POOLEYS

AVIAT 617

AIR NAVIGATION COMPUTER – Instructions for use
Aviat 610 • 613 • 617 • 618 Aviatjet 647

Instructions for Use

POOLEYS

AVIAT
610 • 613 • 617 • 618

AVIATJET

647

TREATMENT & ADJUSTMENT OF THE AVIAT & AVIATJET

This precision instrument is a valuable aid to navigators and deserves careful treatment. The scales should be protected from dirt and scratches in order to preserve their perfect readability. Dust infiltration under the rotary hands or the transparent disks are best removed with a strip of paper or soft cloth passed and repassed between the two surfaces. If this procedure fails, the disks can also be taken apart. Reassembly, however, entails scale adjustments which take some time.

Excessively tight or slack movement of the compass ring on the rear face of computers 613, 617, 618 and 647 can be corrected after loosening the four connecting screws.

Do not leave the AVIAT on heated surfaces and, above all, protect it from direct sun rays In the cockpit. Deformations will result from temperatures higher than 600C (140°F). Computers damaged through these causes will not be exchanged free of charge.

d) **Effective True Air Speed (E.T.A.S.)** is used in pressure pattern navigation for determining the beam displacement (Z_n) when a change of heading has occurred between the two sets of altimeter readings. First the air distance. i e. the direct distance between the Dr or ground position at the first set of altimeter readings and the air position at the second set of altimeter readings, is measured. Then, this value is divided by the time elapsed between the two sets of altimeter readings to obtain the effective true air speed.

e) **Ground Speed** is the speed of an aircraft over the earths surface.

TRACKS, COURSES & HEADINGS

a) **True Track (Course)** is the angle between true north and the path of an aircraft over the ground. Required Track is the direction which an aircraft is intended to follow. **Track Made Good (T.M.G.)** is the actual path over ground covered by an aircraft.

b) **True Course - Co (T). or True Heading (T.H.)** - Is the angle between true north and the longitudinal axis of an aircraft.

c) **Magnetic Course. Co (M), or Magnetic Heading (M.H.)** - is the angle between magnetic north and the longitudinal axis of an aircraft. The angular difference between the true and the magnetic heading is the **Variation**.

d) **Compass Course - Co (C). or - Compass Heading (C.H.)** - is the angle between the direction of magnetic north on the compass card and the longitudinal axis of an aircraft. The angular difference between magnetic and compass course or heading is the Deviation caused by the influence of magnetic fields In the aircraft other than that of the earth.

Wind Angle is the angle between the direction from which the wind is blowing and the direction of the required track or the track made good.

Wind Correction Angle is the angle between the required track and the heading to be steered. In identical wind triangles the wind correction angle has the same numerical value as the drift but the opposite sign *(e.g. W.C.A. +, when the Drift is Port. i.e. minus)*.

13.0 GLOSSARY OF NAVIGATIONAL TERMS

Altitudes

a)   **Absolute Altitude** is the true altitude of an aircraft above ground.

b)   **Density Altitude** is the altitude in the Standard Atmosphere corresponding to the flight level density.

c)   **Pressure Altitude** is the altitude in the Standard Atmosphere corresponding to the flight level air pressure. It is indicated on the pressure altimeter with its subscale set to 1013.2 mb or 29.92 inches of mercury.

d)   **QNH Altitude** is the altitude indicated by a pressure altimeter with its subscale set to the relevant QNH.

e)   **True Altitude** is the height above a fixed datum (usually mean sea level).

Compressibility Error is the error caused by the fact that the air is a compressible gas. This error attains appreciable values only at speeds higher than 200 kt and In higher altitudes.

Drift is the angular difference between the heading and the track made good.

D.Value is the difference *(usually in feel)* between the absolute and the pressure altitude.

Isohypses Contour lines In 500 mb weather charts with 200 ft intervals between isobaric surfaces.

Mach Number is the ratio of true air speed to the speed of sound.

Pressure Pattern Navigation is a system of navigation based on the distribution of the atmospheric pressure between the point of departure and the point of destination. Its typical applications are the minimum flight path, the single heading flight and the determination of the beam displacement and drift in flight by comparison of the absolute altitude, as shown on the radio altimeter, with pressure altitude.

Relative Wind Angle is the angle between the direction from which the wind is blowing and the direction into which the aircraft is heading.

SPEEDS

a)   **Indicated Air Speed (I.A.S.)** is the reading of a particular air speed indicator.

b)   **Rectified Air Speed (R.A.S.)** or **Calibrated Air Speed (C.A.S.)** is the indicated air speed corrected for instrumental and Installation errors.

c)   **True Air Speed (T.A.S.)** Is the air speed relative to the surrounding air undisturbed by the aircraft's motion. It is determined from the rectified (calibrated) air speed by applying a correction for the density 'error and – at higher speeds – for the effects of compressibility. The density error is caused by deviation of the flight level pressure and temperature from the standard sea level values upon which the calibration of air speed indicators is based.

CONTENTS

Example: Compute departure between 5°E and 8°E at 54°N
$\triangle$I = 3° = 180'
90° - φ = 90° - 54° = 36°

Result: **106 NM**

Fig. 81

12.4   Calculation of the Conversion Angle (C.A.)

The approximate formula for finding the conversion angle is:
C.A. = ½ difference in longitude $\triangle$I x sine of mean latitude φ,

or written as a proportion: $\dfrac{C.\,A.}{\sin\,\varphi} = \dfrac{½\;\triangle 1}{\sin\,90°}$

Example: Location of transmitter Lat 51°N
Long 8°E
DR position of aircraft Lat 53°N
Long 4°W
Difference in longitude 12°
(hence ½ $\triangle$I = 6°)
Mean latitude 52°

Fig. 82

Result: **C.A. = 4.7°**

12.5   Calculation of True Bearings:

Given: Relative bearing and true heading.
Required: True bearing of station from A/C and true bearing of A/C from station
                          (to be plotted).
Setting: Set TH on compass rose over the aircraft index. Turn hairline of double
                          indicator over the angular value of the relative bearing on the black inner
                          scale marked 0° to 360°.
Reading: Read under the hairline from the compass rose the true bearing of station
                          from A/C and under the other hairline of the indicator read the true bearing
                          of A/C from station.

Example: Relative bearing = 234°
                                       TH = 78°

Result: **True bearing   312°**
                          to be plotted   132°

TH True Bearing of a/c
78 from Station

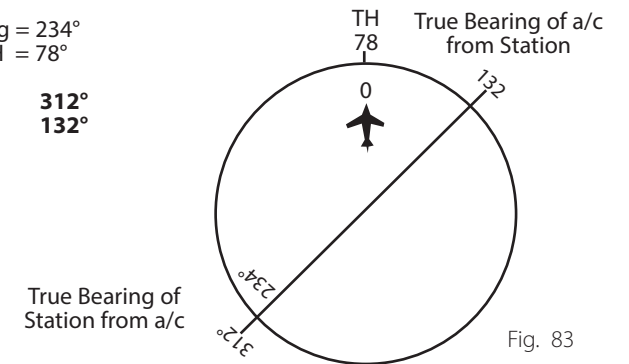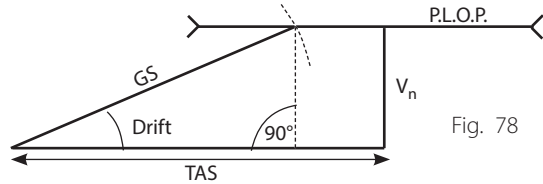True Bearing of
Station from a/c

Fig. 83

12.2.6 Calculation of Drift from beam Displacement (Z_n) or from Cross Wind Component (V_n)

(Pressure Pattern Navigation, see par. 8.1)

Fig. 78

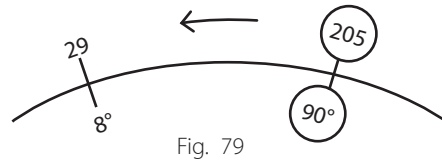**Given:** Gross wind component (V_n) and GS
Required: Drift

As will be seen from fig. 78 the drift may be determined by means of the law of sines:

$$\frac{GS}{\sin 90°} = \frac{V_n}{\sin Dr}$$

EXAMPLE 1

Given: $V_n = + 29$kt
GS = 205kt
Required: Drift

Fig. 79

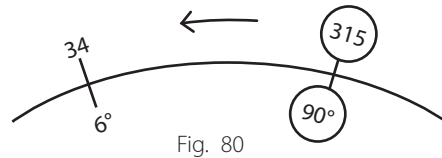**Result:** **Drift = 8°**

EXAMPLE 2

Given: Beam displacement
$Z_n = + 34$kt
GS = 210kt
Time elapsed between the
measurements of D-values 90 min

Fig. 80

Required: Drift
From the ground speed compute the distance flown between the points where the measurements were taken *(315nm, see para. 6.2.3)*. Then calculate drift using the law of sines.

Result: **Drift + 6°**

12.3 CALCULATION OF DEPARTURE

Departure is the distance expressed in nautical miles between two meridians at a give latitude. The approximation for the calculation of departure is:

Departure = difference in longitude $\angle$1 (in minutes) x cosine latitude φ, or, written as a proportion:

$$\frac{\text{Departure}}{\text{Cos } \varphi} = \frac{\angle 1}{1} \qquad\qquad \frac{\text{Departure}}{\text{Sin } (90° - \varphi)} = \frac{\angle 1}{\text{Sin } 90°}$$

1.0 PREFACE

All Aviat Navigation Computers are applicable to a wide variety of practical navigational problems. Derived from earlier Instruments, known as the Knemeyer System of triangle computers, the devices have been further developed to meet current needs in International Air Navigation. The several models are differentiated by the methods used to solve triangle problems and, in the AVIATJET, the method of calculating air speed. With the AVIAT models 613, 617 and the AVIATJET, a simple and straight-forward graphical solution of wind triangles is provided. AVIAT models 610 and 615 use the sine rule to obtain strictly mathematical solutions.

The front faces of all models are identical and can thus be described together. Only in the AVIATJET 647 Is the scale arrangement changed, to facilitate calculation of the true air speed with respect to the compressibility of the air. The AVIAT 610 is the smaller version of model 615, and model 613 is a pocket-size version of 617.

In addition to the scales for the usual distance-time-speed problems, fuel consumption and wind triangle computations, all models have scales for rapid conversion between British/US and Metric units of measurement, as well as for liquid measures, at various specific gravities, to their equivalents in pounds weight or kilos. Special scales or marks are provided for the determination of true air speed, true altitude and density altitude, speed of sound and Mach number, as well as for the solution of problems in pressure pattern navigation.

So that the Navigation Computers shall be suited to use internationally, and in recognition of the fact that English is one of the I.C.A.O. agreed languages in air travel, used the world over in log-book forms, route handbooks and flight control services, the scales are coded and annotated in English.

> **ATTENTION!** **PLEASE DO NOT EXPOSE THE INSTRUMENT TO SUN RADIATION NOR TO TEMPERATURE OVER 60°C (140°F).**

2.0 THE SCALES

The AVIAT is a disk calculator with scales arranged as concentric circles. Colour tinting clearly distinguishes the various scales and a transparent, rotating cursor, with index line, simplifies setting and reading between graduations. On the front face, passing inwards from the fixed outer scale, are the following:

On the Stationary Outer Rim

a) Two short scales, labelled Sp. G., and divided to specific gravities 0.65 to 0.95 for gas and oil for conversions of capacities in Litres. Imp Gallons or US Gallons to Kilograms or Pounds.

b) A continuous logarithmic "slide rule" scale in circular form, labelled DISTANCE, TAS and T. ALT. Marks are furthermore interspersed in the graduation for conversions between:

Kilometres	-	Nautical Miles	-	Statute Miles	*(red)*
Meters	-	Yards	-	Feet	*(black)*
Litres	-	Imp Gallons	-	US Gallons	*(blue)*

On the Rotating Centre Disk

c) A full circle logarithmic scale, coded as RAS, QNH, ALT and MIN. This is the counterpart of scale (b) and has gauge marks for the conversion ft/min to m/sec. It is simultaneously a time scale, divided in minutes between 6 and 60, from the hour mark ⚠ as origin. The mark "sec" at 36 In conjunction with the hour mark provides for the conversion between minutes and seconds. The mark ℘ = 57.3 is occasionally needed to convert between degree and radian measure, whilst the mark ℘ = 3.14 is used in problems involving the circle.
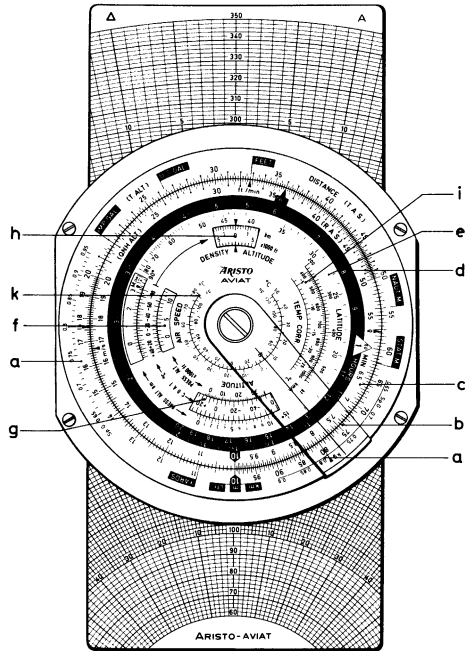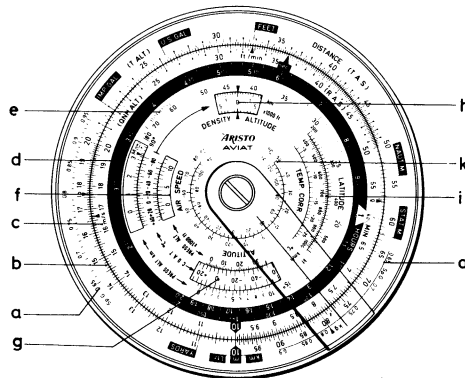
Fig. 1a Front Face of AVIAT 613, 617 and 618

Fig. 1b Front Face of AVIAT 610 & 615

d)　　An hour scale on a black band, 1 to 10 hours on the upper edge of the black band and 10 to 0 hours on the lower edge. This scalelinks up with the minute scale (c) a the hour mark △ opposite 60 minutes. Hence, with the hairline over any value on one scale, the adjacent scale furnishes the equivalent in the other time unit.

e)　　A scale **Latitude**, 15° to 90°, for pressure pattern problems.

