavy aeroplanes often have more stringent requirements in their AFM as compared to aeroplanes with maximum take-off weight not exceeding 5 700 kg.

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

2.2.5 Aeroplane pilots operating solely under Part 91 are not required to apply safety margins[1] to the take-off or landing distances which have been determined using the aeroplane manufacturer's data. However, under regulation 91.055 pilots are required to operate the aircraft in a manner that does not create a hazard to another aircraft, a person, or property. Pilots should be aware that, due to a range of circumstances, the aircraft may not be able to be operated to the manufacturer's optimum performance standards during normal operations.

2.2.6 It is therefore recommended that safety factors be applied to an aircraft's operation to make allowance for degraded aeroplane performance or pilot reaction time.

Note: Refer to Table 1 in Section 7 of this AC for the standard safety factors recommended for aeroplanes.

[1] Also called factors, or referred to as 'factoring'

2.2.7 For aeroplanes with MTOW not exceeding 5 700 kg where the information available to the pilot may be non-specific or incomplete, the use of suitable safety factors to mitigate these risks will maximise the safety outcome.

2.3 Minimum aerodrome requirements for air transport operations

2.3.1 The regulations regarding minimum aerodrome requirements for air transport operations can be found in Part 121, 133 or 135 (as applicable to the aircraft being used).

2.3.2 In some of the Australian air transport operations rules, pilots and operators are required to account for certain matters[2] but the safety factor to be used for those matters is not specified. For aeroplanes with a MTOW not exceeding 5 700 kg, the use of the safety factors recommended in this AC are an acceptable means of compliance for these requirements.

For example, a Part 135 operation is being conducted using an aeroplane with a MTOW of 4 500 kg and landing on a runway that is dry, sealed and has a 1% downhill slope. No other conditions relevant to the application of safety factors are present.

Paragraph 10.14(2)(e) of the Part 135 MOS requires the pilot and operator to account for the runway surface, condition and slope when determining if the landing distance available is sufficient to land. Table 2 of Chapter 7 of this AC does not recommend any safety factors are needed for a sealed dry runway but does recommend that a 1% downhill slope use a 10% safety factor on top of the standard Part 135 landing safety factor.

The standard landing factor required by Part 135 for an aeroplane with a MTOW of 4 500 kg is 1.43. If the landing distance required from the AFM was 1 000 m, then the required landing distance available would be 1 573 m (1000 x 1.43 x 1.1).

[2] For example: aerodrome elevation, runway surface, runway condition, runway slope, wind and obstacles.

3 Aircraft certification and performance

3.1 Basics of certification

3.1.1 The performance of every certificated aircraft has been evaluated as part of the certification process. The certification process allows the manufacturer to determine the take-off and landing performance under ideal conditions. The certification basis of an aircraft is identified in the Type Certificate (TC) or Type Acceptance Certificate (TAC). Australian certification standards use the same Part numbering convention as the US (FAR) and European (CS) standards.

3.1.2 Except for LSA and experimental aircraft, Part 23 is the general certification standard for aeroplanes with MTOW less than 12 500 lbs. Part 23 specifies fewer comprehensive take-off, flight and landing performance standards than Part 25. While most aeroplanes with MTOW greater than 12 500 lbs, and some jets below that MTOW, are certified under Part 25. This AC does not aim to provide technical advice to the operators of aeroplanes certified under Part 25.

3.1.3 Most LSA aircraft are certified by their manufacturer without oversight from their local NAA. The standards may vary considerably from country to country.

3.1.4 The use of factoring or safety factors is the application of an additional safety margin above the performance specified in the aircraft flight manual (AFM). Factoring is not required under Part 91 but is strongly recommended.

3.1.5 For Parts 121 and 135 of CASR, certain additional safety factors are mandated, and some factors are required to be considered but additional factors for these matters are not mandated[3]. Pilots and operators conducting aeroplane air transport operations must comply with rules applicable to the Parts within which they operate.

3.2 Aircraft flight manual/pilot operating handbook

3.2.1 The different certification standards specify what information must be provided in the AFM/pilot operating handbook (POH). Each aeroplane type and category (LSA, normal, utility, commuter, transport etc.) has a certification standard, and operational details and limitations are reflected in the AFM/POH whether approved by the NAA or by the manufacturer.

3.2.2 Amateur-built and experimental aircraft are not required to be certified to specific airworthiness standards and may operate without an NAA or manufacturer-approved AFM/POH. The owners of these aircraft are responsible for establishing aircraft limitations during tests, and are required to demonstrate that the aircraft is controllable when executing any manoeuvre in the normal speed range. They must also demonstrate that the aircraft has no hazardous operating characteristics or design features.

Note: Regulation 91.095 requires the pilot to operate the aircraft in accordance with the aircraft flight manual instructions (this is a defined term in Part 1 of the CASR Dictionary).

[3] See section 2.3 of this AC.

3.3 Performance information

3.3.1 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 aeroplane.

Notes:

1. Paragraph 61.385(1)(e) of CASR states that the holder of a pilot licence is only authorised to exercise the privileges of the licence in an aircraft if the holder is competent in operating the aircraft, including applying aircraft performance data, including take-off and landing performance data, for the aircraft.
2. Regulations 91.795 and 91.800 of CASR 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.

3.3.2 For LSA aeroplanes, although the manufacturer is required to provide performance information in the AFM/POH, it can be limited and lacking in detail compared to Part 23 certified aeroplanes. It may contain a proviso to the pilot that advises 'take-off and landing distances can depend on aircraft condition, environment and pilot skill'. The detail provided may not have been determined using tests of equivalent accuracy to the tests required by Part 23.

3.3.3 As stated, some aircraft are not required to have performance data and, where there may be some information, it may not always be relevant to the actual operation being performed. Normally, performance data is determined by the aircraft builder at the time of testing. The tests to obtain the provided performance data are likely to lack the rigour and accuracy of tests required for an aeroplane certificated to Part 23.

3.3.4 Although not within the scope of this AC, aeroplanes operated under Part 121 or 135 require factoring of performance data to provide appropriate safety margins regardless of whether the aeroplane has been certified under Part 23 or 25. Even if the requirements are already reflected in their take-off and landing performance charts, pilots must be familiar with any factoring applicable to their operation.

3.3.5 Two examples of the factoring requirements applicable to larger or commercial aeroplanes are:

- Most turbine-engine aeroplanes are required to take off from a runway that is the greater of 1.15 times the all-engines-operating take-off distance, or the one-engine-inoperative accelerate-stop distance required (the distance used to establish V_1).
- Jet transports must land only on a runway which is at least 1.67 times the designated landing distance (DLD) (the FAA advise the DLD is not to exceed 60 per cent of the runway available, which amounts to the same factoring), with further allowances for wet runways.

