TPS1200 Quick Guide
4.0 Check & Adjust

What is Check & Adjust?

The instrument has routines that allow you to check and adjust instrument errors electronically by following certain procedures. Leica instruments are manufactured, assembled and adjusted to the best possible quality, but quick temperature changes, shock or stress can cause deviations and influence the instrument's accuracy. It is recommended to check and adjust the instrument to correct for these errors. There are other instrument errors and mechanical parts that can be adjusted mechanically that we will also cover in this chapter.

Electronic Adjustment

The following instrument errors can be checked and adjusted electronically.

- l, t: Compensator longitudinal and transversal index errors.
- i: Vertical index error, related to the standing axis.
- c: Hz collimation error, also called line of sight error.
- a: Tilting axis error.
- ATR: ATR zero point error for Hz and V (optional feature on some instruments).

Every angle measured in your daily work is corrected automatically if the compensator and the Hz corrections are activated in the instrument configuration. The results for the check and adjust procedure are shown as errors, but used with the opposite sign as corrections when applied to the measurements.

Mechanical Adjustment

The following instrument parts can be adjusted mechanically.

- Circular level on the instrument and tribrach.
- Visible red laser beam of the reflectorless EDM (optional feature on some instruments).
- Laser plummet.
- Optical plummet (optional on some tribrachs).
- Allen screws on tripod.

Precise Measurements

To get the most precise measurements in your daily work it is important to remember and follow the advice given below.

- Go through the check and adjust routines from time to time.
- Take high precision measurements during the check and adjust procedures.
- Measure targets in two faces, some of the instrument errors are eliminated by averaging the angles in both faces.

You may ask:

- When do I need to determine these errors?
- What do I need to do before I determine these errors?
- What is the best environment to be in when determining these errors?
- Do I have to wait for the instrument to acclimate to the current temperature?

The following four sections will provide you with answers to these questions.

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4.0 Check & Adjust

When should I Check & Adjust my Instrument?

During the manufacturing process, the instrument errors are determined and set to zero. These errors can change and it is recommended to determine them again in the following situations:

- Before the first use.
- Before every high precision survey.
- After rough or long transports.
- After long working periods.
- After long storage periods.
- When there has been a temperature change greater than 20°C (36°F) between the current environment and the last calibration.

What to do before I Check & Adjust my Instrument?

Before determining the instrument errors, you must level the instrument using the electronic level.

Note: The tribrach, tripod and ground should be very stable and not experiencing vibrations or other disturbances.

Where should I Check & Adjust my Instrument?

The instrument should be protected from direct sunlight. You want to avoid the sun warming one side of the instrument more than the other. You should also pick an area that will allow you to avoid strong heat shimmer and strong winds. The best atmospheric conditions will likely be found early in the morning and on a day with an overcast sky.

What temperature should it be to Check & Adjust my Instrument?

The outside temperature can be any temperature within the specification range that you are willing to work in. The important part of temperature comes in letting the instrument become acclimated to the ambient temperature. It requires approximately 2 minutes for every °C or every 2°F. At a minimum you should give the instrument 15 minutes from storage to working time.

In this Chapter

This chapter explains electronic and mechanical adjustments of errors.

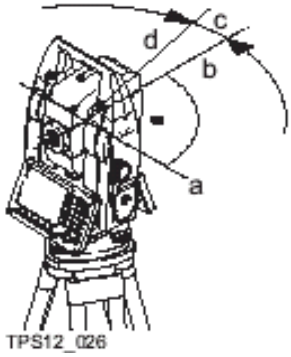
TPS1200 Quick Guide
4.1 Details of Instrument Errors

General Information

Instrument errors occur if the standing axis, the tilting axis and the line of sight are not precisely perpendicular to each other.

Horizontal Collimation Error (c)

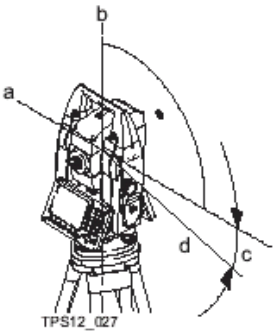
The horizontal collimation error (c) is also called the line of sight error. It is caused by the deviation between the optical line of sight, also known as the direction in which the crosshairs point and the line perpendicular to the tilting axis. This error affects all horizontal readings and increases with steep sightings.



