

EDM Baseline Calibration User Guide

Last updated January 2025

1. Introduction

Under the Licensed Surveyors (General Surveying Practice) Regulations 1961, regulation 20, the Surveyor General is to arrange for a standard or standards to be available to enable surveyors to comply with sub regulation 20(1). This sub regulation requires a surveyor to calibrate measuring equipment at regular intervals, not exceeding 2 years, and in accordance with acceptable practices. The Surveyor General has tasked Survey Services with providing the standards and acceptable practices enabling a surveyor to be able to comply with regulation 20. This procedure shall be applied whenever Landgate calibrates the Curtin, Kalgoorlie and Busselton EDM baselines (standards).

- Reason: Organises document management.
- Position: Geodesist.

2. Western Australian EDM Baselines

Landgate maintains three baselines in WA as well as the [Medjil Online Instrument Calibration](#) application which has been developed specifically for the calibration of EDM instruments over these baselines.

2.1. Curtin University baseline

This baseline is situated on Curtin University property parallel to Kent Street, Bentley. The baseline is managed by Landgate. Refer to this plan for access details and pillar locations.

The baseline consists of 12 co-linear pillars with the first 4 being closely spaced to the extent that for normal calibration operations only pillars 2 and 3 need be occupied.

The baseline is accessible by any vehicle at all times via the track alongside the length of the baseline. Permission is not necessary to use the baseline. Any conflict of usage should be decided on a first to occupy basis.

2.2. Kalgoorlie baseline

This baseline is situated on the Department of Mines and Petroleum, Explosives Reserve in Piccadilly Street, Kalgoorlie. Refer to this plan for access details and pillar locations.

Access to the facility is by any vehicle (when dry) during normal business hours after first obtaining the required entry permission. Any conflict of usage should be decided on first to apply basis.

Contact Reserve Manager, on phone number +61 (0)8 9091 7590 to make appointments to access the reserve.

The following conditions will need to be met for continued access to the site

- Requests for access, are made preferably at least one week in advance.
- The number of people coming onto the reserve to conduct calibration work is kept to an absolute minimum.
- People conducting the calibration must be accompanied at all times by a reserve officer while on the reserve.

The baseline consists of eight co-linear pillars.

2.3. Busselton baseline

This baseline is situated on Reserve 44755. It runs parallel to and to the North of the Busselton Bypass Road, 1.3 Kilometres west of Redgum Way. The baseline is managed by Landgate. Refer to this plan for access details and pillar locations.

The baseline is accessible by any vehicle at all times via the track alongside the length of the baseline, with entry via the west end of the truck bay. Permission is not necessary to use the baseline. Any conflict of usage should be decided on a first to occupy basis.

The baseline consists of six co-linear pillars.

3. EDM Baseline Calibration Procedure

3.1. Request a job to calibrate baselines

Curtin, Kalgoorlie and Busselton EDM baselines are calibrated every 2 years. The last date of calibration can be found on the current Regulation 13 certificate (see GS7/88/33). A geodetic job number is to be created for each of the baseline.

High precision EDM (EDM and prism) must be used to calibrate the EDM baselines. The EDM must be calibrated by an accredited NATA laboratory and requires a current Regulation 13 certificate. Baseline measurements must be performed in accordance with the ISO17123-4:2012 Optics and optical instruments – Field procedures for testing geodetic and surveying instruments – Part 4: Electro-optical distance meters (EDM measurements to reflectors).

The following EDM should be used to calibrate EDM baselines:

- TS30 s/n 364182 and GPH1P prism s/n 100

A current calibration report is also required for all meteorological instruments used in the process of EDM baselines calibration. These instruments are to be calibrated externally by an accredited NATA laboratory. The following meteorological instruments should be used to calibrate EDM baselines:

- Temperature and relative humidity meter s/n 21002807
- Temperature and relative humidity meter s/n 21002811
- Barometer s/n 74003848
- Barometer s/n 11945508

External calibrations are to be undertaken in accordance with CAL-02 document.

- Reason: Maintains legal traceability of equipment for baseline calibration.
- Position: Geodesist.

3.2. Field Booking Sheets

Field Booking Sheets are available here:

- Curtin University Baseline
- Kalgoorlie Baseline
- Busselton Baseline

3.3. Field procedure

Prior to any EDM baseline calibration a notice (email) must be forwarded to the Land Surveyors Licensing Board for it to inform all relevant institutions and practicing licensed surveyors that the relevant EDM baseline will be closed between certain dates due to calibration activities.

All observation should commence only after the daily temperatures have stabilised. Temperature should not fluctuate more than 10°C.

The instrument is initially set up on Pillar 1 and the prism on Pillar 2. An umbrella must shade the EDM instrument and meteorological instruments. The height of the EDM instrument and prism are measured and recorded at each pillar.

Meteorological observations of pressure, relative humidity and temperature are recorded for each distance measured. These measurements should be taken at the instrument and prism. Ensure meteorological equipment has stabilised before making observations.

