Rubert + Co. Ltd.

UKAS Calibration Laboratory No. 4685

Calibration Certificate

Certificate No. nnnnnn

Type of object:	Roughness Specimen Type 543X with regular sinusoidal profile (ISO 5436 Type C)
Manufacturer:	Rubert + Co. Ltd
Manufacturer's serial No:	P14a
Customer:	UKAS
Date of calibration:	9 June 2014
Date of certificate:	13 June 2014
No. of pages:	4
Individual with responsibility for this calibration	Paul Rubert

1 Calibration Method

A Talystep Mk 2 contacting stylus instrument with inductive pickup and diamond stylus of 90 degree pyramidal shape was used for the measurements.
The instrument was first calibrated for height displacement on a certified reference standard with known uncertainty, in accordance with ISO 5436-1 and ISO 12179.

Depth of calibrating step: 241 nm +/- 8 nm
Mean of 5 measurements of this step: 234.93 nm

2 Conditions and method of measurement

Stylus tip size:	0.5 μm width	Datapoint spacing:	34 nm
Traverse speed:	0.096 mm/min	Number of measurements taken:	12
Cutoff λc:	8 μm	Mv	100 000
Cutoff λs:	0.8 μm	Mh	3200
Evaluation length:	40 μm		

The measuring area of the roughness specimen was then measured for the required parameter values, at locations indicated on the Measuring Plan shown on page 3.
Parameter values were evaluated from the data profiles taken, using the details shown in the table of Measuring Conditions below. Unless otherwise stated, or requested by the customer, these conditions are in accordance with ISO 4288.

3 Policy on dealing with defects

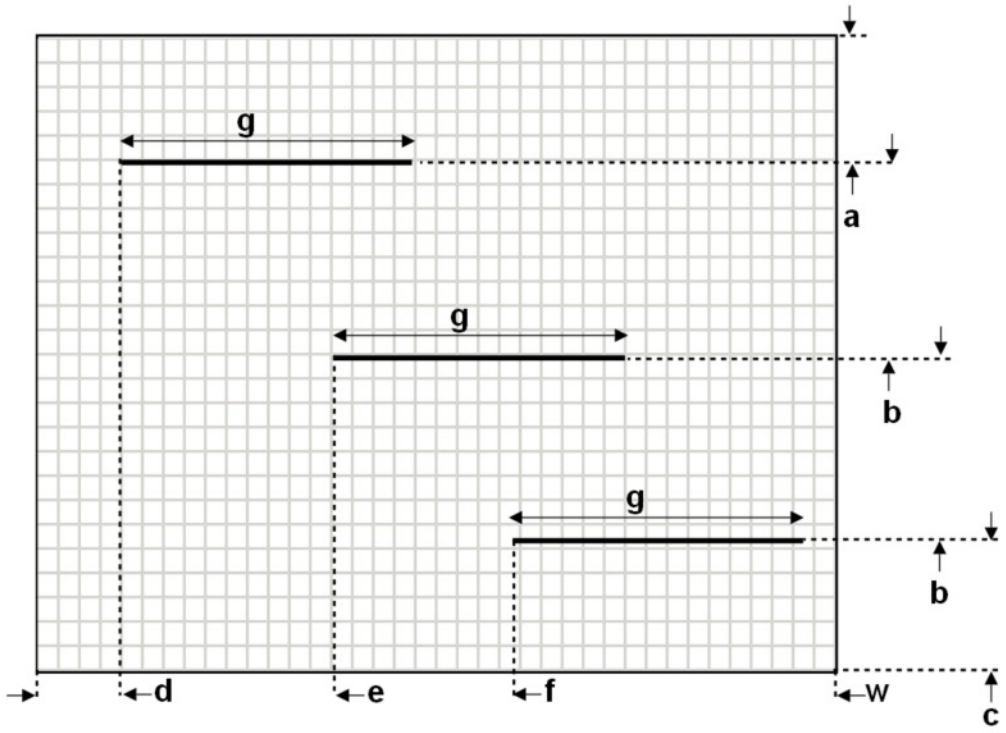
The presence of a defect on the measuring area of any specimen which is to be calibrated can influence the measured values if that defect forms part of the measured profile data which is evaluated.
A deviation on a regular–profile specimen will count as a defect that must be corrected if both of the following are true: its magnitude is more than 100% of the prevailing p to v height, and its width is less than 25% of a wavelength of the profile. If the defect is wider than 25%, then the data should be discarded and the measurement repeated.
For this calibration on a specimen whose profile has a regular, repeating pattern, localised defects which are less wide than 25% of the period of the pattern, have been removed by smoothing at the software stage.

4 Environmental Conditions

The laboratory temperature was 20 $\pm$ 2 degrees. Environmental noise and instrument noise were assessed by measuring a certified glass flat standard for Pt and Pq, with the results for these being entered into the calculation of measurement uncertainty.

5 Measuring Plan

The plan below shows the approximate location of the *n* = 12 profiled evaluation lengths, in three lines of four each, with the start points and separations from the edges of the measuring area of the specimen shown in mm but NOT to scale.



a	b	c	d	e	f	g	w
5	2	5	4	8	12	0.2	17

6 Uncertainty of measurement

All uncertainty calculations are done in accordance with the requirements of ISO document *Guide to the Expression of Uncertainty in Measurement.*

For a total height parameter (Rz, Rt, eg.) the procedure described in NPL Good Practice Guide no. 37 *The Measurement of Surface Texture using Stylus Instruments* is followed: the Type A uncertainty is calculated from the standard error (standard deviation of the *n* parameter values, divided by square root of *n*), and then combined in quadrature with the Type B uncertainty, which is the standard uncertainty due to the instrument and the environment, to give the combined standard uncertainty.

For an average height parameter (Ra, Rq, eg.) the procedure described in VDI/VDE 2602 *Surface measurement – Roughness measurements using stylus instruments – Calibration and uncertainty of measurement* is followed: the standard uncertainty is calculated from a formula which involves the standard error of the mean of the *n* measured values, the uncertainty of the calibrating step height, and terms representing instrument noise, and unknown systematic error.

In all cases the value obtained for combined standard uncertainty is then multiplied by a coverage factor *k,* which is taken to be 2 in order to give a confidence level of 95%, to give the expanded uncertainty.

7 Measuring Results

Parameter	Mean of *n* measured values	Combined Standard Error	Expanded Uncertainty
Ra (nm)	32.73	0.9	1.8
Rz (nm)	107.02	6.5	13

8 Comments

9 Certificate signed and dated

Signed . . . . . .

Date . . . . . .