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

3.4.1 Each aeroplane operation requires an aerodrome of certain dimensions. The AFM/POH normally describes the dimensions required for a take-off conducted at varying combinations of weight, altitude and temperature.

3.4.2 Pilots should be aware that AFM/POH aeroplane performance is tested and calculated under strict criteria that may not replicate the conditions being experienced on any given day. For example, for the certification of landing distance, the requirements for the test are that the:

- aeroplane must approach at not less than 1.3 times the stall speed in the landing configuration
- aeroplane must cross the threshold at not less than 50 ft
- test is done on a dry, sealed surface
- runway slope is between 2% slope up and 2% slope down.

3.4.3 Pilots should be aware that to consistently fly the aeroplane to the tolerances used during certification tests will take extensive practice and recency. Unless the pilot is intimately familiar with the criteria for determining aircraft performance during certification, it is reasonable to assume that the pilot is unlikely to meet these criteria in normal operational circumstances and therefore safety factors should be applied. Refer to section 7 of this AC for more information on safety factors.

3.4.4 When taking off from, or landing at, an aerodrome with minimum dimensions, it is recommended that appropriate safety factoring be applied before attempting the take-off or landing.

3.5 Relevant nomenclature

3.5.1 There are very few standard 'V speeds' (or similar performance notations) formally applicable to aeroplanes with MTOW not exceeding 5 700 kg. Notwithstanding, some notations are often used to describe aeroplane performance parameters of this type and where they are, they must be considered.

3.5.2 Pilots should familiarise themselves with the AFM/POH terminology for the aircraft type they are flying.

4 Information about aerodrome publications

4.1 Aerodrome standards

4.1.1 Standards that apply to certified aerodromes can be found in Part 139.

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

4.1.3 There are no standards for aerodromes that are not certified (listed in the En Route Supplement Australia (ERSA) as an uncertified aerodrome), but noting regulation 91.410 requires the aerodrome to be suitable. CASA has published recommended criteria for landowners or operators of these aerodromes, but these recommendations are guidelines only.

4.2 Publications containing aerodrome data

4.2.1 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.

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

4.2.3 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.

4.2.4 The examples below are two of many possible considerations:

- the obstacles surrounding the aerodrome have been accurately described and are still current (e.g. have the trees on final grown taller since last reported), and
- the information provided enables the pilot to judge whether or not a landing approach can be made from both runway directions.

5 Permission to operate

5.1 Ownership and management

5.1.1 Pilots and operators must consider ownership and management requirements for aircraft operations into any aerodrome. Unless a landing place is unambiguously open for public use for aviation purposes, the pilot should assume that permission is required from the land owner or occupier 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 the ERSA in the first instance)
- private farmland
- roads, parks or fairways owned by local authorities or private interests
- water, land, beaches or dry lakes managed by a state authority such as National Parks, Waterways Authority, Lands Department etc.

5.2 Penalties and liability

5.2.1 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.

5.2.2 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 CASR provides immunity against civil liability in the case of damage to persons or property.

6 Pilot responsibilities

6.1 Compliance with the aircraft 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.

6.1.1 Pilots should develop their own personal operating minimums, taking into account AFM minimums (for performance or operating limits etc.). Pilots should be conservative when assessing their own experience, recency and personal skills. For example, if a pilot knows they do not have extensive and recent experience conducting landings at aerodromes with short runways, or they have not flown frequently in marginal weather conditions, the pilot should consider using personal limits which are more conservative than the AFM minima.

6.2 Deciding to use an aerodrome

6.2.1 It is the pilot's responsibility to be satisfied that the aeroplane is able to safely take off from, or land at, an aerodrome. When operating at an aerodrome, the pilot needs to be aware of any potential hazards.

6.2.2 Section 7 of this AC describes factoring in more detail, however the following is a summary of some, although not all, matters that a pilot should consider when deciding whether or not 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) runway available
- the width of the runway
- the nature of the runway and movement area surface, including its pavement strength
- the runway elevation
- the runway direction
- the runway 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

- whether people, machines, stock or wildlife are 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 aerodrome
- any special procedures applicable at the aerodrome (e.g. one-off activities, noise abatement considerations etc.)
- NOTAMs or AIP Supplements applicable to the area
- for night operations: the availability, type and means of operating the aerodrome lights
- for IMC or night operations: the terrain in the vicinity of the aerodrome.

6.2.3 For water aerodromes, it is recommended that the following factors be considered when determining whether an area of water is suitable for use:

- using a minimum width water channel of 60 metres for day operations
- using a minimum width water channel of 90 metres for night operations
- ensuring that the depth of water over the whole water channel be 300mm or greater below the hull or floats when the aeroplane is stationary and loaded to maximum take-off weight
- ensuring an additional area exists either side of the water channel which creates a protective buffer

  Note: The protective buffer does need not consist of water. If it does consist of water, then it should be clear of moving objects or vessels under way.

- if the centre line of a water channel is curved then the approach and take-off lengths should be calculated from the anticipated point of touchdown or lift-off.

6.3 Accuracy of calculations

6.3.1 Given the considerable effect of different aircraft weights on aeroplane performance, it is very important that the pilot takes into account all relevant information and accurately calculates the capacity for safe operational performance of the aircraft.

6.4 No-go situations

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

6.4.2 It is also important that all persons involved in an operation are informed of pre-identified no-go decision criteria, so that undue pressure is minimised if any such criteria are met. Until the safety of an operation can be assured with appropriate consideration given to safety mitigation and regulatory requirements, the operation should not be commenced.

7 Recommended safety factors

7.1.1 It was outlined earlier in section 3 that take-off and landing performance data contained in AFM/POH documents is obtained through strict testing with specific criteria. Importantly, it is unlikely that a normal pilot can replicate the testing performance during routine flying conditions. The likelihood decreases even further when flying conditions become more challenging.

7.1.2 Using a safety factor provides a safety margin on top of calculated take-off and landing distances. These additional safety margins mitigate risks associated with a range of issues that impact on aircraft performance, including but not limited to:

- pilot inaccuracies compared to performance flight testing (excess landing speed, excess height over threshold, increased float before touchdown, delayed use of braking and deceleration devices, inaccurate application of maximum braking techniques)
- runway characteristics
- aerodrome density altitude
- changed external drag configuration of the aeroplane
- underperforming engine compared to that used for performance testing.

7.1.3 While the use of safety factors when determining if an aerodrome can be used is not a mandated requirement for Part 91 operations, it is nevertheless highly recommended.

7.1.4 Once the AFM/POH aeroplane performance is calculated for the prevailing density altitude and wind conditions, it is recommended that the unfactored runway length required by the AFM/POH be multiplied by a safety factor related to the MTOW of the aeroplane.

7.1.5 For Part 91 operations in aeroplanes with MTOW not exceeding 5 700 kg, it is recommended that minimum standard factors be applied as shown in the Table 1 below.

