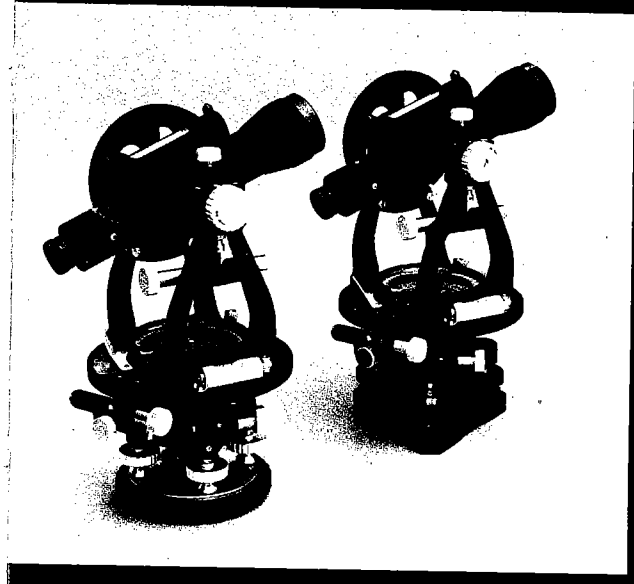
SOKKIA

INSTRUCTION MANUAL



115/116 TRANSITS

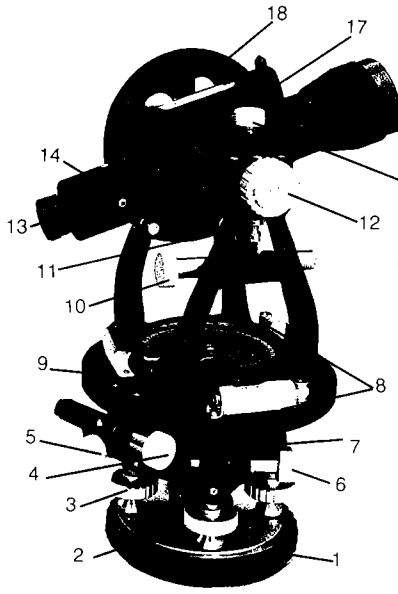
CONTENTS

Immediately upon receipt of your Model 115/116, examine the shipping case for evidence of damage. If such exists, make a notation on the delivery slip "Received in Bad Condition" before signing. For shipments delivered in a damaged condition, it is the responsibility of the consignee to file the claim for damage with the delivering carrier, which claim must be supported by a *Concealed Damage Report.* This will be furnished by the carrier's representative after inspection of the damaged shipment.

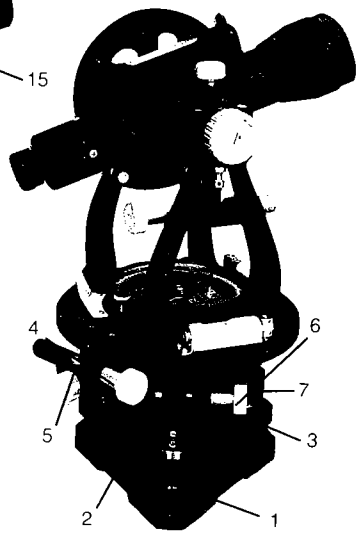
If it becomes necessary for you to ship your Model 115/116, be sure to pack carefully or any damage claim may be disallowed by the carrier.

LIETZ

NOMENCLATURE



115



116

1. Base Plate
2. Leveling Screw Plate
3. Leveling Screw
4. Plate Tangent Screw
5. Plate Clamp Screw
6. Lower Motion Tangent Screw
7. Leveling Head
8. Plate Level Vial (2)
9. Horizontal Circle
10. Vertical Tangent Screw
11. Vertical Vernier
12. Telescope Focusing Knob
13. Eyepiece Focusing Knob
14. Reticle Adjusting Screw Cover
15. Vertical Motion Clamp Screw
16. Objective Lens
17. Telescope Level Vial
18. Vertical Circle

SPECIFICATIONS

Telescope	
Length	185mm
Image	Erect
Objective aperture	32mm
Magnification	23x
Resolving power	4″
Field of view (@1000 ft.)	1º05′ (18.9 ft.)
Minimum focus	2.3m (7.6 ft.)
Stadia ratio	1:100
Horizontal Circle	
Diameter	108mm (4 5/16″)
Graduation	30min.
Vernier	1min.
Vertical Circle	
Diameter	88mm (3½″)
Graduation	30min.
Vernier	1min.
Level Vials	
Telescope	60″/2mm
Plate	137″/2mm
Compass	
Needle length	58mm (2¼″)
Division	1°
Weight	
Instrument	3.0kg (6.6 lbs.)
Case	1.4kg (3.0 lbs.)

Specifications subject to change without notice.

