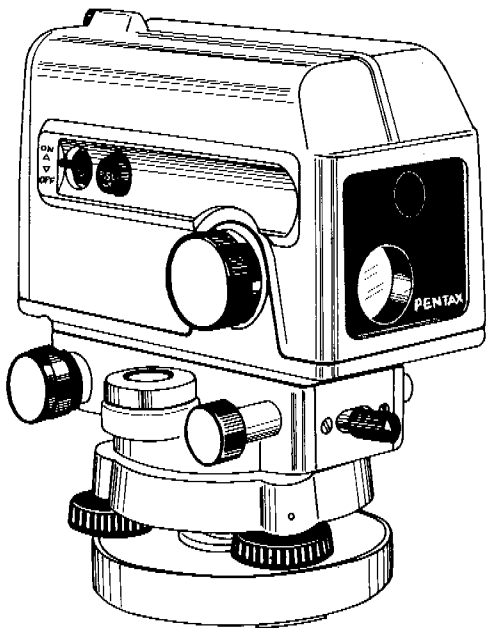


PENTAX®

LASER TILTING LEVEL

TL-1

INSTRUCTION MANUAL



◁For Proper Use of Instrument▷

The PENTAX laser tilting level is of the highest quality and design. We therefore, recommend that you read the instruction manual very carefully so that you will appreciate the full capabilities of your PENTAX precision instrument and ensure years of trouble-free operation.

To prevent accidental damage to your instrument please adhere to the following notes which have been constructed to help you in maintaining your instrument in a precise functioning condition.

Battery replacement

- It is recommended that batteries be replaced before starting field work.
- Be sure to turn off the power switch before battery replacement. Insert batteries with correct polarity as indicated.
- Use batteries with good quality. Note that alkaline batteries serve longer than manganese ones.
- Be sure to turn off the power switch after use. When the TL-1 is not to be used for a long time, take the batteries out of it for good storage.

Environmental conditions

- Because of the diode laser beam, that TL-1 is not suited for use in a very bright environment like sites in the direct rays of the sun. But when such an use is required, make the environment of the target shadowy by some means.
- Do not give a sudden temperature change to the TL-1, by carrying it out of a warmed room to the cold open air, for example. Such a change may cause distortion or dewing inside the TL-1 and its performance may be impaired.

Safety of laser beam

- Do not let the direct beam emitted by the TL-1's diode laser into your eye because it is harmful to human eyes.
(The laser output conforms to the laser safety criterion class 2.)

Storage

- After use, remove dust and moisture from the TL-1 and store it in a dry place with minor temperature change.
- Whenever storing the instrument in its case, make sure the power switch is off and place the instrument in an orderly way in the case.
- When storing the TL-1 for a long period of time, take it out of its case occasionally and expose it to the air.

Transporty

- During transport of the TL-1, be specially careful not to give it shocks or vibrations. When its transport is done by a carrier, wrap it with ample packing before transportation.
- When the user transports the TL-1 in his or her own car, neither wrapping nor packing is necessary. But keep it on somebody's lap or firmly on a seat.
- When the user cannot avoid transporting the TL-1 in areas like the luggage compartment of a car or the bed of a truck, wrap it with thick cloth like a blanket and secure it from moving by some means so that shocks cannot affect the instrument.

Installation on tripod

- Hold the TL-1 with your hand during the installation on the tripod and removal from it.
- Never leave the TL-1 on the tripod to prevent accidental damage
- Since the quality of the tripod greatly affects measuring accuracy, use our tripod bearing the mark, PENTAX.

Other precautions

- Before every use, check the TL-1 as often as possible and checking is needed especially for the instrument stored for a long time or transported over a long distance.
- Even if some malfunction is found, do not disassemble the instrument. Contact your dealer or a authorized repair shop.

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1 Features

- The TL-1's diode laser limits replacement that conventional laser tubes require due to their limited life.
- Turning the TL-1's beam focusing knob sharpens the spot radius into as little as 1mm for a range of 20m.
- Many hours of operation is assured by dry batteries. They are contained inside the TL-1 so that no cable is necessary.
- The TL-1's coincidence-type vial ensures accurate leveling.
- The water resistant TL-1 ensures easy operation even in a wet environment like tunnel construction sites.
- The diode laser makes the TL-1 compact and easy to handle.
- The laser output conforms to the laser safety criterion class 2 and assures safe operation.