- a: Tilting axis
- b: Line perpendicular to tilting axis
- c: Hz collimation error or line of sight error
- d: Line of sight

Tilting Axis Error (a)

The tilting axis error is caused by the deviation between the mechanical tilting axis and the line perpendicular to the vertical axis. This error affects horizontal readings, zero affect in the horizon and increases with steep sightings. To determine this error it is necessary to point at a target well above or below the horizontal plane. To avoid influences from the horizontal collimation error, it must be determined before the tilting axis error.



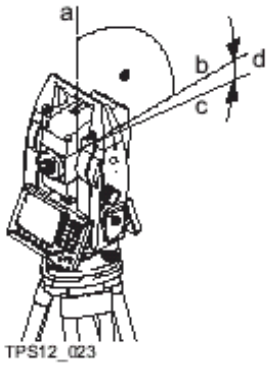
- a: Axis perpendicular to the vertical axis
- b: Mechanical vertical axis of the instrument or standing axis
- c: Tilting axis error
- d: Tilting axis

Continued on next page

TPS1200 Quick Guide
4.1 Details of Instrument Errors

Vertical Index Error (i)

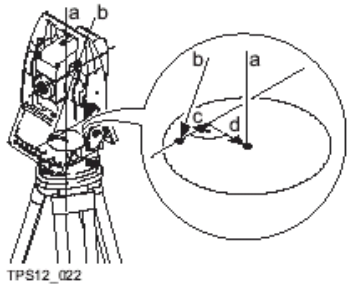
The vertical index error is present if the 0° mark of the vertical circle doesn't coincide with the mechanical vertical axis or standing axis of the instrument. This error affects all vertical angles and is constant with all readings.



- a: Mechanical vertical axis or standing axis
- b: Axis perpendicular to the vertical axis
- c: V angle = 90° in a specific face
- d: Vertical index error

Compensator Index Errors (l,t)

The compensator index errors occur if the vertical axis of the instrument and the plumb line are parallel, but the zero points of the compensator and the circular level do not coincide. The calibration procedure electronically adjusts the zero point of the compensator. The plane of the dual axis compensator of the TPS1200 is defined by a longitudinal component in the direction of the telescope and a transversal component perpendicular to the telescope.
The longitudinal compensator index error has a similar effect as the vertical index error and affects all vertical angle readings.
The transversal compensator index error is similar to the tilting axis error, zero affect in the horizon and increases with steep sightings.



a: Mechanical vertical axis of the instrument or standing axis
b: Plumb line
c: Longitudinal component of the compensator index error
d: Transversal component of the compensator index error

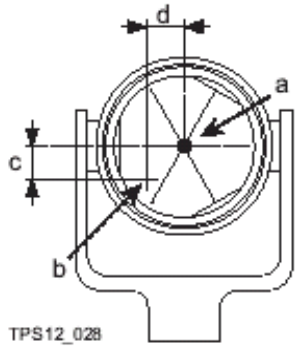
Continued on next page

TPS1200 Quick Guide
4.1 Details of Instrument Errors

ATR Collimation Errors

The ATR collimation error is the angular divergence between the line of sight (direction the crosshairs point) and the ATR CCD camera axis. The ATR CCD camera detects the center of the prism. The horizontal and vertical angles are corrected by the horizontal and vertical components of the ATR calibration errors to measure exactly to the center of the prism.

Note: Even after adjustment, the crosshairs may not be positioned exactly on the center of the prism after an ATR search. This is normal. To speed up the ATR search, the telescope is not positioned exactly on the center of the prism, the difference are the ATR offsets, measured individually for each measurement and corrected electronically. When using ATR, horizontal and vertical angles are corrected twice, first by the ATR errors for Hz and V and also by the individual deviations of the current pointing, ATR offsets.



- a: Center of prism
- b: Crosshairs
- c: V component of ATR collimation error
- d: Hz component of ATR collimation error

Summary of Errors

Instrument Error	Effects Hz	Effects V	Eliminate with two face measurement	Auto correct with proper adjustment
c – Hz collimation error	✔		✔	✔
a – Tilting axis error	✔		✔	✔
l – Compensator index error		✔	✔	✔
t – Compensator index error	✔		✔	✔
i – V index error		✔	✔	✔
ATR collimation error	✔	✔		✔

