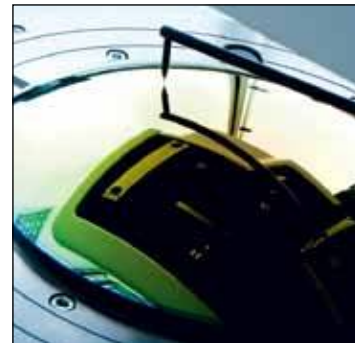


Form Talysurf® PGI Optics Range

Versatile, automated, high range, high resolution systems for precision optics measurement



Ideal for spheres, aspheres, diffractives and freeforms

Advanced metrology

Taylor Hobson – the experts in optics metrology

Taylor Hobson's global brand reputation is built on a foundation of optics manufacturing coupled with an indepth understanding of precision measurement for improving the design, throughput and performance of optics applications.

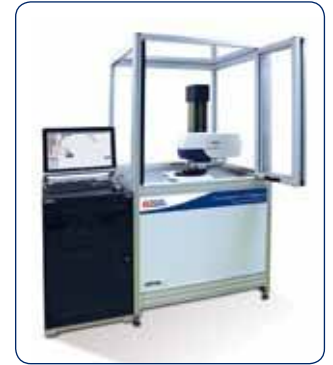
Taylor Hobson was established in 1886 with the vision of the Victorian entrepreneur, William Taylor, who founded a lens making company with his brother in Leicester, England.

He was responsible for developing the world's highest quality cinema lenses which helped to develop the film industry in the early twentieth century.

As Taylor Hobson began to manufacture more accurate lenses, William Taylor realised there was a requirement for instruments that would measure the perfection of each lens. Without anything else on the market, Taylor Hobson did what they knew best - they invented something themselves, the first surface finish and roundness measuring instruments (Talysurf and Talyron®).



Talysurf 1, 1941



Form Talysurf® PGI Freeform, 2017

Today, Taylor Hobson continue to be the pioneers, developing innovative products to meet the ever-increasing demands of next generation optics technologies.

This forward thinking philosophy is captured perfectly in our diverse range of product solutions. Recent developments include new optics measurement systems and a full suite of dedicated software analysis packages.



Form Talysurf® PGI Optics



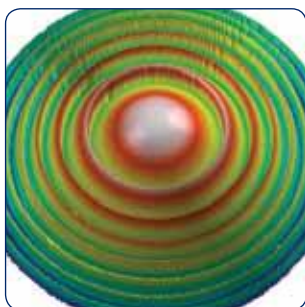
Form Talysurf® PGI Matrix



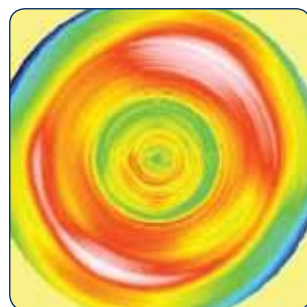
Form Talysurf® PGI Freeform



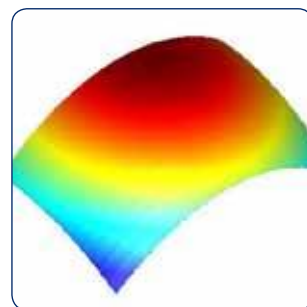
Form Talysurf® PGI Dimension



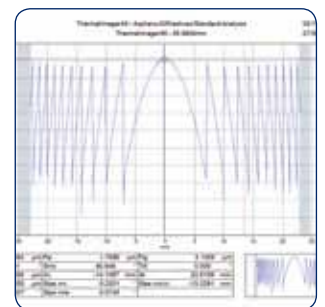
3D view of asphero-diffractive optic



3D astigmatism of single lenslet



Freeform surface raw profile



Diffractive measurement with aspheric form removed



The Form Talysurf® PGI Optics range

Providing versatile, fast and accurate measurement solutions for the Optics industry.

Supported by over 130 years of manufacturing experience.

Form Talysurf® PGI Optics

A benchmark for accuracy and versatility in the measurement of lenses. Measure spheres, aspheres and diffractives with results you can trust.

- New gauge design with improved measurement range - up to 28 mm.
- New Traverse unit length up to 300 mm for a continuous measurement.
- Fast and simple calibration routine enables good metrology practice with regular instrument calibration.



Pages 4-5

Form Talysurf® PGI Matrix

Designed for accurate, fast and easy measurements on batches of individual parts to densely packed wafer lens arrays.

- Dedicated interface allows involved batch measurements to be set up with ease.
- Tolerance the automated analysis for fast pass fail results.
- Fully automated measurement and analysis provides fast and consistently accurate results.



Pages 6-7

Form Talysurf® PGI Freeform

A fully automated, fast and accurate system dedicated to the measurement of high precision freeform optics.

- Ultimate flexibility, measure any surface form in true 3D, no part design information necessary.
- Dedicated 3D system calibration delivering high level of accuracy.
- Freeform Analysis software allows measured surface to be compared to the design.



Pages 8-9

Form Talysurf® PGI Dimension

Fully automated one-touch aspheric optics measurement, for 2D and 3D analysis of spheres, aspherics and diffractives up to 300 mm in diameter.

- Advanced software saves production time and increases output.
- Aspherics Analysis Utility (AAU) - save time and improve error detection.
- Automatically centre and level virtually any rotationally symmetrical part: Steep, Shallow, large, small.



Pages 10-11

The fastest high accuracy measurement instrument for precision optics

Following its first release in 1984, the Form Talysurf[®] quickly became the number one choice for optics manufacturers measuring aspheric form error.

Since then, we have installed thousands across the world, making the Form Talysurf[®] PGI a true industry standard.

Our patented PGI (Phase Grating Interferometer) technology enables you to measure large sags with short length styli for the highest accuracy measurements.

These Taylor Hobson manufactured styli combine very high stiffness and low force, which delivers much greater accuracy and repeatability than comparable products.