2 Equipment

1 Standard equipment

- Instrument
- A set of tools(with case)
(Screw driver, 2 adjusting pins, Cleaning brush)
- Silicone cloth
- Rain cover
- Size C batteries
- Carrying case
- Target plate

2 Optional accessories

- Lighting device(E2)
- Tripod(TS-3)

3 Specifications

■ **Sensitivity of vials**

Main vial40"/ 2 mm (bubble coincidence type)

Circular vial 8' / 2 mm

■ **Optical finder**10 ×

■ **Fine tilting screw**

Fine adjustment range ± 15'

■ **Tripod thread** 5 / 8 " × 11

■ **Ambient temperature**

Range - 10°C ~ + 45°C / + 14°F ~ + 113°F

■ **Dimensions and weight**

Instrument163 (L) × 104 (W) × 187 (D) mm/2.5kg (5.5 lbs)

Case210 (L) × 240 (W) × 380 (H) mm/2.5kg (5.5 lbs)

■ **Laser section**

Laser Visible diode laser

Aperture output0.2mW

Excitation wavelength670nm

Power source 6VDC (4 batteries of 1.5V)

Operation time ... 40hours(With size C alkaline batteries)

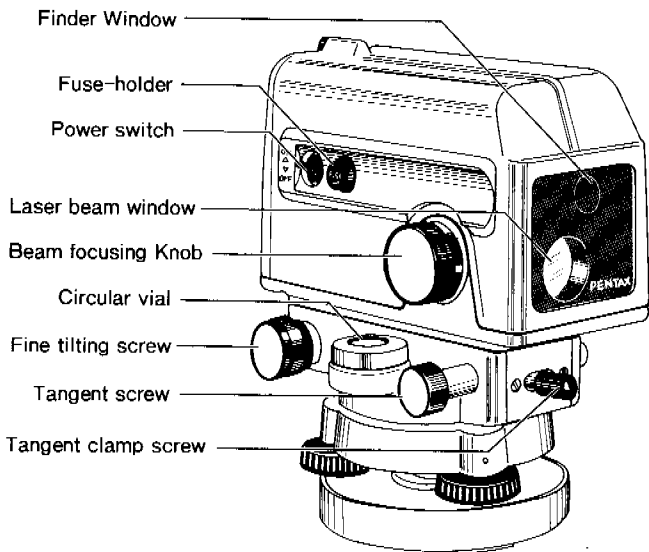
20hours(With size C manganese batteries)

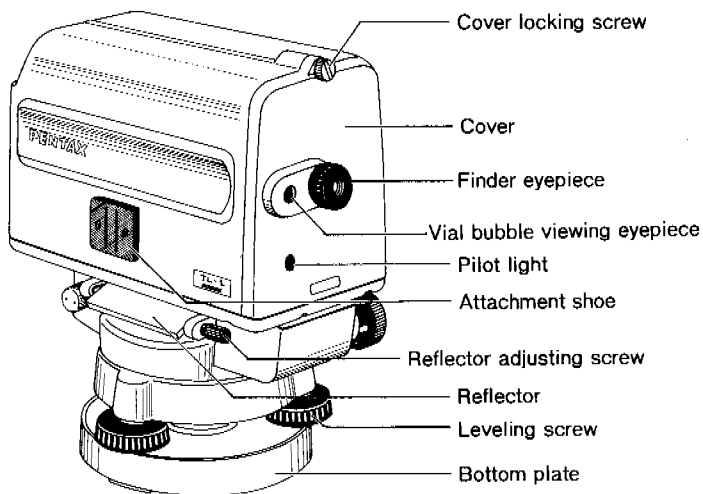
Minimum beam focusing range0.8 m

Focused spot radius	Range (m)	5	10	20	50	100
	Spot radius (mm)	0.3	0.5	1	2.5	5

※ The ranges above are measured in a dark environment. They can be shorer in accordance with the ambient luminosity.