7.1.6 After applying the relevant factor in accordance with Table 1, it is further recommended that the pilot apply additional factors in accordance with any guidance given in the AFM. If the AFM has no such guidance, it is recommended that pilots apply the allowances relevant to the circumstance described and shown in Tables 2 and 3. The allowances within Tables 2 and 3 should be applied in addition to the relevant factor in Table 1. If more than one circumstance applies, then the calculated performance should be multiplied initially by the first applicable factor and then multiplied again by the second applicable factor and so on.

For example, an aeroplane has a MTOW of 2 000 kg, and is landing on a runway with a 1% downhill slope in the direction of landing and your target landing speed is 60 KIAS but the pilot / operator's tolerance for landing speed accuracy is 60-70 KIAS. No other conditions are present that would require the use of a safety factor.

The POH landing distance required is 500 m. Landing 10 knots faster than the target speed of 60 KIAS is a 17% increase which is a safety factor of 2.04 (1.2 x 17 ÷ 10). If the requisite safety factors are applied as recommended, the minimum landing distance available for the runway needs to be 1 173 m (500 x 1.15 x 2.04).

Table 1: Recommended minimum standard safety factors

Aircraft weight	Minimum standard safety factor
For take-off	
up to 2 000 kg MTOW	1.15 or 115%
2 000 to 3 500 kg*	1.15 to 1.25 (or 115 to 125%)
3 500 kg to 5 700 kg	1.25 or 125%
For landing	
up to 2 000 kg MTOW	1.15 or 115%
2 000 to 4 500 kg†	1.15 to 1.43 (or 115 to 143%)
4 500 to 5 700 kg	1.43 or 143%

* In the case of aeroplanes with MTOW between 2 000 kg and 3 500 kg, apply a safety factor determined by linear interpolation between 1.15 and 1.25.

† In the case of aeroplanes with MTOW between 2 000 kg and 4 500 kg, apply a safety factor determined by linear interpolation between 1.15 and 1.43.

Table 2: Recommended additional take-off allowances

Circumstance	Factor increase expressed as a percentage	Multiply minimum standard safety factored take-off distance by
per 10% increase in aeroplane weight	20%	1.2
an increase of 1,000 ft in aerodrome elevation above mean sea level	10%	1.1
an increase of 10°C in ambient temperature above ISA	10%	1.1
tailwind component, per 10% of lift-off speed	20%	1.2
2% uphill slope*	10%	1.1
soft ground or snow†	25%+	1.25+
dry grass† up to 20 cm (on firm soil)	20%	1.2
wet grass‡ up to 20 cm (on firm soil)	30%	1.3

* The effect on aeroplane performance of this circumstance is variable and possibly unpredictable. Expect a ground distance increase, but airborne distance remains the same.

† The effect on aeroplane performance of this circumstance is variable and possibly unpredictable. While rolling resistance is increased, steering and braking effectiveness is reduced. Airborne distance remains the same but expect an increase in ground distance.

‡ If wet grass is on soft ground the effect on rolling resistance is cumulative, so both elements must be considered.

Table 3: Recommended additional landing allowances

Circumstance	Factor increase expressed as a percentage	Multiply minimum standard safety factored landing distance by
10% increase in aeroplane weight	10%	1.1
10% increase in final approach speed over AFM/POH target speed	20%	1.2
an increase of 1,000 ft in aerodrome elevation above mean sea level	5%	1.05
an increase of 10˚C in ambient temperature above ISA	5%	1.05
tailwind component, per 10% of landing speed*	20%	1.2
every 10 foot increase above the standard 50 foot threshold crossing height	NA	Not multiply - add 200 feet (61m) to required landing distance
pilot does not maintain maximum braking until aircraft stops‡	20%‡	1.2‡
1% downhill slope**	10%	1.1
muddy surface or light snow†	25%+	1.25
dry grass† up to 20 cm (on firm soil)	20%+	1.2
wet grass† up to 20 cm (on firm soil)	30%+	1.3
short and dense or very green grass†	60%	1.6
wet sealed runway	15%	1.15
20–50 mm standing water†	50%+	1.5

* In factoring the effect of wind, reduce estimated headwind by 50 percent and assume a tailwind is 50% greater than the estimate.

** Many AFM/POH only include corrections for slope when the slope exceeds 2%. Check your aircraft's AFM/POH to determine if runway slope is included in the landing distance performance calculations.

† The effect on aeroplane performance of this circumstance is variable and possibly unpredictable. While rolling resistance is increased, steering and braking effectiveness is reduced. Airborne distance remains the same, but expect an increase in ground distance.

‡ If the AFM/POH provides a separate ground rollout component of the required landing distance, then apply this factor only to the ground rollout component distance as the air component from 50 feet over the threshold to touchdown is unaffected by this circumstance. If a separate ground rollout component is not available, it is conservative but safe to apply this factor to the entire required landing distance.

8 Explanation of aerodrome suitability considerations

8.1 Overview

8.1.1 The suitability of an aerodrome depends on many factors, including its characteristics, the surrounding terrain and obstacles, the aeroplane being used, as well as the pilot's formal qualifications and personal skills.

8.1.2 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 of CASR.

8.1.3 There are 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.

8.1.4 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.

8.1.5 It is therefore the responsibility of pilots to exercise sound judgment when the necessary information for an aerodrome is not available, and ensure that all required parties are informed that safe operations from the aerodrome cannot be conducted.

8.2 Aerodrome surface characteristics and rolling resistance

8.2.1 Rolling resistance is determined by the aerodrome surface characteristics, aeroplane mass and tyre pressure.

8.2.2 Runway surfaces may be concrete, bitumen, coral, gravel, soil, grass on soil or sand, hard-packed sand or a dry salt bed (e.g. a salt-lake), each with its own characteristics, many of which vary with the weather and season. Generally, the rolling resistance on concrete or bitumen is minimal and predictable, but the rolling resistance on other types of surface varies widely and will even vary with changes in surface solidity along the length of a given runway.

8.2.3 Rolling resistance can be caused by standing water on a runway surface because it builds up in front of the wheels (like the braking effect on a car driven across a water-covered causeway).

8.2.4 In the case of any natural surface, the soil's moisture content significantly affects rolling resistance, as does surface looseness, presence of algal growth, grass mass and characteristics, surface irregularities and subsurface softness. A very dry top is helpful on some natural surfaces, but detrimental on others. A very wet surface almost invariably gives rise to an unsatisfactory surface. Grass density, greenness and length have a significant effect on the rolling behaviour of an aeroplane (e.g. grass can also hide obstructions, holes, water, stones, anthills and erosion trenches).

8.2.5 Up to a point, rolling resistance may be welcome during landing (e.g. the extra resistance may shorten your landing roll), but unexpected rolling resistance on take-off retards aircraft acceleration and may lead to either a decision to abort the take-off, or possibly even an over-run accident if not considered.

