

TOPNAV – PRE-BRIEFING NOTES

Introduction

Thank you for entering TOPNAV; we look forward to meeting you and hope that you will have an enjoyable and illuminating experience. These notes are intended as a guide so that you arrive at the competition venue with all you need and a good idea of what to expect on the day. There are sections on the rules and how the competition is marked plus some detail on the administration of the day. Other sections cover log keeping and some suggested VFR Navigation Techniques.

Rules

1. The General Aviation Navigation Group (GANG) of the Royal Institute of Navigation (RIN) organises the TOPNAV Competition on behalf of the RIN. The ultimate authority for the competition rests with the RIN.
2. The RIN will appoint a Management Committee to organise the event.
3. The RIN will appoint a panel to judge the event and decide the competition winners; the decision of this panel is final and this must be accepted by all competitors as a condition of entry.
4. Competitors will be required to certify that all details of their entry are correct and that they agree to abide by the competition rules. False declarations and/or infringements of the rules will result in disqualification.
5. The aircraft used in the competition must conform fully with the appropriate airworthiness regulations extant at the time. In addition the aircraft must be operated in accordance with UK legislation, including the Rules of the Air Regulations and the Air Navigation Order. Any infringements of the Regulations will result in disqualification and may lead to CAA action.
6. The competition is open to crews, ideally, comprising a minimum of one pilot and one navigator flying any GA type, including, motor gliders, microlights, autogyros and helicopters. By exception we can make special arrangements for single-pilot entries; however, additional navigators/observers may be carried and, indeed, are encouraged where seats are available.
7. TOPNAV will be flown on the stated day; however, where the Management Committee decides that conditions on the day are unacceptable, alternate arrangements will be made. In the event that a competitor cannot arrive at the starting point in time to compete, the Committee may allow that competitor to fly the course on another day, normally within one week; this will normally only be allowed for weather, mechanical or health reasons but all requests will be considered on a case-by-case basis.
8. Entrants encouraged to complete and submit, within 15 minutes of landing, a written log on the forms provided. A verbal debrief of the TOPNAV representative or a copy of 'log-on-chart' notes are acceptable alternatives.
9. Entrants must submit, within 14 days, suitably annotated digital/hard copy photographs of the turning points with a pre-flight and post-flight photograph of the aircraft and a crewmember at the beginning and end of the turning point sequence. A photograph of the aircraft instrument panel is also required to verify the navigation fit.

What to Expect on The Day

<u>Time</u>	<u>Event</u>
A/R - 1030 (Advisory)	Arrivals (following published procedures)
1000 - 1100	Registration, coffee, preparation as required
1030 Onwards	Route available, issue of competition packs and planning
1115 - 1200	Competition Briefing / Met Brief / NOTAM & Ops Brief
1200 - 1300	Lunch available
1300 Onwards	Taxy & take-off
1445 Onwards	Land and deliver logs/Loggers, tea/coffee as required
1515 Onwards	Depart for home base

Members of the Management Committee will be available throughout the day to answer any questions you might have.

Arrival

The formal briefing will be held at 1115 and will finish in time for lunch at 1200; you should aim to be at your chosen venue by 1030 to allow you to register, book-in/out with Ops, have a coffee and check the NOTAM/Met. When booking-in, you should annotate your entry with 'TOPNAV' and fees will be waived. Booking-out/in for the competition flight will be done centrally by the organisers once the 'running order' has been decided.

Format

The course will take around 80 minutes to complete with perhaps an extra 10 minutes for transit to/from off-airfield start/finish points – there is a shorter course for slower aircraft to keep the timings roughly the same – and you will be carrying a GPS Logger which will record your track, turning points, altitude and speed. You are invited to keep a written log on the sheets provided or on your chart and should take photographs of the turning points. These afford a back up should the Logger fail but also allow you to record details of decisions affecting your tracking, tracking action and wind finding, which will allow the judges to better assess your performance. The photographs help to ensure that you found and identified the actual turning point rather than simply turning on ETA; radio contacts, listening watches and airspace avoidance action should also be logged to allow the judges to form a picture of your airmanship.

The route will be available for copying as soon as you arrive and there will be plenty of time for planning before your assigned 'off chocks' time. If you are not ready at the assigned time, you will be given a new time. There should be no pressure, except your desire to win, at this or any other stage – the idea is to have a fun day out!

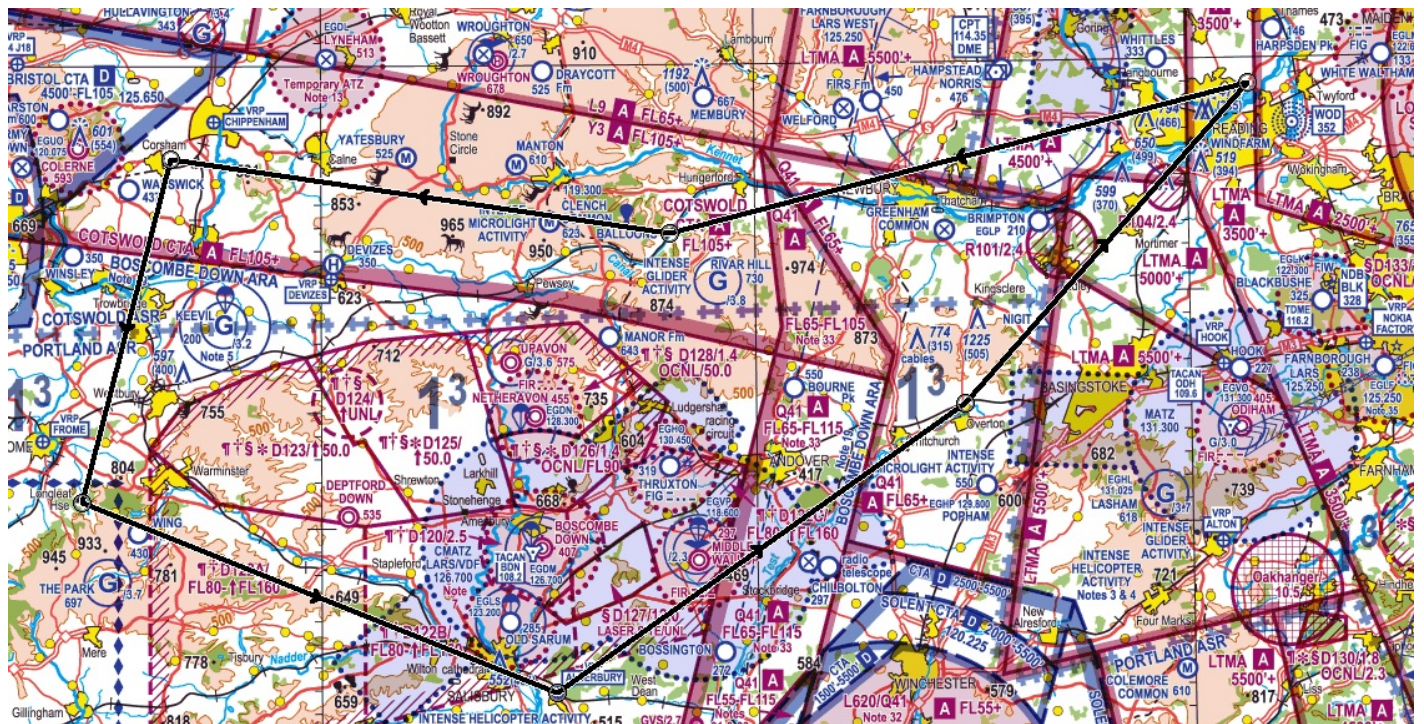
You will need the following kit:

