

Baseline Calibration

There is a need and often a legal requirement to have your instrument checked over an official baseline, typically once per year - after your annual service would be a good time! The procedures and calculations differ by state.

Below we have specified the parameters you will need to feed into the baseline calculation softwares, so that the atmospheric correction to the measured distance can be calculated. The atmospheric correction is also referred to as the 'First Velocity Correction' Note that the C and D parameters as used in Rüeger's formula (see below) have been derived from the ppm formula listed in the operators manuals. Similarly, the Unit of Length is derived from the modulating frequency which is in Sokkia's service manuals. The instruments use multiple modulation frequencies (harmonics of the fundamental frequency), depending on the EDM mode selected. A unit of length of e.g. 2 meters corresponds to a wavelength of 4 meters which (rounded) corresponds to a 75MHz frequency. The value of the Unit of Length determines what baseline lengths to use, so what pillar combinations to set up on. So before you go out into the field, you'll need to know what the Unit of Length of your total station is.

Sometimes the available pillars are a legacy from the past, e.g. only a multiple of 10.0000 meters is available. In that case cyclic errors have to be identified in a different manner (NSW). Talking legacy, have a look at the US NGS service - a *1977* manual on the [use of baselines](#).

EDM type/ Instrument Series	Unit of Length (=half of modulation wavelength)	EDM source	C (Rüeger)	D (Rüeger)	modulation frequency (rounded, in MHz)
iX series iX1001,iX1002,iX1003,iX1005 ()	0.8m?	Red Laser diode (690 nm)	282.324	80.3826	TCXO 29.971
SX (SX101,SX103,SX105) SRX X (SRX1X,2X,3X,5X) (RED- tech800)	0.32m	Red Laser diode (690 nm)	282.324	80.405	468.75MHz
SRX (SRX1,2,3,5) (RedTech EX) SET X	0.8m	Red Laser diode (690 nm)	282.59	80.361	187
FX (FX101,FX102,FX103,FX105,FX107) CX (CX102,CX103,CX105,CX107)	4m	Red Laser diode (690 nm)	282.324	80.405	37.4635

30R (RedTech and RedTech II) 30R,130R,030R instruments (R and R3), 50RX e.g. SET230R, SET530RK3, SET4230RM, SET550RX	2m	Red Laser diode (690 nm)	282.59	80.361	74.927
NET1200	2m	Infrared LED	282.59	80.361	75
EZStation 20/20A,21/21A	2.5m	660nm red laser !			60
SET 3110R,4110R	5m	830nm infrared LED !			30
SET220 series (SET2220,3220,4220) SET110M series (SET3110M,4110M) SET110 series (SET2110,3110,4110) SET010 series (SET1010,2010,3010,4010) SET000 series (PowerSET1000,2000,3000,4000) SET 10 series (SET310,510,610) SET100 series (SET 2100,3100,4100) SET00 series (SET300,500,600, incl S models) SET5W,SET3Bii SET3E,SET4E SET3F,SET5F BII series: SET2BII,3BII,4BII CII series: SET2Cii,3Cii,4Cii	5m	860nm Infrared LED	278.96	79.323	30MHz
SET2,3,4 SET4A SET2B,3B,4B, (not: SET2Bii,3Bii,4Bii,) SET2C,3C,4C all RED's, all SDM's	10m	860nm Infrared LED	278.96	79.323	15MHz
SET5,6 + S models SET5A SET5E,6E SET6F	20m	860nm Infrared LED			7.5MHz

In the EDM handbooks issued in SA and VIC the unit of length is listed for a large number of survey instruments, sometimes different from the above ...

SA landservices.sa.gov.au

VIC EDM handbook v9 , Vict Lands

Handbooks:for other States:

NSW [Direction No 5 - verification of Distance Measurement Equipment](#)

ACT [EDM calibration handbook](#)

WA [EDM Calibration](#)

The correction K_a to be added to the measured distance d_{meas} , can be calculated using Rüeiger's formula,

from NSW Surveyors General's Directions No5, Aug 2004:

$$K_a = \left[C - \frac{D * p}{273.15+t} + \frac{11.27 e}{273.15+t} \right] 10^{-6} d_{meas}$$

Where

'p'= pressure in millibars

't'= temperature in degrees Celcius

'e'=partial water vapour pressure (mb) ; ($p_{\text{millimetres}} = 0.75006 p_{\text{millibars}}$)

'C' and 'D' are parameters specific to the modulation frequency and the carrier wavelength respectively of the EDM instrument.

Sokkia uses a different representation of the same formula, e.g. from the manual for the x30R instruments: (just multiply below and above the dividers with 273.15 to see Rüeiger's formula appear)

Atmospheric Correction Factor

$$\left(282.59 - \frac{0.2942 * p}{1+0.003661*t} + \frac{0.0416 * e}{1+0.003661*t} \right) * 10^{-6}$$

t: Air temperature in °C

p: Pressure in hPa

e: Water vapour pressure in hPa

h: Humidity in %

ew = Saturated water vapour pressure