Southern Cross Operations
Management System

GPS MINE-SITE CALIBRATION (FIELD) PROCEDURE

SURV-GEN-20030509

Revision: draft A

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<tr>
<td>Date Originated</td>
<td>9-May-03</td>
</tr>
<tr>
<td>Deployment Date</td>
<td></td>
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<tr>
<td>Next Revision Date</td>
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<td>Approval Date</td>
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<td>Archive Date</td>
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<tr>
<td>Printed</td>
<td>25-May-03</td>
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</tbody>
</table>

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# Table of Contents

1 PURPOSE .....................................................................................................................................................3  
2 SCOPE ..........................................................................................................................................................3  
3 DEFINITIONS................................................................................................................................................3  
4 PROCEDURE ...............................................................................................................................................4  
5 REFERENCES............................................................................................................................................16  
6 DOCUMENT REVISION HISTORY ..........................................................................................................16
1 PURPOSE

This procedure describes the steps required to complete a RTK Site Calibration.

It is set out in such a way as to act as a more detailed, mine surveying specific, replacement for pages 263 to 272 of the October 2001 release (Revision B) of the Trimble Real-Time Kinematic Surveying Training Manual, part number 33142-40.

The procedure also provides a tie-in of the local mine grid with the national grids (MGA94) via surrounding SSM's.

2 SCOPE

This document applies to all mine sites using Trimble 5700/5800 GPS receivers with TSce controllers.

3 DEFINITIONS

GPS components:

- Zephyr-Geodetic Receiver Antenna
- Base Receiver
- Base Radio
4 PROCEDURE

GPS Site Calibration (Field)
This section shows how to perform a calibration in the field, both manually and automatically.

Performing a Manual Site Calibration
To calibrate a survey manually, the general procedure is as follows:

1. Key in, transfer, or use a conventional instrument to measure the grid coordinates of the control (calibration) point. This is the mine grid primary survey control points. The list of these mine grid points should be categorized as to their order of precision.

2. Obtain the details of three Government SSM that surround the site.

3. Check or set the calibration tolerances. For more information, see Chapter 5, Coordinate Systems and GPS Site Calibration Theory.

262 Real-Time Kinematic Surveying
4. Measure the control points using GPS.
5. Name or select the pairs of points to be used for the calibration. A pair of points consists of the grid coordinates and the WGS-84 coordinates for the same point.
6. Perform the calibration.
7. Check residuals, and recalibrate if necessary.
8. Apply the calibration.
9. Obtain mine grid coordinates with GPS on three surrounding SSM’s.

**Note:** Carry out the complete calibration **before** staking out any points, computing offset and/or intersection points, or computing a resection from GPS points.

### Setting the Calibration Tolerances

To set the tolerances on the TSCe Controller:

- Click on the Configuration icon
- Select Survey Styles > then RTK > then Site Calibration
- Set the following screen:
Keying In Grid Coordinates

To key in grid coordinates:

1. From the main menu, select Key in / Points. The Key in/Point screen appears. Move the highlight to the Point name field and press [>].

2. Type the point name. Press [Enter].

3. Type details or features of the point in the Code field. Press [Enter].

4. Set the Type field to Coordinates. Check that the coordinate fields are North, East, and Elevation. If they are not, press [Options] and change the Coordinate view setting to Grid. Key in the known grid coordinates and press [Enter].

5. Set the Search class field to Control. (This ensures that the point is not overwritten by a measured point.) For more information on Search class rules, refer to the Trimble Survey Controller User Guide.

6. Repeat Steps 2 and 3 for all grid coordinate points. Then press [Esc] or [OK] to return to the Key in screen. Press [Esc] again to return to the main menu.

😊 Tip – Use a minimum of four 3D points. Up to 20 can be used in a combination of 1D, 2D, or 3D mine grid coordinates.

😊 Tip – The preferred convention is to use calibration points around the perimeter of the site, as in theory this is the limit of the validity of the calibration. However, in mine sites this is in almost all cases not a practical reality.
Transferring Grid Coordinates

Transfer coordinates using Trimble Geomatics Office, Data Transfer, or ASCII transfer.

