

Standard Operating Procedure for:
Topcon GTS-225 Electronic Total Station
with TDS Ranger Data Logger

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1 Identification of the test method

Operation of the Topcon GTS-225 Electronic Total Station with TDS Ranger Data Logger

2 Scope of the test method

This method describes the procedures for operating the GTS-225 Electronic Total Station with a TDS Ranger Data Logger.

3 Summary of test method

The total station uses laser theodolite technology to measure distances and angles which are then used to determine elevations at specific locations. To make topographic measurements, aim the total station at the prism on the top of the prism rod being held by the other person, enter the name of the point and the points description and engage the command on the data logger to “take the shot”. When the total station has completed taking the shot, a chime will sound and a message will prompt you to accept the point and enter attribute information. When you select OK the data logger logs the positions information and is then ready to take another shot.

After the survey is complete, connect the data logger to a PC with the TDS Surveyworks – Foresight DXM software and upload the data. A large variety of survey analyses and manipulations can be performed within the software, or the survey data can be exported for use in other database applications.

4 Health and safety

Surveying may require the total station operator or the rod holder to enter streams, rivers or densely vegetated areas. The following health and safety precautions should be taken.

When wading in streams where water depths may be 1 meter deep or more, wear a life preserver and/or remove hip boots or chest waders. Currents can force wading field workers into deep water and water-filled boots can make swimming difficult.

When walking through densely vegetated areas along streams, be sure to look for and avoid toxic plants like poison ivy. Be sure to wear appropriate insect repellent and protective clothing for protection from mosquitoes, chiggers, and ticks. In addition, probe areas in your path with a walking stick to warn and disperse poisonous snakes like the cotton mouth and copperhead which may inhabit riparian areas.

Be sure to clean up with bacteria disinfectant soap and water after wading in streams. This is particularly important for streams that drain livestock areas, sewage treatment plant effluents, and other obvious pollution sources. Under no circumstances.

When operating the total station or the prism rod, avoid looking directly into the laser.

5 Personnel qualifications

Total Station surveys will be performed by Missouri State University (MSU) field and laboratory personnel who have received appropriate training from experienced personnel, prior coursework, and field experience regarding total station surveys, and who are familiar with the appropriate SOP's

6 Equipment and supplies

- Tripod
- Two prism rods with prisms (one extendable to >12 feet)
- 5 to 7 meter long telescoping, fiberglass stadia rod with prism connector
- Global Positioning System (GPS receiver)
- 100 meter fiberglass tape graduated in 0.1 meter units
- 100 meter tag line that is graduated in 1 meter units
- Pack of 10 surveying pins
- Nails to set temporary instrument position pins
- Small, 3-lb sledge hammer for driving stakes
- 2 rolls of fluorescent-colored surveyor flagging ribbon
- 1 digital camera
- 10 wooden stakes to set at both ends of control transects lacking monuments
- 2 machetes for clearing sightlines
- 2 small pruning shears
- 1 can visible spray paint for marking purposes
- 3 two-way radios
- Field book
- Extra batteries and power packs
- Canoe, paddles, life vests for transportation and to survey non-wadeable reaches
- 2 100 meter ropes for boat control in fast or deep water

7 Procedure

Locate Benchmarks

The location of existing benchmarks with known latitude, longitude, and elevation (x,y,z coordinates) should be investigated prior to entering the field. If possible, a minimum of two benchmarks are required to accurately adjust the survey data into an absolute and geo-referenced coordinates system. Elevation (z) benchmarks are more wide spread and can be found on bridges or the center of manhole covers. If no benchmarks are available then the survey crew must establish them in the field with GPS.

Check Power Supply

Batteries for the total station and datalogger should be fully charged prior to entering the field. If any of the equipment requires the use of disposable batteries (GPS, two way radios) they should be checked and replaced if needed.

Level the Instrument

Set up the tripod on stable ground and attach the total station to it using the tripods mounting bolt.

Attach the datalogger to the total station with the interface cord.

Level the instrument first by using the bubble levels on the total station.

