Australian Government
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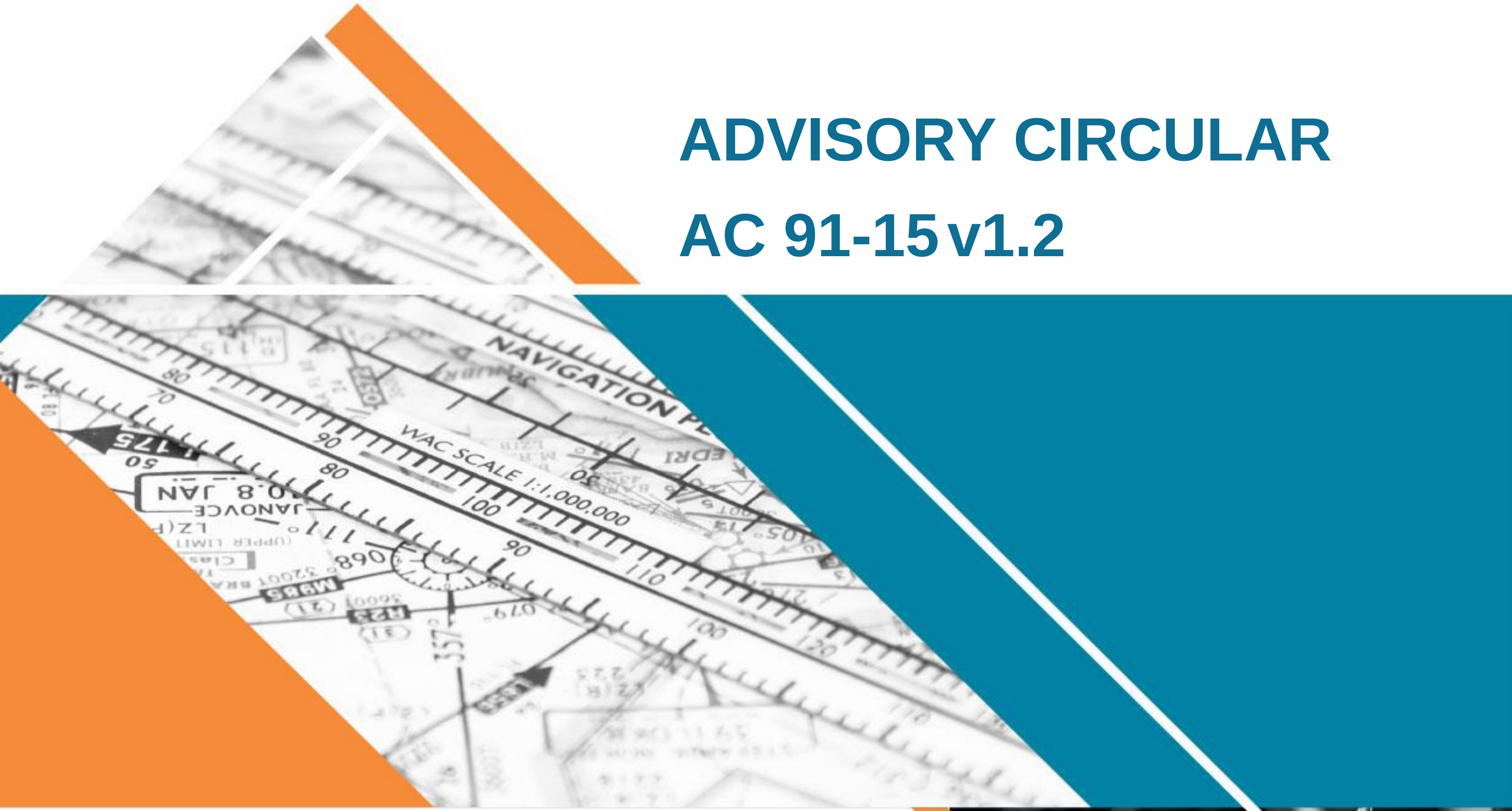

Guidelines for aircraft fuel requirements

Date October 2024

File ref D24/417879

Audience

The audience of this advisory circular (AC) is pilots and operators of aircraft conducting Part 91 operations. It will also be of interest to all pilots and operators of Australian registered aircraft.

Purpose

The purpose of this AC is to provide information on fuel requirements for operations that are required to comply with the Part 91 fuel rules.

Operators and pilots conducting operations under a certificate granted by CASA, such as holders of an Air Operator's Certificate (AOC), aerial work certificate (AWC) or Part 141 certificate, who are required to have an exposition or operations manual that specifies their fuel policies, should read Annex D to AC 1-02 Guide to the development of expositions and operations manuals.

For further information

For further information on this AC, contact CASA's Operations Standards (telephone 131 757).

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

Status

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

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

Version	Date	Details
v1.2	October 2024	Editorial updates and added cross-references to the dedicated operator certificate holder exposition / operations manual fuel policy guidance contained in AC 1-02 Annex D.
v1.1	August 2021	Note added to Table 2 to clarify terminology changes to be made to the Part 91 MOS before 2 December 2021.
v1.0	May 2021	This AC replaces CAAP 234-1(2.1) to provide guidance on aircraft fuel requirements that aligns with the applicable provisions of Part 91 of CASR.

Contents

The following Annexes are published as separate documents to this AC

1 Reference material

1.1 Acronyms

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

Acronym	Description
AC	advisory circular
AFM	aircraft flight manual
ATC	air traffic control
ATS	air traffic services
CASA	Civil Aviation Safety Authority
CASR	*Civil Aviation Safety Regulations 1998*
CP	critical point
ERA	en-route alternate aerodrome
FCM	fuel consumption monitoring
FQIS	fuel quantity indicating systems
ICAO	International Civil Aviation Organization
ISA	international standard atmosphere
IFR	instrument flight rules
MEL	minimum equipment list
MMEL	master minimum equipment list
MOS	Manual of Standards
MTOW	maximum take-off weight
OEI	one-engine inoperative
PIC	pilot in command
VFR	visual flight rules

1.2 Definitions

Terms that have specific meaning within this AC are defined in the table below. Where definitions from the civil aviation legislation 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 civil aviation legislation, the definition in the legislation prevails.

Term	Definition
additional fuel	**Note:** This definition is sourced from the Part 91 MOS. Definitions of this same term are also found in the Part 121, 133 and 135 MOS's. the supplementary amount of fuel required to allow an aircraft that suffers engine failure, or loss of pressurisation at the most critical point along the route, whichever results in the greater subsequent fuel consumption, to: a. proceed to an alternate aerodrome (or, for a rotorcraft, a suitable rotorcraft landing site), and **Note:** For a rotorcraft, an alternate rotorcraft landing site would constitute the alternate aerodrome. b. fly for 15 minutes at the holding speed for the aircraft at 1,500 ft above the aerodrome elevation in ISA conditions, and c. make an approach and landing. **Note:** Fuel planning in accordance with Chapter 19 may place an aircraft in a fuel emergency situation if a failure or loss were to occur as described above. In that case, additional fuel must be carried.
Air Traffic Services	a. in relation to an air traffic service provided in Australian-administered airspace—means: i an ATS provider; or ii the Defence Force in its capacity as a provider of air traffic services; and b. in relation to an air traffic service provided in airspace that is not Australian-administered airspace—an air traffic service provider authorised by the national aviation authority of the relevant foreign country to provide the air traffic service.
alternate aerodrome	has the same meaning as in Annex 2 to the Chicago Convention. From ICAO Annex 2, Rules of the air, to the Chicago Convention: Alternate aerodrome. An aerodrome to which an aircraft may proceed when it becomes either impossible or inadvisable to proceed to or to land at the aerodrome of intended landing where the necessary services and facilities are available, where aircraft performance requirements can be met and which is operational at the expected time of use. Alternate aerodromes include the following: Take-off alternate. An alternate aerodrome at which an aircraft would be able to land should this become necessary shortly after take-off and it is not possible to use the aerodrome of departure. En-route alternate. An alternate aerodrome at which an aircraft would be able to land in the event that a diversion becomes necessary while en route. Destination alternate. An alternate aerodrome at which an aircraft would be able to land should it become either impossible or inadvisable to land at the

