Using the Trimble Access Plug-in, EDMCheq (EDM Calibration)

Introduction

EDMCheq is a Trimble Access plug-in program written by the NCDOT that collects and processes the data for an EDM Calibration. The purpose of an EDM calibration is to determine the scale and constant error of a specific EDM using an NGS calibration baseline. EDMCheq computes the EDM scale and constant error and various statistical quantities based on the raw data, horizontal baseline distances, collected during an EDM calibration.

EDMCheq does not change or adjust any settings on the total station. The program is only reporting the accuracy of the EDM as determined by the calibration. Many surveyors do not perform a full calibration, but will measure one or two baseline distances and compare the measured distance against the published distance. A full EDM calibration is a more formal and rigorous process resulting in statistical report that uses a least squares method to determine the accuracy of the EDM. This report provides a permanent record of the accuracy of the EDM on a specified date. Since tripods and tribrachs are used in the collection of the data, setup and leveling error as well as EDM error contribute to the reported error.

The EDMCheq program uses a variation of the NGS calibrat data input file format. The raw data consists of the published horizontal distances between baseline monuments defined from one of the existing NC calibration baselines. Another data file contains the measured horizontal EDM distances between the baseline monuments.

All algorithms and formulas used in the EDMCheq came from the National Geodetic Survey technical memorandum entitled "NOAA Technical Memorandum NOS NGS-10: Use of Calibration Base Lines, by Fronczek, December 1977, reprinted 1980, 38 pp." Some additional formulas were obtained from the NGS program calibrat.bas source code.

One of the best resources for EDM calibration information is the NGS website http://www.ngs.noaa.gov/CBLINES/calibration.html.

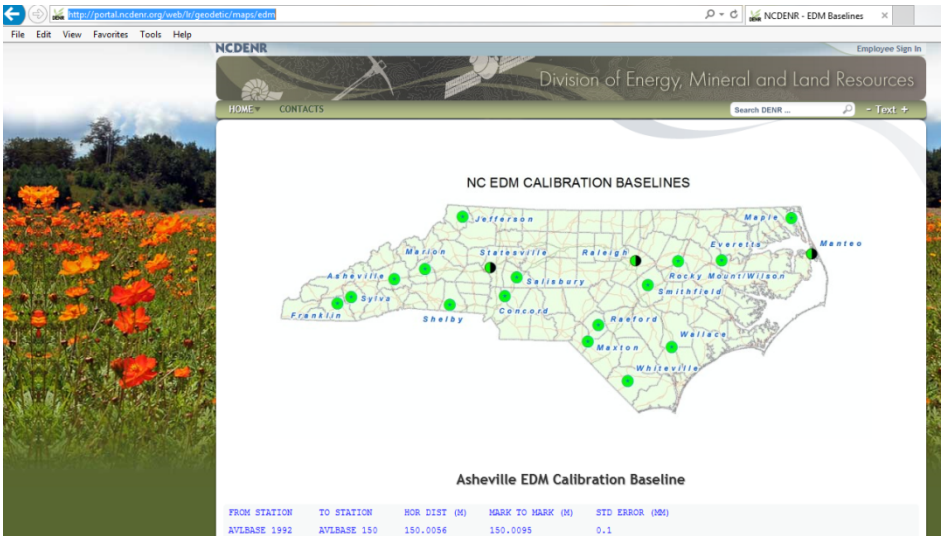
For information on North Carolina EDM Calibration baselines go the following website.

http://www.ncgs.state.nc.us/Pages/edm.aspx

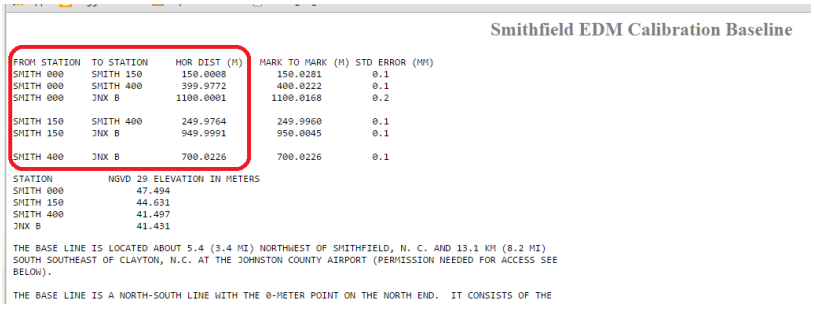
Collecting an EDM Calibration

The first step in completing an EDM calibration is to determine where the closest EDM baseline is. This information can be found on the NC Geodetic Survey site.

http://www.ncgs.state.nc.us/Pages/edm.aspx



Following is a view of the measurement data for the Smithfield baseline downloaded from the above website. The station names and the published horizontal distances are hard-coded into the EDMCheq program for all the North Carolina baselines, so the primary purpose of the NCGS report for EDMCheq users is to determine the status of and where the baseline is.



