



1



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Use the AIP (<https://aip.net.nz>)
 ... and its supplements to get additional enroute information and information on aerodromes.

NOTAMS (<https://ifis.airways.co.nz>)
 Get Aerodrome as well as Enroute NOTAMS. They give short notice advice or indicate recent changes.

GoPreflight (<https://gopreflight.co.nz/> This is a must go !!)
 Get weather and a lot of other useful information here. On the day of the flight look at the GRAFOR and use the Aviation Area Winds (AAW) to calculate headings.

FlightAdvisor (<https://flightadvisornz.io>)
 Check this website for info on military, drone, or other significant low-level operations.



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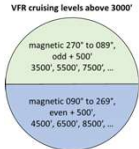


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Minimum safe altitude

Consider terrain on and close to the planned track. Select planned and minimum safe altitudes.

Remember:

- 500 ft above the surface.
- when cruising VFR above 3000 feet, you should maintain cruising levels as indicated in the diagram below.

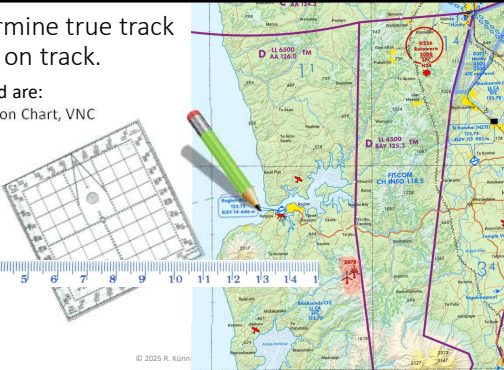
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Step 1: Determine true track and distance on track.

The tools required are:

- Visual Navigation Chart, VNC
- Pen
- Ruler
- Protractor



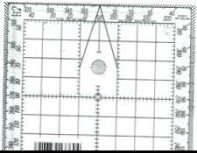
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Example: Huntley VRP to NZRA (Raglan), direction

On your VNC draw a line from Point A to Point B. The clockwise **angle** between the meridian and this line gives the True Course.

Raglan to Huntley: 43° true
Huntley to Raglan: 223° true



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Distance

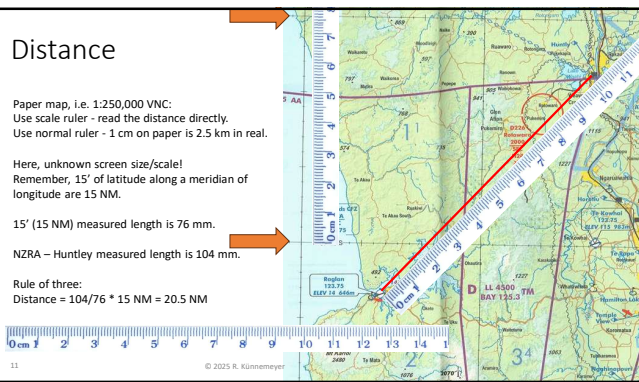
Paper map, i.e. 1:250,000 VNC:
Use scale ruler - read the distance directly.
Use normal ruler - 1 cm on paper is 2.5 km in real.

Here, unknown screen size/scale!
Remember, 15' of latitude along a meridian of longitude are 15 NM.

15' (15 NM) measured length is 76 mm.

NZRA - Huntley measured length is 104 mm.

Rule of three:
Distance = $104/76 * 15 \text{ NM} = 20.5 \text{ NM}$



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Step 2: Winds, speed

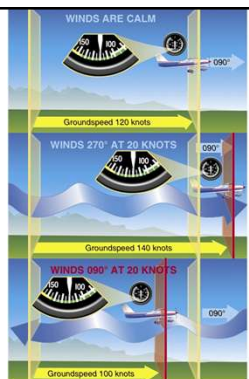
Airspeed is relative to the air mass.
Ground speed is relative to ground.

At the same airspeed:

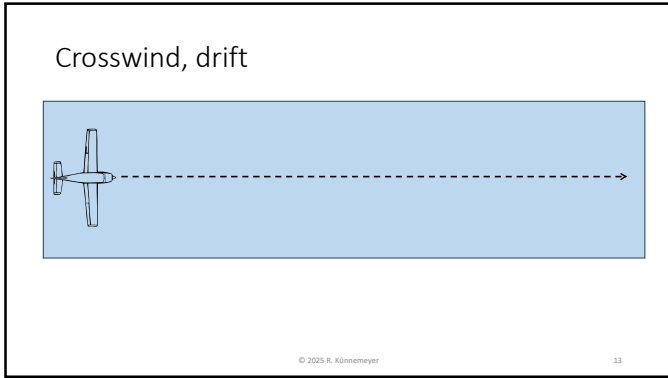
A tailwind pushes along - increases ground speed.

