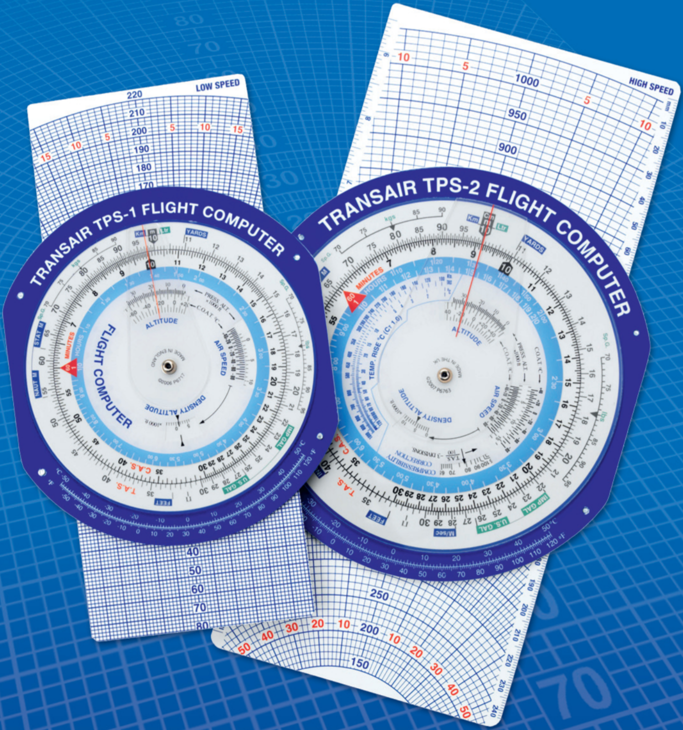
TRANSAIR
FLIGHT EQUIPMENT

TPS-1 & 2 Flight Computer

Instruction Manual



The
TPS-1 & 2
Flight Computer
Instruction Manual

Published by:

TRANSAIR
FLIGHT EQUIPMENT

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Introduction:

Transair Pilot Shop once again bring you fantastic new products... the

TPS-1 & 2 Flight Computers.

Manufactured from the finest materials, using the latest incredibly accurate tooling, the **TPS-1** and **TPS-2** represents the last word in Pilot's Flight Computers.

The **TPS-1** Flight Computer is designed for the student or PPL pilot, and covers all the requirements for the UK PPL exam syllabus.

The **TPS-2** Flight Computer is designed for the ATPL student or Professional pilot, and covers all the requirements for the UK ATPL exam syllabus including compressibility.

Calculations include; Speed, Time, Distance, Weight, Fuel, Pressure and Density Altitude, Conversions, Heading, Drift, Wind calculations and much more...

The Transair Flight Computers have been produced using a unique colour scheme which research has shown minimises confusion and makes the **TPS-1** and **TPS-2** the most user friendly flight planning computer money can buy.

To avoid the use of pens which in time will mark and discolour the information window, we decided to incorporate an integral Wind Arm on the **TPS-1** and **TPS-2**. Pilots will find this a great added feature that not only prolongs the life of the computer but also makes it easier and quicker to use!

The Calculation side of the TPS Computer

The calculation side of this computer consists of a stationary portion overlaid with a rotatable attached circular disc. The numbers along the outside of the stationary portion are referred to as the OUTER SCALE in this booklet (see diagram opposite).
The outer scale is used to represent distance, fuel, groundspeed, true airspeed, or corrected (true) altitude, depending on the calculation being performed.

The numbers on the edge of the rotating portion are referred to as the INNER SCALE in this booklet (see diagram opposite). The inner scale is used to represent time, calibrated or indicated airspeed, and calibrated or indicated altitude, depending on the calculation being performed.

The number "60" on the inner scale has been placed within a red triangle and is an Index (time index) (see diagram opposite). This index is used as a reference to a rate, such as knots (nautical miles per hour) or gallons per hour.

The number "10" on the inner and outer scale has been placed within a black arrow and is also an Index.

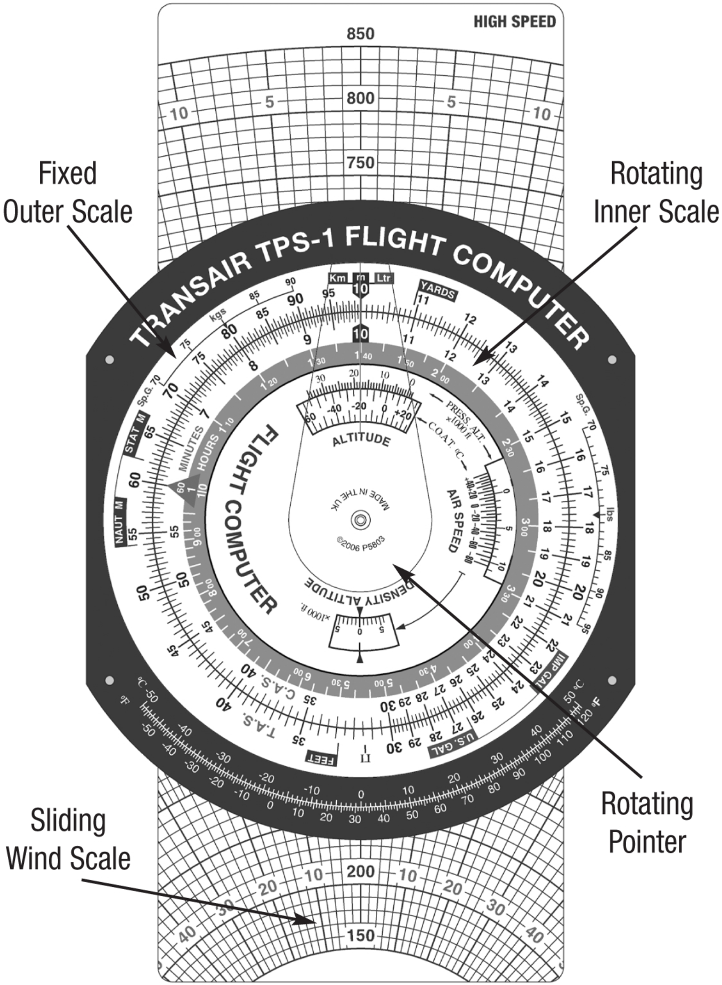
In the centre of the rotating portion are three windows used in corrected (true) altitude, density altitude, and true airspeed calculations (see diagram opposite).

Scale Values:

The numbers on the outer and inner scales represent multiples of 10 of the values shown.

Example:

The number "30" on either scale may represent 0.3, 3.0, 30, 300, or 3,000.
On both the outer and inner scales you will notice that the number of tick marks, or graduations, vary between numbers.


Fixed Outer Scale
Rotating Inner Scale
Rotating Pointer
Sliding Wind Scale
HIGH SPEED
TRANSAIR TPS-1 FLIGHT COMPUTER
FLIGHT COMPUTER
ALTITUDE
DENSITY ALTITUDE
AIR SPEED
PRESS. ALT. ×1000 ft
C.O.A.T. °C
MINUTES
HOURS
STAT M
NAUT M
YARDS
IMP GAL
U.S. GAL
FEET
C.A.S.
T.A.S.
MADE IN THE UK
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Examples:

The first tick mark to the right of "10" may represent 10.1, 101, 1,010, etc.
The first tick mark to the right of "18" may represent 1.82, 18.2, 182, etc.
The first tick mark to the right of "45" may represent 4.55, 45.5, etc.
The second tick mark to the right of "45" may represent 4.6, 46, 460, etc.
On the inner scale, minutes may be translated to hours and minutes by reference to the hour scale, which is below and inside the inner scale.

Example:

180 min., or "18" on the inner scale is also 3 hrs, as indicated by "3:00" below the "18." On the hour scale, the tick marks represent either 5 mins, or 10 mins.

