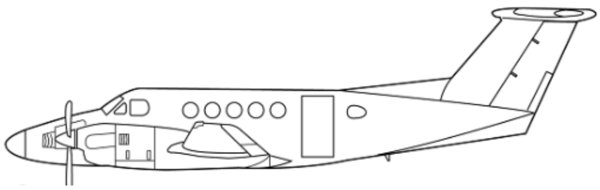
# ANNEX B

# Sample fuel calculations – Multi-engine turboprop aeroplane (Beechcraft B200)

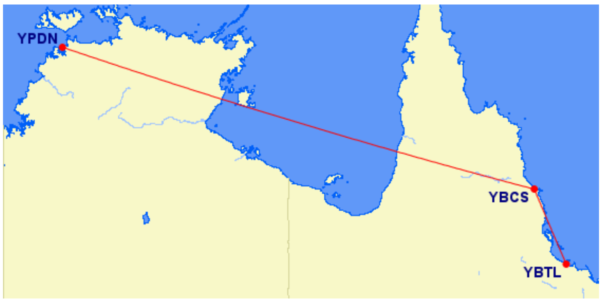
# Super King Air B200 - Sample fuel planning



## Scenario and conditions

Flight Route Scenario is from Darwin to Cairns. Townsville is the destination Alternate for the scenario development where a destination alternate becomes required.

- Flight distance: 906 Nm
- Alternate distance: 153 Nm
- Take-off weight: 11 000 lbs
- Usable fuel capacity: 3 645 lbs
- Climb wind and temp: 20 kt headwind, ISA +20deg
- Cruise wind and temp: 40 kt headwind, ISA +20deg
- 10 000 ft wind and temp: 20 kt headwind, ISA +20deg
- Descent wind and temp: 10 kt headwind, ISA +20deg




For calculations climb wind and temperature is taken at 2/3 of the climb height. Where a descent wind is needed for calculation, the value used is taken at ½ descent altitude.

## Performance data – from AFM/POH

Taken from Beechcraft Super King Air B200 AFM/POH Section 5.

### Start, taxi and take-off

From AFM/POH Section 5 (5-52 Note 1) 90 lbs for engine start, taxi and take-off allowance. This should be taken as the minimum figure, added to where extended taxi or ground delay after starting is anticipated.

As take-off fuel is a constituent of trip fuel, a simple proportional estimate can be used to determine the start and taxi (and run-up if required) and take-off.

- Start and taxi: 40 lbs
- Take-off: 50 lbs

### Climb Data

Data for time, fuel and distance to top-of-climb is provided in AFM/POH Section 5 (5-52).

For Example: 12 500 lbs TOW, ISA+20, climbing to 27 000 ft (from sea level departure aerodrome):

- Normal climb (1 900 RPM/770ITT or 2,230TQ) 12 500 lbs initial climb weight:

  - Time: 20 mins
  - Fuel: 242 lbs
  - Distance: 61 Nm
- Distance/Time will give TAS: 61 Nm/20 mins= Calculated TAS 180.
- Wind adjustment: the climb wind is then used to adjust the top-of-climb position (TOPC):
  - Wind adjustment is made to this NIL WIND TAS to calculate GS: (180-20 kt=160 GS)
  - 160 kt GS for 20 mins = 53 Nm (53.3).

If the departure includes convoluted departure tracking, or airborne holding during the departure is anticipated, allowance should be made to the fuel and time for those anticipated conditions. For a take-off from Runway 11 at Darwin, with a departure runway closely aligned to the departure track, no such adjustment is necessary in the scenario case.

## Cruise data

Cruise data is provided in the AFM/POH Section 5. Normal Cruise Power (1 700 rpm) for ISA and in 10 degree increments are provided. For the scenario example the normal cruise power table at ISA +20 (Section 5, page 5-59) is used. For a short sector it may be valid to use the actual departure weight value (12 000 lbs heaviest provided) as the aircraft weight at F270, although using this value on longer sectors may result in overly conservative cruise fuel burn values. It is more accurate to determine a ‘mid-sector’ weight and use that value for the cruise segment.

Interpolating between the F260 and F280 values provided, cognisant of the non-linear relationship of the TAS as depicted in AFM/POH Section 5 (5-62) the following values based on a 11,000 lbs cruise weight is determined:

- From the AFM/POH Section 5 (5-59):
  - Engine TQ: 1 493 ft/ lbs
  - KTAS: 274
  - Fuel Flow: 520lb/hr (8.66 lbs/min).
- Wind correction: 274-40=234 kt GS
- Distance: Route distance 906 Nm minus TOPC distance 53 Nm = cruise distance 853 Nm
- 853 Nm at 234 kt GS = 219 mins
- 219 mins at 520lb/hr = 1 896 lbs.