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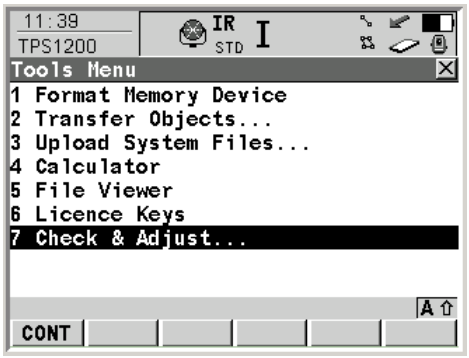
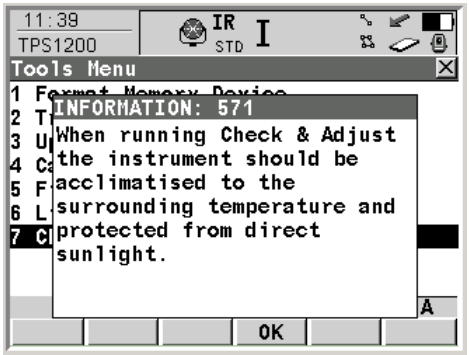
4.2 Access and Configure Check & Adjust

Step	Action	Display
1	From the Main Menu: • Tap on **6 Tools…**. This takes you to the TPS1200 Tools Menu screen.	
2	In the TPS1200 Tools Menu screen: • Tap on **7 Check & Adjust…**. This takes you to the instrument acclimation reminder screen.	
3	In the instrument acclimation reminder screen: • Tap on **OK (F4)** to continue. This takes you to the TOOLS Check & Adjust Menu screen.	

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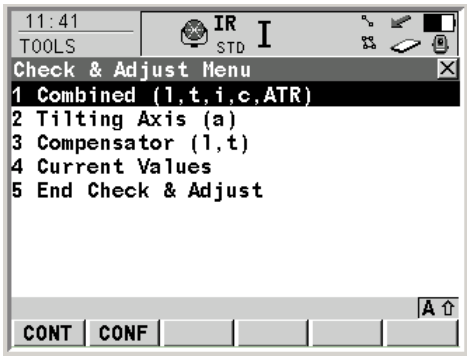
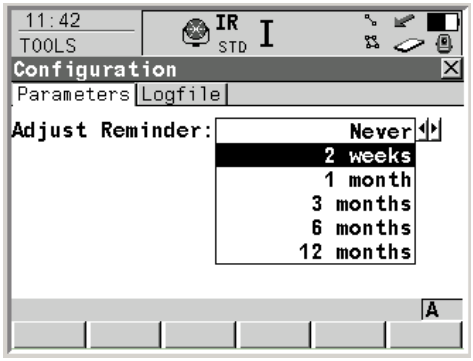
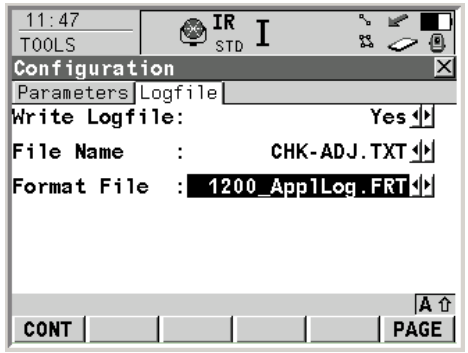
TPS1200 Quick Guide
4.2 Access and Configure Check & Adjust

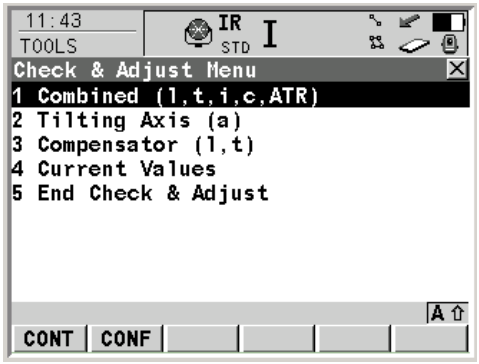
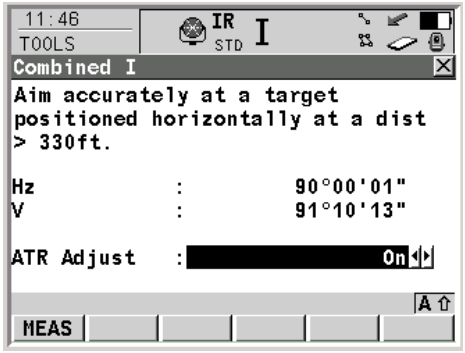
Step	Action	Display
4	In the TOOLS Check & Adjust Menu screen: • Press the **F2 (CONF)** button. This allows you to configure a reminder message and to select a logfile. This takes you to the TOOLS Configuration screen.	
5	In the TOOLS Configuration, Parameters tab: • Select the timeframe for which you would like to be reminded to run the Check & Adjust procedure. **Note:** Each time this amount of time elapses, you will be reminded to run the complete Check & Adjust routine. • Press the **F6 (PAGE)** button to advance to the Logfile tab. This takes you to the Logfile page of the TOOLS Configuration screen.	
6	In the TOOLS Configuration, Logfile tab: • Select **Yes** or **No** for Write Logfile. • Select a file name or create a new file for your logfile data. • Select the format file you wish to use to define your logfile structure. • Press the **F1 (CONT)** button to return to the TOOLS Check & Adjust Menu.	