- ✓ Easy to program
- ✓ One-click measurement
- ✓ Fast and accurate
- ✓ Designed for production environments
- ✓ Powerful analysis tools to improve your capacity and capability
- ✓ Time-saving software functions
- ✓ Automated software routines for repeatable high accuracy measurements
- ✓ Dedicated to optical metrology



“New wide range gauge...
Measurement of large sag
lenses without compromise”



Gauge range

14 mm / 28 mm*

System noise

< 2 nm Rq

Measurement

Up to 300 mm
diameter
(single trace)

Form error

< 100 nm

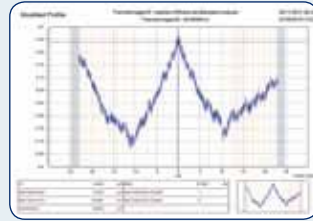
*60 mm / 120 mm styli

Dedicated to optical metrology

Meeting the ever increasing demands of next generation optics

In depth asphero-diffractive analysis

- Easily analyse complex diffractives beyond 500 zones
- Identifies zone diameters with direct comparison to design
- Output diffractive form error for toolpath correction



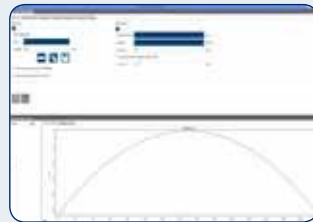
Unique solution for rapid X-offset correction

- Significantly reduce SPDT setup time
- X-offset and form error can be corrected from a single analysis
- Improve throughput with time saving



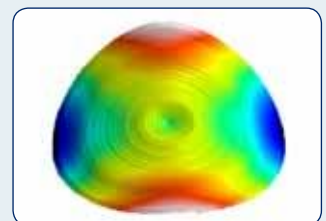
Large diameter optics

- Class leading single trace measurement with lengths up to 300 mm
- Class leading straightness over full 300 mm length
- SAG > 28 mm



Astigmatic analysis

- Easy to program and use routines to determine if astigmatism is present in parts
- Output average profile for toolpath correction
- 3D residual surface generation for advanced corrections



Accessories

Automated motorised stages support accuracy

- Addition of motorised Y and/or Rotary stages, coupled with a precision tilt and centre stage.
- Easy to write routines provide options for single or multiple radial trace measurements
- Automated Astigmatic analysis – combine multiple radial trace measurements to see astigmatism
- Ensure consistently accurate measurements with many different operators.



Form Talysurf[®] PGI Matrix

A fully automated, fast and accurate system for batch optics measurement

Easy set-up, test and analysis for single or multiple parts make this the perfect system for fast and accurate testing of optical components.

The Form Talysurf[®] PGI Matrix's enhanced capabilities and software architecture support high speed measurements of mobile device lenses, ophthalmic lenses, medical and fibre optics, high power LEDs and wafer lens arrays.

“Improve measurement consistency and accuracy whilst reducing measurement cycle time. The Form Talysurf[®] PGI Matrix provides the one stop solution.”

- ✓ Easy to program
- ✓ Easy to use
- ✓ Extremely fast
- ✓ Fully automatic
- ✓ Dedicated to production environments



The Form Talysurf[®] PGI Matrix includes a high precision rotary and Y-stage for accurate and automated part positioning



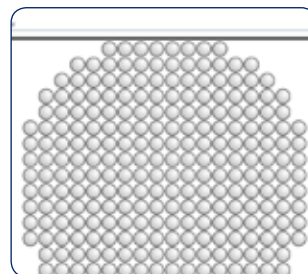
Gauge range

28 mm



Noise

< 4 nm Rq



Measurement

Individual or multi-part measurements



Form error

< 100 nm

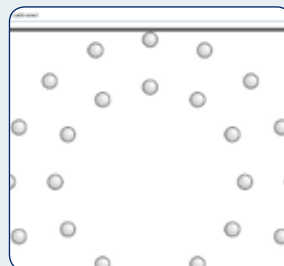
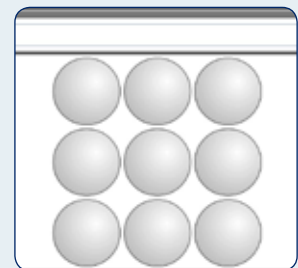


Designed for Production environments

Saving time and money with no loss in accuracy

Simple set-up, measurement and analysis of complex arrays

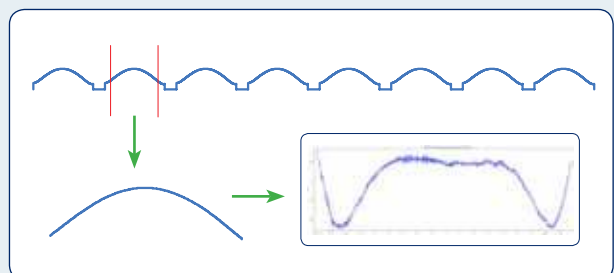
- Define the Array Layout, selecting the part design.
 - Low density, PCD, Wafer, etc.
- Formats for measured and analysed data are easily chosen, with option to store results in location of choice.
- Select location for storing the results.
- Select 'Batch' to measure.
- Live feedback on measurement pass / fail with clear indication.
- Automated analysis shows batch results statistics.
 - Allows individual part results to be explored.
- Define complete measurement offline and transfer to the instrument for the measurement.
- Completed measurements can be reviewed and re-analysed offline by simply transferring the results folder.



Continuous measurement

The Form Talysurf® PGI Matrix enables extraction of individual part profiles from a continuous measurement of an array of parts.

- Measure dense lens arrays quickly and accurately.
- Intelligent profile extraction ensures the correct clear aperture is always analysed.



Form Talysurf[®] PGI Freeform

A fully automated, fast and accurate system for freeform optics measurement

The new Form Talysurf[®] PGI Freeform is a versatile, high resolution system dedicated to the measurement of high precision freeform optics. Providing 3D raster / radial measurement and analysis of:

- Spheres
- Aspheres
- Diffractives
- Freeforms

The Form Talysurf[®] PGI Freeform can work with many of the latest equations used for definition of freeform surfaces such as:

- Toric
- Bi-conic
- Anamorphic asphere
- Ellipsoid
- NURBS
- Zernike
- Cloud of points
- A-Cylinder

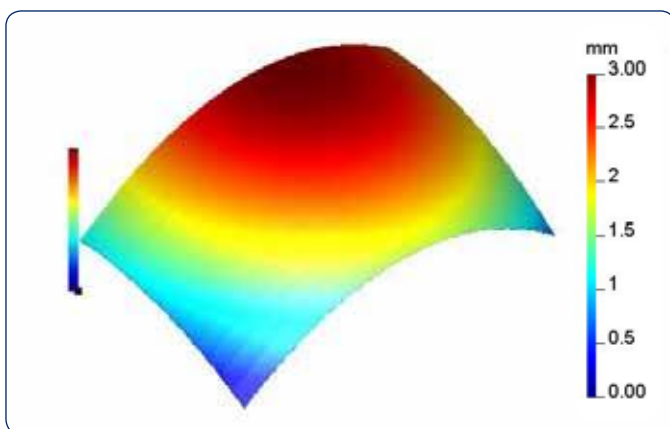
Measurement integrity and reproducibility

Taylor Hobson's Form Talysurf[®] PGI Freeform is underpinned by decades of measurement experience, ultra-precision manufacturing expertise and FEA optimized design. These provide low noise and near flawless mechanical execution of the measuring axes.

