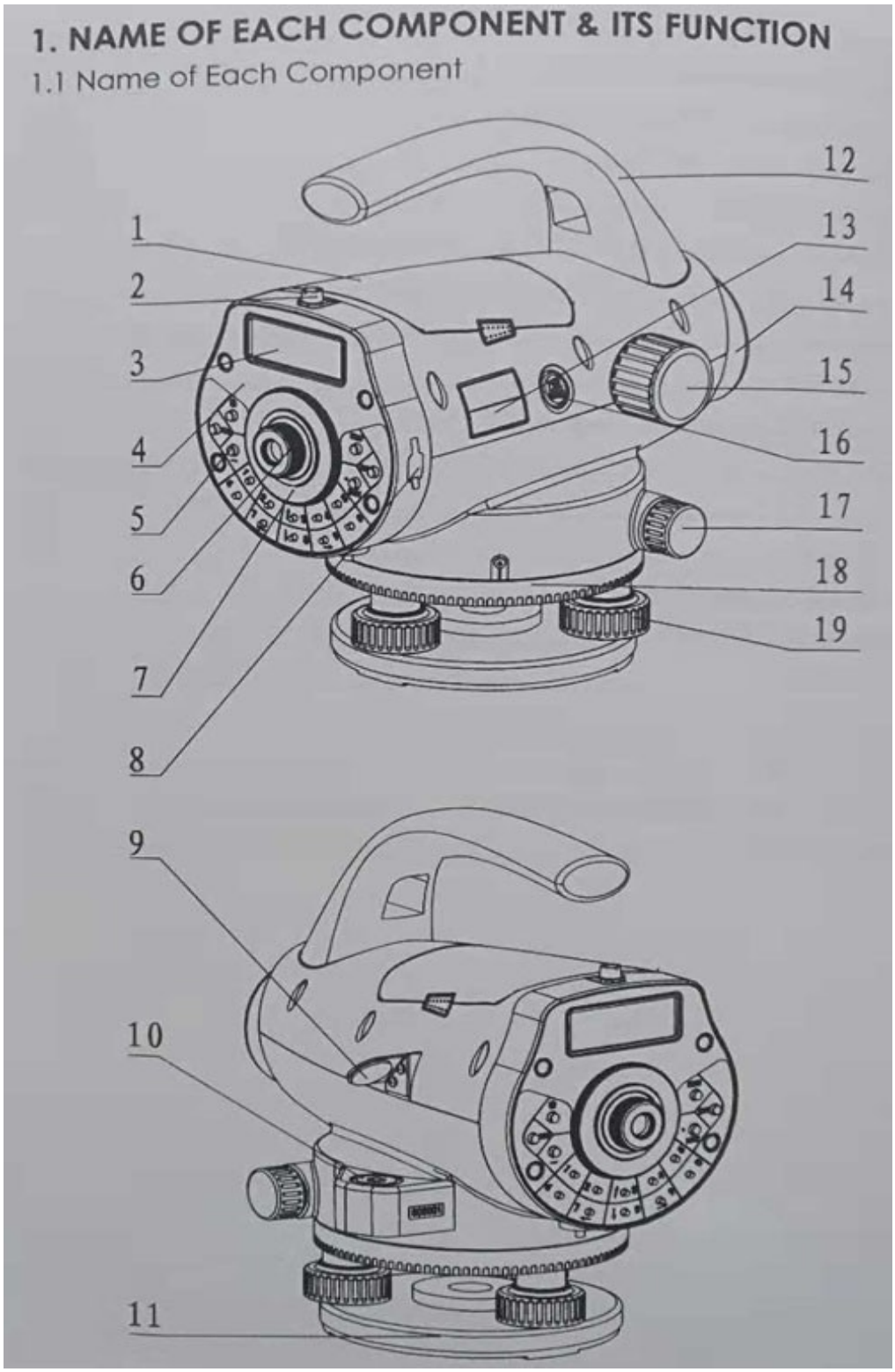
Training Manual for Digital Level Survey

