TOPCON INSTRUCTION MANUAL

AUTO LEVEL
AT-M3

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TOPCON
AT-M3

INTRODUCTION

Congratulations on your choice of the TOPCON Auto-Level, Model AT-M3, which is one of the models in the new series of Auto-Levels developed by TOPCON, based on its more than ten years of experience in designing and manufacturing top-quality Auto-Levels for the world market.

The Model AT-M3 incorporates a highly reliable automatic leveling mechanism (patent pending), of great accuracy and superior shock-resistance, for automatically and accurately levelling the line of sight even when there is slight tilting of the telescope and/or when the circular level is not accurately centered. The mechanism means great savings in leveling-time and increased working efficiency because there is no need to accurately set up the instrument for most surveying operations.

The Model AT-M3 is also completely waterproofed, with the optical system and interior mechanisms effectively sealed against water and moisture, so that it may be used for leveling operations in the rain or in tunnels where water is constantly dripping, without worrying about damage to the instrument and without any clouding of the lens. The Model AT-M3 is also the first instrument to have a minimum focus of zero (patent pending) which means that targets from infinity to zero (or against the front lens surface) can be focused, thus making the instrument a very valuable equipment for working in really crowded quarters.

This manual will acquaint you with some of the finer points of the Model AT-M3, its operation and construction, as well as adjustments, so that you may be able to use the instrument with maximum efficiency in the field, at all times. Carefully read through the manual once before touching the instrument, as you will be able to use the instrument more efficiently when you fully understand it.

NOMENCLATURE

Fig. 1

① Milled horizontal circle plate
② Eyepiece adjustment ring
③ Sighting collimator
④ Focusing knob
⑤ Sun shade
⑥ Objective lens
⑦ Fine horizontal knob
⑧ Leveling screws
⑨ Base plate

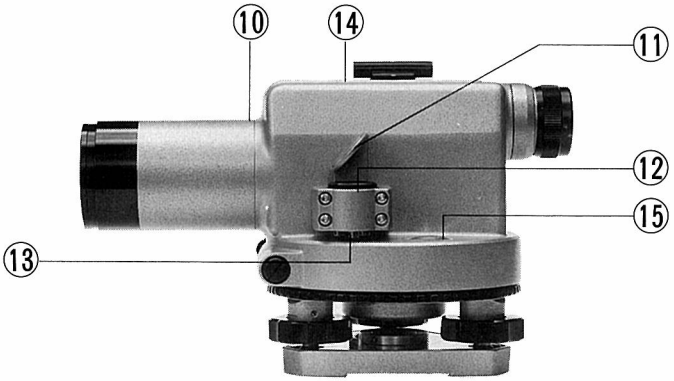


Fig. 2

⑩ Optical micrometer alignment mark
⑪ Circular level view mirror
⑫ Circular level
⑬ Circular level adjustment screws
⑭ Vertical axis mark
⑮ Horizontal circle loupe

SPECIFICATIONS

Telescope

Image	Erect
Magnification	26×
Effective diameter of objective lens	40 mm (1-37/64 in.)
Relative brightness	2.37
Field of view	1°10′ (2.1 m circle at 100 m)
Minimum focus	Front surface of objective lens
Resolving power	3″

Horizontal Circle

Diameter	88 mm (3-15/32 in.)
Scale division	1°

Circular Level

Sensitivity	10′/2 mm

Automatic Leveling Mechanism

Automatic leveling range	±15′

Special Accessories
(Supplied Against Specific Orders Only)

Optical Micrometer

Measuring range	10 mm
Scale division	0.1 mm

Illuminator

Power	2×1.5 V (AA batteries) or 3 V
Continuous illumination time	1 hour
Lamp bulb	2.2V 0.11A (JIS C 7508)

Tripods (Fixed-length or extension-leg type)

Length of fixed-length tripod	1.5 m
Length of Extension-leg tripod	0.9 m—1.5 m

EQUIPMENT

Standard Equipment

Instrument only (with lens cap)

Size	238 mm long × 123 mm wide × 138 mm high (9-23/64 × 4-27/32 × 5-7/16 in.)
Weight	2.3 kgs. (5.1 lbs.)