LIETZ

SETTING UP/MODEL 115

A.) Position the tripod over the set-up point or in a location convenient to the job to be performed. Spread the legs so that they are about 3-½ feet apart. The tripod head should be kept as level as possible and the tripod wingnuts should be tightened.

B.) Carefully place the instrument on the tripod head, making sure the plummet chain goes through the center of the tripod head, and fasten the instrument to the tripod by turning the base plate in a clockwise direction. Make sure the threaded base plate goes all the way to the stop and is firmly secured. **DO NOT OVER-TIGHTEN.**

C.) If it is necessary to position over a point, such as a stake tack, fasten the plumb bob to the plummet chain. Move each tripod leg, as required, to bring the plumb bob to within ¼ inch of the tack, making sure each tripod leg (point) is pressed firmly into the ground and all clamps are tight. Two adjacent leveling screws (e.g. B & C) are then loosened and the instrument can be shifted laterally until the plumb bob is exactly over the tack. The leveling screws are then tightened firmly. DO NOT OVER-TIGHTEN.

D.) **To Level The Instrument**

1. Tighten telescope clamp screw.
2. Position telescope level vial so that it is in line with leveling screws A & B (see Figure 1).
3. Center the telescope level vial bubble by adjusting the leveling screws. Turn leveling screws in opposite directions at the same speed with both hands. The bubble will follow the direction of the left thumb's movement. Never turn both leveling screws in the same direction, unless the intention is to tighten or loosen the leveling base, as in paragraph C above.
4. Rotate the instrument 90 degrees and position telescope level vial over leveling screws C & D (see Figure 2).
5. Center telescope level vial bubble by adjusting leveling screws.
6. Rotate instrument 180 degrees and check level vial. If bubble is not centered, remove ½ of the error with the leveling screws (shift halfway back to center) and the remaining error by turning telescope tangent screw.
7. Repeat this procedure in all four positions until the bubble remains centered.

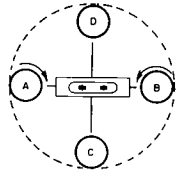


Figure 1

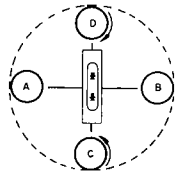


Figure 2

SETTING UP/MODEL 116

A.) Position the tripod over the set-up point or in a location convenient to the job to be performed. Spread the legs so that they are about 3-½ feet apart. The tripod head should be kept as level as possible and the tripod wingnuts should be tightened.

B.) Carefully place the instrument on the tripod head. Support the instrument with one hand and thread tripod draw screw clockwise into the instrument base.

C.) If it is necessary to position over a point, such as a stake tack, attach the plumb bob cord to the hook located in the tripod draw screw. Move each tripod leg, as required, to bring the plumb bob to within ¼ inch of the tack, making sure each tripod leg (point) is pressed firmly into the ground and all clamps are tight. Loosen draw screw and shift instrument until plumb bob is centered exactly over the point. Tighten draw screw.

D.) **To Level The Instrument**

1. Tighten telescope clamp screw.
2. Position telescope level vial so that it is in line with leveling screws A & B (see Figure 3).
3. Center the telescope level vial bubble by adjusting the leveling screws. Turn leveling screws in opposite directions at the same speed with both hands. The bubble will follow the direction of the left thumb's movement. Never turn both leveling screws in the same direction.
4. Rotate the instrument 90 degrees and position telescope level vial over leveling screw C (see Figure 4).
5. Center telescope level vial bubble by adjusting leveling screw C **ONLY.**
6. Rotate instrument 180 degrees and check level vial. If bubble is not centered, remove ½ of the error with the leveling screw (shift halfway back to center) and the remaining error by turning telescope tangent screw.
7. Repeat this procedure in all four positions until the bubble remains centered.

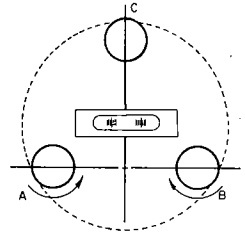


Figure 3

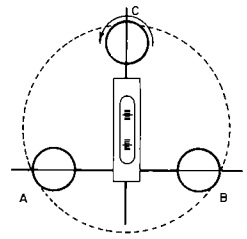


Figure 4

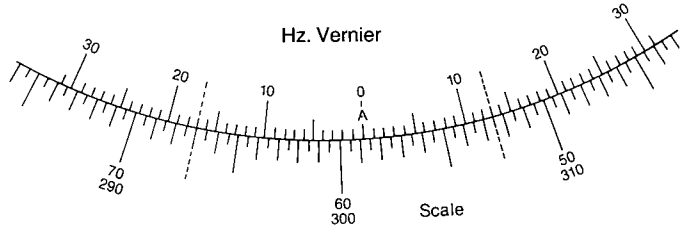
FOCUSING THE TELESCOPE

Point the telescope to the sky and turn the eyepiece focusing knob as far in a counterclockwise direction as possible, then slowly turn in a clockwise direction until the crosshairs are clean and sharp. Next direct the telescope to the target and with the telescope focusing knob bring the target into sharp focus. After focusing on the target, move your eyes *slightly* up and down and left to right. If the crosshairs remain fixed relative to the target, the telescope is without *parallax*. If there appears to be movement of the crosshairs, rotate the eyepiece focusing knob and/or the telescope focusing knob until this apparent movement disappears.