4 Nomenclature of parts





5 Operation

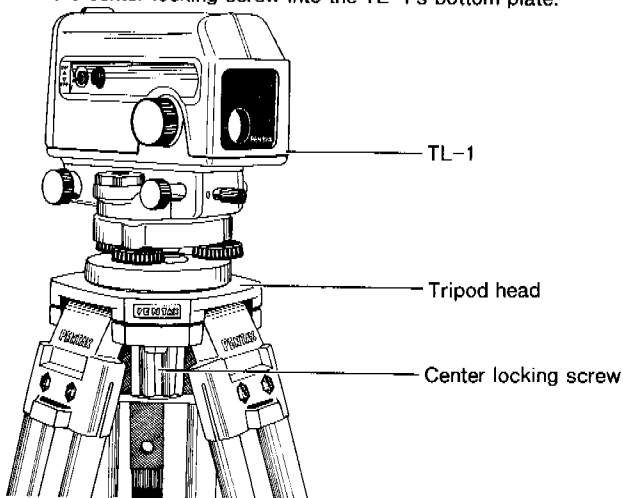
1 Preparation for surveying

1) Setting up the tripod

- ① Prepare a tripod having a center locking screw with $5/8" \times 11$ thread.
- ② Adjust the legs and dig them into the ground so that the head of the tripod will be nearly horizontal.
 - The height of the head can be controlled by adjusting the length and angles of the legs.
 - A spherical head tripod is preferable for a job in a site with steep slope.

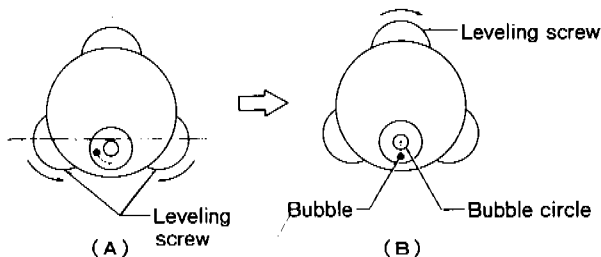
2) Setting up the instrument

- ① Mount the TL-1 on the tripod head and secure it by fastening the center locking screw into the TL-1's bottom plate.



3) Leveling

- ① Turn two of the three leveling screws so that the bubble of the circular vial will be at a position even to the left and the right. (Fig. A)
(Two leveling screws should be turned in opposite directions.)
- ② Turn the remaining leveling screw so that the bubble will be at the center. (Fig. B)
- ③ Turn the telescope 180° to make sure that the bubble does not move away from the center.

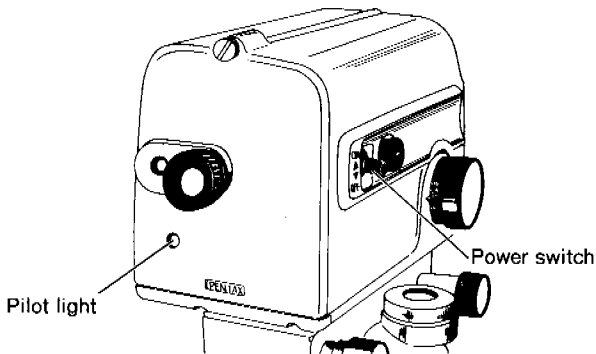


- For the relation between the direction of leveling screw rotation and that of bubble movement, see the arrows in Figures A and B.
- If the bubble is out of the center in ③, "adjustment of the circular vial" on page 19 is needed.

2 Surveying

1) Turning on the power switch

When the power switch is turned on, the pilot light illuminates and a laser beam is emitted.

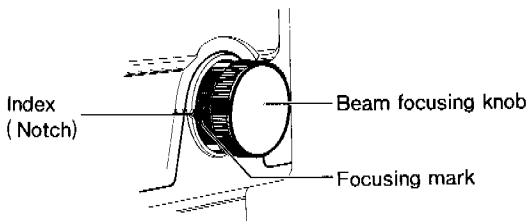


Caution

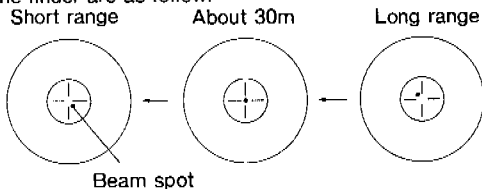
- Do not look into the laser beam window when the laser is on.
- When the pilot light flickers, replace batteries, or the pilot light will turn off and the laser will stop.