Carrying Case (with contents)

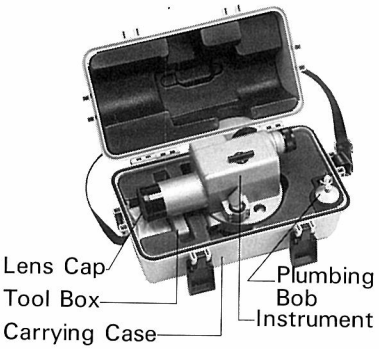
Size	300 mm long × 157 mm wide × 170 mm high (11-13/16 × 6-3/16 × 6-45/64 in.)
Weight	1.2 kgs. (2.6 lbs.)

Special Accessories (Supplied against Orders)

Optical micrometer
Illuminator
Tripod

Contents of Carring Case ng Case

Instrument	1 each	Tool box	1 each
Lens cap	1 each	Adjustment pin	1 each
Plumbing bob	1 set	Cleaning brush	1 each
		Screwdriver	1 each



CONSTRUCTION AND FUNCTIONS

The Model AT-M3 Auto-Level is an automatic level, with a patented waterproofed construction, in which an automatic levelling mechanism has been incorporated in the telescope optical system, for the purpose of automatically re-adjusting the optical axis, to compensate for slight tilting of the telescope, and thus maintaining the line of sight in the horizontal plane at all times.

1. Telescope

The telescope permits speedy sighting of the target, in spite of its high magnification power, because of the wide field of view, while surveying in the early morning hours or in the evening gloom is also quite easy because the large 40 mm effective diameter object lens shows a bright and distinct target under all conditions.

The optical system of the telescope, as illustrated in Fig. 3, consists of a two element objective lens, erecting prism "a" (compensator prism), erecting prism "b", a two element focusing lens, reticule glass of two elements and, finally, a three element eyepiece lens.

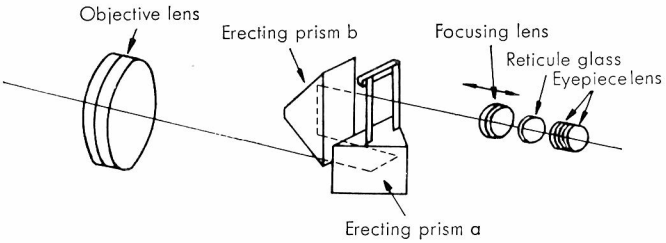


Fig. 3

The light passing through the objective lens is initially reversed laterally by erecting prism "a" and then

reversed vertically by erecting prism "b", thus producing an erect image which is then focused on the reticule glass, for observation through the eyepiece lens.

Rotating the focusing knob moves the focusing lens forward or backward for internally focusing the telescope from infinity to the front surface of the objective lens. Speedy focusing is possible because the distance to the target appears on the focusing knob, for initially setting estimated distances.

The eyepiece lens may also be adjusted in or out, by simply revolving the eyepiece adjustment ring, for adjusting the dioptric power of the eyepiece to the user's eyesight.

All light transmitting glass surfaces of the optical system, excluding the reticule glass, are coated for prevention of reflection, with the result that loss of light due to reflection on the lens surface, as well as stray light which could effect the brilliance of the image, are effectively eliminated and a clear, distinct and brilliant image of great contrast is observed at all times.

The sun shade is built-in on the outside of the telescope tube, on the objective lens side, and is simply pulled out for use and pushed back in for storage. Thus, it is both simple to use and in no danger of getting lost.

2. Automatic Levelling Mechanism

A newly-developed automatic leveling mechanism (patent pending) has been incorporated in the instrument which automatically compensates for tilting of the optical axis, up to ± 15 degrees, even when the instrument is only roughly centered with the circular level or when one of the tripod legs sinks into the soft ground after leveling, thus maintaining an absolutely horizontal line of sight at all times.

Erecting prism "a" is suspended by special ribbon-

like material and, like a compound pendulum, has greatly improved motion characteristics, with very fast return speed for speedy stabilization of the pendulum swing. At the same time, four jewels are used in the automatic leveling mechanism to improve resistance to vibrations and shocks, with the result that the mechanism has highly accurate compensations and great durability.