Smithfield EDM Calibration Baseline

FROM STATION	TO STATION	HOR DIST (M)	MARK TO MARK (M)	STD ERROR (MM)
SMITH 000	SMITH 150	150.0008	150.0281	0.1
SMITH 000	SMITH 400	399.9772	400.0222	0.1
SMITH 000	JNX B	1100.0001	1100.0168	0.2
SMITH 150	SMITH 400	249.9764	249.9960	0.1
SMITH 150	JNX B	949.9991	950.0045	0.1
SMITH 400	JNX B	700.0226	700.0226	0.1

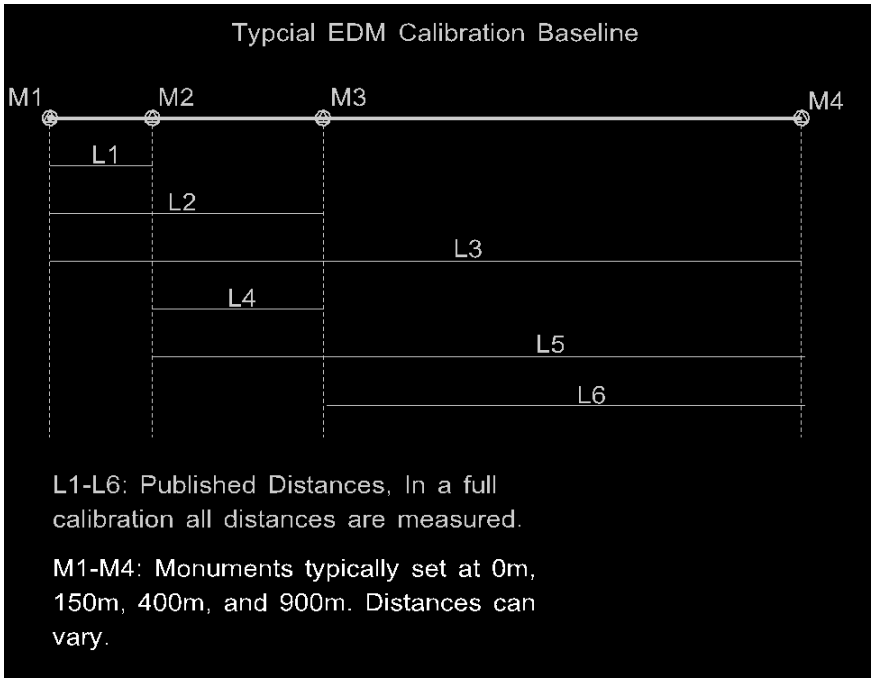
STATION	NGVD 29 ELEVATION IN METERS
SMITH 000	47.494
SMITH 150	44.631
SMITH 400	41.497
JNX B	41.431

THE BASE LINE IS LOCATED ABOUT 5.4 (3.4 MI) NORTHWEST OF SMITHFIELD, N. C. AND 13.1 KM (8.2 MI) SOUTH SOUTHEAST OF CLAYTON, N.C. AT THE JOHNSTON COUNTY AIRPORT (PERMISSION NEEDED FOR ACCESS SEE BELOW).

THE BASE LINE IS A NORTH-SOUTH LINE WITH THE 0-METER POINT ON THE NORTH END. IT CONSISTS OF THE

NOTE: It is important that care be taken when using an EDM calibration baseline. All safety precautions need to be observed. Many baselines are at airports. Airports are dangerous places. The baselines are often beside or near taxiways and airstrips. Make sure permission is obtained before using the baseline, and obey all the rules as indicated by the airport personnel.

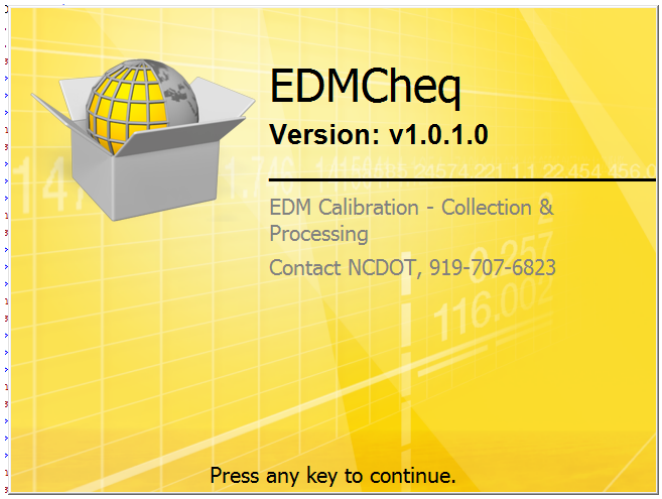
Following is the general schematic of an EDM Calibration baseline. Typically there are four monuments. To perform a complete calibration distances L1-L6 should be collected. M1-M4 represents monuments.



