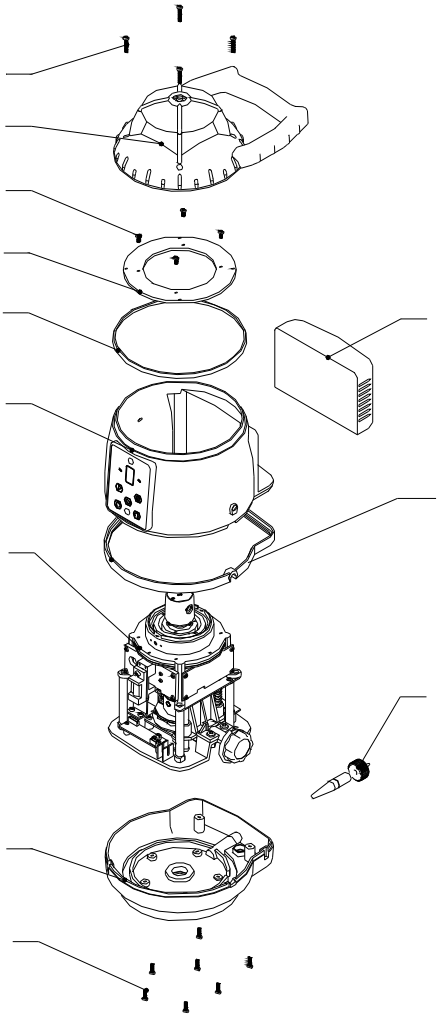
40-6520/40-6530 Self Leveling Rotary Laser

SERVICE MANUAL

Contents

1. Overall Instrument Assembly

Item	JLT Part #	Description	Qty
1.	AP1020	Cross Plate Screw M3×16	4
2.	AP1021	Upper Cover	1
3.	AP1022	Cross Plate Screw M3×6	4
4.	AP1023	Top Mounting Plate	1
5.	AP1024	Top ring	1
6.	AP1025	Housing	1
7.	AP1437	Core Module	1
8.	AP1034	Bottom Ring	1
9.	AP1035	Bottom Base Module	1
10.	AP1026	Cross Plate Self-tapping Screw ST2.9×13	5
11.	AP1036	Vertical Adjusting Screw	1
12.	40-6824	Battery Pack	1



General Assembly Instructions

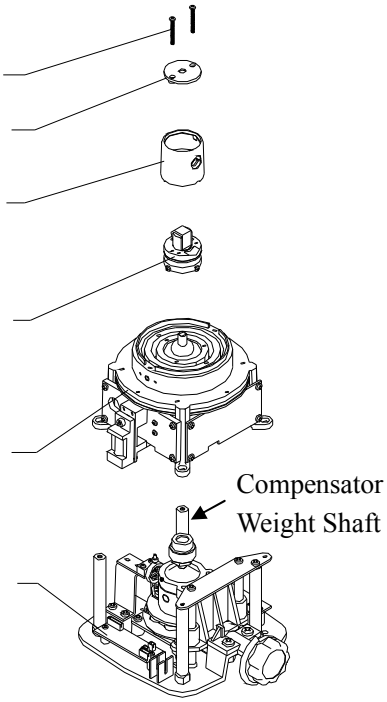
1. Mount the core module (7) to the base (9) using three ST2.9×13 cross plate self-tapping screws and two M3×6 cross plate screws.
2. Attach the bottom ring (8) to the part completed in the step one. The ring should seat over the rim of the base (9)
3. Attach the housing (6) to the part completed in the step two by first making the necessary cable connections (keypad and battery pack), then securing using two ST2.9×13 cross plate self-tapping screws mounting though the bottom of the base (9).
4. Attach the mounting plate (4) to the part completed in the step three using four M3×6 cross plate screws
5. Attach the small ring (5) to the part completed in the step four.
6. Finish the assembly by installing the upper cover (2), securing using four M3×16 cross plate screws

The instrument can be disassembled using the reverse order described above.

