m e t a s

metrologie und akkreditierung schweiz

Certificate of calibration No. 113-3217

Object	**1 plug gauge made of steel, ø 50 mm** Identification: SIP 43046
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	18. April and 3. May 2001
Marking	metas-calibration label

CH-3003 Bern-Wabern, 8 May 2001 Sp

For the measurements	Division of Mechanics, Radiation and Legal Metrology
J. Spiller	i.V. C. Vaucher
Jürg Spiller	Dr. Bruno Vaucher, Deputy Director

metas
Lindenweg 50, CH-3003 Bern-Wabern
Telefon +41 31 32 33 111, Telefax +41 31 32 33 210
www.metas.ch

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

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Extent of calibration

The diameter and roundness deviation at three heights of the cylinder were measured.

Measurement procedure and conditions

The diameter of the plug gauge was calibrated on a length measurement machine using a laser interferometer and mechanical probing, according to the internal calibration procedure 11370K02.

Measurement probe: ruby sphere, ø 4 mm
Measurement force: extrapolated to zero
Measurement direction: between the reference marks, parallel to the marking, perpendicular to the cylinder axis

The roundness measurement was carried out on a form measurement machine.
Measurement probe: ruby sphere, ø 4 mm
Measurement force: < 0.05 N
Filter: 2-50 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 ± 0.2) °C. The temperature of the ring gauge was 19.88 °C. The diameter results were corrected to the reference temperature of 20 °C assuming a linear coefficient of thermal expansion of $11.6 \cdot 10^{-6}$ K^{-1}.

Measurement results

Identification	Measurement position from front face of cylinder	Measured diameter	Roundness
SIP 43046	5.0 mm	50.010'25 mm	0.05 µm
	12.5 mm	**50.010'20 mm**	**0.09 µm**
	20.0 mm	50.010'12 mm	0.09 µm

Measurement uncertainty

diameter: U = 0.15 µm
roundness: U = 0.10 µm

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 ISO.

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

- Attachment: 4 form measurement protocols

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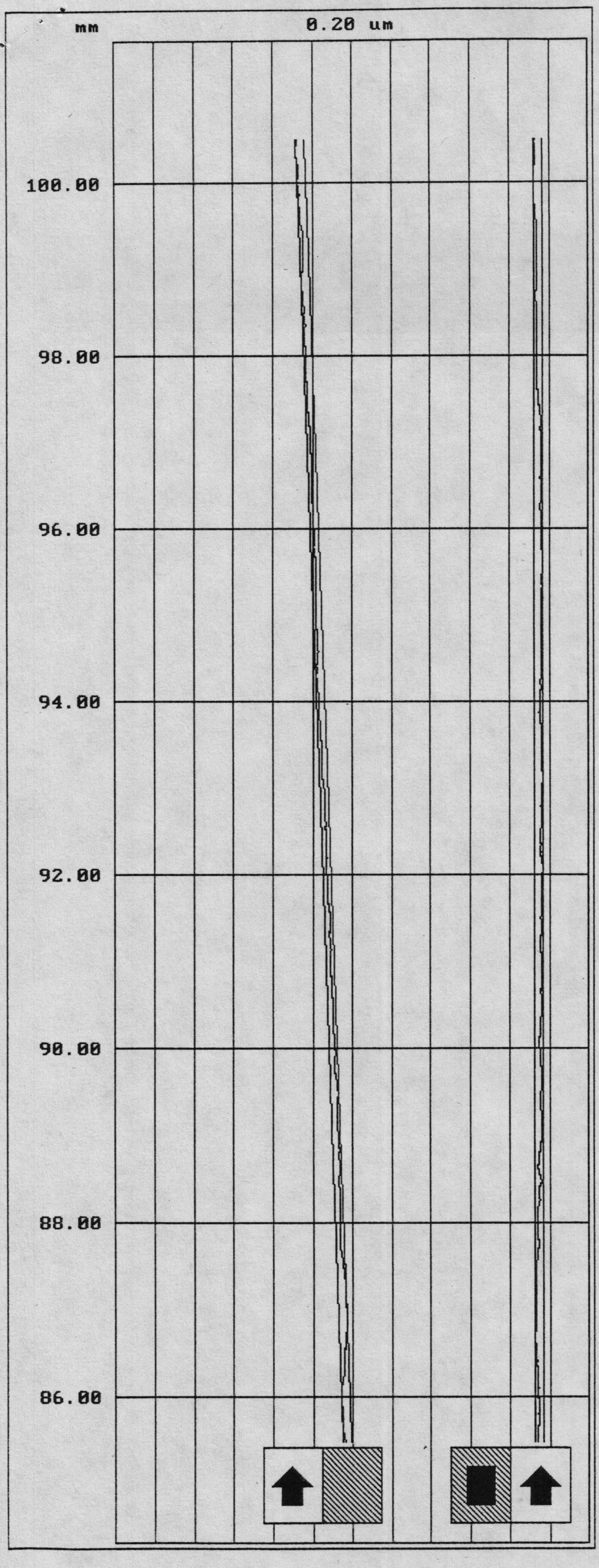

RTH TR300 V04.00 SO

metas, Bern-Wabern

MZ VERT PARALLELISM

Featurename	EAMD
Measurement no.	04
Par.	0.26 um
P-V	0.05 um
Par Angle	-3.2 sec
Trav. Lth.	15.0 mm
Trav. Start	85.5 mm
Trav. End	100.5 mm
Spindle ang.	0.0 deg
Datum	EAMD 03
Filter	0.80 mm
Profile	100.0 %
Meas. Mode	Vert. Up
Meas. date	
Meas. time	20:20:50

SIP

Pflug gauge , SIP , D = 50 mm

1217 Meyrin

Ident. No:43046