3. Focusing Knob

The focusing knob is shaped for easy handling and has a window in which the focused distance appears in distinct figures, thus speeding up leveling operations.

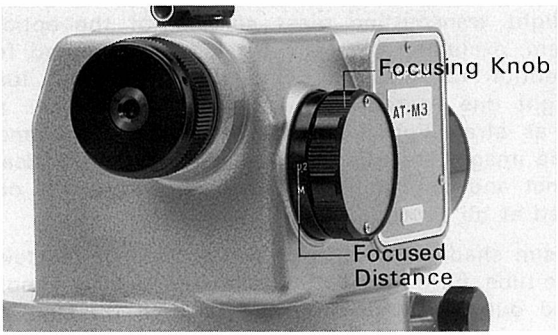


Fig. 4

4. Reticule Glass

The reticule glass is a finely polished optically flat glass of high quality on which extremely fine and durable cross-hairs are deposited by a special chemical process, thus eliminating misalignments and/or breakages of the lines during the service-life of the instrument.

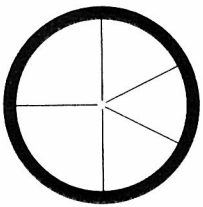


Fig. 5

The wedge line cross-hair pattern has been chosen as it is particularly suited for use with the optical micrometer.

5. Horizontal Circle

The horizontal circle has scale divisions at 1 degree intervals, from zero to 359°, and is also numbered every 10 degrees.

The horizontal circle can be positioned, as required, by turning the milled horizontal circle plate.

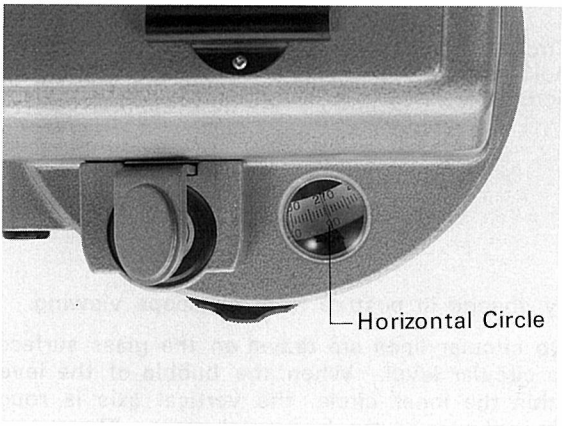


Fig. 6

6. Circular Level

The circular level of the instrument has a sensitivity of 10′/2 mm, which means that each 2 mm movement of the bubble indicates a 10 minute tilt of the level.

Three circular level adjustment screws are found below the circular level for the purpose of making adjustments in the level accuracy.

The circular level view mirror, above the circular level, permits direct viewing of the level without

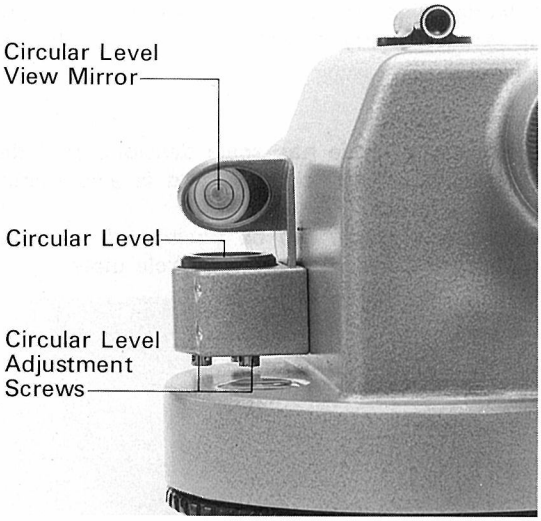


Fig. 7

any change in posture from telescope viewing.

Two circular lines are drawn on the glass surface of the circular level. When the bubble of the level is within the inner circle, the vertical axis is roughly perpendicular to the horizontal plane. The outer red circle, on the other hand, shows the limits of the automatic levelling range, which is 50 percent larger than previous automatic levelling ranges. When the bubble is in contact with the outer circle, the vertical axis is tilted 15 degrees and the instrument is at its limit for automatic levelling action.