The cruise distance, time and fuel values calculated above are to overhead the destination aerodrome at cruise altitude. For accuracy these values are modified following the calculation of the descent data.

Having applied the descent data values to the cruise data, the corrected cruise values to TOPD are now:

- 853 Nm-83 Nm = 770 Nm
- 770 Nm at 234 kt GS = 197 mins

- 197 mins at 520lbs/hr = 1 711 lbs.

## Descent data

The calculations of the descent distance, time and fuel are taken from AFM/POH 5-142:

- Descent data:
  - Time: 18 mins
  - Fuel: 170 lbs
  - Distance: 86 Nm.
- Distance/Time will give TAS 86 Nm/18 mins= Calculated TAS 286.
- Wind adjustment: the descent wind is then used to adjust the top of descent position (TOPD):
  - Wind adjustment is made to this NIL WIND TAS to calculate GS: (286-10 kt=276 kt GS)
  - 276 kt GS for 18 mins = 83 Nm.

## Approach fuel

If an approach to the destination aerodrome is anticipated to consume more fuel than would be used to follow the planned cruise and descent, then it would be prudent to include an approach allowance in addition to the cruise and descent fuel. This may be calculated at an intermediate level and at an appropriate power setting for the anticipated circumstances. If holding is anticipated, the holding fuel consumption rate can also be used.

In this case, an intermediate level off and manoeuvring segment is anticipated in the arrival to Cairns, with an anticipated value not exceeding 5 mins, with a conservative value of 50 lbs based on 'holding fuel' rate of 600 lbs/hr.

- Approach fuel allowance: 50 lbs/5 mins.

## Trip fuel

Having calculated the climb, cruise, descent and approach fuel, the elements of Trip Fuel are known and can be summed. In the scenario presented, the trip fuel would now be:

- Take-off (50 lbs), Climb (242 lbs), Cruise (1 711 lbs), Descent (170 lbs) and Approach (50 lbs) = 2 223 lbs
- Climb (20 mins), Cruise (197 mins), Descent (18 mins) and Approach (5 mins) = 240 mins.

| Item | **Fuel calculation** | Min | lbs, L or kg |
|---|---|---|---|
| **a** | **Taxi fuel** | 0 | 40 |
| **b** | **Trip fuel** | 240 | 2223 |

**Figure 1 – Trip Fuel**

## Fixed fuel reserve

The fixed fuel reserve legislated for a private instrument flight rules (IFR) flight in a small aeroplane is 45 mins[1], calculated at the anticipated weight at holding speed 1500 ft above the destination aerodrome in ISA conditions.

From the AFM/POH Section 5 (5-141) Holding Time gives a holding power setting of 800ft/ lbs TQ at a propeller setting of 1700 rpm, applicable at all temperatures. The fuel required for holding for 1 hour at sea level is 600 lbs, slightly less at 1500 ft. It is widespread practice and consistent with the ICAO standards to round the calculated fuel reserve to an easily remembered figure, hence the use of 600lb/hr for determining the 45 mins, 450 lbs value.

The calculated fixed fuel reserve would be:

- 45 mins at 600 lbs/hr = 450 lbs.

## Minimum fuel to commence flight (private IFR – no destination alternate)

Having calculated the fuel elements in the previous section, the minimum fuel to conduct the flight, in this instance is shown in figure 1.

**Note:** This figure is based on the availability of multiple en-route alternates (ERA) that enable the flight to be conducted such that if an engine failure or loss of pressurisation occurs that the aeroplane can divert to an ERA and conduct an approach and landing with fuel in excess of that required to hold for 15 mins at holding speed above aerodrome elevation in ISA conditions.

| Item | Fuel calculation | Min | lbs, L or kg |
|---|---|---|---|
| a | **Taxi fuel** | 0 | 40 |
| b | **Trip fuel** | 240 | 2223 |
| c | **Variable fuel reserve** (% of b) | 0 | 0 |
| d | **Alternate fuel** | 0 | 0 |
| e | **Fixed fuel reserve** | 45 | 450 |
| f | **Additional fuel** | 0 | 0 |
| g | **Holding fuel** | 0 | 0 |
| h | **Fuel required** (a+b+c+d+e+f+g) | 285 | 2713 |

**Figure 2 – Fuel required (private IFR no destination alternate)**

## Additional fuel

The additional fuel requirements prescribed in the Civil Aviation (Fuel Requirements) Instrument 2018, are such that the flight must also be planned such that fuel is available to enable the

[1] *Civil Aviation (Fuel Requirements) Instrument 2018, 5(6) and Table 1 (Item 2)*

aircraft if engine failure or loss of pressurisation (if applicable), whichever results in the greater subsequent fuel consumption, occurs at the most critical point[2]:

- The aircraft can to proceed to an alternate aerodrome; and
- Fly for 15 mins at holding speed at 1500 ft above aerodrome elevation in ISA conditions; and
- Make an approach and landing.