TPS1200 Quick Guide
4.3 Combined Adjustment

Combined Adjustment

The combined adjustment determines the following instrument errors all in one process: compensator longitudinal and transversal index errors, vertical index error, horizontal collimation error, ATR zero point for Hz angle (optional) and ATR zero point for V angle (optional).

Follow the steps below to perform a Combined Adjustment.

Step	Action	Display
1	In the TOOLS Check & Adjust Menu screen: • Select **1 Combined (I,t,I,c,ATR)**. • Press the **F1 (CONT)** button. This takes you to the TOOLS Combined I screen.	
2	From the TOOLS Combined I screen: • Follow the on screen instructions and aim at your target positioned at approximately 330 ft away. **Note**: The ATR adjustment is optional, if you have ATR you should include it in this procedure. You must use a round prism. • Press the **F1 (MEAS)** button. Motorized instruments automatically advance to the next face. If you are using a non-motorized instrument, flip the telescope to the next face.	

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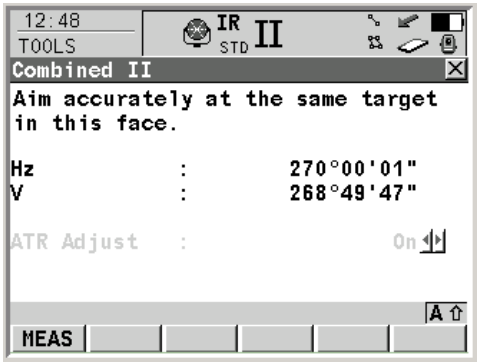
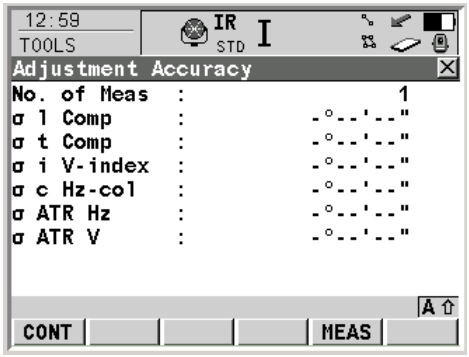
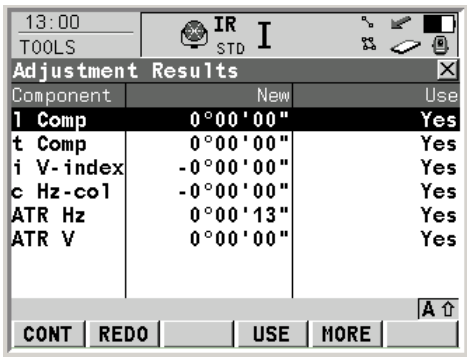
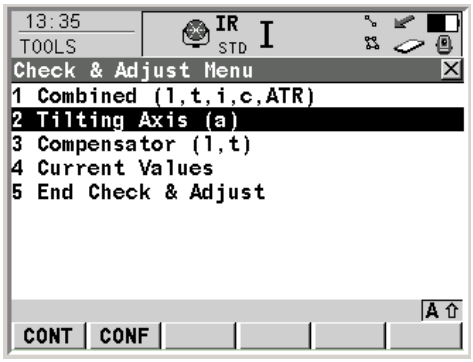
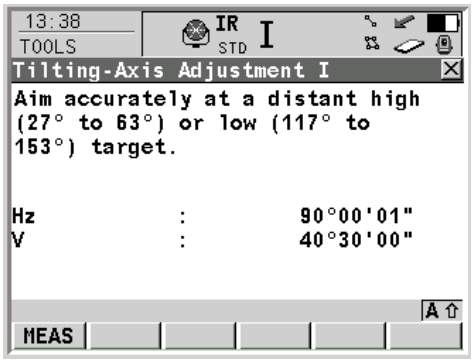
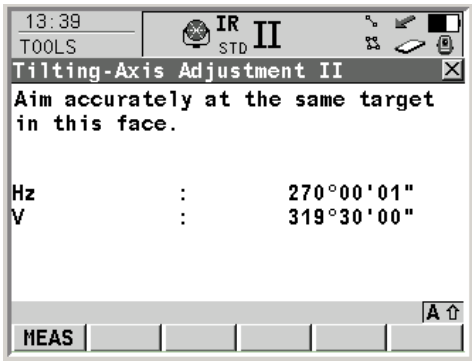
TPS1200 Quick Guide
4.3 Combined Adjustment