A headwind pushes back - decreases ground speed.

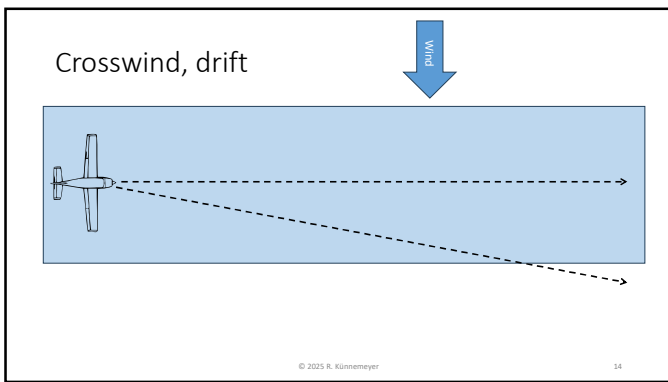
A crosswind is a bit more complicated.



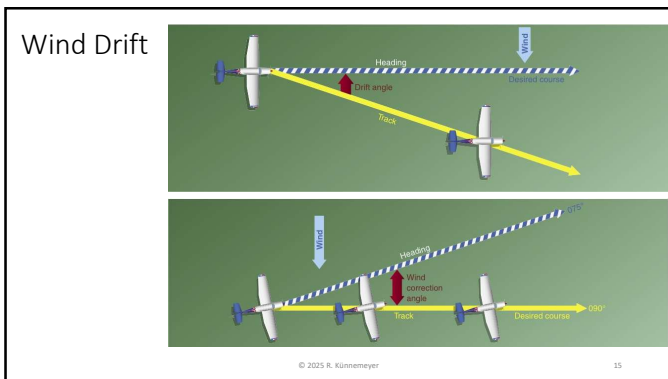
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Airspeeds



Indicated airspeed (IAS): what the airspeed indicator shows.

Calibrated airspeed (CAS): IAS corrected for instrument and pressure errors.

True airspeed (TAS): CAS corrected for changes in density

$IAS \propto \text{dynamic energy} = \frac{1}{2} \rho v^2$

At sea level and standard conditions (1013.25 hPa, 15°C): IAS=TAS.

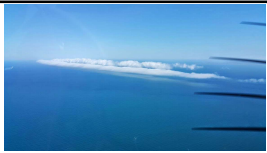
At 10,000ft, -10°C : CAS=100kn, TAS=115kn

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Aviation Area Winds (AAW)

...from 'official' aviation weather website, GoPreflight, IFIS. Here an IFIS example:



Altitude, 1000 ft AMSL

Forecast area, TK

Valid time: 2100 to 1200 hrs Coordinated Universal Time

AAW REPORTS (TK (TE KUITI))
 AVIATION AREA TK VALID 2100-TQ 1200 UTC
 BECOMING 0500-0900

1000	06045	02030
3000	02020	02030
5000	36015 PS05	36030 PS05
7000	35020 PS02	36030 PS02
10000	35020 MS02	

Wind direction, 060°

Wind strength, 15 kts

Temperature, +5°C

Flight planned positive, MS - negative

If cruising in the Te Kuiti forecast area at 4000', assuming a wind of 010° and 18 kn should produce satisfactory results.

Changes expected between 0500-0900 UTC

NOTE: ALL HEIGHTS ARE IN FEET AMSL

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Solving the wind triangle

... or how to figure out where to head.

There are several methods available to solve the wind problem; that is determine the required heading to achieve a certain course across ground and to calculate ground speed, crosswinds, etc.

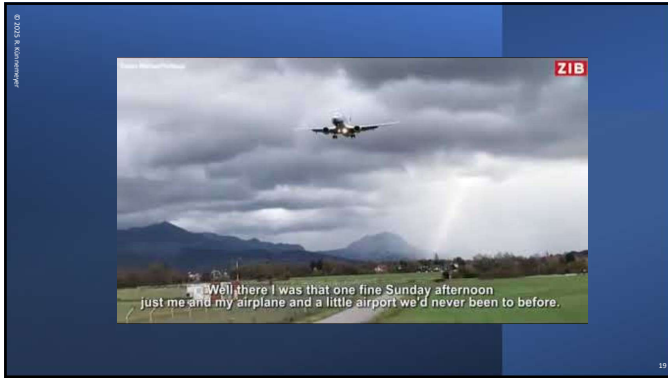
Why should we understand all of this and be able to make these calculations?