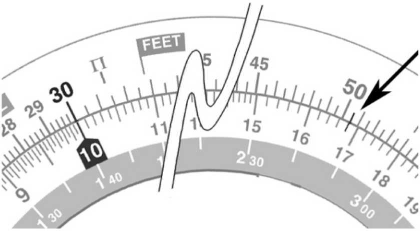
Example:

Between "1:30" and "1:40" the tick mark represents 5 mins. Between "3:30" and "4:00" each tick mark represents 10 mins.
The tick marks on the inner scale can be used to supplement the hour scale.
The calculator side of the flight computer is constructed so that any relationship, or ratio, between a number on the outer scale, and a number on the inner scale, will remain constant for all other numbers on both scales.
Rotate the inner circle so the "10" is opposite the "10" on the outer scale, and note that all the numbers around both circles are identical. Next, rotate "30" under "10" on the outer scale; now all numbers on the inner scale are three times those on the outer scale.

Calculation Examples:

Multiplication: 30 x 16.8

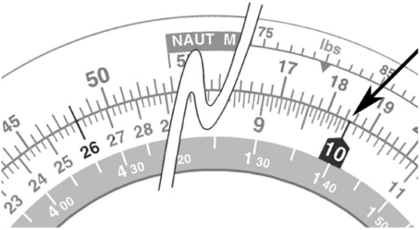
- Turn the arrow 10 (inner scale) below 30 (outer scale).
- Read above 16.8 (inner scale) the result 504 (outer scale).



Division: 48 ÷ 26

For division the same method is Used in reversed order.

- Set 26 (inner scale) below 48 (outer scale).
- Over the arrow 10 the result of 1.85 can be read



Standard conversion of measurement units:

The most commonly used units can be converted with the markers on the calculator. The following shows conversion factors for the most important units.

Distance:

NM - Nautical Mile	1 NM =	1.852 km	= 1.15 mile	= 6076 ft
mile - Statute Mile	1 mile =	1.609 km	= 0.87 NM	= 5280 ft
km - Kilometer	1 km =	0.54 NM	= 0.62 mile	= 3281 ft
m - Metre	1 m =	3.28 ft	= 1.09 yd	
ft - Feet	1 ft =	0.30 m	= 0.33 yd	
yd - Yard	1 yd =	0.91 m	= 3 ft	

Speed:

Kt - Knot	1 kt =	0.51 m/s	= 1.852 km/h	= 1.15 MPH
MPH - Miles per hour	1 MPH =	1.609 km/h		= 0.87 kt
Feet/min - Feet per minute	1 feet/min =	0.018 km/h		= 0.005 m/s
m/s - Metres per second	1 m/s =	3.6 km/h	= 1.94 kt	= 197 feet/min

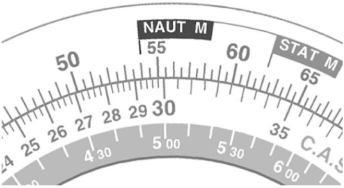
Volume:

ltr - Litre	1 ltr =	0.26 US GAL	= 0.22 IMP GAL
US GAL - US Gallon	1 US GAL =	0.83 IMP GAL	= 3.79 ltr
IMP GAL - Imperial Gallon	1 IMP GAL =	1.20 US GAL	= 4.55 ltr

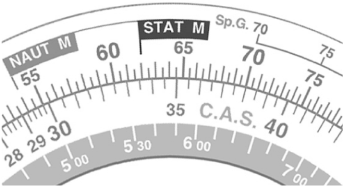
Mass:

kg - Kilogram	1 kg =	2.2 lb
lb - Pound (Imperial)	1 lb =	0.45 kg

Conversion of Distances:



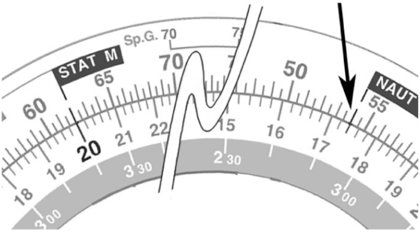
You can use the calculator side of your TPS Flight Computer to convert nautical miles (NM) to statute miles (SM), or knots (kts) to miles per hour (mph). Remember, the units you use must be equivalent, i.e., nautical miles and knots or statute miles and miles per hour. On the outer scale at "54" there is an arrow labelled "NAUT M" (nautical miles) and at "62" there is an arrow labelled "STAT M" (statute miles).



Example:

Convert: 200 mph to knots.

- Rotate the inner scale so that 200, or "20," is under the "STAT M" index arrow.
- Look at the "NAUT M" index arrow on the outer scale to determine 174 kts on the inner scale.



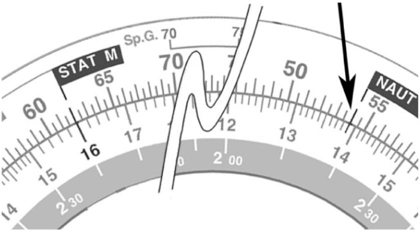
Use the TPS-1 to solve these practice problems.

NM	SM
113	___
125	___
___	122

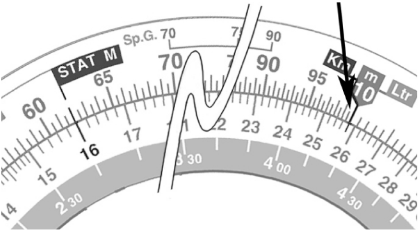
Example:

Convert: 160 SM to NM and km.

- Rotate 160 (inner scale) to the marker "STAT M" (outer scale).

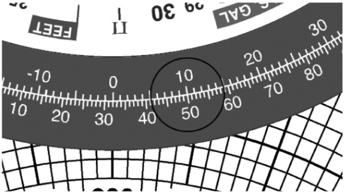


- At "NAUT M" read 139 miles and at the “Km” marker read 258 kms.
- Metres, yards, feet, litres, Imperial gallons and US gallons can all be converted in the same way.



Temperature Conversions:

A temperature conversion scale is provided for your use at the bottom of the Computer. The top scale is degrees Celsius and the bottom scale is degrees Fahrenheit.



Example:

Convert 50°F to Celsius.

- Locate 50°F on the bottom scale. Directly above read 10°C.

Speed, Distance and Time Calculations:

Speed, distance and time are three interrelated elements.
With any two of these elements, the third can be found. Note that in any problem both the speed and distance must be in either SM or NM. Distance in kilometers must be converted into nautical miles first.
You can convert SM to NM or vice versa easily as explained previously.

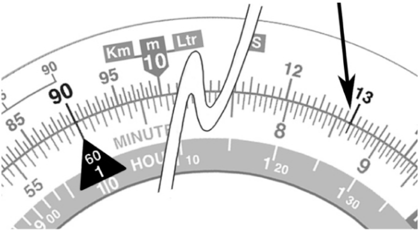
Determining Time Required:

With groundspeed and the distance given you can calculate time.
Time equals distance divided by groundspeed.

Example:

How much time will it take to fly 130 NM at a groundspeed of 90 kt.?

- Rotate the inner scale so the "60" Index is opposite 90 kts, or "90", on the outer scale.
- Locate 130 NM, or "13", on the outer scale. Under 130 on the outer scale read 86.5 mins on the inner scale or 1:26.5 on the hour scale.



Use your TPS Flight Computer to solve these practice problems:

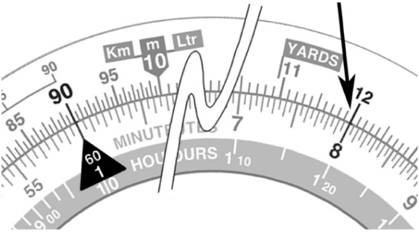
Groundspeed	Distance	Time?
80 kts	300 NM	___
105 kts	62 NM	___
120 mph	142 SM	___

Determining Distance:

With groundspeed and time given you can determine distance. Distance equals groundspeed multiplied by time.

Example:

Flight time is 00:08 hrs
Ground speed GS 90 kts.
What distance can be covered?



- Set "60" Index (inner scale) to 90 kt (outer scale).
- At 8 min (inner scale) read 12 NM (outer scale).