1. Instrument Description

1.1 Structure of Digital Level



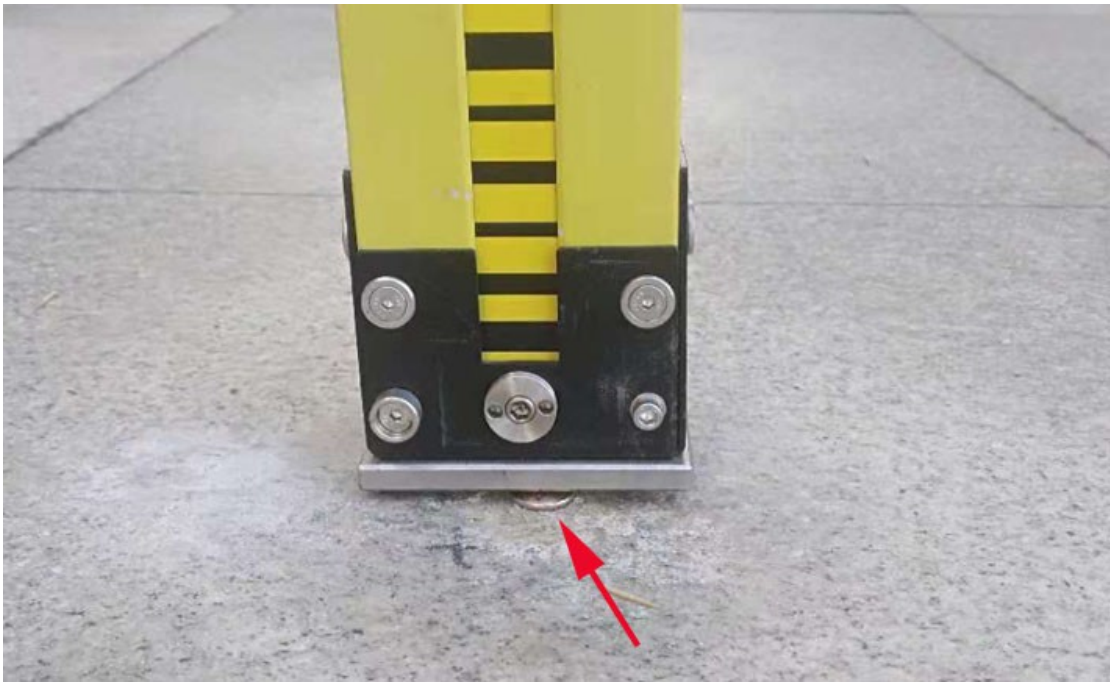
1 battery
2 rough collimator
3 LCD display
4 keyboard panel
5 keys
6 eyepieces: use for adjusting the definition of the crosshair.
7 protecting cover of eyepieces: by releasing this cover, you can implement the mechanical adjustment of the reticle in order to correct the optical collimation line error.
8 data transfer port: connecting with PDA or computer.
9 reflector of circular vial
10 circular vial
11 tribrach
12 lifting handle
13 model label
14 objective lens
15 focusing hand wheel: use for focusing of digital staff.
16 power/measure key: use for instrument power ON/OFF, and measure.
17 horizontal tangent hand wheel
18 horizontal dial: use for setting the horizontal direction value of the collimating direction to 0 or other required values.
19 leveling screws of the tribrach

1.2 Illustration of Leveling Staff

,The circular vial of digital staff shall be in the center during the survey.

1.3 Illustration of Scale Pads

The scale pads shall not be placed on the control point, but on the intermediate transition point.



Leveling staff shall be on the control point.

Scale pads shall be on the intermediate transition point.

2. Setting-up of Digital Level

2.1 Setting-up of Tripod

(1) The tucked tripod shall be at chin level.

（2）Three feet of tripod are roughly equilateral triangle with length of side about 90cm. Not too short or too long. The proper length shall ensure your eyes slightly higher than the instrument eyepiece during observation.

（3）Tripod base keeps level.

True　　False

2.2 Installment of Digital Level

（1）The digital level is placed on the tripod base with one hand controlling the instrument and the other hand tightening the leveling screws of the tribrach in case the instrument falls.

（2）After the instrument is fixed or before it is reset, rotate leveling screws of digital level to make sure three screws are all in the middle.

True False

2.3 Level the digital level (make circular vial center)

（1）The direction of the instrument is parallel to two spiral wires.

（2）Two fingers of your right hand push or pull the screw at the same time to make circular vial in the center between front and rear.

（3）Use your left hand to rotate the third screw to make circular vial in the center between left and right.

（4）Repeat step b and c till the circular vial is in the center.

3. Level Observation an Calculation

3.1 Competition Venues

It’s known that Elevation of Point A is 21.836m. Measure the elevation difference between the two surveying sections, and then calculate the elevation of Point B.

3.2 Requirement on Position of Instrument and Leveling Staff

（1）The distance from the level to front view and rear view is basically equal. (Front view- rear view discrepancy ≦1.5m)

Method 1: Count your steps first, then the instrument measures the distance and does the adjustment.

Method 2: Pull a measuring rope (Measurement of the rope)

（2）Front view and rear view elevation≥0.55m and ≤1.85m

（3）The instrument is not required to be in a straight line with the level staff.

3.3 Level Observations

（1）Hit the target and adjust the eyepiece screw to make the reticule clear. Aim at staff and adjust the focusing hand wheel to make the reticule align clearly with the center of the staff.

（2）Follow the steps as below to measure. The digital level shall show the distance from the instrument to the level staff and the reading of the level staff.

(3) False Observation Posture

Tripod is placed in between your legs.

Place your hands on the tripod.