2) Focusing of laser beam

- ① Direct the laser tilting level to the target and tighten the tangent clamp screw.
- ② Adjust a reading of the focusing mark (approximate target range) on the beam focusing knob to the index (a notch.)



- ③ Turn the eyepiece Knob, looking into the finder eyepiece so that the beam spot can be most clearly seen.
Note : The center of the cross hairs usually does not meet that of the beam spot though this depends on the distance from the target.
 - ④ Turn the beam focusing knob so that the beam spot on the target will be smallest.
 - ⑤ Turn the tangent screw to direct the beam spot to the target.
- Positional relations of the beam spot and the cross reticle hairs in the finder are as follow.

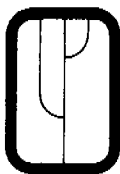


- When surveying at short range, it will be easier to focus the beam by looking at it directly rather than by looking it through the finder.

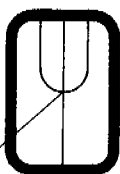
3) Reading of spot position or marking

- ① Adjust the triangle mark of the fine tilting screw to the proximity of the index line.
- ② Turn the reflector adjusting screw, looking into the vial bubble viewing eyepiece, so that the bubble image can be most clearly seen.
- ③ Turn the fine tilting screw to achieve the exact agreement of the bubble images. With the instrument in this state, read the graduation on a staff for the beam spot center on the target, or mark the beam spot center.

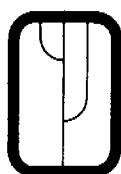
Laser beam
upward



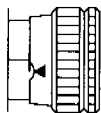
Laser beam
horizontal



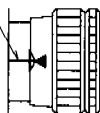
Laser beam
downward



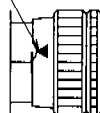
← Agreement of bubble images



Index line

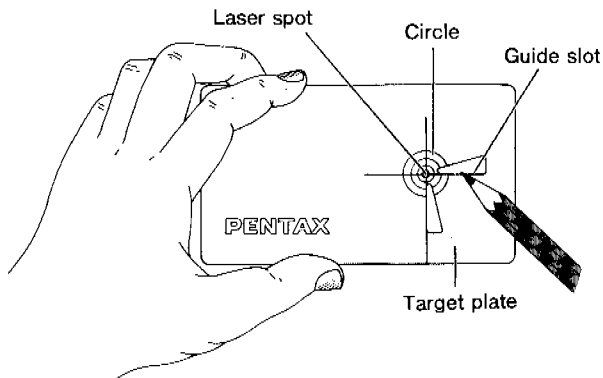


Triangle mark



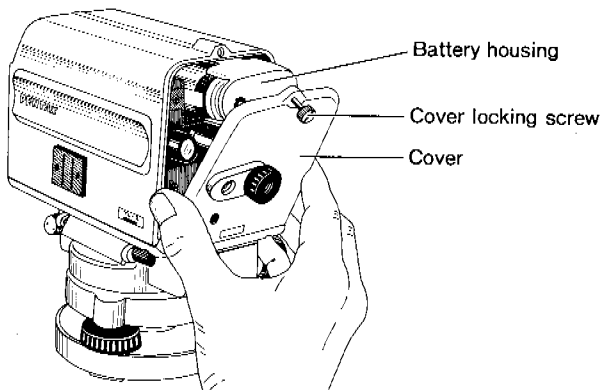
4) **Marking with target plate**

Position the target plate so that the laser spot will be at the center of the circle on the target plate, and draw marking lines along the edges of the guiding slot with a marker.



6 Replacement of batteries

- ① Make sure that the power switch is off.
- ② Loosen the cover locking screw with a coin or similar and remove the cover.
- ③ Take the battery housing out of the instrument and replace old batteries with new ones.



