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## Certificate of calibration

No. 113-3296

Object

**Spherical standard of ceramic (Al<sub>2</sub>O<sub>3</sub>), ø 35 mm**  
Identification: 35-00-087

Order

Calibration of diameter and roundness deviation

Applicant

**SIP, Société Genevoise d'Instruments de Physique**  
CH-1217 Meyrin

Traceability

The reported measurement values are traceable to national standards and thus to the SI-units.

Date of calibration

2. and 5. July 2001

Marking

metas-calibration label

CH-3003 Bern-Wabern, 5 July 2001 Sp

For the measurements

Division of Mechanics, Radiation and Legal Metrology

Jürg Spiller

*Bruno Vaucher*

Dr. Bruno Vaucher, Deputy Director



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Bundesamt für Metrologie und Akkreditierung  
Office fédéral de métrologie et d'accréditation  
Ufficio federale di metrologia e di accreditamento  
Swiss Federal Office of Metrology and Accreditation

Eidg. Justiz- und Polizeidepartement  
Département fédéral de justice et police  
Dipartimento federale di giustizia e polizia  
Federal Department of Justice and Police

**Certificate of calibration (ctd.)****No. 113-3296****Extent of calibration**

Mean diameter and deviation from roundness of the sphere.

**Measurement procedure and conditions**

The diameter was calibrated on a length measurement machine using a laser interferometer with mechanical probing.

Measurement probes: plane, hard metal, 5 mm diameter

Measurement force: 1.3 N

The measurement force produces an elastic compression of the sphere, which has been calculated to be  $0.20 \mu\text{m}$ . The measurement result is given for zero measurement force, i.e. a correction by this value.

The roundness measurement was carried out on a roundness measurement machine with a rotating spindle. The sphere was measured in the equatorial plane perpendicular to the spindle axis (Plane 1) and in two planes tilted by  $45^\circ$  with respect to the equatorial plane (planes 2 and 3). The deviations were determined from the average of five succeeding measurement profiles, thereby separating the run out errors of the spindle from the roundness deviation of the component.

Probing element: ruby sphere, 4 mm diameter

Measurement force: 50 mN

Filter: digital filter, 1-150 upr, 2RC, phase corrected

The roundness deviation was measured according to ISO 6318. It is defined as the peak-to-valley deviation from the least squares (LS) circle fitted to the measured profile.

The ambient temperature during the measurements was  $(20 \pm 0.2)^\circ\text{C}$ . The temperature of the sphere gauge was  $20.19^\circ\text{C}$ . The diameter results were corrected to the reference temperature of  $20^\circ\text{C}$  assuming a linear coefficient of thermal expansion of  $5 \cdot 10^{-6} \text{ K}^{-1}$ .

**Measurement results**

Identification	Measured Diameter	Roundness Plane 1	Roundness Plane 2	Roundness Plane 3
35-00-087	34.998'93 mm	0.07 $\mu\text{m}$	0.11 $\mu\text{m}$	0.10 $\mu\text{m}$

