INSTRUCTION MANUAL

Automatic Level

ESL2

Contents

1. Equipment

1.1 Standard Equipment

1x Set ELS2 Universal Automatic Level, with 360°/400g circle

1x Adjusting pin each container

1.2 Optional Accessories

ESM1 parallel plate Micrometer can be used with WILD NA2/NAK2 and ESL2 Measuring range:10mm

Parallel Plate Micrometer ESM1

With glass reading scale	Range	Interval	Estimation
	10mm	0.1mm	0.01mm

2. Applications

Model ESL2 Automatic Level is adoptable for the second and third class leveling, It is also used for general construction engineering and installation of large size machines. The advantage of the automatic is that as soon as the circular bubble is centered, the line of sight is horizontal for all pointings of the telescope. Elimination of the traditional tubular level speeds up work and improves accuracy.

3. Technical Data

	ESL2	ESL2+ESM1
Standard deviation of 1KM double run	±1.0mm	±0.5mm
Telescope		
Image	Erect	
Magnification	32x	
Clear objective aperture	45mm	
Shortest focusing distance	1.6m	
Multiplication factor	100	
Additive constant	0	
Compensator		
Working range	±14′	
Setting accuracy	≤0.3″	
Circular level sensitivity	8′/ 2mm	
Horizontal circle	360°(400g)	
Minimum reading	1°(1g)	
Weight	2.5 kg	

4. Description

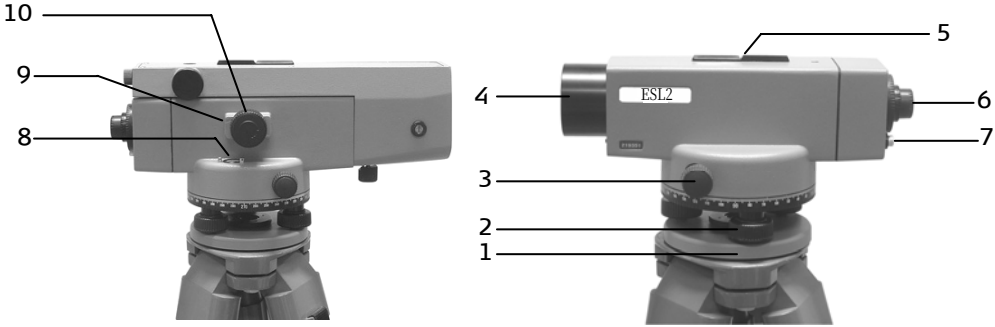


Fig.1 Automatic Level

1. Base plate
2. Footscrew
3. Horizontal drive, endless
4. Telescope objective housing
5. Optical sight
6. Telescope eyepiece
7. Press button
8. Circular level
9. Prism for viewing circular level
10. Focussing knob with cores/fine motion

4.1 Instrument

The base plate (1) has a standard thread enabling the ESL2 to be used on any of our tripods which are sufficiently stable (and on any other tripod having a 5/8″thread fixing screw). The rotatable upper part of the instrument consists chiefly of the telescope with an optical mechanical compensator. The compensating element is essentially a pendulum, supported by four suspension tapes and carrying a prism. The rapes are of a special alloy to guarantee correct compensator functioning even at extreme temperatures (-30℃ to +50℃). Provided the circular bubble(8) (sensitivity 8′ per 2mm) has been set in its setting circle by turning the three footscrews(2). The line of sight will be automatically horizontal as the pendulum will be well within its working range of ±14′. The movement of the pendulum is efficiently air damped.

The ESL2 is equipped with a press button(7) to check the functioning of the compensator. When the button is pressed, before reading the staff, the pendulum is given a slight tap and, as a result of the pendulum's swing, the staff image swings smoothly away and then floats gently back to its original position with respect to the horizontal cross hair. The observer is then certain that the compensator is working and that the line of sight is

horizontal. The press button also verifies the leveling up of the ESL2′ because the staff image will not show the correct movement on pressing the button if the circular bubble is long away from its central position, but the movement will be quicker and shorter due to the pendulum reading its stop.

The eyepiece(6) with dioptric scale is turned to focus the reticle cross hairs. After turning the bayonet locking ring anticlockwise, the eyepiece can be removed and replaced by an optional eyepiece.

The reticle has wedged-shaped hairs for precise leveling with the parallel plate micrometer, and a single horizontal hair for normal leveling staffs. It also has 1:100 stadia hairs(6.2).

The focusing knob(10) is turned to obtain a sharp image of the staff. It has a coarse and fine motion. Rotation of the instrument is friction-braked. Fine-pointing is by means of the endless horizontal drive screw(3). The drive has knobs at each side for use with either hand.

