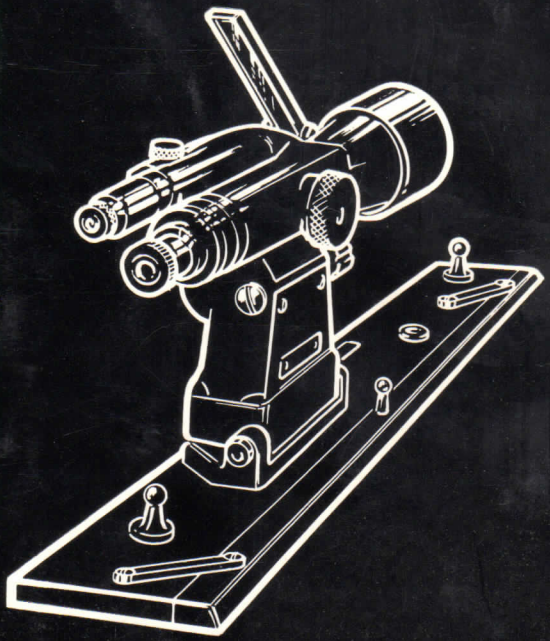
WATTS

MICROPTIC ALIDADE

OPERATING INSTRUCTIONS

WATTS

20-7



Operating Instructions for the **WATTS MICROPTIC ALIDADE**
SA 100
SA 101

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CONTENTS

SPECIFICATION

Telescope magnification:	×15
Telescope aperture:	31 mm
Elevation and depression:	45° or 50^g
Focusing range:	4·2 m (14 ft) to infinity
Reader magnification:	×20
Circle material:	Glass
Circle diameter:	51 mm (2 in)
Circle graduated:	10′ or 0·2^g
Reading can be estimated to:	1′ or 0·02^g
Altitude bubble sensitivity:	40″ per 2 mm division
Parallel rule: length:	380 mm (15 in)
Offset from optical axis:	11·1 mm (0·45 in)
Height of optical axis above plane table:	130·8 mm (5·15 in)
Overall height:	216 mm (8½ in)
Weight of instrument:	2·0 kg (4½ lb) approx.
Weight of instrument in case:	5·7 kg (12½ lb) approx.
Overall size of case:	410×220×145 mm (16¼×8½×5¾ in)