Term	Definition
	aerodrome of intended landing. **Note:** The aerodrome from which a flight departs may also be an en route or a destination alternate aerodrome for that flight.
contingency fuel	**Note:** This definition is sourced from the Part 91 MOS. Definitions of this same term are also found in the Part 121, 133 and 135 MOS's. for an aircraft in a kind of flight mentioned in an item of Table 19.02 (2), means the amount of fuel required to compensate for unforeseen factors, and which must not be less than: a. the percentage (if any) of the planned trip fuel for the flight, as specified in column 4 of the same item; or b. in the event of in-flight replanning — the percentage (if any) of the trip fuel for the replanned flight, as specified in column 4 of the same item.
critical point	The point at which an aircraft is the same flying time from two potential en-route diversions. Also known as an equi-time point.
destination alternate aerodrome	means an alternate aerodrome that is a destination alternate (within the meaning of ICAO Annex 2). **Note:** Refer to definition of alternate aerodrome.
destination alternate fuel	**Note:** This definition is sourced from the Part 91 MOS. Definitions of this same term are also found in the Part 121, 133 and 135 MOS's. the amount of fuel required to enable an aircraft 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.
discretionary fuel	an extra amount of fuel to be carried at the discretion of the PIC.
emergency fuel situation	Refer to subsection 6.5.
en route alternate aerodrome	an alternate aerodrome that is an en route alternate (within the meaning of ICAO Annex 2). **Note:** Refer to definition of alternate aerodrome.
final reserve fuel	**Note:** This definition is sourced from the Part 91 MOS. Definitions of this same term are also found in the Part 121, 133 and 135 MOS's. means the calculated amount of fuel that: a. is required to fly an aircraft: i at 1 500 ft above aerodrome elevation in ISA conditions for the period of time specified for the flight in column 3 of Table 19.02 (2); and ii for an aircraft that is a rotorcraft conducting IFR flight or VFR flight by night, or an aeroplane, or an airship — at holding speed; and iii for an aircraft that is a rotorcraft conducting a VFR flight by day — at range speed; and iv at the aircraft's estimated weight on arrival at the destination alternate aerodrome or the planned destination aerodrome when

Term	Definition
	no destination alternate aerodrome is required (the relevant aerodrome) to the relevant aerodrome; and b. is usable fuel remaining in the fuel tanks on completion of the final landing at the relevant aerodrome.
holding fuel	**Note:** This definition is sourced from the Part 91 MOS. Definitions of this same term are also found in the Part 121, 133 and 135 MOS's. the amount of fuel an aircraft requires to fly for the period of time anticipated for holding (taking into account the operating conditions) calculated at the holding fuel consumption rate established for the aircraft for the anticipated meteorological conditions, or ISA. Note: See also the definition of established.
margin fuel	the amount of usable fuel in excess of the fuel required.
master minimum equipment list (MMEL)	for a type of aircraft, means the document: a. that includes a list of items in the aircraft that may (subject to any conditions or limitations specified in the document) be inoperative for a flight of the aircraft; and b. prepared by the holder of the type certificate for the aircraft; and c. approved by the national aviation authority that issued the type certificate for the aircraft.
planned destination aerodrome	means the aerodrome which a flight is planned to fly to and land at.
point of in-flight replanning	**Note:** This definition is sourced from the Part 91 MOS. Definitions of this same term are also found in the Part 121, 133 and 135 MOS's. means a point en route during a flight of an aircraft, determined by the operator or pilot in command for the flight before the flight commences, at which an aircraft 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 19.04 (2) — continue to that aerodrome; or b. otherwise — divert to an en route alternate aerodrome while maintaining the fuel required by subsection 19.04 (3).
point of no return	The last possible geographic point at which an aircraft can proceed to an available en route alternate aerodrome for a given flight. It is the point beyond which diversion to the en route alternate aerodrome is no longer possible and the PIC is committed to proceeding to the destination aerodrome.
remote island	Christmas Island, the Cocos (Keeling) Islands, Lord Howe Island or Norfolk Island.
take-off alternate aerodrome	an alternate aerodrome that is a take-off alternate (within the meaning of Annex 2 to the Chicago Convention). **Note:** Refer to definition of alternate aerodrome.
taxi fuel	**Note:** This definition is sourced from the Part 91 MOS. Definitions of this same term are also found in the Part 121, 133 and 135 MOS's. means the amount of fuel expected to be used by an aircraft before take-off, taking into account: a. local conditions at the departure aerodrome, including taxi time and traffic congestion; and

Term	Definition
	b. APU consumption (if applicable). Note: For rotorcraft operations requiring a take-off prior to taxi, such as hover taxi from a confined helipad, taxi fuel is expected to be consumed prior to the commencement of the departure.
trip fuel	**Note:** This definition is sourced from the Part 91 MOS. Definitions of this same term are also found in the Part 121, 133 and 135 MOS's. means the amount of fuel required to enable an aircraft to fly from any point along a route until landing at a destination aerodrome including (as applicable) the following: a. fuel for take-off and climb from departure aerodrome elevation 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 at the planned destination aerodrome.
unforeseen factors	**Note:** This definition is sourced from the Part 91 MOS. Definitions of this same term are also found in the Part 121, 133 and 135 MOS's. means factors that could have an influence on an aircraft's fuel consumption to the planned destination aerodrome, including the following: a. the aircraft's deviation from the expected fuel consumption data for an aircraft of the same type; b. extended delays and deviations from planned routings or cruising levels.
unusable fuel	The amount of fuel which is on board the aircraft but is unable to be used due to fuel tank design/construction. **Note:** Unusable fuel is included in the basic weight and maximum zero fuel weight as apply.
usable fuel	The amount of fuel which is available in the fuel tanks for supply to the engine(s).

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

International Civil Aviation Organization documents

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

Many ICAO documents are also available for reading, but not purchase or downloading, from the ICAO eLibrary (https://elibrary.icao.int/home).

Document	Title
ICAO Document 9976	Flight Planning and Fuel Management (FPFM) Manual (1st edition 2016)
ICAO Doc 4444 PANS-ATM	Air Traffic Management (16th edition No. 7A 2016)

Advisory material

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

Document	Title
AC 1-02 Annex D	Exposition and operations manual fuel policy guidance
Part 91 AMC/GM	Acceptable means of compliance and guidance material – General operating and flight rules

Aircraft flight manuals

Document	Title
B200/B200C POH/AFM	Hawker Beechcraft Super King Air B200/B200C pilot's operating handbook and FAA approved airplane flight manual
C210 POH	Cessna Centurion 1978 Model 210M pilot's operating handbook

1.4 Data

Document	Title
	Cessna 210M fuel usage data used with permission of Textron Innovations Inc.
	Beechcraft B200/B200C fuel usage data used with permission of Textron Innovations Inc.

2 Introduction

2.1 Aircraft fuel management

2.1.1 The primary goal of effective fuel management is to ensure protection of fuel reserves to allow safe completion of flight. A secondary goal is to improve operational efficiency by reducing unnecessary fuel uplift.

2.1.2 The total amount of usable fuel required to be carried on board an aircraft must not only be sufficient for the planned flight it must also include a safe margin for deviations from the planned operation.

2.1.3 Operators and pilots conducting operations under a certificate granted by CASA, such as holders of an Air Operator's Certificate (AOC), aerial work certificate (AWC) or a Part 141 certificate, who are required to have an exposition or operations manual that specifies their fuel policies, should read Annex D to AC 1-02 Guide to the development of expositions and operations manuals.

2.2 Basic principles

2.2.1 Part 91 of CASR requires fuel to be planned, uplifted, and managed to ensure that an aircraft is landed with not less than the required final reserve fuel on board. The basic principles of aircraft fuel management are divided into four broad topics that address fuel-related considerations and procedures:

- matters that must be considered when determining whether an aircraft has sufficient fuel to complete a flight safely (section 3)
- the amounts of fuel that must be carried on board an aircraft for a flight (section 4)
- procedures for determining and monitoring amounts of fuel during a flight (section 5)
- procedures to be followed if fuel reaches specified amounts (section 6).

2.3 Differences between CAR 1988 and Part 91 of CASR

2.3.1 One of the policies guiding the development of Part 91 of CASR was, where suitable, closer alignment with international standards.

2.3.2 In the context of fuel management, these policies have resulted in only minor changes which are all concerned with definitions. The legacy terms and the replacement new terms as a result of the development of Part 91 of CASR is shown at Table 1.

Table 1: Comparison between legacy terms and terms used in Part 91 of CASR

Legacy term	Part 91 term
Alternate fuel	Destination alternate fuel
Decision point	Point of in-flight replanning
Destination aerodrome	Planned destination aerodrome

Legacy term	Part 91 term
Destination alternate	Destination alternate aerodrome
En-route alternate	En-route alternate aerodrome
Fixed fuel reserve	Final reserve fuel
Variable fuel reserve	Contingency fuel

3 Matters that must be considered when determining whether an aircraft has sufficient fuel to safely complete a flight

3.1 General

3.1.1 To mitigate some of the risks posed by the variability of the aviation environment, a range of fuel-related matters must be addressed[1]. The amount of fuel required to ensure the safe completion of a flight must be determined before the flight commences. During a flight, the amount of fuel on board must be monitored.

3.2 Aircraft-specific fuel consumption data

3.2.1 Effective fuel planning and fuel management rely on the accuracy of the predicted fuel consumption rate. The accuracy of the fuel consumption data used for planning and decision-making varies according to the source of the data.

3.2.2 The most recent aircraft-specific fuel consumption data derived from a fuel consumption monitoring (FCM) system or the aircraft manufacturer's fuel consumption data must be used[2]. Where the aircraft flight manual or pilot's operating handbook does not contain such data, the engine manufacturer's fuel consumption data should be used.