Direction of runway 265°
Wind 330°/30 kt
Wind angle 65° (head wind)
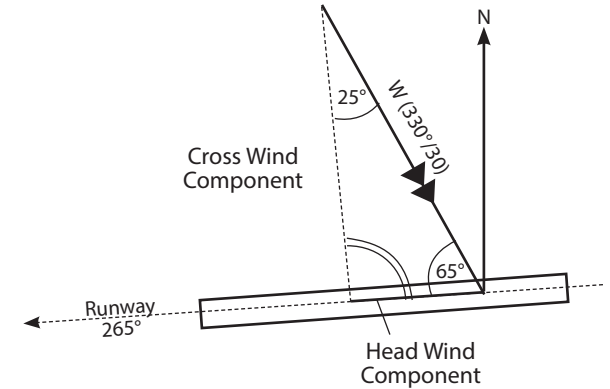Complement of wind angle 25°

Fig. 74

Result:

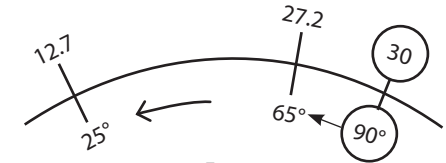**Cross wind component 27.2 kt**
Head wind component 12.7 kt

Fig. 75

Direction of runway 075°
Wind 200°/40 kt
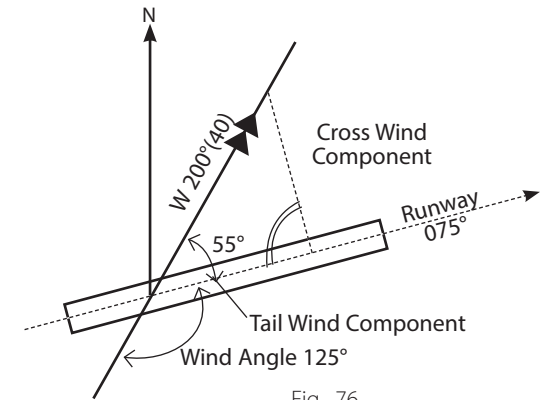Wind angle 125° (tail wind!)
Complement of wind angle 35°

Fig. 76

Result:

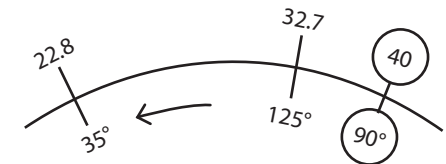**Cross wind component 32.7 kt**
Tail wind component 23 kt

Fig. 77

12.2.4   CALCULATION OF DRIFT & GROUND SPEED

Given: TH   **Required:** Dr
          TAS   GS
          Wind

In practice the solution of this problem *(DR navigation by computation)* by means of the computer is of little importance. This is particularly true if several true headings are flown in succession *(e. g. when by passing a thunderstorm)*. In this case it is easier to solve the whole problem graphically on the chart since, even if Dr and GS have been calculated with the computer, the DR position will be determined by plotting the headings and distances in the chart anyway.

In solving this problem by means of the AVIAT 610 and 615, the law of sines cannot be directly applied, Just as in the case of wind determination from DR and GS, since the given angle *(relative wind angle)* does not lie opposite one of the given sides *(air speed or wind speed),* but is included between them. For the solution the relative wind angle must be fitted between the wind speed and the air speed. Then the drift is read from the ⟨ sin-scale under the wind speed on the outer scale, and the ground speed over the relative wind angle. For convenience it is advisable to start with setting the relative wind angle over the air speed and then to add to the former the angular value which is read under the wind speed. Repeat this by trial and error method until the correct angle is found.
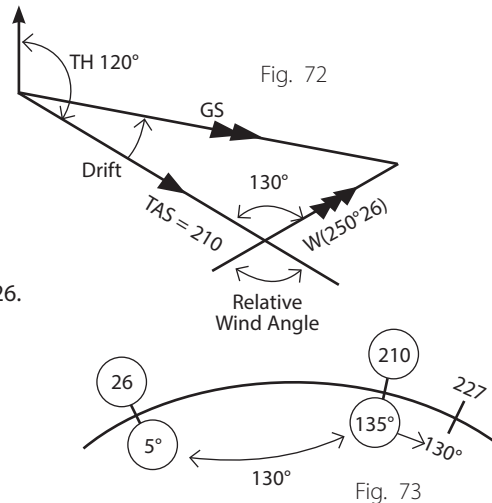
Example

Given: TH   = 120°
              TAS = 210 kt
              Wind = 250°/26 kt
              (Relative wind angle = 130°)
Required: Dr and GS
Setting: The relative wind angle of 130°
              is fitted between 26 (wind speed)
              Relative Wind Angle & 210 (T.A.S.)
              if 135° is under 210 & 5° is under 26.
              Then GS of 227 kt read over 130°.

Result: **Dr = –5° (wind from right)**
              GS = 227 kt

Fig. 72

Fig. 73

12.2.5   Calculation of the Cross Wind & Course Wind Components

When taking off from or landing on a runway it is in many cases important to know the crosswind and or head or tail wind components. For the solution by means of the AVIAT the angular difference between the wind direction and the true direction of the runway is first determined.

Setting: Set 90° on the ⟨ sin-scale under the wind speed on the outer scale.
**Reading:**   Over the angular difference between wind direction and direction of the runway on the ⟨ sin-scale read the cross wind component from the speed scale and over the complement of the angular difference read the head or tail wind component.

(f)   Two concentric scales in red colour inside their respective "windows", labelled **AIR SPEED** for air speed calculations, with a third scale on the intervening strip, for corrected outside temperature (COAT °C) + 50° to –80°. The pressure altitude scale (PRESS. ALT.) in km from 0.6 to + 20 km appears in the upper window frame and in thousands of feet from –2 to 65 (thousand feet) in the lower window. The marks M (km/h) and M (kt) serve for calculating Mach Numbers and Speed of Sound.

(g)   A "window" with blue scales and numeration labelled **ALTITUDE** for altitude calculations. The scale immediately above the cutout is the pressure altitude scale in km from –0.5 to + 10.7 and the scale below is the pressure altitude scale in thousands of feet from –2 to + 35.2. The terminal lines apply to all altitudes from 10.7 to 25 km, or, respectively, 35,200 to 80,000 ft. The corrected outside temperature (COAT °C) appears within the cutout numerated from –70° to + 50°C.

(h)   Aperture scales, graduated in km 2 to + 14.6 and in thousands affect –6 to 48, are for finding **DENSITY ALTITUDE**, related to the air speed by means of a red arrow.

In the Central Part of the Rotary Disk

(i)   Paired scales. **TEMP. CORR.** for correction of the outside temperature at high altitudes and at high speeds (400 to 1000 km/h or 200 to 550 knots).

(k)   A concentric temperature scale, for conversions, Fahrenheit ← → Celsius (Centigrade).

Modification AVIATJET
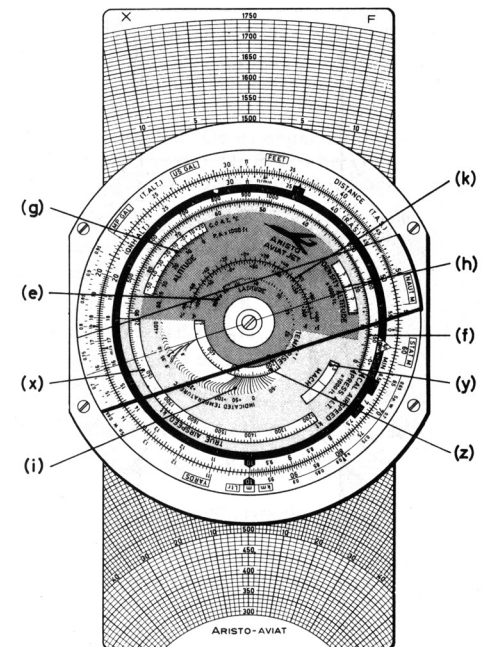
In the scale-field tinted grey-yellow, certain scales are differently arranged and new scales have been Introduced. As far as possible, scale identifications, for scales of like function, are retained. All data are given In kt, ft and °C units.

(e)   A sine scale, Identified as **LATITUDE**, figured for parallels of latitude between 15° and 90°. This is for use In problems in pressure pattern navigation.

(f)   Two contra-progressive scales, marked **CAL. AIR SPEED** kt and **PRESS. ALT**. x 1000 ft., serving for high air speeds, 100 to 1850 kt and aircraft altitudes, 0 to 80 000 ft.

(g)   An aperture scale, **ALTITUDE**, divided and figured in blue, for computing true height, in   association with scales (b) and (c). At the lower edge is a scale for pressure altitude, PA x 1000 ft., between –2 and 35.2, the terminal mark being valid for heights up to 80000 ft. In this aperture is also a scale for the correction of the outside temperature COAT °C, between –70°C and + 50°.

(h)   The aperture scale **DENSITY ALTITUDE** x 1000 ft., divided and figured in red between –5 and 50, associated with the red figured temperature scale, –80°, to + 50°C, located in   the un-graduated section of the **CAL. AIR SPEED** scale (f).

(i)   A family of curves for setting the **INDICATED TEMPERATURE** in °C, associated with the reference spiral in the base disk.

(k)   A temperature conversion scale, Fahrenheit ← → Celsius (Centigrade).

(x)   Scale for true air speed T.A.S., 100 to 1750 kt.

(y)   Window, for leading Mach numbers 0.25 – 3.5, with cursor line, on the underlying scale.

(z)   Window, for scale of temperature rise, **TEMP. RISE**, between 5 and 400° C.

The Rear Face of the Models AVIAT 613, 617, 618 and AVIATJET 647

Fig. 2a Rear face of AVIAT 613, 617 & 647   Fig. 2b Rear Face of the AVIAT 618
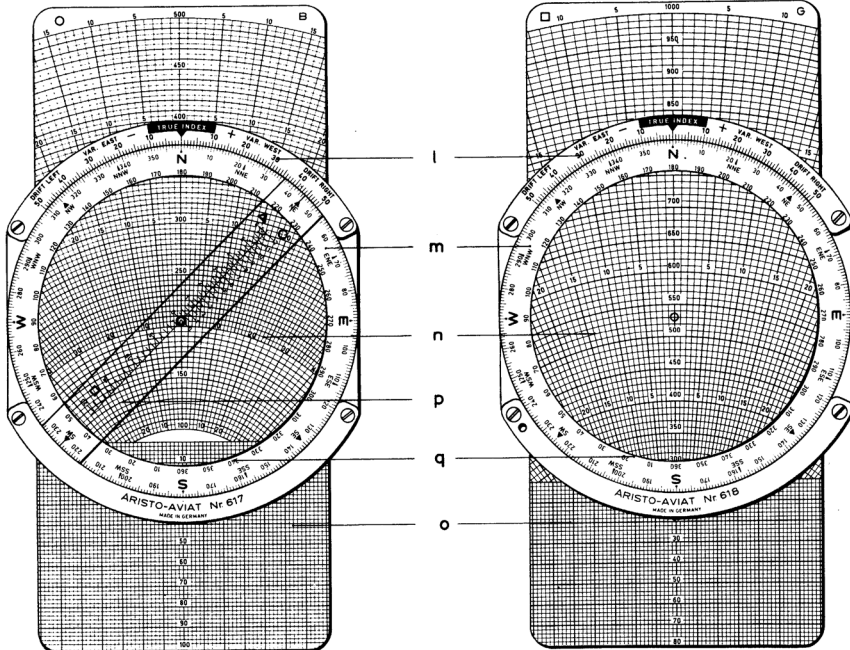
Setting and Reading Procedure:

1.   Turn ◊ sin scale until an angular difference of 7° on this scale corresponds with the interval between the speed 176 and 200. This is obtained when on the ◊ sin scale 40° is under 176 on the outer scale and 47° is under 200, respectively.

2.   Read wind speed 33.5 kt from the outer scale over the drift of 7° an the ◊ sin scale.

3.   Read the relative wind angle of 40° from the ◊ sin scale under the ground speed of 176. (The acute angle is taken since there Is a head wind; ground speed is less than air speed.)

4.   Set true heading 310° over the aircraft index. Turn hairline of the double indicator towards the left (wind from left!) until the hairline coincides with 40° (relative wind angle) on the black inner scale. Then read under the hairline wind direction 270° (W) from the compass rose (fig. 69).

Result: **Wind 270°/ 33.5 kt**
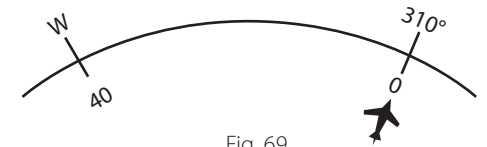
Fig. 69

EXAMPLE 2

Given:	TH = 50°
	T.A.S. = 190 kt
	GS = 218 kt
	Dr = –5°

Required: Wind

          GS greater than T.A.S., relative wind angle more than 90°.

Drift: wind from the right.

Fig. 70

          For the solution fit angular difference of 5° between 190 and 218. (For convenience it is advisable to set the hairline of the cursor over 218.)