- ④ Make sure that the polarity of the batteries is correct as indicated and be sure to replace all the four batteries at a time.
- ⑤ After replacement, insert the battery housing back into the instrument as the arrow mark indicates on top of the housing.
- ⑥ Put the projections at the bottom of the housing to the groove of the instrument, and then tighten the cover locking screw, pressing the battery housing with the cover.
- ⑦ Turn on the power switch to verify that the pilot light flickers on.
- When the instrument is not to be used for a long time, remove the batteries from their housing for good storage.

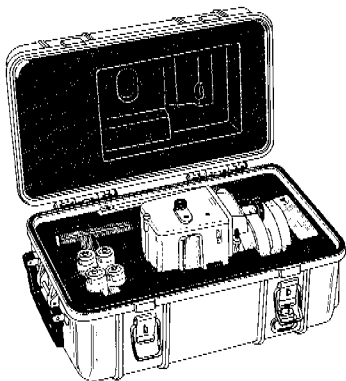
7 Maintenance and storage

1 Maintenance

- ① After every use, clean the dust and moisture from the instrument and put it back into the case.
- ② The outside of the instrument should be brushed first, and wiped with soft cloth.
- ③ Lenses should be brushed first, and lightly wiped with clean cotton cloth with a little alcohol on it.

2 Storage

- ① With the eyepiece upward, place the instrument carefully in the packing of the case.
- ② Close the case and secure the latch.
 - Before storing, make sure that the power switch is off with the pilot light put out.
 - The case should be opened or closed in a lying position as shown below.



8 Precaution

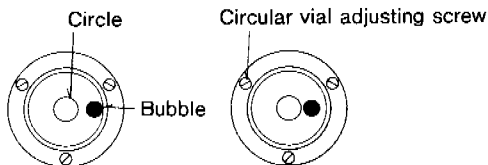
- ◇ Be specially careful not to look at laser beams directly.
- ◇ Be sure to turn off the power switch when finishing operation.
- ◇ If some malfunction is found, contact your local dealer or an authorized repair shop with sufficient facility. Never disassemble the level.
- ◇ When a malfunction is found in the working of some section due to an accident like tumbling, contact your local dealer or an authorized, repair shop without forcibly disassembling the instrument.
- ◇ Make sure that there is no defect like looseness in the tripod.

9 Inspection and adjustment

1) Circular vial

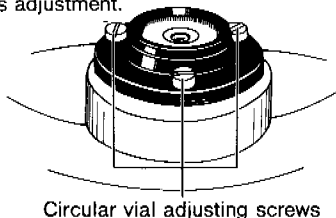
1) Checking

- ① Mount the laser tilting level on the tripod and level the instrument and adjust the bubble of the circular vial to the center of the circle.
- ② Turn the telescope 180°.
- ③ If the bubble is located at the center, no adjustment is necessary.

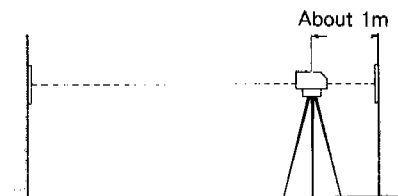
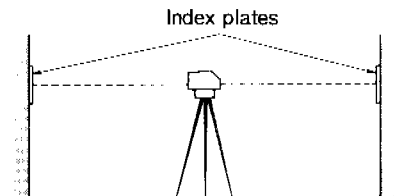


2) Adjustment

- ① When the bubble of the circular vial is away from the center, turn the leveling screw to move the bubble half the distance of deviation toward the center.
- ② Remove the circular vial cover, and turn the circular vial adjusting screws with a screw driver to move the bubble to the correct position at the center of the circle.
- ③ Turn the telescope 180° horizontally to make sure that the bubble does not deviate from the center.
- ④ If deviation occurs, repeat this adjustment.



2 Paralleling of laser beam and main vial



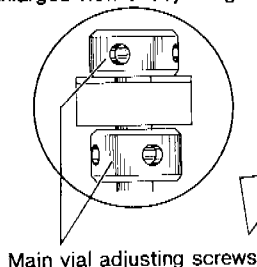
1) Checking

- ① Prepare two index plates of the same type. Situate the laser tilting level in the middle of two walls about 20m apart, and level it.
- ② Direct a laser beam alternately to the two walls, and position and secure the index plates so that the same spot position will be established on both walls when the bubble images agree with each other.
- ③ Move the tilting level to a position about 1m from one of the walls, and level it.
- ④ Direct a laser beam to both index plates and read the spot positions when the bubble images agree with each other.
- ⑤ If the readings of both index plates are identical at that time, no adjustment is necessary.