7. Fine Horizontal Adjustment

Fine horizontal adjustments are possible immediately after coarse adjustments, without clamping action, simply by turning the fine horizontal knob, and at any point around the circle.

8. Waterproofed Construction

The instrument has a completely waterproofed construction and, therefore, may be used in the rain or in tunnels where water is constantly dripping. Dry gas (nitrogen) is sealed inside the telescope tube and effectively prevents condensation on the lens surface inside the telescope tube, when there are sudden changes in the surrounding temperature, which could prevent observation of the target.

9. Illuminator

(Special Accessory supplied only against order.)

A special accessory illuminator is available for the instrument. Since the reticule glass is illuminated with this special accessory, surveying becomes possible in dark tunnels or at night when it is used.

10. Optical Micrometer

(Special Accessory supplied only against order.)

A special accessory optical micrometer is also available for the instrument, for use in high precision surveying operations.

OPERATION

(1) Tighten the winged nuts on the tripod with the tripod legs spread as required.
Spread the legs and press in firmly so that the tripod head is roughly level and at a suitable height for attachment of the instrument.
When using an extension-leg tripod, first extend the legs to suitable lengths and tighten the winged nuts on their mid-sections, before setting up the tripod.
Once the tripod has been set up, re-tighten the winged nuts below the tripod head.
Use tripods with a tripod screw of 5/8 in. diameter and 11 threads per one inch, as per J. I. S. B standards.

(2) Take the instrument carefully out of the metal carrying case and place it on the tripod head; screw the tripod screw into the instrument's tripod socket and tightly fix the instrument to the tripod.

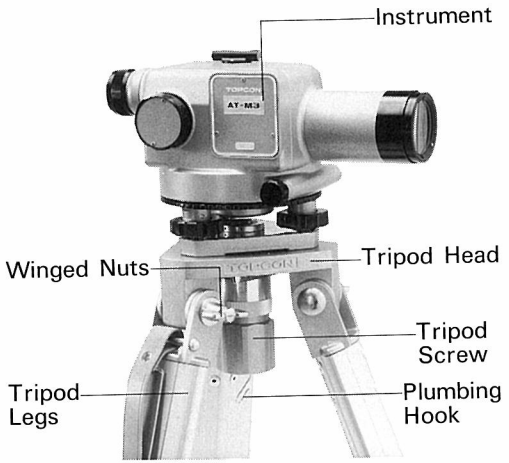


Fig. 8

(3) When the instrument is to be used for measuring angles or establishing a line, the instrument must be set up exactly over the point.
Therefore, set up the tripod so that the center of the instrument is approximately over the point, hang the plumbing bob on the hook of the tripod screw and shift the instrument (and tripod) around until the plumbing bob is about one centimeter directly above the point.
Next, loosen the tripod screw slightly and shift the instrument around on the tripod head until it is exactly over the point, at which point tighten the tripod screw.

(4) Leveling the instrument.
Adjust the three leveling screws, while looking at the circular level bubble, and center it correctly, as illustrated in Fig. 9.
Do not touch the telescope during this operation.

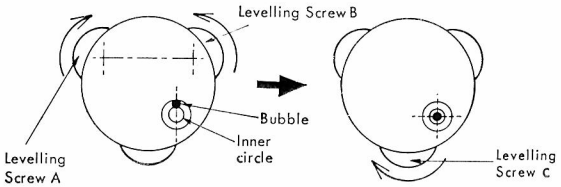


Fig. 9

(a) First, use two of the leveling screws and move the bubble so that it is centered on a line perpendicular to a line running through the centers of the two leveling screws being used for the initial adjustment.
(b) Next, use the remaining leveling screw and shift the bubble towards the center of the circular level.

If it is not possible to center the level bubble, then repeat once more from the beginning.

(5) Take a firm hold on the lens cap attached over the objective lens and pull strongly, which will extend the sun shade. (See Fig. 10)
Another strong pull will detach the lens cap itself.