**Measurement uncertainty**

diameter:  $U = 0.20 \mu\text{m}$

roundness:  $U = 0.05 \mu\text{m}$

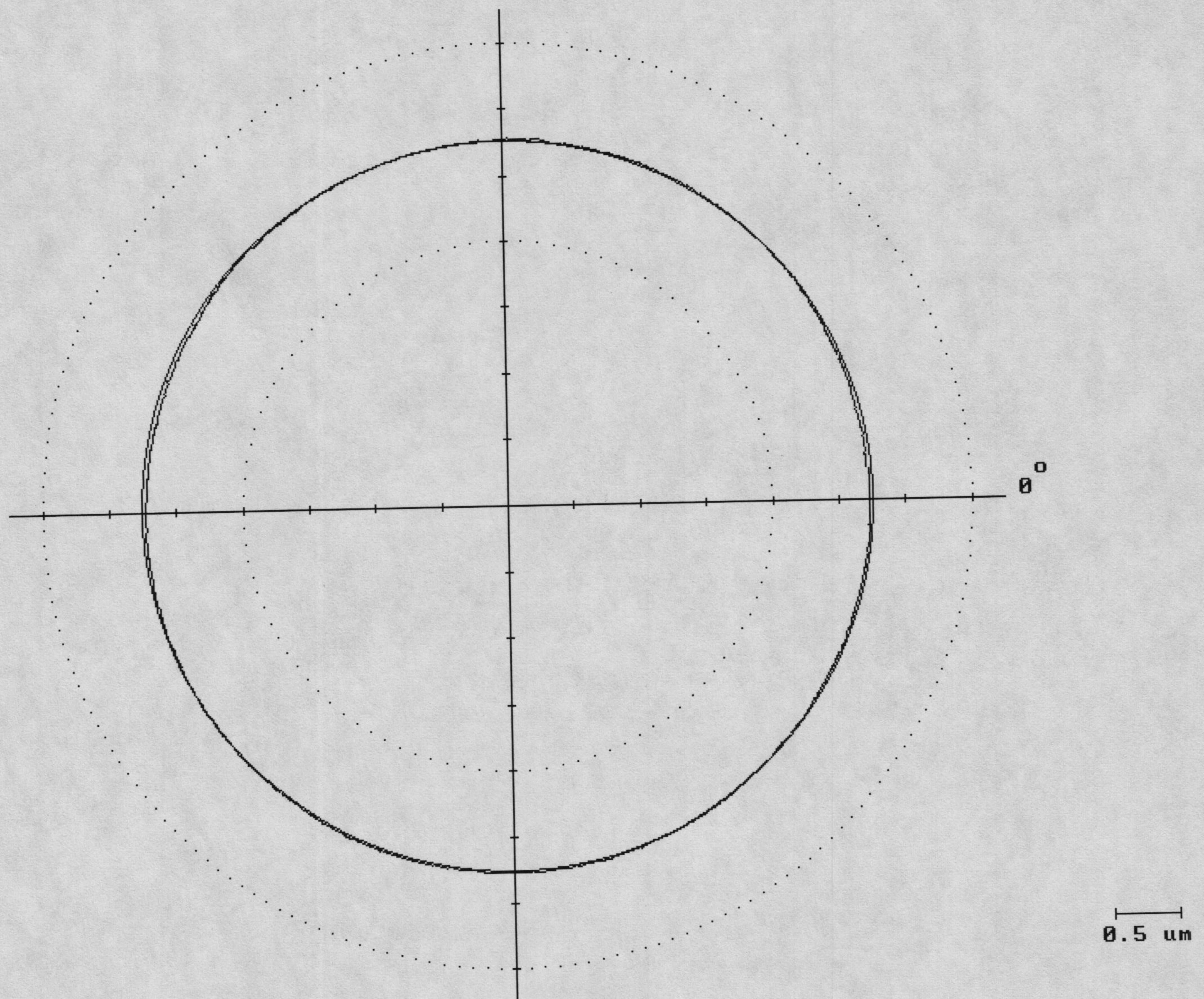
The reported uncertainty of measurement is stated as the combined standard uncertainty multiplied by a coverage factor  $k = 2$ . The measured value ( $y$ ) and the associated expanded uncertainty ( $U$ ) represent the interval  $(y \pm U)$  which contains the value of the measured quantity with a probability of approximately 95%. The uncertainty was estimated following the guidelines of the International Vocabulary of Metrology (VIM).

The measurement uncertainty contains contributions originating from the measurement method, from the environmental conditions and from the object being measured.

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Datum 03-07-101 10:12  
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Bemerkung

Spherical standard of ceramic  
No. 35-00-087  
Plane 1



LS RUNDHEITS-RESULTATE

○	0.07 μm	Messmodus	Extern
E	0.00 μm	Z-Hoehe	150.0 mm
∠	0.0 deg	Filter	150 W/U 2CR
↗	0.07 μm	Profil	Vollstaendig