Note: This may be the case for certain piston engine rotorcraft.

3.2.3 Where no specific fuel consumption data exists for the precise conditions of the flight, the aircraft may be operated in accordance with known or estimated fuel consumption data. There are aircraft for which no aircraft or engine manufacturer provided fuel consumption data exists. The use of fuel consumption data taken from the recent historical consumption records satisfies, in the simplest form, the requirement for fuel consumption data to be derived from a fuel consumption monitoring system.

3.2.4 Regardless of the way in which it is presented (which might be by electronic means), it is the responsibility of the PIC to ensure the data was originally obtained from one of the sources mentioned in paragraph 3.2.2 of this AC.

3.3 Operating conditions for the planned flight

3.3.1 The following operating conditions have the potential to affect the predicted fuel consumption for a planned flight:

- weight of the aircraft (actual or anticipated)
- Notices to Airmen
- weather reports and forecasts (i.e. temperature, wind, turbulence, icing, smoke)
- ATC procedures, restrictions, and anticipated delays
- effects of deferred maintenance items and/or configuration deviations (e.g. configuration deviation list or supplementary type certificate).

[1] Chapter 19 of the Part 91 MOS.
[2] Section 19.03 of the Part 91 MOS.

Note: Any fuel consumption performance penalties associated with unserviceable items, usually permitted in accordance with the MEL or MMEL, should be applied to the planned flight.

3.4 Potential deviations from planned flight path

3.4.1 The pre-flight planning stage should produce an efficient flight plan that provides minimum sector time and associated minimum fuel consumption on the best possible route that avoids adverse weather conditions and meets all air traffic management requirements.

3.4.2 Pilots and operators must consider the adverse effects on fuel consumption of potential or likely deviations from the optimum planned path or flight conditions. To this end, flight planning must be based on realistic assumptions and assessments. When potential or likely deviations from planned fuel consumption are not well considered, there is an increased likelihood that the actual fuel consumption may exceed planned consumption, with possible erosion of safety margins.

4 Amount of fuel that must be carried on board an aircraft for a flight

4.1 General

4.1.1 The amount of fuel that must be on board an aircraft varies according to the stage of flight at which it is confirmed or checked. In this context, the stages are:

- at the commencement of the flight
- during the flight at the following times:
  - at the time of a fuel quantity check
  - at a point of in-flight replanning.

4.2 Usable fuel required at the commencement of a flight

4.2.1 The pre-flight planning process includes a calculation of the amount of usable fuel that must be on board an aircraft when the flight commences. The amount of usable fuel required to be on board at the commencement of a flight includes the following[3]:

- taxi fuel
- trip fuel
- destination alternate fuel (if required)
- holding fuel (if required)
- contingency fuel (if applicable)
- final reserve fuel
- additional fuel (if applicable).

4.2.2 Explanations of each of these fuel amounts can be found in the Reference material section of this AC.

4.2.3 The commencement of a flight, for the purposes of fuel requirements, is when the aircraft first moves under its own power for the purpose of take-off. There may, however, be rotorcraft operations that, for the purposes of departing the aerodrome, require an airborne segment of the taxi before take-off.

4.3 Usable fuel required during a flight

4.3.1 If the PIC or operator has determined a point of in-flight replanning before a flight, the fuel that must be on board from that point includes the following[4]:

- trip fuel from that point
- destination alternate fuel (if required)
- holding fuel (if required)
- contingency fuel (if applicable)
- final reserve fuel

[3] Subsection 19.04(1) of the Part 91 MOS.
[4] Subsection 19.04(2) of the Part 91 MOS.

- additional fuel (if applicable).

4.3.2 Regardless of whether a point of in-flight replanning has been determined, throughout a flight the PIC must regularly check the amount of fuel on board the aircraft. At any time, the amount of fuel that must be on board includes the following[5]:

- trip fuel from that time
- destination alternate fuel (if required)
- holding fuel (if required)
- final reserve fuel
- additional fuel (if applicable).

4.3.3 If the fuel on board the aircraft is below the amount required by paragraph 4.3.2, the procedure mentioned in section 6 of this AC must be conducted.

Note: The principle difference between the generic fuel requirements to continue a flight (paragraph 4.3.2) and the fuel required from a point of in-flight replanning (paragraph 4.3.1) is the requirement for a contingency fuel.

4.3.4 If, during pre-flight planning, the PIC decides to use fuel for a purpose other than was intended, they must conduct a re-analysis and, if applicable, adjust the planned flight to ensure continued compliance with the minimum usable fuel requirements[6]. This will ensure that fuel that was intended or required for the continuation of the flight is not consumed during a prior flight phase without the PIC giving appropriate consideration to the consequences.

4.3.5 Consumption of taxi fuel in excess of that planned may reduce the amount of remaining available fuel to less than the amount required to safely conduct the flight. In such a case, the flight may not proceed without replanning. Similarly, the use of trip fuel in excess of that planned may reduce the amount of available destination alternate fuel to less than the required amount, necessitating replanning or diversion.

4.3.6 When planned fuel is not consumed in a prior phase, the surplus fuel may be used in a subsequent phase. For example, if a flight is planned with the requirement for a destination alternate aerodrome and, during the course of the flight, that operational requirement is removed, the planned destination alternate fuel may be used for other purposes. However, the final reserve fuel must be preserved in all cases.

4.3.7 Circumstances may arise during a flight where the suitability of the destination aerodrome, a destination alternate aerodrome, or an en route alternate aerodrome may change. As an example if, during a flight, the PIC becomes aware of a change to conditions that imposes a fuel requirement, such as the requirement to nominate an alternate aerodrome or notice of holding requirements, the PIC must comply with the requirements described in paragraph 4.3.2 of this AC. For the avoidance of doubt, the point at which the PIC becomes aware of changes in conditions is not considered a point of in-flight replanning.

Note: In some circumstances, the PIC may be required to divert to an alternative suitable aerodrome when a requirement is imposed that was not in place prior to the commencement of the flight, placing the aircraft in a situation where fuel requirements brought about by the change in circumstances cannot be met. If

[5] Subsection 19.04(3) of the Part 91 MOS.
[6] Subsection 19.04(4) of the Part 91 MOS.

this situation occurs when the aircraft is beyond the last point of safe diversion, the PIC's options will have been reduced to continuing to the planned destination with less than the required fuel.

4.4 Contingency fuel and final reserve fuel

4.4.1 For Part 91 operations, the contingency fuel and final reserve fuel are prescribed in the Part 91 MOS and are described below.

4.4.2 Because of the varying nature of the operations, the amounts of fuel mentioned below do not apply to air transport operations. Air transport operators must comply with the requirements of Parts 121, 133 or 135 of CASR, as applicable.

4.4.3 Contingency fuel, for an aircraft in a kind of flight mentioned in an item of Table 2, means the amount of fuel required to compensate for unforeseen factors, and which must not be less than:

- the percentage (if any) of the planned trip fuel for the flight, as specified in column 4 of the same item

  or
- in the event of in-flight replanning — the percentage (if any) of the trip fuel for the replanned flight, as specified in column 4 of the same item.

4.4.4 Final reserve fuel means the calculated amount of fuel that:

- is required to fly an aircraft:
  - at 1 500 ft above aerodrome elevation in ISA conditions for the period of time specified for the flight in column 3 of Table 2
  - for an aircraft that is a rotorcraft conducting IFR flight or VFR flight by night, or an aeroplane, or an airship — at holding speed
  - for an aircraft that is a rotorcraft conducting a VFR flight by day — at range speed
  - at the aircraft's estimated weight on arrival at the destination alternate aerodrome or the planned destination aerodrome when no destination alternate aerodrome is required (the relevant aerodrome) to the relevant aerodrome.
- is usable fuel remaining in the fuel tanks on completion of the final landing at the relevant aerodrome.

Table 2: Final reserve fuel and contingency fuel requirements

	Aircraft (by aircraft category)*	Kind of flight (by flight rules)	Final reserve fuel flight time	Contingency fuel amount
Item	Column 1	Column 2	Column 3	Column 4
1	Aeroplane with an MTOW of not more than 5 700 kg (piston engine or turboprop)	Day VFR	30 minutes	N/A
2		Night VFR	45 minutes	N/A
3		IFR	45 minutes	N/A
4	Turbojet aeroplane or aeroplane with an	IFR or VFR	30 minutes	5% of trip fuel

	Aircraft (by aircraft category)*	Kind of flight (by flight rules)	Final reserve fuel flight time	Contingency fuel amount
	MTOW of more than 5 700 kg (turboprop)			
5	Aeroplane with an MTOW of more than 5 700 kg (piston engine)	IFR or VFR	45 minutes	5% of trip fuel
6	Rotorcraft	VFR	20 minutes	N/A
7	Rotorcraft	Night VFR	30 minutes	N/A
8	Rotorcraft	IFR	30 minutes	N/A

***** The defined terms '*small aeroplane*' and '*large aeroplane*' appeared in the initial versions of the Part 91 MOS and the Plain English Guide and have historically referred to aeroplanes below and above the 5 700 kg MTOW limit. To avoid potential confusion with the new terms, '*smaller aeroplane*' (Part 135) and '*larger aeroplane*' (Part 121), all references to the terms '*small aeroplane*' and '*large aeroplane*' are to be replaced with explicit MTOW limits.