Result: **Wind speed   = 33 kt**
          Relative wind angle = 145°
          Wind direction   = 195°
          Wind 195°/33 kt

Fig. 71

The wind angle 58° is obtained either mentally or by use of the computer with step (a). By applying the law of sines to the wind triangle of Fig. 65 step (b) is as shown in fig. 66.
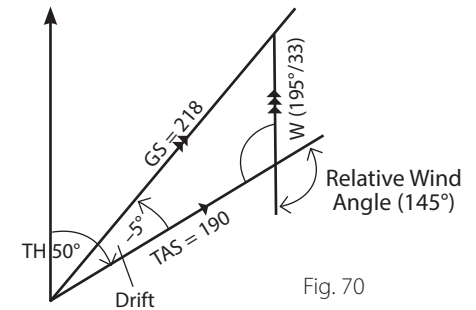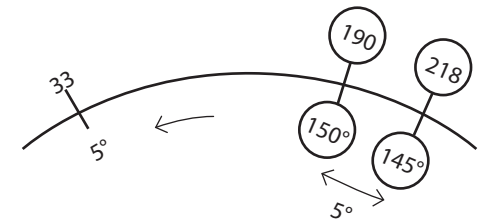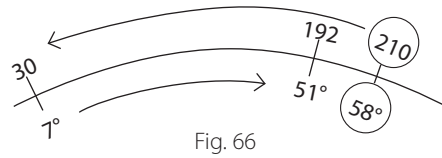
Result: **WCA = –7° (wind from left)**
              Relative wind angle
              we = 58° – 7° = 51°
              GS = 192 kt

Fig. 66

12.2.3   Determination of Wind from Drift & Ground Speed

If drift and ground speed can be determined during flight, direction and speed of the wind may be calculated by means of the AVIAT 610 and 615. In this problem the following parts of the wind triangle are known:

              Heading (T.H.)
              Air speed (T.A.S.)
              Ground speed (GS)
              Drift (Dr)

When the given parts of the wind triangle are studied it will be noticed that neither one of the two given sides T.A.S. and GS lies opposite the given angle (drift).   Therefore, the law of sines is not directly applicable. On the computer the drift angle is included between air speed and ground speed. Therefore, to solve this problem the ◊ sin scale must be rotated until the angular value of drift is included as difference between the angle readings lying opposite the air speed and ground speed. Thereby the normal setting is obtained again: wind speed and drift, air speed and wind angle, ground speed and relative wind angle are respectively opposite.   Accordingly the wind speed is read from the outer scale opposite the drift on the sine scale and the wind direction may then be obtained from the relative wind angle and the true heading.   If, in problems of this kind, the ground speed is less than the air speed the value of the relative wind angle will be less than 90°. In the case of a tail wind the relative wind angle will be larger than 90°; therefore, the obtuse angle must be read from the ◊ sin scale.   The wind direction is obtained as follows:

Setting: Set true heading over the aircraft index in the central part an the back of the AVIAT. Set the hairline of the double cursor over the relative wind angle - to the left of the aircraft index in the case of positive drift, to the right of the aircraft Index when drift is negative - on the black inner scale.

W (270°/33.5)

TAS = 200

GS = 176

7°

Drift

TH

310°

Fig. 67

Reading: Read wind direction under the hairline from the compass rose.
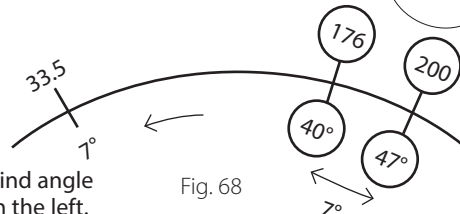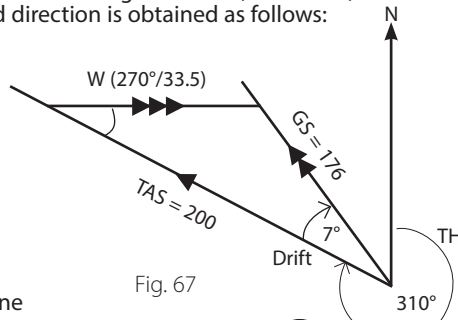
EXAMPLE 1 | TH   = 310°
          | TAS = 200 kt
          | GS   = 176 kt
          | Dr   = +7°

Required: Wind direction and speed
              GS smaller than T.A.S: relative wind angle less than 90°. Drift +: wind from the left.

33.5

176

200

40°

47°

1°

7°

Fig. 68

40

On the Stationary Arc

(l)   A circular arc divided each single degree, 0° to 50°, to right and left of the TRUE INDEX. The labels DRIFT LEFT – DRIFT RIGHT, VAR. EAST – VAR, WEST, supplemented by plus and minus signs, are self-explanatory.

On the Rotary Circle Limb

(m)   An azimuth graduation, 0° to 360°, including a 16-point compass rose. The wind directions are set on the red azimuth graduation.

(n)   A matt, transparent plotting surface.

(o)   A diagram slide moves in a slot beneath the plotting surface. Both sides of the diagram slide are ruled with concentric speed arcs cut by radiating rays for the drifts.

(p)   AVIAT models 613, 617 and 647 have a rotating indicator (p) which moves over the plotting surface. The indicator has three scales of wind velocity, associated with the curves of the diagram slide.   The indicator and diagram wind scales are marked A. △ ○ □ and X for use in pairs.

The following diagram slides are available:

A   for speeds   60 to 300   △
B   for speeds 100 to 500 with a rectangular grid numerated 0 to 100 ○
D   for speeds 100 to 1000   □
F   for speeds 300 to 1750   ×
G   for speeds 300 to 1000 with a rectangular grid numerated 0 to 80   □
H   for speeds   40 to 250 with rectangular grid numerated 0 to 80   △
K   for speeds 150 to 750   ○

In accordance with the air speed ranges, the air speed arcs of the several diagram slides have different intervals and figuring, identified by the symbols △ ○ □ and ×. All air speeds are given in knots or km/h.
     The diagram slides are interchangeable, but as it is convenient to have all frequently needed speeds on one slide, the following combinations, assembled from experience, have data on both faces, for the commonly used speeds:

AB Diagram slide with ranges A and B
AD Diagram slide with ranges A and D
AG Diagram slide with ranges A and G
AK Diagram slide with ranges A and K   The Corresponding diagrams are distinguished,
BD Diagram slide with ranges B and D   in the pocket model AVIAT 613, by the small
BF Diagram slide with ranges B and F   letters ab, ag, ak.
BH Diagram slide with ranges B and H

The Rear Face of the models AVIAT 610 and 615 contains the following scales from the rim inward:

(r)   A logarithmic scale (red) labelled "SPEED" and numbered from 5 through 100 up to 1500.

(s)   A logarithmic sine scale (blue) labelled " ◊ sin" numbered from 1° to 90° and in the opposite direction from 90° to 179°.

(t)   An azimuth graduation (blue) from 0° to 360° including a 16-point compass rose.

(u)   A circle graduated from 0° to 180° to left and right of an index in the shape of an aircraft silhouette, with a second numeration continued from 180° to 360°, reading clockwise.

9

(v)   In the central area of the computer disk, concentrically about the pivot point, aircraft altitudes in the Quadrantal Height System are tabulated to recall to memory the prescribed flying heights within the ranges for L.E.R. and V.E.R. flight.
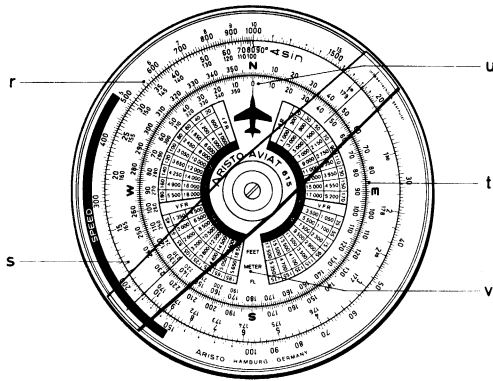

Fig. 2c Rear Face of AVIAT 610 & 615

3.0   EVERYDAY ARITHMETIC

Scales (b) and (c) are two circular logarithmic scales, similar to the scales of the conventional type of slide rule.   As such, they are used for every kind of computation involving multiplication, division, proportion and "rule of three" problem.

3.1   Reading the Scales

As in any logarithmic scale, the intervals decrease progressively in width in clockwise direction. The system of subdivision, therefore, changes between the ranges **10** – 20, 20 – 50 and 50 – **10** . The user should study this system carefully. The sample settings in fig. 3 exemplify the differences in readings taken within the three ranges.
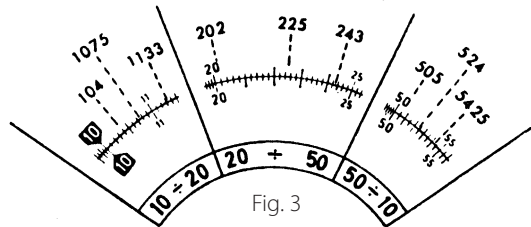
Readers not skilled in slide rule manipulations will soon be able to read the scales at sight after a little systematic practice with a number of different values.

Fig. 3

As with any conventional slide rule, the location of the decimal point cannot be determined with the computer because its scales only take account of the significant figures of a number in their correct order.   When, for instance, the answer to a problem set on the computer is given 12, this may stand for 0.12 or 1.2 or 12 or 120...   In practice the magnitude of the answer is usually unmistakably clear from the outset. Where doubts arise, a quick approximative computation with strongly rounded-off factors settles the question.

The initial line of the scale is called the index and is marked **10** . The large numerals 20, 30 etc, divide the scale into its principal intervals and the graduations of the numbers give the first decimal place in the answer to a calculation.   The smaller figures – or the extended graduations – within the principal intervals give the second place of decimals, whilst the smallest graduations provide the third place. This may need to be found by interpolation between graduations.

The wind triangle results from the vectorial combination of velocities, namely the true air speed T.A.S. and heading as well as the wind speed and direction; the resultant of these two components is the ground speed GS along the track made good T.M.G.

If the aircraft drifts to the right, or starboard, the drift is plus; if to the left, or port, the sign is minus.

If the aircraft is headed to the right of the track, the W.C.A. (wind correction angle) is plus, if headed to the left, the sign is minus.

Relative wind angle = wind angle – wind correction angle (or drift)
Wind angle = relative wind angle + wind correction angle (or drift)
Wind correction angle (or drift) = difference between wind angle and relative wind angle.

The following relation may, therefore, be derived from the individual parts of the wind triangle:

$$\frac{\text{Wind Speed W.S.}}{\text{sin Dr or W.C.A. -}} = \frac{\text{True Air Speed T.A.S.}}{\text{sin w}} = \frac{\text{Ground Speed GS}}{\text{sin we}}$$

w = wind angle,   we = relative wind angle

12.2.2   Determination of the Wind Correction Angle and the Ground Speed

Given: Required track, air speed and wind
Required: Wind correction angle and ground speed
Setting: (a)   Set the required track on the blue compass rose over the "aircraft index". Turn the hairline of the double indicator over the wind directlon on the blue compass rose.
Reading: Read the wind angle under the hair line from the black inner scale (u) which is divided from 0° to 180° to the right and left of the aircraft index.
Setting: (b)   Set the wind angle on the blue scale (s) labelled " ◊sin" under the air speed on the red scale (r) labelled SPEED.
Reading: Read the wind correction angle from the sine scale opposite the wind speed on the outer scale.

Sign convention: wind from **right** – wind correction angle **plus**
wind from **left** – wind correction angle **minus**

To obtain the relative wind angle subtract the wind correction angle from the wind angle. With the setting (b) unaltered read the ground speed from the speed scale opposite the relative wind angle on the ◊sin scale.

Example

Given: TT   = 48°
Wind = 3500/30 kt
wind angle w = 58°
T.A.S. = 210 kt

Required: W.C.A. and GS
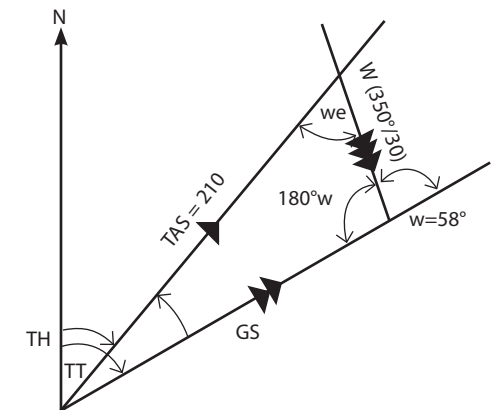
## 12.0 TRIGONOMETRIC SOLUTION OF TRIANGLE PROBLEMS WITH THE AVIAT 910 & 615

Triangle problems are solved with the scale (r) labelled SPEED and the scale (s) labelled ∢sin.
The law of sines states: $\dfrac{a}{\sin \propto} = \dfrac{b}{\sin \beta} = \dfrac{c}{\sin \lambda}$

Hence, when three parts are given, the remaining elements can be computed.
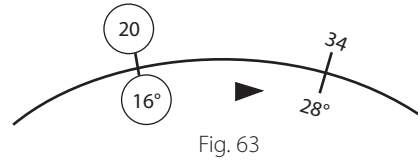
12.1 Solution of Triangle Problems in General

Setting: Set the given angle on the sine scale (s) under the given opposite side of the triangle on the speed scale (r).
Reading: Read the required side from the outer scale opposite the given angle of the triangle on the outer scale.

EXAMPLE (1) a = 30 in
∝ = 25°
b = 52 in

Required: angle β
Result: β = **47°**

Fig. 62
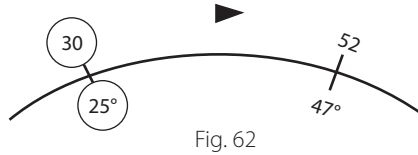
(2) b = 20 in
β = 16°
λ = 28°

Required: side c
**Result:** **c = 34 in**

Fig. 63

12.2 Wind Triangle Problems

12.2.1 The Wind Triangle
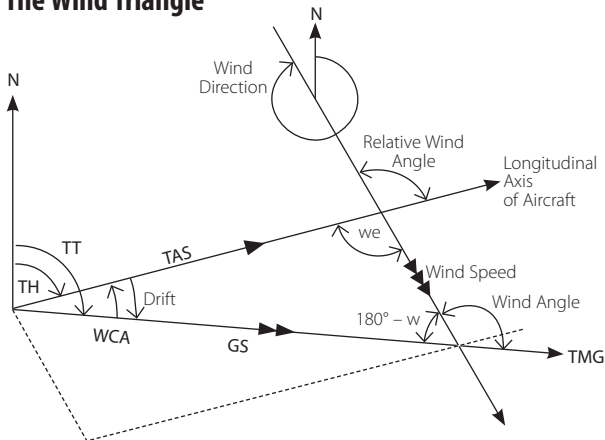
3.2 Multiplication

Identical in principle to solution by tables of logarithms, sections of the rotating inner scale are added (geometrically) to sections of the stationary outer scale. Thus, in the example 32 × 1.4, the index **10** of the inner scale is set opposite 32 on the outer scale. The answer 44.8 then appears over 14 on the outer scale. The use of the rotary hairline indicator facilitates the operation.

Fig. 4
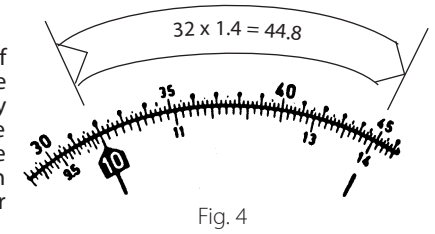
3.3 Division

As division is the inverse of multiplication, the order of the steps described above is simply reversed. With the cursor hairline, set 14 on the inner scale to 44.8; of the outer scale. The quotient 32 then appears over the index mark **10** of the inner scale.