With the new dedicated software interface, accurate freeform measurements are easy to set-up and analyse. The versatility of the Form Talysurf[®] PGI Freeform makes it the complete optics metrology solution.



“Designed for quick and accurate measurement of surfaces generated by grinding, slow or fast tool servo and MRF.”



Freeform surface raw profile



Feedback results for toolpath correction direct to machine

Gauge range
Up to 28 mm

Resolution
0.8 nm

Slope
Slope up to 50 degrees

3D form error
150-250 nm



Results you can trust

3D calibration capability delivers unparalleled measurement

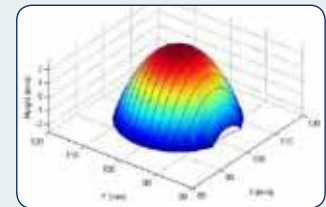
3D Calibration routine

Accurate 3D measurements to optical levels of accuracy cannot be achieved by simply adding a Y-stage.

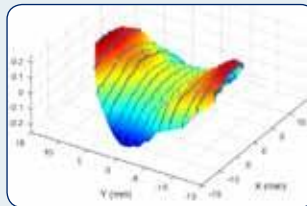
- Unique, new true 3D calibration.
- Corrects for alignment errors beyond those mechanically possible.
- Critical for accurate 3D measurements.
- Typical form errors:
 - <500 nm without 3D calibration.
 - <150 nm with 3D calibration.



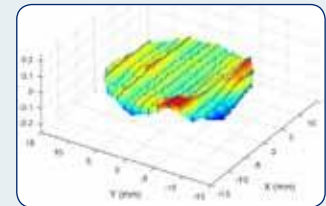
Taylor Hobson's calibration artefact



Calibration Measurement



Form error before 3D calibration routine



Form error after Taylor Hobson's 3D calibration routine

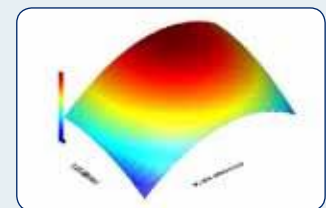
Measurement & analysis

Full 3D measurements for accurate surface analysis.

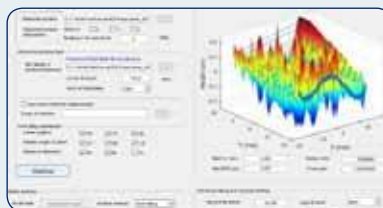
- Easy to define measurement set-up.
- 3D point cloud raw surfaces.
- Dedicated freeform analysis utility allows raw surface comparison to design.
- Residual surface shows form error.
- Output residual surface for connection to manufacturing process.



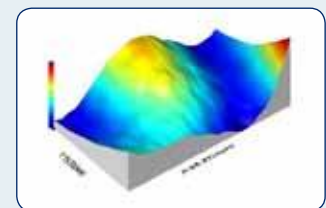
Measurement set-up



Measured raw surface



Compare measured surface to design



Residual form error output

Form Talysurf[®] PGI Dimension

The most versatile automated system for 2D and 3D optics measurement

Fully automated one-touch aspheric optics measurement.

Based on two of Taylor Hobson's core technologies - Aspheric profilometry and high accuracy roundness. The Form Talysurf[®] PGI Dimension delivers rapid optics cresting and precise measurement.

Versatile 2D and 3D analysis for spheres, aspherics and diffractives

Form repeatability of <100 nm and slope angles of up to 85 degrees mean that the Form Talysurf[®] PGI Dimension instrument is a versatile instrument for spherical, aspheric, diffractive lenses and moulds, which allows a wide range of accurate 2D and 3D measurements and analysis. The fully automatic centre and levelling feature includes new routines to ensure the accurate alignment of virtually any part: steep, shallow, large and small.

Designed for ease of use in the production environment

The new production interface gives fully automated operation, ideal for use on the shop-floor. The easy-to-use 'single-click' operation is quick to learn and will provide an automatic 2D or 3D analysis and output display. The instrument can be initially set up by quality specialists for the use of a wide range of manufacturing staff. After commencing the measurement Form Talysurf[®] PGI Dimension can then be left unmanned to complete the cycle.



“The new AAU software from Taylor Hobson has increased our capability to manufacture high accuracy Infrared optics with enhanced diffractive analysis capabilities.”

**Tim Olsen, Director of Engineering
Janos Technology**



Measurement

Up to 300 mm diameter

Resolution

0.2 nm

Slope

Slope up to 85 degrees

SAG

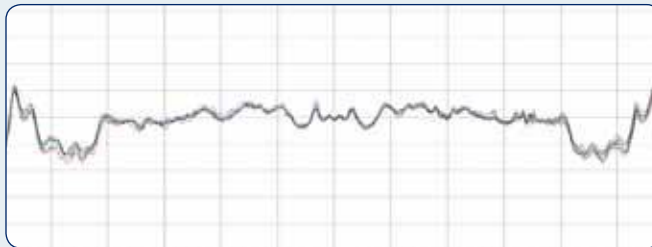
Up to 50 mm



Unique capability for steep-sided lens moulds

Results you can trust – unmatched repeatability

The table below illustrates excellent form error repeatability on a precision mold. Results are from the Form Talysurf® PGI Dimension, ideal for small steep-sided, concave lens moulds.



Measurement	1	2	3	4	5	6	7	8	9	10	SD
Form Error (Pt) nm	375	378	383	366	362	372	383	358	366	369	8.55

Form error (Pt) results (0–180 deg)

UMICORE IR GLASS

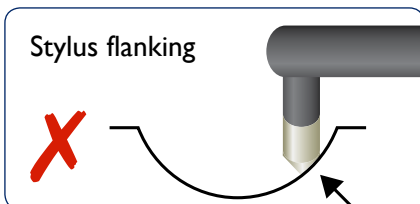
“The PGI Dimension has given us much improved capability to measure a very large range of optics from small steep spheres to large diameter diffractives and gull wing aspheres. The Dimension also has a very impressive accuracy and robust performance, giving us results we can trust and reliability we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

Yann Guimond,
General Manager

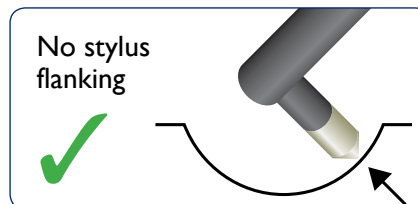
Measure steep-sided optics with ease

By tilting the traverse datum, the Form Talysurf® PGI Dimension prevents stylus flanking and eliminates the need for steep-sided measurements. This prevents data distortion.