8.2.6 Tables 2 and 3 in section 7 of this AC provide some guidance about the effects of various surface conditions, but these tables do NOT cater for all scenarios or all factors, and pilots must develop an ability to make their own assessments. Some of the factors that will affect the safety of take-off are:

- Transverse or lateral slope:
  - which can affect the aerodynamics of flight and may also result in a longer take-off roll because the pilot needs to use asymmetric brake, nosewheel steering or rudder to keep straight.
- Gravel:
  - which may mean a longer take-off roll because power may need to be applied slowly during the initial roll to avoid stone-chip damage to the propeller, and this may, if very soft, give rise to a wave effect in front of the wheels that resists forward motion.
- Grass:
  - which resists the passage of an aeroplane rolling over it; while attempts are made to predict the effects of certain lengths of grass, rolling resistance will vary not just with the length, but also freshness, moisture content, density of stalks and the mass of material present.
- Free water:
  - which not only affects the softness or slipperiness of the surface, but can build up in front of an aeroplane’s wheels and cause a resistance to rolling or, at higher speeds, lift the wheels and cause aquaplaning and difficulty in maintaining directional control.
- Water in soil:
  - can create mud, which can affect an aircraft’s directional control and may choke spats or wheel wells and restrict rotation of the wheels. In addition, soft spots may allow an aeroplane’s wheel(s) to sink enough for the propeller to hit the ground, or may cause erratic rates of acceleration during a take-off.
- Bearing capacity:
  - which is related to the type of runway surface and the aeroplane’s weight and tyre pressure. If the bearing capacity is insufficient for the combination of aeroplane, tyres and surface, a form of bogging may occur even in dry conditions (as might be experienced when driving a vehicle over sand or a freshly ploughed paddock) which is usually worse than gravel in terms of creating rolling resistance.
- Uniformity, or lack of uniformity, in the surface (i.e., surface variability), can introduce added risks due to the differing rolling resistance of the different surfaces:
  - for take-off on soft surfaces, the estimation of the ground run can be more difficult as the rolling resistance changes as more lift is generated during the take-off roll

- o directional control is likely to be reduced, potentially beyond the aircraft and pilot capabilities, and combined with the lack of a visible runway centre line, the effects of aircraft deviations off the centre line may be exaggerated and not picked up early enough to correct the deviation (if the deviation can be corrected), thereby potentially resulting in runway excursions.

8.2.7 The limits of safety during landing would be that which would cause damage to the tyres or aeroplane structure, or loss of directional control. Low tyre pressure can have a very significant effect. An under-inflated tyre is more prone to blowout or failure during the take-off or landing, which may cause the pilot to lose directional control. In any case, an under-inflated tyre will increase the rolling resistance and lengthen the take-off run.

8.2.8 Without engineering support it is often difficult to be sure of the correct tyre inflation in aeroplanes with MTOW not exceeding 5 700 kg. Pilots should be aware of the correct tyre pressures. These can normally be found in the AFM/POH.

8.2.9 Surface conditions on unsealed runways can be difficult to assess. At non-controlled aerodromes, it may be useful for the pilot to drive or walk an unsealed runway to view and critically evaluate the surface condition. The effect of the weight of the vehicle and the depth of wheel tracks can give a useful indication of the surface condition. A vehicle or person should only enter a runway when it is safe to do so and it is clear of any aircraft, ensuring to continually lookout and/or listen-out for aircraft traffic.

8.2.10 Notwithstanding the preceding points, the precise effect of many surface conditions on take-off or landing performance can sometimes not be accurately quantified. Therefore, it is recommended to use factoring as described in Tables 2 and 3 to provide a safety margin, and where conditions are different to what a pilot has previously experienced, consider delaying until conditions improve.

8.3 Ambient conditions

8.3.1 Wind speed and direction

Note: Regulation 91.380 requires the pilot to land and take off into wind to the extent practicable unless the 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.

8.3.1.1 Pilots should be aware that wind affects the length of runway required for take-off or landing. However, it is particularly dramatic when taking off or landing downwind. Although the tables in section 7 above provide guidance relating to the tailwind effect on a take-off and landing, where landing or taking off into the wind is an option then this is preferable. Aircraft conducting operations at non-controlled aerodromes into wind have priority over aircraft conducting downwind operations.

8.3.1.2 For non-controlled 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 been used for many years to provide pilots with wind direction and strength at the aerodrome surface.

8.3.1.3 While other systems that provide wind information are now routinely available to pilots, 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.

8.3.1.4 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.

a. A windsock at a 30º angle to the direction of the runway indicates that half of the total windspeed will be crosswind.

c. A windsock at a 45º angle to the runway indicates at least a 15 kt crosswind.

d. 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.

8.3.1.5 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. Localised weather, such as gusts, or a 'willy willy', can produce significant fluctuations of the windsock.

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

Note: When operating into unfamiliar uncertified aerodromes it is recommended that, in addition to windsocks, pilots are able to use additional methods to judge the windspeed and direction, such as observing aeroplane drift, tree movements, glassy water on dams, directions of farm windmills, blowing dust etc.

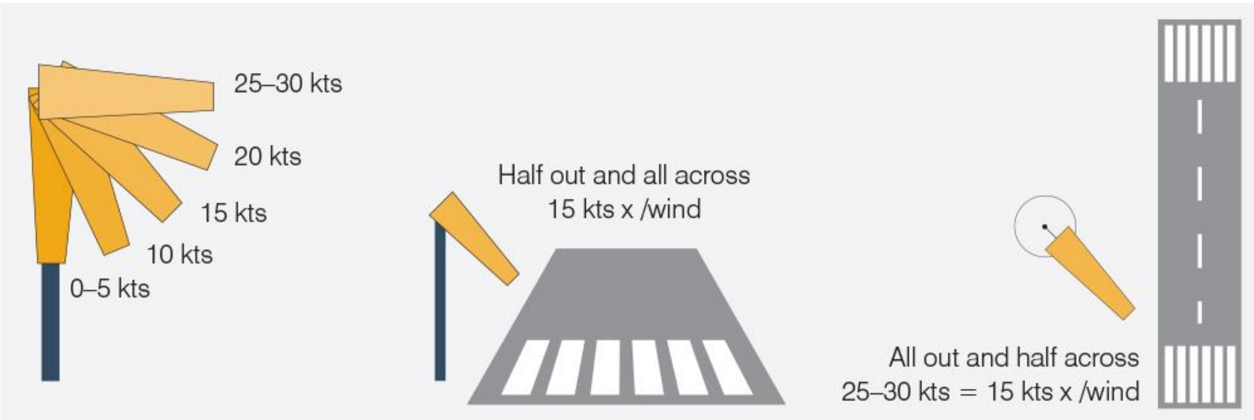

Figure 1: Windsock interpretation

8.3.2 Pressure altitude considerations

8.3.2.1 Pressure altitude 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 an important basis for determining aircraft performance.