Step	Action	Display
3	In the TOOLS Combined II screen: You are now ready to aim at the same target in this second face. • Press the **F1 (MEAS)** button to measure to this target.	
4	After each set of measurements to your target, the TOOLS Adjustment Accuracy screen displays the standard deviations from the second set onward. **Note:** If one or more errors are bigger than the predefined limits, the procedure is repeated, all measurements are rejected and not averaged with the previous sets. • It is recommended to measure at least two sets. • Press the **F5 (MEAS)** button to measure more sets or press the **F1 (CONT)** button to continue.	
5	After pressing **F1 (CONT)** you will advance to the TOOLS Adjustment Results screen. • **F1 (CONT)** will accept and store the results in the New column where **Yes** is set in the Use column. • **F2 (REDO)** will reject all results and repeat the entire procedure. • **F4 (USE)** allows you to keep the current error (No) or use the new error (Yes). • **F5 (MORE)** displays more information about the New and Old errors.	

TPS1200 Quick Guide
4.4 Tilting Axis Adjustment

Tilting Axis Adjustment

Follow the steps below to determine the Tilting Axis error and adjustment.

Step	Action	Display
1	In the TOOLS Check & Adjust Menu screen: • Select **2 Tilting Axis (a)**. • Press the **F1 (CONT)** button. This takes you to the TOOLS Tilting-Axis Adjustment I screen.	
2	In the TOOLS Tilting-Axis Adjustment I screen: • Follow the on screen instructions and aim at your target positioned high between 27°-63° or low between 117°- 153° approximately 330 ft away. • Press the **F1 (MEAS)** button. **Note:** Motorized instruments automatically advance to the next face. If you are using a non-motorized instrument, flip the telescope to the next face.	
3	In the TOOLS Tilting-Axis Adjustment II screen: You are now ready to aim at the same target in this second face. • Press the **F1 (MEAS)** button to measure to this target.	

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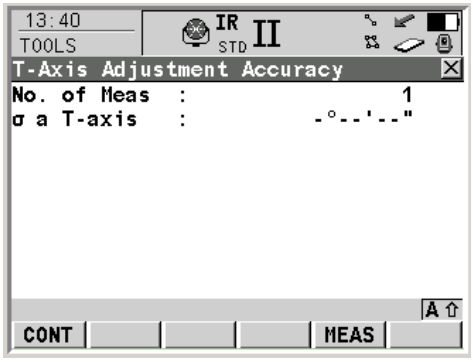
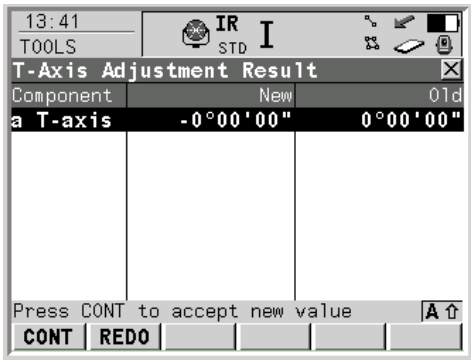
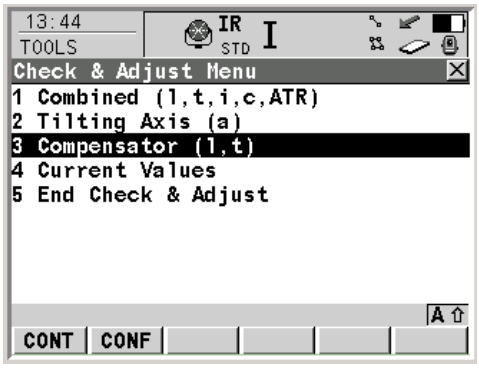
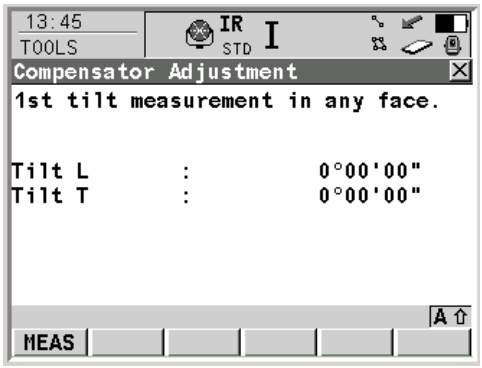
TPS1200 Quick Guide
4.4 Tilting Axis Adjustment