4.2 Leveling Staffs

As the telescope of the ESL2 gives an erect image, leveling staffs with erect numbers should be used. It is emphasized that the accuracy of leveling depends just as much on the staffs as on the level.

High quality staffs must be used.

4.3 Tripod

For normal leveling the model L tripod with telescopic legs is usually preferred. For precise leveling and severe conditions e.g. strong wind the model M tripod is recommended. As the fixing screw on all of our tripods have the same thread however, any our tripods can be used. Each tripod has a plastic cover for the tripod head.

5. Instructions for Use

5.1 Unpacking and Setting Up

When setting up the tripod. The legs must be trodden firmly into the ground. The tripod head should be as horizontal as possible and height should be such that the telescope eyepiece will be comfortably at the observer's eye level. With a telescopic leg tripod check that the clamps are tight. The instrument is set on the tripod head.

5.2 Leveling Up

To level up the instrument turn the footscrews (2) until the circular level (8) lies in the centre of its setting circle. The line of sight is then automatically

set by the compensator to horizontal. For adjustment of the circular level, please refer 7.2.

5.3 Focusing and Sighting

The telescope is pointed towards a uniformly light surface. Or a sheet of white paper and the telescope eyepiece (6) is turned until the reticle cross-hairs appear sharp and absolutely black. The eyepiece diopters scale reading now indicates the correct setting for the observer's eye. By looking alone the optical (or open) sight (5) and turning the instrument by hand the telescope is pointed roughly at the Leveling staff. Turn the focusing knobs (10), which have coarse and fine motion. Until the staff image appears sharp and free from parallax with respect to the cross hairs, i.e. there should be no apparent movement between the horizontal hair and a staff graduation when the observe moves his eye slightly up and down. To bring the vertical cross-hairs exactly on to the centre of the staff turn the horizontal drive (3).

5.4 Compensator Checking

Before reading the staff, when the button (7) is pressed, the staff image swings smoothly away and then floats gently back to its original position

with respect to the horizontal cross hair. Then the compensator is working and the line of sight is horizontal. The press button also verifies the leveling up of the ESL2, because the staff image will not show the correct movement on pressing the button if the circular level is a long away from its central position, but the movement will be quicker and shorter due to the pendulum reaching its stop line. To level up the instrument until the circular level lies in the centre of its setting circle.

6. Measuring

☞ Before starting field work or after longer periods of storage/transport of your equipment check the field adjustment parameters specified in this User Manual.

☞ Reduce possible vibrations by holding the tripod legs.

☞ If the optical parts of your instrument are dirty of fogged, your measurements can be affected. Keep clean all optical parts of your instrument and follow the cleaning instructions specified in the User Manual.

☞ Before starting work, let the instrument adjust to the ambient

temperature.

6.1 Normal Height Measurement

Procedure:

1. After pointing at the staff, check the circular bubble is centered, then press the push button to verify that the compensator is functioning and finally read the position of the horizontal cross hair on the staff.
2. Because of the erect image telescope the staff numbers will increase from the bottom to the top in the field of view.
3. Take the nearest whole centimeter value from the graduation below the horizontal cross hair (114cm) and estimate the millimeters within the centimeter interval cut by the cross hair (3mm). The reading in fig.3 is therefore 1.143m. For line leveling of high accuracy, and as a check against gross error, the staff readings of the cross hair and both stadia hairs should be taken (the 3 wire method). The mean of the two stadia readings serves as a check on the middle cross hair reading.

Example:

Horizontal cross hair	1.143m
Upper stadia A1	1.216m
Lower stadia A2	1.068m
1/2(A1+A2)	1.142m

Should the telescope image tremble due to ground vibrations or a strong wind, the observer can reduce the effects by holding the tripod legs at about their mid-point.

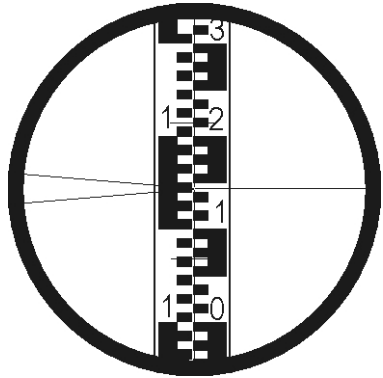


Fig.2

6.2 Distance Measurement from Stadia Readings (fig.2)

To obtain the distance, the readings of the upper (A1) and lower (A2) stadia hairs are used. The difference between the two readings multiplied by 100 gives the horizontal distance from instrument to the staff (see fig.3)

ESL2 field of view with leveling staff

Height reading from horizontal hair 1.143m

Example: Upper stadia A1	1.216m
Lower stadia A2	1.068m
A1-A2	0.148m
×	100
Horizontal Distance	14.8m

To simplify the distance reading, the footscrews closest to the line of sight can be turned until the lower stadia hair is on a full decimeter value. Only the upper stadia hair has now to be read and the subtraction is easier.