4.4.5 The calculation and uplift of contingency fuel is a means of mitigating, to some degree, the risks associated with operational factors or hazards that cannot be planned for, anticipated, or controlled.

4.4.6 In many instances, the contingency fuel remains unconsumed throughout flight and is remaining on board upon arrival at the destination. At other times, operational factors may necessitate consumption of contingency fuel throughout the flight, or even before becoming airborne.

4.4.7 Examples of operational factors include:

- the possibility of inaccurate wind forecasting
- unanticipated delays at the departure aerodrome
- inability to maintain a planned level (through stress of weather or some other factors) resulting in increased fuel consumption associated with operating at lower levels.

4.5 Additional fuel

4.5.1 The requirement for additional fuel is intended to protect against the very unlikely event of an engine failure or depressurisation at the most critical point (CP) in the flight and presumes that the majority of the fuel used in basic fuel planning will be available for use in proceeding to an en-route alternate aerodrome. The consideration of engine failure or depressurisation at the most critical point along the route is called the critical fuel scenario.

4.5.2 In addition to the standard fuel amounts, pilots of pressurised or multi-engine aircraft are required to determine how much fuel must be carried to address the critical fuel scenario.

4.5.3 During flight planning, up to three calculations will be required:

- basic fuel planning (assuming all operations normal)

- fuel to address critical fuel scenario assuming engine failure at the most critical point
- fuel to address critical fuel scenario assuming depressurisation at the most critical point.

4.5.4 In calculating the fuel required to address the critical fuel scenario, the following fuel is considered:

- assuming normal operations up to the most critical point:
  - taxi fuel
  - trip fuel from take-off to the CP.
- calculated for depressurised and/or OEI operations (whichever results in the greater subsequent fuel consumption):
  - fuel to proceed from the most critical point to an alternate aerodrome or helicopter landing site
  - fuel to fly for 15 mins at the holding speed for the aircraft at 1 500 ft above the aerodrome elevation in ISA conditions
  - fuel to conduct an approach and landing.

4.5.5 Additional fuel is the difference between the fuel required by basic fuel planning and the fuel required to address whichever critical fuel scenario requires the most fuel. Note that in circumstances where the fuel required by the basic fuel planning exceeds the fuel required in either critical fuel scenario, no additional fuel is required.

4.5.6 Appendix A - Additional fuel calculations shows examples of additional fuel calculations.

4.6 Protected and unprotected fuel amounts

4.6.1 An amount of fuel is considered protected if, for regulatory or operational reasons, it must not to be consumed until a determined point in a flight. A fuel amount can be protected, partially protected or unprotected. Final reserve fuel must always be protected to the final landing.

4.6.2 Contingency fuel might be protected if its presence is used in the calculation of additional fuel. Typically, if additional fuel must be carried, contingency fuel might be protected to the critical point and unprotected from the critical point to the destination aerodrome or alternate aerodrome.

4.6.3 Destination alternate fuel should be protected until either the planned destination aerodrome is reached, or the operational requirement to carry destination alternate fuel no longer applies such as unexpected weather improvements at a planned destination aerodrome.

4.6.4 A partially protected fuel amount means that some but not all of the amount must be protected.

4.6.5 In cases where fuel amounts must be protected, pilots and operators should considerer carrying discretionary fuel to ensure an adequate safety margin above minimum fuel amounts is maintained.

4.7 Sample fuel calculations

4.7.1 Appendix B - Sample fuel calculations shows examples of sample fuel calculations.

5 Determining and monitoring amount of fuel on board

5.1 General

5.1.1 Knowing how much fuel is on board during the flight is essential to safety. The process of determining, recording, and monitoring fuel amounts to ensure fuel reserves are protected is divided into four task phases in order to differentiate the priorities and consequential elements required as a flight commences and then continues:

- pre-flight fuel quantity checks (subsection 5.2)
- in-flight fuel management (subsection 5.3)
- in-flight fuel quantity checks (subsection 5.4)
- post-flight fuel quantity checks (subsection 5.5).

5.2 Pre-flight fuel quantity checks

5.2.1 Before commencing a flight, the PIC must ensure that a pre-flight determination of the amount of useable fuel on board the aircraft is conducted[7]. It is of critical importance that the amount of usable fuel on board an aircraft at the commencement of and during a flight is known with the highest level of certainty. The amount of fuel contained in the tanks at the commencement of the flight is the datum upon which fuel calculations and subsequent fuel-related decisions are based.

5.2.2 Unless assured and verified by the PIC that the aircraft fuel tanks are completely full, or a totally reliable and accurately graduated dipstick, sight gauge, drip gauge or tank tab reading can be made, the PIC should endeavour to use the best available cross-check process before engine start. The cross-check should use at least two different verification methods to determine the amount of fuel on board. The following are examples of recommended verification combinations:

- check of visual readings (e.g. tank tab, dipstick, drip gauge, sight gauges) against fuel consumed indicator readings
- having regard to previous readings, a check of cockpit fuel quantity indications or visual readings against fuel consumed indicator readings
- after refuelling and having regard to any recorded post-flight fuel quantities, a check of cockpit fuel quantity indications or visual readings against the refuelling uplift readings
- when a series of flights is undertaken by the same pilot and refuelling is not carried out at intermediate stops, checking of the cockpit fuel quantity indications against computed fuel on board and/or fuel consumed indicator readings, provided the particular system is known to be reliable.

5.2.3 Where a discrepancy in fuel quantity is apparent between fuel quantity verification methods, another method should be used to attempt to eliminate an erroneous figure. CASA recommends that a conservative approach be taken, using the lower quantity figure as the basis for fuel calculations, and the higher figure for aircraft weight

[7] Subsection 19.05(1) of the Part 91 MOS

calculations. Any persisting disparity between fuel verification methods should be investigated and resolved.

5.2.4 Fuel gauges, particularly on smaller aircraft, may be unreliable. Except when the fuel tank is full, it is difficult to accurately establish the quantity of fuel in a tank unless the aircraft is in the attitude recommended by the manufacturer, and the manufacturer has provided an accurately graduated dipstick, sight gauge, drip gauge or fuel tank tab. Unless the aircraft is in the attitude recommended by the manufacturer, any direct reading of a partially filled tank should be discounted or rounded down to a figure consistent with the next lower tab or marking.

5.2.5 Placing sole reliance on a fuel quantity gauge to assess fuel quantity and not cross-checking fuel quantity information from a second source, exposes the PIC to the risk of being unable to determine actual fuel remaining should the fuel quantity gauge indication become faulty.

5.2.6 Given the designs and location of some aeroplane and rotorcraft fuel tank installations, it is often difficult to obtain a direct reading of fuel tank quantity at a level other than full. To ensure an accurate fuel quantity, it is imperative that flight times and fuel uplifts are recorded and routinely reconciled as part of the fuel quantity cross-checks. The accurate recording of flight times and respective fuel uplifts presents an additional means of tracking actual fuel consumption for subsequent flight planning and in-flight fuel management decision-making. Periodic filling to full allows a baseline from which flight-time based fuel consumption tracking can be verified.

5.2.7 Modern certified fuel quantity indication systems (FQIS) can integrate fuel tank probe volume readings and fuel density measurements, combined with full authority digital engine control engine fuel consumption information to present the flight crew with the weight of the fuel remaining in the fuel tanks. These systems may also contain independent fuel tank low fuel level warning sensors. the manufacturers of these systems still recommend that flight crew conduct regular in-flight checks of the fuel quantity remaining according to the FQIS to confirm anticipations and detect any discrepancies.

5.3 In-flight fuel management

5.3.1 In-flight fuel management can be thought of as the combination of the in-flight fuel quantity checks described in subsection 5.4 of this AC and the procedures contained in section 6.

5.3.2 In-flight fuel management is the practical means of ensuring fuel is either:

- used in the manner intended during pre-flight planning or in-flight replanning, or
- used to enable an alternative course of action to safely complete the flight when conditions or fuel consumption during a flight differs from those expected during planning.

5.3.3 In-flight fuel management does not replace pre-flight planning or in-flight replanning activities; rather, it acts to ensure continual validation of planning assumptions that influence fuel usage and required fuel reserves. Such validation serves as a trigger for re-analysis and adjustment activities that ultimately ensure that each flight is safely completed with the required final reserve fuel on board upon arrival.

5.3.4 The simplified conceptual elements for in-flight fuel management include:

- determining useable fuel remaining
- comparing actual consumption and useable fuel remaining against the planned values
- analysing whether sufficient fuel remains to continue with the planned flight
- where insufficient fuel remains to continue with the planned flight, replanning to an available alternate aerodrome
- if no option exists where a landing can be accomplished at an aerodrome whilst maintain the required fuel reserves, declaration of an emergency fuel situation.