Use your TPS Flight Computer to solve these practice problems:

Groundspeed	Time	Distance?
95 kts	17 mins	___
105 kts	43 mins	___
120 mph	1 hr 24 mins	___

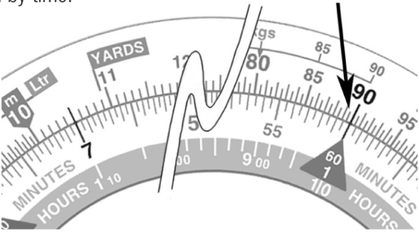
Determining Groundspeed:

With time and distance given you can determine groundspeed.
Groundspeed equals distance divided by time.

Example:

Distance 10.5 NM, flight time 7 min.
What is the ground speed GS?

- Set 7 min (inner scale) to 10.5 NM (outer scale).
- At the "60" Index read 90 kt.



Use your TPS Flight Computer to solve these practice problems:

Distance	Time	Groundspeed?
5.5 NM	3 mins	___
15 NM	9 mins	___
5 SM	4 mins	___

Fuel Calculations:

You may calculate either fuel used, fuel consumption rate, or time remaining (endurance) using calculations similar to those for speed, distance and time. These computations are made on the flight computer in the same way as time and distance calculations, except that gallons are used in place of miles.

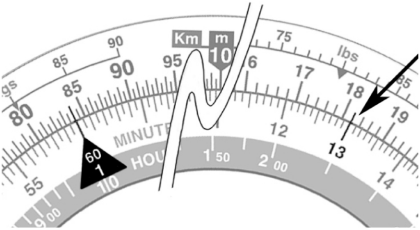
Determining Amount of Fuel Used:

With fuel consumption rate and the time given you can determine fuel used.
Fuel used equals fuel consumption rate multiplied by time.

Example:

How much fuel will be used during a flight of 2 hrs and 10 mins if the fuel consumption rate is 8.4 gallons per hour (GPH)?

- Rotate the inner scale so the "60" Index is opposite 8.4, or "84," on the outer scale.
- Locate 2:10 on the hour scale or 130 mins on the inner scale.
- Opposite 130 is 18.2 gallons on the outer scale.



Use your TPS Flight Computer to solve these practice problems:

Consumption Rate	Time	Fuel Used?
7.0 GPH	30 mins	___
10.2 GPH	2 hrs 5 mins	___
9.4 GPH	90 mins	___

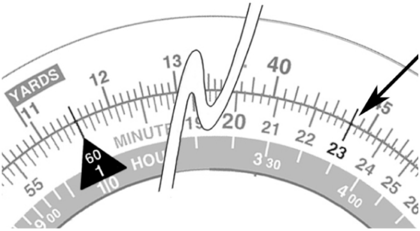
Determining Endurance:

With fuel consumption rate and usable fuel on board the airplane given you can determine endurance, or time that the airplane can remain airborne.
Endurance equals amount of fuel divided by the fuel consumption rate.

Example:

If the fuel consumption rate is 11.5 GPH and there is 44 gallons of usable fuel, how long can the airplane fly?

- Rotate the inner scale so the "60" Index is opposite 11.5 on the outer scale.
- Locate 44 on the outer scale. Opposite 44 on the inner scale is 230 mins, or 3 hr. 50 min.



Use your TPS Flight Computer to solve these practice problems:

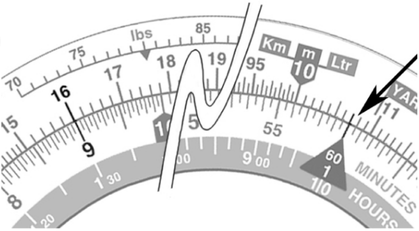
Consumption Rate	Usable Fuel	Endurance (Time)?
8.2 GPH	24.5 gals	___
10.6 GPH	50.0 gals	___
9.0 GPH	38.0 gals	___

Determining Fuel Consumption Rate:
With the amount of fuel used and the time given you can determine the fuel consumption rate.
Fuel consumption rate equals fuel burned divided by time.

Example:

If an airplane used 16 gals on a 1 hr. 30 mins flight, what was the fuel consumption rate in gallons per hour (GPH)?

- Rotate the inner scale so that 1:30 on the hour scale, or 90 on the inner scale, is opposite 16 on the outer scale.
- The fuel consumption rate is on the outer scale opposite the "60" Index, which is 10.7 GPH.



Use your TPS Flight Computer to solve these practice problems:

Time	Fuel Used	Consumption Rate?
54 mins	17 gals	___
1 hr 15 mins	10.4 gals	___
3 hrs 40 mins	36 gals	___

Conversion of Volume to Weight:

Precise fuel planning is an essential part of flight preparation. In practice several ways of measuring fuel are in use e.g. by volume (Imperial gallons, US gallons, Litres) or by weight (kilograms, pounds). The conversion of units from one to another is therefore very important.

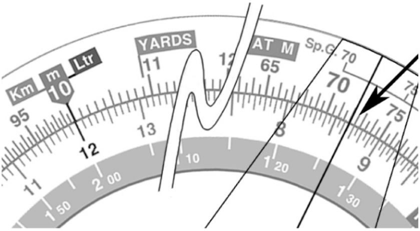
Specific Gravity (Sp.G.) is needed to convert volume into weight, and vice versa.
The mass of a volume unit of a material is called Specific Gravity and is generally given in kg/litre.

The TPS Flight Computer contains conversion scales for Sp.G. in kg and in lbs.

Example:

Volume of fuel 120 litres, Specific Gravity 0.72 kg/litre.
What is the weight?

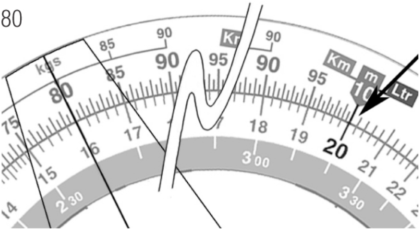
- Rotate volume 120 (inner scale) to marker ltr (outer scale).
- Set hairline of cursor to 0.72 on Specific Gravity scale (kg).
- Read 86.5 kg (inner scale) at the hairline.



Example:

Fuel load 1600 kg Specific Gravity 0.80
How many litres is this?

- Rotate the hairline of the cursor to 0.80 on the Specific Gravity scale (kg). Set 1600 (inner scale) under the hairline.
- Read the result of 2000 litres on the inner scale under the ltr marker.



Calculation and Definition of Altitudes:

Height: Vertical displacement above a fixed point, usually the airfield; altimeter sub-scale is set to QFE.

Altitude: Vertical displacement above MSL (mean sea level). Altimeter sub-scale is set to QNH.

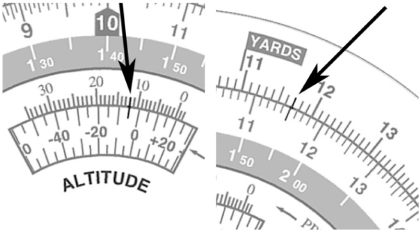
Pressure Altitude: The indicated altitude if the adjustable altimeter scale is set to 1013.2 hPa or 29.92 in HG International Standard Pressure (ISA).

Density Altitude and True Altitude are calculated from the Pressure Altitude as a base. If the indicated pressure does not comply with ISA, it needs to be converted to obtain the Pressure Altitude. Pressure Altitudes are lower for pressures above 1013.2 hPa, and vice versa (subtract or add 30 feet per millibar).

Example:

Altitude QNH 11,500 feet, Pressure altitude 12,000 feet,
Outside Air Temperature OAT –5°C
What is the True Altitude?

- Rotate 12,000 feet to OAT -5°C in the ALTITUDE window.
- At indicated altitude QNH of 11,500 feet (inner scale) read true altitude 11,700 feet (outer scale).