2. Component Assembly

2.1 Core Module Assembly (AP1437)

Item	JLT Part #	Description	Qty
7-1	AP1026	M2×16 Cross Plate Screw	2
7-2	AP1027	Cover Plate	1
7-3	AP1028	Rotating head	1
7-4	AP1029	Prism Base Module	1
7-5	AP1031	Gimbal Mount Assembly	1
7-6	AP1033	Core Module Base Assembly	1



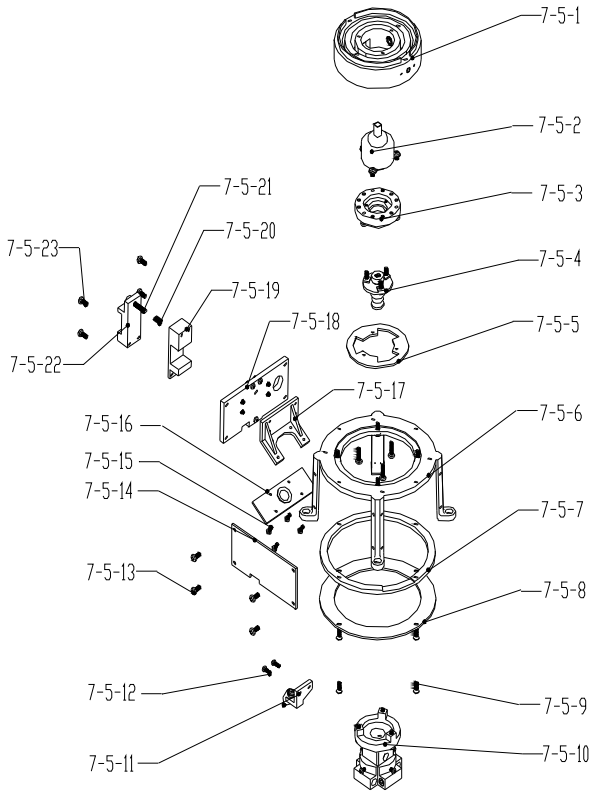
General Assembly Instructions

1. Attach the Gimbal Mount Assembly (7-5) to the core module base assembly (7-6) using four M3×8 cross screws and one M3 hexagon screw. Make sure to insert shaft of compensator weight into mating component of gimbal assembly.
2. Using a 13mm wrench, tighten locking nut of compensator shaft to corresponding part mating component (indicator head, 7.5.4) on the gimbal assembly
3. Attach the prism base module (7-4) to the part completed in the step one using two M2×5 pressing screws
4. Attach the rotating head (7-3) to the part completed in the step two, and finish the assembly with the cover plate (7-2) using two M2×16 cross screws.
5. Connect respecting cables/wire connections to appropriate receptacles. Reference circuit board connection diagram in section 3 of this manual.

The assembly can be disassembled using the reverse order described above.

2.2 Gimbal Mount Assembly (AP1031)

Item	JLT Part #	Description	Qty
7-5-1	AP1438	Gimbal	1
7-5-2	AP1439	Motor	1
7-5-3	AP1440	Connector Base/Laser Assembly	1
7-5-4	AP1441	Indicator Head	1
7-5-5	AP1442	1# Circuit Board	1
7-5-6	AP1443	Mount	1
7-5-7	AP1444	Gasket	1
7-5-8	AP1445	2# Circuit Board	1
7-5-9	AP1446	M2.5×6 Cross Sunk Screw	4
7-5-10	AP1447	Base Part	1
7-5-11	AP1448	Alarm Mount Part	1
7-5-12	AP1449	Cross Plate Screw M2.5×6	2
7-5-13	AP1449	M2.5×6 Cross Plate Screw	4
7-5-14	AP1450	5# Circuit Board	1
7-5-15	AP1451	ST2.2×6 Cross Plate Self-tapping Screw	4
7-5-16	AP1452	4# Circuit Board	1
7-5-17	AP1453	Mount II	1
7-5-18	AP1454	Connector Panel II	1
7-5-19	AP1455	Vial Base Mount	1
7-5-20	AP1456	Press Spring	1
7-5-21	AP1457	M3×12 Inner Hexagon Column-headed Screw	1
7-5-22	AP1458	Vial Base	1
7-5-23	AP1449	M2.5×6 Cross Plate Screw	4