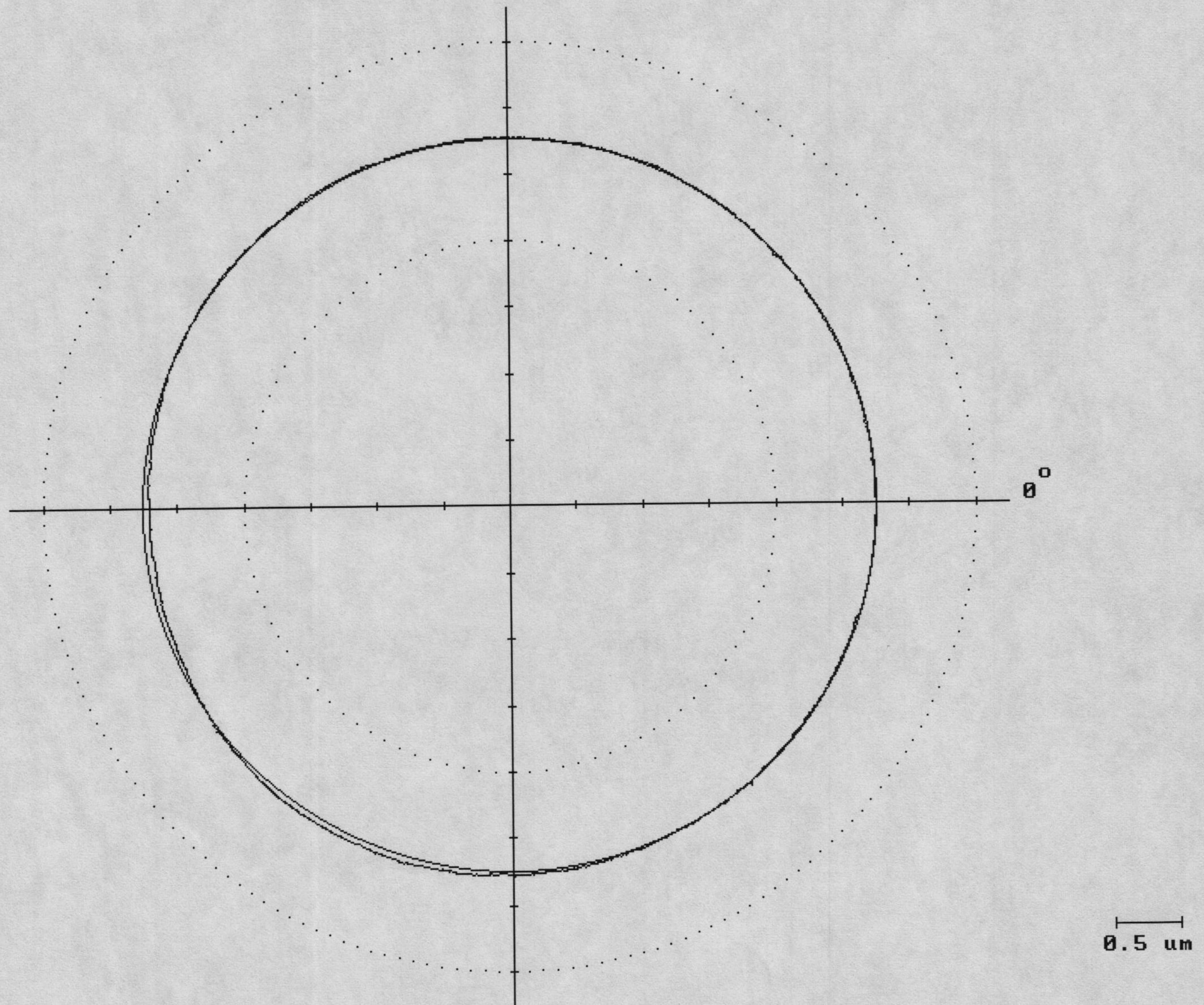
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Bemerkung

Spherical standard of ceramic  
No. 35-00-087  
Plane 2



LS RUNDHEITS-RESULTATE

○	0.11 μm	Messmodus	Extern
E	0.00 μm	Z-Hoehe	150.0 mm
∠	0.0 deg	Filter	150 W/U 2CR
↗	0.11 μm	Profil	Vollstaendig