Using the EDMCheq Plug-in in the field

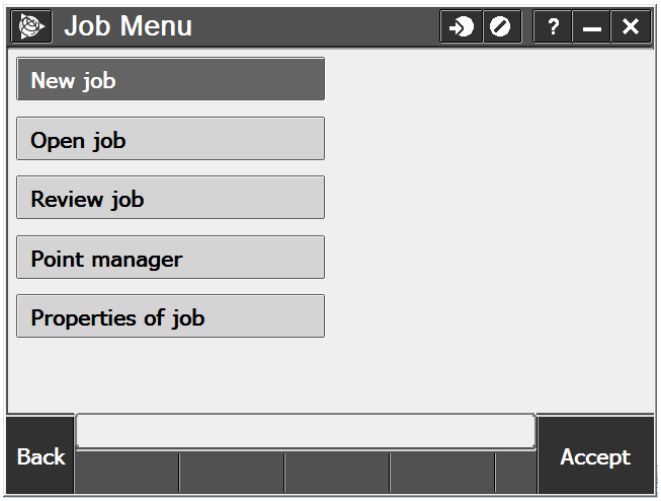
Select EDMCheq.

After clicking the EDMCheq icon the following screen is displayed. Press any key to continue.

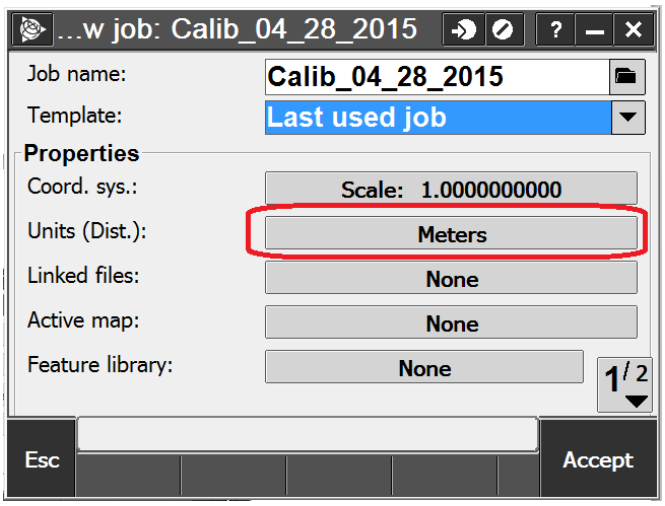


Following is the opening screen of the EDM calibration program. A new job should be created for every calibration performed.

The ‘Job Menu’ presents some standard Trimble Job options. EDMCheq users will use ‘New job’ to create a new job when starting a new calibration. Users may find it necessary to ‘Open job’ if an existing job needs to be reviewed, edited or reprocessed.

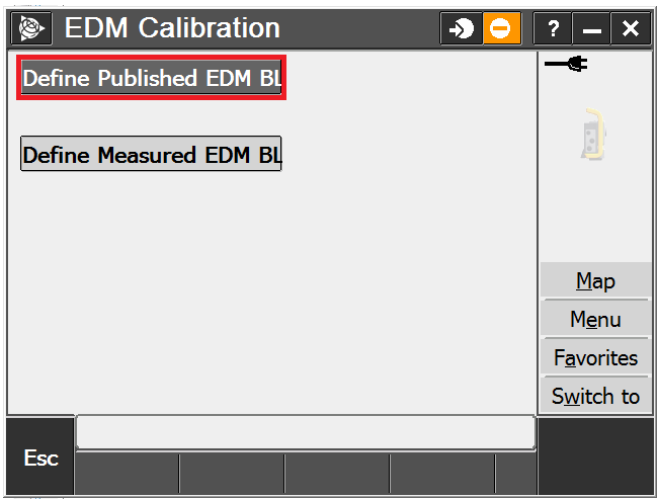


After pressing ‘New Job’ the following screen is displayed. **The difference between creating an EDM calibration job and a typical NCDOT Trimble job is that distance units must be set to Meters.** All the other settings can be set as usual. Press ‘Accept’ to create the job, and return to the main screen.