- **In Date Charts.** A CAA 1:500000 North for TOPNAV North and a CAA 1:500000 South for TOPNAV South and TOPNAV West should be the minimum carried. The 1:250000 charts of the relevant area are useful for detail and the most successful past entrants have used these for navigation. All of the turning points will be easily identifiable from the 1:500000 charts.
- **Plotting Kit.** You will need equipment for plotting your turning points and route; this should include a minimum of:
 - **Marker Pens.** Permanent (fine) for lettering and permanent (medium) for track lines/turning points work best – water soluble ink is great for corrections, not so great when exposed to light rain or sweaty thumbs! Something to clean permanent pen off charts is useful – meths works but is not recommended because of the fumes – injection swabs are very good but can lead to funny looks when you buy them in bulk...
 - **Rule.** A rule with the scale(s) appropriate to your chart(s) is vital. Some navigators shorten them for ease of manipulation in the cockpit and others use flexible items; notches cut at suitable intervals allow one stroke of the pen to produce a track line with 'automatic' distance-to-go marks. A rule with a suitable circle cut in it can be used as a neat stencil for turning point circles. There are dozens of varieties available; the choice is yours, as is how you modify it.
 - **Protractor.** Obviously a vital item and again there is a variety of different types available. One with a parallel rule and/or turning point circle, heading box stencils etc is more useful than a straight protractor. Full 360° items are easier to use than the half circle type.
 - **Pencils.** You will need a pencil for the log; the best for this job are the click-for-lead type with a built in eraser. You will need an attachment/secure stowage to stop your pencil becoming a loose article hazard.
- **Camera.** You must carry a camera to photograph your crew and each turning point. A photograph of your instrument panel will assist the judges in assessing your navigation fit and awarding points. If possible, carrying a back up camera and spare batteries/film would be wise.
- **Clipboard.** A clipboard is useful for keeping the paper under control and as a firm surface for writing. The 'Pilot Shop' kneeboard types are good but customising a standard A4 item also works well, especially the 'fold over' type. Take care that your customised item is free of loose article hazards and does not interfere with the controls.

The turning points will be provided in table form as part of the log form you might wish to complete:

To	Position	Description	w/v	Trk (°M)	Dr	Hdg (°M)	TAS	GSpd	Leg Dist	Leg Time	ETA	ATA	Time	Observations
A	5343N 00107W	Power Station												
B	5351N 00027W	Beverley Racecourse												
C	5428N 00112W	Stokesley VRP												

This is an example form and there may be additional columns on the day. A4 size charts of the route will also be available and, whilst these are ideal for 'log-on-chart' notes, they must not be used for navigation:



Marking

The aim of the TOPNAV Competition is to encourage good general airmanship and promote excellence in visual navigation by GA pilots and crews; these are the guiding principles in the marking of the competition. Broadly speaking, the marking scheme is as follows:

<u>Action</u>	<u>Qualifier</u>	<u>Scoring</u>
Planning	On a form to be handed in with GPS tracker	Up to 20
Flying the planned track	Per % of total distance within 0.5 nm of planned track <small>(NB. The area within 1.5nm of a TP is not part of the total distance to allow for positioning for a photo whilst aiming to pass within 0.5nm of TP)</small>	1
Deviation from track	If noted in log/log-on-chart or explained at verbal debrief	No penalty
Log keeping/'Hot' Debrief	On a form to be handed in with GPS tracker or verbal debrief notes	Up to 10
Airmanship	As noted in the log/log-on-chart or debriefed	Up to 20
Awareness	Airspace etc, as noted in the log/log-on-chart or debrief	Up to 10
Overflight of a WP	Within 0.5 nm, per WP of seven	5
ATA matching (revised) ETA at \pm 1 minute, per WP of seven WP		5
Highest possible score		230

In assigning subjective scores for Airmanship and Awareness above, the judges will use the guide below:

- Marks are deducted for:
 - Using Satellite Navigation Systems (major deduction) – allowance will be made for equipment that is integral to aircraft systems and cannot safely be disabled.
 - Experience (minor deduction).
 - Sophisticated navigation equipment, which removes the onus on basis navigational calculation eg. RNAV.
 - Major alterations of heading not explained in the log.
 - Not handing in log/Logger within 15 minutes after landing.
 - Unauthorised entry to an ATZ or NOTAM Advisory Avoidance Area.
 - Quality of log keeping and/or failure to supply turning point photographs.
- Marks may be added for:
 - Poor aircraft navigation fit.
 - Complete, legible and accurate log keeping, including noting broadcast safety information.
 - Timely corrective action and logging of reason.
 - Airmanship – as implied by log entries.
- Crews will be disqualified for:
 - Infringing Controlled or Restricted Airspace (including Danger Areas).
 - Any breach of Flying Regulations.
 - Use of undeclared navigation equipment.
 - Failure to hand in log/logger within 30 minutes of landing.