8.3.2.2 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.

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

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

b. Apply a correction factor to the aerodrome elevation according to the reported mean sea level pressure.

8.3.2.4 Pressure altitude is the height above the ISA datum of 1013 hPa.

8.3.2.5 To determine pressure altitude at an aerodrome, apply the regional or airfield pressure setting (QNH) to the aerodrome elevation as compared to 1013 hPa. An aerodrome at 1,000 ft elevation with a QNH of 1003 hPa has 10 hPa higher pressure altitude than at 1013 hPa. Where 1 hPa is equal to approximately 30 ft, 10 hPa x 30 ft gives a pressure altitude of 300 ft above the aerodrome elevation (or 1,300 ft above 1013 hPa). Refer to Figure 2 below.

PRESSURE ALTITUDE = Altitude above 1013 hPa

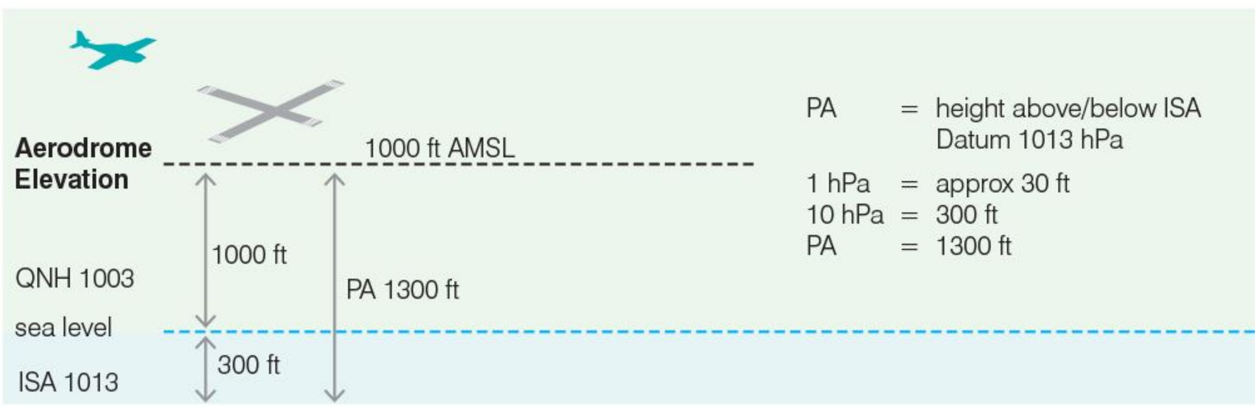

Figure 2: Pressure altitude calculation

8.3.2.6 As stated above, a pilot is also able to simply read the pressure altitude for the aerodrome (1,300 ft) directly off the altimeter of the aircraft at the aerodrome by setting standard pressure 1013 hPa on the altimeter subscale.

8.3.3 Density altitude considerations

8.3.3.1 Density altitude, i.e. the altitude in the standard atmosphere corresponding to a particular value of air density, directly affects aircraft performance.

8.3.3.2 Air density decreases as temperature increases, diminishing both engine and aircraft aerodynamic performance. As air density decreases the engine power output is markedly reduced, significantly decreasing the aircraft's take-off and climb performance. This detrimental effect is reduced with a turbo-charged engine, which can maintain a regulated inlet air pressure to flight levels. However, in all cases, with an increase in temperature, not only is engine power reduced, but the density of the air over the wing that generates lift is also diminished. Increased humidity also has a detrimental effect on lift, because water vapour is less dense than dry air.

8.3.3.3 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 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.

8.3.3.4 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.

8.3.3.5 However, LSA or experimental aircraft do not always have performance charts that allow for the determination of performance when operating in other than ISA conditions. Although some POHs suggest corrections are to be made, the pilot is often left with limited 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.

8.3.3.6 Density altitude (DA) can be determined by applying an ambient temperature correction to the pressure altitude. Each 1°C variation from ISA (15°C at sea level) is equivalent to a 120 ft variation in DA. Thus, for the aerodrome in the example above with 1,000 ft elevation and 1,300 ft PA, ISA equals approximately 12°C (as the ISA change of temperature with altitude is 2°C per 1,000 feet). If the aerodrome has an outside air temperature (OAT) of 30°C, this is 18°C hotter than ISA. Therefore, 120 x 18 = 2,160 ft, plus PA 1,300 ft, equals a DA of 3,460 ft. So, the performance of the aircraft will be significantly degraded. It will perform as if the aircraft was at 3,460 ft and not at 1,000 ft aerodrome level.

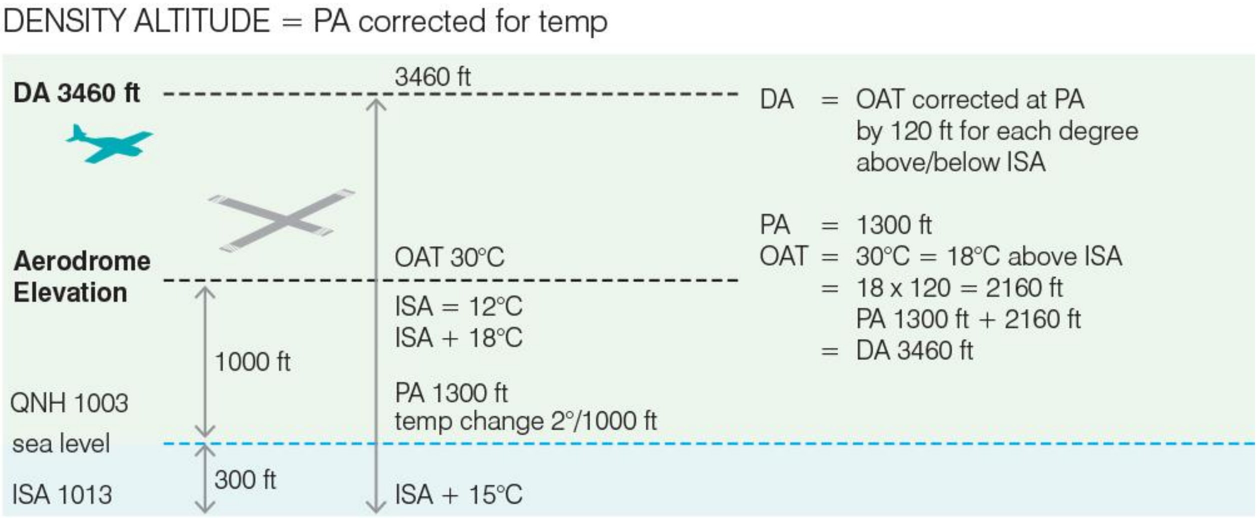

Figure 3: Density altitude calculation

8.3.4 Humidity

8.3.4.1 The performance data for aeroplanes with MTOW not exceeding 5 700 kg does not usually include a humidity correction. Nevertheless, pilots should be aware that as well as a reduction in aerodynamic performance, engine performance will also be adversely affected by increases in humidity. This is due to water vapour displacing oxygen, which reduces the temperature rise during combustion. Irrespective of the availability of performance documentation that addresses humidity, the pilot should consider its effects prior to take-off.