Make sure that these coordinates are:

- Transferred as grid coordinates (N, E, E), not as WGS-84 coordinates (L, L, H)
- Control class points

Using GPS to Measure Calibration Points

Use GPS to survey the points. Trimble Survey Controller automatically matches the grid points to the WGS-84 values and then calculates, stores, and applies the calibration.

When one point has been calibrated or a projection and datum transformation have been defined, the [Find] soft key appears. You can use this to navigate to the next point.

As you measure another calibration point, the new calibration is calculated, stored, and applied to the job.

To measure a calibration point:

1. From the main menu, choose Survey.
2. From the Select Survey Style menu, choose your RTK Survey Style.
3. Select Measure points. Arrow down and change the Type field to Calibration point.
4. Access the Grid point name field and press [List]. A list of keyed in grid coordinates appears. Highlight the point to be measured and press [Enter]. The point name is inserted into the Grid point name field. The GPS point name field is filled in by Trimble Survey Controller depending on the settings in the Calibration point name field in the Site calibration option in the Survey Style.
Tip - If you have not yet keyed in the grid coordinates for this point, press [Key in] while the cursor is in the Point name field. The Key in/Point screen appears. Enter the coordinates and then press [Enter].

5. Enter values for the Code and Antenna height fields. Press [Enter] to accept the screen.

6. When the antenna is centered and vertical over the control point, press [Measure] or [Enter]. The data collector starts to record data. Keep the antenna vertical and stationary while data is recorded.

7. When the preset required time has elapsed, the [Store] softkey appears. Inspect the precisions. If they are satisfactory, press [Store] to store the point.

8. The calculations are then done automatically and the results are stored. While this is happening, the following messages appear:

   Please wait. Storing point
   Calculating calibration
   Storing calibration

   Note - When Trimble Survey Controller is performing an automatic calibration, the results of the calibration are not normally displayed. However, if a calibration exceeds the tolerances that have been set, the residuals are displayed. For more information, see the next section.

9. Enter the next calibration point name in the Point name field and press [Find]. The graphical display screen appears, with the azimuth and distance to the next point displayed on the right.

   To use the arrow display, start moving with the TSCE data collector held in front of you as normal. The arrow points in the direction of the next calibration point. Walk towards the point. About 10 feet (or 3 meters) from the point, the arrow disappears and the point is displayed.

   When the point is located, press [Esc]
10. Go back to Step 4 and measure the next calibration point. Repeat the procedure until all the calibration points are measured.

Selecting the Points Pairs and Performing the Calibration

The following steps describe how to select the points for a calibration and then perform the calibration using Trimble Survey Controller. Do this once you have entered grid coordinates, checked the settings in the Survey Style, and measured the points using GPS.

1. From the main menu, choose Survey. Select a real-time Survey Style.
2. From the Survey menu, choose Site calibration. The Site calibration screen appears.
3. Press [Add]. The following dialog appears:

![Calibration point dialog box](image-url)
4. Enter the name of the grid point. To do this, highlight the Grid point field and press [List]. Select a point that you have keyed in, transferred, or measured using a conventional instrument. Do the same for the GPS point field. The two point names do not have to be the same, but they should correspond to the same physical point.

Set the Use field as required. Choose whether to use the vertical coordinate of the grid point, the horizontal coordinates, or both horizontal and vertical coordinates.

😊 Tip – Pair up the primary or datum height point of the mine grid first.

😊 Tip – The origin of the horizontal calibration is the centroid of the measured calibration points. However, the origin of the vertical adjustment is the first point in the calibration that has an elevation.

5. Press [Calc]. The following dialog appears

The residuals for each point are not displayed until at least three 3D points are included in the calibration to provide redundancy.
6. Press [Results] to see the horizontal and vertical shifts that the calibration has calculated. The following dialog appears:

7. To add more points, press = to return to the Calibration screen.
8. Repeat Step 3 through 6. Continue until all the points are added.
9. Do one of the following:
   - If the residuals are acceptable, press [Apply] to store the calibration.
   - If the residuals are not acceptable, recalculate the calibration.
Checking the residuals

The calibration residuals are only displayed if the calibration tolerances are exceeded. The residuals appear in the following dialog:

If this happens, consider removing the point with the most extreme residuals:

- If at least four points are left after removing that point, recalibrate using the remaining points.
- If not enough points are left after removing that point, measure it again and recalibrate.