General Assembly Instructions

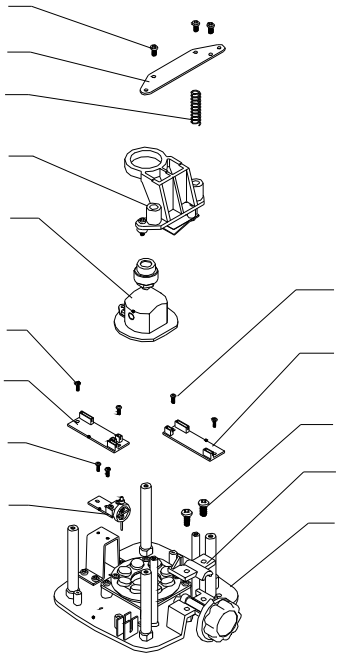
1. Attach the motor (7-5-2) to the connector base (7-5-3) using three M2.5×4 cross screws.
2. Attach the indicator head component (7-5-4) to the assembly completed in the step one using three M2×8 cross screws.
3. Attach 1# circuit board (7-5-5) to the assembly completed in the step two using three M2.5×4 cross screws.
4. Insert the gasket (7-5-7) between 2# circuit board (7-5-8) and the mount (7-5-6), and then attach it using four M2.5×6 cross screws.
5. Attach the gimbal (7-5-1) to the assembly completed in the step four using four M2.5×8 cross screws.
6. Attach the part completed in the step three to the assembly completed in the step five using three M2.5×10 cross screws
7. Solder hairsprings between 1# circuit board (7-5-5) and 2# circuit board (7-5-8). Hair springs are 0.06mm diameter brass wires coiled into 23 circles of 3mm diameter in spring shape, whose two ends are soldered on the 1# and 2# circuit board respectively.
8. Attach the base (7-5-10) to the assembly completed in the step seven using four M2.5×12 cross screws and solder two laser wires and one alarm pin wire to their respective places on #1 circuit board.

9. Attach the alarm mount (7-5-11) to the assembly completed in the step eight using two M2×6 cross screws.
10. Connect the 4# circuit board with the mount II (7-5-17) using four ST2.2×6 cross self-tapping screws.
11. Attach the part completed in the step ten to the connector II (7-5-18) using four ST2.2×6 cross self-tapping screws.
12. Fix the vial base (7-5-22) on its mount (7-5-19) using two M2×6 cross screws and one M3×16 inner hexagon screw.
13. Fix the part completed in the step twelve to the one completed in the step eleven using three M2×6 cross screws.
14. Fix the part completed in the step thirteen to the one completed in the step nine using four M2.5×8 cross screws
15. Fix 5# circuit board (main control board) to the part completed in the fourteen, and thus finish the assembly of mount component using four M2×6 cross screws.

The assembly can be disassembled using the reverse order described above.

2.3 Base Assembly (AP1033)

Item	JLT Part #	Description	Qty
7-6-1	AP1022	M3×6 Cross Screw	3
7-6-2	AP1459	Connector Panel	1
7-6-3	AP1460	Press Spring	1
7-6-4	AP1461	Mount	1
7-6-5	AP1462	Compensator Weight	1
7-6-6	AP1451	Cross Plate Self-tap Screw ST2.2x6	2
7-6-7	AP1463	9# Circuit Board	1
7-6-8	AP1464	M2×6 Cross Screw	2
7-6-9	AP1465	Compensation Component	1
7-6-10	AP1466	Bottom Board	1
7-6-11	AP1467	Press Board	1
7-6-12	AP1468	M4x12 Cross Screw	2
7-6-13	AP1469	8# Circuit Board	1
7-6-14	AP1451	ST2.2x6 Cross Plate Self-tap Screw	2