READING THE CIRCLES AND VERNIERS

The 115/116 transit's horizontal and vertical circles are graduated every 30 minutes. The verniers, which are the scales accompanying the circles, are 1 minute.* The middle of zero point of the vernier scale also serves as the index. The angle is read by first noting the graduations on the circle just before the vernier index line, and then adding to the value of that graduation the value of the vernier graduation that coincides with a circle graduation. In Figure 5 the clockwise angle is 58°47′. Note: The vernier index line lies beyond the 58°30′ graduation, and the vernier coincides at the 17′ mark.

Figure 5



Hence the reading is 58°30′ + 17′ = 58°47′. A hand magnifying glass may be used. When reading the circle, it is essential that the observer should have his eye *directly* over the line of coincidence to eliminate the effect of parallax between the circle and vernier.

*Remember, there are 360° in a circle and 60′ in a degree. The circle is then read as so many degrees and so many minutes.

MEASURING A HORIZONTAL ANGLE

If a horizontal angle is to be measured:

1.) Set your Model 115/116 up over point A.
2.) Sight the telescope along line AB (see Figure 6). Tighten the horizontal clamp screw, then use the tangent screw for precise positioning.
3.) If it has not already been set, measure the desired distance to point B and mark it with a stake.
4.) Position the horizontal circle to read 0 degrees, 00 minutes.
5.) Release the horizontal clamp screw and rotate the instrument until the desired angle can be read on the horizontal circle, then tighten the horizontal clamp (see Figure 7).
6.) Set the angle precisely, using the horizontal tangent screw.
7.) Measure distance to point C and set a stake on line AC (see Figure 7).

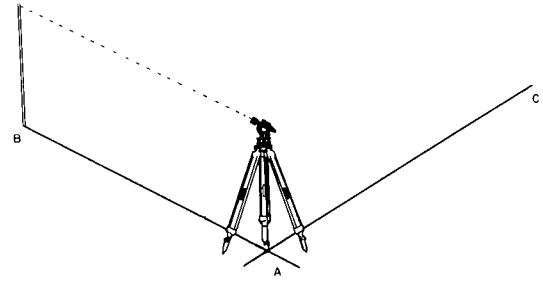


Figure 6

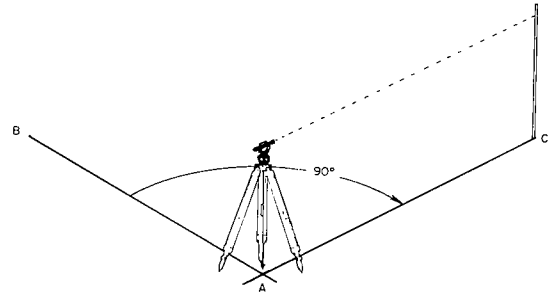


Figure 7

LIETZ

MEASURING AN ANGLE BY REPETITION

With your 115/116 transit, a horizontal angle may be mechanically multiplied, and the product can be read with increased precision over a single value (see page 8). The precision increases directly with the number of repetitions up to four or six (precision is not appreciably increased beyond this number due to accidental errors).

To repeat an angle, the instrument is set up over point A and the single value of the angle is observed as previously described. The vernier setting is left unaltered; the *lower* motion is unclamped, the telescope is transited and the 115/116 is turned in the preceding direction to point B and a second sight is taken.

In this way the process is continued until the angle has been multiplied the required number of times. The value of the angle is determined by dividing the final reading by the number of times the angle was turned.

Usually the angle is multiplied an even number of times, half the observations being made with the telescope normal and half with it inverted.

MEASURING A VERTICAL ANGLE

The vertical angle, to a point, is an angle of elevation (+) or depression (−) from the horizon (0 degrees).

The instrument is set up and leveled as previously described. The horizontal crosshair is sighted approximately at the point, and the telescope is clamped by the telescope clamp screw. The horizontal crosshair is brought exactly on the point by turning the telescope tangent screw, the angle is read by means of the vertical circle and vernier.

If you are required to set a line of sight at an established percent of grade, the following table will help you determine the equivalent angle in degrees and minutes.

Corresponding Vertical Angle to give Percent of Grade.