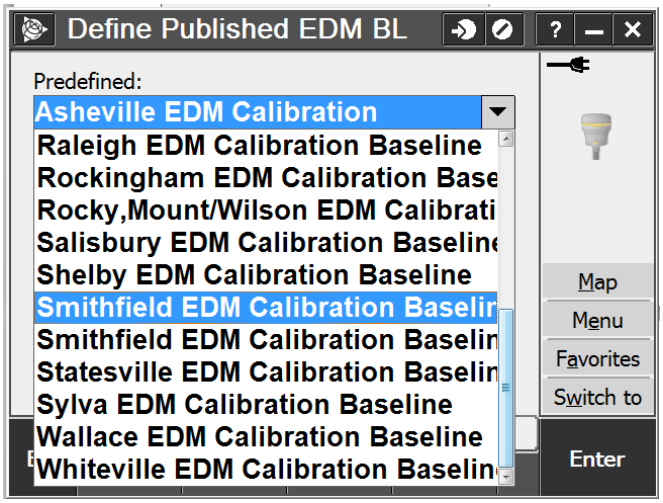


After the job has been created and you have returned to the main menu, press the 'EDMCheq' icon to begin the collection and processing of an EDM calibration.

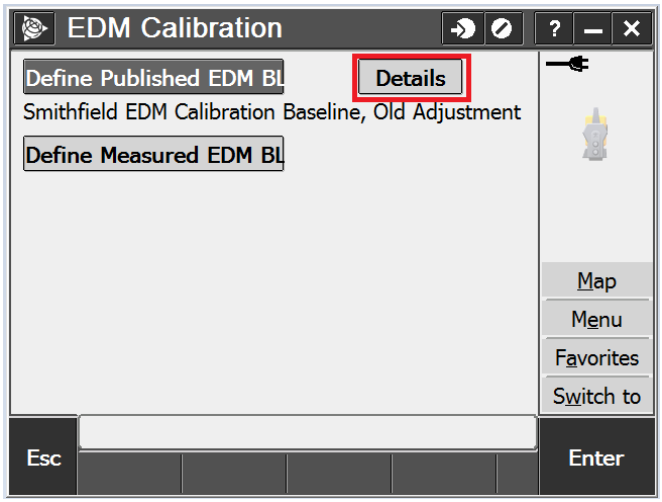
The collection, processing, editing and reviewing of the EDM calibration is initiated from the following screen. First, the published EDM baseline being used has to be designated. Press the 'Define Published EDM BL' button.



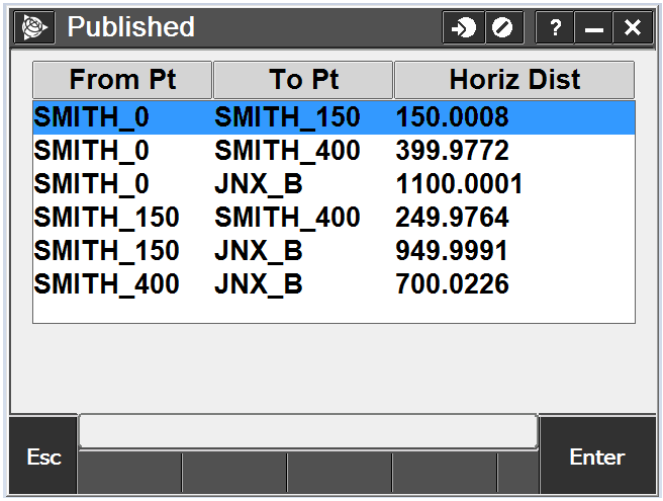
All of the published North Carolina baselines are available. Choose the baseline being used and press the 'Enter' soft key.



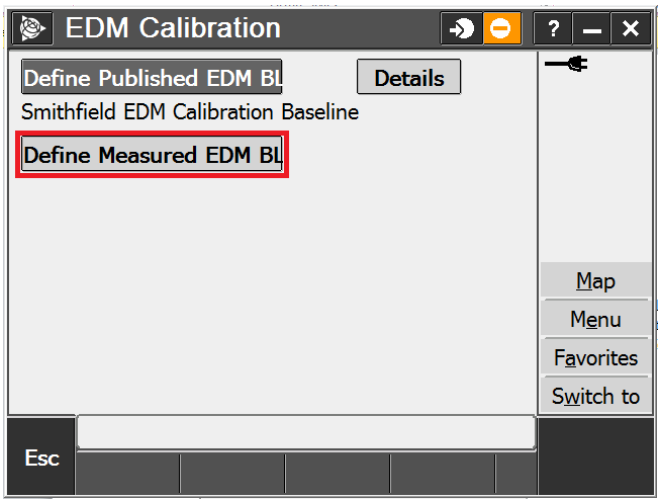
Notice, that after the published baseline has been selected the baseline description is displayed and a new button 'Details' is displayed. Press the 'Details' button to review the details of the baseline.