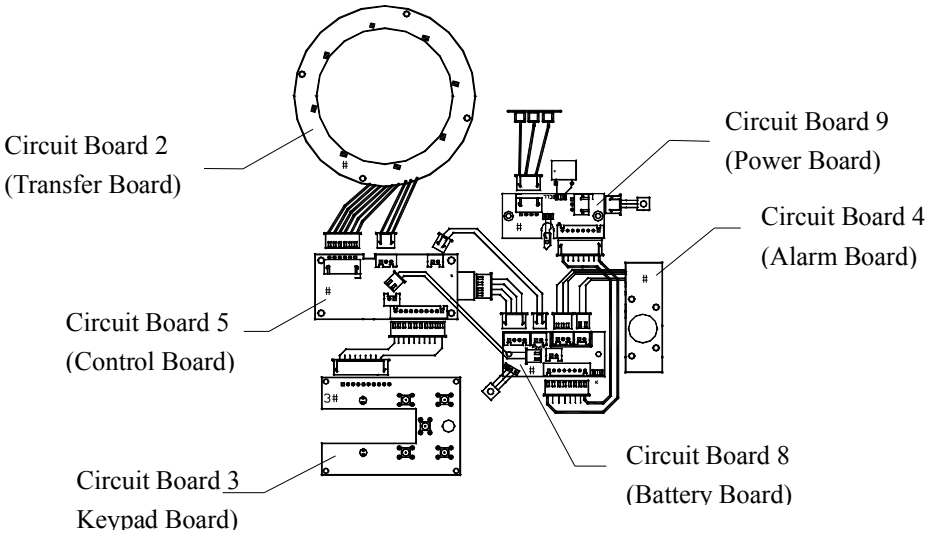


General Assembly Instructions

1. Attach the press board (7-6-11) on the base part to press the handle using Two M4×12 cross screws and two M4 hexagon screws.
2. Put the compensator weight (7-6-5) on the bottom board component (7-6-10).
3. Fix the mount component (7-6-4) on the connection pillar of the bottom board component, and then put the press spring (7-6-3) on.
4. Fix the connector panel (7-6-2) to the part completed in the step three using three M3×6 cross screws
5. Fix the compensation part to the part completed in the step four using two M2×6 cross screws
6. Fix the 8# circuit board (7-6-13) to the part completed in the step five using two ST2.2×6 cross self-tapping screws
7. Finally fix the 9# circuit board (7-6-7) using two ST2.2×6 cross self-tapping screws

The assembly can be disassembled using the reverse order described above.

3. Circuit Board Connection



4. Calibration

Calibration is a process that is used to correct for accuracy and/or functional errors above and beyond those stated in published specifications. While Manual-leveling, Self-leveling, and Automatic-leveling (motor driven) devices have different mechanisms that require calibration, there are similarities with optics that is consistent regardless of the leveling mechanism. This section of the service manual discusses calibrations specific to the 40-6520. Each item discussed is shown below.