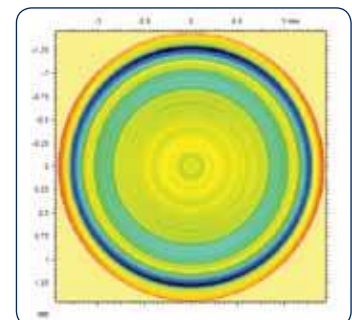
Before the start of the measurement, the sample is aligned using Taylor Hobson’s patented advanced centre and level technique. The alignment is achieved by taking 4 measurements in turn, indexing the spindle by 90 degrees each time.



Standard profilometer



Form Talysurf® PGI Dimension
with tilted traverse



3D astigmatism

Excellent repeatability – results you can trust!

All Taylor Hobson instruments provide highly stable measurement platforms. This is the foundation for true characterisation of precision optics. It ensures that the sample remains well aligned for measurement, delivering unmatched repeatability and providing the perfect solution for production process control and research work.

Powerful analysis software with easy-to-use interface

Software automation reduces operator dependency

Designed specifically for production use

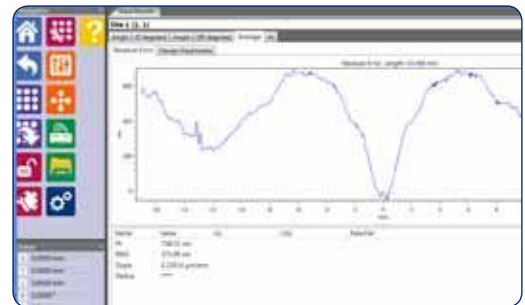
This interface provides an easy method of instrument operation, presenting clear control options to the operator when measuring of optical moulds and lenses.

Software tools to eliminate operator error

A sag and slope calculator is provided to allow quick check of lens drawing equation against the instrument equation to verify sign convention, while also checking for flanking conditions based on stylus/part combination.

Typical output results include:

- Profile form-error Pt and RMS
- Slope error
- Diffractive Zone analysis
- 2D and 3D error maps can be linked back to the manufacturing process for process improvement with MRF, Diamond Turning, CNC grinding and polishing.
- Reverse fit aspheric and/or diffractive terms
- Toleranced optimised radius fitting
- X-offset and tool radius for diamond turning feedback



Software features

Measurement start memory

The software automatically remembers the start position of measurements. This allows repeat measurements to be taken on the part, or any subsequent parts without the need for re-cresting (finding the centre of the part).

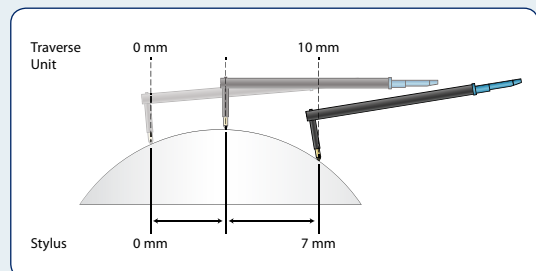
- Providing significant time savings.
- Start positions for any number of different parts can be stored.



Smart move - Auto crest & measure clear aperture (CA)

Software calculates the arc motion of the stylus compared to the lens equation.

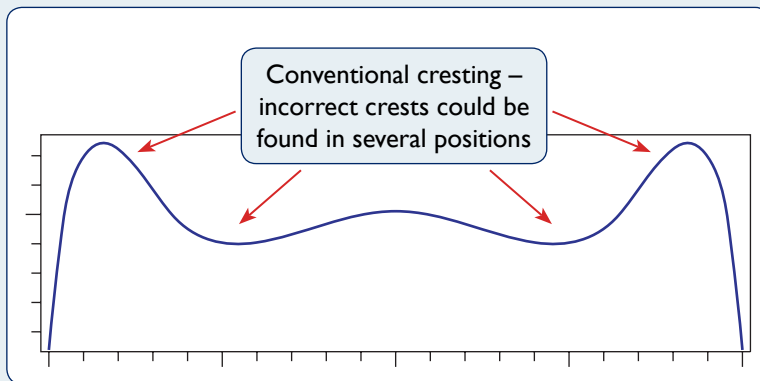
- Smart move software makes quick, balanced measurement over the CA.
- Saves time and improves accuracy / repeatability.



Intelligent cresting

The new cresting routine accurately identifies the part centre regardless of surface form allowing accurate measurements to be taken automatically on challenging optical forms.

- Conventional cresting can be fooled and incorrectly identify any high or low turning points on part as the true centre of the part.
- Intelligent cresting uses the part design to identify where the stylus is on the part and move to the true crest of the part.
- Allowing accurate measurements to be taken over the clear aperture of the part.



The new PGI Optics software cresting routine uses the design of the part to identify where the true crest is (centre of the part), saving time and improving accuracy.

Software flexibility to fit in with production environments

Remote and offline capability to set up and analyse measurements.

- Setup new part measurements, analyse and re-analyse results offline on a separate PC.
- Reduce instrument down time associated with programming measurements and checking results.

Measurement files can be easily transferred between instruments.

- Once a measurement has been defined a copy of the settings file can be transferred to another instrument and used to run the measurement without any further changes.

Safe measurement check.

- Facility to confirm that the measurement is possible before actually measuring the part on the instrument.
- Reduce risk to instrument and part damage.

User configurable interface

Customise the positions of the menus, toolbars and results to work for your production environment.

- Split software across two monitors.
- Drag & re-size menus, toolbars and results.

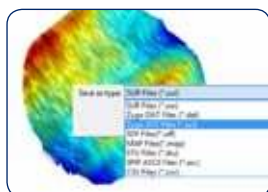
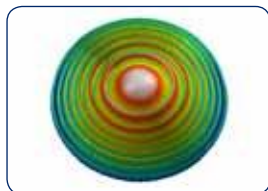
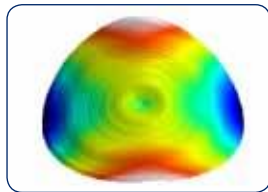
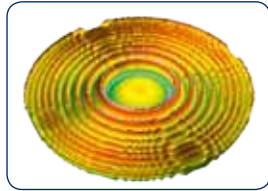


Note: PGI Optics software is only available on the Form Talysurf® PGI Optics, Matrix and Freeform.

TalyMap® surface analysis software

The unique solution for advanced 2D and 3D data analysis

TalyMap® is continuously evolved by a multi-disciplinary team of specialists in metrology, software engineering and automation in order to meet present and future surface metrology needs.