Meteorological observations should not fall outside of the range for which the instrument has been calibrated. Below are the current ranges.

- Temperature: +10 to +40°C
- Pressure: 750.00 to 1150mbars
- Relative Humidity: 11 to 75 %RH

Meteorological observations and the instrument and prism heights are entered into the EDM instrument. A minimum of four distances are measured at each setup and the prism is moved progressively through all pillars. The EDM instrument is then moved to Pillar 2 and the prism is moved back through all pillars to Pillar 1, measuring in the above manner. This process is repeated until the EDM instrument has occupied all pillars.

Short distances of 10 metres were not measured prior to 2021, however these distances are now observed.

Recommended sequence of measurements for calibration:

CURTIN UNIVERSITY BASELINE

Place EDM on pillar 2 and measure to pillars 4, 5, 6, 7, 8, 9, 10, 11B and 12 in turn. Then shift EDM to pillar 3 and measure to pillars 12, 11B, 10, 9, 8, 7, 6, 5 and 4 in turn. This sequence requires the reflector to be moved up and down the line only once.

KALGOORLIE BASELINE

Place EDM on pillar 1 and measure to pillars 3, 4, 5, 6, 7 and 8 in turn. Then shift EDM to pillar 2 and measure to pillars 8, 7, 6, 5, and 4 in turn. This sequence requires the reflector to be moved up and down the line only once.

BUSSELTON BASELINE

Place EDM on pillar 1 and measure to pillars 2, 3, 4, 5 and 6 in turn. Shift EDM to pillar 2 and measure to pillars 6, 5, 4, 3 and 1 in turn. Shift EDM to pillar 3 and measure to pillars 4, 5 and 6 in turn. Shift EDM to pillar 4 and measure to pillars 6 and 5. Then shift EDM to pillar 5 and measure to pillar 6.

The pillar alignment and height differences must be verified. All observations are recorded digitally and manually on booking sheets. Observations to be signed and stored by geodesist in an ECAL folder.

- Reason: Observe data to compute the new baseline distances.
- Output: Completed observation booking sheets and digital file.
- Position: Geodesist.

3.4. EDM Baseline interlaboratory comparison

After completing the EDM Baseline survey and calibration as per 2.3, another EDM Baseline should be surveyed using the same instrument for the purpose of interlaboratory comparison.

In Western Australia the following instrument and prism must be used for calibration and interlaboratory comparison:

S16 s/n 3012827 and GPH1P prism s/n 100

This EDM calibration is to be undertaken in accordance with CAL-03.

- Reason: Capture data for evaluation of calibrations. Ref ISO 17025:2017 7.2.2.

- Position: Geodesist.

3.5. Import observations into the EDM Baseline calibration portal

Prior to importing, the EDM baseline observations must be corrected by the values provided in the Table 2 (results of measurement) of the NMI calibration report. Only the corrected observations are then imported into the "Baseline calibration" portal for processing to determine the new certified distances and uncertainties of the EDM Baseline.

- Reason: Computation of Certified EDM Baseline distances.
- Position: Geodesist.

3.6. Data entry QA

All data must be verified by the Senior Geodesist (or another Senior Property Location Officer) by comparing a hardcopy print of the input data with the original baseline booking sheets.

Any errors found must be corrected before the computation.

- Reason: Data QA control.
- Position: Senior Geodesist

Inspect the calibration report and certificate and compare the new certified distances against the previous certified distances. Large residuals may indicate pillar movement or an error in the calibration process. If differences between new and previous certified distances are found included in the final report potential reason for the difference (e.g. pillar movement).

- Reason: Ensures no gross errors and/or pillar movement.
- Position: Geodesist

3.7. Estimate uncertainty of distances

The estimation of uncertainty is to be considered in conjunction with ISO 17123:4.

The estimated EDM baseline distances are influenced by the following sources of uncertainty:

- Uncertainty of the EDM measurement
- Atmospheric measurements
- Error patterns from mechanical setup
- Rounding error quantities

The following table lists the error budget used for the calculation of uncertainty of EDM Baseline's distances:

Sources of uncertainty	Evaluation	Distribution
Uncertainty of the EDM measurement		
1. EDM scale factor	B	Normal
2. EDM scale factor (temp. effect)	B	Rect.
3. EDM scale factor (drift over time)	B	Rect.
4. EDM zero offset	A	Normal
5. LS fit uncertainty fixed term	A	Normal
6. LS fit uncertainty proportional term	A	Normal
Uncertainty of atmospheric measurements		
7. Temperature uncertainty	B	Normal
8. Pressure uncertainty	B	Normal
9. Humidity uncertainty	B	Normal
Error patterns from mechanical setup		
10. Levelling and centring (axial)	B	Normal
11. Heights & offsets (transverse)	B	Normal
Rounding error quantities		
12. Heights & offsets (transverse)	B	Rect.

Calculation of these uncertainties should be done with the template CAL-01E.