- It would be nice to arrive at the planned location irrespective of wind interference.
- You think you have enough fuel to go 500 NM, but there is now a strong headwind reducing your range. This can be embarrassing or even fatal.
- Most microlights have a demonstrated crosswind limit of around 15 kts on landing. It can be very character building or worse if we exceed this limit.

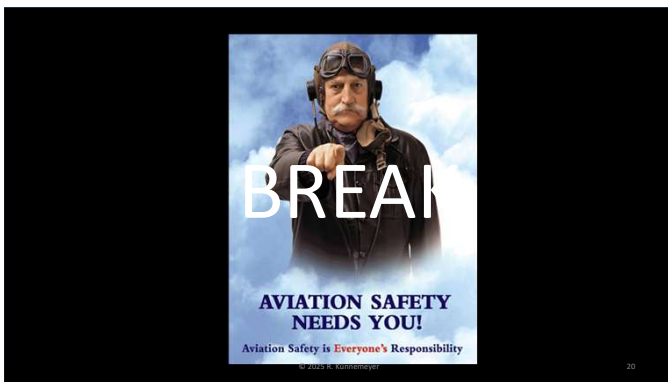
The next part discusses four methods to determine or calculate required information.

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Solving the wind triangle
... or how to figure out where to head.

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Vectors and Velocity

Aircraft and wind movement have a direction and speed. This is called velocity.

Velocity can be represented by a line that has a length proportional to speed and a direction, called a vector.

Vectors can be added (tip to base) to represent their combined effect. The new vector has a new direction and length.

This can be done graphically.

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The Wind Triangle -- Draw and Measure

Since wind directions are given as "From" rather than "To", we need to add 180° to get the wind velocity vector pointing in the correct (downwind) direction.

$WindDirection = MetWindDirection + 180^\circ$

Unknown: Groundspeed, Heading

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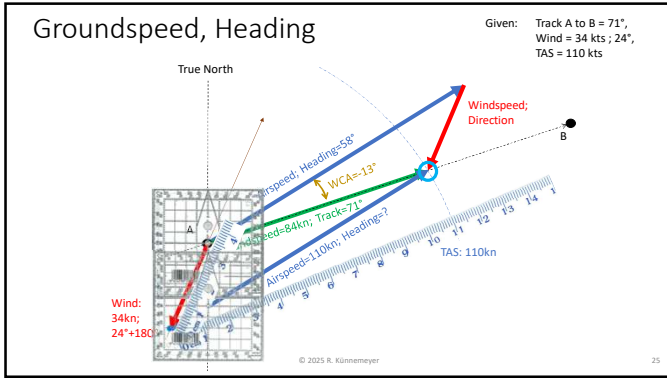
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Head-/tail- and crosswind

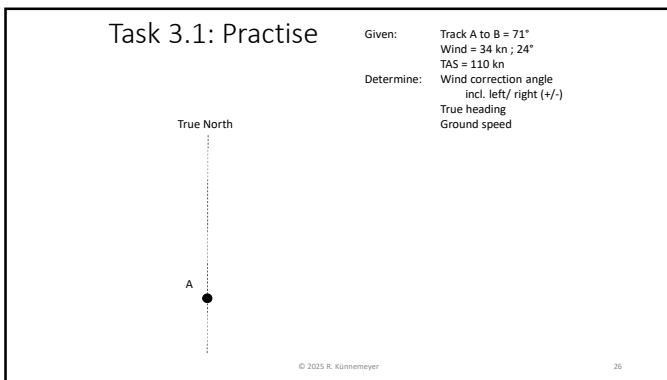
Given: Track A to B = 71°, Wind = 34 kts ; 24°