Then fine tune the level by using the leveling function on the total station

Press the F4 button to scroll to page 2 (P2), then press the F1 button (Tilt) to view the tilt sensor. This screen shows the X and Y offset when leveling the instrument. If the instrument were completely level it would read X: 0°00'00" Y: 0°00'00". However, this is nearly impossible to accomplish. For our surveying purposes X: 0°00'30" Y: 0°00'30" or less will be sufficient. Once you are satisfied with the tilt sensor press the ESC button to go back to the main screen.

Now use the laser plummet to mark the instrument location on the ground.

Press the MENU button, then press F4 to scroll through the pages.
Press the F3 button (LASER PLUMMET).

Press the F1 button (ON) to turn it on.

Find the laser on the ground and mark the point with a nail and flagging.

Turn the laser plummet off and then press ESC twice to get back to the main screen

Set Up the Survey Plane

Turn on the datalogger by pressing the black button in the upper right-hand corner of the key-pad.

Open the Survey-Pro program by double clicking on the Survey-Pro icon and then click NEW to create a new job file.

Use the keypad to enter a name for the job and click NEXT.

Make sure the Aximuth Type is set to North Azimuth, the Units for Distances are set to Feet and the Units for Angles are set to Degrees, then click NEXT.

"Enter First Point", this is where you will give the total station a hypothetical X,Y,Z location value. Leave the default values as they are and enter IP_1 as the Point Name and IP (for Instrument Position) as the Description. Click FINISH.

Set Up the Backsight

After clicking FINISH you will be brought to the main menu screen for the project you just created.

Click Survey (3), then click Backsight Setup (A)

The Occupy Point should default to IP_1, the point you just setup. If it does not, click the dropdown arrow to the right of the Occupy Point text box and click Choose From List, then click on IP_1 and click OK.

Enter the instrument height (HI) and the rod height (HR). Both the instrument height and the rod height should be measured using the tape measure. The instrument height is measured from the nail in the ground up to the marking on the side of the total station. The rod height is measured from the tip of the point on the bottom of the rod up to the marking on the side of the prism. It may be helpful to use the following conversion chart when converting the tape measure measurements into tenths of feet:

Inches	Feet	Inches	Feet
1	0.08	1/16	0.005
2	0.17	1/8	0.01
3	0.25	3/16	0.015
4	0.33	1/4	0.02
5	0.42	5/16	0.026
6	0.50	3/8	0.03
7	0.58	7/16	0.036
8	0.67	1/2	0.04
9	0.75	9/16	0.047
10	0.83	5/8	0.052
11	0.92	11/16	0.057
12	1.00	3/4	0.063
		13/16	0.068
		7/8	0.073
		15/16	0.078
		1	0.08



Set the BS Direction to 0.000

Using the GPS or a compass, find North. If neither are available, simply estimate north.

The rod holder will stand with the rod in line with the north azimuth

Use the sight on the top of the total station to line it up with the prism. Then Look through the eyepiece on the total station (make sure the lens cap has been removed) and center the cross-hairs on the prism. The total station can be focused by turning the rubber ring around the outside of the eyepiece. Then, if necessary the cross-hairs can be locked into position and fine-adjusted using the vertical and horizontal adjusters on the side (horizontal) and front (vertical) of the total station.

Once the prism is sighted in, click Solve on the datalogger. The Map will then display showing a line which represents the backsight direction.

Click on the Input tab on the right side of the screen. This will again display the input section of the backsight setup.

Click on Circle, then Send to Instrument. The display screen on the total station should read HR: 0°00'00", meaning that the horizontal survey plane has been set to 0.

Click Close in the upper right-hand side of the screen, then click Yes when asked if you want to close without checking the backsight.

Click on Traverse/Sideshot (B). In the Foresight textbox enter the PIC for backsight point number one: BS_1 and in the description type BS. MAKE SURE THE HR IS CORRECT. The total station should still be aimed at the prism, if not, realign it, then click Side Shot. The total station will beep twice, followed by a series of beeps. This indicates that the shot has been taken. Then click OK. A chime will sound, indicating that the point has been saved to the project.