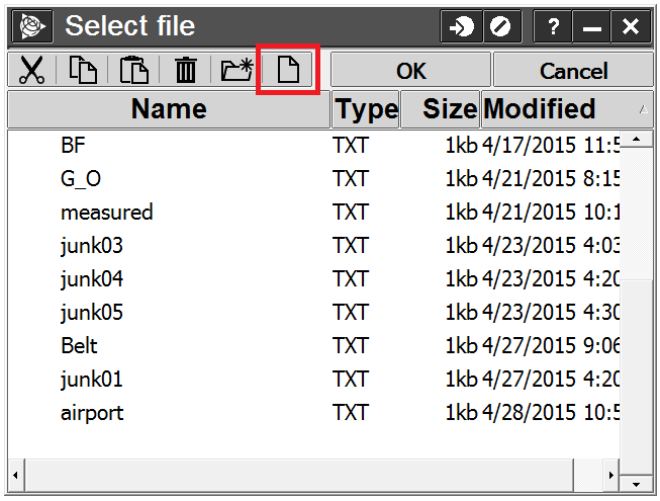
The following screen shows the details of the Smithfield baseline. This data should match the baseline report that was downloaded from the NCGS website.



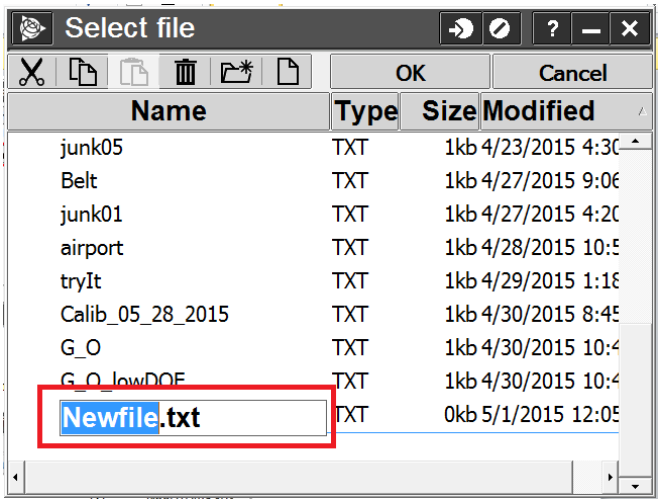
After the published baseline has been chosen a new data file containing the measured horizontal distances needs to be created if a new calibration is being performed. An existing measurement calibration file can also be opened for review, editing, reprocessing, and appending. Press the 'Define Measured EDM BL' button to create a new measurement file or open an existing measurement file.



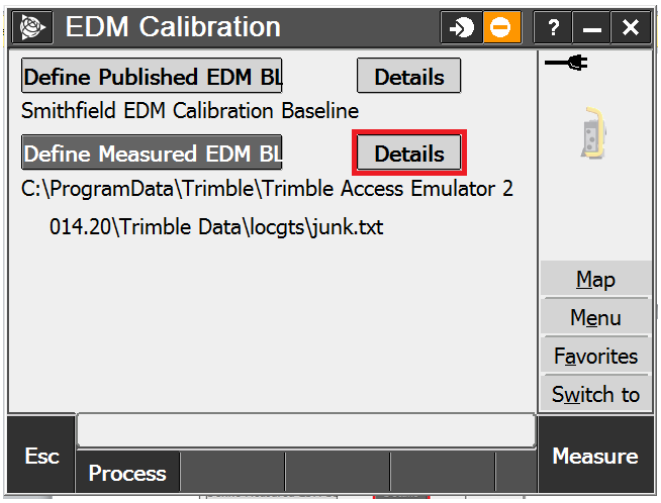
If you are creating a new EDM calibration file, press the 'new File' icon.



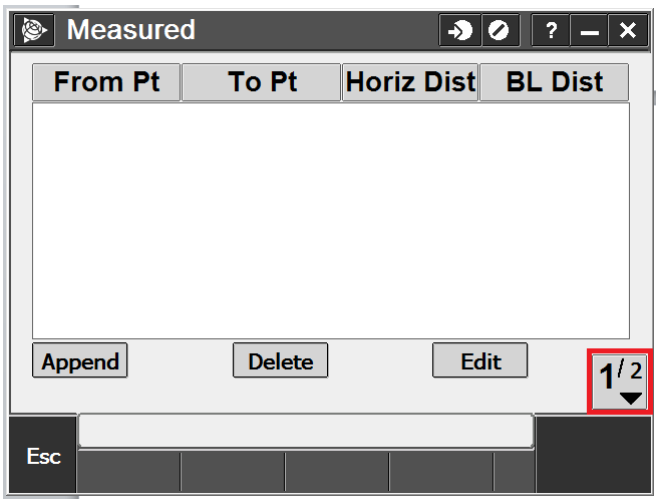
Enter the name of the new file. This file is an ASCII file containing the station names and horizontal distance measurements.