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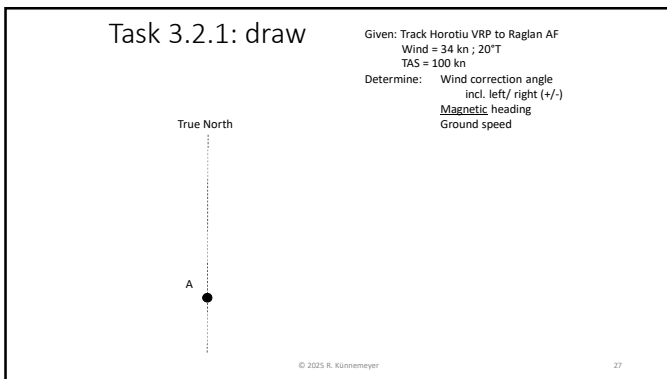
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Trigonometry

$WindDir = MetWindDirection + 180^\circ$
 $WTA = Track - WindDir$
 $\sin(WCA) = \frac{Windspeed}{TAS} \cdot \sin(WTA)$
 $Heading = Track + WCA$
 $Groundspeed = TAS \cdot \cos(WCA) + Windspeed \cdot \cos(WTA)$

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Calculations

$WindDir = MetWindDirection + 180^\circ = 24^\circ + 180^\circ = 204^\circ$
 $WTA = Track - WindDir = 71^\circ - 204^\circ = -133^\circ$
 $\sin(WCA) = \frac{Windspeed}{Airspeed} \cdot \sin(WTA) = 34/110 \cdot \sin(-133^\circ) = -0.226$
 $WCA = \arcsin(\sin(WCA)) = \arcsin(-0.226) = -13^\circ$
 $Heading = Track + WCA = 71^\circ + (-13^\circ) = 58^\circ$

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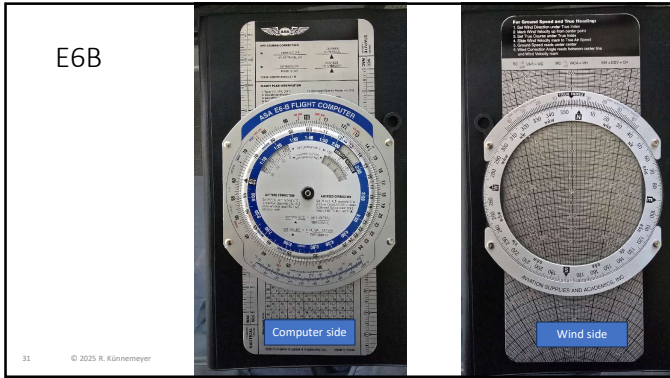
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Calculations

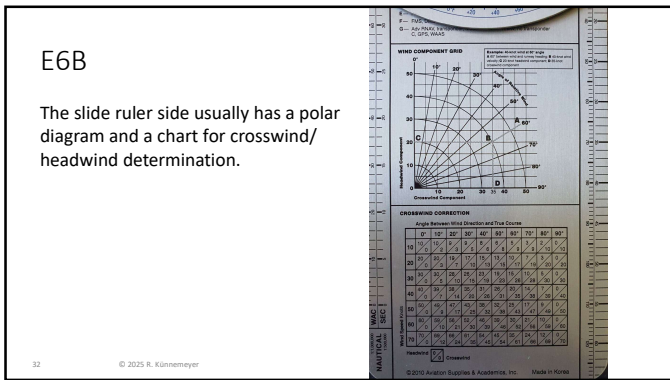
$Groundspeed = Airspeed \cdot \cos(WCA) + Windspeed \cdot \cos(WTA)$
 $= 110kn \cdot \cos(-13^\circ) + 34kn \cdot \cos(-133^\circ)$
 $= 110kn \cdot 0.974 + 34kn \cdot (-0.682)$
 $= 84kn$

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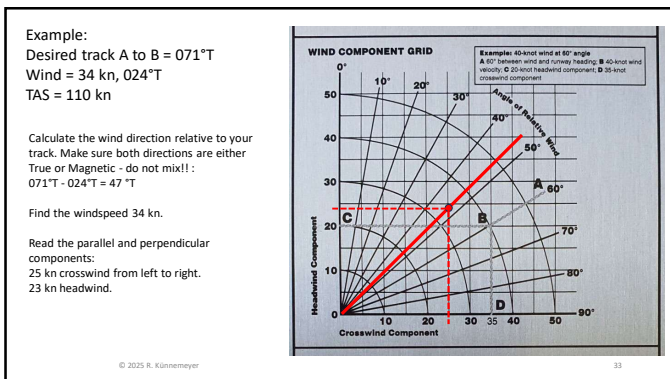
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Rotate the azimuth plate until your desired course (true course) is aligned under the True Index mark.
Use 071° for this example.

Slide the grid until the wind dot is over your true airspeed.
Here 110 knots.