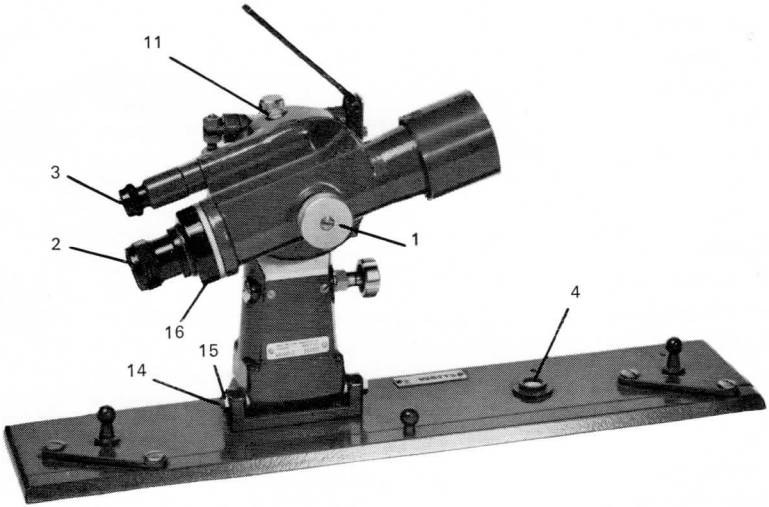

Figure 1 – THE ALIDADE

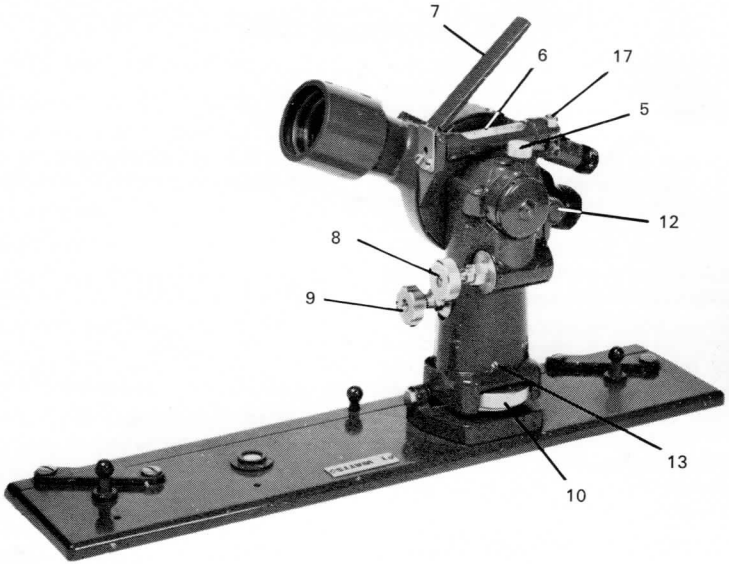

Figure 2 – THE ALIDADE

1 – INTRODUCTION

1.1 – GENERAL

The Watts Microptic Alidade is a lightweight, yet accurate, instrument for use in plane table surveying. The vertical arc and Beaman scales are fully enclosed and are read through an eyepiece which is conveniently adjacent to the telescope eyepiece. With the scales the observer can rapidly reduce the stadia readings to obtain the difference in elevation between instrument and staff and the true horizontal distance of the staff.

1.2 – THE EQUIPMENT

The complete instrument comprises:

Alidade on base with parallel rule
Rayshade
Screwdriver
Spanner
Tommy bar
Instruction book
Lockable wooden case

Optional accessories that are available include:

SF17	Prismatic eyecap for use at steep angles
SA25	Prismatic eyecap for reader
SA8	Plane table size 760×610 mm (30×24 in.)
SA71	Universal adjustable plane table tripod with tilting head.

2 – METHOD OF USE

2.1 – THE PARTS OF THE INSTRUMENT

The various parts of the instrument are shown in Figures 1 and 2.

(1) Telescope focusing knob. Turn anti-clockwise to increase the focusing distance.

(2) Telescope eyepiece.

(3) Circle reader eyepiece.

(4) Circular bubble. For levelling plane table.

(5) Telescope clamp.

(6) Altitude bubble. This is associated with the circle so that when the bubble is centred, the zero of the circle indicates that the telescope is truly horizontal.

(7) Mirror for observing altitude bubble.

(8) Telescope tangent screw. Only operative when the telescope is clamped (5).

(9) Altitude bubble tangent screw.

(10) Pillar levelling screw.

(11) Window. For illuminating scales.

(12) Cross bubble. For indicating when the pillar is upright.

The other numbered items in Figures 1 and 2 are adjustments which are described in section 3.

2.2 – SETTING UP

Place the tripod approximately centred over the station mark and press the feet of the tripod firmly into the ground.

Fasten the plane table on to the tripod head and set it level by eye. As a general rule the table should be set up a little below elbow height.

Remove the alidade from its case, set all the knobs to the middle of their run and make sure that the bottom of the blade is clean. Place the instrument on the plane table and, using the tilting adjustment on the tripod head, level the table with reference to the circular bubble.

Sight in the required direction and centre the cross bubble with the pillar adjusting screw.

2.3 – TO TAKE AN OBSERVATION

To focus the telescope eyepiece, point the telescope at the sky, unscrew the eyepiece to its fullest extent and then slowly screw it in until the graticule lines appear sharp and black. Focus the

circle reader eyepiece similarly until the scales are in sharp focus.

Sight in the required direction and centre the cross bubble, using the pillar adjusting screw (10 Figure 2). Focus carefully by turning knob 1 (Figure 1) until there is no parallax between the image and the graticule, i.e. the image must remain stationary relative to the graticule when the head is moved from side to side. Clamp the telescope (5 Figure 2) and use the tangent screw (8 Figure 2) to bring the image of the object sighted on the intersection of the crosslines.

If vertical circle readings are required, first use the altitude bubble tangent screw (9 Figure 2) to centre the altitude bubble.