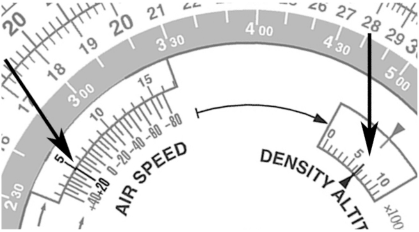


The Density Altitude is a very important issue for the interpretation of the performance tables in the aircrafts flight manual. Data in the table is based on ISA conditions at the present temperature at the altitudes indicated.
Deviation from temperature means deviation from density altitude.
Increase of temperature means increase of density altitude and vice versa.
Correction factors are given in most flight manuals.
If they are missing, they can be calculated with the TPS Flight Computer.

Example:

Pressure Altitude 5000 feet Temperature OAT +20°C
What is the density altitude?

- The temperature is higher than ISA at given altitude.
- The density altitude thus will be higher than the pressure altitude.
- In the window AIR SPEED Rotate +20°C to 5000 feet.
- The DENSITY ALTITUDE of 6700 feet can be read from the arrow.



Definition of Speeds:

The Primary use of the Air Speed window is for the determination of the True Air Speed (TAS). You need TAS for navigational tasks on the “Wind” side of your TPS Flight Computer. Four types of speeds are used:

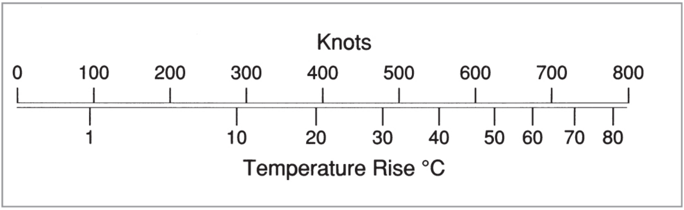
IAS (Indicated Airspeed)
This is normally the airspeed from the airspeed indicator.
Corrected for position error by the values taken from the Flight Manual to give:

CAS (Calibrated Airspeed/Rectified)
This value must be corrected for compressibility to give:

EAS (Equivalent Airspeed)
Corrected for density to give:

TAS (True Airspeed)

We will assume for all the airspeed calculations in this booklet that you have already checked in your aircraft flight manual to convert indicated airspeed to calibrated airspeed.
It is also assumed that you have the corrected outside air temperature (COAT) figure. This is obtained from the forecast temperature at your planned altitude.
If you are calculating true airspeed whilst airborne, using the OAT reading, you should be aware of the effect of temperature rise with airspeed. As an aircraft flies faster, the indicated temperature is affected by a temperature rise due to the increasing friction of the airflow passing around the aircraft.
For high performance aircraft there will be a table in the aircraft flight manual, with a correction factor for different airspeeds. In slower aircraft this correction is rarely calculated, to give an idea of the difference between indicated temperature and corrected temperature at airspeeds, a sample table is reproduced below:



Practically it is advisable to use to the forecast temperature at altitude at airspeeds up to 250 knots.

The airspeed indicator is subject to a further error at high airspeeds due to the compressibility of air inside the pitot. The table below shows the correction factor to be applied to true airspeed (TAS) to allow for compressibility. As this table does not make allowance for temperatures at altitudes other than in ISA conditions it is not strictly accurate. It will however give a very close answer.

To use the table apply the correction factor to the true airspeed.
So, given a TAS of 350 knots, at a pressure altitude of 30,000 feet,
the correction factor is 0.94.
350 X 0.94 = 329 knots

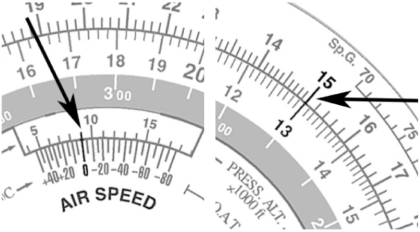
		Pressure Altitude in ft.				
		10,000	20,000	30,000	40,000	50,000
	200	1.0	0.99	0.97	0.96	0.93
Calibrated/Rectified	250	1.0	0.98	0.96	0.94	0.90
Air Speed in knots	300	0.99	0.97	0.95	0.92	0.87
	350	0.98	0.97	0.94	0.90	0.86
	400	0.98	0.96	0.92	0.90	0.86
	450	0.98	0.95	0.91	0.87	0.84
	500	0.97	0.94	0.90	0.87	0.84
	550	0.97	0.93	0.89	0.86	0.84

The calculation of true airspeed is quite simple.

Example:

Pressure altitude 9000 feet, temperature 0°C, calibrated airspeed 130 knots
What is true airspeed?

- In the AIRSPEED WINDOW set the temperature (0°C) under the pressure altitude (9000 feet).
- Against 130 (knots calibrated airspeed) on the inner scale read off true airspeed on the outer scale (150 knots).



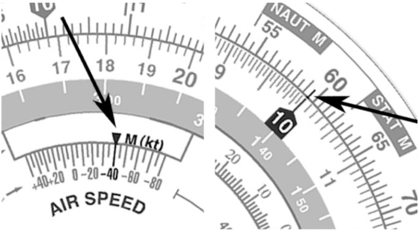
Note: that with pressure altitude and temperature set you can read off density altitude in the Density Altitude window if required. 9800 feet in this example.

Calculation of the Speed of Sound:

The speed of sound is solely a function of temperature and is referred to as MACH. The Mach No. Index can be found in the Air Speed window by setting the "60" Index on the inner scale against 40 on the outer scale.

Example:

Corrected air temperature -40°C
What is the speed of sound?



- Set the Mach No. Index against -40°C in the AIR SPEED window.
- Opposite the arrow 10 on the inner scale, read off the speed 595 knots on the outer scale.

With the scales set as in the above example,conversions of TAS to Mach Number can be made.
Convert 300 knots to a Mach No. Against 300 on the outer, read off Mach 0.505
Conversely, Mach 0.7 (inner scale) gives a TAS of 417 knots (outer scale).

True Airspeed and Density Altitude:

Air density affects the indications of the airspeed indicator and the performance of the airplane. Density altitude is the theoretical altitude in the standard atmosphere where the density is the same as the actual density you are experiencing in flight.

Density altitude is found by correcting pressure altitude for non-standard temperature. Pressure altitude can be determined by setting the airplane's altimeter to 1013.2 hPa and then reading the altitude. If this is done in flight, make a note of the altimeter setting before turning it to 1013.2 hPa.

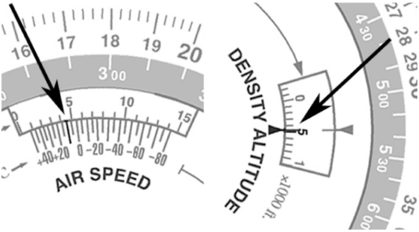
After you determine the pressure altitude, reset the altimeter to the current setting. The outside air temperature (OAT) can be determined by reading the current temperature on the airplane's OAT gauge. You will need to use the Celsius scale.

Calculating True Airspeed and Density Altitude:

True airspeed and density altitude is calculated on your TPS Flight Computer using the windows located within the central disc of your computer.

Example:

What is the TAS and density altitude if the IAS is 95 kts, OAT is 10°C, and the pressure altitude is 4,500 ft.?



- Using the AIR SPEED window locate the OAT of 10°C and rotate the disk so the pressure altitude of 4,500 ft. (which is between "4 and 5" on the scale) is under 10°C.
- In the window labelled DENSITY ALTITUDE, read the density altitude of approximately 5,000 ft.

- Locate the IAS of 95 kts, or "95," on the inner scale.
- Without moving the disk, read the TAS on the outer scale opposite the IAS, which is 102.5 kt.

Use your TPS Flight Computer to solve these practice problems:

OAT	Pressure Altitude	IAS/CAS	TAS?	Density Altitude?
0°C	7,000 ft	130 kts	_____	_____
-20°C	10,000 ft	150 kts	_____	_____
-10°C	9,500 ft	115 kts	_____	_____

Climb and Descent Calculations:

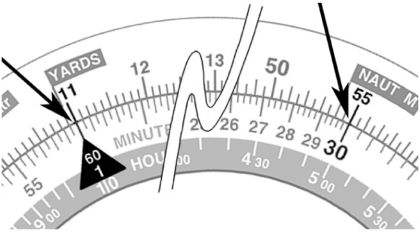
This calculation can be used to calculate rate of descent required or rate of climb to clear an obstacle. Rates of climb/descent are usually given in feet per minute.