Where marks may be deducted, evidence in the log may provide mitigation resulting in the loss of fewer marks, or indeed none at all. The experience marks are discretionary and may be added for exceptionally inexperienced navigators or deducted for exceptionally experienced crews or not awarded at all. Quality of log keeping is entirely

subjective but a sparse log will not earn points and will not explain logger events thus potentially losing more marks. For the subjective marks, the judges' decision is final.

Planning

Clearly, the more planning you do before flight, the more capacity you will have to devote to your en-route navigation; to that end, there is now plenty of time for planning and the pre-flight pressure has been alleviated. The time available should be devoted to planning, route study and making sure that you are ready to fly and so, there is much you can do beforehand that will allow you to concentrate your efforts and capacity on the actual planning process:

- Pre-crease your chart so that it can be folded easily to show the route and a minimal area around once you have the route plotted.
- Clean all old markings off the chart.
- Highlight the lat/long grid on the chart.
- Calculate and mark area Safety Altitudes on your chart.
- Familiarise yourself with salient features in the likely route area.
- Practice using your plotting kit (in the air if practicable).
- Plot NOTAM the night before and check them on the day – an update will be given at the Briefing.
- On the day, study the low level wind forecast and mark vectors on your chart.

Log Keeping

Completing a navigation log is a good way of ensuring that you follow a sound VFR navigation work cycle and is always a good practice. The log is not, as some believe, an exercise in handwriting. The judges rely heavily on the logger to reproduce the actual track over the ground; however, even the best equipment can fail. In addition, the judges will take note of any deviation from the required flight track shown by the logger and seek to find a reason. An explanation for the deviation in the log may not only protect you from a deduction in points but may even result in the award of extra points for good airmanship. In TOPNAV there are marks available for good log keeping and the log is a record of your reasons for deviations from track and/or your actions to regain track when required; thus it provides the mitigation where your Logger shows that you were off the planned route. A simple log can be kept by making notes on your chart and you can use the A4 chart you will receive on the day for this; an example is at **Annex A**. A photograph or photocopy of you annotated chart would also be acceptable. A more detailed log will give the judges a better understanding of your actions, which could save you penalty points, and of your airmanship, which could add to your bonus marks. The log forms are self explanatory and a worked example is at **Annex B**. You will notice that the log form allows for mid-leg recalculation of w/v, drift and groundspeed, which will give rise to altered headings and a revised ETA. The last entered ETA will be used with ATA to decide your early/late penalties, if any; however, simple entry of a 'revised' ETA matching the ATA will not work without supporting entries! Tracking actions, weather avoidance, safety information, bonus answers etc should be recorded against a time in the 'Observations' column. In the event of two identically flown entries the log could be the decider between first and runner-up!

Navigation Techniques

The choice VFR navigation technique that you employ is entire left to you; the RIN VFR Navigation Techniques Booklet contains a guide to some of the methods in common use. **Annexes C and D** are some worked examples of the RAF MDR (Mental Deduced Reckoning) technique and an aide-memoire kneeboard; **Annexes E and F** are the graphical calculators, instructions and worked examples for the VORTRACK system, which, once mastered, is simple, easy to use in the air and very accurate. The graphical calculator sheet is designed to have the appropriate tables for your declared TAS pasted into the space provided; the sheet may then be copied if you need one for each leg or you can 'fablon' it to your clipboard and use a chinagraph/marker pen. The VORTRACK compass rose can also be used with the RAF MDR system to help you to visualise the vectors.

Departure

After handing in your Logger and completed log, refreshments will be available and you are free to depart for your home base whenever you wish. Booking out arrangements will be briefed on the day; however, individual pilots are ultimately responsible for ensuring that this is done and that they comply with local departure procedures.

Postponement

The Management Committee will make continuous assessments of the forecast weather up to and including the day of the competition. Multiple routes are available in case of marginal weather in parts of the competition area. The go/no go decision will be made as early as possible with a view to minimising wasted transit time by competitors. If the forecast for the day is irredeemably poor, the competition will be postponed and arrangements made for entrants to fly on a more suitable day. This may be by a complete restaging of the event or by allowing a period when entrants can pick up competition packs from Ops at Retford/Gamston or White Waltham. Please ensure that you inform the Management Committee of any changes to your contact details prior to the competition.

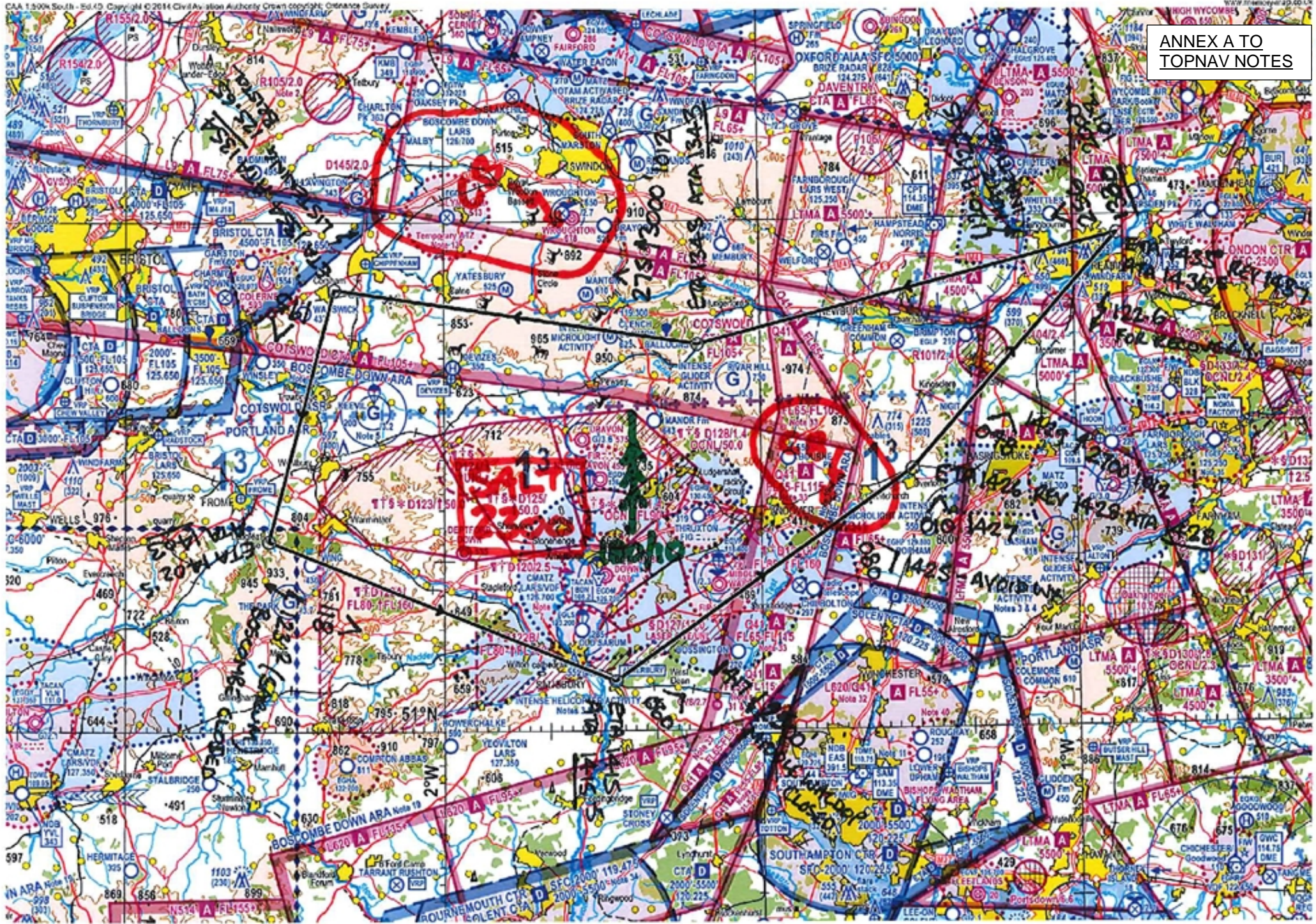
Notification of Winners and Prize Giving