5.3.5 A depiction of the conceptual elements and process flow of in-flight fuel management is provided in Figure 1.

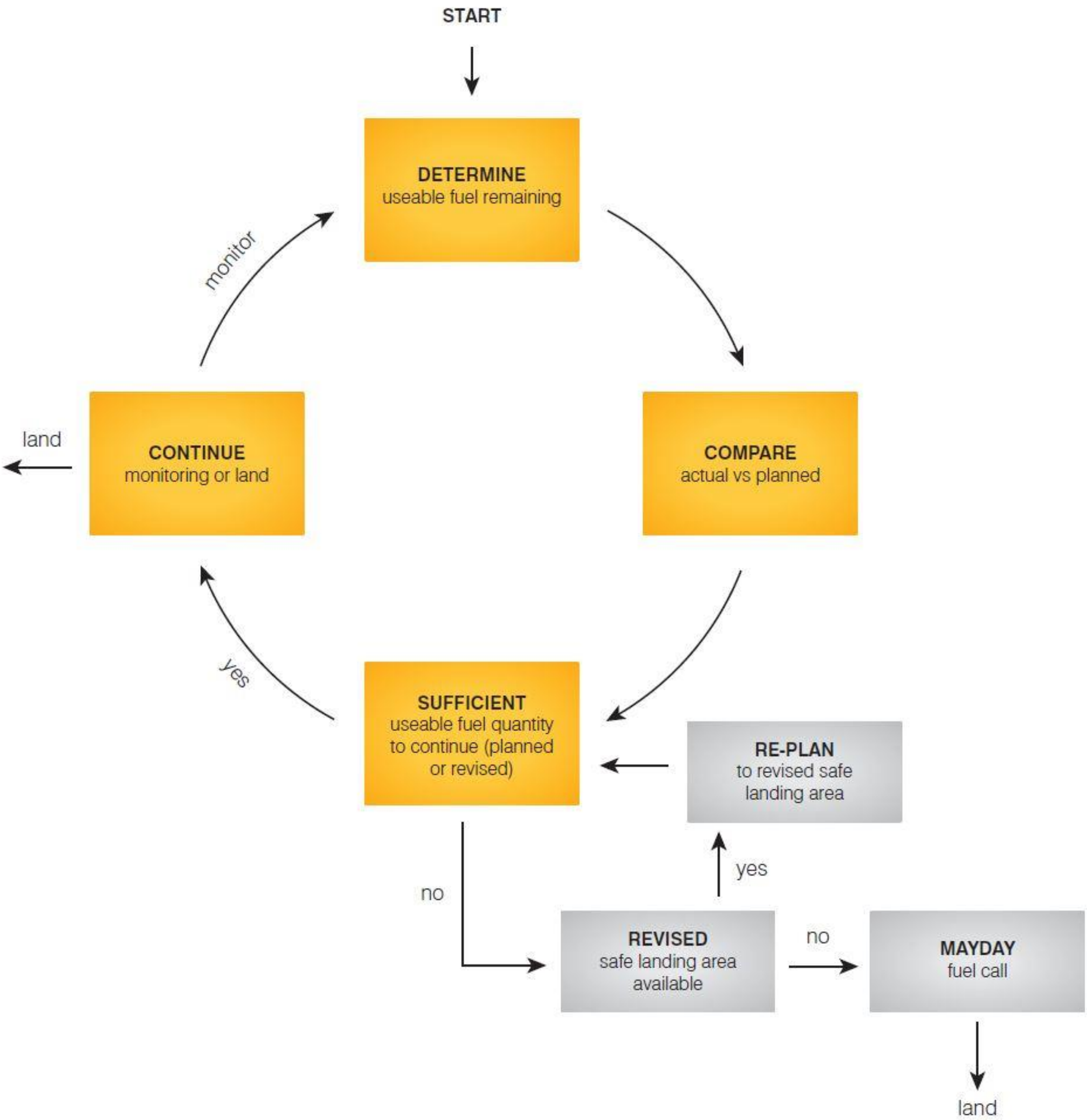

Figure 1: In-flight fuel management process diagram

5.3.6 For flights that are limited to uplifting only a small margin of fuel above minimum requirements, the PIC should ensure a point of in-flight replanning is identified during the pre-flight planning stage. The point of in-flight replanning is the final opportunity to assess options for preserving the required fuel reserves should the destination aerodrome no longer be available.

5.3.7 During flight the point of in-flight replanning should be assessed, based on actual fuel consumption and known or anticipated in-flight conditions, and revised if necessary. This is particularly important when operating to a remote island or other isolated aerodrome.

5.3.8 The PIC should obtain updated destination information (i.e. meteorological conditions, traffic, and other operational conditions at the destination aerodrome) early enough to allow assessment to be completed before reaching a point of in-flight replanning. The assessment will validate the destination planning assumptions or trigger diversion to an alternate aerodrome.

5.4 In-flight fuel quantity checks

5.4.1 As part of in-flight fuel management, the PIC must ensure that fuel quantity checks are carried out at regular intervals[8]. The established quantity of usable fuel remaining is evaluated to:

- compare planned fuel consumption with actual fuel consumption
- determine the amount of usable fuel remaining
- determine whether the usable fuel remaining is sufficient to satisfy:
  - from any point of in-flight replanning — the requirements described in paragraph 4.3.1 of this AC
  - otherwise — the requirements described in paragraph 4.3.2 of this AC.
- determine the amount of usable fuel expected to be remaining when the aircraft lands at the destination aerodrome.

5.4.2 The interval between in-flight fuel quantity checks should be sufficient to allow the PIC to remain aware of the aircraft fuel state. In addition to periodic fuel quantity checks, there are instances where a specific fuel check is necessary to ensure that in-flight decisions are supported by accurate fuel state awareness. For example, specific checks are needed before passing a point of in-flight replanning, point of no return where applicable, or a critical point.

5.4.3 In-flight fuel quantity checks must include a reconciliation of the fuel remaining indicated from available aircraft fuel quantity indication systems, such as debit-meters. Raw data, such as readings from fuel quantity gauges, should also be checked to confirm fuel balance and fuel tank quantity against known fuel usage to minimise the possibility of an undetected fuel leak. The maximum efficiency for fuel quantity checks is achieved when conducted at regular intervals that follow a consistently applied methodology.

5.4.4 The intent of recording the in-flight fuel check results is to allow a time-based reference to previous in-flight fuel checks to be made so that trends can be identified. The recording of the relevant information can be achieved by many methods, including flight plan or fuel log written entry, photographing fuel gauges, or even in some advanced systems using a fuel quantity snapshot capture capability.

5.4.5 There may be instances where conducting an in-flight fuel quantity check and/or recording the results may not be necessary, such as for very short duration flights. The application of good airmanship may necessitate that in certain operational environments, such as poor weather or low-level operations, the full extent of the fuel check or recording the results may be a lower priority than maintaining aircraft flight path control.

[8] Subsection 19.05(2) of the Part 91 MOS.

5.5 Post-flight fuel management

5.5.1 In all instances it is highly recommended that the post-flight fuel quantity be determined and recorded.

5.6 Fuel quantities and associated flight manual procedures

5.6.1 In the event of fuel below specified levels, many aircraft flight manuals contain procedures to be followed. Many aircraft FQIS have gauge or indicator markings that are designed to indicate the 'safe operating ranges' as determined by the aircraft manufacturer. Pilots and operators should be aware that such indications do not necessarily ensure compliance with the usable fuel required during a flight (see subsection 4.3 of this AC).

5.6.2 Additionally, some aircraft have systems that provide to the PIC independent fuel tank low fuel level warnings or cautions. Those indicators may have associated flight manual procedures to be followed by the PIC if the indication occurs.

5.6.3 Pilots are reminded of the legislative requirements to comply with an instruction, procedure, or limitation concerning the operation of the aircraft which is set out in the aircraft's flight manual.

Note: There may be requirements, instructions, procedures, or limitations contained in aircraft flight manuals which establish minimum fuel quantity values that exceed the legislative minimum values. Where these exist, the flight manual value must be complied with.

6 Procedures if fuel reaches specified amounts

6.1 Identification and communication of fuel states

6.1.1 The intent of these procedures is to ensure that an aircraft will arrive at an aerodrome, whether that is its planned destination aerodrome, planned alternate aerodrome or another aerodrome, with the required final reserve fuel on board.

6.1.2 Four procedural steps can be used to identify and communicate situations in which the fuel quantity falls below the threshold level for that step (Table 3). A detailed description of each step follows in subsections 6.2 to 6.5 of this AC.

Table 3: Steps to protect fuel reserves

Steps to identify and communicate fuel states	
Step 1	Monitor the amount of usable fuel remaining on board to check against usable fuel required during a flight.
Step 2	Request delay information when unexpected circumstances may result in landing at the destination aerodrome with less than the required final reserve fuel.
Step 3	Declare 'MINIMUM FUEL' when committed to land at a specific aerodrome and any change in the existing clearance may result in a landing with less than required final reserve fuel.
Step 4	Declare a fuel emergency when the calculated fuel on landing at the nearest suitable aerodrome (i.e. where a safe landing can be made) will be less than the required final reserve fuel.