4.1 Horizontal Mode Operation

4.1.1 Quantifying Accuracy Error

4.1.2 Characterize the type of error

4.1.2.1 Oblique Error

4.1.2.2 Taper Error

4.1.2.3 Wave Error

4.2 Vertical Mode Operation

4.2.1 Vial Calibration

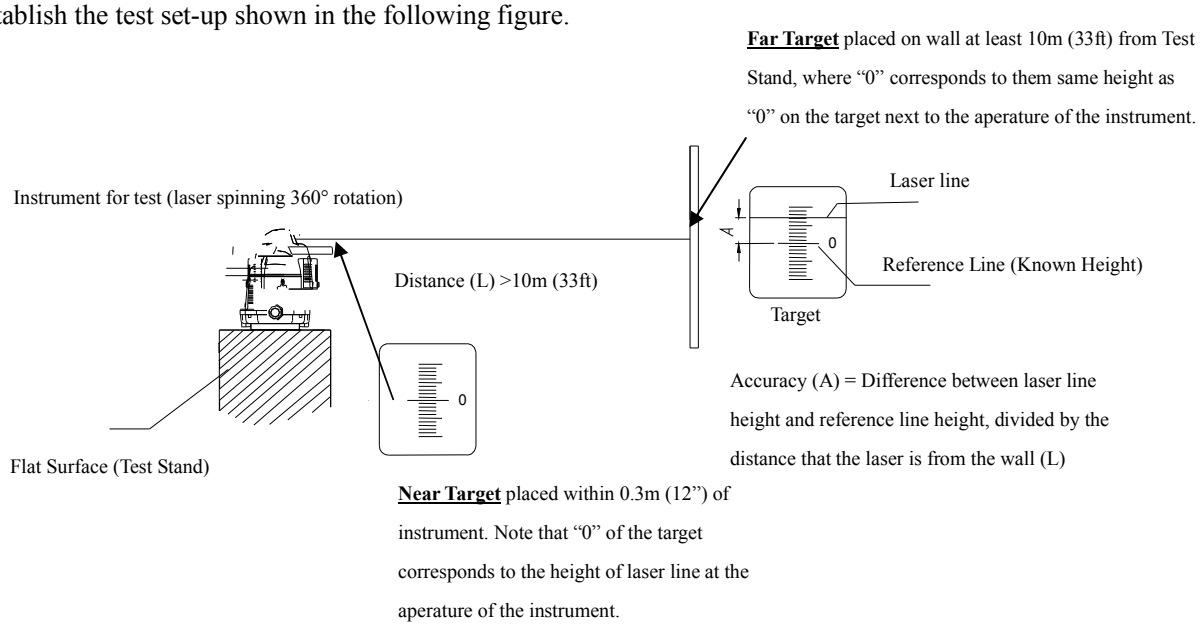
4.3 Leveling Range Alarm Calibration

4.1. Horizontal Mode Operation

In this mode of operation, the instrument is self-leveling, where by a major factor of accuracy is how well the leveling compensator is balanced. Different types of errors require different methods of calibration. These errors are easily characterized by placing the instrument on a flat surface following the guidelines below, and running the instrument with the rotating head continuously rotating 360°.

4.1.1. Quantifying Accuracy Error

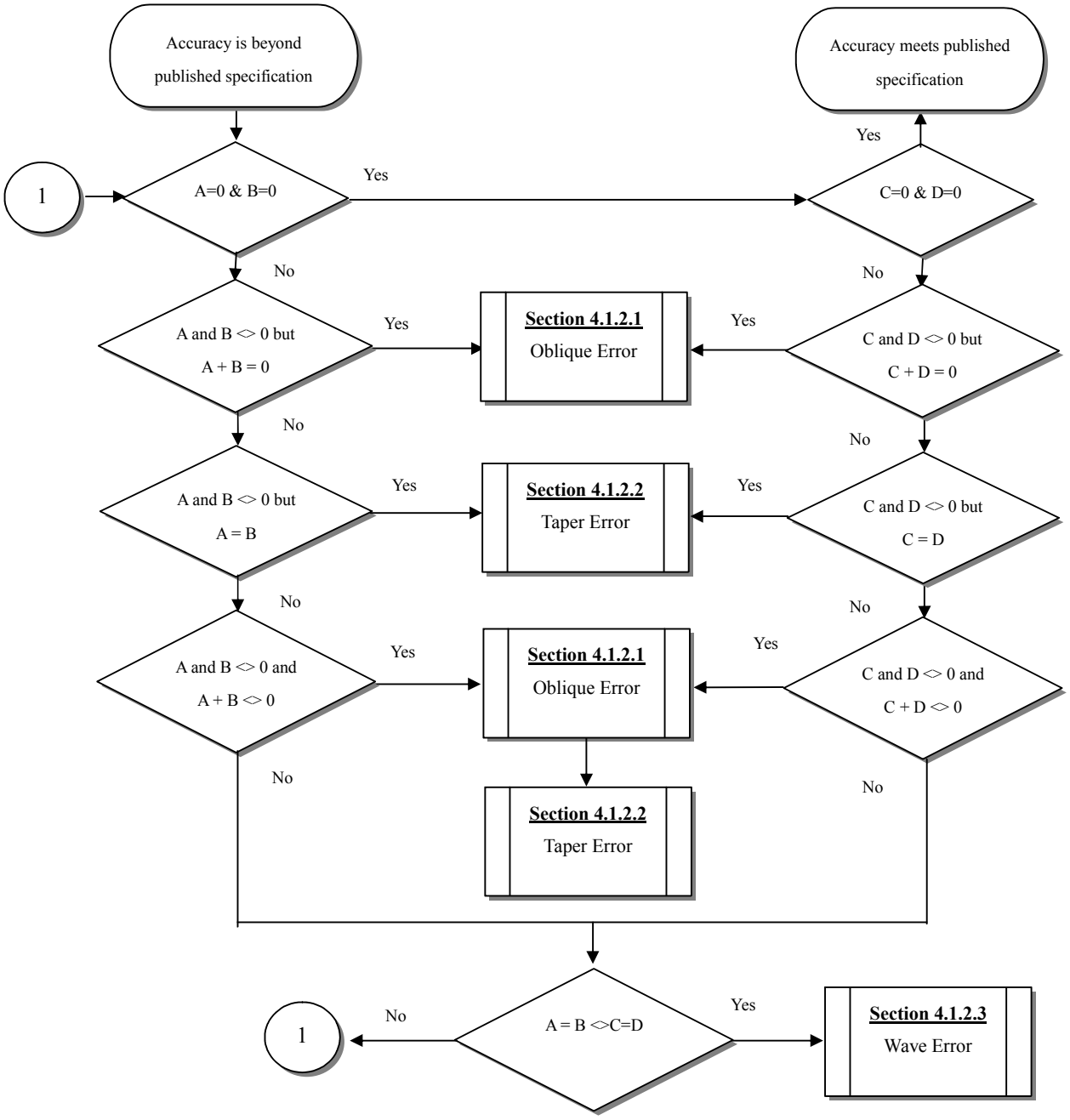
Establish the test set-up shown in the following figure.