2.4 – THE SCALES

The field of view visible in the reader eyepiece is illustrated in Figure 3. The upper scale is graduated in degrees sub-divided at 10-minute intervals or in grades with 0·2^{g} sub-divisions. The zero indicates the telescope is horizontal. In order to indicate whether the angle is above or below the horizontal when the angle is small, the first few divisions at each side of zero are marked plus for elevation and minus for depression. At steeper angles, the attitude of the telescope will be obvious.

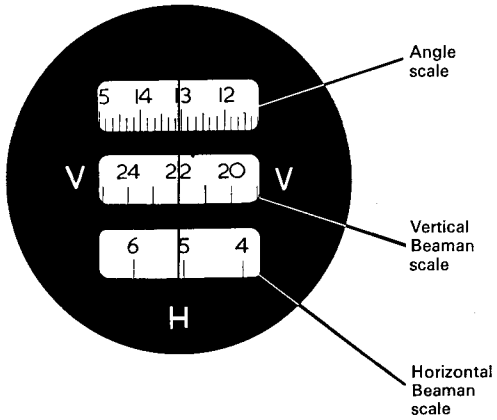

Figure 3 – FIELD OF VIEW OF READER EYEPIECE

The angle scale is also marked for use when the telescope is reversed for backward sights, although in this condition it may be necessary to reflect light into the window (11 Figure 1) with a piece of white card to illuminate the scale.

The lower two apertures are associated with the vertical ("V") and horizontal ("H") Beaman scales. These enable the operator rapidly to reduce staff readings to –

(*a*) the difference in elevation between the instrument and staff, and

(*b*) the true horizontal distance of the staff.

The divisions on the "V" scale are proportionate to sin E cos E where E is the angle of elevation or depression. The scale is engraved in terms of 100 sin E cos E to take into account the stadia ratio and to give a series of whole numbers from 0 to 40 (estimated sub-divisions are not required).

The horizontal scale "H" is graduated proportionate to $1-\cos^2 E$ to provide the correction factor for true horizontal distance.

2.5 – TO OBTAIN THE DIFFERENCE IN ELEVATION

(1) Centre the altitude bubble.

(2) Set up the levelling staff and sight the telescope anywhere on it, then use the tangent screw to bring the nearest graduation of the "V" scale exactly onto the index line. Note this whole-number reading (a Figure 4) and book it as plus for elevation or minus for depression. Remember that although only the first few graduations either side of zero are marked + or –, all "V" readings made with the telescope depressed must be booked as minus.

(3) Take the staff reading b at the centre line of the graticule (B Figure 4) and then note the distance c on the staff intercepted by the graticule stadia lines (C and D).

(4) The vertical height E of the base of the staff above or below the telescope axis is given by

$$E = (a \times c) - b$$

Example

a = "V" reading = +22

b = Staff reading = 9·35 ft

c = Stadia intercept = 5·20 ft

$$E = (22 \times 5{\cdot}20) - 9{\cdot}35 \text{ ft}$$

$$= 105{\cdot}05 \text{ ft}$$

2.6 – TO OBTAIN TRUE HORIZONTAL DISTANCE

(5) With the instrument set up as described in the previous section, adjust the telescope to align the nearest graduation of the "H" scale with the index line. Note the reading e (see Figure 4). This value is always positive irrespective of whether the telescope is elevated or depressed.

(6) Read the new stadia intercept c. The true horizontal distance F between the staff and the centre of the telescope is

$$F = 100c - (e \times c)$$

Example e = "H" scale reading = 5
c = New stadia intercept = 5·10 ft

$F = 510 - 25{\cdot}5$ ft
$= 484{\cdot}5$ ft

2.7 – TO OBTAIN SLANT DISTANCE

The slant distance from the telescope to the staff mark coinciding with the horizontal crossline is one hundred times the stadia intercept c (Figure 4).

Note–Under some conditions it may be more convenient to view a staff positioned horizontally instead of vertically. The stadia marks on the horizontal crossline can then be used to obtain the stadia intercept.