It may be necessary to remove (and measure again) more than one point.

To remove a point from the calibration calculations:

1. Highlight the point name and press [Enter].
2. Change the setting in the Use field to Off and press [Enter].
   The calibration is recalculated and the new residuals are displayed.
3. Press [Apply] to accept the calibration.
Recalculating a Calibration

Recalculate a calibration if the residuals are not acceptable, or if you want to add or delete points. Recalculate using one of the following:

- Some of the points
- Only the horizontal component of a point
- Only the vertical component of a point

To recalculate a calibration:
1. From the main menu, select Survey. Select a real-time Survey Style.
2. From the Survey menu, choose Site calibration.
3. Do one of the following:
   - To remove (exclude) a point, highlight the point name and press [Delete].
   - To add a point, press [Add]. For more information, see Step 4 on page 267.
   - To change which components are used for a point, highlight the point name and press [Enter]. Change the Use field as required. (Choose whether to use the vertical coordinate of the grid point, the horizontal coordinates, or both horizontal and vertical coordinates.)
4. Press [Apply] to apply the new calibration.

*Note* - Each calibration calculation is independent of the previous one. When a new calibration is applied, it overwrites any previously calculated calibration.
Using Autocalibrate

A calibration calculates the parameters needed to convert the GPS-measured coordinates into local grid coordinates. During an RTK survey, Trimble Survey Controller can do this automatically. When you use the Auto calibrate function, it automatically computes and stores a calibration every time a calibration point is measured.

In general, to calibrate a survey automatically:

1. Key in, transfer, or use a conventional instrument to measure the grid coordinates of the local control points.
2. Set the Auto calibrate field to Yes.
3. Use GPS to measure the calibration points.

These three steps complete the automatic calibration.

The following steps are optional:

4. Inspect the calibration results.
5. Change the results if they are unsatisfactory.

Setting Auto Calibrate to Yes

To set Auto calibrate to Yes:

1. From the main menu, choose Survey. The Select Survey Style menu appears.
2. Highlight your RTK Survey Style and press [Edit]. The menu that appears has the same name as the RTK Survey Style that you added.
3. Select Site calibration. The Site calibration screen appears.
4. Set the Auto calibrate field to Yes. For more information on site calibration see Chapter 5, Coordinate Systems and GPS Site Calibration Theory. Press \ to accept the screen. This takes you back to the menu for the chosen Survey Style.
5. Press [OK] or [Esc] to return to the Select Survey Style menu. Press [Esc] again to return to the main menu, or [Enter] to access the Survey menu.
GPS Site Calibration for Grid Transformations

A GPS site calibration establishes the relationship between WGS-84 points collected by GPS receivers, and local grid positions on a local map grid. The local map grid includes elevations above sea level, and the GPS data includes WGS-84 heights.

Published coordinate systems and geoid models do not usually allow for local variations in the projection. A GPS site calibration can reduce these variations and obtain more accurate local grid coordinates.

😊 Once a site calibration has been established from the mine survey control points, obtain mine grid co-ordinates of the SSM’s.

This will provide the transformation parameters between various grid systems and height datums.

😊 Set up the base receiver on one of the points used in the calibration.

On the Controller select Files > Open Job > select the site calibration file.

Set up the 5800 Rover Receiver on a SSM. Record the mine grid values on the SSM as a control point into the same calibration job file.

Take reading on two other SSM’s – if practical.

The co-ordinates obtained will be the ones used in grid transformations, such as the two point transformation in Surpac software.
5 REFERENCES

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<tr>
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<th>Number</th>
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6 DOCUMENT REVISION HISTORY

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<td>Draft A</td>
<td>OG</td>
<td>Initial draft</td>
<td>9/05/03</td>
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<tr>
<td>Draft B</td>
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