

METEOROLOGICAL OFFICE

Pilot Balloon Slide Rule, Mark 5

OBSERVERS INSTRUCTION

Amendment No.	1	2	3	4
Date				

When an amendment is made to this instrument instruction, the number and date should be entered alongside the amendment as well as in the above table.

1. General Description

The slide rule is used for computing upper winds from readings of the azimuth and elevation of a pilot balloon at regular intervals. The theory of the method, with other details, is given in Met O 804 (Measurement of Upper Winds by means of Pilot Balloons), the quantities involved being as follows:-

E = elevation

A = azimuth (acute angle)

K = graticule constant

l = length of tail

m = apparent length of tail in graticule units
(see page 26 of Met O 804)

D = total distance travelled by balloon

$\left. \begin{matrix} D \\ E \end{matrix} \right\}$ = easterly and northerly components of this distance

$\left. \begin{matrix} V_W \text{ to } E \\ V_S \text{ to } N \end{matrix} \right\}$ = easterly and northerly components of distance travelled in the one minute in question

h = height of balloon above starting point.

The general relations between these quantities, as used in operating the slide-rule, are:-

$$h = \frac{Kl}{2m} \sin 2E = D \tan E$$

$$D = \frac{Kl}{m} \frac{1}{\sec^2 E}$$

$$D_N = D \cos A \text{ and } D_E = D \sin A$$

The following scales are incorporated:-

A logarithmic scale of numbers, three times repeated, on both the upper and lower edges of the slider.

A logarithmic scale, twice repeated, on the upper part of the stock, identical with part of the slider scales.

Sine and cosine scales, partly duplicated, on the upper part of the stock.

A Secant² scale, from 0° to 63°, on the left part of the lower stock.

A tangent scale, from 3° to 84.3° on the right part of the lower stock.

A graticule scale (reciprocal logarithms), replacing part of the logarithmic scale on the lower left part of the slider.

IMPORTANT. The product of K, the number of graticule divisions per radian, and l, the length of the tail in feet, is normally 1.2×10^5 . In other cases adjust the length of tail so that $\frac{Kl}{1.2 \times 10^5} = 1$.

Fiducial marks A, B, C and D are engraved on the upper part of the stock, marks E and \uparrow on the lower stock, for conversion of units (see Section 3).

2. Standard Procedure

The standard procedures for the computation of winds by the use of pilot balloons and theodolites are described fully in Met O 804. Three methods are described (a) winds by pilot balloon using a fixed rate of ascent (b) using a tail of known length and (c) using two theodolites.

3. Change of units

The use of the fiducial marks in reading values of wind speed directly in knots or metres per second, etc., is fully described in Met O 804. When the slide rule is used for other purposes or in a non-standard way, care must be taken that the fiducial marks still apply e.g. when using time intervals other than one minute or when performing a radar wind ascent where ranges are in yards. In these cases other reference points may have to be found.

Inter-unit conversions may be made using the fiducial marks on the slide rule by directly reading between the marks thus:-

- A → B converts kts to ft/s
- B → A " fts to kts
- A → C " kts to m/s
- C → A " m/s to kts
- E → Tan 45 converts ft to m or ft/s to m/s
- Tan 45 → E " m to ft or m/s to ft/s

4. Multiplication and division

The additional logarithmic scale on the upper part of the stock permits of the rule being used in a limited way as an ordinary slide-rule.

5. Maintenance

The rule should always be used with care and not handled with soiled or stained fingers. If it is necessary to clean the surface warm soapy water should be used. Abrasives, petrol or solvents must never be used.