

Test report No 111-01519

Object

Goniometer GA-1L

11.2004

Serial no: 09030302

Order

Performance test according to procedure as specified by the

applicant

Applicant

ZG Optique SA

Fin-de-Praz 24 CH-2024 St. Aubin

Traceability

The reported measurement values are traceable to national

standards and thus to internationally supported realizations of

the SI-units.

Date of test measurements

16 May 2006

Marking

Calibration label METAS 05.2006

CH-3003 Bern-Wabern, 16 May 2006

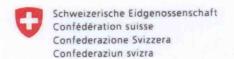
For the measurements

Section Length, Optics and Time

R. Talenau

Jörg Scheidegger

Dr Rudolf Thalmann, Head of Section



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Test procedure and conditions

The measurements and the evaluation of the data have been carried out according to a procedure specified by the applicant (see appendix to this report). The optical polygon used for these measurements was 8-sided, from glass, and calibrated at METAS at the same time using independent equipment (certificate no 111-01518). The entire procedure was performed two times. In the following, the results of the second measurement are reported.

The laboratory temperature during the measurements was (20 ± 0.5) °C.

Measurement results

Average standard deviation

 $u_1 = 0.026$ "

Type B uncertainty contributions

 $u_2 = 0.104$

 $u_3 = 0.019$ "

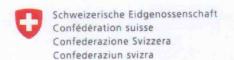
Combined standard uncertainty

 $u_c = 0.11$ "

Comparison of polygon measurements

Pitch angles between adjacent faces

Position	$\widetilde{\varphi}_i$ (GA-1L)	φ_i^{tr} (METAS)	$\delta_i = \widetilde{\varphi}_i - \varphi_i^{tr}$
1-2	1.93"	(1.94 ± 0.1)"	-0.01"
2-3	0.91"	(0.91 ± 0.1)"	0.00"
3-4	-0.20"	-(0.17 ± 0.1)"	-0.03"
4-5	0.09"	(0.08 ± 0.1)"	0.01"
5-6	-0.20"	-(0.23 ± 0.1)"	0.03"
6-7	0.31"	(0.32 ± 0.1)"	-0.01"
7-8	-2.01"	-(2.02 ± 0.1)"	0.01"
8-1	-0.83"	-(0.82 ± 0.1)"	-0.01"



Appendix to Test Report No 111-01519

Test procedure for Automatic Goniometer GA-1L in goniometer mode

- The procedure of the performance test should be carried out by means of standard n-faced optical polygon (OP) calibrated by the Swiss Federal Office of Metrology (METAS).
- 2. The procedure of performance test considers the evaluating of the following parameters:
 - Standard uncertainty,
 - · Combined standard uncertainty.
- The central angles of the OP φ_i are measured.
- 4. The OP is turned in relation to the rotary table on the angle that is equal to the nominal value of the central angle of the OP.
- 5. The central angles of the OP are measured again.
- 6. Then the points 4 and 5 are carried out again and so on until n measurement are made, where n is the number of the OP faces. As a result we have an array of angle values φ_{im} where i is a number of angle between faces i and i+1, and m is the number of the OP position.
- 7. The mean values of the angles $\widetilde{\varphi}_i$ are estimated using the averaging upon the different positions of the OP:

$$\widetilde{\varphi}_i = \frac{1}{n} \sum_{m=1}^n \varphi_{im}$$

8. The uncertainty (type A) is determined as average of standard deviations σ_{im} over all faces and all positions

$$u_1 = \sqrt{\frac{\sum\limits_{i=m}^{n}\sum\limits_{m}^{n}\sigma_{im}^2}{n \cdot n}}$$

9. The uncertainty (type B) is determined as

$$u_2 = \frac{\max \left| (\widetilde{\varphi}_i - \varphi_{im}) \right|}{\sqrt{3}},$$

$$u_3 = \frac{\max \left| (\widetilde{\varphi}_i - \varphi_i^{tr}) \right|}{\sqrt{3}}$$

Where φ_i^{tr} are the true values of central angles obtained at calibration of the OP.

10. The combined standard uncertainty is determined as

$$u_c = \sqrt{u_1^2 + u_2^2 + u_3^2}$$

Note: The single measurement for GA-1L is considered as the measurement during 16 revolutions of the rotary table. φ_{im} , σ_{im} are the results of the single measurement the central angle value and the standard uncertainty, correspondingly.

Prof. Dr. Yuri Filatov