0°34′	1°09′	1°43′	2°17′	2°52′	3°26′	4°00′	4°34′	5°09′	5°43′
1%	2%	3%	4%	5%	6%	7%	8%	9%	10%

LEVELING

For leveling with your Model 115/116:

1.) Set up and precisely level the instrument using the telescope level vial.
2.) Secure the telescope clamp and adjust the telescope to the Horizontal Position via the telescope vial.*
3.) With the instrument leveled and the telescope vial set, it is safe to assume that the instrument's line of sight is horizontal. Figure 8 demonstrates how to determine a difference in height or elevation between two points. If the rod reading at point B is 6.0 feet and the reading of point C is 7.0 feet, we know that point B is 1.0 foot higher than point C. Using the same principle, you can check the level of foundations, the slope of driveways, etc.

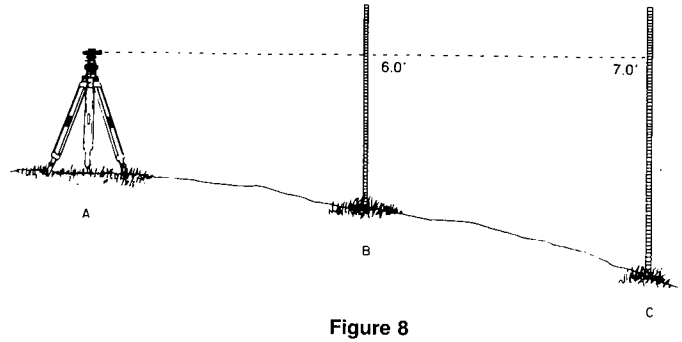


Figure 8

*Precise adjustment of telescope vial is required for accurate leveling. (See Adjustment section for details.)

COMPASS NEEDLE AND MAGNETIC DECLINATION

The Model 115/116 is provided with a built in circular compass for rough orientation in relation to magnetic North. Orientation is achieved by releasing the compass clamp screw and rotating the instrument alidade until the compass needle indicates the desired direction. Note: for information concerning magnetic declination consult the Adjustment section.

LIETZ

CONTINUING A LINE

With the ability to rotate your instrument's telescope vertically through 360 degrees, it is possible to sight a ground point in front of the instrument (see Figure 9), then rotate the telescope vertically and sight to a ground point behind the instrument, without turning the instrument horizontally (see Figure 10). This capability allows the user to continue a line with high accuracy. (Prior to setting stakes using this procedure, check adjustment of double centering and height of standards alignment — see Adjustment section for details).

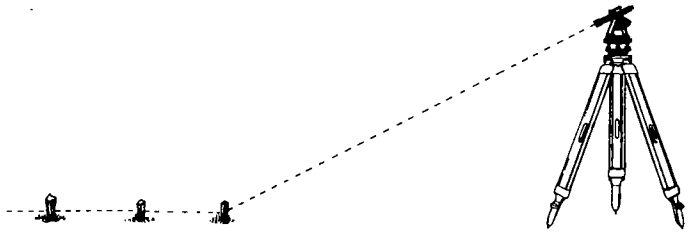


Figure 9

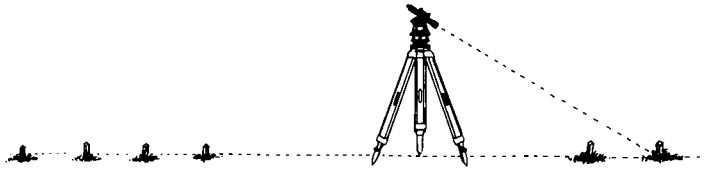


Figure 10

VERTICAL ALIGNMENT

Your Model 115/116 can be utilized when erecting structure walls, installing vertical guttering, or any application which requires accurate vertical alignment. To perform accurate vertical alignments:

1.) Set up and precisely level instrument.
2.) Sight bottom of item to be plumbed (see Figure 11).
3.) Rotate telescope up and sight top of object (see Figure 12).
4.) Move object until it is in alignment and repeat steps 2 & 3 (check standard alignment prior to setting object. See Adjustment section for details).