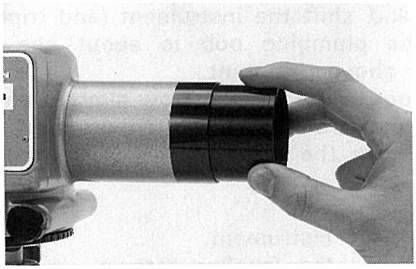


Fig. 10

(6) Point the telescope towards the light and rack the eyepiece out fully, by revolving the eyepiece adjustment ring counter-clockwise.
Then, revolve the ring gradually in the clockwise direction, while looking through the eyepiece, until the cross-hairs of the reticule glass are seen sharply and distinctly, at which point the eyepiece will be adjusted to the user's eyesight.

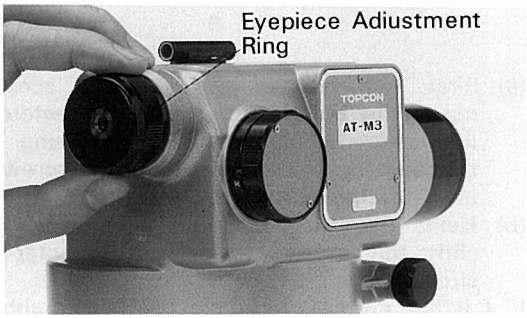


Fig. 11

(7) Align the telescope with the target, using the sighting collimator on top of the telescope.
Focusing will be speeded up if the visually-estimated distance is set to the distance scale on the focusing knob, at this time. (See Fig. 12)

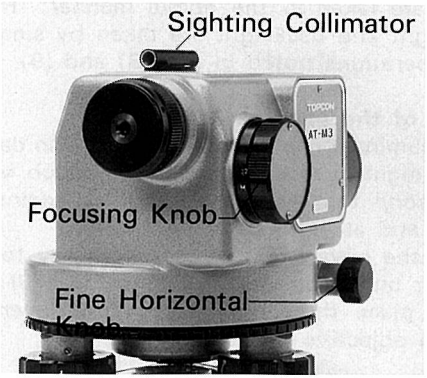


Fig. 12

(8) Next, revolve the focusing knob slowly, in either direction, until the target is seen distinctly through the telescope. At the same time, revolve the fine horizontal knob until the vertical line of the reticule cross-hairs is coincided with the levelling rod or target.
Check focus once more.
Rotating the focusing knob in the clockwise direction, as far as it will go, will let you focus on the front surface of the lens.

(9) Shift the eye to the left and right and check whether there are any deviations between the cross-hairs and the levelling rod image at this time, which will mean that parallax exists. When there is parallax, either focusing is incomplete and/or dioptric adjustment of the eyepiece with the eye-

piece adjustment ring is improper and, therefore, there will be errors in the reading of the levelling rod. Parallax must be eliminated by re-focusing or re-adjusting the eyepiece to the user's eyesight, or both.

Readings are taken in the above manner. Readings at the foresight and backsight are taken by simply repeating the operations noted in (7), (8) and (9).

(10) **Use of the Illuminator**

For illumination of the reticule glass in dark tunnels or at night, use the illuminator, which is a special accessory that is only supplied against specific order and at extra cost.

Hook the power unit of the accessory to the metal hanger on the tripod leg. (See Fig. 13)

Next, place the illuminator section over the front of the objective lens. (See Fig. 13)

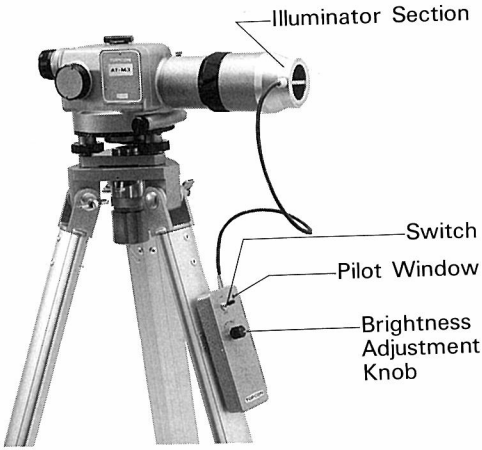


Fig. 13

Switch the power unit's snap switch ON which will

illuminate the red pilot window, next to the switch, indicating that electricity is being supplied.
Turn the brightness adjustment knob, while looking through the eyepiece, until the reticule glass is suitably illuminated.