6.2 Step 1: In-flight fuel check value less than planned value (not less than required)

6.2.1 If an in-flight fuel quantity check indicates that the fuel on board is less than planned, the PIC should endeavour to restore fuel safety margins provided by contingency fuel (as applicable) by:

- flying at a more economical speed than planned
- seeking a more economical cruise level
- seeking more efficient routing from ATC
- re-routing to reduce the length of the critical diversion
- selecting a different (closer) destination alternate (if feasible).

6.3 Step 2: Expected fuel remaining is approaching minimum values

6.3.1 When the PIC recognises that unexpected circumstances have arisen that may result in the aircraft landing at the destination aerodrome with less than the fuel required to proceed to an alternate aerodrome (if required) plus final reserve fuel, they must request delay information from ATS[9].

6.3.2 The request for delay information is not a request for assistance or an indication of urgency. It is simply a procedural means for the PIC to determine an appropriate course of action when confronted with unexpected delays.

6.3.3 There is no specific phraseology recommended for use with ATS in this case, as each situation may be different. The PIC would use the information obtained from ATS to determine the best course of action, up to and including a determination of when it would be necessary to divert to an alternate aerodrome and/or make additional declarations related to the fuel state of the flight.

6.4 Step 3: Minimum fuel state

6.4.1 After a request for delay information, the minimum fuel declaration represents the third step taken by the PIC to ensure remaining fuel on board is used as planned and the final reserve fuel is protected. The PIC must declare ‘MINIMUM FUEL’ when, based on the current ATC clearance at the aerodrome to which the aircraft is committed, any change to the existing clearance to that aerodrome will result in landing with less than the final reserve fuel for the aircraft[10].

6.4.2 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 occur.

6.4.3 A PIC should not expect any form of priority handling because of a ‘MINIMUM FUEL’ declaration. ATS will, however, advise the flight crew member of any additional expected delays, and coordinate when transferring control of the aircraft to ensure other ATS units are aware of the aircraft’s fuel state.

6.5 Step 4: Emergency fuel situation

6.5.1 The aircraft is in an emergency fuel situation when the usable fuel predicted to be remaining upon landing at the nearest suitable aerodrome (i.e. where a safe landing can be made) will be less than the required final reserve fuel.

6.5.2 The PIC must declare an emergency fuel situation by broadcasting ‘MAYDAY MAYDAY FUEL’[11]. This declaration provides the clearest and most urgent expression of an emergency situation brought about by an insufficient quantity of usable fuel remaining to protect the final reserve fuel. It communicates that immediate action must be taken by both the PIC and ATC (if subject to an ATC clearance) to ensure that the aircraft can land as soon as possible.

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[9] Subsection 19.06(2) of the Part 91 MOS.
[10] Subsection 19.05(3) of the Part 91 MOS.
[11] Subsection 19.05(4) of the Part 91 MOS.

6.5.3 The word ‘FUEL’ is used as part of the emergency declaration simply to convey the nature of the emergency to ATC. It is also important to note that an emergency declaration may make courses of action available that were not previously, and it also allows ATC to apply extra flexibility in handling the aircraft.

6.5.4 When operations are not subject to an ATC clearance, the declaration of emergency fuel situation on Area VHF frequency notifies ATS of the emergency situation and helps with situational awareness of other aircraft in the vicinity. In locations where Area VHF communication is limited, aircraft in the vicinity may be able to provide assistance through radio relay to ATS.

7 Operational variations

7.1.1 The purpose of section 19.07 of the Part 91 MOS is to provide a mechanism for certain operators to substitute alternative requirements, instead of the requirements in sections 19.03 and 19.04 of the Part 91 MOS, relating to the calculation of specified types of fuel. Those alternative requirements are called operational variations and, to be effective, must be contained in a certificate holder's operations manual or exposition as applicable.

7.1.2 Those operators are the following:

- Part 141 operators
- Part 142 operators
- aerial application operators
- aerial work operators.

7.1.3 Those operators may propose operational variations for the following fuel amounts[12]:

- taxi fuel
- trip fuel
- contingency fuel, if any
- destination alternate fuel
- additional fuel.

7.1.4 Note that operators are not permitted to propose operational variations relating to holding fuel[13].

7.1.5 While Part 141 and 142 operators are not permitted to propose an operational variation relating to final reserve fuel, aerial application operators and aerial work operators are permitted to do so. Restrictions apply to such a proposal; only flight crew members may be carried for the operation[14].

7.1.6 At least 28 days before using an operational variation, a relevant operator must submit to CASA the following information.[15]

a. evidence that the operational variation will maintain or improve aviation safety[16]in the form of either:
   i. documented in-service experience

or

   ii. the results of a specific safety risk assessment conducted by the operator that shows at least the following:
      A. flight fuel calculations
      B. operator capabilities, including a data-driven method for calculating amounts of fuel including a fuel consumption monitoring program and the

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[12] Subsection 19.07(2) of the Part 91 MOS.
[13] Subsection 19.07(3) of the Part 91 MOS.
[14] Subsection 19.07(4) of the Part 91 MOS.
[15] Subsection 19.07(5) of the Part 91 MOS.
[16] Subsection 19.07(5) and (6) of the Part 91 MOS.

use sophisticated techniques for determining the suitability of alternate aerodromes

C. specific risk mitigating measures.

b. A copy of the operator’s procedures proposed for inclusion in the operations manual or exposition (as applicable), in relation to using the operational variation.

7.1.7 Proposed operational variations do not require specific CASA approval. If, following assessment, CASA finds there is insufficient evidence that the variation maintains aviation safety then it may direct the operator to amend or remove the variation. As applicable, refer to regulations 137.080, 137.085, 137.090, 138.068, 141.100 and 142.155 of CASR.

8 Rotorcraft fuel differences

8.1 General

8.1.1 While the requirements for rotorcraft generally follow the same rules as for aeroplanes, the ability of a rotorcraft to land safely away from aerodromes influences the required fuel reserve quantities.

8.1.2 Flights over hostile terrain or populated areas (i.e. where precautionary landings are not possible or that present a consequential survival problem) may prompt the carriage of increased fuel reserves to mitigate the risks posed by the limited options for a safe precautionary landing.

Appendix A

Additional fuel calculations

A.1 Example 1 – Additional fuel not required

A.1.1 Figure A 1 illustrates a generic scenario where the uplift of additional fuel is not required. The basic fuel planning for the flight results in a greater amount of fuel than that required to address the critical fuel scenario.

A.1.2 This scenario also illustrates an instance where the contingency fuel amount needs to be partially protected. Some of the contingency fuel could be consumed without reducing the basic fuel planning value to less than the amount required to address the critical fuel scenario. That contingency fuel would have to be protected to the critical point.

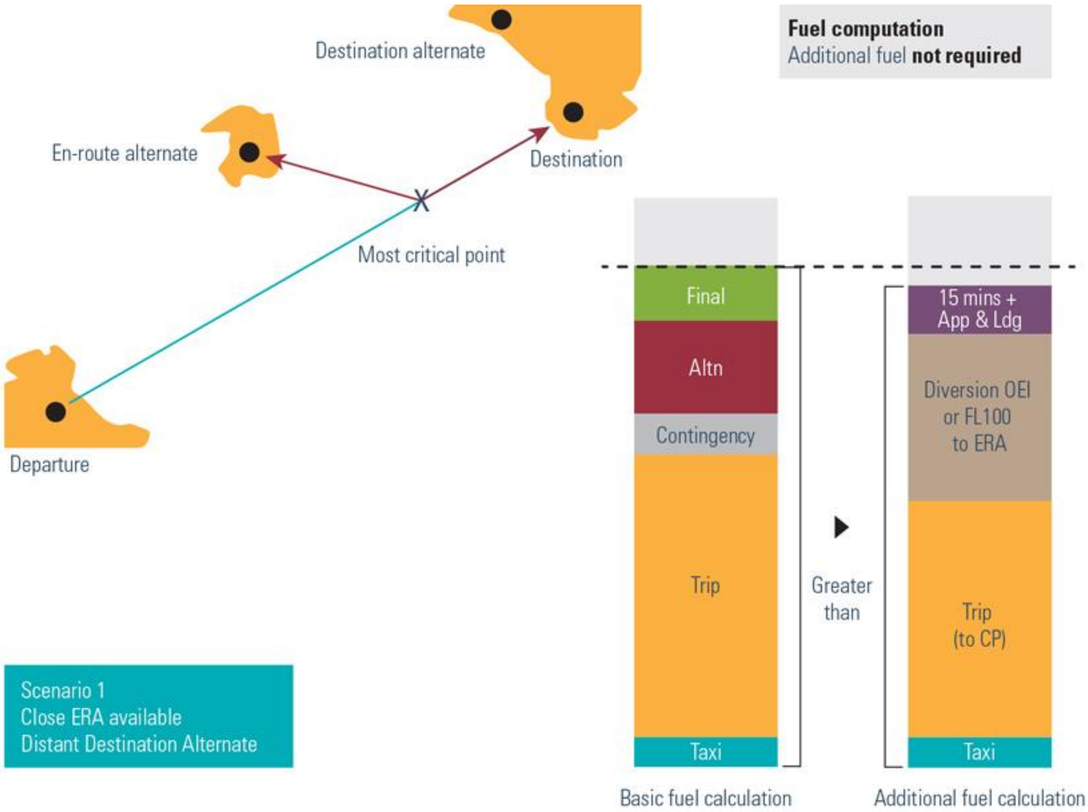

Figure A 1: Fuel calculation scenario – additional fuel not required

A.2 Scenario 2 – Additional fuel required

A.2.1 The generic scenario illustrated in Figure A 2 varies from Figure A 1 in that the ERA is more distant from the CP, and the destination alternate is closer to the destination. This decreases the amount of destination alternate fuel and increases the amount of fuel required to address the critical fuel scenario.