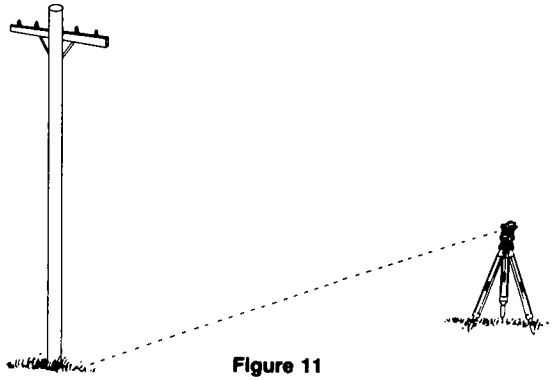


Figure 11

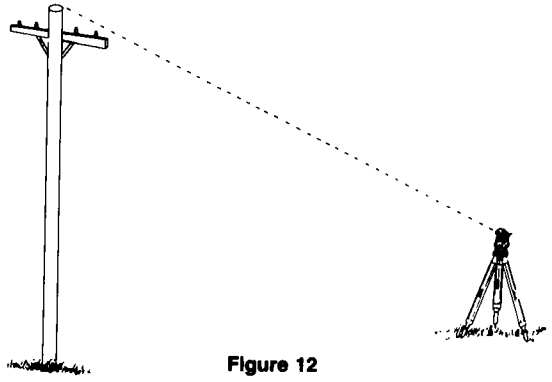


Figure 12

STADIA

The 115 and 116 transits are equipped with two supplementary horizontal crosshairs, equally spaced above and below the center hair. These crosshairs are called stadia lines (see Figure 13). When a graduated rod is viewed through the telescope, the apparent distance on the rod between the stadia lines is called the Stadia Intercept. Assuming that the telescope is level (vertical circle at 0 degrees 00 minutes) and the vertical intercept on a level rod is one foot (1'), the rod would be 100 feet away from the instrument (1 x 100).

Sometimes it is not possible to read the level rod when the telescope is level. In this instance, you must first determine the Stadia Intercept and the vertical angle; then calculate the Horizontal Distance as shown below.

STADIA METHOD OF MEASUREMENT:

With the telescope level, the **Horizontal Distance** = Stadia Intercept x 100. With the telescope inclined, the **Horizontal Distance** = Stadia Intercept x 100 x COS^2 Vertical Angle (see Figure 14).

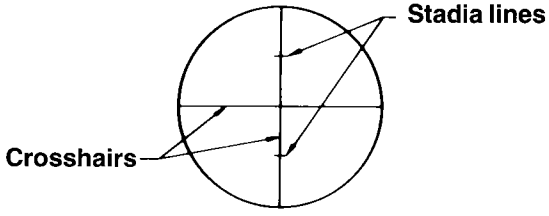


Figure 13

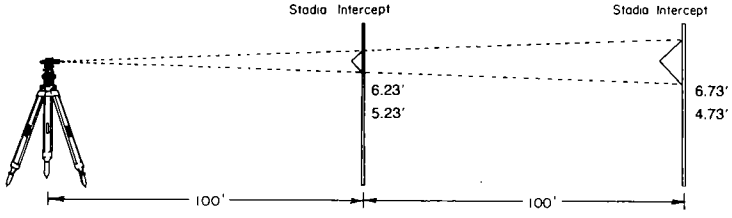


Figure 14

INSTRUMENT ADJUSTMENT PROCEDURES

The 115/116 instruments may be affected by sudden changes in weather and excessive vibration. To prevent inaccuracies caused by abnormal conditions, IT IS IMPORTANT TO CHECK AND ADJUST THE 115/116 INSTRUMENTS BEFORE AND DURING USE. The following is a list of simple checks which can be performed to ensure maximum accuracy.

ORDER OF CHECKS AND ADJUSTMENTS

1) Adjust plate vial.
2) Check Standards Alignment.
3) Tracking a Point (Squareness of Crosshairs).
4) Double Center.
5) Vertical Indexing.

1.) **ADJUSTMENT OF PLATE VIAL**

The 115/116 instruments are equipped with two leveling vials. The telescope vial is mounted on the top of the telescope and is capable of achieving the highest accuracy. With the accuracy of the telescope vial and the ease of leveling, using the telescope clamp and tangent screws (see the Setting Up section) it is possible to accurately level the instrument while the vials are out of adjustment. When the instrument is leveled with the telescope vial, the plate vial bubble is centered exactly, by use of the two opposing capstan nuts (see Figure 15).

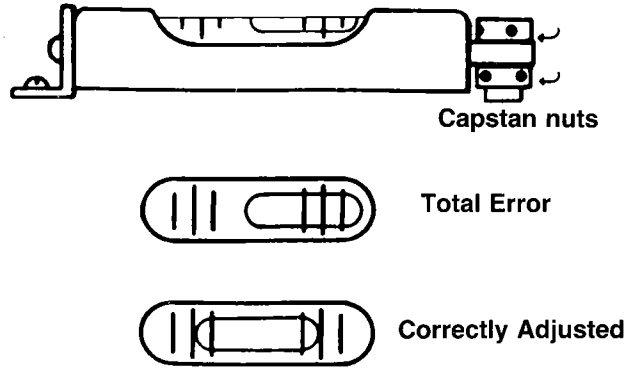


Figure 15

LIETZ

2.) **CHECK STANDARDS ALIGNMENT**

The standards are the portion of the instrument which support the telescope assembly. It is essential that the 115/116 be capable of tracking a true vertical line when erecting walls or plumbing tall structures and when continuing a line.