The instrument is too low.

The instrument is too high.

3.4 Requirement on Level Observation and Calculation

(1) The number of surveying stations in each surveying section is even. The order of observing leveling rod for odd stations is: back-front-front-back; for even-numbered stations the order is: front-back-back-front.

(2) Sight length of the station, the difference of the visual distance between the front and the rear and its accumulative total, the elevation of the line of sight and the number of repeated surveys of the digital level are specified in Table 1.

Sight length/m	Front view- rear view discrepancy/m	Cumulative Front view- rear view discrepancy /m	sight elevation/m	Error of elevation discrepancy between 2 readings /mm	Error of closure of leveling route /mm
⩾3 and ⩽50	⩽1.5	⩽6.0	⩾0.55 and ⩽1.85	⩽0.6	⩽4mm

Table 1 Requirements for 2″ Degree Leveling (Leveling Rod 2 m)

(3) Recording requirements:

The competition records and calculations shall be in accordance with the Degree 2 Leveling Records and Calculation Results provided by the executive committee. All records and calculations are completed in pencil. Examples of record formats are shown in table 2.

surveying station No.	rear sight	front sight	direction and rod No.	rod reading		difference between two readings	remark
	sight distance discrepancy	Cumulative Front view- rear view		first reading	second reading		
1	31.5	31.6	rear	15397	15396	+1	
			front	13927	13926	+1	
	-0.1	-0.1	rear	+1470	+1470	0	
			h	+0.1470			
2	36.9	37.2	rear	1374	13741 ~~13735~~	-1	mistake
			front	11	11440	+1	
	-0.3	-0.4	rear	+2	+2301	-2	
			h	+0.2300			
3	41.5	41.4	rear	11	14391	+1	
			front	10	13926	+1	
	+0.1	-0.3	rear	+	+ 465	0	
			h	+0.0465			
4	23.5	24.4	rearB1	13	13532	-1	ultral imit
			front	13	13451	+11	
	-0.9	-1.2	rear	+	+ 81	-12	
			h				
4	23.4	24.5	rear B1	13	13832	-1	resurvey
			front	13	13761	+1	
	-1.1	-1.4	rear	+6	+ 71	-2	
			h	+0.0070			

Table 2 An Example of Degree 2 Leveling Surveying Manual

The figures and texts recorded during the observation shall be clear, neat and in the order of surveying records. Do not leave empty column; Do not copy the results; Do not alter on the word; Do not use an eraser.

The wrong numbers and characters recorded during the observation shall be marked with a single horizontal line in the middle, with the correct numbers and characters written on the top of them. The reasons such as "Measuring Error" or "Recording Error" shall be indicated in the preparation column. The reason of calculation error need not be indicated.

If the observation error is beyond the limit, contestants can resurvey immediately on condition that the elevation of the instrument must be changed for the resurveying. If the error is found after the station has been relocated, contestants should return to the starting point for resurveying. The results of "exceeding the limits" shall be marked with a single horizontal line in the middle in the preparation column, with "exceeding the limits" and "resurveying" respectively indicated in the preparation column.

Team information should only be provided in the position specified on the cover of the contest results, and no information unrelated to the contest survey data can be filled in any position within the results.

(4) The calculation of elevation follows the trade-off principle of surveying. The measurement of lengths is 0.1m; that of elevation differences and adjustments is 0.0001m; that of elevations is 0.001m. The format of calculation is Table 3. In the form, error of closure and its allowable values must be listed.

Spots	Length of Route (m)	Elevation Difference Surveyed (m)	Readings Adjusted (m)	Elevation Difference Adjusted (m)	Elevation (m)
A	82.1	0.1246	+0.0003	0.1249	21.836

B					21.961
	82.4	- 0.1252	+0.0003	-0.1249	
A					21.836
Σ	162.5	- 0.0006	+0.0006		

W=-0.6mm　　$W_{允}$=±4mm

Table 3 Tolerance Allocation of Elevation

*Reminder: In the Chart of Calculation of Elevations, figures and words must be clear and tidy; the use of rubber is allowed, but clarity and tidiness, without visible alterations, must be maintained.

（5）End Results Submitted: After finishing the out-house observation, each team shall fulfill on the spot the calculation of tolerance allocation of elevation and complete the form of achievements of elevations. The material to be submitted is: archives of achievements in secondary level surveying competition.

3.5 Additional Notes

(1) The recording and calculation of one spot must be completed before competitors move to the next spot.

(2) When the scale pads are moved or flipped for whatever reasons, contestants should go back to the starting point to survey again.

(3) Starting from when the apparatus is taken, the qualification to compete is lost in the case of the apparatus or scales being dropped to the ground.

(4)Each person completes the observation record and surveying station calculation of one test section respectively.

(5) When the competition ends and competing teams submit their results, the scaffold shall be put in place to end the timing.