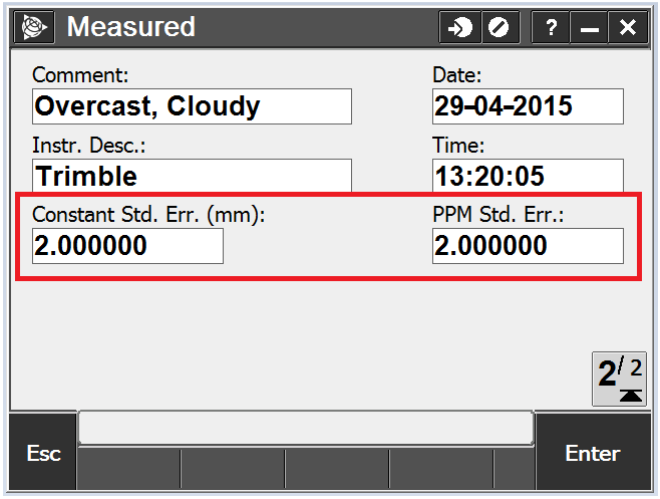
After creating the file, the name of the new file is displayed in the following screen, and a new 'Details' button is now displayed. Two new soft key options, 'Process' and 'Measure, are now displayed when both the published EDM baseline and the measured EDM baseline file have been defined. Though the 'Process' button is displayed choosing it with a new file would generate a warning message since no measurements have been collected. Press the 'Details' button.



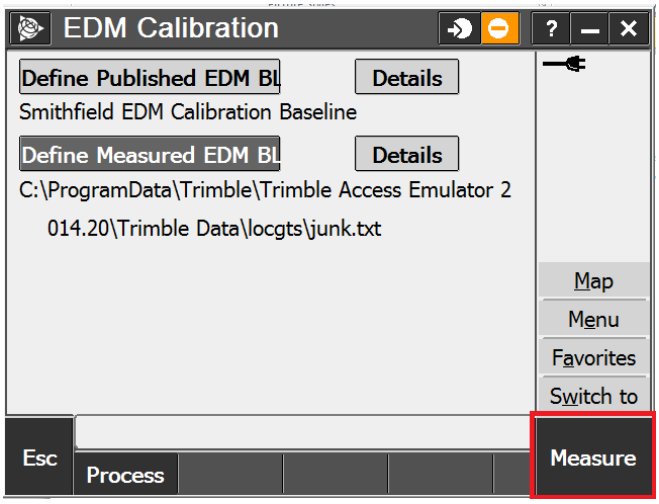
Since the file is a new file with no measurements, the measurement list is initially empty. Press the 'Next Page' soft key.



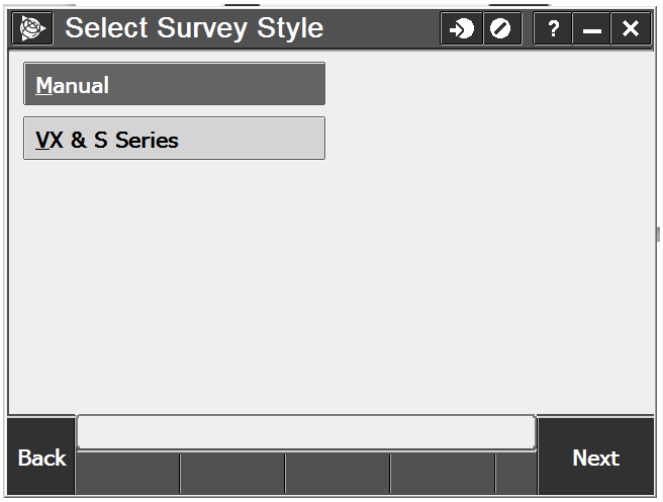
On page two there are six fields to be filled out. The fields, Comment, Inst. Desc., Date, and Time are all text fields that have no impact on any computations or processing. These fields only become part of the final report. The Constant Std. Err. And PPM Std. Err. define the predicted error of the EDM being tested. The program defaults to an EDM constant error of 2mm and 2PPM. The accuracy of most EDM's used by NCDOT is specified by the manufacturers to be 2mm and 2PPM. There may be times when you are using an EDM with different specifications or there may be circumstances when a different value of 2mm and 2PPM may be desired.



After defining the published EDM baseline and creating the measured EDM baseline file the next step is to collect the horizontal distance measurements. Press the 'Measure' soft key to begin the data collection procedure.



First, the appropriate survey style being used needs to be designated.



After the correct total station has been designated the atmospheric and curvature/refraction settings need to be entered. It is recommended that Curvature and Refraction correction be checked 'On'. Temperature and atmospheric pressure need to be entered. Atmospheric pressure needs to be entered as at-elevation pressure..