Fig. 5
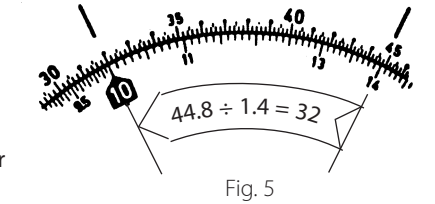
3.4 Multiplication & Division Combined

In problems of the type $\dfrac{a \times b}{c}$ the division always comes first and the multiplication of the quotient by b follows. In the problem $\dfrac{44.8 \times 3.4}{1.4}$ the division 44.8 ÷ 1.4 is done as just explained. Without stopping to read the answer then set the hairline to 3.4 of the inner scale and, opposite this value, read the answer 108.8 on the outer scale.

EXAMPLE $\dfrac{327 \times 5.22 \times 0.453}{128}$

Roughly $\dfrac{300 \times 5 \times \frac{1}{2}}{100}$ = 7.5 (approximate magnitude of the answer)

Procedure: (1) Hairline over 327 of outer scale
(2) Turn 128 of inner scale under hairline
(3) Hairline over 5.22 of inner scale
(4) index **10** moved under hairline
(5) Hairline moved to 0.453 of inner scale
(6) Under hairline read the answer 6.04 on the outer scale

3.5 Proportions

Many typical air navigation problems can be easily expressed in the more usable form of proportion. When the given ratio is set with the terms apposite each other on the two scales, the same ratio prevails throughout the entire range of the scales.

The example in par. 3.4, reduced to proportion form, would read $\dfrac{44.8}{1.4} = \dfrac{108.8}{3.4}$

The joint between the scales may be regarded as the dividing line in a common fraction.

Example of a percentage problem: Original tank contents 960 L, Consumption 647 L
To find: Consumption in per cent of the original contents.
The contents 960 is to 100% as the consumption is to the required percentage.

$$\frac{960}{100} = \frac{647}{\times}$$

Answer: $\times = 67.47\%$

Example of a time conversion problem: Given the flying time 0.43 hours as resulting in a time-distance-speed problem (see par. 6.2.1).
To find: The equivalent in minutes.
Since l h = 60 min, write the proportion

$$\frac{l}{60} = \frac{0.473}{\times}$$

Set the Hour Mark ⚠ opposite the Index 🔟 Rotary Index to 43 on the outer rim scale. On the adjacent rim scale read x = 25.8 min.

4.0 Conversions between Metric & British/US Standards

The index 🔟 on the rim scale (b) is labelled "m" "km" "Ltr" to show that all three metric units are set or read at this one mark, to obtain or convert the various non-metric units whose labels are conspicuously printed and graduated on the circumference of this scale.

Fundamentally every conversion commences by setting the value to be converted on the inner scale under the mark of the given unit. The result is then read from the rotary inner scale against the mark for the required unit. In the following figures the first setting is enclosed in a circle and arrows point out the direction of rotation of the indicator.
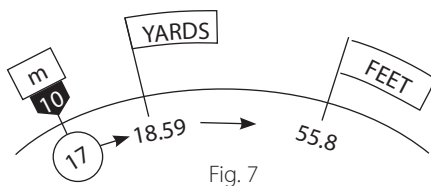
4.1 Conversion of Lengths & Distances

4.1.1 **Given:** 3 ft
Required: value in yards and m
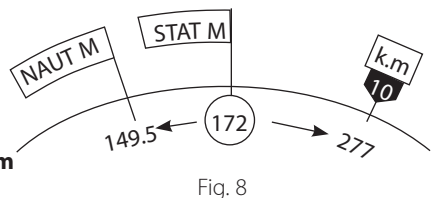**Result:** **3 ft = 1 yard = 0.915 m**

Fig. 6
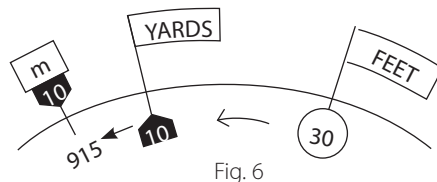
Turn scale value 30 under ft mark and read result from rotatable scale under the corresponding mark for yards or metres.

4.1.2 **Given:** 17 m
Required: Value in yards and ft
Result: **18.59 yards, 55.8 ft**

Fig. 7

4.1.3 **Given:** 172 stat miles
Required: naut miles and km
Result: **149.5 naut miles, 277 km**

Fig. 8

11.2 Departure Problems

Departure *(also known as Parallel Distance)* is the distance expressed in nautical miles between two meridians along a parallel of latitude. For departure problems use the approximate formula:

Departure = difference of longitudes × cosine latitude

Computer solution:
a) Set N to TRUE INDEX.
b) Set horizontal Zero line of rectangular grid under centre bore.
c) In a suitable scale plot the difference in longitude given in minutes of arc from centre bore horizontally leftward.
d) Rotate the given latitude under the TRUE INDEX.
e) The horizontal distance of the end point of the line segment which represents the difference in longitude, measured from the centre axis of the slide, gives the departure expressed in NM in the scale ratio adopted for step (c).

EXAMPLE

Find the departure between Long 5° E and 6° E at Lat 54° N.
Difference in longitude 1° = 60′.

Result: **35 NM.**

11.3 Finding the Conversion Angle (C.A.)

The approximate formula for the conversion angle is:

C.A. = ½ difference of longitude x sine of the mean latitude

Computer solution:
a) Set N to TRUE INDEX.
b) Shift horizontal Zero line of rectangular grid to centre bore.
c) From centre bore leftward, in a suitable scale ratio, *(e.g. side of a square bounded by strong lines = 1° change in longitude)* plot half the difference in the two given longitudes.
d) Set the mean latitude to the TRUE INDEX.
e) In the scale chosen under (c) read the conversion angle as the perpendicular distance of the plotted point from the horizontal Zero line.

EXAMPLE

Location of transmitter Lot 51° N Long 8° W
DR position of aircraft Lot 53° N Long 4° E
Difference in longitude 12° (hence ½ difference = 6°)
Mean latitude 52°

Setting: (1) N to TRUE INDEX.
(2) Horizontal Zero line of rectangular grid to centre bore.
(3) Scale off 6 unit squares leftward along the horizontal line.
(4) Set 52° to TRUE INDEX.
Reading: Conversion angle 4.7° as explained under (e). The numerations of the centre axis are helpful in taking the count.

EXAMPLE 2 **Tail Wind**

Direction of runway 075° Wind 200°/40 kt

Procedure:
(1) Set 200° to TRUE INDEX.
(2) Set Zero of rectangular grid to centre bore.
(3) Plot wind vector 40 kt down-grid.
(4) Set direction of runway 075° to TRUE INDEX.
(5) Shift the horizontal Zero line of the
     rectangular grid to coincide with the end
     point of the wind vector and read the cross
     wind component 33 kt counting leftward.
(6) Read the tall wind component 23 kt on
     the centre axis under the centre bore.

Fig. 60
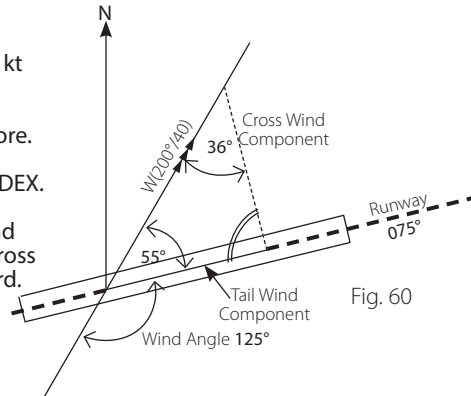
11.1.9 Calculation of Drift from Cross Wind Component (V_n) or from Beam Displacement (Z_n) (Pressure Pattern Navigation. see par. 8)

Given: True air speed, ground speed and V_n
Required: Drift

Drafted Solution:

Fig. 61
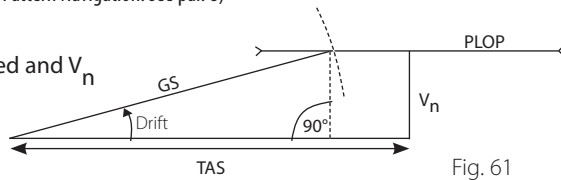
Computer Solution:
(a) Set one of the cardinal points of the compass rose (N, for instance) against the
     TRUE INDEX and plot the V_n vector from centre bore upward or downward.
(b) Set one of the compass points differing by 90°either way from the first adjustment
     (E for instance) against TRUE INDEX, and shift the slide to bring the black speed arc
     for the ground speed under the end point of the V_n vector.
(c) Read the drift under this location.

EXAMPLE 1

Given: V_n = 29 kt to the right
               Ground speed 205 kt
Required: Drift
**Result:**   Drift + 50

EXAMPLE 2

Given: Beam displacement Z_n =34 NM to the right
               Ground speed 210 kt, time elapsed between measurements of D-values 90 min.
Required: Drift

From the ground speed and the time flown determine the distance 315 NM made good between
the air positions of the two altitude measurements (cf. 6.2.3). Next calculate the drift as described
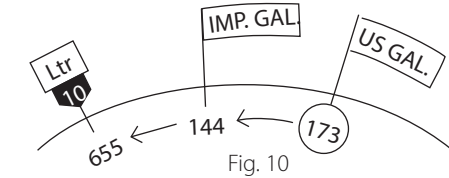above but substituting the distance 315 NM between the two air positions for the ground speed.

Result: **Drift + 6°**

4.2 Conversion of Liquid Measures

4.2.1 **Given:**   2350 l
           Required: Imp gal and US gal
           Result: **517 imp gal, 621 US gal**

Fig. 9
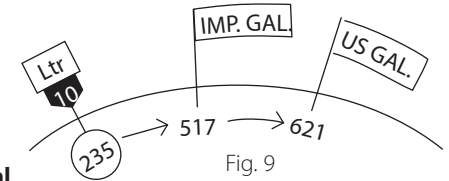
4.2.2 **Given:**   173 US gal
           Required: imp gal and I
           Result: **144 imp gal 655 l**

Fig. 10

4.3 Calculation of Weights from Liquid Measures

For the conversion of liquid measures of specific gravities 0.65 to 0.95 into their equivalents in
weight, there are two scales along the extreme rim of the outer ring, one for conversions into kg,
the other for conversions into pounds. For any given number of litres or gallons the equivalent
weight in kg or lb can be determined. The arrow bearing the marks kg and lb is used in converting
from one system to the other. The computer converts on the basis of British Standard:

1 imp gal = 4.546 kg = 10.0253 lb;
1 kg = 2.205 lb.   As an approximation, 1 gallon is often assumed equivalent to 10 lb.

Set the fluid quantity to be converted on the rotatable inner scale (c) under the appropriate mark
(I, imp gal. or US gal) on the outer scale (b) and turn the indicator over the specific gravity value of
the liquid on scale (a).

Read under the indicator from the inner scale the weight corresponding to the given fuel
quantity.   The weight will be shown in kg if the indicator was set over the specific gravity scale
labelled kg or will be shown in lb if the indicator was set over the scale labelled lb.   With these
marks the equivalents of weights in pounds and kilograms can be found directly as described
in   par. 4.1.

4.3.1 **Given:**   234 US gal, spec. grav. 0.72
           Required: weight in kg and lb
           Result: **637 kg. 1407 lb**

Fig. 11
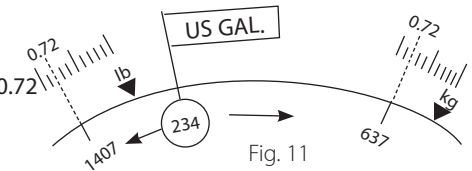
4.3.2 **Given:**   156 imp gal, spec. grav. 0.74
           Required: Weight in lb
           Result: **1157 lb**

Fig. 12
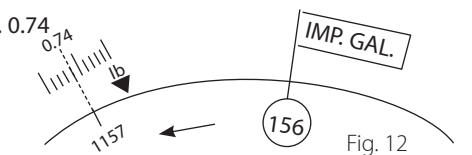
5.0 TIME AND SPEED CONVERSIONS

The difference between conversions of this type and those just described consists in that the
time and speed marks are printed an the movable scale (c). Hence the mark labelled with the
given unit is set opposite the given quantity on the stationary scale. The result can then be read
opposite the mark for the other unit.

5.1 Conversion of Time

5.1.1 Reduction of Minutes to Hours

On the minute scale(c) and hour scale(d) the respective equivalents of 1 to 10 hours are aligned to each other. On the inner rim of the black circle the hour scale is extended to 20 hours = 1200 minutes. The Aviatjet 647 has marks for two hours only –11 and 12.

5.1.2 Reduction of Minutes to Seconds with the marks △1 & ⌐SEC⌐

Given: 17 minutes
Required: Equivalent in seconds
Result: **1020 seconds**
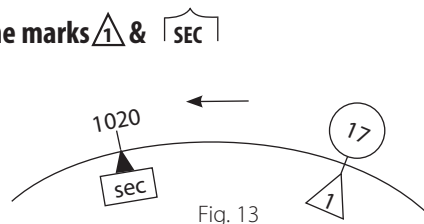
Note that the hour mark △1 is used for both hours and minutes. As fig. 14 shows, the solution is analogous when the problem is stated in reversed order.

1020

17

sec

1

Fig. 13

5.2 Conversion of Speeds

5.2.1 Reduction of m/sec to km/h

By reason of its coincidence with the graduation line for "36", the ⌐SEC⌐ mark also simplifies conversions between hours and seconds, in consideration of 1 h = 36000 sec and 1 m/sec = 3.6 km/h. When, for instance, the mark **10** of the minute scale(c) is matched with 35.8 m/s on scale(b), the mark ⌐SEC⌐ supplies the answer 129 km/h.