Step	Action	Display
4	After each set of measurements to your target the TOOLS T-Axis Adjustment Accuracy screen displays the standard deviation from the second set onward. **Note:** If the error is bigger than the predefined limit, the procedure is repeated, all measurements are rejected and not averaged with the previous sets. • It is recommended to measure at least two sets. • Press the **F5 (MEAS)** button to measure more sets or press the **F1 (CONT)** button to continue.	
5	After pressing **F1 (CONT)** you will advance to the TOOLS T-Axis Adjustment Result screen. • **F1 (CONT)** will accept and store the tilting axis error results in the New column. • **F2 (REDO)** will reject the results and repeat the entire procedure.	

TPS1200 Quick Guide
4.5 Compensator Adjustment

Compensator Adjustment

Follow the steps below to determine the Compensator longitudinal index error and the Compensator transversal index error.

Step	Action	Display
1	In the TOOLS Check & Adjust Menu screen: • Select **3 Compensator (l,t)**. • Press the **F1 (CONT)** button. This takes you to the TOOLS Compensator Adjustment screen.	
2	From the TOOLS Compensator Adjustment screen: • No specific target has to be used for aiming the instrument. • Press the **F1 (MEAS)** button. **Note:** Motorized instruments automatically advance to the next face and take a measurement. If you are using a non-motorized instrument, flip the telescope to the next face and press **F1 (MEAS)** to take the second measurement.	

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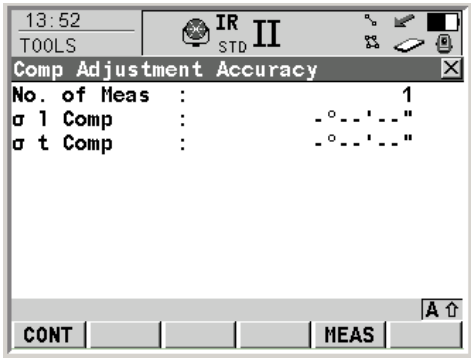
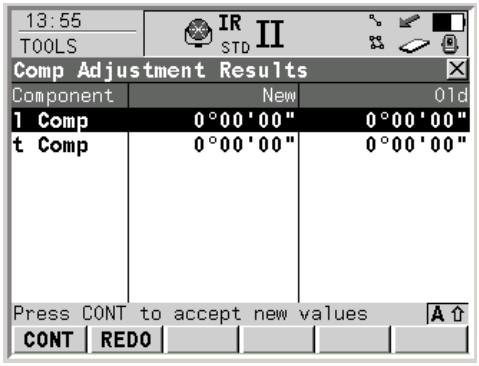
TPS1200 Quick Guide
4.5 Compensator Adjustment

Step	Action	Display
3	After each set of measurements to your target the TOOLS Comp Adjustment Accuracy screen displays the standard deviation from the second set onward. **Note:** If the error is bigger than the predefined limit, the procedure is repeated, all measurements are rejected and not averaged with the previous sets. • It is recommended to measure at least two sets. • Press the **F5 (MEAS)** button to measure more sets or press the **F1 (CONT)** button to continue.	
4	After pressing **F1 (CONT)** you will advance to the TOOLS Comp Adjustment Results screen. • **F1 (CONT)** will accept and store the tilting axis error results in the New column. • **F2 (REDO)** will reject the results and repeat the entire procedure.	