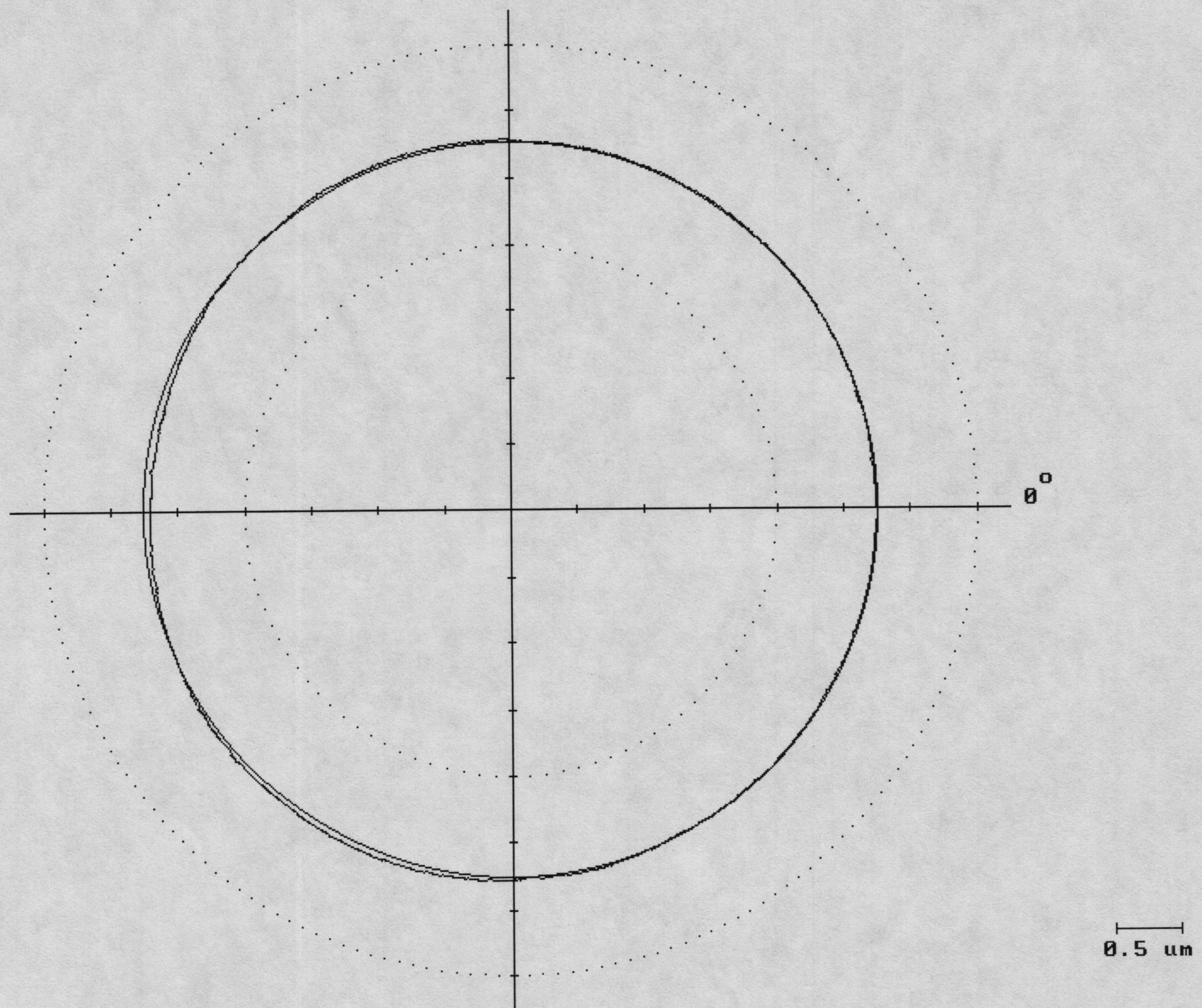
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Teilebez. SIP87 30  
Bemerkung

Spherical standard of ceramic  
No. 35-00-087  
Plane 3



LS RUNDHEITS-RESULTATE

○	0.10 um	Messmodus	Extern
E	0.00 um	Z-Hoehe	150.0 mm
∠	0.0 deg	Filter	150 W/U 2CR
↗	0.10 um	Profil	Vollstaendig

Referenz : SPINDEL

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