5.2.2 Conversion with the Marks m/sec and ft/min

Given: 500 ft/min
Required: m/sec
Result: **2.54 m/sec**

2.54

50

m/s   Fig. 14   ft/min
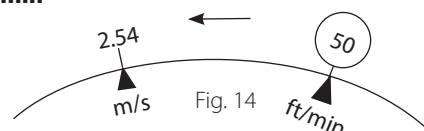
## 6.0 DISTANCE - TIME - SPEED PROBLEMS

Problems of this kind are usually given in rule-of-three form but can easily be changed to the more usable proportion form *(see par. 3.5).*

6.1 Time or Rate of Climb and Descent

6.1.1 *Example:* An aircraft is to climb from an altitude of 2000 ft to 11000 ft at the rate of 700 ft/min. Required is the time to climb the altitude difference of 9000 ft.
The rate of climb 700 ft/min means that the aircraft climbs 700 ft in one minute. Hence the first ratio in the proportion is 700:1.
Therefore: $\dfrac{700}{1} = \dfrac{9000}{\times}$

Setting: Set movable **10** under rate of climb 700.
Reading: Read duration of climb 12.85 min from the movable scale under the altitude difference 9000.
Result: **Duration of climb 13 min.**

70   90

10   1285

Fig. 15
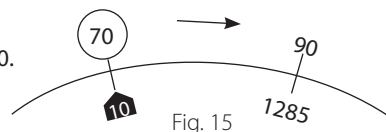
11.1.8 Calculation of Cross Wind and Head or Tail Wind Components

When taking off or landing on a runway it is in many cases important to know the cross wind and/ or head or tail wind components. These computations are made by the use of the rectangular grid on slide B, G or H.

Setting: (1) Wind direction to TRUE INDEX.
(2) Shift Zero of grid net under centre bore & plot the wind vector downward.
(3) Set direction of runway to TRUE INDEX.

Reading: (1) The distance from the labelled axis of the rectangular grid, counted along one of its horizontal lines to the end of the wind vector, gives the cross wind component.
(2) Counting from the Zero line vertically downward to the end of the wind vector gives the head or tail wind component.

⌐EXAMPLE 1⌐   **HEAD WIND**

Direction of runway 265°, Wind 330°/30 kt.

Procedure:

(1) 330° to TRUE INDEX
(2) Set Zero of rectangular grid to centre bore.
(3) Plot wind vector 30 kt downward.
(4) Set direction of runway 265° to TRUE INDEX.
(5) Read the cross wind component 27 kt by following the respective horizontal grid lines from centre axis to end of wind vector (fig. 58).
(6) Read the head wind component 13 kt by following one of the vertical grid lines from Zero line down to the end point of the wind vector (fig. 59).

N

W (330°/30)

Cross Wind Component

Runway 265°

Fig. 58

13 kt
27 kt

Fig. 59
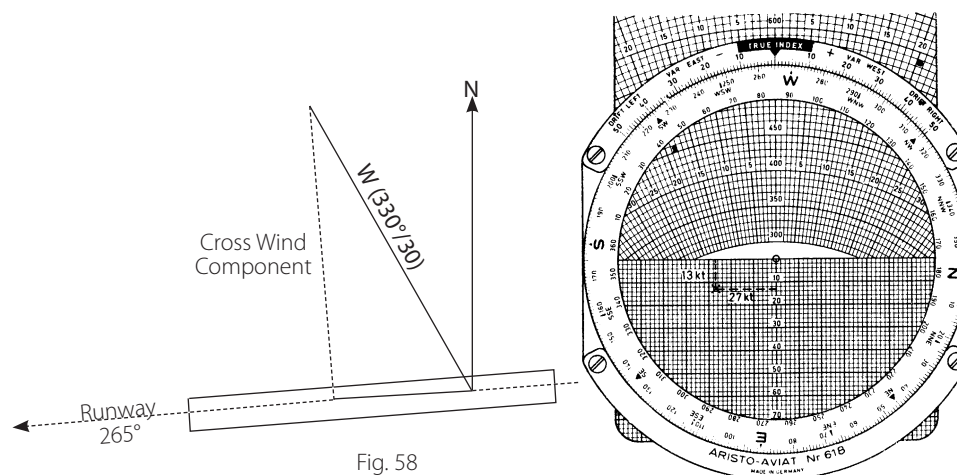
(3) Set another cardinal compass point differing by 90° from the original setting to TRUE INDEX.
(4) Set distance flown on centre axis of slide under centre bore.
(5) At the pencil dot read the angular value of the departure from the drift rays of the slide.
(6) Set the distance to go under the centre bore and read the course correction angle for the distance to go, analogous to the procedure under (5).
(7) Add the two angular values and apply the total correction to the true heading: Subtract for right departure, add for left departure.

EXAMPLE

Given: True Heading 100°
Distance along intended track 380 nm
Departure 24 nm to the right after flying 210 nm

Required: Course correction angle

Drafted Solution:

Fig. 55
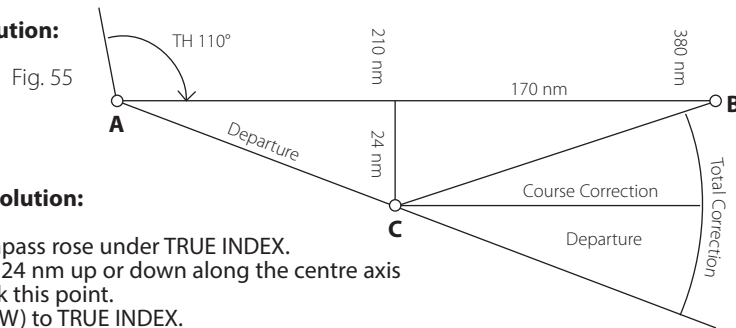
Computer Solution:

(1) N of compass rose under TRUE INDEX.
(2) Scale off 24 nm up or down along the centre axis and mark this point.
(3) Set E (or W) to TRUE INDEX.
(4) 210 on centre axis of slide under centre bore.
(5) Read angle of departure 6.5° at the marked point (fig. 56).
(6) Set distance to go 170 under centre bore and find the course correction angle 8° (fig. 57).
(7) To the true heading (100°) apply the total correction 6.5° + 8° = 14.5° leftward to obtain the new heading 85.5° to be maintained to destination. This operation can also be performed with the arc wing DRIFT LEFT.
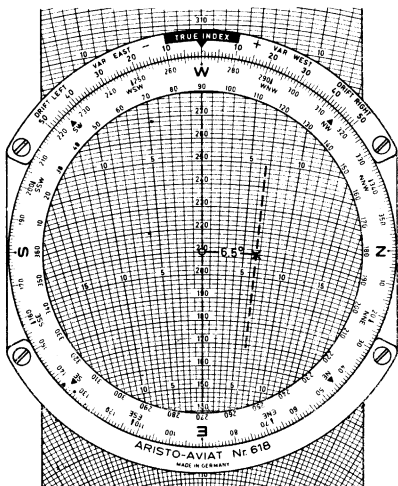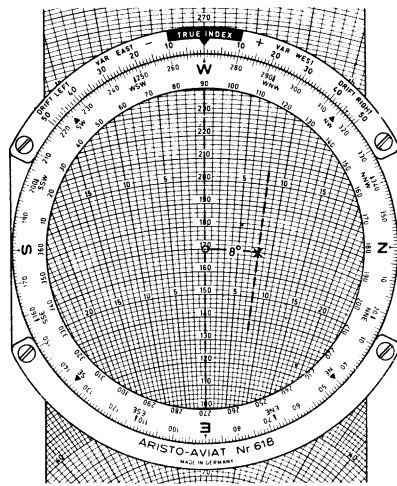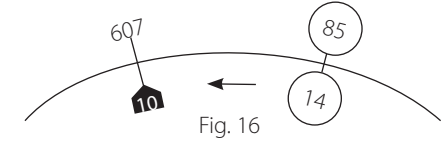

Fig. 56

Fig. 57

34

6.1.2 EXAMPLE: An aircraft descends 8500 ft in 14 min, required is the rate of descent.

Proportion: $\dfrac{8500}{14} = \dfrac{\times}{1}$

Setting: 14 under 85
Reading: 607 over **10**
Result: **Rate of descent 607 ft/min**

Fig. 16

6.2 Distance-Time-Speed Problems

6.2.1

Given: Ground speed 246 kt
Distance 745 nm
Required: Flying time
Approach: Knots are nautical miles per hour, accordingly:
$\dfrac{246}{1} = \dfrac{745}{\times}$


Fig. 17
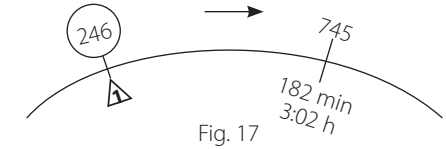
Setting: Set hour mark $\triangle{1}$ of the time scale against the ground speed 246 on the outer scale *(distance scale)*.
Reading: Read under distance 745 on the distance scale the flying time 182 min=3:02h from the time scale. White scale for minutes, black for hours.

6.2.2

Given: Distance 412 km
Flying time 1:28 h = 88 min
Required: Ground Speed
Setting: Set flying time 88 min on the time scale under the distance 412 km on the distance scale.

Fig. 18
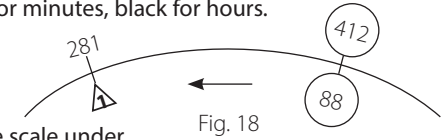
Reading: Read over the hour mark $\triangle$ of the time scale the ground speed 281 km from the distance scale. By a lucky coincidence the logarithmic interval separating the mark ft/min from the hour mark $\triangle$ is numerically approximately equal to the conversion factor between km/h and kt. Thus, opposite ft/min we can also read the speed in knots: 153 kt. The strictly correct reading would lie two division lines to the left: 152 kt.

6.2.3

Given: Ground speed 247 kt
Flying Time 2:16 h = 136 min
Required: Distance Flown
Setting: Set hour mark $\triangle$ under ground speed 247 kt on distance scale.

Fig. 19

Reading: Read over flying time 136 min on the time scale the distance flown 560 nm from the distance scale.

6.2.3 Point of Equal Time (Critical Point)

If for example engine trouble occurs during flight it is important for the pilot to know whether the airport of departure or the airport of destination can be reached sooner. For this purpose the Point of Equal Time (PET) or Critical Point (CP) is determined, ie. the point from which the continuation of the flight to the destination would require the same time as the return flight to the point of departure. The formula used is:

$$T_{PET} = \frac{T_F \times GS_{home}}{GS_{out} + GS_{home}} \quad \text{(Time Formula)}$$

Where: T_{PET} Flying time to Point of Equal Time.
T_F Time to fly from base to destination (flight plan time).
GS_{out} Ground speed on flight out (ground speed out).
GS_{home} Ground speed on return flight (ground speed home).

15

The distance from the point of departure to the Point of Equal Time (Critical Point) is calculated by means of the following formula:

$$D_{PET} = \frac{D_z \times GS_{home}}{GS_{out} + GS_{home}} \quad \text{(Distance Formula)}$$

Where: D_{PET} = Distance from base to PET.
D_z = Distance from base to destination.

These equations may be transposed to the more convenient proportion form, as follows:

$$\frac{GS_{home}}{GS_{out} + GS_{home}} = \frac{T_{PET}}{T_F} \text{ or } \frac{D_{PET}}{D_z}$$

EXAMPLE

Given: Distance to destination D_z = 920 nm
GS$_{out}$ = 240 kt
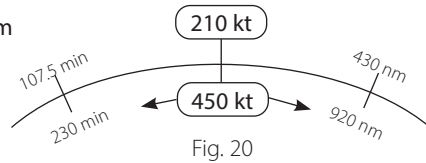GS$_{home}$ = 210 kt
Flight Plan Time
T_F = 3:50 h = 230 min
Required: Flying time to PET distance D_{PET}
Intermediate Calculation: GS$_{out}$ + GS$_{home}$ = 450 kt
Setting: Set indicator over GS$_{home}$ = 210 on the outer scale and set the sum GS$_{out}$ + GS$_{home}$ = 450 on the rotatable inner scale under the index hairline. With this setting and in accordance with the above mentioned proportion the corresponding flying times T or the distances D will appear opposite each other.
Reading: 1. Turn hairline to T_F = 230 on the inner scale and read T_{PET} = 107.5 min from the outer scale.
2. Turn indicator over D_z = 920 on the inner scale and read D_{PET} = 430 nm from the outer scale.
Result: **The PET will be reached after a flying time of 107.5 min.**
The distance flown will then be 430 nm.

Fig. 20

6.2.5 Determination of the "Point of No Return"

The point of no return depends upon the endurance of the aircraft. After passing the point of no return the remaining fuel will not be sufficient for a return flight to the point of departure. The flight can only be continued to the destination or to an alternate airfield. Also the point of safe return is often to be determined, the calculation of which is based upon the amount of available fuel after deducting the required reserve.

The formula for the Point of No Return is:

$$T_{PNR} = \frac{E \times GS_{home}}{GS_{out} + GS_{home}} \quad \text{(Time Formula)}$$

Where: T_{PNR} = Flying time to point of no return
E = Endurance

This formula is of the same type as the PET formula so that here again the same proportion is valid:

$$\frac{T_{PNR}}{E} = \frac{GS_{home}}{GS_{out} + GS_{home}}$$

Computer Solution:

Setting: (1) 145° to TRUE INDEX and Zero line of rectangular grid on diagram B, G or H under centre bore.
(2) Scale off 25.5 nm from centre bore down.
(3) 90° to TRUE INDEX.
(4) Shift zero line of rectangular grid to the plotted point and scale off 17 nm from end of first plotted heading downward.
(5) 20° to TRUE INDEX.
(6) Shift zero line of rectangular grid to the second point and scale off 30 nm, downward again.
(7) Wind direction 340° to TRUE INDEX.
(8) Shift the lower rim of rectangular grid to the third point and scale off drift 14 nm from last point up. The drift for 17 min total flight time is determined from the equation: $\frac{50}{\triangle} = \frac{\text{Wind Drift in NM}}{\text{Total Flight Time}}$
wherein 50 kt is the wind speed in nautical miles per hour.
(9) Turn end point of wind vector downward to match the centre axis of the grid and shift its zero line under the centre bore.
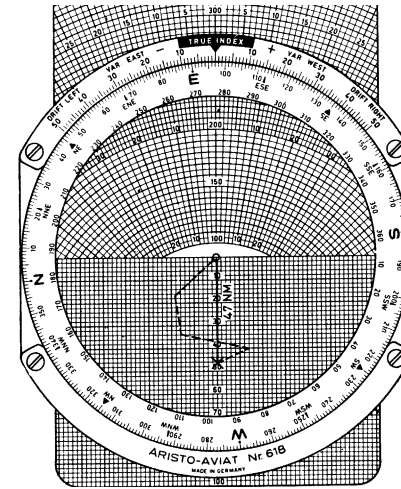
Fig. 54

Reading: Direction of DR position 97° opposite TRUE INDEX. Distance from starting point 47 nm along centre axis (fig. 54)

11.1.7 Off-Course Corrections
Given: The lateral departure in nm from the intended route.
Distance of airplane from starting point.
Required: Angle of departure and course correction angle.
Procedure: (1) Set one of the cardinal compass points under TRUE INDEX.
(2) From centre bore, either up or down along the centre axis, scale off the amount of lateral departure by use of its numeration or the red concentric circles. Place a pencil dot.