The marking of the competition begins as soon as it is finished; however, the marking cannot be completed without the turning point photographs – please ensure that these are sent in as soon as possible and in any case within 14 days. An order of merit will be established and prizes allocated as deemed appropriate. The prize winners will be invited to attend a prize giving ceremony during the RIN AGM at 1430 on 15 July 2015.

Good Luck!

Annexes

- A. Log-on-Chart Example
- B. Log Sheet Example
- C. MDR Technique and Examples
- D. MDR Kneeboard
- E. VORTRACK Calculator and Groundspeed/Drift Tables
- F. VORTRACK Example and Instructions



ANNEX B TO TOPNAV NOTES – EXAMPLE LOGSHEET

To	Position	Description	W/V	Trk (°M)	Dr	Hdg (°M)	TAS	GS	Leg Dist	Leg Time	ETA	ATA	Leg SALT	Leg ALT	Time	Observations			
A	5343N 00107W	Power Station	210/15	148	10P	158	90	83	5	3.6	1400	1400	2000	1500	1350	Wx 200/10 Sct 050 +14/+10			
																Wrn Burn Glider Site active			
																	1356	↗Take off	
																		1356	T/O plus 25s S/H 148M
																		1400	↗Cruise climb 3000' 1006 set -lowest forecast RPS
B	OTR307/15	Racecourse	210/15	075	8P	083	90	98	25	15.3	1415 ³	1415	2000	3000	1400	S/H 083 for Beverley Racecourse			
																Level 3000' 1006 set			
																	1409	1nm S abm HOSM - on trk/time	
																		1410	Beverley Racecourse in sight
																		1413	↗Cruise climb 4500' 1006 set
															1414	↘Leeming LARS Basic Service			
C	GAM71.5 POL54	Small Town	210/15	328	8S	320	90	100	45.5	28 ⁵	1443 ⁵	1439	3300	4500	1416	Level 4500' 1006 set			
																1427 ⁵ ⊙ E end Malton bypass			
																		TMG 331/QS 110	
																		1428	A/H 320 new W/V 200/30
																		1436	↘Cruise descent 3000' 1006 set
																Continuing on Barnsley RPS			
D	5428N OTR341	Rail/River Bridge	200/30	093	16P	109	90	102	20	12	1451	1454	3300 ↘ 2800	3000	1439	Level 3000' 1006 set			
																1444 ⁷ ⊙ Railway & River DTG 11nm new			
																		Qs 95 revise ETA	
																		1453	↗Cruise climb 3500' 1006 set

Information		Runway	QFE	QNH	RPS1	RPS2	Squawk	Surface W/V	Other
		24	1003	1004	Barn 1006	Humb 1008	7000	200/10	Tyne 1008
En-route Frequencies	Station/Facility	Sherburn	Linton LARS	Leeming LARS	London Info	Tees LARS			
	Frequency	122.6	118.55	127.75	125.475	118.85			

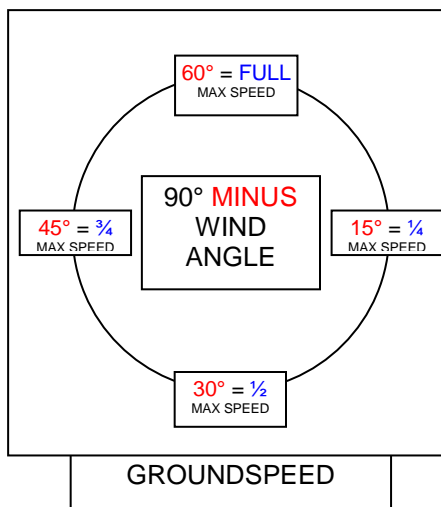
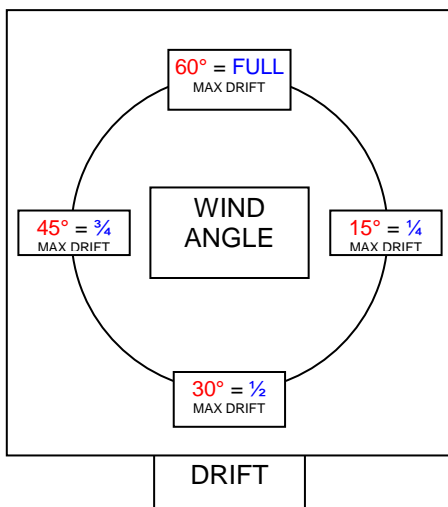
ANNEX C TO TOPNAV NOTES – MDR

MENTAL DEDUCED RECKONING (MDR)

There are numerous methods for solving the triangle of velocities and arriving at values for drift and groundspeed for use in the air. Mental Deduced Reckoning (MDR) is widely used in the RAF, especially in aircraft with restricted space in the cockpit; it is quick, versatile, can be applied across a wide range of speeds and, once mastered, very easy to use. The system of MDR taught in the RAF is based on TAS and works well at low-level across the speed range encompassed by light aircraft and helicopters at one end and fast jets at the other; it is very useful when a check of the planned calculations is required and comes very much into its own when the plan is not working and a new one is needed – urgently! No equipment is required and the mental load can be eased by using cockpit instruments, such as a HSI or vertical compass to envisage the vectors.