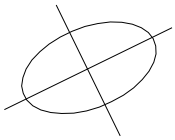
1. Place the instrument for test on the test stand (preconfigured from the illustration above) with handle facing the far target .
2. Power the laser and function in full rotation mode (head rotates 360°)
3. Note the errors in all four quadrants of the instrument as read on the far target (i.e. x axis A = 0° and B = 180°, y axis C = 90° and 270°)
    - You should end up with 4 numbers
        i. A (0°) = _____
        ii. B (180°) = _____
        iii. C (90°) = _____
        iv. D (270°) = _____
4. Since all of the errors are referenced against "0" on the far target, essential the largest number from the data collected (A – D) / the distance should be equal to or less than the published specification for the product. If not, characterize the error and determine method of calibration as defined by section 4.1.2 of this document.

4.1.2. Characterize the type of error

Use the following rules to determine what to of accuracy error the instrument for test has, and reference the stated section to adjust for it. Note that the unit my have a combination of different types of errors to adjust for, in which case, multiple calibration must be performed.



4.1.2.1. Oblique error



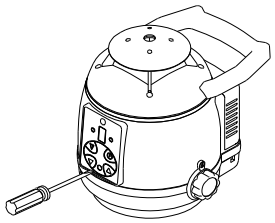
This type of error occurs when leveling compensator does not hang straight (as illustrated to the right), i.e. is not properly balanced. When the laser spins, it actually rotates on a plain that is not level, i.e. perfectly horizontal whose rotating axis is not plumb. So value A on the left target does not has the same sign as that on the right target, like, $A_{0°}$=+2, $A_{180°}$= -2. A number of factors can cause this situation to exist.

- Normal use – Depending upon how careful the user is with the instrument, finely tuned adjustments can be altered by very large changes in temperature, vibrations (due to handling and transportation)
- Shock – The instrument was dropped and components of the leveling system (gimbal, compensator weight and shaft., screw adjustments) have either been damaged or came out of alignment. If defective components are present, they will need to be repaired or replaced prior to the calibration procedures defined below being initiated.