This test is performed by sighting a stable, well defined object, located high above the instrument. NOTE: The horizontal clamp screws should be tightened. The telescope is then depressed and a point on the ground marked along the line of sight (see Figure 16). The instrument is then rotated 180 degrees horizontally and the telescope repositioned and sighted on the originally chosen object. Depress telescope again (see Figure 16). If both points on the ground are the same, no adjustment is necessary. If not, send or take the instrument to a qualified service facility for calibration.

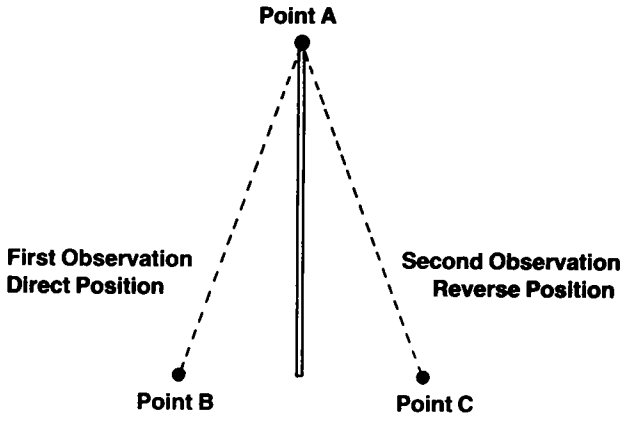


Figure 16

3.) **TRACKING A POINT (SQUARENESS OF CROSSHAIRS).**

A) Set the point of an easily visible, sharply defined target (i.e. the tip of a roof) at Point A on the upper part of the vertical crosshairs (see Figure 17).

B) Slowly raise the telescope, using the telescope tangent screw, until the target is located at Point B (see Figure 18).

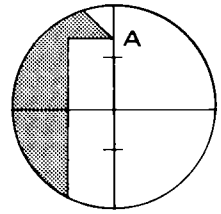


Figure 17

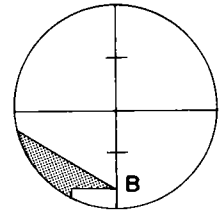


Figure 18

C) If the target has moved off the vertical line, remove the reticle cover, loosen two adjacent reticle screws and rotate the reticle slightly, to correct the tilt, and re-tighten the screws (see Figure 19).

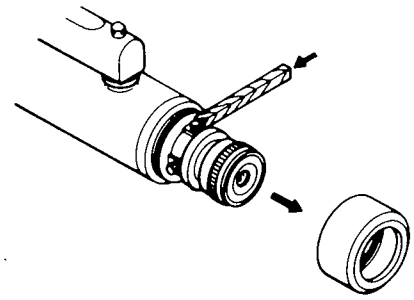


Figure 19

D) Repeat steps A & B and re-adjust if necessary.
Note: Any reticle adjustment should be followed by checking double center and vertical indexing.

LIETZ

4.) **DOUBLE CENTER**
To ensure the exact positioning of the vertical crosshair in the telescope tube, perform the following:

a. Set up and level instrument.
b. Sight a point A located 200 to 400 feet in front of the instrument (see Figure 20).
c. Rotate the telescope vertically without loosening the horizontal clamp screws and sight to a point B behind the instrument at approximately the same distance as point A . . . a leveling rod laid perpendicular to the line can be used for easy establishment of point B.
d. Loosen the horizontal clamp screw, rotate the instrument horizontally 180 degrees and resight point A.
e. Rotate telescope vertically and establish point C.
f. If points B and C are not in the same place, remove the telescope reticle cover and turn the left and right reticle adjusting screws with an adjusting pin until ¼ of the error is removed and the reticle is positioned at point D.
g. Repeat steps B through F until points B and C are at the same position.

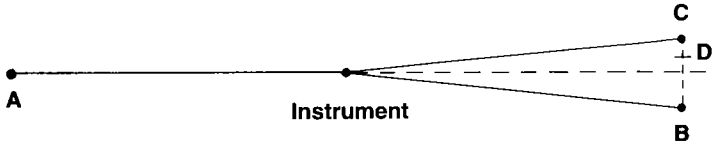


Figure 20

5.) **VERTICAL INDEXING**
The vertical indexing is a multiple-item adjustment, which involves the following:

Telescope Horizontal Crosshair
Vernier
Telescope Level Vial

A) TELESCOPE HORIZONTAL CROSSHAIR

1. Set 2 level rods 100 feet apart at points A & B (see Figure 21).
2. Set up and level your 115/116 in the middle between the two level rods at point C.
3. Sight each rod and determine the difference in elevation between points A & B (see the Leveling section for information on determining the difference in elevation).