It works via the following steps:

1. Calculate the Maximum Drift (Max Dr) by taking the wind speed in knots and dividing by TAS in nm per minute (or multiply wind speed by 60 and divide by TAS if you prefer).
2. Work out the Wind Angle (WA), which is the least angular difference between track and wind direction. Using the DI or the HSI can take the pain out of this.
3. Decide whether you have a tailwind or headwind component.
4. Use the diagrams below to work out the figures for drift and groundspeed correction. These are related to a clock face, $15 = \frac{1}{4}$, $30 = \frac{1}{2}$ etc, and are designed to be memorised but they can easily be drawn out on a kneeboard.



Example 1: Track 240°, wind 285/18, TAS 90 knots.

Max Dr is: $18 \div 1.5 = \underline{12}$

WA is: $285 - 240 = \underline{45^\circ}$ and is a headwind

Drift is: $12 \times \frac{3}{4} = 9$ Port, therefore heading to make good track 240° is 249°

Groundspeed is: $90 - 45 = 45$ and so $18 \times \frac{3}{4} = 13.5$ (14) knots are applied as headwind = 76 knots

Example 2: Track 250°, wind 340/20, TAS 120 knots.

Max Dr is: $20 \div 2 = \underline{10}$

WA is: $340 - 250 = \underline{90^\circ}$ and is all crosswind

Drift is: 10 Port (ie. Max Dr), therefore heading to make good track 250° is 260°

ANNEX C TO TOPNAV NOTES – MDR

Groundspeed is: $90 - 90 = 0$ and so there is no groundspeed correction

Example 3: Track 270° , wind 165/25, TAS 150 knots.

Max Dr is: $25 \div 2.5 = \underline{10}$

WA is: $270 - 165 = 105^\circ$ but where this angle is greater than 90° it must be subtracted from 180° to give WA ie. $180 - 105 = \underline{75^\circ}$ and is a tailwind

Drift is: 10 Stbd (Max Dr is applied for WA > 60°), therefore heading to make good track 270° is 260°

Groundspeed is: $90 - 75 = 15$ and so $25 \times \frac{1}{4} = 6.25$ (6) knots are applied as tailwind = **156 knots**

Example 4: Track 210° , wind 170/25, TAS 80 knots.

Max Dr is: $25 \div 1\frac{1}{3}$ (or $25 \times \frac{3}{4}$) = $18\frac{3}{4}$

WA is: $210 - 170 = 40^\circ$ and is a headwind

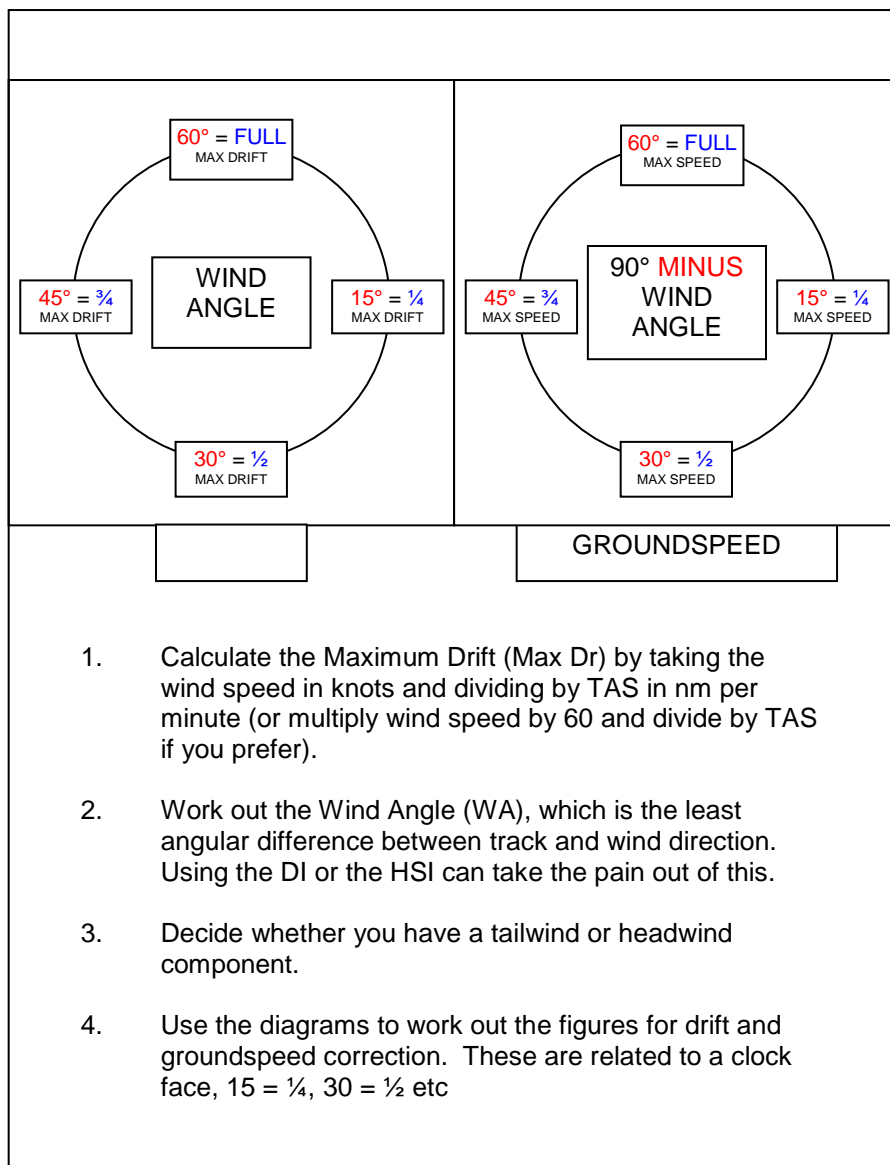
Drift is: $18\frac{3}{4} \times$ a-bit-less-than $\frac{3}{4} = 12$ Stbd, therefore heading to make good track 210° is 198°