8.3.5 Light conditions

8.3.5.1 Pilots should not underestimate the difficulties associated with taking off or landing directly into a low sun and should take into account haze, smoke or low light when manoeuvring in the vicinity of an aerodrome or looking for other traffic.

Note: If a take-off or landing into sun is known to be likely, it is recommended that the pilot consider the condition of the windscreen prior to commencing the flight, as the impact of any reduction in visibility is significantly increased under these conditions.

8.4 Weight altitude temperature (WAT) limitations

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

8.4.2 For aeroplanes with MTOW not exceeding 5 700 kg, the take-off distance in the AFM has been determined from the commencement of the take-off run, through to lift off and to a height of 50 ft. For landing, it is taken from 50 ft at a speed of 1.3V_{so} through to touchdown and stopping with maximum braking applied. For certain LSA, experimental or other aircraft, the POH may only quote the take-off or landing roll, which is significantly shorter than the true distance required to take off and land from 50 ft with certainty and safety.

8.4.3 To ensure that climb performance does not fall below prescribed certification minima, 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.

8.5 Obstacles on, and in the vicinity of, an aerodrome

8.5.1 Pilots should be aware that uncertified aerodromes may declare an available runway length that begins and ends directly at an obstacle. Common examples might be small trees at the beginning or the end of the runway surface.

8.5.2 Obstruction-free areas on a runway extended centreline provide for low angles of take-off and safe clearance on approach. A significant clear area at the end of a runway may have an important psychological effect on the way a pilot handles an aeroplane during take-off and landing.

8.5.3 During take-off, close-in obstructions on the runway extended centreline may cause a pilot to lift off early and climb at an excessive angle, which will aggravate any problem of poor view of obstructions through the windscreen at high pitch angles, which in turn may lead to a further increase in pitch.

8.5.4 During landing, high ground or obstructions in the approach area can cause a pilot to adopt a higher than normal approach path to avoid the obstacle, but still achieve a touchdown early in the available runway length. Conversely, significant obstacles below the runway such as sea walls, creeks, or ditches may generate optical illusions that cause difficulties for the pilot in assessing whether they are on a normal approach path. This effect is likely to be worse when the aeroplane has poor forward visibility or is approaching in a flapless configuration. In all cases, the likely outcome is a long landing and the subsequent psychological effect of continuing a landing from an unusual situation outside the experience of the pilot.

8.5.5 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.

8.5.6 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 an aeroplane, it may, nevertheless, minimise structural damage or injury if an aeroplane undershoots or overruns the runway.

8.5.7 For low-powered twin-engine aeroplanes, 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. If the runway being used for take-off does not have such an area, pilots should consider the use of an alternative runway.

8.6 Forced landing in the event of engine failure after take-off

8.6.1 It is recommended that before conducting a take-off from any aerodrome, pilots of single-engine aeroplanes 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.

8.7 Flap settings

8.7.1 The use of flap during take-off may be optional, or it may be the standard configuration for the aircraft. The latter is most likely to be the case in aeroplanes with wings optimised for higher indicated airspeeds. Pilots should be aware that while flap generally reduces the take-off roll by permitting lift-off at a slower speed, drag is always increased and the rate of climb after take-off is reduced until flap is retracted. Despite the reduced rate of climb, use of flap will allow a slightly slower take-off safety speed, which usually results in a steeper climb angle than in the clean configuration.

8.7.2 Where a take-off flap setting is optional, flap can be used to reduce rolling resistance on a soft or rough runway (and thus the length of the ground roll), but it would normally be retracted at a safe speed after take-off and the aeroplane then allowed to accelerate to the speed for best rate of climb.

8.7.3 It is imperative that pilots are aware of the correct aircraft configuration to use to obtain shortest take-off or landing. Pilots should consult the most reliable source for this information, such as the AFM/POH, and not rely on unverified or untested advice.

8.8 Braking performance

8.8.1 The nominal braking performance of an aeroplane is a design feature of each type. Braking performance is a function of many considerations, such as aeroplane speed and mass, runway surface conditions, availability of anti-skid, the pilot's braking technique, tyre condition and pressure, brake disc condition and residual temperature, and the presence of slush, mud, water and other more subtle factors. In the case of a minimum field landing in an aeroplane which is not equipped with anti-skid, a significant challenge for the pilot is correctly judging the application of maximum brake just short of wheel-skid. Many factors must be considered when assessing the aeroplane's likely performance in a critical situation, while remembering that if the wheels are locked, the ability of the pilot to bring the aircraft to a stop within the available runway distance is significantly compromised.

8.9 Reverse thrust

8.9.1 Most jet aircraft have thrust reversers and modern turbo-prop aeroplanes are equipped with reversible propellers. Reverse thrust can significantly reduce ground roll, but the power available from full reverse thrust is considerably less than forward thrust. Reverse thrust effectiveness varies, but for jet engines it is typically 20% to 50% of forward thrust, with improved performance from turboprop configurations. Aeroplane manufacturers sometimes provide performance manuals which include accelerate-stop and landing distance charts showing the effect of reverse thrust on stopping distance, but many AFMs do not contain charts that include the effect of reverse thrust.

8.9.2 While the availability of reverse thrust does not reduce the length of runway dictated by the AFM for landing, its use reduces brake and tyre wear and can be an important factor in turnaround times that might otherwise be limited by residual brake and tyre heating. Reduced landing roll through the use of reverse thrust can also minimise runway occupation times at busy aerodromes and may be helpful in reducing taxi distances, depending on the aerodrome configuration.

8.9.3 Pilots should be alert to the possibility of slow or asymmetric application of reverse thrust, or engine or propeller malfunction, and therefore should avoid planning to land at any place where its availability is critical to safety. Nevertheless, reverse thrust may be useful in an emergency situation where a pilot has to land on a short or slick runway.

8.9.4 The effects of vortices should also be considered if thrust is reversed during a landing. It is therefore recommended that reverse thrust be reduced and cancelled at a speed well before taxi speed, particularly on an unswept bitumen or natural surface runway.

8.10 Propeller strikes and engine damage

8.10.1 A muddy, irregular or watery surface on an aerodrome or taxiing area can cause a propeller tip strike that may not be noticed by the previous operating pilot. Particularly when considering operations on a natural surface runway, careful inspection of the propeller(s) is imperative prior to flight, and appropriate considerations applied during taxiing, runup and subsequent take-off.