(11) **Use of the Optical Micrometer**

The optical micrometer is also a special accessory which is only supplied against specific orders and at extra cost.
Simply insert the optical micrometer over the front end of the objective lens. (See Fig. 14)
Align the edge of the optical micrometer with the optical micrometer alignment mark on the telescope and then fix securely with the clamping knob of the accessory. Rotate the micrometer knob and take a reading of the micrometer scale when the scale-line (wedge lines) is aligned with the target.

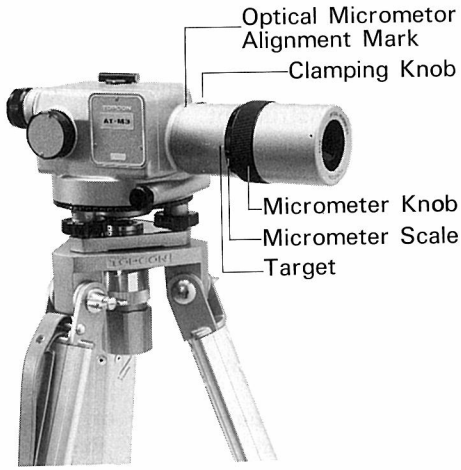


Fig. 14

ADJUSTMENT

The Auto-Level, Model AT-M3, is an exceptionally sturdy and ruggedly constructed instrument which will seldom require adjustments, in spite of incorporating an automatic leveling mechanism.
All instruments delivered undergo strict and rigid inspections, from the time the raw material is delivered to the factory until the final equipment is thoroughly inspected and precisely adjusted, by experienced technicians, and then carefully packed for shipment to you.
Unless the instrument is subject to excessive rough handling during transportation, it should arrive properly adjusted and ready for operation.
Even if it is suspected that the instrument has been subjected to excessive rough treatment by the carrier, be absolutely certain that adjustment is required before making the adjustment. Check the instrument until it is absolutely certain beyond doubt that adjustment is required and then proceed as explained following.
After adjustments, check the instrument once more to see whether adjustments have been properly made.
The adjustments noted following are also important for the purpose of obtaining the greatest accuracy and service from the instrument.

Adjustment of the Circular Level

(1) Set the instrument up on the tripod and carefully center the bubble of the circular level with the three leveling screws.
(2) Revolve the telescope 180° around its vertical axis. If the bubble remains centered, adjustment is not required but, if the level bubble moves from the center, then the following adjustment is required.
(3) Tighten the adjustment screw on the side that the bubble has moved to, with the adjusting pin, which will return the bubble towards the center. However, return the bubble by only one-half the

amount of error by this method.

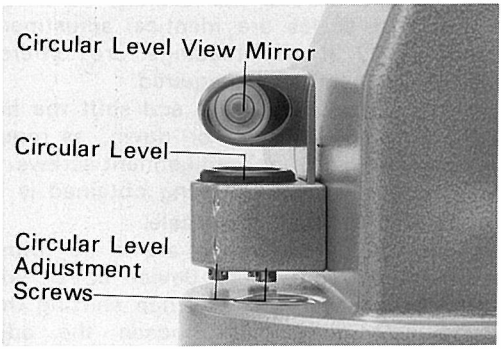


Fig. 15

(4) Re-center the level bubble with the three leveling screws.
(5) The level bubble should now remain centered as the telescope is revolved around its vertical axis. If not, repeat the adjustments noted above until the level bubble remains centered when the instrument is revolved on its axis.

Collimation of the Instrument

(1) Set the instrument up on a tripod at a point midway between two walls which are approximately 50 meters distance apart.
(2) Level the instrument properly by centering the circular level bubble with the three leveling screws.
(3) Place the test scales against both walls and alternately collimate both scales on a horizontal line of sight, using 100 on the test scales for collimation, and adjusting the test scales up or down as required.
(4) Move the instrument to a position 2 to 3 meters from one of the test scales and center the level bubble once more, with the three leveling screws.

(5) Collimate both test scales on a horizontal line of sight again and read the scales. If the readings on both test scales are identical adjustment is not required but, if the readings are different, the following adjustment is required.

