

PGI Dimension – traceability

Definitive assessment of radius accuracy and form error

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Introduction

Ultra-high precision optical systems and components require measurement of sub-micron form accuracy and nanometric surface finish in order to meet the stringent demands of modern optical technology.

By use of a high precision calibration reference standard, this application note shows how Taylor Hobson's PGI Dimension provides definitive assessment of radius accuracy and form error.

Validation and traceability

To help validate the PGI Dimension absolute accuracy, Taylor Hobson used leading class accuracy R22.5 mm and R12.5 mm reference calibration standards (Figure 2) calibrated by the Swiss Federal Institute of Metrology (METAS). Radius uncertainty of these calibration standards is within 50 nm and calibration is carried out by a micro CMM.

“The PGI Dimension has given us much improved capability to measure a very large range of optics from small steep spheres to large diameter diffractives and gull wing aspheres. The Dimension also has a very impressive accuracy and robust performance, giving us results we can trust and reliability we can count on day after day.”

Yann Guimond
General Manager
UMICORE IR GLASS

 Schweizerische Eidgenossenschaft Confédération suisse Confederazione Svizzera Confederaziun svizra		 Federal Department of Justice and Police EDLP Federal Office of Metrology METAS	
Certificate of Calibration No 115-01449			
Object	1 reference sphere Size: $\varnothing = 25$ mm Material: Si ₃ N ₄ Identification: H3003		
Order	Calibration of diameter and roundness deviation.		
Applicant	Taylor-Hobson LTD Po Box 36 Leicester, LE4 9JQ UK		
Traceability	The reported measurement values are traceable to national standards and thus to internationally supported realizations of the SI-units.		
Date of calibration	10 June 2009		
Marking	without		
CH-3003 Bern-Wabern, 18 June 2009			
For the measurements	Section Length, Optics and Time		
			
Dr. Alain Küng	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 (CIPM). 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 http://www.bipm.org .			
<small>This document may not be published or forwarded other than in full.</small>			
<small>METAS Lindbergh 95, CH-3003 Bern-Wabern, Tel. +41 31 31 31 115, www.metas.ch</small>			

Fig. 1: METAS certificate of calibration standard

Fig. 2: R22.5 mm and R12.5 mm calibration standards



Measurement procedure

- 1 Calibration using an R = 22.5 mm calibration standard
- 2 Measurement of an R = 12.5 mm calibration standard, up to 65 degrees slope using Taylor Hobson's PGI Dimension's traverse tilt capability. (See Fig. 3).
- 3 Analysis of the radius and form of the R = 12.5 mm calibration standard using an LS radius optimised fit.
- 4 Comparison of the R = 12.5 mm analysed radius against the METAS calibrated radius value.



Fig. 3: PGI Dimension measurement of R12.5 mm calibration standard – traverse unit tilted at 30 degrees.

Measurement results – example

Compared with the METAS calibrated radius of 12.49964 mm, Figure 4 shows a PGI Dimension measurement radius result of 12.49966 mm which has a form error (Pt) of 33 nm.

This radius difference of ~20 nm is within the calibration standard's uncertainty level and indicates an extremely high level of absolute accuracy.

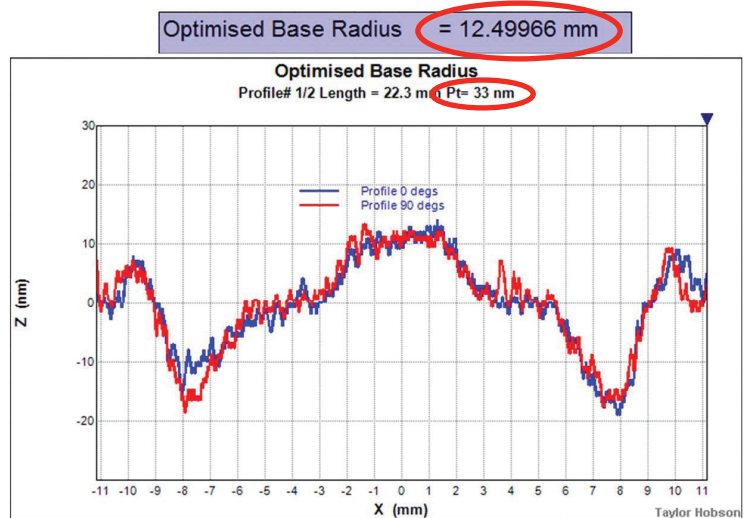


Fig. 4: PGI Dimension measurement of R12.5 mm Calibration standard – residual profiles showing form error after LS Arc form fit

Conclusion

Tests using traceable standards show that the PGI Dimension provides highly reliable results for radius and form error assessment.

The PGI Dimension is fully automatic, able to measure a wide range of samples and provides the optics and lens moulding industry with highly accurate and repeatable measurement data.



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