### Critical point DN to CS (with no en-route alternates)

An illustrative example to assist in understanding the additional fuel calculation is as follows. The case for the Darwin to Cairns flight (with no alternate required) has two available aerodromes. Clearly, in the absence of any other aerodromes, the critical point is the wind adjusted point between the two aerodromes from which the flight must have sufficient fuel to fly depressurised on or back and conduct an approach and landing with 15 mins fuel reserve remaining. (The One Engine Inoperative OEI case is not the most critical fuel case for this aircraft type). If the planned fuel at that point is less than the critical fuel, an amount of additional fuel must be uplifted.

#### Critical point - planned cruise level - all engines operating (CPA)

At the planned cruise level of F270 the distance to the equi-time point (ETP) between Darwin and Cairns is calculated with the formula:

$$\frac{Total\ Distance \times Ground\ Speed\ Back}{Ground\ Speed\ Back + Ground\ Speed\ Forward} \qquad \frac{906 \times 314\ (274TAS + 40TW)}{314 + 234}$$

The calculation returns an ETP (CPA) 519 Nm from DN (387 Nm distance to run to CS).

#### Critical point depressurised (CPD)

For the Depressurised ETP, the position will change on the basis of the change in cruise level required for the depressurised cruise (10 000 ft) and the TAS at that level. For the scenario the depressurised performance setting chosen is the Normal Cruise Power.

Selecting a depressurised performance setting of Maximum Range power would, in most instances, provide the best available air range for fuel burn. (Calculation of the point at which the wind effect alters the chosen performance on the basis of optimising ground range, is outside the scope of this document.)

AFM data depressurised: Normal Cruise Power 1700 rpm ISA+20, 11 000 lbs (AFM page 5-59) 10 000 ft, 270TAS, 830 lbs/hr. (10 000 ft wind is 20 kt HW on to CS, 20 kt TW back to DN. At the depressurised cruise level of 10 000 ft the distance to the equi-time point (ETP) between Darwin and Cairns is calculated with the formula:

$$\frac{Total\ Distance \times Ground\ Speed\ Back}{Ground\ Speed\ Back + Ground\ Speed\ Forward} \qquad \frac{906 \times 290\ (270TAS + 20TW)}{290 + 250}$$

The calculation returns an ETP (CPD) 487 Nm from DN (419 Nm distance to run to CS).

[2] *Civil Aviation (Fuel Requirements) Instrument 2018, 5(2)(g)*

Fuel back to Darwin: 487 Nm at 290GS, results in flight interval of 101 mins, which at a burn rate of 830 lb/hr, results in diversion fuel of 1394 lbs. The required approach and landing (notional B200 approach and landing value of 50 lbs) and 15 mins holding of 150 lbs is then added, culminating in a total fuel value required at 487 Nm from Darwin of 1594 lbs.


**Figure 3 – Critical point depressurised (CPD) DN to CS without ERA**

Fuel onward to Cairns: 419 Nm at 250GS, flight interval of 101 mins, burn rate of 830lb/hr, diversion fuel of 1,394 lbs. Approach and landing fuel of 50 lbs and 15 mins holding fuel of 150 lbs is then added. Culminating in a total value required at 419 Nm from Cairns of 1594 lbs. (This verifies the ETP calculation).

To determine whether ‘additional fuel’ is required, the basic calculation value is compared to the value required for flight to the CPD under planned conditions added to the fuel from the CPD to the ERA under the conditions for the critical fuel case.

From Figure 2 the required fuel value for the planned flight Darwin to Cairns is 2713 lbs. This is then compared to the value of planned trip fuel required to fly to the CPD (496 Nm from DN) added to the fuel for the CPD case calculated above.

Calculation summary: start and taxi 40 lbs, take-off 50 lbs, climb to (TOPC 53 Nm) 242 lbs, cruise distance (496-53=443 Nm), 443 at 234GS is 114 mins at 520 lb/hr results in 985 lbs. The planned to fuel to the CPD 1,317 lbs (40+50+242+985) plus the fuel for the depressurised segment of 1594 lbs necessitates a total of 2911 lbs. The ‘basic’ flight fuel required was calculated as 2713 lbs. Given that the basic fuel calculation returns a value 198 lbs less than the fuel (2704 lbs) required for the critical fuel case, the 198 lbs of ‘additional fuel’ must be planned and uploaded. This is graphically illustrated in Figure 4.