2.8 – OPERATING NOTES

(1) Do not slide the alidade across the paper, otherwise the paper may be disturbed and any grit on the table could score the paper or scratch the blade.

(2) Whenever the alidade is pointed in a different direction, recentre the cross bubble.

(3) If the instrument is damp, wipe down thoroughly and dry it before returning it to its case.

(4) Occasionally carry out the checks detailed in section 3.

(5) The life of the instrument is dependent upon the care with which it is used; if it is mishandled its life will be shortened and its accuracy impaired.

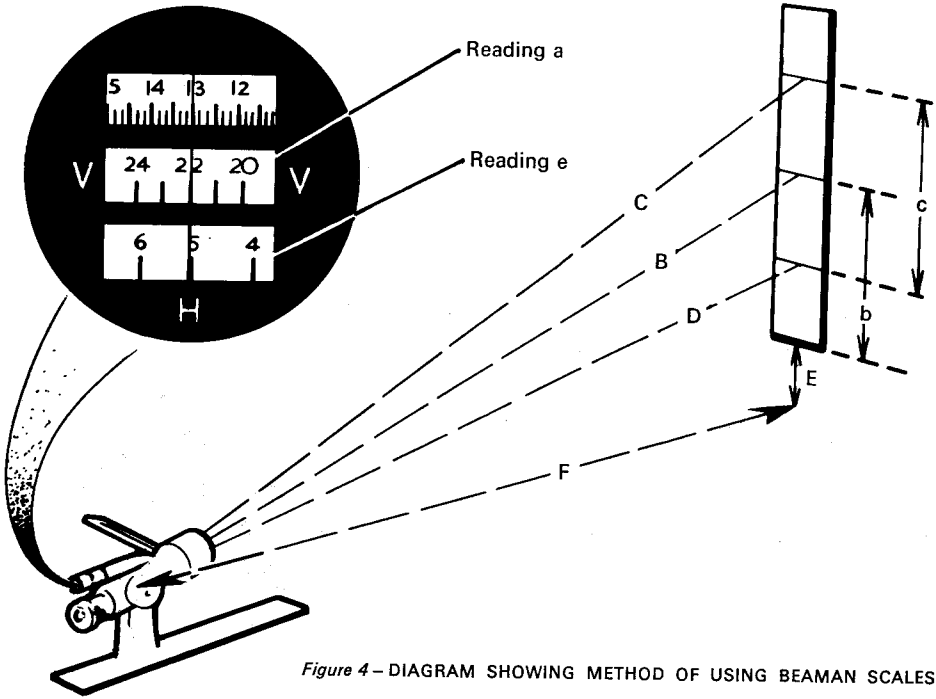

Figure 4 – DIAGRAM SHOWING METHOD OF USING BEAMAN SCALES

3 – CHECKS AND ADJUSTMENTS

Before any optical checks and adjustments can be satisfactorily made, it is necessary to ensure that the mechanical movements work smoothly and without shake. The mechanical adjustments are therefore described first.

3.1 – VERTICAL PILLAR ADJUSTMENTS

Wear on the pillar adjusting screw threads can be taken up by adjustment of screw 13 Figure 2.

The ball foot of the screw is held in place by a spring plate, the pressure of which can be adjusted by the two screws accessible from the underside of the blade. Loosen the locknuts beneath the spring plate and tighten the screws until the ball is held firmly, but do not tighten more than necessary, as this could cause excessive wear. When the adjustment is satisfactory, tighten the locknuts.

The pillar pivots on the two screws 14 Figure 1. If there is any shake in the pivots, loosen locknut 15 Figure 1 and adjust the screw; do not over-tighten. When the adjustment is satisfactory, tighten the locknut.

3.2 – GRATICULE VERTICALITY

To check that the vertical crossline of the graticule is parallel to the plane of movement of the telescope, sight on a mark at the upper end of the crossline. Now elevate the telescope until the object is at the bottom end of the line. If it has moved away from the vertical line, adjust the graticule as follows.