Climb:

Example:

A climb ratio of 300 feet per mile is needed to cross a hill.
The ground speed GS is 110 kts.
What rate of climb is needed?

- Rotate the "60" Index to 110kts (outer scale).
- Read the rate of climb 550ft/min opposite 30 on (inner scale).

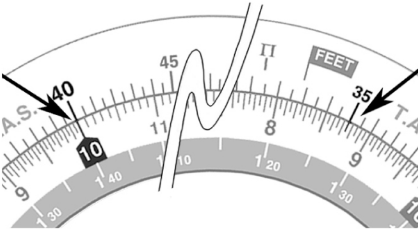


Descent:

Example:

How long does it take to descend from 5,000 feet to 1,500 feet at a rate of descent of 400 feet per minute?

- Rotate the arrow 10 (inner scale) to the rate of descent ROD 400 feet/min (outer scale).
- At the altitude difference 3,500 (outer scale) read the time of descent 8.75 min (inner scale).

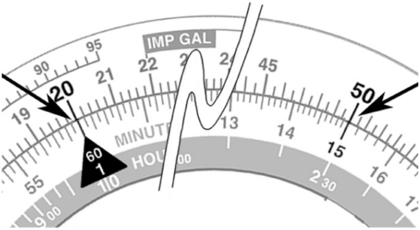


The distance to commencing the descent can be calculated given the duration of descent and the ground speed.

Example:

Descent 15 mins, Ground Speed GS 200 kts.
At what distance from the destination does descent need to start?

- Set time arrow “60” on the (inner scale), under 200 kts on the (outer scale).
- At 15 minutes (inner scale), read 50 NM on the (outer scale).



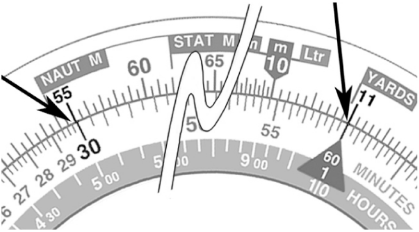
Heading Correction (The 1 in 60 Rule):

Using three calculations, the deviation from course can be calculated:
First the heading error is calculated from the distance off track over the distance flown.
Next the correction angle is calculated using distance off track and distance remaining.
The sum of both values is equal to the angle the course needs to be corrected by.

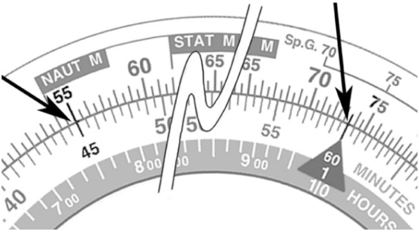
Example:

An aircraft has deviated 5.5 NM LEFT of track over a distance flown of 30 NM.
What is the correction angle for the remaining 45 NM?

- Rotate the initial distance flown, 30 NM (inner scale) to the deviation of 5.5 NM (outer scale).
- Read the angle of deviation 11° at the “60” time arrow.



- The remaining distance of 45 NM (inner scale) is adjusted to the deviation of 5.5 NM (outer scale) and the closest complementary angle of 7.5° can be read from the "60" Index. The sum of 11° + 7.35° = 18.35° is the angle by which the heading needs to be corrected, to the right.



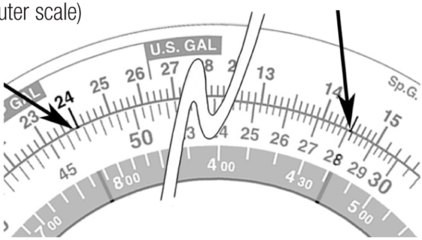
The Point of no Return PNR:

With this calculation you can determine the distance you can fly outbound and still keep sufficient fuel for return to your starting point.
You will need to know the fuel consumption, fuel quantity available and the ground speed (GS). We will assume that you have already determined the GS for the outbound and inbound flight.

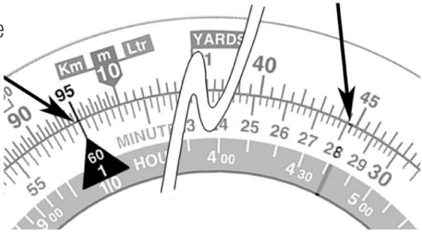
Example:

Fuel 35 IMP GALs, rate of consumption 4.5 IMP GAL per hour
GS outbound 95 kts. GS inbound 145 kts.
A quick calculation shows that we have fuel for about 8 hours of flight.
For the determination of the exact flight time see the an example on page 13.
The result is 7hrs 47mins.
For the given GS the PNR will be slightly more than half of the total flight time.
Add the GS outbound to GS inbound, the sum is 240 kt.

- Rotate the flight time 7hrs 47mins. under 240 kt on the outer scale.
- Read under GS inbound 145 kts (outer scale) the time 4hrs 41mins (inner scale). Thus with a total flight time of 7hrs 47mins you can fly outbound for 4hrs 41mins at 95 kts.
- After this there is still sufficient fuel available for 3hrs 06mins inbound flight at 145 kts.
- (Remember to add in a margin for safety). For converting this value in the related distance you can use the outbound speed.



- Set "60" Index under the outbound speed 95 kts. Read above PNR 4hrs 41mins (inner scale) the distance 446 NM (outer scale).



The Wind Side of the TPS Computer

The wind side of the TPS Flight Computer allows you to determine the effect wind has on your aircraft in terms of heading and groundspeed.
The wind side consists of a transparent circular rotating disk attached within a frame, an attached wind arm and a vertically sliding card.
A compass rose is printed on the outside of the rotating disk.
There is a small metal rivet located at the centre of the plotting transparency.
At the top of the frame is a triangle called the Index.
A drift correction scale is shown in degrees PORT (left) and STBD (right) of the INDEX.
This scale can be used when applying the wind correction angle (WCA).

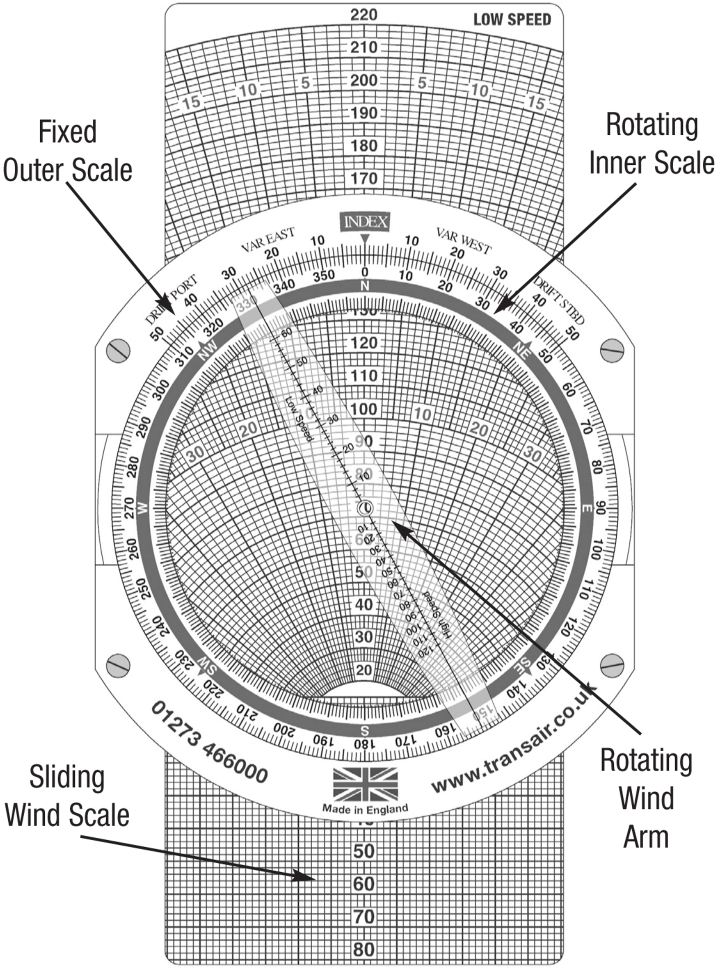
The sliding card has printed vertical converging lines, called wind correction lines.
They represent degrees left or right of the centre line.
The slide is marked Low Speed on one side and High Speed on the other.
The horizontal arcs, called speed arcs, are concentric circles around the centre of the circle and represent a distance from the centre.