8.10.2 If a tip strike occurs during taxi for take-off, it could easily result in an abandoned take-off and possibly a major accident. Any propeller strike will probably cause some form of blade bending, distortion or delamination, but a serious strike will bend the tips back, distort the angle of the blades, may damage a gear-case or bend the propeller shaft, and will usually give rise to severe and probably dangerous vibration.

8.10.3 If damage is suspected, it must not be ignored. If a pilot has any reason to suspect that a propeller may have been struck or an engine otherwise compromised, they must take appropriate action to maximise the safety outcome by either avoiding becoming airborne or by landing as soon as they are safely able to.

8.11 Foreign object damage, gravel and dust

8.11.1 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 nosewheel, or picked up in a vortex under the engine intake at high power.

8.11.2 Dust will damage both piston and turbine engines, but can be reduced in piston engines by use of filtered air. Pilots should be aware that full power for take-off is predicated on selection of unfiltered ram air, and that carburettor heat is usually unfiltered. Foreign objects, especially gravel, may cause propeller chipping and give rise to propeller cracks after being caught up in the propeller tip vortices of an engine during run-up checks or at high rpm during the early stages of take-off. The possibility of propeller damage by gravel may be a significant operational consideration in a take-off from an unswept bitumen or natural surface runway. This is because, while the potential for damage can be greatly reduced by progressive application of power during the take-off roll (thus reducing vortices), the take-off distance required is usually calculated assuming full power at brakes release and is a significant consideration in these circumstances.

8.12 Performance category

8.12.1 Aeroplane performance categories are an ICAO classification system used in the development of instrument approach procedures. Turning radii for each aeroplane category are based on a manoeuvring speed of 1.3 × Vs in the approach configuration at maximum landing weight. The radii are used to design instrument approach charts for the various categories of aeroplanes.

8.12.2 Pilots should be aware that an aeroplane’s performance category is based on its approach speed, but does not take account of the braking or other stopping qualities of the aircraft, and should not be used to assess the runway requirements of individual aeroplanes.

9 Critical operations

9.1 Obstructions and mechanical turbulence

9.1.1 Obstructions near the runway edge, such as buildings or trees, will create mechanical turbulence in windy conditions near the ground. On some occasions, it can be severe. Aerodromes that are geographically situated in hilly or 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 circumstances, 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.

9.1.2 In turbulent and windy conditions, approach and landing speeds may require a safety margin to be applied. Pilots should remember that the safety margin provided by a higher approach speed will add to the AFM/POH-derived landing distance.

9.1.3 A rule of thumb when landing in turbulent, windy conditions is for the pilot to add half of the gust factor to the target threshold speed or Vref. Therefore, for a mean wind of 15 kts that is gusting to 25 kts, five kts would be added to the target threshold speed or Vref.

9.2 Aerodromes that only allow one-way operations

9.2.1 One-way operations are not often used in Australia, although they are more common in hill-country agricultural operations. If the only available runway faces into a hill, then landings usually take place toward the hill and take-offs are made away from the high ground. A number of operating issues are associated with one-way landing strips; rising ground may preclude a go-around beyond some point short of the target threshold, and the wind direction will not always suit operations into-wind.

9.2.2 The use of one-way strips should only be attempted by formally trained pilots who have recent experience landing in minimum distance, or on the runway in question. If a pilot intends to operate from one-way strips, evidence of appropriate training is recommended.

9.2.3 Be aware that many one-way strips have a steep slope, and even experienced pilots may have difficulty with approach perspective on final. A normal approach angle is likely to appear too steep, causing the pilot to descend to establish an abnormally shallow approach angle with a high approach speed. If the landing area backs onto high ground, the pilot may find they are committed to a landing above target threshold speed and either:

- attempt a go-around and fail to outclimb the gradient

or

- have to proceed with a high-speed landing that results in over-running the (usually short) landing strip.

9.2.4 Another major issue for one-way operations is the possibility of adverse winds. Tail winds on a minimum length strip may cause an over-run, and turbulent winds in hilly areas can cause severe handling problems even if they are generally in the optimum direction.

10 Take-off and approach and landing technique

10.1 General

10.1.1 Take-offs and landings on short runways require practised pilot technique.

10.1.2 Take-offs and landings in aeroplanes with MTOW not exceeding 5 700 kg from aerodromes that have long runways are not operated close to their limitations. The take-off or landing performance as prescribed in the AFM/POH is rarely achieved because the aircraft is not flown to the specified criteria. When taking off in these circumstances, the result of the pilot applying full power slowly, accelerating slowly, or using more distance when lining up because the aeroplane has plenty of runway ahead, is unlikely to reduce safety markedly. In addition, obstacles may not pose a problem after take-off. Likewise, when landing, if the approach is flown faster that prescribed, the additional float during the hold off may not an issue because there is plenty of runway available after touchdown on which to safely stop.

10.1.3 A take-off or landing in an aeroplane with MTOW not exceeding 5 700 kg that achieves the minimum distance prescribed in the AFM/ POH is often referred to as a ‘short field’ take-off or landing. However, this expression is a misnomer as the performance charts indicate if the runway is suitable for the intended operation.

10.1.4 If a runway is only just suitable (long enough), then the technique adopted is often described as a short field take-off or landing. This is where the speeds prescribed, such as Vx after take-off or Vref at 50 ft for landing, allow the aircraft to take off or land in the distance determined from the AFM/POH.

10.1.5 A pilot must demonstrate competency in this technique for the issue of a pilot licence. However, following the grant of a pilot licence, the technique is often rarely used or practised because operations are typically conducted from runways far longer than the minimum required.

10.1.6 Most often a demonstration of competency is also at a long runway, and the extra pressure of clearing or avoiding actual obstacles cannot be fully simulated. Therefore, without continued practice, it can become more challenging to operate an aeroplane within the minimum distances and performance criteria provided in the AFM/POH. When determining the minimum take-off or landing distance from the AFM/POH, pilots should review the safety factors and considerations described in this AC.

10.2 Take-off

10.2.1 To take off within the minimum distance determined from the AFM/POH, including avoiding or clearing an obstacle after take-off, requires consideration of all relevant circumstances and prevailing conditions. After lift-off, accelerate and climb at best angle of climb (Vx) until clear of the obstacle, then lower the attitude and climb at the best rate of climb (Vy) or at the speed recommended in the AFM/POH.

10.2.2 The decision criteria to discontinue a take-off should be well known before flight, and this decision made early if the aeroplane is not accelerating or performing as expected during take-off. Note that any variation of technique will increase the take-off distance, and hence the need for appropriate safety factors to be considered.