Key features

Full metrological traceability	A new analysis workflow makes it easy to trace every step in an analysis document. New steps can be added and existing steps can be fine-tuned or deleted at any time.
Statistics for quality control	The new statistics option makes it possible to track and generate statistics on parameters across multiple measurement data sets.
Multi-language support	It is possible to change the software to work in one of six European languages, Japanese, Chinese, Korean or Brazilian Portuguese.
Quick results	Using the Minidoc function, any sequence of analysis steps can be defined and saved into a Minidoc library, significantly speeding up the preparation of a new report.
Customisation	Add company logos, measurement identity cards, screen notes and illustrations including bitmaps, text blocks and arrows.
Advanced modules	TalyMap® advanced modules enhance the functionality of TalyMap® by providing additional analysis or presentation capabilities.
TalyMap® Contour	Interrogate geometric features in a measurement. Angles, slopes, heights, distance, intersection, radii etc.
Output of surfaces	Output a residual surface from an analysis in most common industry formats.
Astigmatic analysis	The whole PGI Optic Range allows multiple radial measurements on single parts to be automatically combined, allowing form error variation around the part, such as astigmatism to be identified.
Zernicke analysis	Zernicke analysis of a 3D residual surface.

Fast and accurate surface metrology reports

Intuitive desktop publishing environment

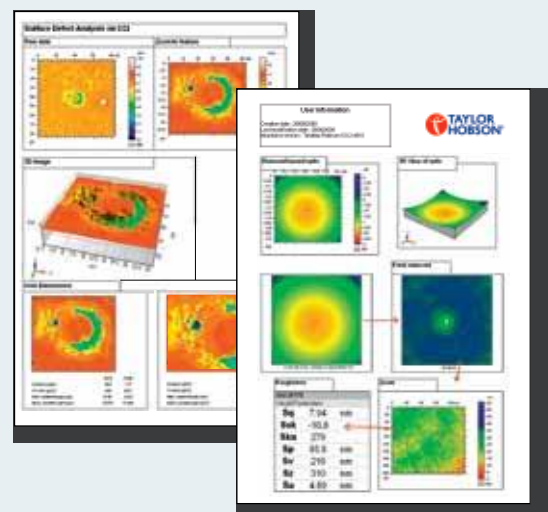
Using TalyMap®, an analysis document can be built quickly and easily frame by frame, applying filters and scientific operators to measurement data, and carrying out graphical analytical studies.

Additional information

Company logos, measurement identity cards, screen notes and illustrations including bitmaps, text blocks, arrows can all be added to enhance the report.

Fast report generation

Using the in-built desktop publishing facilities, the report layout can be finalised to create a professional quality report.





Software functionality to save time and improve error detection

Industry leading accuracy for the competitive edge

Aspherics Analysis Utility (AAU)



Expressly designed for aspheric optical components the software fits measurement data to the component design formula, and aligns the resulting error profile with respect to the aspheric axis.

Base radius optimization (PV or rms) to highlight base radius variation in production, allowing users to quickly determine the best-fit radius within a set radius tolerance for the component, which can then be checked against allowable production tolerances.

Automatic spike removal can be defined by set width and heights to save time, eliminate user subjectivity and give more repeatable results.

Derived coefficients module for calculation of best fit asphere through a particular measurement. Resulting values can be used in conjunction with optical design software to assess the impact of form deviations on the optical performance of critical systems.

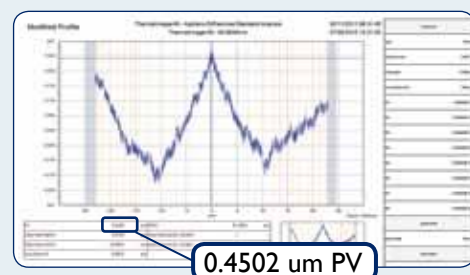
“Only Taylor Hobson can extract the true form”

Diffractive analysis



Software for the analysis of diffractive components An increasing number of applications, particularly in infra-red applications, are making use of asphero- diffractive designs. Diffractive analysis software is written specifically to enable the assessment of these complex surfaces, providing the user with form error and zone parameters.

Diffractive analysis when used in conjunction with the aspheric analysis software, allows the user to examine the underlying form of an asphero-diffractive component. Individual zone results are tabulated and can be output to a CSV file for further analysis. Diffractive polynomial settings can be saved and restored, enabling the user to quickly change between different designs.



Unique solutions for challenging applications



Diffractive lens analysis

Challenge: To measure a diffractive lens.

Solution: Form Talysurf® PGI Optics with AAU analysis.

Benefits:

- Quick, easy and automated measurements for consistent and repeatable results.
- Fully automated analysis providing diffractive form error and zone table.
- Output residual diffractive form error for corrections.



Wafer Lens arrays / Batches of parts

Challenge: To measure an array of parts. This could be as a batch array of individual part, moulded lens tree or wafer lens array.

Solution: Form Talysurf® PGI Matix with Matrix Productivity toolkit.

Benefits:

- Assisted programming allows quick and easy generation of array layout, including .dxf compatibility to input array design.
- Automatic alignment routines ensure accurate part measurements whether single parts or arrays are being measured.
- Live pass/fail indication during array measurements.
- Analysed results stored in any location in one or all common formats.



3D surface measurement of Freeform Optics

Challenge: To measure and analyse a freeform surface.

Solution: Form Talysurf® PGI Freeform with Freeform Analysis Utility.

Benefits:

- Any surface, regardless of design can be measured quickly and accurately.
- Output the measured surface as a point cloud.
- Using the Freeform analysis utility to align and compare the measured surface against the design surface, generating a residual surface showing form error deviation across the surface.



Steep aspheric lenses / moulds

Challenge: To measure an aspheric lens with a slope steep of 70 degrees.

Solution: Form Talysurf® PGI Dimension with TalyMap® Astigmatic analysis.

Benefits:

- Automated measurement routine including fully automatic centering and levelling of the component for highest measurement accuracy.
- Automated analysis providing a 3D residual surface allowing form error variation around the part. For example, form errors such as Astigmatism, Coma and spherical aberration can easily be seen.
- Residual form error results can be output as; 2D residual for average form error correction or 3D residual for full surface correction.