(6) Sight the farther test scale and shift the horizontal cross-hair line either up or down, as required, by revolving the cross-hair adjustment screws with the adjusting pin until the reading obtained is identical to that of the nearer test scale.
The four adjustment screws are to be found under the cross-hair adjustment device cover, when it is unscrewed. (See Fig. 16) When shifting the cross-hair reticule glass, first loosen the adjustment screw in the direction in which the horizontal cross-hair line must be shifted and then tighten the adjustment screw, on the opposite side, by an equal amount. Thus, if the bottom adjustment screw is revolved a half turn in the counter-clockwise direction to loosen, then revolve the top adjustment screw by the same half turn in the clockwise direction to tighten, which will leave the tensions of the adjustment screws unchanged.

(7) Check once more whether the test scales give identical readings with the instrument set in the above manner and, if not, repeat the adjustment once more.

Adjustment of the Cross-Hair Reticule Glass

(1) Set the instrument up on the tripod and carefully center the bubble of the circular level with the three leveling screws.

(2) Sight on a suitable target about 40 meters from the instrument or place a suitable mark on the leveling rod, if the former is unavailable.

(3) Coincide the horizontal cross-hair line with the mark so that the mark is aligned flush with the line.

(4) Next, revolve the fine horizontal knob so that the horizontal cross-hair line traces the mark

(5) If the target mark is displaced from the horizontal cross-hair line as it is moved across the field of view, then adjustment is required in the cross-hair reticule glass.

(6) Revolve the cross-hair adjustment device cover in the counter-clockwise direction and take it off, which will expose four fixing screws, in addition to four capstan adjustment screws. (See Fig. 16)

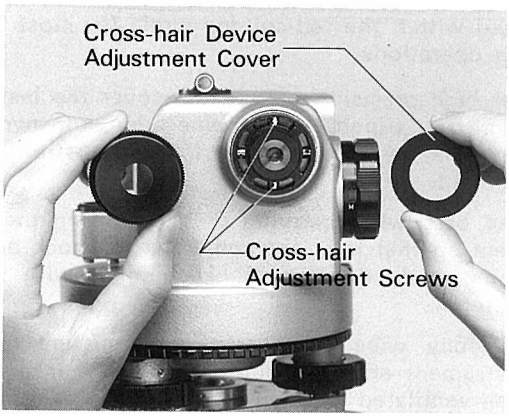


Fig. 16

(7) Slightly loosen all four fixing screws, with a screwdriver, and revolve the reticule glass so that the horizontal cross-hair line is correctly located.
Re-tighten the fixing screws by the amount that they were loosened.

(8) Repeat the checking operation once more and if the target mark is still displaced from the horizontal cross-hair line when the telescope is revolved with the fine horizontal knob, repeat adjustments once more. The accessory test scale may be used as the target for this purpose.

IMPORTANT

(1) To increase precision in surveying operations, always eliminate parallax by making proper dioptric adjustments of the eyepiece and by focusing carefully.

(2) For precision operations, place the circular level bubble inside the black circle, otherwise, it can be used within the red-colored circle for most surveying operations.

(3) For high precision surveying, cover the instrument and the tripod with some kind of awning or umbrella to shield them from the strong direct sunlight.

(4) Use care when carrying or transporting the instrument so that it is not subjected to shock or vibrations, and, if possible, cushion it with suitable material.

(5) Carefully wipe away dust and moisture from the instrument after use and then store it in a dry and well-ventilated location, which is, at the same time, not dusty.

(6) Do not try to dismantle the instrument, especially the screws and revolving parts, but contact the nearest experienced and well-equipped factory for this purpose.

CARE AND MAINTENANCE

(1) Clean the lens surface by brushing away the dust with the cleaning brush first, or blowing it away with an air blower.

(2) When absolutely necessary to wipe dirt or fingerprints from the lens surface, use a well-washed soft cotton cloth, dipped in alcohol or a mixture of alcohol and ether, and lightly wipe the lens surface several times. On no condition should the surface be rubbed hard but repeat the light wiping action, if necessary.

(3) To ascertain whether the automatic leveling mechanism is in action, revolve the nearest leveling screw slightly, to the left or right, while looking into the telescope through the eyepiece. If the line of sight is momentarily shifted but instantly returned to its horizontal plane, the mechanism can be considered as being in proper working order.