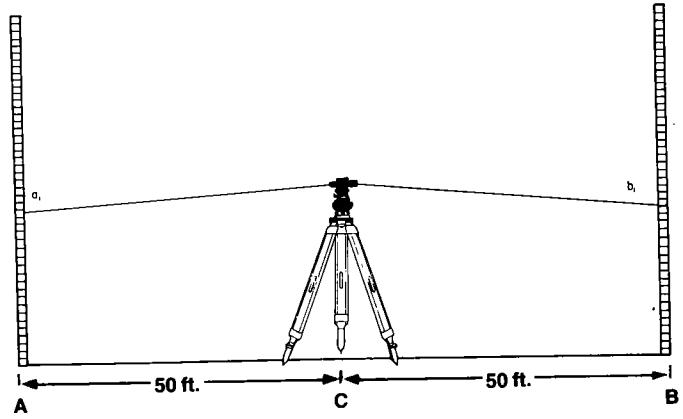


Figure 21

4. Move instrument and set up 10 feet from point A, at point D.
5. Sight each rod and calculate the difference in elevation between points A and B (see Figure 22). If the horizontal crosshair is properly adjusted, the difference in elevation between points A and B will be the same, whether the instrument is set up at point C or point D. If the horizontal crosshair is not adjusted correctly, the true difference in elevation will be the value calculated at point C. Adjust the horizontal crosshair as follows:
   a. Determine true difference in elevation of points A and B with instrument set up and leveled at point C (see previous page).
   b. Set up and level instrument at point D.
   c. Determine difference in elevation of points A and B at point D.
   d. Remove the telescope reticle cover and turn the top and bottom reticle adjusting screws with an adjusting pin until the correct reading on Rod B is sighted. The correct reading for Rod B = $a_2 + b_1 - a_1$. Check difference of elevation of points A and B with instrument set up at point C and D. Repeat adjustment procedures until values at points C and D agree.

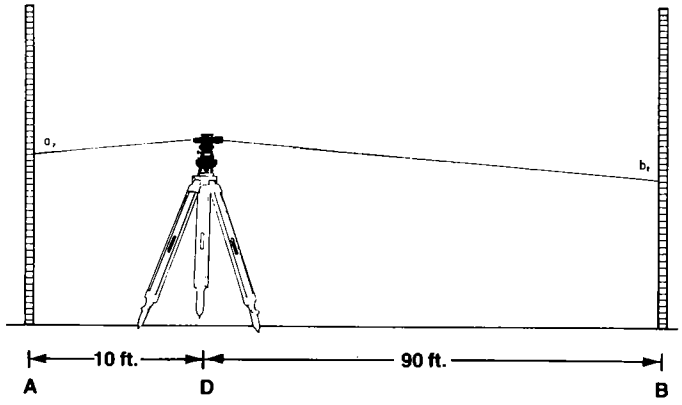


Figure 22

B) VERNIER

1. Set up and level instrument.
2. Lock telescope in horizontal position.
3. Check vernier and circle alignment with hand-held magnifier. The vertical angle reading should be 0 degrees, 00 minutes.
4. If not 0 degrees, 00 minutes, the vernier is not properly aligned. Loosen the two capstan screws located on the back of the vertical and shift vernier to correct position.
5. Re-tighten two capstan screws.
6. Re-check alignment.

C) TELESCOPE LEVEL VIAL

1. Set up and level instrument.
2. Adjust vertical circle to read 0°00′.
3. If the bubble is not centered, adjust capstan screw B to center bubble on level vial (see Figure 23).

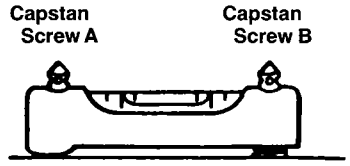


Figure 23

LIETZ

GENERAL INFORMATION

Lietz precision-made instruments, such as the Model 115 and 116 Transits are unparalleled in accuracy and reliability.

The 115/116 Transits are multi-purpose instruments, capable of performing all your construction leveling and transit work.

Set the vertical circle to read 0°00′ and your transit becomes a level for precisely leveling objects such as foundations, concrete slabs and retaining walls. It is also capable of determining the grade of parking lots, driveways and hills. The Model 115/116 Transits rotate horizontally 360 degrees, keeping the line of sight in a true horizontal plane. The horizontal circle and vernier allow you to turn or set an angle to the nearest one minute.

The ability to rotate the 115/116's telescope vertically through a 360 degree range enables the user to perform transit work, such as plumbing vertical lines for building corners, erecting poles and installing guttering. It is also useful when straight lines are needed for setting stakes or flags, laying curbs, sewer pipes and foundation lines.

The Model 115 Transit is equipped with a four-screw leveling system and a 3½ x 8 inch base-plate for attachment to conventional tripods. The Model 116 Transit uses a three-screw leveling system with a ⅝ x 11 inch base plate, which is standard on most automatic level and theodolite tripods.