EXAMPLE | True air speed 240 kt
First true heading 210° drift angle -6°
Second true heading 260°, drift angle +2°

SETTING:
(1) 240 kt under centre bore.
(2) 210° to TRUE INDEX (fig. 51).
(3) Trace the - 6° drift ray with a pencil.
(4) Turn 260° under TRUE INDEX (fig.52).
(5) Mark the place where the +2° drift ray cuts the pencilled line.
(6) Set the indicator to this mark.
(7) Read the wind direction and velocity.

USERS OF THE AVIAT 618: Turn the intersection of the drift lines downward to the Zero axis and read the wind direction under the TRUE INDEX.

RESULT: **Wind 248°/36 kt.**

11.1.6 Keeping an Air Plot

To keep an airplane on a plotted route use the rectangular grid net on side B, G or H of the slide.

GIVEN: True headings flown, time on each lap, true air speed and wind data.
REQUIRED: Direction and distance of dead reckoning position from starting point or last known position.
SETTING:
(1) First true heading to TRUE INDEX.
(2) Upper border of rectangular grid under centre bore and, in a convenient scale ratio vertically down-grid plot the distance made good in the first lap flown with the first heading, ignoring the wind effect.
(3) For the second true heading proceed as before and plot the distance made good from the end point of the first line downward.
(4) Proceed accordingly for further headings, if any.
(5) Wind direction to TRUE INDEX.
(6) Plot the total wind effect for the times flown on the several headings from end point of the drafted true headings upward on the grid.
(7) Turn the end point of the wind vector so plotted downward so as to lie on the centre axis of the slide.
READING: Under TRUE INDEX: Direction of DR position from starting point.
The distance of the DR position from the starting pint is measured between the end point of the wind vector and the centre bore. This reading is taken by use of the numbers on the slide axis.

EXAMPLE

GIVEN: True air speed 255 kt Wind 340°/50 kt
1st True Heading 145° time elapsed 6 min (air distance 25.5 nm)
2nd True Heading 90° time elapsed 4 min (air distance 17 nm)
3rd True Heading 20° time elapsed 7 min (air distance 30 nm)
The air distances are calculated as given in para. 6.2.3.
REQUIRED: Direction and distance of DR position from starting point.

DRAFTED SOLUTION:

Fig.53
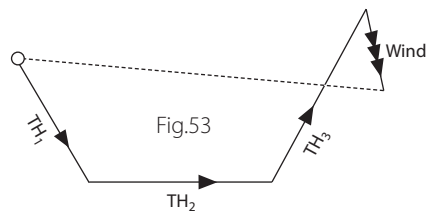
EXAMPLE

GIVEN: Endurance 6:30 h = 390 min
GS_{out} = 240 kt
GS_{home} = 210 kt
GS_{out} + GS_{home} = 450 kt
REQUIRED: Point of No Return, distance
SETTING: Set GS_{home} over GS_{out} + GS_{home} = as shown in para. 6.2.4.
READING: Read flying time to Point of No Return from the outer scale over the endurance on the inner scale.
RESULT: The point of no return will be reached after a flight of 182 min = 3:02 h. If the point is to be located geographically, determine the distance to the point of no return by means of GS_{out} according to the usual time-distance calculation (see para. 6.2.3). **The distance is 728 nm.**

Fig. 21

7.0 FUEL CONSUMPTION

7.1
GIVEN: Consumption 220 imp gal per hours, specific gravity of fuel 0.72 and flying time 3:24 h = 204 min.
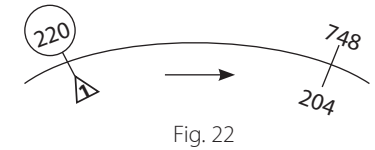REQUIRED: Total consumption and weight of fuel in lb
SETTING: Set hour mark △ of the time scale under the hourly consumption 220 on the outerscale.
READING: Read total consumption 748 imp gal from the outer scale over flying time 204 on the time scale.
INTERMEDIATE RESULT: Total Consumption 748 imp gal.
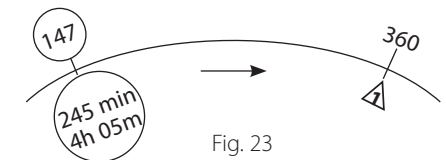**CONVERSION TO WEIGHT:** (see para. 4.3.2)
RESULT: **5390 lb**

Fig. 22

7.2
GIVEN: Total consumption 1470 US gal, flying time 4:05 h = 245 min
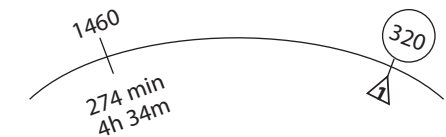REQUIRED: Consumption per hour
RESULT: **360 US gal**

Fig. 23

7.3
GIVEN: Hourly consumption 320 gal, fuel available 1460 gal
REQUIRED: Maximum flight duration
SETTING: Set hour mark of the timescale under hourly consumption.
READING: Read opposite expendable fuel on the outer scale the maximum flight duration **274 min** from the time scale.

Fig. 24

8.0 PRESSURE PATTERN FLYING

8.1 Calculation of Cross-Wind Component V_n from Pressure Comparison

The formula for the calculation of the cross-wind component is: $V_n = \dfrac{C \times (D_2 - D_1)}{\sin \varphi \times AD}$

Where: C   =   constant 21.47
         φ   =   mean latitude between points of pressure comparison
         D1 =   difference value in ft for the first measurement
         D2 =   difference value in ft for the second measurement
         AD =   air distance in NM

The latitude scale on the inner disc of the computer takes care of the term $\frac{C}{\sin \varphi}$ in the above equation, ie. the "K Factor", which leads to the simplified equation:
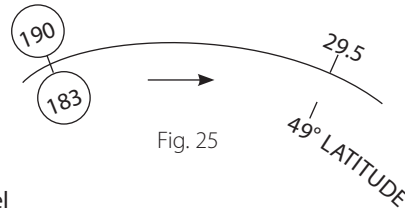
$$V_n = \frac{D_2 - D_1}{AD} \times K$$

Fig. 25

EXAMPLE   10:00 h Absolute height above sea level
          (Radio Altimeter): .... 10240 ft
          Pressure Altitude: .... 10100 ft
          D_1 .... + 140 ft

          10:50 h Absolute height above sea level: 10050 ft
          Pressure Altitude: .... 10100 ft
          D_2 .... − 50 ft

$D_2 - D_1 = -50 - (+140) = -190$

True Air Speed = 220 kt
Air Distance (in 50 minutes) = 183 nm
Mean Latitude: 49°N

The value $D_2 - D_1$ is negative. This indicates that the aircraft is flying from an area of higher pressure to one of lower pressure. Under these conditions, according to the Buys Ballot's wind law, in the northern hemisphere the wind is blowing from the left. The cross-wind component is, therefore, positive.

Setting: Set difference of D-values 190 on the outer scale (DISTANCE) opposite the air distance 183 on the edge scale (MIN) of the inner disc. Turn hairline over mean latitude 49° on LATITUDE scale.

Reading: Under hairline read cross-wind component V_n + 29.5 kt.

8.2   Calculation of Beam Displacement (Z_n)

The formula used is:

$$Z_n = \frac{K \times (D_2 - D_1)}{ETAS} \qquad \frac{Z_n}{K} = \frac{D_2 - D_1}{ETAS}$$

Where: K   =   K factor (see para. 8.1)
           D_1 =   difference value in ft for first measurement
           D_2 =   difference value in ft for second measurement
           ETAS   =   Effective True Air Speed between measurements

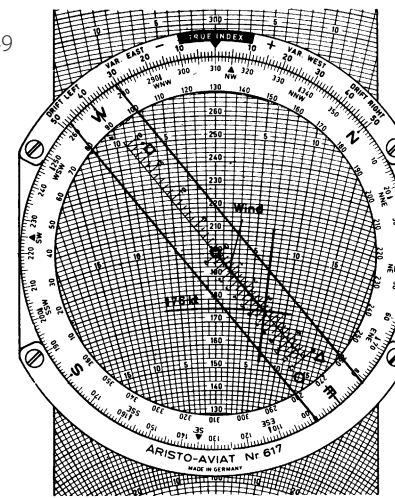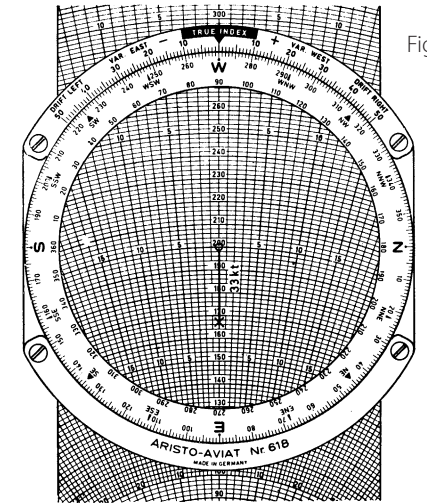The Z_n value is used for obtaining pressure lines of position (PLOP)

Fig. 49

Fig. 50

11.1.5   Drift Problems

When two true headings are flown and the drift angles are measured, the wind can be determined from the drifts and the true air speed. The two courses shown should make an angle of at least 45° in order to produce satisfactory results.

Computer Solution:
(a)   Set the true air speed on the slide scale under the centre bore.
(b)   Set the first true heading against the TRUE INDEX.
(c)   With a pencil trace on the plotting surface the drift line along the slide ray corresponding to the observed first drift angle.
(d)   Set the second true heading against the TRUE INDEX.
(e)   Pencil-mark the place where the black drift ray for the second heading meets the previously drawn pencil line.
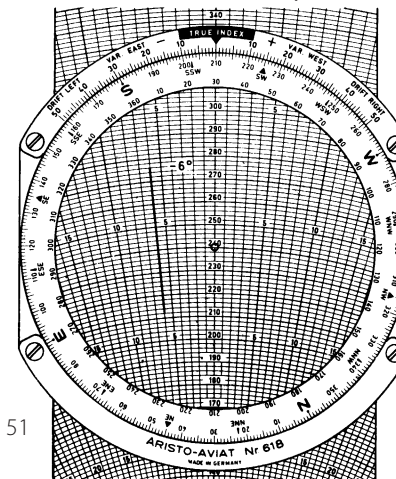(f)   Turn the indicator to the pencil-marked point to find the wind direction and velocity.
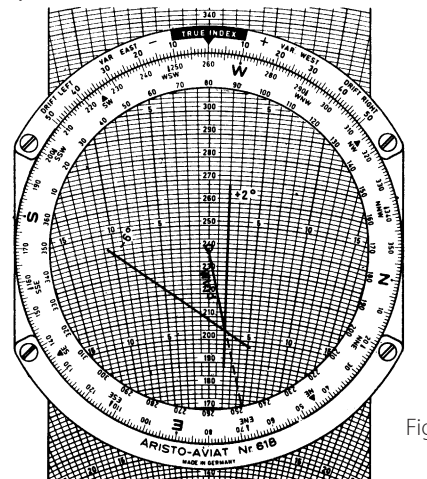
Fig. 51

Fig. 52

Solution of the same problem by Aviat 618: Set the wind 350° on the black azimuth graduation to TRUE INDEX. Plot the wind vector from centre bore upwind, therefore upward along the centre axis. Count off 30 knots on the speed arcs of the slide and pencil-mark the point so determined (fig. 46). Now rotate the true track 48° under the TRUE INDEX and shift the true air speed 210 kt of the slide to coincide with the plotted end point of the wind vector. Then read the result as explained above.

11.1.4 To find Wind Direction and Velocity from Drift Angle and Ground Speed

GIVEN: True Heading
                True Air Speed
                Ground Speed
   Drift Angle
REQUIRED: Wind direction and velocity

Fig. 47
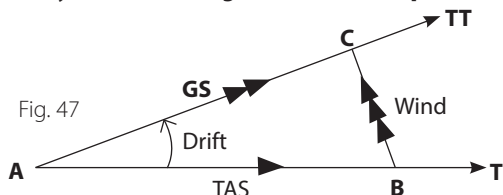
Drafted Solution:

(1)   Along a line drawn from A to represent the true heading lay off the true air speed (line AB).
(2)   From A lay off the drift angle, to the right of AB if the drift is +, to the left if –.
        Along this side of the angle scale off the ground speed to obtain point C.
(3)   The line drawn from B to C defines the wind direction and velocity.

Computer Solution:

(a)   Set true heading to TRUE INDEX.
(b)   Draw the true air speed under centre bore.
(c)   Pencil-mark intersection of drift ray with speed arc for the ground speed.
(d)   Set the indicator to the marked point using the wind scale corresponding to the diagram slide.
(e)   Read the wind velocity on the indicator scale over the pencilled mark and the wind direction on the azimuth graduation (red).
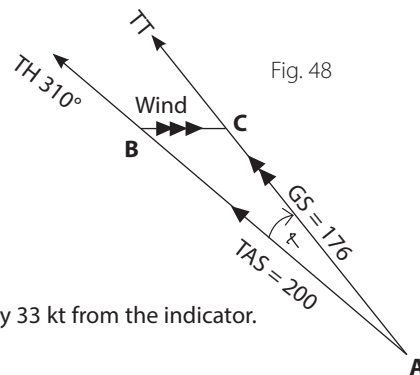
EXAMPLE

GIVEN: True Heading 310°
                True Air Speed 200 kt
                Ground Speed 176 kt
                Drift + 7°
REQUIRED: Wind direction and velocity
SETTING: 310° to TRUE INDEX (fig. 49)
                200 kt to centre bore
                Pencil-mark the intersection of the black drift ray + 7° (on the right) with the speed arc 176.
READING: Read the wind direction 270° and velocity 33 kt from the indicator.