Groundspeed is: $90 - 40 = 50^\circ$ and so, you need to apply between $\frac{3}{4}$ and all 25 ie. 20 as headwind = **60 knots**

Top Tips

1. Always round down a tailwind and round up a headwind.
2. A wise navigator always gives a heading of 249° as 250° or 222° as $220^\circ/225^\circ$ - have you ever seen a GA compass calibrated in single degrees? Have you ever met a pilot who can fly to 1° between marks on the compass? It is far better for both pilot and navigator to keep it simple and for them to know which way the likely error will be. Where there is a choice it is wise to round into the wind ie. for port drift, round up – the drift is always more than you thought!
3. When using MDR, it is easiest to recalculate ETAs by working out the percentage difference between actual and planned groundspeed then applying that difference to the planned leg time.

ANNEX D TO TOPNAV NOTES – MDR KNEEBOARD



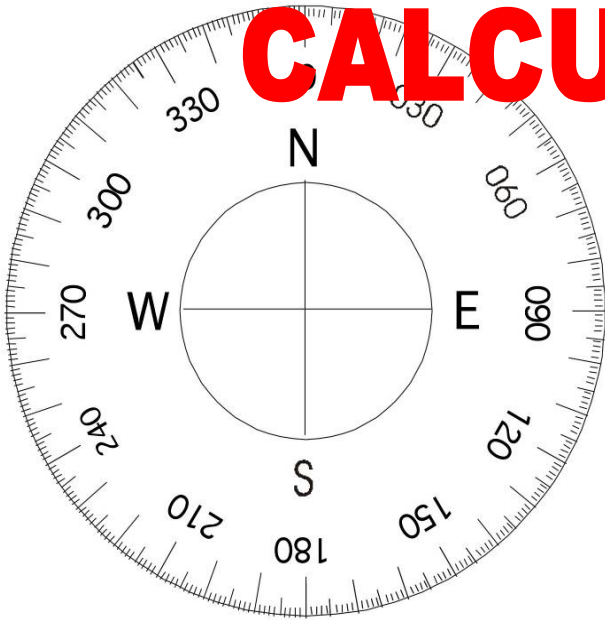
ANNEX D TO TOPNAV NOTES – MDR KNEEBOARD

TOPNAV - VORTRACK

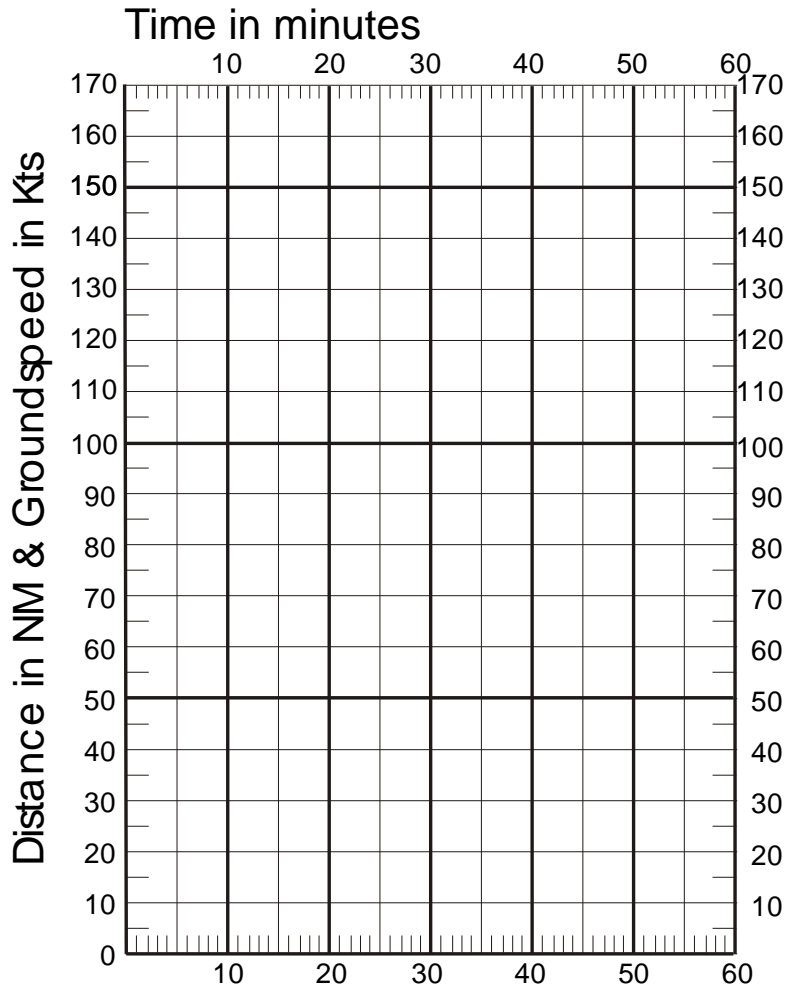
VORTRACK navigation aid designed by Gordon Wansborough-White

EDINI

CALCULATOR



W/V	
Track(T)	
Wind Angle	
TAS	
Speed Correction	
Groundspeed	
Variation	
Track(M)	
Drift	
Heading(M)	
Deviation	
Heading(C)	



Paste the Drift & Wind Component Table for your declared TAS here

ANNEX E TO TOPNAV NOTES – CALCULATOR

DRIFT & WIND COMPONENT TABLES

TAS 60kts						
Wind Angle	10kt Wind		20kt Wind		30kt Wind	
	Drift	Corr ⁿ	Drift	Corr ⁿ	Drift	Corr ⁿ

