

## UNCERTAINTY CALCULATION / BUDGET

### ITEM : Measurement of Dimension and Position

Uncertainty Sources / Elements	Init Value ( $\mu\text{m}$ )	Co-eff	Abs Value	Dist'n	Divisor	U value @ K=1	U <sup>2</sup>	
1	Instrument resolution	0.1000	1.0000	0.1000	R	1.732	0.0577	0.0033335
2	Typical instrument repeatability	0.2500	1.0000	0.2500	R	1.732	0.1443	0.0208346
3	Axis straightness (published)	1.0000	1.0000	1.0000	N	2	0.5000	0.2500000
4	Typical temperature drift of 0.1°/hour	0.0070	1.0000	0.0070	N	2	0.0035	0.0000123
5	Compressive effect of stylus force	0.2670	1.0000	0.2670	R	1.732	0.1542	0.0237644
6	Calibrated error in test sphere (from NMI cert)	0.0520	1.0000	0.0520	N	2	0.0260	0.0006760
7	Uncertainty for test sphere (from NMI cert)	0.0160	1.0000	0.0160	N	2	0.0080	0.0000640
8	Assumed error for stylus tip sphericity	0.2500	1.0000	0.2500	N	2	0.1250	0.0156250
9	Assumed typical surface roughness of workpiece	0.2500	1.0000	0.2500	N	2	0.1250	0.0156250
10	Gauge block wringing film (alternative axis calibration)	0.0500	1.0000	0.0500	R	1.732	0.0289	0.0008334
11	Gauge block error (from PTB cert)	0.0400	1.0000	0.0400	N	2	0.0200	0.0004000
12	Gauge block uncertainty (from PTB cert)	0.0280	1.0000	0.0280	N	2	0.0140	0.0001960

**Sum of U<sup>2</sup> = 0.3313641**

<b>Combined Uncertainty (K) = <math>\sqrt{\Sigma U^2}</math> :</b>	<b>± 0.5756</b>
<b>Expanded Uncertainty @ K=2 :</b>	<b>± 1.1513</b>

<b>FOR A CONFIDENCE PROBABILITY OF 95% , THE PRACTICAL UNCERTAINTY IS :-</b>	<b>± 1.20 <math>\mu\text{m}</math></b>
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**NOTES :-**

1. **Co-efficient** is only required when converting **Initial Value** from one unit to another , ie wavelength to  $\mu\text{m}$
2. All entries in the **Absolute Value** column must be in the same units
3. **Normal distribution (N)** = a verified value (Systematic Type 'A') , ie a measured/certified value = a divisor of 2
4. **Rectangular distribution (R)** = a statistical value (Random Type 'B') , ie resolution , repeatability etc = a divisor of 1.732