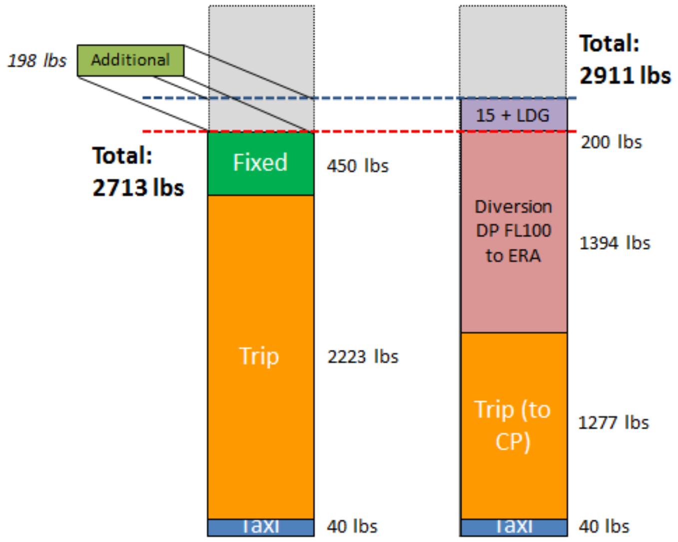



**Figure 4 – Basic fuel required and critical fuel scenario comparison**

In light of the 'additional fuel' requirement of an extra 198 lbs to meet the critical fuel scenario, the minimum fuel to commence the flight of 2911 lbs is now shown below in Figure 5. A time value is determined based on the cruise fuel flow (198 lbs at 830 lbs/hr is 14 mins).

| Item | Fuel calculation | Min | lbs, L or kg |
|---|---|---|---|
| a | **Taxi fuel** | 0 | 40 |
| b | **Trip fuel** | 240 | 2223 |
| c | **Variable fuel reserve** (% of b) | 0 | 0 |
| d | **Alternate fuel** | 0 | 0 |
| e | **Fixed fuel reserve** | 45 | 450 |
| f | **Additional fuel** | 14 | 198 |
| g | **Holding fuel** | 0 | 0 |
| h | **Fuel required** (a+b+c+d+e+f+g) | 299 | 2911 |

**Figure 5 – Fuel required including additional fuel**

## Destination alternate fuel

If the flight was conducted under such conditions that a destination alternate was required, the alternate fuel would need to be calculated[3]. This is done in a manner similar to the calculation of trip fuel (without the take-off element).

For the scenario, the destination alternate is 153 Nm from the destination (actual flight distance under real conditions, via required routing, may differ). The alternate fuel is the fuel required from the missed approach point, to climb to an appropriate cruising altitude, cruise to the destination alternate, descend and conduct an approach at the destination alternate as required. It may be prudent to calculate the alternate fuel based on Maximum Range Profile, to minimise unnecessary fuel carriage and excessive burn in the preceding trip fuel calculation.

### Alternate - Climb distance, time and fuel

Conditions assumed for the scenario are at ISA+20 and a 10 kt headwind at all levels for the alternate fuel calculation. Real-world values would be used in actual planning. F210 selected as the alternate leg cruising level.

- Normal Climb (1900 rpm/770ITT or 2230TQ) at an initial climb weight of 10 000 lbs:
  - Time: 9 mins
  - Fuel: 130 lbs
  - Distance: 27 Nm
  - Distance/Time: 27 Nm/9 mins= Calculated TAS 180.
- Wind adjustment: the climb wind is then used to adjust the top of climb position (TOPC):
  - GS: (180-10 kt) = 170 kt GS
  - 170 kt GS for 9 mins = 25 Nm (25.5).

### Alternate - descent distance, time and fuel

The descent distance, time and fuel from F210 is then calculated from AFM/POH 5-142:

- Descent Data:
  - Time: 14 mins
  - Fuel: 142 lbs
  - Distance: 66 Nm
  - Distance/Time will give TAS (66 Nm/14 mins) = Calculated TAS 283.
- Wind adjustment: the descent wind is then used to adjust the top of descent position (TOPD):
  - GS: (283-10 kt) = 273 GS
  - 273 kt GS for 14 mins = 64 Nm.

### Alternate - cruise distance, time and fuel

The cruise distance, time and fuel can now be determined:

Cruise distance = Total distance 153 – (climb 25 + descent 64) = 64 Nm.