Hardware

	Form Talysurf® PGI Optics	Form Talysurf® PGI Matrix	Form Talysurf® PGI Freeform	Form Talysurf® PGI Dimension
Gauge - 8 mm	✓	✓	●	-
Gauge - 14 mm	●	●	✓	✓
Traverse Unit - 100 mm	✓	-	-	-
Traverse Unit - 150 mm	●	-	-	-
Traverse Unit - 200 mm	●	✓	✓	✓
Traverse Unit - 300 mm	●	-	-	-
Column - 450 mm (Fixed)	✓	✓	✓	-
Column - 450 mm (Tilting)	-	-	-	✓
Pneumatic AV	✓	✓	✓	-
Active AV	●	-	-	✓
Standard Y-Stage - 100 mm	●	-	-	-
Standard Y-Stage - 200 mm	●	-	-	-
High Accuracy Y-Stage - 200 mm	-	✓	-	-
High Accuracy & Straightness Y-Stage - 200 mm	-	-	✓	-
Standard Rotary Stage	●	-	-	-
High Accuracy Rotary Stage	-	✓	✓	-
Vacuum Chuck	-	✓	✓	-
Environmental cabinet	●	✓	✓	✓
Air bearing spindle + Auto C & L table	-	-	-	✓

Software

	PGI Optics software			Ultra
PGI Optics Range	Measurement and analysis for aspheric, diffractive and spherical optics	✓	✓	✓
	Manual Astigmatic Analysis	✓	-	-
	Automated Astigmatic analysis	●	✓	✓
	PGI Matrix Productivity Toolkit*	-	✓	-
	3D surface measurement	-	-	✓
Freeform analysis Utility	-	-	✓	

Additional software

Aspheric Analysis Utility (AAU)	L1 - Aspheric + Spherical analysis	✓	-	-	-
	L2 - Diffractive analysis	✓	-	✓	-
	L3 - Derived Aspheric	●	✓	●	✓
	L4 - Derived Diffractive	●	●	●	●
	Error Compensation (X-offet, tool tip radius)	●	●	●	●
TalyMap®	Talyprofile Silver (Straightness analysis)	✓	✓	-	-
	Talyprofile Gold (Roughness)	●	●	-	-
	Talyprofile Gold + 3D astigmatism	●	●	-	-
	TalyMap Platinum + 3D astigmatism	●	●	✓	✓

* Batch measurements and testing, Go-no-go indicators, average profile, batch results, 1 off - additional off-line software to configure runs

✓ Standard ● Options - Not an option

Buy with confidence - results you can trust

Taylor Hobson understands the importance of consistently accurate measurements

Taylor Hobson's extensive history of lens manufacturing led to the development of the Form Talysurf optical metrology range of instruments. When manufacturing high precision optics it is critical to use best metrology practise.

Best metrology practise includes regular re-calibration of the instrument using a UKAS certified standard, which is especially important after a change of styli. Results taken without a valid calibration should not be fully trusted.

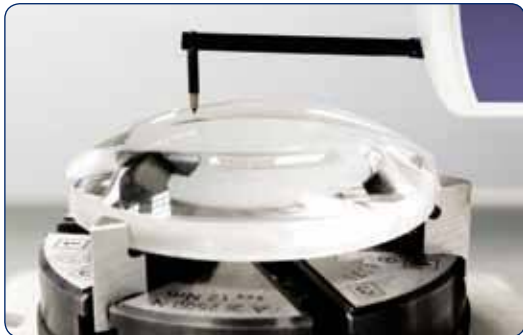
Unique patented calibration routine

Artefacts from Taylor Hobson's UKAS approved laboratory are used throughout the process

The Form Talysurf® PGI Optics Range uses an easy to use, patented ball calibration routine.

Ensuring that:

- Taylor Hobson are the only company to calibrate up to 95% of the gauge range on a single artefact.
- Typical calibration time is < 3 minutes (five times quicker than comparable instruments).
- Good metrology practice of regular re-calibration, especially after a stylus change, is possible.



“Our automated calibration routine delivers a true and accurate system calibration”



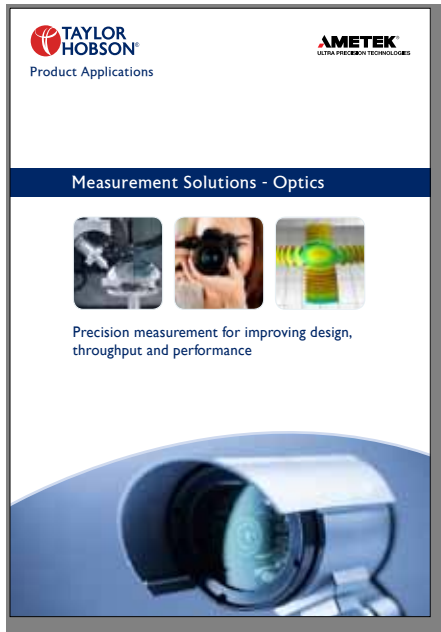
Datum straightness

The straightness accuracy of the reference datum to which the measured surface is compared, is fundamental to the measurement of form and radius.

The Form Talysurf® PGI Optics Range uses a precision datum bar, which has been ground and lapped in-house, to ensure optimum straightness. This gives the Form Talysurf® PGI Optics Range the best in class straightness specification with less than 0.110 µm.



Further optics metrology reading



Measurement Solutions - Optics

For further information detailing applications and our optic products, either:

- Request the 'Measurement Solutions - Optics' brochure or
- Visit www.taylor-hobson.com

Multi-part measurements

Multi-part measurements

Optics manufacturers are looking for a quality control process which provides the high precision measurement and analysis of single or multiple parts, or even of large wafers. Such a process needs to be rapid, precise and versatile. Taylor Hobson provides the perfect solution.

Save time - import your design for quick measurement
Import a CAD/IDF file of the top face of the fixture and the...

High accuracy and repeatability for multiple parts
Taylor Hobson understands the importance of ensuring measurement data is highly reliable, repeatable and accurate. To this end, we carry out extensive studies on our products as an example of which is shown. Multiple traces have been taken and the results show the average error profile (dark blue line) as well as the envelope for part variation (light blue).

Name	Value	Min	Max	SD
PI	84.4 mm	84.4 mm	84.4 mm	0.0 mm
Radius	10.000 mm	9.9997 mm	10.0003 mm	0.0003 mm

Each statistics showing excellent accuracy and repeatability

Each measurement envelope and average form error

Large optics

Large optics

Taylor Hobson's contact and non-contact measurement solutions provide full 3D characterisation for small and large optics. These cover optics with high or low gradients, whilst maintaining high accuracy and repeatability.