0	0	-10	0	-20		
10	2	-10	3	-20		
20	3	-9	7	-19		
30	5	-9	10	-18		
40	6	-8	12	-17		
50	7	-7	15	-15		
60	8	-6	17	-13		
70	9	-4	18	-10		
80	9	-3	19	-7		
90	10	-1	20	-3		
100	9	1	19	0		
110	9	3	18	4		
120	8	4	17	7		
130	7	6	15	11		
140	6	7	12	14		
150	5	9	10	17		
160	3	9	7	18		
170	2	10	3	19		
180	0	10	0	20		

TAS 80kts						
Wind Angle	10kt Wind		20kt Wind		30kt Wind	
	Drift	Corr ⁿ	Drift	Corr ⁿ	Drift	Corr ⁿ

0	0	-10	0	-20	0	-30
10	1	-10	3	-20	4	-30
20	2	-9	5	-19	7	-29
30	3	-9	7	-18	11	-27
40	4	-8	9	-16	14	-25
50	5	-7	11	-14	17	-23
60	6	-6	13	-12	19	-19
70	6	-4	14	-9	21	-15
80	7	-3	14	-6	22	-11
90	7	-1	15	-2	22	-6
100	7	1	14	1	22	0
110	7	3	14	5	21	5
120	6	4	13	8	19	11
130	6	6	11	11	17	16
140	5	7	9	14	14	21
150	4	8	7	17	11	25
160	2	9	5	19	7	28
170	1	10	3	20	4	29
180	0	10	0	20	0	30

TAS 100kts						
Wind Angle	10kt Wind		20kt Wind		30kt Wind	
	Drift	Corr ⁿ	Drift	Corr ⁿ	Drift	Corr ⁿ

0	0	-10	0	-20	0	-30
10	1	-10	2	-20	3	-30
20	2	-9	4	-19	6	-29
30	3	-9	6	-18	9	-27
40	4	-7	7	-16	11	-25
50	4	-7	9	-14	13	-22
60	5	-5	10	-11	15	-18
70	5	-4	11	-9	16	-14
80	6	-2	11	-5	17	-10
90	6	0	12	-2	18	-5
100	6	1	11	2	17	1
110	5	3	11	5	16	6
120	5	5	10	9	15	12
130	4	6	9	12	13	17
140	4	8	7	15	11	21
150	3	9	6	17	9	25
160	2	9	4	19	6	28
170	1	10	2	20	3	29
180	0	10	0	20	0	30

TAS 120kts						
Wind Angle	10kt Wind		20kt Wind		30kt Wind	
	Drift	Corr ⁿ	Drift	Corr ⁿ	Drift	Corr ⁿ

0	0	-10	0	-20	0	-30
10	1	-10	2	-20	3	-30
20	2	-9	3	-19	5	-29
30	2	-9	5	-18	7	-27
40	3	-8	6	-16	9	-24
50	4	-7	7	-14	11	-21
60	4	-5	8	-11	13	-18
70	5	-4	9	-8	14	-14
80	5	-2	9	-5	14	-8
90	5	0	10	-2	15	-4
100	5	1	9	2	14	2
110	5	3	9	5	14	7
120	4	5	8	9	13	12
130	4	6	7	12	11	17
140	3	8	6	15	9	21
150	2	9	5	17	7	25
160	2	9	3	19	5	28
170	1	10	2	20	3	29
180	0	10	0	20	0	30

TAS 140kts						
Wind Angle	10kt Wind		20kt Wind		30kt Wind	
	Drift	Corr ⁿ	Drift	Corr ⁿ	Drift	Corr ⁿ

0	0	-10	0	-20	0	-30
10	1	-10	1	-20	2	-30
20	1	-9	3	-19	4	-29
30	2	-9	4	-18	6	-27
40	3	-8	5	-16	8	-24
50	3	-7	6	-14	9	-21
60	4	-5	7	-11	11	-17
70	4	-4	8	-8	12	-13
80	4	-2	8	-5	12	-8
90	4	0	8	-1	12	-3
100	4	1	8	2	12	2
110	4	3	8	6	12	7
120	4	5	7	9	11	13
130	3	6	6	12	9	17
140	3	8	5	15	8	22
150	2	9	4	17	6	25
160	1	10	3	19	4	28
170	1	10	1	20	2	29
180	0	10	0	20	0	30

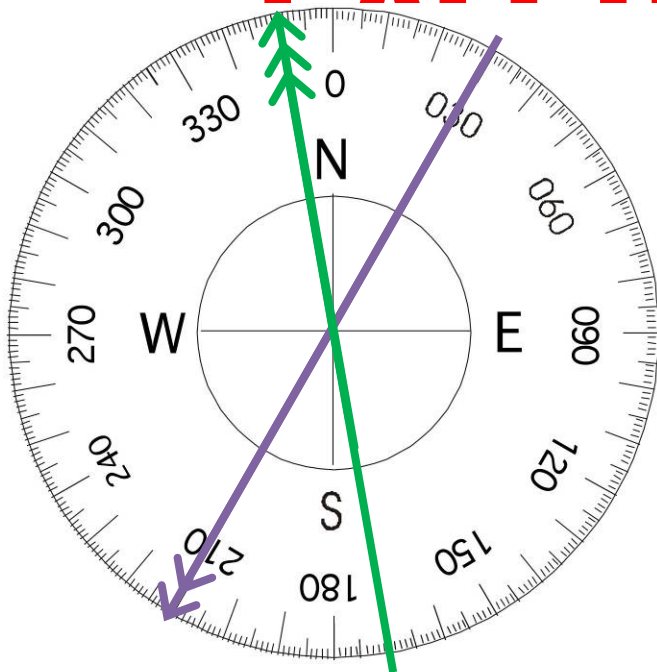
TAS 160kts						
Wind Angle	10kt Wind		20kt Wind		30kt Wind	
	Drift	Corr ⁿ	Drift	Corr ⁿ	Drift	Corr ⁿ

0	0	-10	0	-20	0	-30
10	1	-10	1	-20	2	-30
20	1	-9	2	-19	4	-28
30	2	-9	4	-18	5	-27
40	2	-8	5	-16	7	-24
50	3	-7	6	-14	8	-21
60	3	-5	6	-11	9	-17
70	3	-4	7	-8	10	-13
80	4	-2	7	-5	11	-8
90	4	0	7	-1	11	-3
100	4	1	7	2	11	3
110	3	3	7	6	10	8
120	3	5	6	9	9	13
130	3	6	6	12	8	18
140	2	8	5	15	7	22
150	2	9	4	17	5	25
160	1	9	2	19	4	28
170	1	10	1	20	2	30
180	0	10	0	20	0	30