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[3] *Civil Aviation (Fuel Requirements) Instrument 2018, 5(2)(e)*

Max Range Power (1,700 rpm) at F210, ISA+20 is taken from interpolating the data in the AFM/POH 5-119 resulting in cruise performance of:

- TAS of 221 kts and fuel flow of 409 lbs/hr
- Wind adjustment: 221-10=211 kt GS
- 64 Nm at 221 kt GS = 17 mins (17.4)
- 17.4 mins at 409lb/hr = 118 lbs.

If the approach and landing anticipated at the alternate aerodrome include extra time and fuel requirements, they should be added to the alternate fuel quantity calculated. In this instance, anticipating no extra requirements the alternate fuel quantity is:

- Climb (130 lbs), Cruise (118 lbs), Descent (142 lbs) and Approach (0 lbs) = 388 lbs
- Climb (9 mins), Cruise (14 mins), Descent (17 mins) and Approach (0 mins) = 43 mins.

| Item | **Fuel calculation** | Min | lbs, L or kg |
|---|---|---|---|
| **d** | **Alternate fuel** | 43 | 388 |

**Figure 6 – Alternate Fuel**

## Variable fuel reserve

For a private operation of a small aeroplane (including B200) as defined in the Civil Aviation (Fuel Requirements) Instrument 2018, variable fuel reserve is not a requirement[4]. The pilot-in-command may choose to apply variable fuel reserve if they see fit. (See scenario development section for RPT/Charter for a Variable Fuel Reserve calculation example and description).

## Minimum fuel to commence flight (private IFR – destination alternate required)

Having calculated the fuel elements in the previous sections, the minimum fuel to conduct the flight, in this instance is shown in Figure 7.

[4] *Civil Aviation (Fuel Requirements) Instrument 2018, 5(6) and Table 1 (Item 1 and Item 2)*

| Item | Fuel calculation | Min | lbs, L or kg |
|---|---|---|---|
| a | Taxi fuel | 0 | 40 |
| b | Trip fuel | 240 | 2223 |
| c | Variable fuel reserve (% of b) | 0 | 0 |
| d | Alternate fuel | 43 | 388 |
| e | Fixed fuel reserve | 45 | 450 |
| f | Additional fuel | 0 | 0 |
| g | Holding fuel | 0 | 0 |
| h | Fuel required (a+b+c+d+e+f+g) | 328 | 3101 |

**Figure 7 – Fuel required (private IFR with destination alternate)**

## Margin fuel and endurance

Having determined the fuel and time for the planned flight, a calculation of the fuel in excess of requirements allows endurance to be calculated. The starting point for this calculation is the known or planned start state of aircraft fuel, up to full capacity. In this example we will use full tanks, for the scenario B200, that is 3645 lbs of usable fuel.

Having determined the various elements required by the nature of the flight, we simply deduct the required fuel quantity from the usable fuel capacity (or payload limited capacity). This margin fuel can then be converted to a useful value of time (for a given parameter) such as at cruise fuel consumption or holding consumption. By convention (for turbine-powered IFR aeroplanes) holding fuel rate of 600 lbs/hr can be used to calculate a fuel margin value of time.

The maximum usable fuel capacity of 3645 lbs is known. The required fuel from the scenario is 3101 lbs. The margin is therefore 544 lbs, which at a holding fuel flow of 600 lbs/hr gives a time margin of 54 mins.

| Item | Fuel calculation | Min | lbs, L or kg |
|---|---|---|---|
| h | Fuel required (a+b+c+d+e+f+g) | 328 | 3101 |
| i | Discretionary fuel | 0 | 0 |
| j | Margin fuel | 54 | 544 |
| k | Endurance (h+i+j) | 382 | 3645 |

**Figure 8 – Margin and Endurance**

## Additional fuel

The following section describes the additional fuel calculation for flights with en-route alternate/s (ERA).

**Critical point DN to CS (ERA Mt ISA) - no destination alternate required.**

In order to illustrate a scenario variation and calculation, we will consider an en-route alternate (ERA) of Mt Isa and destination aerodrome as the available aerodromes. To simplify the illustration, the destination alternate fuel is not required for the following discussion.

### Critical point depressurised (CPD)

The starting point for the calculation of the critical point is a point on the planned route that is equidistant (nil-wind) from Cairns and Mt Isa. There are several methods available to calculate position and relative distance of the point; they are however outside the scope of this document.