TOPCON CORPORATION

75-1 Hasunuma-cho, Itabashi-ku, Tokyo, 174 Japan.
Phone: 3-3967-1101 Fax: 3-3960-4214 Telex: 0272-2384

TOPCON AMERICA CORPORATION

CORPORATE OFFICE
65, West Century Road, Paramus, New Jersey 07652, U.S.A.
Phone: 201-261-9450 Fax: 201-387-2710 Telex: 134338

WESTERN REGIONAL OFFICE
6940 Koll Center Parkway Pleasanton, California 94566, U.S.A.
Phone: 510-417-0107 Fax: 510-417-0130

TOPCON MIDWEST
1728 West Algonquin Road Arlington Heights, Illinois 60005, U.S.A.
Phone: 708-818-9188 Fax: 708-818-9342

TOPCON EUROPE B.V.

Esse Baan 11, 2908 LJ Capelle a/d IJssel, The Netherlands.
Phone: 10-4585077 Fax: 10-4585045 Telex: 23783 TOPCO NL

TOPCON DEUTSCHLAND G.m.b.H.

Krefelder Straße 19-21, D-4156 Willich 1, Germany.
Phone: 02154-427061~5 Fax: 02154-40909 Telex: 8531981 TOPC D

TOPCON S.A.R.L. (Medical)

107-109 Rue du Président, Wilson 92300 Levallois-Perret, France.
Phone: 1-47390267 Fax: 1-47390251 Telex: 620287 TOPCON F

TOPCON ESPAÑA S.A.

HEAD OFFICE
Frederic Mompou, 5 08960, Sant Just Desvern Barcelona, Spain.
Phone: 3-4734057 Fax: 3-4733932

MADRID OFFICE
Dr. Esquerdo 148, Bajos 28007, Madrid, Spain.
Phone: 1-552-4160 Fax: 1-552-4161

TOPCON OPTICAL SVENSKA A.B. (Medical)

Industrivägen 4 P.O. Box 2140 43302 Partille SWEDEN
Phone: 031-261250 Fax: 031-268607 Telex: 21414

TOPCON SINGAPORE PTE. LTD.

Alexandra Distripark Block 4, #05-15, Pasir Panjang Road, Singapore 0511.
Phone: 2780222 Fax: 2733540 Telex: 26622 TOPSIN RS

TOPCON AUSTRALIA PTY. LTD.

253 Princes Highway Arncliffe NSW 2205, Australia.
Phone: 2-597-2466 Fax: 2-597-3842

TOPCON INSTRUMENTS (THAILAND) CO., LTD.

147/229-230 New Southern Bus Station Pinklao-Nakarnchaisri RD.
Bangbumru, Bangplad Bangkok 10700, Thailand.
Phone: 662-435-4002 Fax: 662-435-4005

TOPCON INSTRUMENTS (MALAYSIA) SDN. BHD.

Lot 226 Jalan Negara Dua, Pusat Bandar Taman Melawati, 53100
Kuala Lumpur, Malaysia.
Phone: 03-4079801 Fax: 03-4079796

BLOOMFIELD COMPUTING SERVICES PTY. LTD.

Suite 313, Henry Lawson Business Centre, Birkenhead Point.
Drummoyne, NSW 2047, Australia.
Phone: 02-819-6488 Fax: 02-819-7461

TOPCON KOREA CORPORATION

Hyobong Bldg., 1-1306, Seocho-Dong, Seocho-Gu, Seoul, Korea.
Phone: 02-557-9231~2 Fax: 02-556-1928 Telex: K23231 EXT2264

TOPCON OPTICAL (H.K.) LIMITED

2-4/F Meeco Industrial Bldg., No. 53-55
Au Pui Wan Street, Fo Tan Road, Shatin, N.T. Hong Kong
Phone: 0-6049688 Fax: 0-6910264

TOPCON CORPORATION ATHENS OFFICE

Athens Tower "B" Suite 401, 2-4 Mesoghion Street, Athens 115 27 Greece.
Phone: 7798912/7798913 Fax: 7793974 Telex: 219447/216553 TOP GR

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