The optical and mechanical components used in the Lietz Model 115 and 116 instruments are of the finest quality and integrity. The instruments are equipped with three level vials, one mounted on top of the telescope and the others mounted on the horizontal circle cover plate. The horizontal circle rotates for ease of orientation to the vernier. The circle is graduated to 30 minutes and the vernier in one minute increments. The clamp, tangent, and leveling screws are precisely machined and equipped with large knobs for smooth control in setting up and sighting the target.

CARE AND MAINTENANCE

1.) When removing the instrument from its carrying case, observe how it was secured. Upon return, make sure the instrument rests easily in its proper position. NEVER FORCE THE CASE CLOSED.
2.) Keep the instrument clean and dry. Remove dust with a dust brush. Should the instrument become damp, remove all moisture and air dry before returning instrument to the case.
3.) Never grasp the instrument by the telescope.
4.) Should your instrument become inoperable or severely damaged, contact the nearest authorized Lietz instrument repair facility. Most Lietz Authorized Distributors are equipped to offer precision repair and maintenance. In addition, the Lietz Factory Service Center is ready to serve you. The shipping address is below:

The Lietz Company
9111 Barton
Overland Park, KS 66214
(913) 492-4900

LIETZ WARRANTY

The Lietz Company warrants that if during the lifetime of your Lietz optical instrument you discover any defect in workmanship or material, Lietz will repair or replace, at its option, the defective component(s) without charge. The experience and reputation of The Lietz Company in precision equipment since 1882 stand behind this warranty.

To have your Lietz optical instrument repaired or replaced, you must carefully package and return the complete unit (transportation prepaid) with your written comments, your mailing address and proof of the date of your purchase, to any Lietz Dealer. The Dealer will package and ship at your expense, the complete unit to Lietz. Lietz will then deliver to you without charge, the repaired Lietz optical instrument or its replacement.

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY OTHER EXPRESS WARRANTY. THIS WARRANTY DOES NOT COVER DEFECTS OR DAMAGE CAUSED BY SERVICING BY UNAUTHORIZED PARTIES, MISUSE, NEGLIGENCE, TAMPERING, ABNORMAL CONDITIONS OR OPERATION, FIRE, ACCIDENT, WATER DAMAGE, ACTS OF GOD, OR OTHER CASUALTY. ANY IMPLIED WARRANTY SHALL EXIST ONLY FOR A PERIOD OF 5 YEARS FROM THE ORIGINAL PURCHASER'S DATE OF PURCHASE. THE LIETZ COMPANY SHALL UNDER NO CIRCUMSTANCES BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES.

This warranty gives you specific legal rights and you may have other rights which vary from state to state. Some states do not allow the exclusion or limitation of incidental or consequential damages or limitations on how long an implied warranty lasts, so the above exclusion or limitations may not apply to you.

GLOSSARY

Achromatic Lenses — Color corrected lenses that increase image contrast and brightness without distorting color.

Alidade — The portion of the instrument that supports the telescope.

Bench Mark — A relatively permanent object (natural or artificial) whose elevation is known, e.g., metal discs set in concrete.

Datum — Any level surface to which elevations are referred.

Degree — A unit of measurement. There are 360 degrees in the circumference of a circle.

Elevation — The vertical distance from sea level to a given point.

Field of View — The complete area visible through the telescope at any given distance. The greater the increase in magnification or power, the smaller the field of view.

Horizontal Circle — The round plate located above the leveling screws. The horizontal circle is graduated in 30 minute increments.

Horizontal Clamp Screws — The screws located below the plate vial which lock the instrument alidade in position.

Horizontal Tangent Screws — Located on the right side of the horizontal clamp screws. The horizontal tangent screws are used to precisely position the instrument after it is locked with the horizontal clamp screws.

Leveling — The process of finding the difference in elevation between two points.

Leveling Screws — Located above the instrument base plate, the leveling screws are used to align the instrument so its vertical axis is plumb.

Level Surface — A continuous surface that is at all points perpendicular to the direction of gravity. The level surface for the earth is spheroidal in shape, but in surveys of limited area, the level surface is treated as a plane surface.

continued on next page

GLOSSARY continued

Minute — A subdivision of a degree. There are 60 minutes in each degree.

Power — The magnification of a telescope. A 23 power (23x) telescope will make a distant object appear 23 times closer than when viewed with the naked eye.

Second — A subdivision of a minute. There are 60 seconds in each minute.

Stadia — Additional crosshairs on the telescope reticle used to determine distance.

Telescope Clamp Screw — A screw located on the alidade used for securing the telescope in position while sighting.

Telescope Tangent Screw — Located below the telescope clamp screw and used for precise positioning of the telescope.

Transit — A surveyor's instrument which is used to measure horizontal and vertical angles.

Turning Point — A temporary bench mark.

Vernier — A graduated scale that subdivides each degree division into smaller parts for more precise measurements of horizontal and/or vertical angles.

Vertical Circle — A vertical scale on transit instruments divided in degrees and used to determine both upward and downward angles.