Calibration Certificate

Model: Focus Premium Serial Number: LLS092332712 Certificate Number: LLS32712-20231113-TH Certification Date: 13-Nov-2023

Measurement Items Used, Traceable to National Standards

Laser Tracker
Model: Vantage Serial No.: V01001405346 Cert. No.: V05346-12062023 Cert. Date 12-Jun-2023

Reflectance Targets
Model: CalibLine Target 90% Serial No.: 6631 Cert. No.: 22120516 Cert. Date 5-Dec-2022
Model: CalibLine Target 10% Serial No.: 6630 Cert. No.: 22120515 Cert. Date 5-Dec-2022

Power meter
Model: XLP12-3S-H2-D0 Serial No.: 298082 Cert. No.: 298082-221216 Cert. Date 15-Dec-2022

Calibration Results

3D Position Accuracy

Target 1	Target 2	Zone	Distance [m]	Uncertainty, k=2 [mm]	Scanner [m]	Deviation [mm]	Spec., k=1 [mm]	Spec., k=2 [mm]	Result
ZK71	ZK72	10 m	3.21049	0.20	3.21036	-0.14	1.5	2.0	pass
ZK72	ZK73	10 m	2.34512	0.20	2.34538	0.27	1.5	2.0	pass
ZK73	ZK74	25 m	16.00177	0.20	16.00263	0.86	1.5	2.0	pass

Ranging Noise

Reflectance	Distance	Uncertainty, k=1 [mm]	Scanner	Specifications	Result
90%	10 m	0.067	0.1	0.1	pass
	25 m	0.067	0.1	0.2	pass
10%	10 m	0.067	0.1	0.3	pass
	25 m	0.067	0.2	0.4	pass
2%*	10 m	0.067	0.3	0.7	pass
	25 m	0.067	0.7	1.2	pass

* All measurements were performed with a nominal laser output power of 20% of the standard laser output power using the calibrated 10% reflectance targets. The exact output powers were measured with the calibrated power meter.

The results of this certificate relate only to the items calibrated or tested.
The calibration is done at FARO or FARO Scanner Production operations sites according to FARO test protocols integrating guidelines defined in the Joint Committee for Guides in Metrology guidance document JCGM 100:2008 - Evaluation of measurement data - Guide to the expression of uncertainty in measurement, and the requirements for traceability according to the International Vocabulary of Basic and General Terms in Metrology (VIM) and the National Institute of Standards and Technology (NIST).

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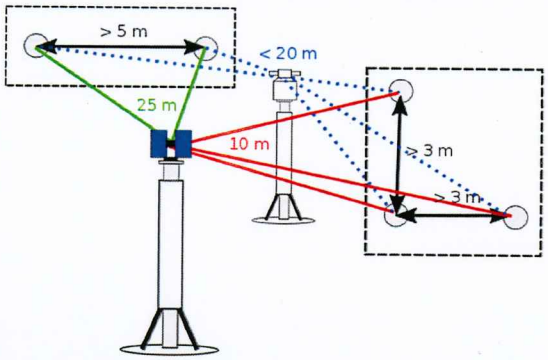
3D Position - Uncertainty Budget

The 3D Position calibration is performed by scanning spheres in distances of ca. 10m and 25m and comparing the distances between these spheres measured with the scanner to the distances between these spheres measured with a reference laser tracker.



Uncertainty Contributors

Absolute position of the spheres:
FARO Vantage Tracker: Point to Point Accuracy (20m max):

$$u_{ref} = 0.085\ mm$$

Repeatability of tactile determination of sphere center:

$$u_{tact} = 0.06\ mm$$

SMR center error:

$$u_{SMR} = 0.007\ mm$$

Combined Uncertainty

Combined standard uncertainty $u_{c3DPosition-k1}$ for k = 1:

$$u_{c3DPosition-k1} = \sqrt{u_{ref}^2 + u_{tact}^2 + u_{SMR}^2} = 0.1\ mm$$

Combined standard uncertainty $u_{c3DPosition-}$ for k = 2:

$$u_{c3DPosition-k2} = 2 * u_{c3DPosition-k1} = 0.2\ mm$$

Further details regarding the uncertainty budget are available on request.

Ranging Noise Measurement - Uncertainty Budget

Ranging noise is defined as a standard deviation of values of the best-fit plane.

Combined standard uncertainty u_{cNoise}:

$$u_{cNoise} = 0.067mm$$

All measurements for this calibration certificate were made with a measurement speed of 122,000 points/sec.