The point en-route at a distance of 312 Nm from Cairns is also 312 Nm from Mt Isa. Consequently, the CP is 594 Nm (906-312) along track from Darwin. The effect of wind displaces equidistant point and transforms it into an equi-time point (ETP). For the scenario, a nominal headwind in the cruise is applied, assuming that the headwind component (20 kt headwind) applies to the ETP-to-Cairns as it does to the ETP-to-Mt Isa; we have relatively simple fuel calculations.

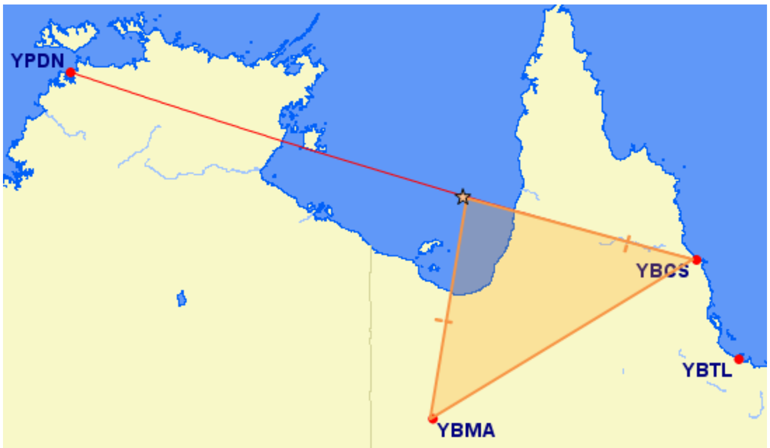


**Figure 9 – Decision point DN to CS with MA as ERA**

The fuel required from the CP to either Cairns or Mt Isa is now calculated for the required critical fuel scenarios:

AFM data depressurised: Normal Cruise Power 1700 rpm ISA+20, 11 000 lbs (AFM page 5-59) 10 000 ft, 270TAS, 830 lb/hr, 10 000 ft wind is 20 kt HW on to CS, 20 kt TW back to DN:

- 20 kt headwind, (270TAS-20HW) = 250 kt GS
- 312 Nm at 250 kt GS = 75 mins
- 75 mins at 830 lbs/hr= 1036 lbs

- APP and LDG (5 mins, 50 lbs)
- Holding (15 mins, 150 lbs)
- Fuel required at CPD: 1036 lbs + 150 lbs + 50 lbs (1236 lbs).

Taking the fuel from Figure 2 of 2,713 lbs at start, the Planned Fuel at CPD would be 1,179 lbs:

- DPD is at 594 Nm from Darwin, less the 53 Nm to TOPC = 541 Nm cruise
- 541 Nm at 274TAS-40 kt HW, 234 kt GS = 139 mins, at 520lb/hr = 1202 lbs
- Taxi (40 lbs), take-off (50 lbs), climb (242 lbs), cruise (1,202 lbs) = 1534 lbs.

Given the fuel used to fly to the CPD is 1534 lbs and the planned fuel prior to departure is 2713 lbs, the planned fuel at CPD would be 1179 lbs (2713 lbs-1534 lbs). As this is less than the fuel required at CPD of 1236 lbs, a quantity of 'additional fuel' of 57 lbs must be uplifted. This is graphically represented in Figure 10.

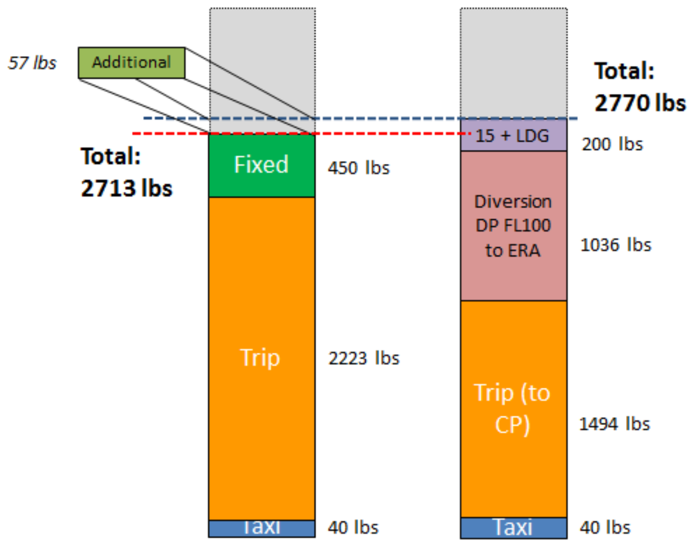


**Figure 10 – Fuel required with critical point DN to CS with MA as ERA**

**Critical point DN to CS (ERA Mt ISA) - with destination alternate required.**

To illustrate a scenario variation and calculation, we again consider an en-route alternate Mt Isa, however; in this case the destination Cairns requires a destination alternate, with Townsville being selected.