Unscrew the cover ring 16 Figure 1 to reveal the adjusting screws shown in Figure 5. Loosen the four clamping screws A and then turn the

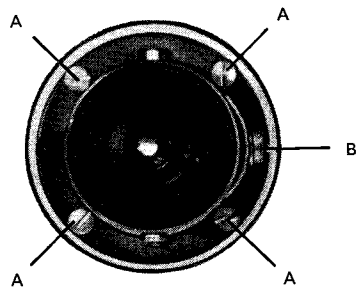

Figure 5 – GRATICULE ADJUSTMENTS

graticule to halve the error. Tighten the screws and recheck.

3.3 – HORIZONTAL COLLIMATION

The telescope line of sight must be at right angles to the axis about which the telescope rotates. In order to check this, the graticule verticality must first be checked and, if necessary, adjusted (section 3.2). Then check the collimation as follows.

(1) Set up the tripod and plane table on firm ground and level carefully.

(2) Select a suitable observation mark as far away as possible and set up a levelling staff horizontally about 100 m (300 ft) away from the table, on the opposite side to the mark.

(3) Place the alidade on the table, point it towards the mark and level the cross bubble carefully. Sight accurately on the mark.

(4) Transit the telescope and take a reading on the staff.

(5) Draw a line on the table along the parallel rule. Open the rule 22·2 mm ($\frac{7}{8}$ in) and move the alidade sideways until the rule lies along the line already drawn. Close the rule and draw a second line along it.

(6) Reverse the alidade and set the rule against the second line. Since the telescope axis is offset from the edge of the rule by 11·1 mm ($\frac{7}{16}$ in), this sets the telescope optical axis in the same position as before.
Sight accurately on the mark, transit the telescope and take a second reading on the staff.

(7) If the two readings are the same, there is no collimation error. If, however, the readings differ, there is an error equal to a quarter of the difference. Adjust as follows.

(8) Unscrew the cover ring 16 Figure 1 to reveal the adjusting screws shown in Figure 5. Adjust screw B to displace the graticule towards the first reading on the staff by an amount equivalent to a quarter of the difference between the two staff readings.

(9) Recheck and repeat the adjustment if necessary until the two readings are the same.

3.4 – CROSS BUBBLE

Only if the pillar is truly upright will the telescope sweep out a circle in a vertical plane. The purpose of the cross bubble is to enable the pillar to be set

vertical; this assumes that the telescope axis is parallel to the cross bubble. It can be checked as follows.

(1) Place the alidade on the table and level the table carefully. Sight on a well-defined mark about 30° above the horizontal.

(2) Place a staff horizontally at a distance not less than 100 m (300 ft) from the table. Bring the mark onto the vertical crossline, depress the telescope and note the staff reading where the crossline crosses it.

(3) Mark a line on the table along the rule, reverse the alidade and set the edge of the rule along the line. Centre the cross bubble. Transit the telescope, sight on the 30° mark, then depress the telescope and take a second reading on the staff. If the two staff readings are the same, the bubble is in correct adjustment. If not, adjust as follows.

(4) Adjust the pillar tilt until the two staff readings are the same, irrespective of bubble position. The telescope axis is now level and the bubble must be adjusted to correspond.

(5) To do this loosen the two screws securing the bubble mount and position it until the bubble is centred. Tighten the screws.

3.5 – ALTITUDE BUBBLE

When the zero of the circle is vertical, the altitude bubble should be centred. Check as follows.

(1) Bring the image of a well defined mark to the intersection of the crosslines. Centre the altitude bubble and then note the angle scale reading.

(2) Reverse the alidade, transit the telescope and repeat step 1. The two readings should be the same.

(3) If they differ use the altitude bubble tangent screw to bring the scale to the mean of the two angles, which is the correct angle. Loosen one of the locknuts 17 Figure 2 and adjust the other to centre the bubble. Tighten the nuts and recheck.

3.6 – PARALLEL RULE

The edge of the parallel rule should be parallel to the line of sight, although this is not essential if the error is permanent and only the one alidade is in use.

It can be corrected, however, by loosening the three screws securing the pillar to the blade and turning the pillar.

We reserve the right to make such alterations in design as we may consider necessary in the light of experience. For this reason, particulars and illustrations in this handbook may not conform in every detail to models in current production.

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