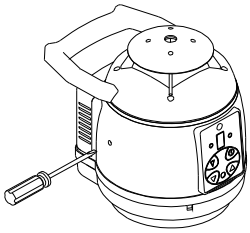
Depending upon the magnitude of the error (±5mm or 0.2”), only fine adjustments need to be made. Larger errors (>5mm or 0.2”) require coarse adjustment to get close, the fine adjustment to bring the unit within specification. Both adjustments are defined below

Fine Adjust:

As shown in the figure to the right, the plastic screws in the front and side of the housing can be removed, exposing fine adjust calibration screws.
Calibration screws are adjusted with a flat head screw driver. Clockwise rotation shifts the weight on the compensator to the opposite side of the adjustment screw causing the laser line to drop. Conversely, counterclockwise rotation shifts the weight on the compensator to the near side of the adjustment screw causing the laser line to rise.



x-axis

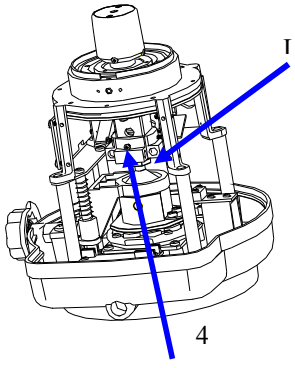


y-axis

Coarse Adjust

Remove the top cover and housing using the method defined in section 1 “Overall Instrument Assembly”

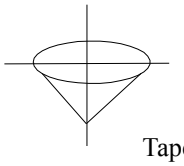
a. Referring to section 2.3 of this document, use a 13mm open end wrench to slightly loosen the lock nut of compensator weight.
b. Adjust the M2×10 screws for respective axis to be calibrated. Depending upon which way the compensator needs to be adjusted for balancing, one screw will have to be loosened, the other (180° from the one loosened) will have to be tightened by the same amount.



- Note: A method used for determining how much adjustment to make is determined by how far out of calibration the instrument is. One rule of thumb is to split the error i.e. if A = -2 and B = -6, splitting the error would result in a target value of -4. This amount of adjustment might amount to an 1/8th of a turn on each screw. How much screw adjustment is something a service tech has to acquire a feel for.

c. Tighten the compensator lock nut after adjustment and recheck accuracy.
d. Repeat the procedure defined above for both the x and y axis as necessary.
e. Once desired accuracy has been achieved, reassemble housing .

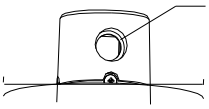
4.1.2.2 Taper Error



Taper error

Taper error results when the prism base module (discussed in section 2.1, item 7.4) does not reflect the laser light exactly 90° (i.e. non-perpendicularity between the rotating line and the rotating axis). The end result is a laser rotating surface that is not a plane, but a tapered one as shown in the figure to the right. The value A in the left target shares the same symbol as the one in the right target during the check, that is, $A_{0°}$=+2 and $A_{180°}$= +2. The error is removed by adjusting the optical wedge of the laser output window to make the rotating laser beam and rotating axis plumb beam. The details are listed as follows:

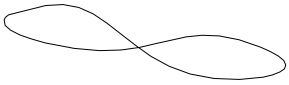
a. Remove the top cover as discussed in section 1 of this document
b. Screw the wedge out of its base with special spanner as shown in the figure to the right.
c. Adjust the laser to the zero position of the target.



Optical wedge

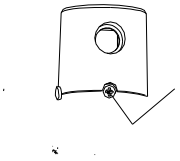
Note: Only one direction (X or Y) is necessary for the adjustment.

4.1.2.3 Wave Error



Wave error

This error occurs when the rotating laser surface is not a plane, but a turn up one as shown in the figure to the right. The rotating beam projected on the wall is crooked, similar to waviness, which is caused by the unbalance of rotating head. The value A checked in the X-direction deviates upwards while the one in the Y-direction downwards, or the value A in the Y-direction upwards while the one in the X-direction downwards. Meanwhile, you can see the laser point above the head is mobile and its orbit is inclined to be a circle.