Industry leading accuracy and repeatability for large optics

Form error of large optic shown by Form Talysurf PGI Dimension (5 µm)

Typical 3D result of an ascon

Large convex optic on L

LuphoScan technology for full 3D form measurement of high quality optical surfaces

- Investigation of any rotationally symmetric surface - aspheres, spheres, flats and slight trefoils
- Ultra high, repeatable accuracy - $\pm 0.1 \mu\text{m}$
- Almost every material - transparent, specular, opaque...
- Large spherical departures - pinholes, pulsing, profiles with points of reflection...
- Steep slopes - up to 90° (hemispheres)
- Highly flexible - annular optics, rectangular surfaces, aspheric, axicon, segmented surfaces...
- Complex lens characterisation - Lens thickness, wedge error, decenter error, lens-mount positioning
- Diameter - up to 400 mm
- Fast measurement speeds

Unique solution for rapid machine tool set-up

Unique solution for rapid machine tool set-up

A major cause of down-time in diamond turning and CNC generating/grinding is the set-up of a new cutting tool. Taylor Hobson is now able to deliver an average saving of 1 to 2 hours per set-up with its new X-offset and tool radius error software, replacing traditional set-up methods.

Challenges of correcting X-offset and tool tip

X-offset errors are caused by a misalignment of the machine's X-axis and the spindle's rotational axis. Any time a new tool is set-up it needs to be accurately aligned to the spindle axis. The alignment of the X-axis can drift over time due to the effects of temperature.

Example of over-correction with misalignment

Traditional set-up vs Taylor Hobson method

Traditional set-up can take several iterations of cutting and measurement. Alignment usually needs to be better than 1 µm to achieve the required accuracy.

Traditional method

- Configure machine for setup fixture and piece
- Cut set-up piece - Measure - Measure - Measure (Repeat process many times until aligned)
- Setup the optic sample and fixture for machining

Average down time ranges from 30 minutes to 2 hours

The PGI Dimension has given us much improved capability to measure steep slopes in large diameter aspheres and full ring aspheres accuracy and robust performance, giving us results we can trust

UMHICRE IR GLASS - Yam Guimond, General Manager

Correlation and repeatability

Correlation and repeatability

Taylor Hobson has a long history in optics development and in providing metrology for the optics industry. We know the importance of ensuring measurement data is highly reliable, repeatable and accurate across all measurement platforms. To this end, we carry out extensive correlation studies on our products - just one example of which is shown below.

Inter-instrument comparison - LuphoScan vs. PGI Dimension vs. PGI Matrix

6 individual radial traces from the LuphoScan

LuphoScan 3D segmented plot

6 individual radial traces from the Form Talysurf PGI Dimension

PGI Dimension 3D segmented plot

6 individual radial traces from the Form Talysurf PGI Matrix

PGI Matrix 3D segmented plot

Outstanding inter-product correlation - results you can trust!

Instrument	Optimised Radius (mm)			Maximum Pt of 6 profiles (mm)		
	Repeat 1	Repeat 2	Repeat 3	Repeat 1	Repeat 2	Repeat 3
LuphoScan	10.0010	10.0011	10.0011	756	771	776
Form Talysurf PGI Dimension	10.0010	10.0010	10.0017	761	758	769
Form Talysurf PGI Matrix	10.0010	10.0010	10.0017	728	714	724
Standard Deviation*	0.0003	0.0006	0.0003	17	29	25

Typical results showing inter-product correlation

* Standard deviation is given for 10 repeats

Positions of the radial traces in space from the Form Talysurf PGI system

The Metrology Experts

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- **Design engineering** – special purpose, dedicated metrology systems for demanding applications.
- **Precision manufacturing** – contract machining services for high precision applications and industries.

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- **Inspection services** – measurement of your production parts by skilled technicians using industry leading instruments in accord with ISO standards.
- **Metrology training** – practical, hands-on training courses for roundness and surface finish conducted by experienced metrologists.
- **Operator training** – on-site instruction will lead to greater proficiency and higher productivity.
- **UKAS calibration and testing** – certification for artifacts or instruments in our laboratory or at customer's site.

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- **Preventative maintenance** – protect your metrology investment with an AMECare support agreement.



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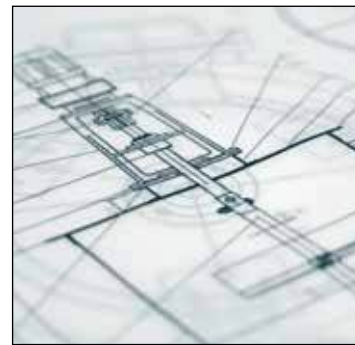
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Form Talysurf® PGI Optics

Product specification



The most versatile metrology in the industry

Form Talysurf® PGI Optics specification

X-axis (horizontal) performance				
Traverse length - X Max / Min	100 mm / 0.1 mm	150 mm / 0.1 mm	200 mm / 0.1 mm	300 mm / 0.1 mm
Measuring speeds ¹	0.1 mm/s to 13 mm/s			
Traverse speeds	up to 13 mm/s max			
Data sampling interval in X	0.125 µm over 300 mm length			
Straightness accuracy (Pt) ²	100 mm Traverse unit - 0.08 µm (3.2 µin)	150 mm Traverse unit - 0.08 µm (4.3 µin)	200 mm Traverse unit - 0.110 µm (4.3 µin)	300 mm Traverse unit - 0.110 µm (4.3 µin)
Z-axis (column) performance				
Usable height	380 mm			
Positioning speeds	0.25 mm/s to 10 mm/s			
Gauge				
Nominal measuring range (Z) (traverse set to 0°)	60 mm stylus arm	14 mm		
	90 mm stylus arm	21 mm		
	120 mm stylus arm	28 mm		
Resolution	0.8 nm @ 14 mm range			
Stylus arm length, tip size, force	60 mm arm, 2 µm radius conisphere diamond stylus, 1 mN force			
System performance ³				
Form error - Pt ⁴ (ball calibration radius)	Max 100 nm @ 22 mm (Typically less than 60 nm @ 22 mm)			
Radius measurement uncertainty ⁵	0.1 mm - 80 mm = 1 % - 0.005% of nominal 80 mm - 1000 mm = 0.005 % - 0.1% of nominal 1000 mm - 2000 mm = 0.1% of nominal			
Physical dimensions		Electrical supply		
Dimensions L x D x H	See floor plan (page 3)	Supply type	Alternating supply, single phase with earth (3-wire system)	
Weight (main instrument)	223 kg	Instrument and computer voltage	90 V - 130 V or 200 V-260 V (switch selectable)	
Environment		Frequency	47 Hz to 63 Hz	
Storage temperature	5 °C to 40 °C	Supply voltage transients - width	EN 61000 - 4 - 4 : 1995	
Storage humidity	10% to 80% relative, non-condensing	Power consumption	500 VA	
Operating temperature	18 °C to 22 °C	Safety	EN 61010 - 1 : 2001	
Temperature gradient	< 2 °C per hour	EMC	EN 61000 - 6 - 4 : 2001 EN 61000 - 6 - 1 : 2001	
Operating humidity	45% to 75% relative, non condensing	Measuring capacity		
Maximum RMS floor vibration	5.0 µm/s at < 50 Hz	Maximum component diameter	300 mm	
Laser classification		Maximum component height	190 mm	
Class 1 product to EN 60825-1 (2001) Continuous Wave (CW) output < 1 mW Max power for the laser < 50 µW Max power for the product		Maximum component weight	10 kg	

The above quoted technical data is for measurements taken in a metrology laboratory controlled environment: 20°C ±1°C (68°F ± 1.8°F), draft free and isolated from low frequency floor borne vibration.

