

TOTAL STATION CALIBRATION

Field Procedure, Checks & Calibration Guide

This guide explains the main calibration and field-check procedures used for total stations. It is intended for surveyors, survey technicians and training purposes. Exact adjustment limits, menus and service procedures vary by instrument manufacturer and model; always follow the current manufacturer manual for final acceptance and internal adjustments.

1. What is Total Station Calibration?

Total station calibration is the process of checking and, where permitted, correcting systematic instrument errors so that measured horizontal angles, vertical angles and distances meet the required survey accuracy. Calibration is different from routine setup/leveling: setup makes the instrument ready for observation, while calibration determines whether the instrument itself is within specification.

2. Main Calibration / Error Components

Component	Purpose / Typical Check
Compensator / Vertical index	Checks the vertical angle reference and compensator behavior.
Horizontal collimation	Checks line-of-sight error in horizontal angle observations.
Vertical collimation / index error	Checks vertical-circle/index reference error.
Face Left / Face Right	Dual-face observations help identify and reduce systematic angular errors.
EDM / Distance	Checks measured distance against a traceable or known reference.
Optical / Laser plummet	Checks whether the centering reference is aligned with the vertical axis.
Tribrach / circular level	Checks mechanical leveling and centering stability.
Axis geometry	Checks relationships among vertical, horizontal and line-of-sight axes.

3. Equipment and Site Requirements

- Stable tripod and tribrach in good condition.
- Known/verified survey points or a suitable calibration baseline.
- Clear line of sight with minimal atmospheric disturbance.
- Prism and prism constant known and correctly entered.
- Instrument battery sufficiently charged and instrument allowed to reach normal operating temperature.
- Field book or digital observation log for Face Left (FL) and Face Right (FR) readings.
- For high-accuracy work, use manufacturer-approved procedures and a calibrated baseline or laboratory service.

4. Pre-Calibration Inspection

- Inspect telescope, objective, eyepiece, EDM window, connectors and tribrach for damage.
- Check that the tripod and tribrach clamps are secure and free from excessive play.
- Check the circular and electronic levels.
- Verify instrument firmware/settings, units, prism type and prism constant.
- Check compensator status and instrument self-test messages.

- Perform careful centering and leveling before every calibration observation.

5. Two-Face Angular Check

A fundamental field check is to observe the same target in both telescope faces. Observe the target in Face Left, record the horizontal and vertical angles, then change to Face Right and observe the same target again. The comparison helps reveal systematic angular errors. For precise work, repeat the observations according to the manufacturer's prescribed number of sets and target geometry.

Important: Do not simply average readings and assume the instrument is calibrated. The manufacturer's calculation and adjustment procedure should be followed when an error exceeds the specified tolerance.

6. Horizontal Collimation Check

- Set up on a stable point and accurately level the instrument.
- Select a well-defined distant target with a clear line of sight.
- Observe the target in Face Left and record the horizontal angle.
- Rotate through the appropriate instrument position and observe the same target in Face Right.
- Repeat observations if required by the instrument procedure.
- Calculate the collimation error using the manufacturer's prescribed formula or let the instrument's calibration routine calculate it.
- If the error is outside tolerance, perform the permitted electronic adjustment or send the instrument to an authorized service/calibration center.

7. Vertical Index / Vertical Collimation Check

- Choose a stable, clearly defined target at a suitable elevation angle.
- Observe and record the target in Face Left.
- Observe the same target in Face Right.
- Compare the paired vertical observations according to the manufacturer's method.
- Determine the vertical index error and compare it with the required tolerance.
- Apply the instrument's approved adjustment procedure only if necessary.

8. Compensator Check

The compensator maintains the vertical reference when the instrument is slightly displaced from perfect mechanical leveling. Check the electronic level/compensator status and repeat observations after small controlled changes in setup orientation when the manufacturer requires it. Abnormal compensator behavior, unstable readings or repeated calibration failure should be treated as a service issue rather than corrected by arbitrary field settings.

9. EDM Distance Check

Distance calibration should be performed against a known, stable reference where possible. Verify prism constant, target type, atmospheric corrections and measurement mode before comparing observed distances. Take repeated measurements at several distances and compare them with the reference values. A consistent offset may indicate an incorrect prism constant or EDM/additive constant; a scale-related discrepancy may require professional calibration.

10. Plummet and Tribrach Check

- Center the instrument carefully over a known point.
- Rotate the instrument through approximately 180° and observe the plummet position.

- A significant movement indicates a possible plummet or centering-axis issue.
- Check tribrach locking, foot-screw condition and mechanical play.
- If mechanical adjustment is required, use an authorized service procedure.

11. Typical Calibration Workflow

Step	Activity	Record
1	Instrument inspection	Condition / serial no.
2	Tripod & tribrach check	Stable / play / condition
3	Center & level	Electronic level status
4	Warm-up / self-test	Status / warnings
5	Horizontal collimation	FL/FR observations
6	Vertical index	FL/FR observations
7	Compensator	Calibration result
8	EDM check	Reference vs observed distance
9	Plummet check	Offset / condition
10	Final verification	Pass / further service

12. Calibration Record Sheet

Field	Entry
Instrument manufacturer / model	_____
Serial number	_____
Date	_____
Operator / technician	_____
Job / project	_____
Horizontal collimation result	_____
Vertical index result	_____
Compensator result	_____
EDM reference / result	_____
Plummet / tribrach result	_____
Final status	PASS / ADJUST / SERVICE

13. Important Accuracy Notes

- Calibration constants and allowable tolerances are model-specific; do not copy values from another total station.
- High-precision construction, deformation monitoring, control networks and legal/survey-control work should use traceable calibration procedures.
- Field checks can identify problems but do not automatically replace an accredited or manufacturer calibration certificate.

- Temperature, pressure, humidity, tripod stability, centering, target quality and prism constant can affect observations.
- If an instrument repeatedly fails its internal calibration routine or shows unstable errors, stop using it for precision work and obtain professional service.

Training note: This PDF is a general methodology guide. For a specific Leica, Topcon, Sokkia, Trimble, GeoMax or other model, the exact menu sequence, formulas and acceptance tolerances should be taken from that model's official service/user documentation.