If the barometric pressure is being obtained from a weather report or airport it is sea-level barometric pressure and needs to be converted to at-elevation. Following is a simplified formula that can be used to convert at-sea level barometric pressure to at-elevation barometric pressure.

$$P(e) = P(s) - \frac{H}{900}$$

$$where\ P(e) = at - elevation\ atmospheric\ pressure\ in\ inches\ mercury.$$

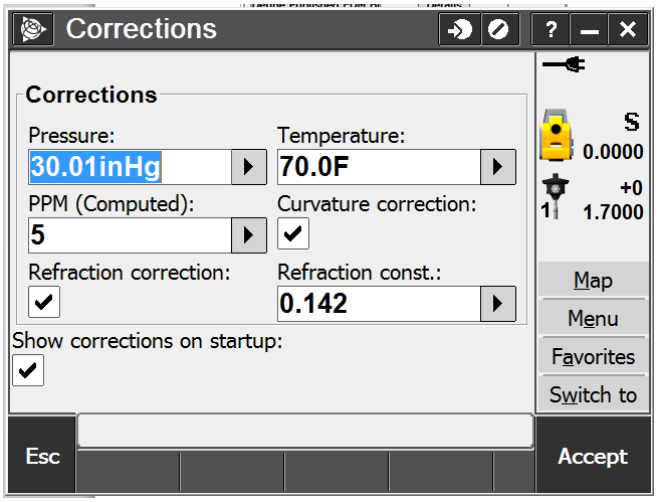
$$P(s) = at - sea\ level\ atmospheric\ pressure\ in\ inches\ mercury\ as\ reported\ at\ airports\ and\ weather\ reports.$$

$$H = average\ elevation\ in\ feet.$$

Example: The Sylva baseline is at an elevation of 2857'. The barometric pressure as published as part of the weather report at the airport is 30.19 in.

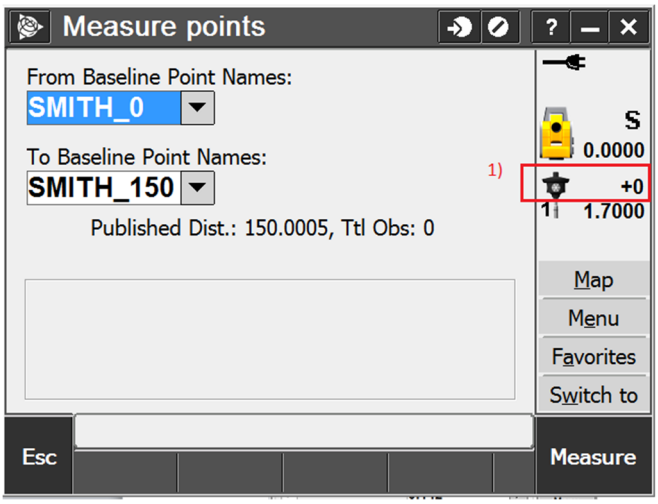
$$P(e) = 27.02 = 30.19 - \frac{2857}{900}$$

If the atmospheric PPM correction is set on both the instrument and the data collector the correction will be applied twice. It is recommended that the atmospheric PPM correction be set to 0, 30.2 in. HG, 65F on the instrument and the current temperature and at-elevation atmospheric pressure is set on the TSC3 data collector. The correction as set in the data collector is stored with the .job file so there is a permanent record of the setting during the calibration. Press the 'Accept' soft key once the screen is filled out correctly.

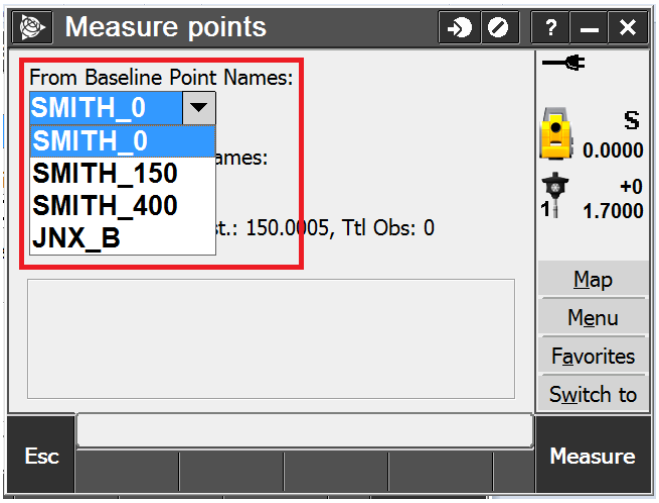


The following screen is the main measurement screen. Horizontal distance measurements are initiated from this screen.