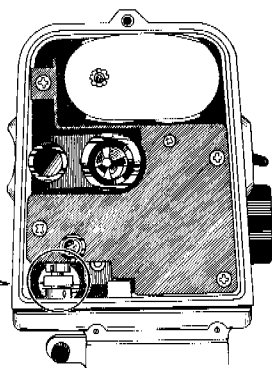
2) Adjustment

- ① When the readings of the index plates are not identical, direct a laser beam to the farthest index plate.
- ② Turn the fine tilting screw to agree with the reading of the other index plate.
- ③ Remove the cover, and turn the main vial adjusting screws with the adjusting pins to eliminate the gap between the bubble images. Put the cover back and perform checking ④ to ⑤ to verify that the adjustment has been correct.

Enlarged view of adjusting screws



Main vial adjusting screws



3) Caution on inspection and adjustment

- ◇ Finish adjustment with adjusting screws fully tightened. Be sure to stop turning an adjusting screw if it becomes too tight. In this case, loosen the other screw slightly and proceed.
- ◇ Repeat checking after adjustment to make sure that adjustment has been performed correctly.

10 Optional accessories

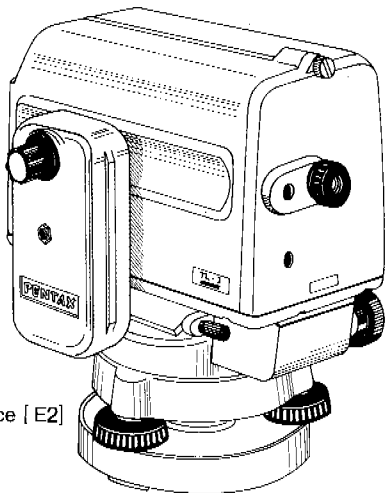
Lighting device [E2]

Used to illuminate the main vial at night or in dark condition such as a tunnel.

1) Operation

- ① Attach the lighting device to the attachment shoe of the laser tilting level.
 - ② Switch on the resistor and adjust the brightness of the bubble images, looking into the bubble viewing eyepiece.
- When the lighting device is not to be used for a long time, remove batteries from it.

If the device is left with batteries in it for a long time, it can be damaged due to leakage of battery acid.



Lighting device [E2]

11. NOTICE TO THE USER OF THIS PRODUCT

To assure compliance with the Safety standard 12 CFR, Chapter 1, Subchapter J, The U.S. Bureau of Radiological Health requires the following information to be provided to the user:

1) Specifications of Laser Radiation

A. This laser system is designed and built to have a InGaAlP laser diode radiating at 670 nm.

B. Radiant power

This laser product is designed and built to radiate a maximum of 0.27 mW during functional operation.

The user may be subjected to this radiation until such time that the instrument is turned off.

2) The following labels are affixed to and must remain attached to this laser product.

A. Certification label

(more)

"This laser product conforms to the provisions of 21 CFR 1040.10 and 1040.11. For a class II laser product."

Located on the surface of the side cover

B. Aperture label

"LASER RADIATION IS EMITTED FROM THIS APERTURE"

Located near to exit aperture

C. Warning logotype

"LASER RADIATION DO NOT STARE INTO BEAM VISIBLE DIODE
LASER MAXIMUM OUTPUT 0.27mW WAVELENGTH 670 nm
CLASS II LASER PRODUCT"

Located on the surface of the top of cover

(more)

- 3) Caution to maintain safety in compliance with the standard
- * To maintain the safety standard, refrain from any operation, maintenance or adjustment other than described in this instruction manual.
 - * Operation, maintenance or adjustment other than those specified in this instruction manual may result in hazardous radiation exposure.
 - * Maintenance and repair not covered in this manual must be done by an authorized Pentax dealer.
-

PENTAX®

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