### Critical point depressurised (CPD)

Similar to the previous example, the starting point for the calculation of the critical-point is identifying the point on the planned route that is equidistant (nil-wind) from the reference aerodromes. In this case the ERA (Mt Isa) and the destination alternate (Townsville).

The point that is equidistant (323 Nm) from Mt Isa and Townsville, along the Darwin to Cairns track is at 202 Nm from Cairns (704 Nm from Darwin). This is graphically depicted in Figure 11.

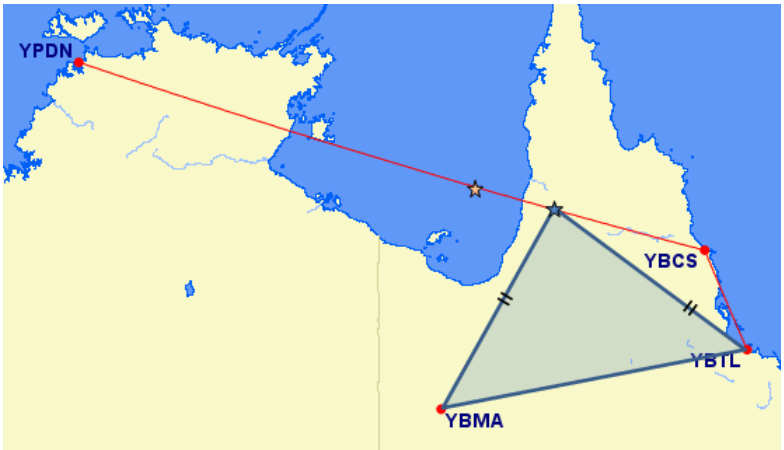


**Figure 11 – Critical Point**

The fuel required from the CP to either Mt Isa or Townsville is calculated for the required critical fuel scenarios:
AFM data depressurised: Normal Cruise Power 1700 rpm ISA+20, 11 000 lbs (AFM page 5-59) 10 000 ft, 270TAS, 830lb/hr, 10 000 ft wind is 20 kt HW on to CS, 20 kt TW back to DN:

- 20 kt headwind, (270TAS-20HW) = 250 kt GS
- 323 Nm at 250 kt = 78 mins
- 78 mins at 830 lbs/hr= 1072 lbs
- APP and LDG (5 mins, 50 lbs)
- Holding (15 mins, 150 lbs).

Fuel Required at CPD: 1072 lbs + 150 lbs + 50 lbs (1272 lbs).

Due to the destination alternate requirement, taking the fuel from Figure 7 of 3,101 lbs at start, the planned fuel at CPD would be: 1322 lbs:

- CPD is at 704 Nm from Darwin, less the 53 to TOPC = 651 Nm cruise
- 651 Nm at 274TAS-40 kt HW, 234GS = 167 mins, at 520lb/hr = 1447 lbs
- Taxi (40 lbs), take-off (50 lbs), climb (242 lbs), cruise (1447 lbs) = 1779 lbs.

Given the fuel used to fly to the CPD is 1779 lbs and the planned fuel prior to departure is 3101 lbs, the planned fuel at CPD would be 1322 lbs (3101 lbs-1779 lbs). As the fuel required at CPD to meet the critical fuel scenario is 1272 lbs and the planned fuel at that point is 1322 lbs, no additional fuel is required. This is graphically represented in Figure 12.

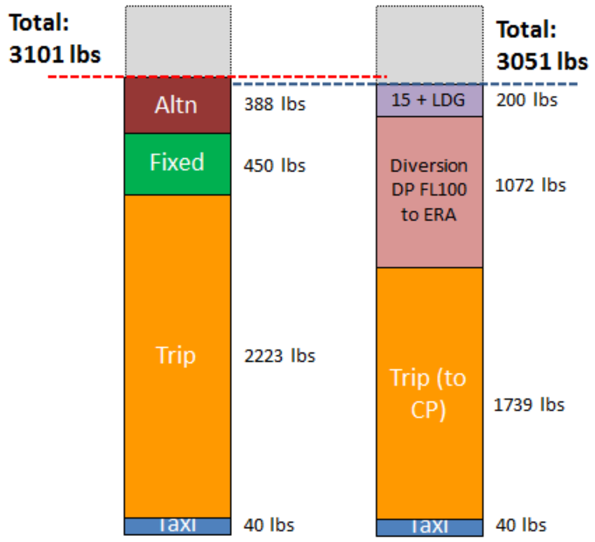


**Figure 12 – Fuel required at CPD**

## RPT and charter

Civil Aviation (Fuel Requirements) Instrument 2018 details specific values for fixed fuel reserve and variable fuel reserve applicable to RPT and Charter operations and also describes operational variations which an AOC holder's operations manual may contain[5].