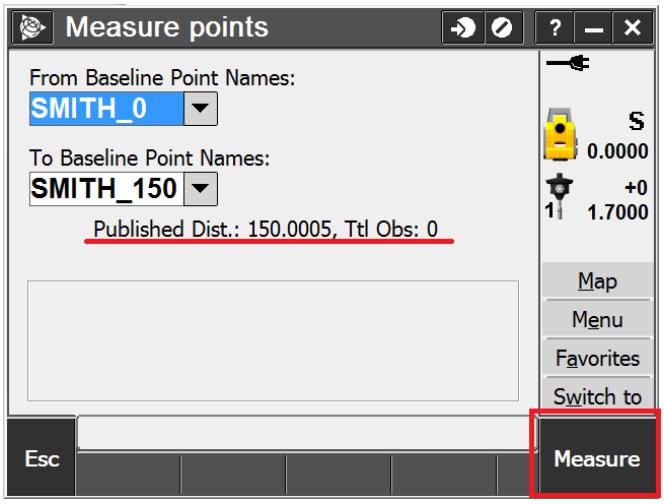
1) Make sure the prism offset is correct for the equipment being used. One of the principal blunders in using an EDM is having an incorrect EDM offset set.



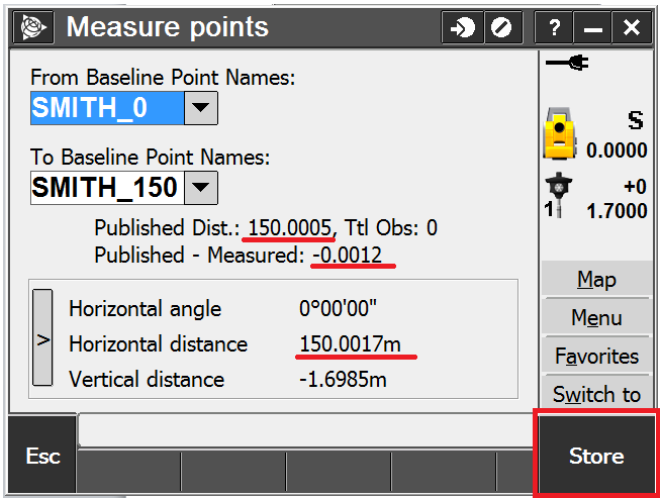
First, make sure that the ‘From’ and ‘To’ point name are correct. Only the preexisting baseline names can be chosen.



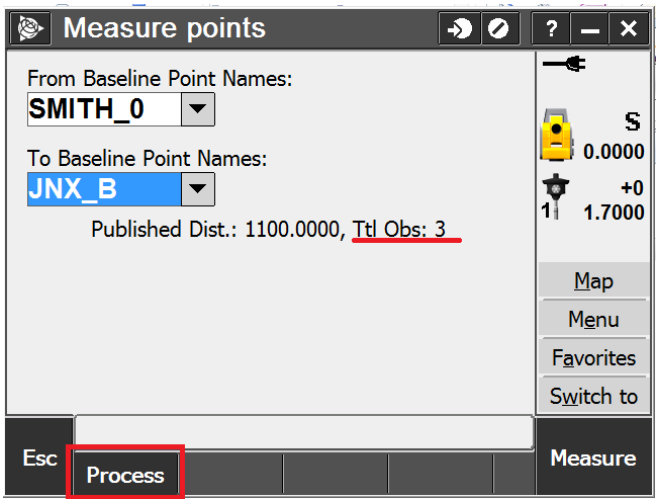
The published distance is displayed as well as the total number of observations that have been collected. Make sure you are leveled and sighting the ‘To’ point then Press the ‘Measure’ soft key to initiate the measurement.



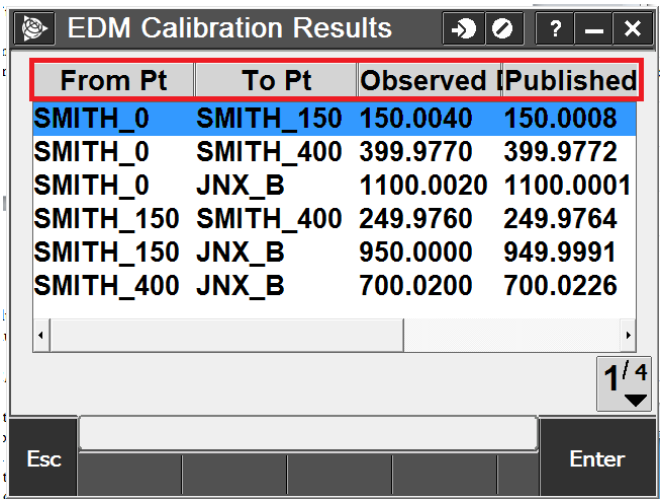
After the distance measurement has been collected the following screen is displayed allowing the review of the measurement before storing the measurement to the file. It's a good idea to compare the published distance to the measured horizontal distance before storing the measurement. Typically, there should only be a few millimeters difference between the measured and the published distance. Press the 'Store' soft key after reviewing the measurement.



After an observation has been stored the 'Process' button is available if three or more distances have been collected. Press the soft key 'Process' to obtain the results of the calibration.



The following screen shows the first page of the results report. The station names, the observed and published distances are displayed.



See the following EDMCheq Review pages for detailed information regarding results and reviewing the report.