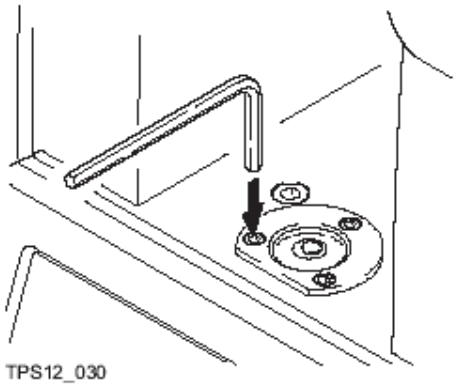
TPS1200 Quick Guide
4.6 Mechanical Adjustments

Mechanical Adjustments

There are several mechanical adjustments that you can maintain without having to send your equipment to a service center. In the following section we will discuss how to adjust your circular level on the instrument, the circular level on the tribrach, the reflectorless EDM, the laser plummet and the tripod.

Circular Level Adjustment on Instrument

The following steps explain how to adjust the circular level on the instrument.

Step	Action	Display
1	Level the instrument in advance with the electronic level, assuming that the electronic level is correctly adjusted. • The bubble of the circular level must be centered. If it extends beyond the circle, use the allen key supplied with the instrument to center it. • Turn the instrument 180°. • Repeat the adjustment procedure if the bubble does not stay centered.	

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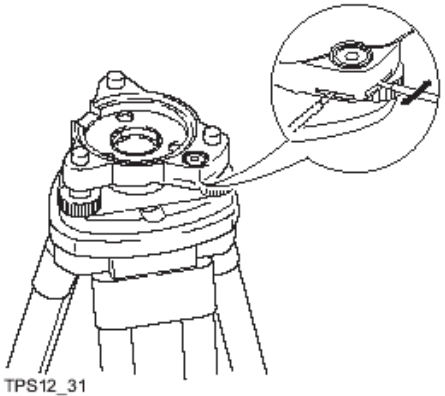
TPS1200 Quick Guide
4.6 Mechanical Adjustments

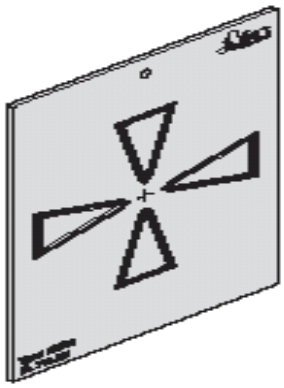
Circular Level Adjustment on Tribrach

The following steps explain how to adjust the circular level on the tribrach.

Step	Action	Display
1	Level the instrument in advance with the electronic level, assuming that the electronic level is correctly adjusted. • Remove the instrument from the tribrach. • The bubble of the circular level must be centered. If it extends beyond the circle, use the adjusting pin in conjunction with the two cross headed adjustment screws to center it. • After adjustment, no screw should be loose.	 TPS12_31

Reflectorless EDM Adjustment

The following steps explain how to adjust the red laser beam of the reflectorless EDM so that it is arranged coaxially with the line of sight of the telescope.

Step	Action	Display
1	To adjust the reflectorless EDM to align with the crosshairs or line of sight: • Set up the target provided with the instrument between 5m-20m (16.5ft-65.6ft) with the grey reflective side facing the instrument. • Flip the telescope to face II. • Turn on the visible red laser by activating the laser pointer.	 TPS12_36

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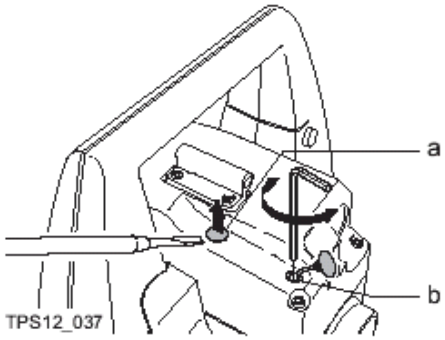
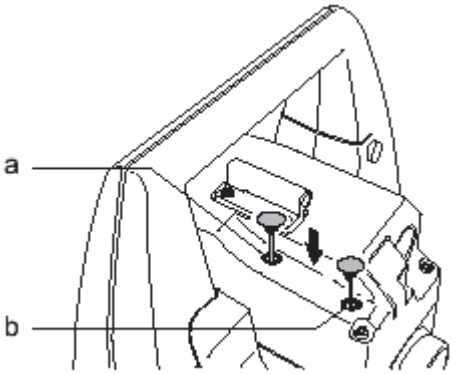
4.6 Mechanical Adjustments