A.2.2 This generic scenario now results in a basic fuel planning value less than the fuel required to meet the critical fuel scenario, therefore, the flight is required to uplift a corresponding amount of additional fuel.

A.2.3 In this case, it should be noted that all of the contingency fuel is required to be combined with the amount of additional fuel to meet the overall fuel requirements. Therefore, the contingency fuel is required to be protected.

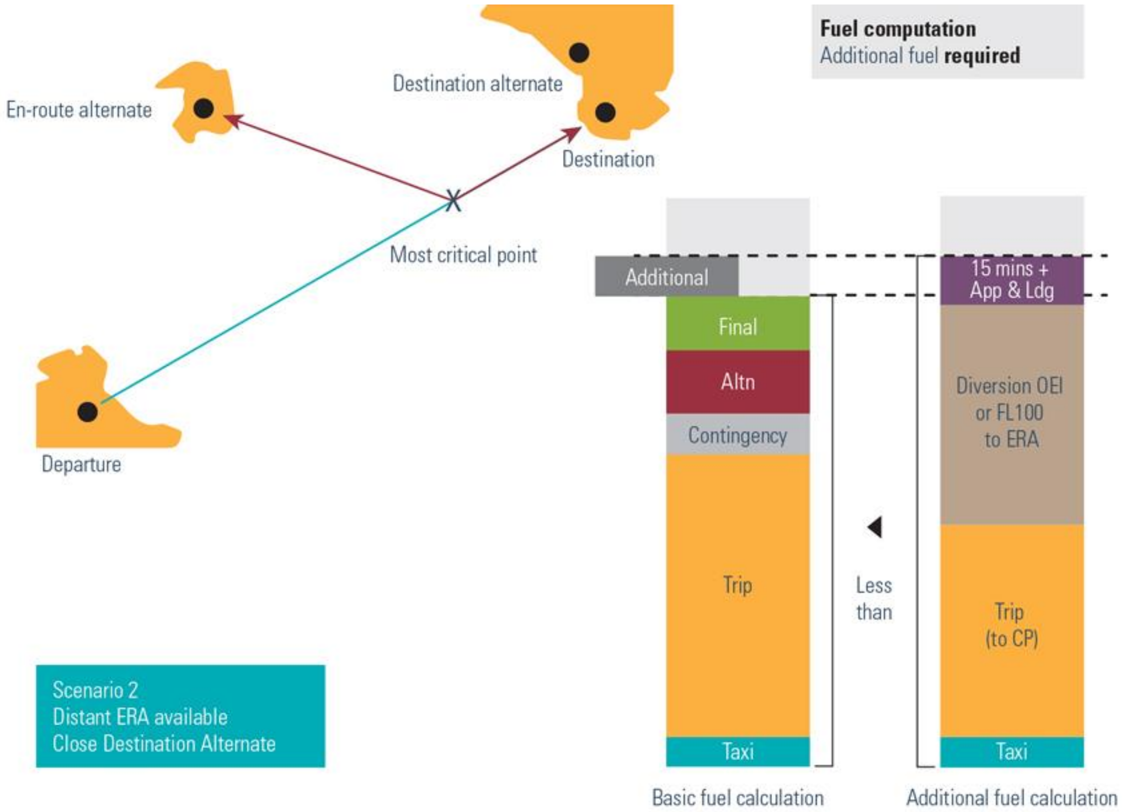

Figure A 2: Fuel calculation scenario – additional fuel required

Appendix B

Sample fuel calculations

B.1 Sample fuel calculations

B.1.1 This appendix contains several sample fuel calculations that incrementally build in complexity based on the fuel requirements legislation.

B.1.2 The intent is to provide samples that serve to illustrate the practical application of the requirements and guidance contained in the body of this AC.

B.1.3 The units of measurement for fuel values will be pounds (lb), litres (L) or kilograms (kg) according to the AFM. In these examples, fuel delivery and uplift information has been stated in litres. The conversion of AVGAS (specific gravity 0.720 at sea level ISA conditions) from lb to L is based on a conversion factor of 1.58.

B.2 Sample 1a: Part 91 Day VFR flight - Essendon to Swan Hill (no destination alternate)

B.2.1 The flight is a day VFR flight conducted under Part 91 of CASR in a single-engine piston aeroplane from Essendon to Swan Hill.

B.2.2 The amount of usable fuel required to be on board at the commencement of the flight, based on subsection 4.2 and taking into consideration the factors contained in paragraph 3.3.1, is the following:

Start and taxi: 0 min/6 lb

Trip fuel: 70 min/111 lb

Take-off (0 min/6 lb), Climb (16 min/25 lb)

Cruise (56 min/76 lb), Descent and Approach (0 lb)

Final reserve fuel: 30 min/30 lb

Table B 1: Fuel analysis – day VFR (no destination alternate)

Item	Fuel amount	Minutes	lbs	Litres
a	Taxi fuel	0	6	4
b	Trip fuel	72	111	70
c	Contingency fuel	0	0	0
d	Destination alternate fuel	0	0	0
e	Final reserve fuel	30	29	18
f	Additional fuel	0	0	0
g	Holding fuel	0	0	0
h	Fuel required (a+b+c+d+e+f+g)	102	146	92
i	Discretionary fuel	0	0	0
j	Margin fuel	298	397	251

Item	Fuel amount	Minutes	lbs	Litres
k	Endurance (h+i+j)	407	543	343

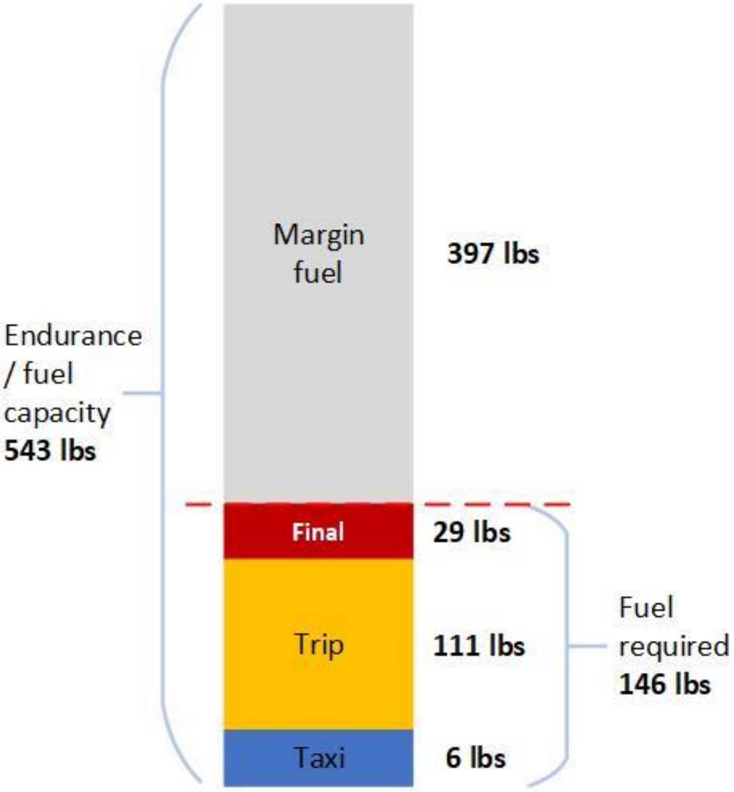

Figure B 1: Graphical depiction - day VFR

B.2.3 Additional information pertaining to this sample calculation is contained in Annex A to this AC.

B.3 Sample 1b: Part 91 IFR flight - Essendon to Swan Hill (with destination alternate - Mildura)

B.3.1 Following from the fuel calculated in section B.1 Sample fuel calculations, the flight now requires a destination alternate, in this case Mildura is selected. Destination alternate fuel is now required.