Click on Backsight at the bottom of the screen. Then click BS Direction which will change it to BS Point. Then click the dropdown arrow next to the BS Point text box and click choose from list. Select the BS_1, the point you just took, click OK, then click solve. The backsight is now recorded as a point, and the total station is ready to perform the survey.

Perform the Survey

Sight in the prism.

On the Traverse/Sideshot screen, enter the point name and the point description and MAKE SURE THE HR IS CORRECT. The point name and description will be communicated to the total station operator by the rod holder.

Click Sideshot

The New Point dialogue box will appear. If feature attributes are being used for the current project there will be an Attribute button on the bottom left side of the dialogue box (adding feature attributes to a project is explained in the next section). Click on the Attribute button and select/enter the appropriate attribute information, then click O.K.

Repeat steps 8.6.1 through 8.6.4 until all of the survey points have been collected, or until the instrument needs to be moved in order to extend the survey.

When the survey is completed, turn off power to all instruments. Data is saved as it is created, so there is no need to save otherwise.

Move the Instrument (Traverse)

The total station operator will communicate to the rod holder that the instrument must be moved in order to collect more survey points.

The rod holder will hold the rod at the new instrument location.

The rod holder will then mark that position with a nail and flagging.

Sight in the prism and then click Traverse, rather than sideshot.

After the shot has been taken a dialogue box will prompt you to decide whether you want to “Traverse Now” or “Traverse Later”. If you will be taking more survey shots before moving the instrument, select Traverse Later. If you will not be taking any more shots before moving the instrument, select Traverse Now.

If you selected Traverse Now (this is the most common), the New Occupy Point screen appears.

Turn off the datalogger and the total station and move to the new location.

Set up the instrument at the new location, making sure that the instrument is level and that it is directly over the nail and flagging using the laser plummet.

Turn the instruments back on. The datalogger will still be on the New Occupy Point screen. The datalogger automatically enters the New Occupy Point and the New Backsight Point (which is the old instrument location).

Measure the instrument height and enter that value for the New HI.

The rod holder will now stand at the old instrument location (previously marked with a nail and flagging) and hold the rod directly on the nail.

Sight in the prism, and click Send Circle to Instrument.

You can then verify that the traverse was successful by clicking on the Map tab and looking at the new instrument location in relation to the new backsight. You are now ready to proceed with the survey.

8 Data acquisition, calculations, and reporting

TDS Ranger Datalogger Data Download Procedure:

Note: Survey data can only be viewed and manipulated on a computer running the TDS Surveyworks – Foresight DXM software.

Attach download cable to the datalogger.

Press the Power button on the datalogger

Open Microsoft ActiveSync and click File – Connection Settings

Make sure that “Allow connections to one of the following:” is checked and COM1 is selected.

Click Connect...then click Next

A message will then appear on the datalogger, click Yes.

The New Partnership window will open on the computer, select No, then click Next.

The datalogger can now be browsed from the file explorer as a Mobile Device.

All of the jobs on the datalogger are stored under My Computer/Disk/Survey Pro Jobs.

Each job consists of two files, a JOB file and a TDS Raw Data File. Both files must be transferred in order to open properly in Foresight DXM

9 Computer hardware and software

The TDS Ranger Datalogger has a Microsoft WindowsCE platform. It uses TDS Survey Pro for WindowsCE to perform the survey.

TDS Surveyworks – Foresight DXM is used to view and manipulate the survey data on the PC.

This document is created using Microsoft Word. The Word file name for this SOP is:

10 Data assessment and acceptable criteria for quality control measures

The analyst should review all data for correctness. One way to do this is to overlay the survey on an aerial photo for an initial visual inspection.

11 Corrective actions for out-of-control or unacceptable data

If the data are unacceptable for any reason, the analyst should review the data acquisition/analysis process prior to conducting the survey again.

The instrument may require trouble shooting if the data are unacceptable

12 References

User's Manual, Survey Pro for Pocket PC/Recon. 2003. Tripod Data Systems, Inc. 345 SW Avery Ave. Corvallis, OR 97333

User's manual, ForeSight DXM. 2007. Tripod Data Systems, Inc. 345 SW Avery Ave. Corvallis, OR 97333