10.2.3 General considerations for take-off:

- apply flap only if recommended in the AFM/POH
- when lining up, use the full length of the runway
- once lined up, apply maximum braking and smoothly apply full or take-off power
- after checking the engine parameters and instruments, release the brakes
- minimise drag by keeping the control surfaces neutral where applicable
- at the predetermined rotation speed, rotate and set attitude to climb at Vx
- maintain Vx until clear of any obstacles
- relax the back pressure and set pitch to climb at Vy, or the climb speed recommended in the AFM/POH.

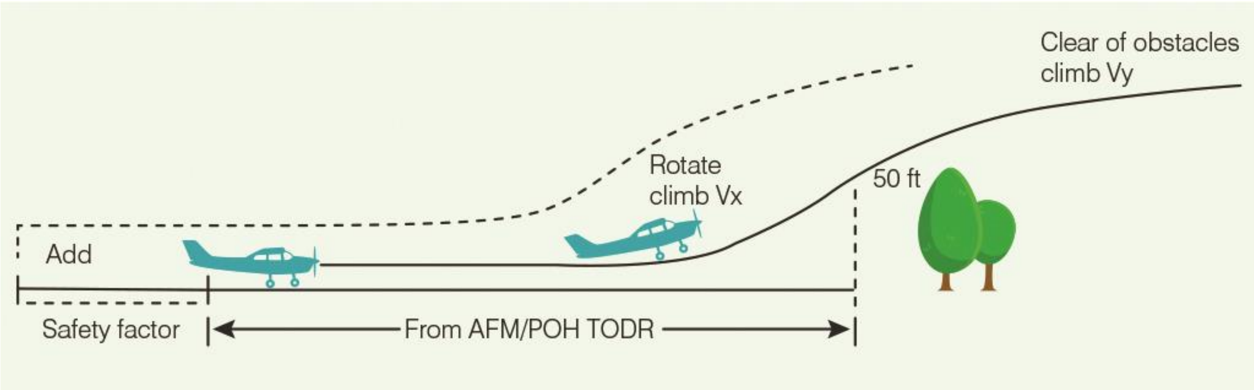

Figure 4: Take-off distance with additional safety factor

10.3 Landing

10.3.1 To land within the minimum distance determined from the AFM/POH, including avoiding or clearing obstacles on final approach to the runway, requires due consideration of all the circumstances and prevailing weather conditions as previously discussed in this AC.

10.3.2 The final approach should be stabilised to ensure the aeroplane achieves 1.3 × Vso (Vref) at 50 ft (or the speed recommended in the AFM/POH), from which point the power is reduced to idle while flaring for landing. Any fluctuations above this speed will increase the landing distance. Fluctuations below this speed could result in a heavy landing. If the Vref speed is not achieved by 50 ft, a decision to discontinue the landing should be made early and a safe go-around executed.

10.3.3 General technique for landing:

- configure the aircraft on final as recommended in the AFM/POH with designated flap to stabilise speed and the approach path
- ensure the approach is stablised to achieve Vso x 1.3 (Vref) by 50 ft
- as the aeroplane passes 50 ft, reduce power to idle and flare
- after touchdown, apply braking to stop within the landing distance available.

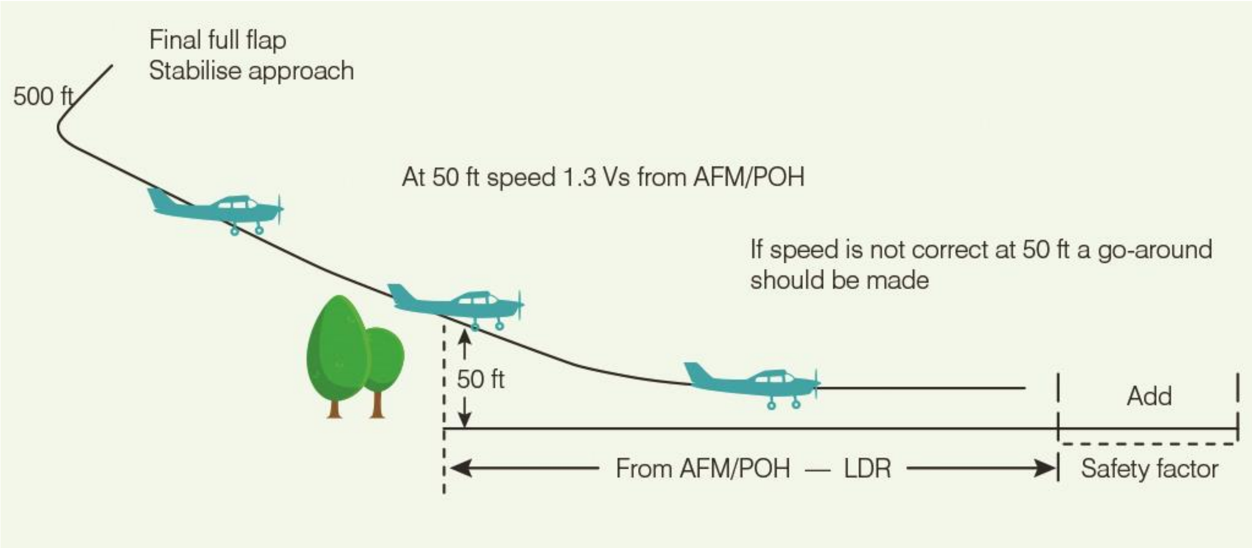

Figure 5: Landing distance with additional safety factor

10.3.4 Pilot training emphasises that a safe landing is the result of a stabilised approach. If pre-determined stabilised approach criteria are exceeded, then a safe landing is not assured. The decision to execute a go-around should be made as early as possible to maximise the safety outcome. At the conclusion of an effective go-around, the pilot will then have an opportunity to consider what options are available to conclude the flight.

10.3.5 After establishing the aircraft in the landing configuration, a stabilised approach is achieved by maintaining a constant glide path towards the aim point on the runway to achieve a pre-determined speed by 50 ft. The aim point will not be the point at which the aeroplane touches down, because some float will occur during the round out or flare. However, achieving the pre-determined speed at 50 ft will eliminate undue float during the landing, and the landing distance determined from the AFM/POH is therefore more likely to be achieved.

11 Precautionary search and inspection procedure

11.1.1 Unforeseen circumstances may make it necessary for a pilot to conduct an unplanned landing at a place that may not be an intended, suitable aerodrome. This could be the result of changed weather conditions, inadequate planning or poor decision making.

11.1.2 With sound pre-flight preparation and planning, this would be a rare event for most pilots. However, if a pilot is faced with an unplanned landing, the decision to conduct a precautionary search and inspection procedure and land safely when there is still adequate time, under full control and before conditions deteriorate, is essential.

11.1.3 The ability to accurately assess the prevailing environmental conditions, potential obstacles, surface conditions, dimensions and ultimate suitability of a landing area, will be enhanced by using a well-practised procedure to maximise the likelihood 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 remaining 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 the precautionary search and inspection procedure, and pilot skill in this regard is directly related to recency in conducting such a procedure.