B.3.2 The amount of usable fuel required to be on board at the commencement of the flight, based on subsection 4.2 of this AC and taking into consideration the factors contained in paragraph 3.3.1 of this AC is the following:

Start and taxi: 0 min/6 lb

Trip fuel: 82 min/120 lb

Take-off (0 min/6 lb), Climb (10 min/20 lb)

Cruise (62 min/81 lb), Descent and Approach (10 min/13 lb)

Final reserve fuel: 45 min/45 lb

Destination alternate fuel: 46 min/65 lb

Climb (9 min/17 lb), Cruise (37 min/48 lb)

Descent and Approach (0 min/0 lb)

Table B 2: Fuel analysis - IFR (with destination alternate)

Item	Fuel amount	Minutes	lbs	Litres
a	Taxi fuel	0	6	4
b	Trip fuel	82	120	76
c	Contingency fuel	0	0	0
d	Destination alternate fuel	46	65	41
e	Final reserve fuel	45	44	28
f	Additional fuel	0	0	0
g	Holding fuel	0	0	0
h	Fuel required (a+b+c+d+e+f+g)	173	235	149
i	Discretionary fuel	0	0	0
j	Margin fuel	231	308	195
k	Endurance (h+i+j)	404	543	344

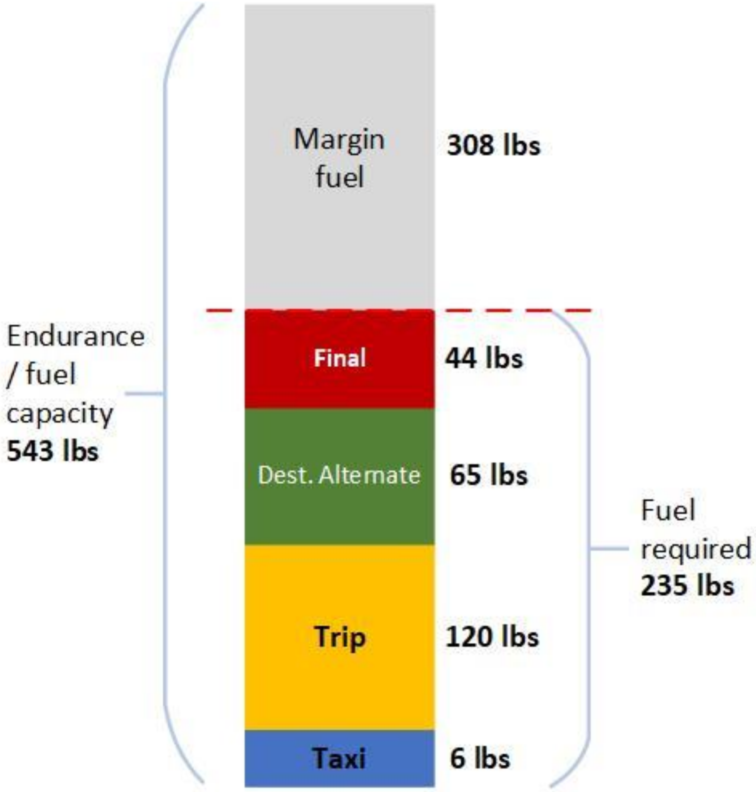

Figure B 2: Graphical depiction - IFR (with destination alternate)

B.3.3 Additional information pertaining to this sample calculation is contained in Annex A to this AC.

B.4 Sample 2a: Part 91 IFR flight - Darwin to Cairns (No en route alternate)

B.4.1 To illustrate a scenario where the additional fuel calculation is required, the following IFR flight is provided.

B.4.2 The flight is an IFR flight conducted under Part 91 of CASR in a small turboprop multi-engine aeroplane from Darwin to Cairns, with no available en route alternates and no requirement for a destination alternate.

B.4.3 Detailed information pertaining to this sample calculation is contained in Annex B to this AC.

B.4.4 The amount of usable fuel required to be on board at the commencement of the flight, based on subsection 4.2 of this AC and taking into consideration the factors contained in paragraph 3.3.1 of this AC is the following:

Start and taxi: 0 min/40 lb

Trip fuel: 240 min/2223 lb

Take-off (0 min/50 lb), Climb (20 min/242 lb),

Cruise (197 min/1711 lb), Descent (18 min/170 lb), and

Approach (5 min/50 lb)

Final reserve fuel: 45 min/450 lb

Table B 3: Fuel analysis - Basic

Item	Fuel amount	Mins	lbs	Litres
a	Taxi fuel	0	40	25
b	Trip fuel	240	2,223	1,407
c	Contingency fuel	0	0	0
d	Destination alternate fuel	0	0	0
e	Final reserve fuel	45	450	285
f	Additional fuel	0	0	0
g	Holding fuel	0	0	0
h	Fuel required (a+b+c+d+e+f+g)	285	2,713	1,541

B.4.5 The scenario describes a situation where there are no available ERAs. In that case, the basic fuel planning shown may not address the critical fuel scenario requirements. The amount of additional fuel required must be calculated.

B.4.6 The first step in determining the amount of additional fuel required is to determine the critical point for the flight. The CP occurs (for the depressurised case – being most limiting for the aeroplane type chosen) at a position 487 NM from Darwin and 419 NM from Cairns.

B.4.7 Knowing the position of the CP allows us to calculate the fuel required to meet the critical fuel scenario as shown in Table B 4.

Table B 4: Fuel analysis - critical fuel scenario

Item	Fuel amount	lb	Litres
a	Fuel required (taxi + trip fuel) to fly to the calculated CP (assuming normal operations)	1,317	
b	Fuel required to fly from the calculated CP to either aerodrome and to conduct an approach and landing with 15 minutes of holding fuel remaining (assuming depressurised)	1,594	
c	Total fuel required to meet critical fuel scenario (a+b)	2,911	
d	Basic fuel required	2,713	
e	Additional fuel required (c-d)	198	

B.4.8 The basic fuel required is 2,713 lb; however, the fuel required to meet the critical fuel scenario is 2,911 lb. The difference of 198 lb must be uplifted as additional fuel and as part of the fuel for the flight.

Table B 5: Fuel analysis - Basic fuel with additional fuel

Item	Fuel amount	Minutes	lb	L
a	Taxi fuel	0	40	23
b	Trip fuel	240	2,223	1,263
c	Contingency fuel	0	0	0
d	Destination alternate fuel	0	0	0
e	Final reserve fuel	45	450	256
f	Additional fuel	14	198	113
g	Holding fuel	0	0	0
h	Fuel required (a+b+c+d+e+f+g)	299	2,911	1,654
i	Discretionary fuel	0	0	0
j	Margin fuel	73	734	417
k	Endurance (h+i+j)	355	3,645	2.071

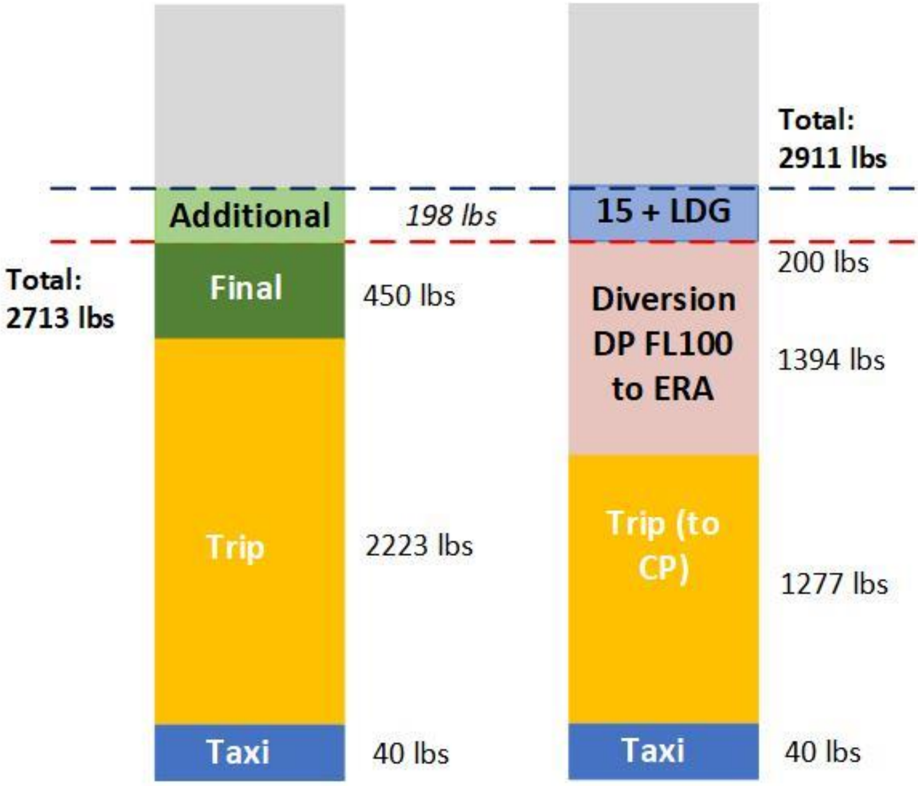

Figure B 3: Graphical depiction - Basic fuel with additional fuel