6.3 Precise Height Measurement with ESM1 (fig.3)

For leveling work of very high accuracy the ESL2 is used with the parallel plate micrometer ESM1. The micrometer is slipped onto the telescope objective and locked in position by turning the locking knob.

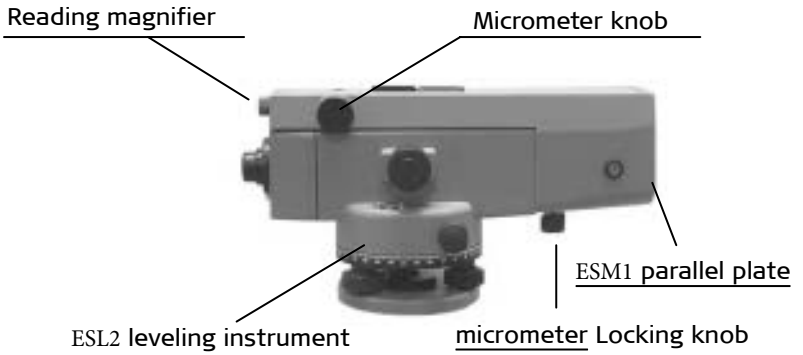


Fig.3

☞

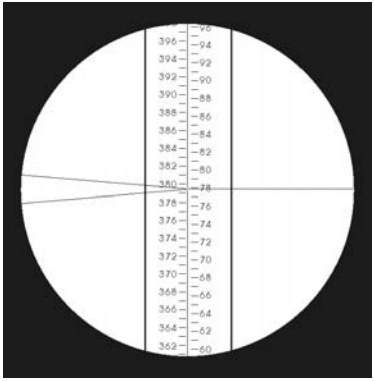
In sloping terrain, the lower part of the staff should not be used, as refraction close to the ground can cause errors.

In sunny weather an umbrella should be used to shelter the instrument to ensure that the level is protected from the glare of the sun.

Procedure:

1. Sequence of measurements is the same as with normal height leveling measurement.
2. When reading the staff, turn the micrometer knob until a graduation line is centered between the wedge-shaped hairs of the reticule.
3. Centimeters are read from the staff and millimeters from the micrometer scale.
4. Invar staffs have two sets of graduations. These are read alternatively between foresight and back sight. This provides two independent results and

serves as a check.



Example above:

Staff reading 77cm

Micrometer reading 0.556cm

Height 77.556cm

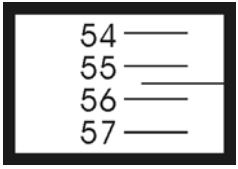


Fig.4

7. Testing and Adjusting

7.1 Tripod

There should be no play between the various components of the tripod. The hexagonal key should be used to tight up the tripod screws when necessary. The hinges between the tripod head and the legs can be adjusted; they should be sufficiently stiff so that when the tripod is lifted by its head, the legs just remain spread-out.

7.2 Circular Level(fig.5)

The tripod, with instrument attached, is set up on firm ground. Using the three footscrews, the circular bubble is centered exactly in the middle of the setting circle. The instrument is now rotated through 180°. If the bubble is displaced, it no longer lies within the setting circle it should be adjusted. When doing this the bubble's cover must not be touched with the finger. Half of bubble displacement is taken out with the footscrews and the other half with two adjustment screws.

Fig.5 Adjusting the circular bubble.

As an adjustment screw is tightened the bubble runs towards it and, as it is loosened, the bubble runs away from it. The first adjustment screw to be turned, therefore, is the one that is the nearest to being in line with the middle of the bubble and the centre of the setting circle. It is turned only until the bubble reaches the centre of the circle or until it can be set in the centre by means of the other screw. It is necessary to complete the adjustment that the screws must not be tuned more than. The circular bubble is in correct adjustment when it stays in the centre of the circle in whatever direction the telescope is pointing. Keep the circular level in adjustment, thereby ensuring that the compensator will always be well within its working range.

7.3 Horizontality of the Line of Sight

7.3.1 Testing (Fig.6)

In flat terrain a test bay, between 45m and 60m long, is selected and divided into three equal sections of length d, A staff is set up on an iron ground plate or peg at each of the intermediate points B and C (if only one staff is used it must be moved as required from point B to point C).