Fig. 48

NOTE: In the case of the 618 model, turn the plotted point downward to coincide with the Zero axis of the slide and read the wind direction opposite the TRUE INDEX. Count off the wind velocity on the numerated black speed arcs and their subdivisions. Counting along the Zero axis is made easier when some round value, 200 for instance, is adjusted to the pencil-mark (fig. 50).

EXAMPLE $D_2 - D_1 = -170$ ft
                   ETAS = 175 kt
                   Mean Latitude: 38° N
SETTING: Set true air speed 175 kt on rim scale of inner disc under difference of D-values 170 ft on outer scale and turn indicator over mean latitude 38° on latitude scale.

Fig. 26

READING: Read under hairline beam displacement Z_n = 34 nm for the time elapsed between the first and second measurement. $D_2 - D_1$ is negative, therefore, for the time of the second measurement, the beam displacement is to be plotted perpendicular to the heading 34 nm to the right of the respective air position.
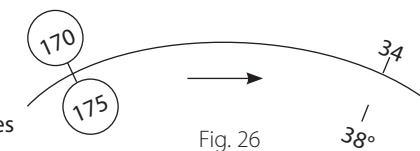
8.3 Calculation of Drift from V_n or Z_n

The determination of drift from the value of the cross-wind component or of the beam displacement will be described in para. 11.1.9 dealing with the graphical solution of triangles.

9.0 AIRSPEED CALCULATIONS

9.1 With Aviat 610, 613, 615, 617 & 618

Air speed indicators are calibrated in accordance with the international standard atmosphere at sea level. If the actual air density at the flight level differs from standard air density at sea level the true air speed will deviate from the indicated air speed even if the indicator is free from defects or instrument errors. The main factors governing air density are air pressure and temperature. Because of the relationship between air pressure and altitude pressure, altitude may be used in place of air pressure for the calculation of true air speed.

   With the Aviat 610, 613, 615, 617 & 618, air speed calculations are carried out by means of the scales labelled AIR SPEED (see fig. 1, f). It should be noted that at high speeds, due to compressibility heating, the thermometer will indicate a higher than actual temperature. Therefore, the observed temperature must be corrected before being used for setting the computer. The temperature correction is read from a double scale in the central part of the AVIAT eg. for an air speed of 324 kt the thermometer reading must be reduced by 10°C; for 500 kt the correction is – 23°C.

   The temperature correction scale can only give estimative values, since the magnitude of the error caused through frictional heating depends on the type and position of the thermometer bulb. Closer correction values can be obtained from the table usually furnished by the manufacturers of the particular type of aircraft.

9.11 Calculation of True Air Speed (TAS)

GIVEN: Rectified Air Speed (RAS)
                Corrected Outside air Temperature (COAT) in centigrade;
                Pressure altitude in ft or km
REQUIRED: True Air Speed (TAS)
SETTING: Set corrected temperature on the red scale (f) labelled "C.O.A.T" against PRESSURE ALTITUDE in km in the upper part of the window or against pressure altitude in ft in the lower part.
READING: Read true air speed (TAS) from outer scale (b) over rectified air speed (RAS) on moveable scale (c).

When setting the temperature it s algebraic sign must be observed. For clarity only the values 20°, 40°etc, are numbered. By aid of the 5° lines one degree can be estimated. On the altitude scale every interval represents 1000 ft; intermediate values can be located to 100 ft by estimate. On the metric altitude scale each interval represents 200 m. The two pressure altitude scales, in conjunction with the index hand, facilitate conversion of ft to km and vice versa.

EXAMPLE

Fig. 27

194

170

-5°

9

Given: Rectified Air Speed (RAS) 170 kt
Corrected Outside Air Temp. –5° (COAT)
Pressure Altitude 9000 ft

Required: True Air Speed (TAS)

Result: **TAS = 194 kt**
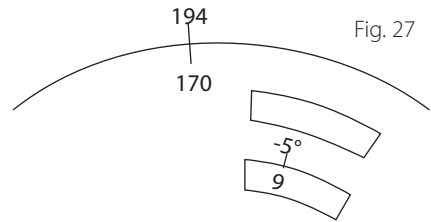
9.1.2 Calculation of Rectified Air Speed (RAS)

Fig. 28

230

160

6,8

-26°

Given: True Air Speed (TAS) = 230 kt
Outside Air Temperature –21°C
Pressure Altitude 6800 m

Required: Rectified Air Speed (RAS)
Temperature Correction –5°
COAT –26°C

Setting: As in para. 9.1.1

Reading: Read rectified air speed from scale (c)
opposite true air speed on the adjacent scale (b)

Result: **RAS = 160 kt**
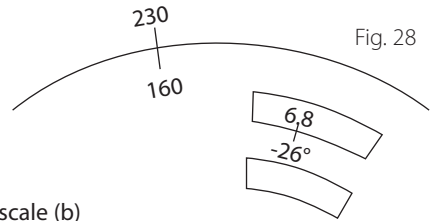
9.13 Compressibility Correction

Computations of true air speed with the Aviat 617 and 618 disregard the error due to compressibility of the atmosphere. Such errors only take on major proportions at speeds above 200 kt and in higher altitudes. The calibration of the air speed indicator takes the effect of compressibility at sea level into account. Aircraft flying at speeds that make it necessary to compensate for compressibility usually carry special correction tables or speed diagrams in which the corrections are incorporated. These correction tables or speed diagrams, compiled by builders of aircraft from data collected in trial flights and furnished together with the performance curves, enable an accurate determination of the true air speed corrected for compressibility. There are also now available true air speed indicators which automatically register the true air speed corrected for compressibility. Still another approach is offered by the machmeter installed in jet planes, and consists in solving for the true air speed from:

$$\text{Mach Number} = \frac{\text{True Air Speed}}{\text{Speed of Sound}}$$

In the absence of better facilities, the correction factors for various speeds and altitudes can be determined from the following table:

(1) Plot direction of the true track.
(2) From some arbitrary point C on this line plot the wind vector upwind to obtain B.
(3) Swing an arc with B as its centre and radius true air speed, intersecting the track to obtain A. Draw line AB. Angle BAC is the wind correction angle and line segment AC is the ground speed.

Computer Solution:

(a) Set true track to TRUE INDEX.
(b) Turn the indicator to the wind direction, in this case using the black azimuth graduation (the angle being upwind counting anti-clockwise).
(c) Shift the speed arc corresponding to the true air speed so as to coincide with the wind speed on the indicator.
(d) Read the wind correction at the same place. Read the ground speed under the centre bore from the scale on the axis of the slide.

EXAMPLE

Fig. 44

Given: True track 48°
Wind 350°/30 kt
True Air Speed 210 kt
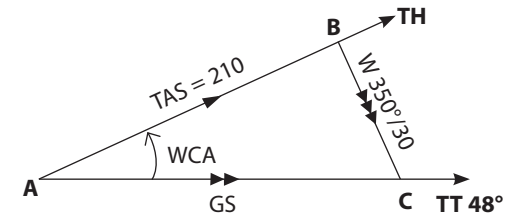
Required: Wind correction angle and ground speed

Setting: 48° to TRUE INDEX (fig. 45)
Set the indicator to 350° on the black azimuth circle (being upwind). Adjust the speed arc labelled 210 of the diagram slide to the wind speed 30 kt of the indicator scale.

Reading: Under the plotted point read the wind correction angle – 7°. Under the centre bore read the ground speed 192 kt.
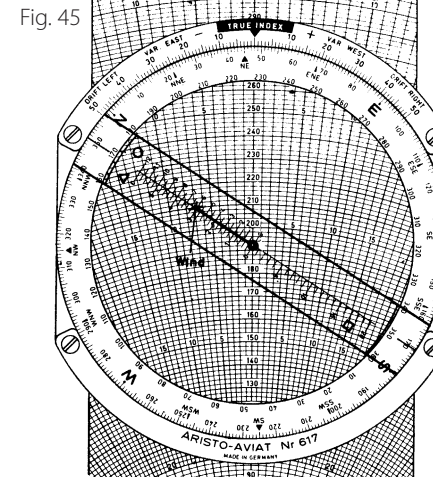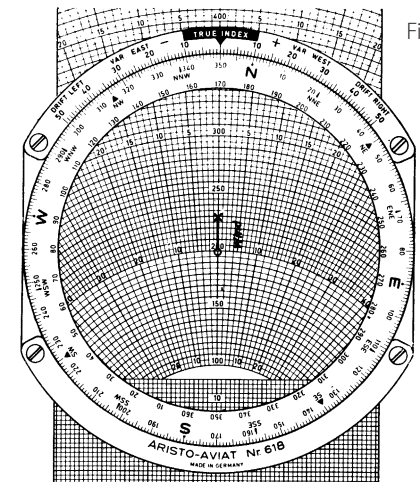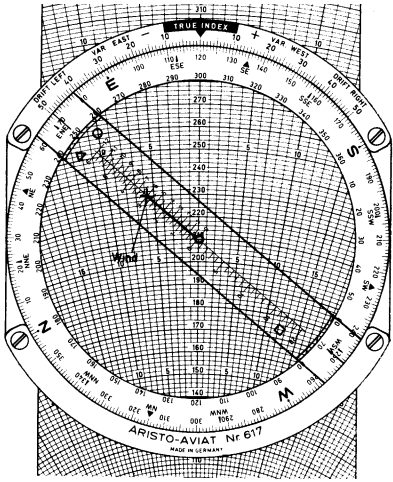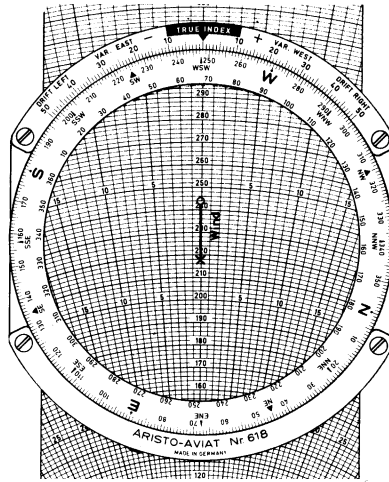
Fig. 45

Fig. 46

Fig. 41

Fig. 42

Given: True heading and true air speed, as before, but wind 248°/26 kt
Required: Drift and ground speed
Setting: (1) Wind direction 248° to TRUE INDEX (fig. 42)
(2) From centre bore plot 26 kt downward (best done by placing the arc 126 or 226, for instance, under the centre bore and marking the wind vector by a dot or cross at 100 or 200, respectively, along the numerated axis).
(3) True heading 120° to TRUE INDEX
(4) True air speed 210 kt under centre bore.

Reading: Under the plotted end point of the wind vector find the drift angle – 5° and the ground speed 227 kt on the diagram slide.

11.1.3 Finding the Wind Correction Angle and the Ground Speed

Given: The true track (required track or track made good, respectively) True air speed, Wind.
Required: Wind correction angle and ground speed.
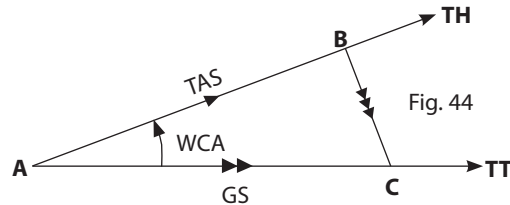
Drafted Solution:

Fig. 43

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

To find the true air speed corrected for compressibility, the correction factor is read against the rectified air speed and the pressure altitude from the foregoing table. The true air speed computed as usual (see para. 9.1.1) is then multiplied by the correction factor. The result will not be strictly accurate, since it disregards the variation of temperature at flight level (pressure altitude) in comparison with the standard atmosphere.

Rectified Air Speed 320 kt
Pressure Altitude 20000 ft
Observed Outside Air Temperature – 6°
Estimated TAS 430 kt (for obtaining temp. correction)
Temperature Correction – 17°
Add this value to the observed outside temperature to obtain the corrected outside air temperature – 23°C
True Air Speed (without compress. corr.) 440 kt
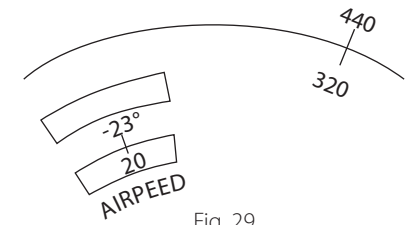Correction factor 0.97

Fig. 29

0.97 x 440 = 427 kt (true air speed corrected for compressibility)

9.1.4 Calculation of Speed of Sound and Mach Number

From the relation between Mach number, true air speed and sound mentioned in para. 9.1.3 any one of the values may be readily obtained from the other two given ones.

9.1.4.1 Mach Number

For the determination of the Mach number there are two marks on the scales appearing in the window for air speed calculations, one of which is labelled M (km/h) in the window for pressure altitude in km and the other labelled M (kt) in the window for pressure altitude in ft; the M (kt) mark is best found by turning the inner disc anti-clockwise starting from zero on the red pressure altitude scale.

Setting: Set corresponding mark M (km/h) or M (kt) against outside temperature (COAT) at flight altitude.
Reading: Read under true air speed on outer scale the Mach number from the rotatable scale (c)

Fig. 30

True air speed 420 kt, outside temperature at flight altitude – 35°C.

Result: Mach Number 0.7

9.1.4.2   Speed of Sound

Since the speed of sound changes with the temperature and $C_s = \dfrac{TAS}{M}$ expresses the relation

between these factors, the speed of sound can be found by setting the M (kt) mark or M (km/h) mark opposite the outside temperature as in the para. 9.1.4.1.

Setting: Respective M mark opposite COAT at flight level.
Reading: Opposite the mark **10** of the minute scale read the speed of sound on the stationary outer scale.

Example   COAT at flight level – 35°C.

Fig. 31

Result: **Opposite 10 read the speed of sound 600 kt**

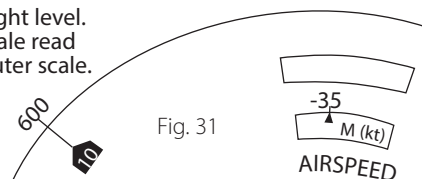## 9.2   Calculation of Air Speed with AviatJet 647

Air speed computation, at high speeds and at high altitudes, is simplified with the AVIATJET 647. Air compressibility-heating, can be rad in the aperture TEMP. RISE. The true outside temperature can therefore be derived. From the initial setting of CAL. AIR SPEED against PRESS. ALTITUDE, the Mach number is apparent. To read true air speed a further setting of the rotating index suffices.