Calculating Heading and Groundspeed:

To determine the magnetic heading and groundspeed you must know
The magnetic course of your planned flight, as plotted on your chart.
Magnetic course (MC) is the true course (TC) corrected for magnetic variation

$$MC = TC \begin{matrix} +W \\ -E \end{matrix} \text{ Variation}$$

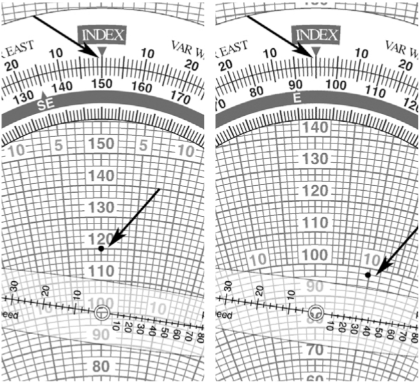
If the flight is to or from a VOR station, magnetic course is determined from the compass rose surrounding the VOR station on the chart.
True airspeed (TAS) as determined from the performance chart(s) in your aircraft's Pilot's Operating Handbook (POH).
If the POH provides TAS in mph, convert mph to knots.
Wind direction and speed, as obtained from the forecast winds aloft.


Fixed Outer Scale
Rotating Inner Scale
Sliding Wind Scale
Rotating Wind Arm
LOW SPEED
INDEX
VAR EAST
VAR WEST
DRIFT PORT
DRIFT STBD
Low Speed
High Speed
01273 466000
www.transair.co.uk
Made in England

Wind direction is based on true north, so you must convert to magnetic direction by correcting for magnetic variation. Be sure that you are using the same units of direction and speed throughout your calculations.
Winds aloft are forecast in knots so you MUST convert your TAS if it is in mph.
If your course has been determined in magnetic direction (e.g. you are using a VOR radial), you must convert the wind direction to magnetic. As illustrated below.

<u>Example:</u> (Wind-Up Method)

Wind Input | Magnetic Course & Drift



Magnetic course 095°
True airspeed 98 kts.
Magnetic wind 150° at 20kt.

Find magnetic heading and groundspeed given the above conditions?

- Rotate the plotting transparency so the magnetic wind direction of 150° is opposite the True Index.
- Move the sliding wind scale so the grommet is over the 100 speed arc.
- Using the speed arcs, place a dot or cross 20 kts up from the rivet. This represents the wind speed, also called a wind dot. As the grommet is on the 100 kts. speed arc, the dot should be placed on the centre line at the 120 kts speed arc.
- Then rotate the plotting transparency so the magnetic course of 095° is opposite the True Index.
- Move the sliding wind scale so the wind dot is on the 98kt. speed arc, which is the TAS. The WCA (wind correction angle) is determined by the wind dot and the wind correction lines. In this example, the wind dot is 10° to the right of the centre.

Magnetic Course (Trk) (MC)

↓

-L (WCA - Wind Correction Angle) +R

=

Magnetic Heading (MH)

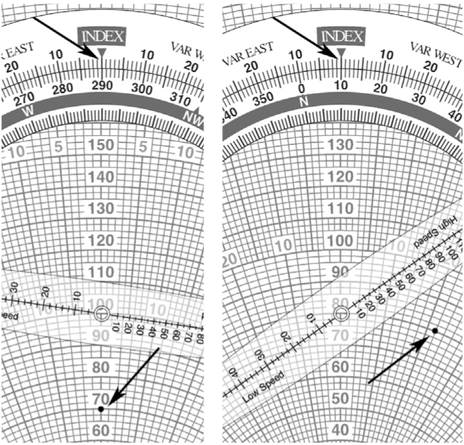
In this problem, MH = 105° (95° + WCA of 10°).
Groundspeed is read under the grommet; it is 85 kts. in this example.
With the given conditions, the magnetic heading is 105° and the groundspeed is 85 kt.

Use your TPS Flight Computer to solve these practice problems:

Wind	MC	TAS	WCA	MH	G/S
215°/15kts	260°	130 mph	___°	___°	___kts
050°/20kts	350°	105 kts	___°	___°	___kts

Example: (Wind-Down Method)

Wind Input / Magnetic Course & Drift



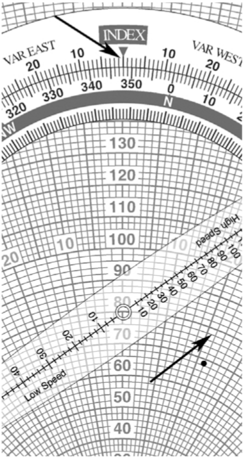
Magnetic course 010°
True airspeed 80 kts.
Magnetic wind 290° at 30kt.

Find magnetic heading and groundspeed given the above conditions?

- Input the wind direction (inner scale) under the INDEX arrow. Slide the wind scale, so the grommet is over the 100 arc, then mark the wind strength, down from 100, i.e. in this case, 30 kts down, to the 70 arc.
- Now rotate the inner scale and input your desired Magnetic course under the INDEX.
- The grommet in the clear window becomes your TAS marker, so move it over the 80 arc. The wind is now blowing through the grommet to the dot. Thus, the dot is now showing Starboard Drift of 22° our wind correction angle (WCA).
- Because we have starboard drift we will need to adjust our WCA heading to Port. Rotate the inner scale to minus 22° from the magnetic course already set (i.e. a turn to Port). If the drift angle where to change at this point, you need to use the new drift as your WCA.

* We can see now our Magnetic heading becomes 348° with a G/S of 69 kts (Drift still 22°).

Magnetic Heading & Groundspeed



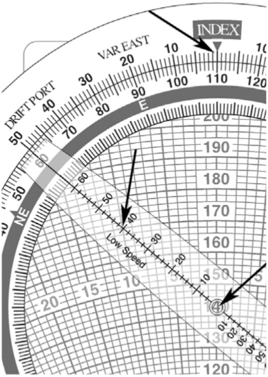
Using the Wind Arm:

One half of the arm is marked Low Speed and the other High Speed. The arm must be used with the correct side of the slide. Low with Low and High with High.
Its purpose is to avoid having to mark the surface of the window.
Set the wind direction using the centre line of the wind arm. The location of the wind mark will then be below the appropriate speed mark on the wind arm.
Where the wind mark is UP, use the top of the Low Speed half of the wind arm. If the wind mark is to be DOWN, rotate to the other side.

Calculation of G/S and Drift Angle:

Example:

Track 110°, Wind 060°/40kts, TAS 170 kts
Find: Wind correction angle, G/S, Heading?

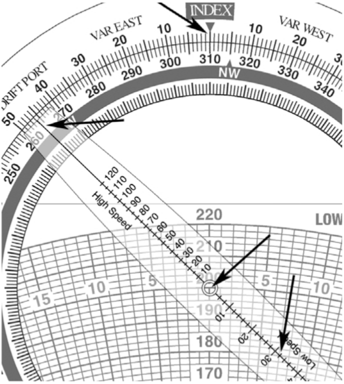


* Position track 110° to the INDEX.
  Rotate the middle line of the wind arm to 060°.
* Slide the circular TAS arc on the slide representing 170 kts to intercept the wind speed of 40 kts on the arm.
* Read the wind correction angle L of 10° at the Intercept.
* Read G/S 142 kts at the arc through the central grommet.
* The heading that needs to be manoeuvred will be 110° -10°(WCA) = 100°.