The instrument is set up, in turn, over the terminal points A and D. With the instrument at A-after centering the circular bubble and checking the compensator with the press button – readings a1′ and a2 are taken to the staffs held at B and C, with the instrument at D, readings a3′ (to C) and a4′ (to B) are then taken. If the line of sight is absolutely horizontal, these readings will be the correct readings a1, a2, a3, a4, respectively, and the following relationship will be valid. As can be seen from the figure: a4 – a1 = a3 – a2

If this is not so, however, the line of sight is inclined to the horizontal plane by the small angle, δ. If an imaginary line parallel to a1′ a2′, is projected through a3′, it will cut the staff at B in the correct position a4, thus giving the required value for a true horizontal line of sight from D. This is seen quite plainly in the figure.

a4′ – a1′ = a3′ – a2′

than a4′ = a1′ – a2′ + a3′

If the actual reading a4′ differs from the computed correct value a4 by more than 2mm in 30m, the whole procedure must be repeated. If the difference is confirmed, the line of sight must adjusted as described

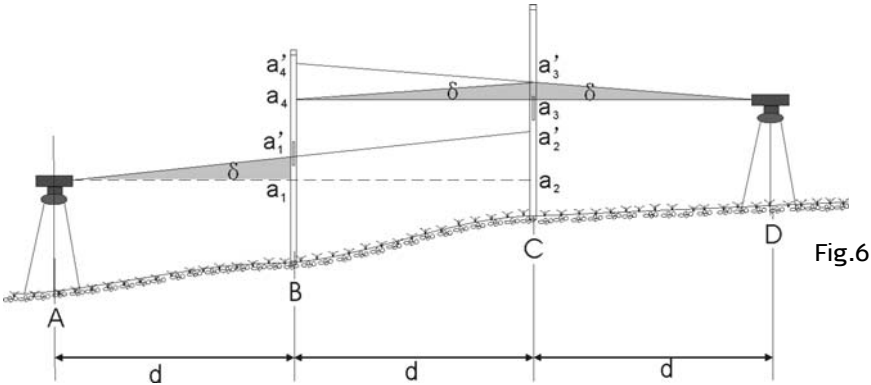


Fig.6

Fig.6 Testing the horizontality of the line of sight

In 7.3.2 the tolerance of 2mm in 30m is a practical value for routine leveling with the instrument. If necessary, however, a customer can make a more precise adjustment.

7.3.2 Adjusting (Fig.6 and Fig.7)

Fig.7

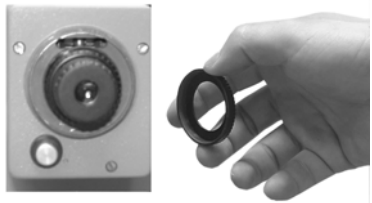


Fig.7 Adjusting the line of sight

The instrument is still at D. The line of sight is adjusted by shifting the reticule plate slightly. This is done with the capstan-headed adjusting screw which can be seen after screwing off the black, protective cover. Using the adjusting pin

from the instrument container, carefully turn the adjusting screw until the horizontal hair gives the computed correct reading a4 on staff B. The last turn of the adjustment screw should be clockwise, i.e. to the left. Screws on the protective cover and finally repeat the test (7.3.1) to verify the adjustment.

8. Care and Transport

8.1 Transport

Transport in the field

When transporting the equipment in the field, always make sure that you

- Either carry the product in its original transport container,
- Or carry the tripod with its legs splayed across your shoulder, keeping the attached product upright.

Transport in a road vehicle

Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its transport container and secure it.

Shipping

When transporting the product by rail, air or sea, always use the complete original packaging, transport container and cardboard box, or its equivalent, to protect against shock and vibration.

Field adjustment

After transport inspect the field adjustment parameters given in this user manual before using the product.

8.2 Storage

Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "7. Technical Data" for information about temperature limits.

Field adjustment

After long periods of storage inspect the field adjustment parameters given

in this user manual before using the product.

8.3 Cleaning and Drying

Product and Accessories

• Blow dust off lenses.

• Never touch the glass with your fingers.

• Use only a clean, soft, lint-free cloth for cleaning.

If necessary, moisten the cloth with water or pure alcohol.

Do not use other liquids; these may attack the polymer components.

Damp products

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than +50°C / +122°F and clean them.

Do not repack until everything is completely dry.

NOTE:

These designs, figures and specifications are subject to change without notice. We shall not be held liable for damages resulting from errors in this instruction manual.

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