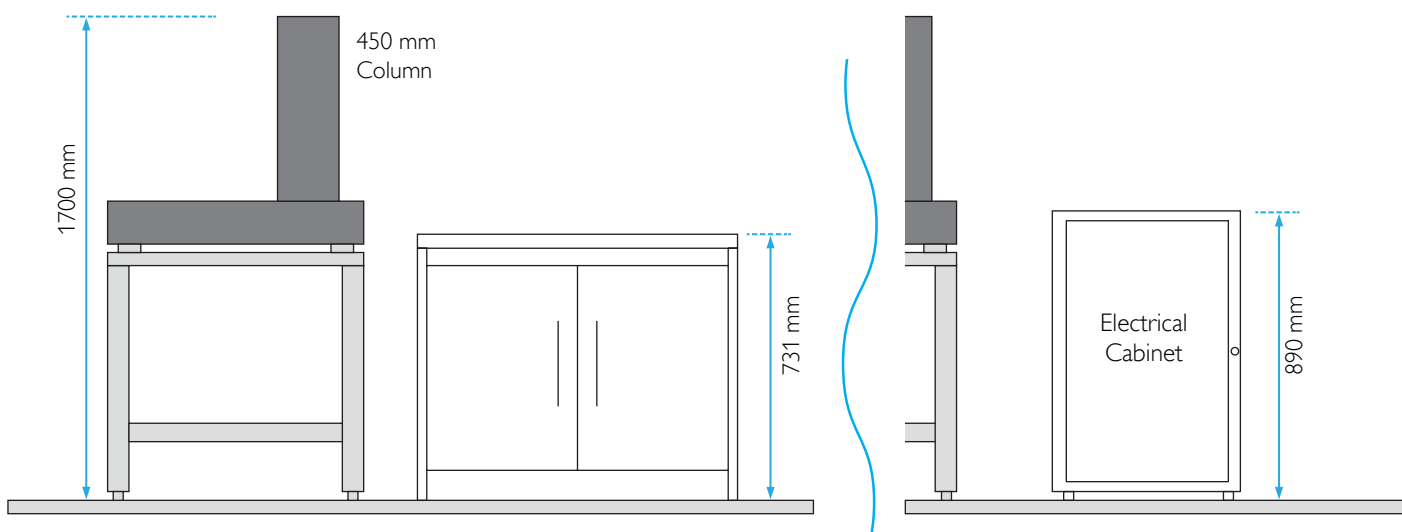
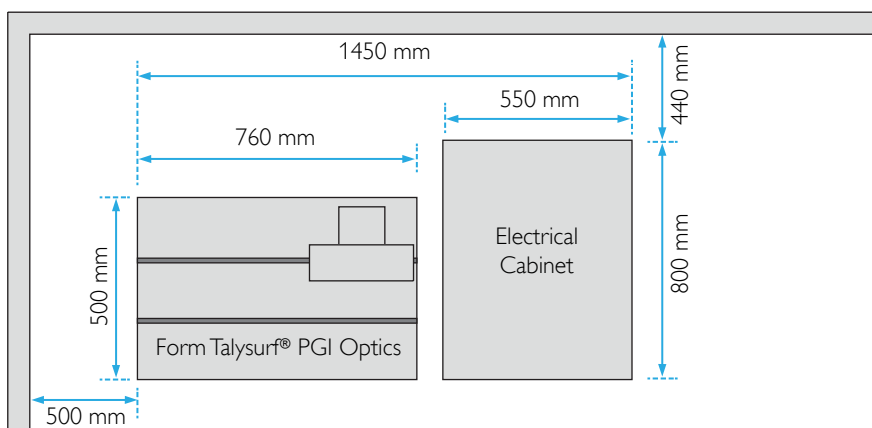
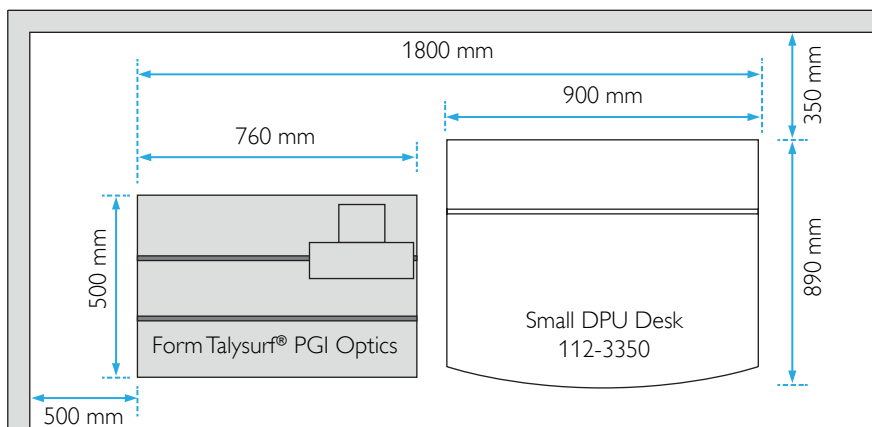
Uncertainties and maximum permissible errors (MPEs) are at 95% confidence in accordance with recommendations in the ISO Guide to the expression of uncertainty in measurement (GUM:1993). All errors are expressed as MPEs.

Taylor Hobson pursues a policy of continual improvements due to technical developments. We therefore reserve the right to deviate from catalogue specifications.

Notes

- For surface texture measurements, speeds of 0.5 mm/s and less are recommended.
- Measured over a glass flat nominally parallel to the traverse datum using a 60 mm diamond stylus (speed = 2 mm/s, LS Line analysis, primary filter Ls = 2.5 mm). A 300 mm glass flat is used for 300 mm traverse unit.
- Using a 60 mm arm with a diamond stylus.
- From a repeat measurement on the calibration artifact over 48% of the gauge range (LS Arc analysis, primary filter λs = 0.25 mm).
- Assumes a calibration artifact of perfect radius.

Form Talysurf® PGI Optics floor plan



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