Calculation of Wind from G/S and Drift:

Example:

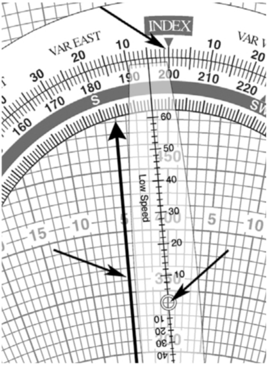
Heading (MH)	310°
TAS	200 kts
G/S	180 kts
Drift angle	+7°



- Magnetic Heading (MH) 310° is positioned at the INDEX.
- TAS 200 kt to be adjusted beneath the central grommet in the clear window.
- Rotate the middle line of the low speed wind arm to the drift angle line +7 on the G/S 180 kts circular line on the sliding wind scale.
- Read the wind speed of 32 kts at that intercept.
- Then on the wind arm, work back through the grommet, to the opposite end to read the wind direction of 264° at the end of the cursor.

Calculation of Wind from several Drifts:

The wind can be calculated from the drifts of two true headings if the TAS is known.



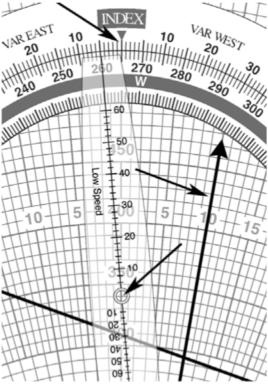
Example:

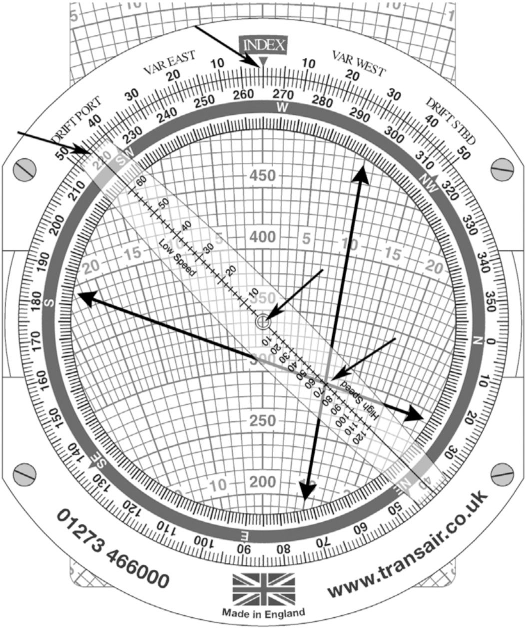
TAS	340 kts	
Heading	200°, Drift angle	- 5°
Heading	265°, Drift angle	+10°

- Position the circular speed line of TAS 340 kts below the central grommet in the clear window using the High Speed sliding wind scale.
- Rotate Heading 200° to the INDEX.

- Mark the drift line at - 5° with a long line using a pencil.
- Then rotate Heading 265° to be adjusted at INDEX.
- Mark the drift line at + 10° with a long line using a pencil.

- Then Position the central line of the High Speed wind cursor to the two intercepting lines.
- Read the wind speed of 70 kts at the intercept. The wind direction of 220° can be read from the opposite end of the wind cursor.



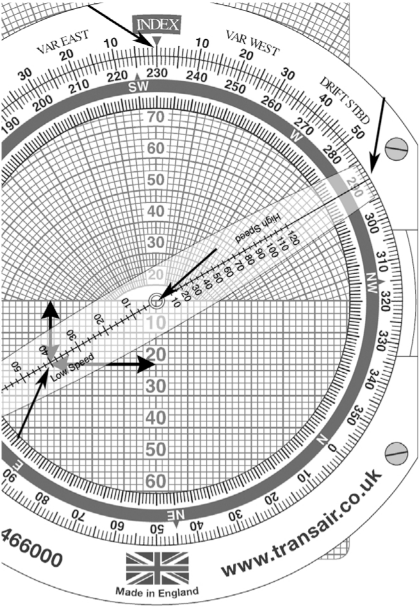


Wind Components for Take-Off and Landing:

Example:

Head Wind:

Wind 290°/40 kts
Runway direction 230°

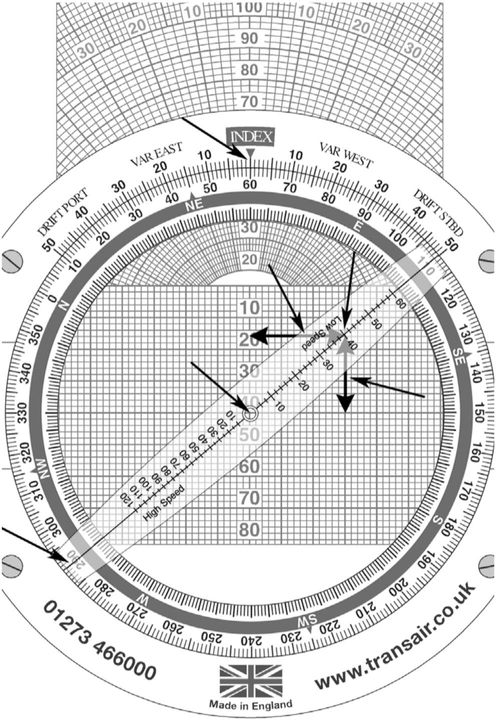


- Rotate the Runway direction 230° to the INDEX.
- Position the zero point of the squared portion of the slide under the central grommet of the clear window.
- Position the rotating low speed wind arm downward and put the opposite side of the wind arm centre line, on the wind of 290°.
- Now locate 40 kts on the low speed wind arm.
- Read the cross wind component of 33 Kts where the horizontal lines cross the 40 kts point on the wind arm.
- Read the head wind component of 20 Kts where the vertical lines cross the 40 kts point on the wind arm.

Example:

Tail Wind:

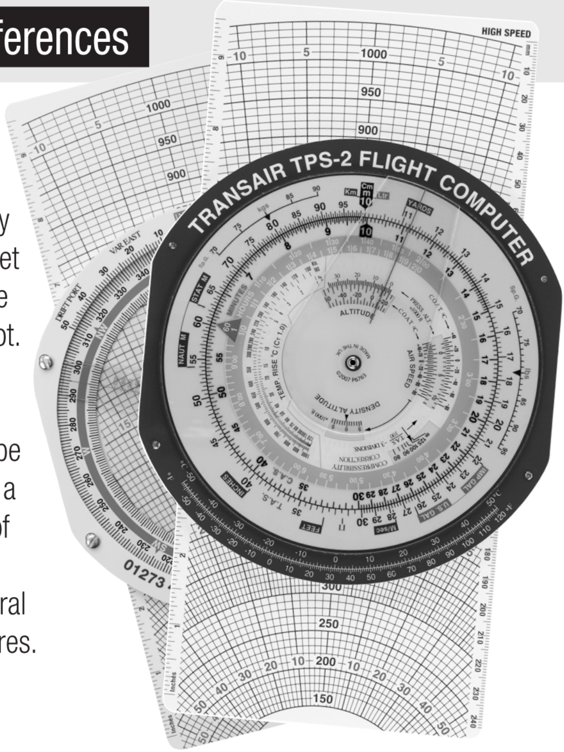
Wind 290°/40 kts
Runway direction 60°



- Rotate the Runway direction 060° to the INDEX.
- Position the central grommet to kts downwind within the squared portion of the slider.
- Position the low speed rotating arm upward and put the opposite side of the wind arm (high speed) centre line, on the wind of 290°.
- Now locate 40 kts on the low speed wind arm.
- Read the cross wind component of 30 Kts where the horizontal lines cross the 40 kts point on the wind arm.
- Read the tail wind component of 24 Kts where the vertical lines cross the 40 kts point on the wind arm.