Read ground speed under the grommet.
Ground speed is 84 knots.

Find the wind correction angle (WCA)
WCA is 13° to the left, -13°.

Read the true heading as 058°T.

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Eye balling

Example: Desired track A to B = 071°T
Wind = 34 kn, 024°T
Relative wind: 071°T - 024°T = 47°T
TAS = 110 kn

Headwind, 68%, 23 kn
Crosswind, 73%, 25 kn

vertical looks like 2/3: $2/3 * 34 \text{ kn} \approx 23 \text{ kn}$
horizontal looks like 3/4: $3/4 * 34 \text{ kn} \approx 25 \text{ kn}$

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1:60 rule

60 units along and 1 unit across give an angle of about 1°

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Maximum drift angle

Maximum drift occurs when the wind is at right angle to our planned track.

$$\text{Max Drift Angle} = \frac{\text{Windspeed}}{\text{Airspeed}}$$

$$\text{Max Drift Angle [°]} = \frac{\text{Windspeed}}{\text{Airspeed}} \cdot \frac{60}{1}$$

$$= \frac{\text{Windspeed [knots]}}{\text{Airspeed} \left[\frac{\text{NM}}{\text{min}} \right]} \cdot 60$$

$$= \frac{34 \text{ kn}}{1.8 \frac{\text{NM}}{\text{min}}} \cdot 60$$

$$= 19^\circ$$

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Let's work out our example using the polar chart from before.

The relative angle between wind and track is:
 This is a crosswind from the LEFT at 73% of wind speed: cw% = 73%
 This is a HEAD wind at 68% of wind speed: hw% = 68%.

The maximum drift from before is: MD = WS/TAS*60 = 19°.
 The wind correction angle then calculates as: WCA = cw%*MD = 73%*19° = 14° to the LEFT.

The heading, with '-' for left and '+' for right crosswind, is: True heading = track ± WCA = 71°-14° = **057°T**

The headwind component of the WCA is: wca% = 97%

The ground speed then, with '-' for head and '+' for tail wind, calculates as:
 GS = (TAS * wca%) ± (WS * hw%)
 = (110 kts * 97%) - (34 kts * 68%)
 = 106.7 kts - 23.1 kts
 = **84 kts**

These results are within ±1 unit of the correct values.

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True / Magnetic / Compass North

Variation **East** magnetic **Least**.
 Variation **West** magnetic **Best**.

Magnetic variation:
 difference between true and magnetic north, see VFR chart

Compass deviation: see placard under magnetic compass

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Calculations

Assume:
 True heading: 58°
 Magnetic Variation: 20° East
 Compass Deviation: 0°
 Distance: 70 NM
 Fuel Burn: 20 L/hr
 Other: as before

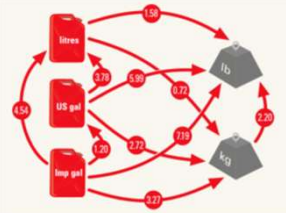
Calculate:

Compass Heading	= Heading + West MagVar - East CompDev	= 58° - 20° + 0°	= 38°
Elapsed Time	= Distance / Groundspeed	= 70 NM / 84 kn = 0.833 hr	= 50 min
Fuel on track	= FuelBurn * ElapsedTime	= 20 L/hr * 0.833 hr	= 17 L

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Fuel required



... equals Fuel on Track(s)
 + Reserve (45 min. recommended)
 + Unusable (flight manual !)
 + Taxi and take off / circuit
 = 17L + 15L + 10L + 5L = 47L

Fuel weight (Avgas) = Total fuel loaded * 0.72kg/L
 = 90L * 0.72kg/L = 65kg

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Task 3.2.1: calc

Given: Track Horotlu VRP to Raglan AF
 Wind = 34 kn ; 20°T
 TAS = 100 kn
 Determine: Wind correction angle
 incl. left/ right (+/-)
 Magnetic heading
 Ground speed

$WindDir = MetWindDirection + 180° =$
 $WTA = Track - WindDir =$
 $WCA = \arcsin(\sin(WCA)) =$
 $Heading = Track + WCA =$
 $Magnetic Heading = Heading +/- variation =$

$Groundspeed = Airspeed * \cos(WCA) + Windspeed * \cos(WTA)$

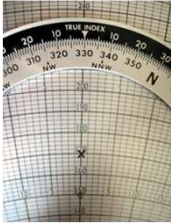
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Task 3.2.1: E6B

