



# Certificate of Calibration No 115-02266

**Object** **Line Scale**  
Length 50 mm, interval 0.1mm

Manufacturer: Mitutoyo  
Type: 172-116  
Serial Number: 25921

**Order** Calibration of various intervals of the line scale.

**Applicant** **MPT sistemi d.o.o**  
Čečovje 17b  
2390 Ravne na Koroškem

**Traceability** The reported measurement values are traceable to national standards and thus to internationally supported realizations of the SI-units.

**Date of Calibration** 06.06.2012


**Marking** Calibration label METAS 06.2012

CH-3003 Bern-Wabern, 06 June 2012

For the Measurements

Section Length, Optics and Time

  
Daniel Schneeberger

  
Dr Rudolf Thalmann, Head of Section



## Mutual recognition

This certificate is consistent with Calibration and Measurement Capabilities (CMCs) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures. Under the MRA, all participating institutes recognize the validity of each other's calibration certificates and measurement reports for the quantities, ranges and measurement uncertainties specified in Appendix C (for details see [www.bipm.org](http://www.bipm.org)).



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### Extent of the Calibration

The glass scale was calibrated from 0 mm to 50 mm in steps of 5 mm.

### Measurement Procedure

The distances between the graduations were measured with a photomask measuring system consisting of a precision x-y air bearing table, a two-axis differential plane mirror interferometer and a microscope. The table moves the graduations to the focus of microscope while the interferometer measures its position. The relative position of a graduation within the field of view of the microscope is determined by digital image analysis.

The scale was cleaned, supported at its ends and was measured with the graduation on top. The positions of the line centres were evaluated at half the length of the shortest lines (reference line).

### Measurement Conditions

The temperature of the glass scale was 20.02 °C. The measurement results were corrected to the reference temperature of 20°C assuming a linear coefficient of thermal expansion of  $8.5 \cdot 10^{-6} \text{ K}^{-1}$ .

### Measurement Results

From 0 mm to 50 mm, step 5 mm:

Interval (mm)	Measured value (mm)	Deviation ( $\mu\text{m}$ )
0 .. 5	4.99965	-0.35
0 .. 10	9.99957	-0.43
0 .. 15	14.99969	-0.31
0 .. 20	19.99886	-1.14
0 .. 25	24.99851	-1.49
0 .. 30	29.99872	-1.28
0 .. 35	34.99929	-0.71
0 .. 40	39.99896	-1.04
0 .. 45	44.99879	-1.21
0 .. 50	49.99957	-0.43

Uncertainty of measurement :  $U = 0.20 \mu\text{m}$

### Remark

As the graduations are not perfectly parallel to each other, an additional contribution to the uncertainty must be taken into account if there is a deviation from the reference line as defined above. For this scale the contribution is up to  $0.7 \mu\text{m}$  for 1 mm deviation from the reference line.



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### Uncertainty of Measurement

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. The long-term characteristic of the object being calibrated is not included.