Adjustment screw

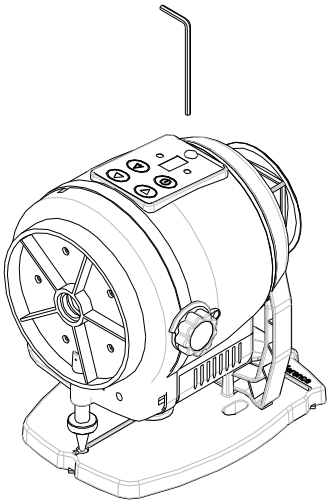
The error can be removed by adjusting the balance block of the Rotating head as follows:

a. Remove the top upper cover
b. Regulate the adjusting screws on the four balance block as shown in the figure to the right, until the laser point above the head becomes stable, namely, the laser point projected on the ceiling being a stable one.

4.2 Vertical Mode Operation

In this mode of operation, rotating laser surface is a plumb plane, and meanwhile the laser line projected from the top is in horizontal situation. While in this mode, the instrument is manually level, meaning that accuracy is a function of how accurately the vial is calibrated.

4.2.1 Vial Calibration

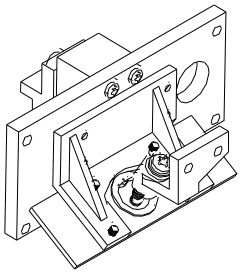


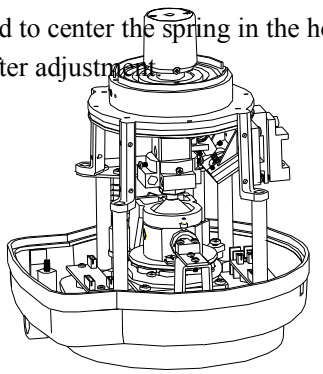
To check whether the laser line from the top is horizontal can result in the knowledge of whether the rotating plane is plumb. The details are listed as follows:

a. Tightly lock the lock screw, horizontally position the instrument and adjust the knob to make laser level.
b. Demarcate the line laser with leveling laser, confirm the line laser horizontal, and then observe whether the bubble centers or not. If not, screw the screw out of bubble adjusting hold and adjust the bubble with inner hexagon spanner for centering as shown in the figure 16.
c. After adjustment, put the screw back to the bubble-adjusting hole.

4.3 Alarm Range Adjustment

a. Fix the circuit board and vial bottom board on the instrument.
b. Put the instrument on the horizontal base.
c. Loosen the two screws, adjust the position of the alarm circuit board to center the spring in the hole, and then screw down the two screws. Fix the housing and the upper cover after adjustment.





5. Troubleshooting Guide

No.	Symptom	Cause	Corrective Action
1	Failure to start (instrument does not turn on)	Battery case does not work.	Replace the battery case.
		3# operating panel and 5# control panel does not work.	Replace the 3# operating panel and 5# control panel.
		Ten-core wire does not work.	Replace the ten-core wire.
		Fork spring switch does not work.	Replace the fork spring switch.
2	remote control does not work with the instrument	5# control panel does not work.	Replace the 5# control panel.
		Remote control does not work	Try with known good remote control
3	No laser	Hairspring is cut.	Replace the hairspring.
		Laser source does not work.	Replace the laser source.
4	No rotation of rotating head after the start	Hairspring is cut.	Replace the hairspring.
		4# alarm board does not work.	Replace the 4# alarm board.
		5# control panel does not work.	Replace the 5# control panel.
5	No light from charging indicator lamp	Rechargeable battery case does not work.	Replace the rechargeable battery case.
		7# rechargeable board does not work.	Replace the 7# rechargeable board.
6	No light from indicator lamp after normal start	3# operating panel does not work.	Replace the 3# operating panel.
7	No extinguishing of the operating panel indicator lamp after shutting off the power	5# control panel does not work.	Replace the 5# control panel.
8	Abnormal range scan	Hairspring is cut.	Replace the hairspring.
		5# control panel does not work.	Replace the 5# control panel.
9	No alarm	Hairspring is cut.	Replace the hairspring.
		4# alarm board does not work.	Replace the 4# alarm board.
10	No start for the horizontal working	9# board does not work.	Replace the 9# board.