Given: Track Horotiu VRP to Raglan AF
 Wind = 34 kn ; 20°T
 TAS = 100 kn

Determine: Wind correction angle
 incl. left/ right (+/-)
 Magnetic heading
 Ground speed



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Flight planner/log

For each leg:

- Magnetic heading
- Ground speed
 - Est. elapsed time (ETE);
 - Fuel required;
- Safe height, planned height
- Radio Frequencies

actual time on track (ATE)
 actual fuel used

Overall:

- Alternatives
- Total fuel
- ECT

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Example flight plan

FROM	TO	True Air Speed (kts)	Altitude	Track (degrees true)	Est. Wind Direction (degrees true)	Est. Wind Speed (kts)	True Heading	Mag Var.	East Mag. Heading	Ground Speed (kts)	Distance (Nautical Miles)	Est Elapsed Time (min)	Fuel Burn Rate (L/hr)	Fuel Req. (L)
ardmore	tauranga	110	110	123	260	25	132	20	112	127	70	34	35	20
tauranga	rotorua	110	188	260	25	181	20	161	108	28	16	35	10	10
rotorua	hamilton	110	288	260	25	282	20	262	87	49	34	35	20	20
hamilton	ardmore	110	341	269	25	328	29	308	103	53	31	35	19	19

Total Time	115 Fuel Req.	69
	RESERVE	16
	UNUSABLE	12
	TAXI + TKOF	10
TOTAL	FUEL	107

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VFR FLIGHT LOG

Date:	7/02/2016		FUEL		
PILOT	A. Pilot	AIRCRAFT	ZK-ABC	BURN RATE (L/hr)	11.0
FROM	NZMA	TO	NZMA	TOTAL REQUIRED (L)	22.0
TAKE OFF	09:30	LANDING	11:39	UNUSABLE (L)	4.0
TRK (deg)	45	DISTANCE (nm)	74.7	FUEL RESERVE (L)	8.0
TAKE OFF	15	FLIGHT TIME	1:39	TOTAL ENDURANCE (hr)	2.43
TAKE OFF TIME	0:30	FLIGHT TIME	1:04	COMMUNICATIONS	
SUNSET	07:50	TOTAL FLIGHT TIME	2:09	DIYERS & DTS	
SQUAWK	1200	VELOCITY	20 E	STATION	SERVICE
1000' W/V	000	TEMP		CHC	INFO
3000' W/V	000	TEMP			
DEPARTURE INFORMATION (Refer to Section 13-10 NZDF)					
Set time 07:00 (13:30 NZDT)					
Destination	Distance	Altitude	Time	Altitude	Notes
NZMA - Matamoras	106	000	1.46	0.41	13:30
NZTO - Tokoroa	288	000	2.68	0.22	11:04
NZS3 - Waipapa South	219	000	3.59	0.35	11:39
NZMA - Matamoras	019	000	0.35		

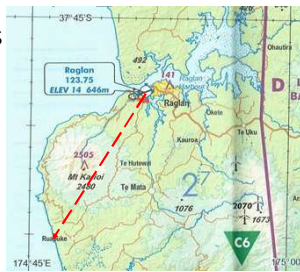
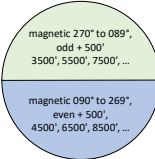
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Safe height, cruising levels

VFR cruising levels above 3000'



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UTC - Coordinated Universal Time

UTC + 12 = NZST (winter) UTC + 13 = NZDT (summer)
i.e.: 1600utc = 0400nzst = 0500nzdt

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AIP GEN 2.7: Daylight Tables

ATE – actual time enroute. Monitor !!
ECT - evening civil twilight (the end of daylight)
20-35 min after sunset. Plane must be on the ground, preferably in the hangar. The lower you get, the darker it is.

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Task 4, Planning practice

Plan a flight in a Zenith CH601XL using maps, ruler, protractor, and calculator (no flight planning app)

- From Te Kowhai via
 - Kawakawa Bay,
 - Orewa,
 - NZSL (Springhill)
- To Dargaville (and back if time allows)

Generate a VFR flight log for that flight.

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Area forecast: TA 1000 30015
3000 31020
5000 32015
FN 1000 27005
3000 28010
5000 25005

Zenith: cruise 90kts at 18L/hr, climb 60kts at 25L/hr.
fuel 90L max, 5L unusable.
342kg empty, 544kg max legal (595kg manual)
2 pilots 75kg.

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