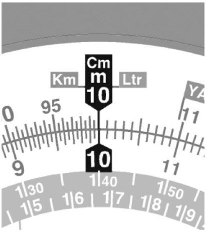
TPS-2 Differences

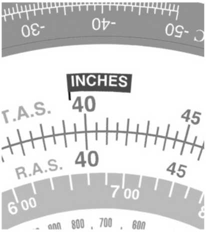
The TPS-2 Flight Computer has been specifically designed to meet the needs of the professional pilot. Its larger size allows calculations to be performed with a higher degree of accuracy.
It also has several additional features.



Conversions

In addition to the standard units found on the TPS-1, the units of distance inches and centimetres have been added to the TPS-2. These are particularly useful in centre of gravity calculations.





Compressibility Error

At high airspeeds, the compression of air within the pitot tube leads to a significant error in the Airspeed Indicator reading. The ARC-2 has a ‘window’ that allows for the correction of compressibility at a given TAS.

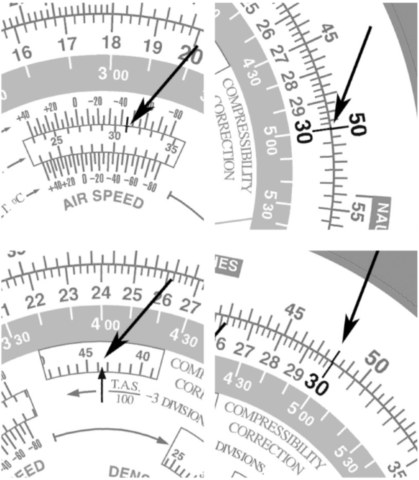
First, the initial calculation of TAS is made. The calculated TAS is then divided by 100 as shown next to the ‘Compressibility Correction’ window; and 3 is subtracted from the resulting figure. The inner ring is then moved this number of units anti-clockwise in the ‘Compressibility Correction’ window (the direction of movement is shown by an arrow).

Without moving the scales, find the original RAS/CAS on the inner scale. Above it read off the new TAS on the outer scale.

<u>Example:</u>

Given a CAS of 300 knots, pressure altitude of 31,000 feet and a temperature of -45°C. Find the TAS corrected for compressibility.

- Put 31,000ft under -45°C in the ‘Air Speed’ window.
- Read of 500kts TAS on the outer scale over 300kts CAS on the inner scale.
- 500 ÷ 100 = 5.00 - 3 = 2.00.
- Move the arrow in the ‘Compressibility Correction’ window 2.00 units to the left (as shown by the arrow).
- Read off the corrected TAS of 480kts on the outer scale above the original CAS of 300kts on the inner scale.



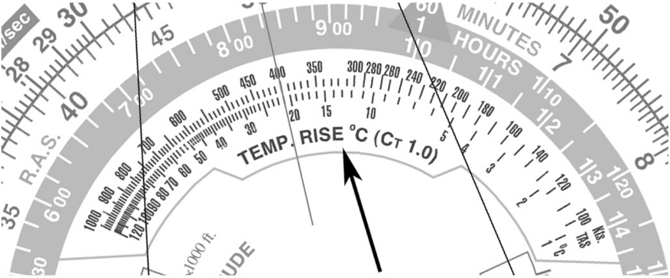
Temperature Rise (COAT)

At higher airspeeds kinetic heating between the aircraft and the air causes a rise in air temperature. This can lead to an error in the reading of the Outside Air Temperature (OAT) gauge. The TPS-2 has a temperature rise scale to calculate this temperature rise. Based on a recovery coefficient of 1.0, it shows the expected temperature rise (in °C) from 100 to 1,000 knots TAS. To find the Corrected OAT (COAT) calculate the TAS initially, use the temperature rise scale to find the increase in temperature and deduct this from the indicated temperature.

Example:

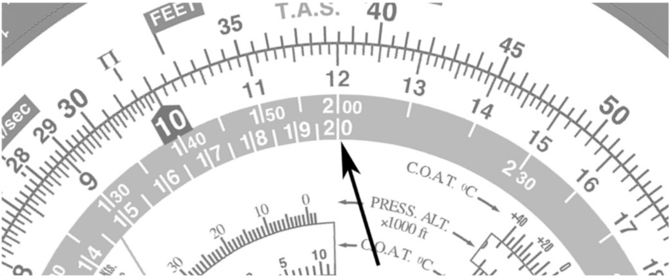
At 400 knots TAS,
the indicated temperature is -25°C.
What is the air temperature corrected for temperature rise?

- On the ‘TEMP. RISE °C’ scale set the cursor line at 400 knots.
- Below 400 knots read-off a temperature rise of 21°C.
- Deduct 21°C from the -28°C to give the answer of -46°C.



Time, Speed & Distance

The time scale of the TPS-2 has extra hours markings up to 20 hours.



Wind Scale Side

- The ‘LOW SPEED’ side of the wind slide can be used in the same way as the one on the TPS-1.
- The ‘HIGH SPEED’ side of the wind slide should be used as per the ‘HIGH SPEED’ side of the TPS-1 wind slide.

Note: That when making calculations on the ‘HIGH SPEED’ side of the wind slide, you cannot apply the W/V to the ‘LOW SPEED’ wind grid as the scale on that side is different. When using the ‘HIGH SPEED’ side of the wind slide, you must always apply the W/V to the ‘HIGH SPEED’ slide side.

Current Abbreviations:

Term	Abbreviation
Altitude:	
Indicated Altitude	IA
Density Altitude	DA
True Altitude	TA
Speed:	
Indicated Airspeed	IAS
Calibrated Airspeed	CAS
Equivalent Airspeed	EAS
True Airspeed	TAS
Ground Speed	G/S
Rate of Climb	ROC
Rate of Descent	ROD
Mach Number	Mach
Local Sonic Speed	LSS
Standard Values:	
Mean Sea Level	MSL
International	ISA
Standard Atmosphere (1013.25 mbar = 1013.25 hPA = 29.92 inch HG)	
Standard Temperature 15°C	
Outside Air Temperature	OAT
Course:	
True Course	TC
True Heading	TH
True Track	TT
Magnetic Course (Track)	MC
Magnetic Heading	MH
Wind Correction Angle	WCA

Answers:

Page 12:

NM	SM	Answers
113	130 SM	130 SM
125	144 SM	144 SM
106 NM	122	106 NM

Page 14:

Groundspeed	Distance	Time?
80 kts	300 NM	225 mins
105 kts	62 NM	35.5 mins
120 mph	142 SM	71 mins

Page 14:

Groundspeed	Time	Distance?
95 kts	17 mins	27 NM
105 kts	43 mins	75 NM
120 mph	1 hr 24 mins	168 SM

Page 15:

Distance	Time	Groundspeed?
5.5 NM	3 mins	110 kts
15 NM	9 mins	100 kts
5 SM	4 mins	75 mph

Page 16:

Consumption Rate	Time	Fuel Used?
7.0 GPH	30 mins	3.5 gals
10.2 GPH	2 hrs 5 mins	21.2 gals
9.4 GPH	90 mins	14.1 gals

Page 17:

Consumption Rate	Usable Fuel	Endurance (Time)?
8.2 GPH	24.5 gals	179 mins
10.6 GPH	50.0 gals	283 mins
9.0 GPH	38.0 gals	253 mins

Page 17:

Time	Fuel Used	Consumption Rate?
54 mins	17 gals	18.9 GPH
1 hr 15 mins	10.4 gals	8.3 GPH
3 hrs 40 mins	36 gals	9.8 GPH

Page 24:

OAT	Pressure Altitude	IAS/CAS	TAS?	Density Altitude?
0°C	7,000 ft	130 kts	144 kts	6,800 ft
-20°C	10,000 ft	150 kts	169 kts	8,100 ft
-10°C	9,500 ft	115 kts	131 kts	8,900 ft

Page 31:

Wind	MC	TAS	WCA	MH	G/S
215°/15kts	260°	130 mph	5°L	255°	103 kts
050°/20kts	350°	105 kts	9°R	359°	94 kts