9.2.1   Calculation of True Air Speed TAS

Known: Indicated air speed V_a (CAS) in kt
             Indicated temperature °C
             Pressure altitude in ft
Required: True air speed TAS
             Mach Number
             Temperature rise
             Corrected outside temperature
Setting: Set indicated air speed CAS in the grey edge-field to the pressure altitude on scale (f) Bring the three line indicator over the intersection of the reference spiral and the temperature curve (i) for the indicated temperature.
Note: Rotary indicators are available for C_T = 1.0, 0.95 and 0.8 C_T is the coefficient of temperature recovery. The solid lines are valid for the standard atmospheric temperature at approximately 35000 ft., – 56.5°C. The dotted lines refer to standard temperature at sea level, + 15°C. For C_T = 1.0 the single intersecting line of the rotary indicator is used.
Reading: Read true air speed on the TRUE AIR SPEED scale (x) under the rotary indicator. Beneath the index line of the rotary indicator read temperature increase on scale (z) TEMP. RISE. The Mach number is shown under the index line at the window marked Mach.
Note: The temperature rise is always read with reference to C_T = 1.0 if calculated with the curves of the cursor, the result is the temperature rise – from Temp. Rise x C_T.

11.1.2   Determination of Drift Angle and Ground Speed

Given: True Heading
             True Air Speed
             Wind Direction and Velocity
Required: Drift angle and ground speed

Drafted Solution:

(1)   Along a line from A in direction of true heading lay off the true air speed.
(2)   From point B, so determined, plot the wind vector downwind to obtain point C.
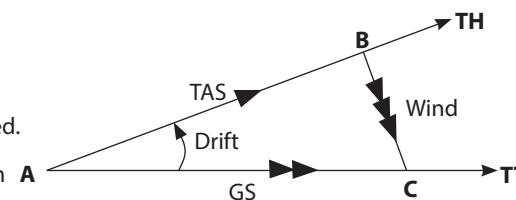(3)   Angle BAC is the drift angle (Dr) and the line AC gives the ground speed.

Fig. 39

Computer Solution:

(a)   Match the true heading on the azimuth circle with the TRUE INDEX mark. Shift the diagram slide so as to make the true air speed on its centre axis coincide with the centre bore in the plotting surface.
(b)   From the centre bore plot the wind vector downwind by help of the indicator using for the wind direction the red azimuth graduation.
(c)   Under the end of the wind vector find the drift by means of the drift lines and the ground speed by means of the speed arcs of the diagram slide.
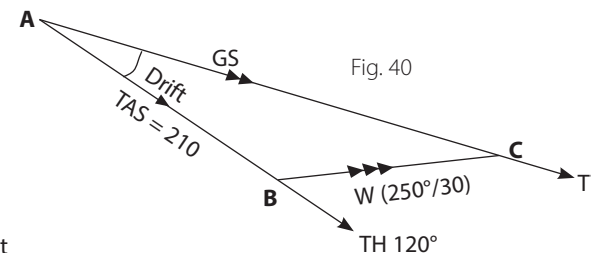
Fig. 40

EXAMPLE

Given: True Heading 120°
             True Air Speed 210 kt
             Wind 250°/30 kt
Required: Drift and ground speed.
Setting: 120° against TRUE INDEX (fig. 41) 210 kt under centre bore of plotting surface.
Reading: Under the wind speed 30 kt on the indicator scale read the drift – 6° on the black drift line and the ground speed 230 kt on the black speed arc.

The arc marked DRIFT RIGHT and DRIFT LEFT AND NUMERATED 0° TO 50° in both directions from the TRUE INDEX is used for adding and subtracting the drift from the true heading to obtain the true track. Under the 6° line of the left wing of the arc bearing the minus sign the reading for the true track gives 114°.

Users of the AVIAT 618 with its blank plotting surface will find it somewhat tricky to plot the wind vector. They will employ the following method: Set the wind direction to the TRUE INDEX. Move any convenient numerated speed arc of the slide under the centre bore and lay off the wind velocity downward along the centre axis. Mark the end point of the wind vector with a pencil dot or cross. Now turn the true heading under the TRUE INDEX and continue as explained under (a) and (c).

The centre line is the ZERO axis and the rays to the right and left thereof give the various drift angles in degrees. The concentric arcs drawn about A as their centre represent the speeds (km/h or knots), which are marked on them, increasing outward from A = Zero.

When the wind vector is plotted with its origin at the centre bore of the plotting surface, the indicator signifies the flight courses, viz. the centre axis the true heading and the rays the track over ground. The angle between the Zero axis and the respective ray is the angular value of the drift, one degree from ray to ray, every fifth ray numerated.

Each diagram on a slide includes only that section of the complete system of radiating rays and concentric arcs which corresponds to its individual range of speed.

The diagram in fig. 38 demonstrates the graphic construction of the wind triangle with the AVIAT when the given elements are the true heading, the true air speed and the wind data. The true air speed on the Zero axis of the diagram slide is brought under the centre bore of the plotting surface. The wind vector is then plotted from the wind speed and direction, with its origin at the centre bore. The zero axis is assumed as the true heading and the ray which passes through the terminal point of the vector is the resultant which completes the triangle and indicates the true track, the ground speed being readable at its intersection with the speed arc and terminal point of the wind vector.
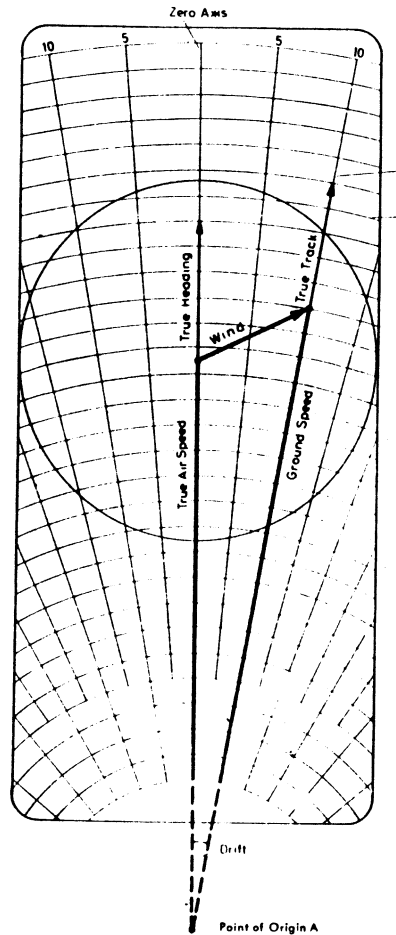

Fig. 38 The Wind Triangle on the AVIAT

The AVIAT 613, 617 and 647 have a rotary indicator. With these computers the wind vector does not need to be drafted but is established mechanically by setting the indicator to the wind direction on the circle limb and locating the wind speed on the indicator graduation. This is the terminal point of the wind vector where the ground speed and the drift can then be read from the lines of the diagram slide.

Dependent upon the air speed ranges selected, the diagram scales listed in para. 2 have systems of graduated lines, each of which is related to the scales of wind velocity engraved on the rotary indicator. To avoid errors in pairing scales, the scales of the diagram slide are marked with identical symbols △, ○, □ and X as are seen on the rotary indicator.

EXAMPLE	Sub-Sonic Flight. $C_T = 1.0$

Given:	V_a = 325 kt
	Press. Alt.= 22000 ft
	In. Temp. = +10°C
Required:	TAS = 455 kt
	Temp. Rise = +27°
	Outside Temperature: 10°–27° = –17°
	Mach No. = 0.727

Fig. 32

EXAMPLE	Super Sonic Flight. $C_T = 1.0$

Given:	V_a = 437 kt
	Press. Alt. = 40000 ft
	Ind. Temp. = +25°C
Required:	TAS 772 kt
	Temp. Rise = 78°
	Outside Temperature: = +25°–78° = 53°C
	Mach = 1.34

Fig. 33

For C_T = 0.8, the solid cursor curve identified as 0.8 is set to the +25°C intersection of the reference spiral.
The TAS = 797 kt can then be read, together with the temperature rise 82°C x 65.6°C.
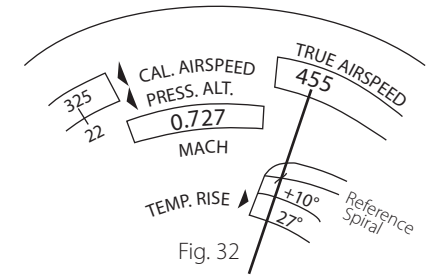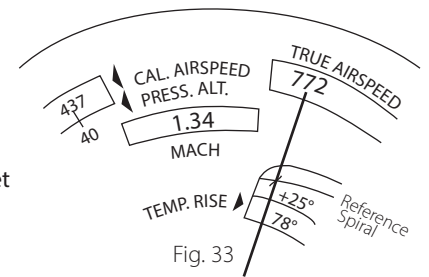
10.0   ALTITUDE CALCULATIONS

10.1   Calculation of True Altitude

Altimeters are calibrated according to the conditions of standard atmosphere. Deviations of the actual air pressure from standard values are compensated by the respective altimeter setting (QNH or QFE). However, temperature variations, another source of erroneous indication, cannot be compensated by an altimeter setting as in the case of pressure deviations. For calculating true altitude the window scale (g) labelled ALTITUDE is used.

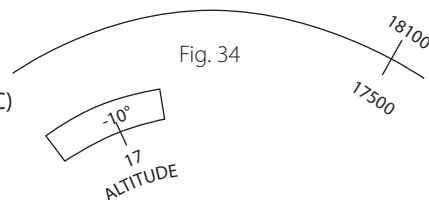| **Given:** | Pressure Altitude 17000 ft |
	QNH - altitude 17500 ft
	Corrected Outside Air Temperature –10°C
Required:	True altitude
Setting:	Set pressure altitude (17000) against
	Corrected Outside Air Temperature (–10°C)
Reading:	Read true altitude (18100) on the
	outer scale (T. ALT) against QNH ALT.
	(17500) on the inner scale (QNH ALT.)
Result:	**18100 ft.**

Fig. 34

10.2 Calculation of Density Altitude

### 10.2.1 With Aviat Models 610, 613, 615, 617 and 618

Setting: Set corrected outside air temperature on the red scale (f) labelled COAT against PRESS. ALT. in km in the upper part of the window or over PRESS. ALT. in ft in the lower part.

Reading: Follow the red arrow from the AIR SPEED scales to the right and read density altitude on the subscale in km against the index at the upper edge of the window or in ft against the index at the lower edge of the window labelled DENSITY ALT.

EXAMPLE

Given: Pressure altitude 16000 ft, COAT –30°C
Required: Density Altitude

Result: 14300 ft

Fig. 35
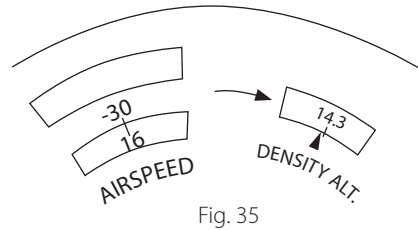
10.2.2 Density Altitude with AviatJet 647

The red scale (h), DENSITY ALTITUDE x 1000, at the labelled aperture, is associated with the red temperature scale in the unfigured range of scale (f), CAL. AIR SPEED.

Setting: Set the pressure altitude on scale (f) labelled PRESS. ALTITUDE, under the indicated outside temperature COAT, using the red temperature scale.

Reading: The density altitude is read on scale (h) at the window.
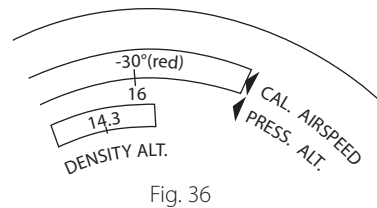
Fig. 36

For the previous example of para. 10.2.1, the illustration, fig. 36, shows a similar setting and reading. Following international usage heights are given in feet.

11.00 GRAPHIC SOLUTION OF TRIANGLES WITH THE AVIAT 613, 617, 618 AND 647

The wind triangle face of the Aviat 613, 617, 618 and 647 is used in conjunction with the diagram slide (o) and the rotary plotting surface (n) for solving general problems in lane trigonometry. The radiating drift lines together with the concentric speed arcs of the slide are used for wind triangle problems. The rectangular grids on the diagram faces B, G and H are applied to the specific case of the right angled triangle.

Use only soft lead pencils or a fountain pen for marks on the plotting surface never indelible lead, crayons or ball point pencils.

11.1 Wind Triangle Problems

With the Aviat the approach to these problems consists of forming a clear conception of the given elements and their correct relationship in the solution design. Fig. 37 shows the wind triangle in all its details and is a key to the terms and symbols commonly used.

Fig. 37
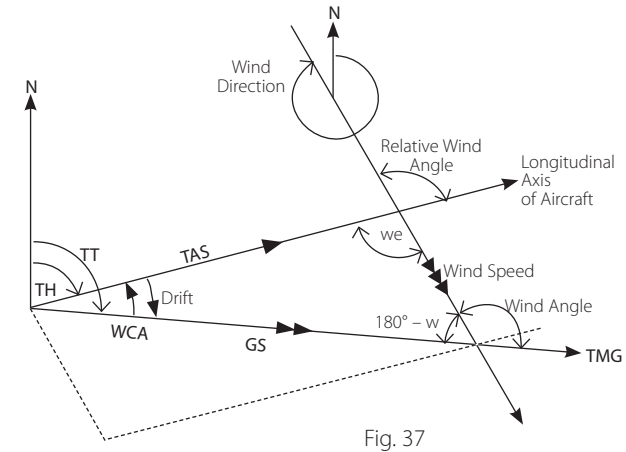
11.1.1 The Wind Triangle

The wind triangle results from the vectorial combination of velocities, namely the true airspeed TAS and heading as well as the wind speed and direction; the resultant of these two components is the ground speed GS along the track made good TMG.

If the aircraft drifts to the right, or starboard, the drift is plus; if to the left, or port, the sign is minus.

If the aircraft is headed to the right of the track, the WCA (Wind Correction Angle) is plus, if headed to the left, the sign is minus.

On the Aviat the wind triangle takes shape before the user's eye. On the diagram slide the drifts are indicated by a fan of diverging rays which, if traced back, would have their origin at a point A beyond the slide.