Step	Action	Display
2	To continue adjusting the reflectorless EDM: • Align the crosshairs with the center of the target plate and inspect the position of the red laser dot. • If the dot illuminates the cross on the target then adjustment precision has been reached. If it lies outside the limits of the cross, continue to step three. • a: Rear adjustment port. • b: Front adjustment port.	
3	To continue adjusting the reflectorless EDM: • Pull out the two plugs from the adjustment ports. **Note:** These will not come completely out of the ports. Do not break the attachment strings. • To correct the height of the beam, use the supplied screwdriver in the rear adjustment port. Turn it clockwise to adjust obliquely up or anti-clockwise to move in the opposite direction. • To correct the beam laterally, use the supplied screwdriver in the front adjustment port. Turn it clockwise to move the dot on the target plate to the right and anti-clockwise to move it to the left. • After completing the adjustment, put the plugs back to keep out dust and water. **Note:** Throughout the adjustment procedure make sure to check that the crosshairs are aligned with the target point.	

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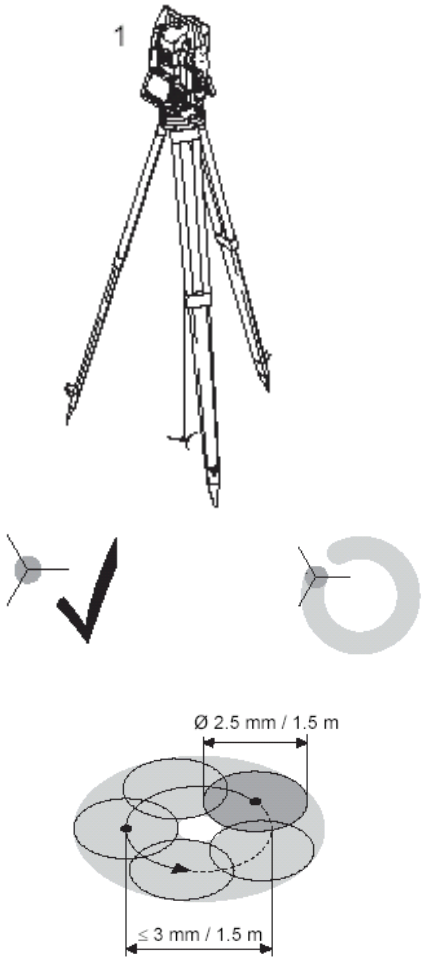
TPS1200 Quick Guide
4.6 Mechanical Adjustments

Laser Plummet Adjustment

The laser plummet is located in the vertical axis of the instrument, under normal conditions the laser plummet should not need adjusting. The following information allow you to check your laser plummet and if you find that it needs adjusting, you can send it to any Leica Geosystems authorized service center.

Step	Action	Display
1	Inspecting the laser plummet: **Note:** Depending on the brightness of the laser plummet and the surface, the diameter of the spot can vary, but typically at 1.5m the spot size should be about 2.5mm. • Setup the instrument on a tripod. • Level the instrument with the electronic level and access the laser plummet page. **Note:** The inspection should be done on a bright smooth surface, such as a sheet of paper. • Mark the center of the red dot on the ground. • Slowly turn the instrument 360°, observing the movement of the red laser dot. • The maximum diameter of the circular movement should not exceed 3mm with the instrument at a height of 1.5m. If the laser dot has a perceptible circular movement more than 3mm away from the first point you marked, contact your nearest authorized Leica Geosystems service center.	

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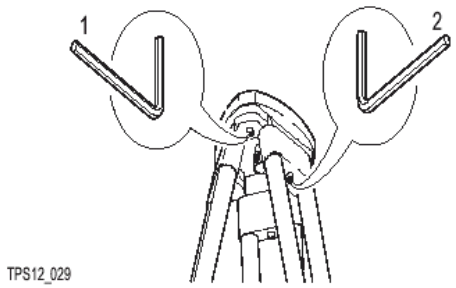
4.6 Mechanical Adjustments

Tripod Adjustment

The following steps explain how to adjust the tripod.

Step	Action	Display
1	Before you install your instrument on the tripod: • Check that the connections between the metal and wood are firm and tight. • Moderately tighten the allen screws (1) with the allen wrench supplied in the tripod cap. • Tighten the hinge joints (2) just enough to keep the tripod legs open when lifting the tripod off the ground.	
2	Continuing to check and adjust the tripod: • Tighten the allen screws of the tripod legs (3).