## Fixed fuel reserve

For the scenario, if the charter or RPT turbine-powered aeroplane (B200) was conducting a charter operation and the AOC holder's operations manual fuel policy was based on the on the Civil Aviation (Fuel Requirements) Instrument 2018, the fixed fuel reserve would be 30 mins.

## Variable Fuel Reserve

The variable fuel reserve applicable to a charter or RPT turbine-powered aeroplane is the greatest of 5% of the trip fuel or 5 mins (calculated at the holding rate). For the scenario the calculation is as follows:

- Calculated trip fuel: 240 mins / 2223 lbs
- Variable Fuel Reserve: the greater of:
- 5% = 111 lbs, or
- 5 mins at holding fuel rate (600 lbs/hr) = 50 lbs.

For an RPT or charter operation conducting the scenario flight, given the calculated 5%, 110 lbs is greater than the 5 mins value of 50 lbs, 111 lbs of variable fuel reserve must be planned and available at the commencement of the flight.

**Note:** The Variable Fuel Reserve calculation does not apply to the alternate fuel, only to trip fuel.

[5] *Civil Aviation (Fuel Requirements) Instrument 2018, 5(6) and Table 1 (Item 9) and Subsection 8.*

## Minimum fuel to commence flight (Charter IFR – destination alternate required)

To demonstrate the differences and expand on the understanding from the previous scenario, we apply the Darwin to Cairns, with Townsville as destination alternate and Mt Isa as the ERA.

The 30 mins fixed fuel reserve is applied, as is the required variable fuel reserve. The alternate fuel is calculated but does not have variable fuel reserve compounded upon it. The resultant fuel required is 3062 lbs, the components are illustrated in Figure 14.

| Item | Fuel calculation | Min | lbs, L or kg |
|---|---|---|---|
| a | Taxi fuel | 0 | 40 |
| b | Trip fuel | 240 | 2223 |
| c | Variable fuel reserve (% of b) | 12 | 111 |
| d | Alternate fuel | 43 | 388 |
| e | Fixed fuel reserve | 30 | 300 |
| f | Additional fuel | 0 | 0 |
| g | Holding fuel | 0 | 0 |
| h | Fuel required (a+b+c+d+e+f+g) | 325 | 3062 |
| i | Discretionary fuel | 0 | 0 |
| j | Margin fuel | 58 | 583 |
| k | Endurance (h+i+j) | 383 | 3645 |

**Figure 13 - Fuel for charter with destination alternate**

Again, the determination of the fuel required to address the critical fuel scenario is conducted. As the fuel required for the basic fuel calculation exceeds the fuel for the critical fuel scenario, no additional fuel is required to be uplifted. This example does illustrate a situation where some of the variable fuel reserve must be protected prior to the critical fuel point. As can be seen in Figure 15, the difference between the basic fuel calculation and the critical fuel calculation is 11 lbs. The basic fuel calculation requires 111 lbs of variable fuel reserve be uplifted. If more than 11 lbs (the unprotected quantity) of the variable fuel reserve is consumed prior to the critical fuel point, the critical fuel scenario cannot be assured as the protected amount of variable fuel reserve will have been compromised.

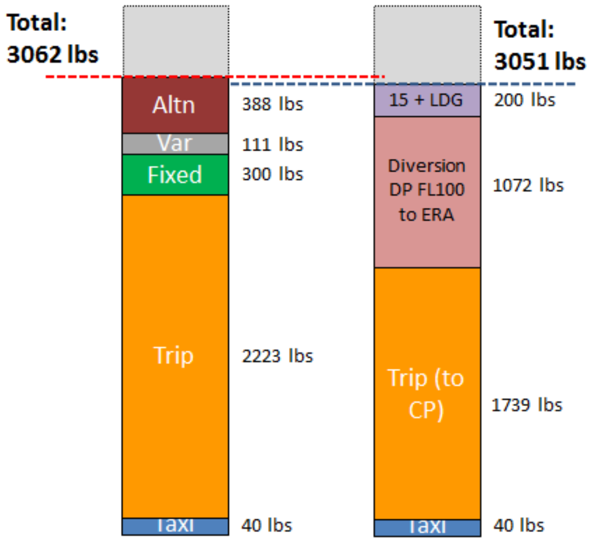


**Figure 14 - Fuel for charter with destination alternate**