ANNEX E TO TOPNAV NOTES – CALCULATOR

TOPNAV - VORTRACK

The VORTRACK system is a very simple method of graphically solving the triangle of velocities to give drift and groundspeed corrections. Track, TAS and W/V are the first requirements; these are noted in the table and track and W/V are drawn onto the compass rose



W/V	170/25
Track(T)	210°T
Wind Angle	
TAS	80kts
Speed Correction	
Groundspeed	
Variation	2W
Track(M)	
Drift	
Heading(M)	
Deviation	
Heading(C)	

This gives the wind angle of 40°, which we can use to enter the 80kt TAS table to find the speed correction and drift. The table works in 10kt increments of wind and so, some interpolation is required; the drift is halfway between 9° and 14° (clearly to starboard from the compass rose diagram) and the headwind correction is halfway between -16kts and -25 – giving 12° Stbd drift and -20 groundspeed correction.

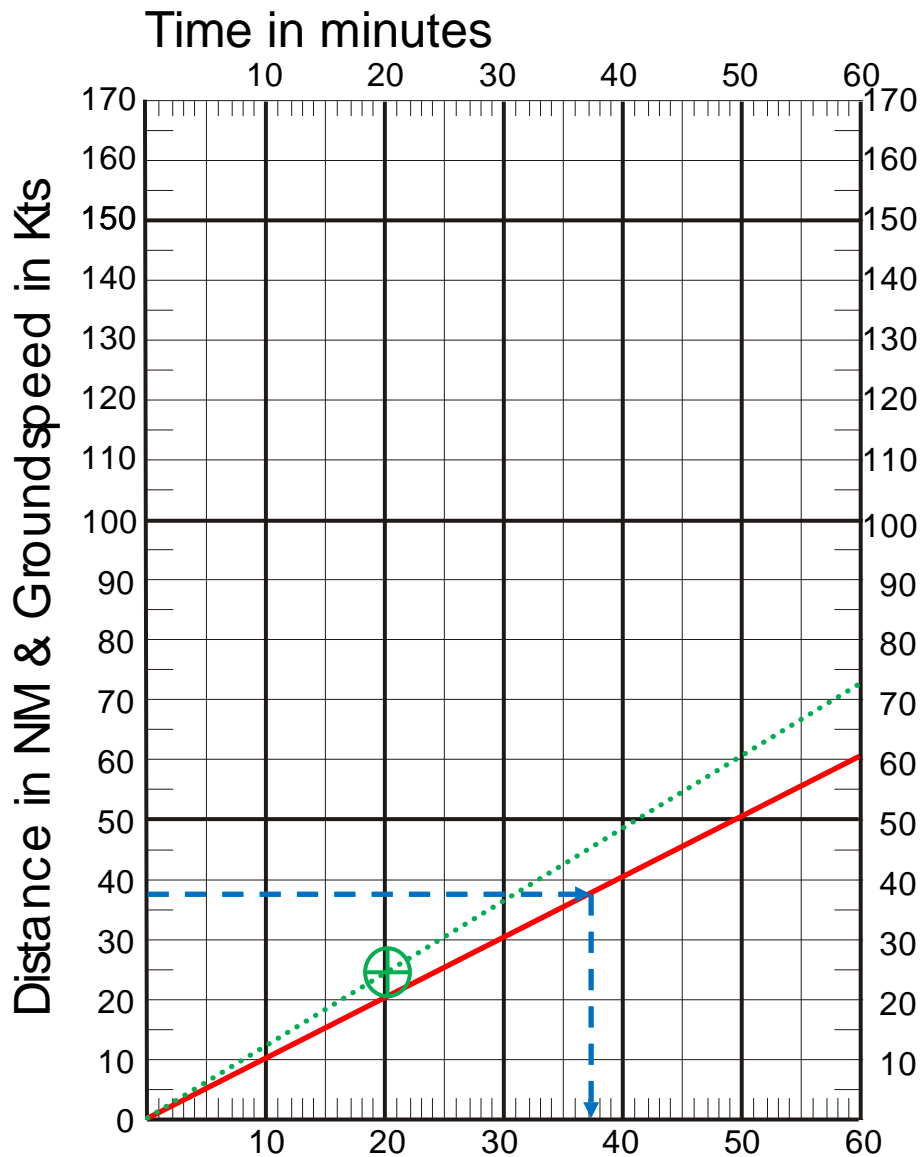
TAS 80 Kt						
Wind Angle	10kt wind		20kt wind		30kt wind	
	Drift	Corr	Drift	Corr	Drift	Corr

0	0	-10	0	-20	0	-30
10	1	-10	3	-20	4	-30
20	2	-9	5	-19	7	-29
30	4	-9	7	-18	11	-27
40	5	-8	9	-16	14	-25
50	6	-7	11	-14	17	-23
60	6	-6	13	-12	19	-19
70	7	-4	14	-9	21	-15

W/V	170/25
Track(T)	210°T
Wind Angle	40°
TAS	80kts
Speed Correction	-20
Groundspeed	60kts
Variation	2W
Track(M)	212°M
Drift	12S
Heading(M)	200°M
Deviation	3W
Heading(C)	203°C

ANNEX F TO TOPNAV NOTES – CALCULATOR EXAMPLE

This data can now be transferred to the log (or it could be placed directly there as it is extracted) and by applying groundspeed and leg distance to the graph below it is possible to quickly extract leg time and so, ETA at the next waypoint/turning point. To find these values, simply plot the groundspeed on the right hand scale and join this point to the origin. By entering the vertical scale with leg distance, the leg time can be read off the horizontal scale. Thus for a leg distance of 37nm the leg time is 37 minutes as shown.



After 20 minutes on this leg a fix is obtained showing that the aircraft is on track with 13nm to go to the turning point; there is less headwind than originally calculated and a revised ETA is required. By plotting 20 minutes against 24 miles, joining that point to the origin and extending the line to the right hand scale a revised groundspeed line is obtained – 72kts. The line can then be used with the original leg distance to produce a revised total leg time of 30 minutes and thus a revised ETA.