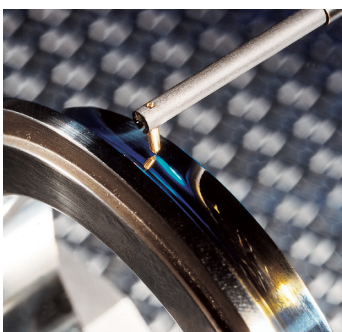


Form Talysurf Intra

Precision solutions for surface finish and contour measurement



Form Talysurf Intra

The original Form Talysurf, launched in 1984, was the first instrument ever to measure texture, form and contour simultaneously. Now, our newly developed Form Talysurf Intra measurement system has reinforced Taylor Hobson's leadership position and created a new global standard for the assessment of surface finish and form. With a full millimetre of range, a wide selection of interchangeable styli and a patented calibration routine, the Intra system is ideal for almost all high precision applications.

Form Talysurf Intra System Features and Benefits

- **1mm vertical range / 16nm resolution**
Delivers form (contour) as well as surface finish measurement capability for precision metal forming and other applications.
- **50mm horizontal traverse**
Ideal for the majority of shop floor applications. The unit combines both accuracy and portability.
- **0.40µm / 50mm straightness error**
The high accuracy traverse datum makes possible skidless measurement of waviness, form and contour, even on large components.
- **0.5µm horizontal data spacing**
Small components and features can be measured more effectively than ever before. Reduced run-up and run-down length further improve usability.
- **Manual column**
For large or tall components the available manual column provides a stable, dedicated work station for improved throughput.

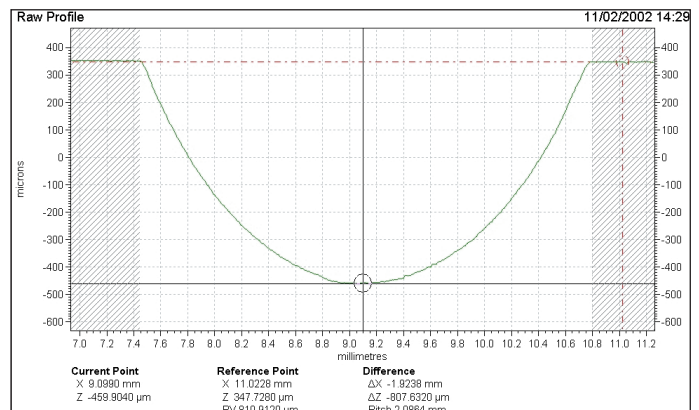


Ultra Software - comprehensive surface finish analysis

The Form Talysurf Intra System include everything important to the measurement of surface finish. Fundamental roughness and waviness parameters are included, plus form error analysis, feature exclusion, zoom tool and full programmability for shopfloor applications.

- **Form Analysis***
Measure and evaluate Radius, Angle (Slope) and Dimension
- **Simple User Interface***
Combines with system programmability to deliver a true shopfloor solution; custom designs available.
- **Dual Profile Analysis***
Allows comparison of measurements for wear, tolerancing, etc.
- **Ultra Contour Analysis**
Separate software utility for dimensional applications, allowing design data and measurements to be directly compared, and error results obtained. Special hardware is also available for wide-range applications.
- **Talymap 3D Analysis**
Separate software utility for topography applications; special hardware is also required.

*Ultra Software Licence Options



Taylor Hobson delivers an excellent investment

- Save money with flexible, modular system configurations
- Improve accuracy with our patented calibration routine
- Save time with multi-tasking measurement systems
- Increase productivity with automatic, unattended operation
- Prevent mistakes with programmed measurement routines

Choosing the right product

Simple roughness parameters like Ra can be checked with our Surtronic series instruments. If you need advanced analysis, higher levels of accuracy or greater flexibility, Form Talysurf Intra is the perfect choice. It combines industry leading specifications with simplicity of operation for unbeatable practicality and value.

Analysis fundamentals

The measurable elements of a surface are dimension, form, roughness and waviness. Many high specification components require analysis of all four.

Dimension - the functional shape of a surface as defined by radius, angle, distance, and the linear relationship between features.

Form - deviations from the intended shape of a surface (flat, spherical, tapered, etc.); often caused by machine tool inaccuracies.

Roughness - a deliberate, controllable element of the component design produced by the action of the cutting tool or machining process.

Waviness - an undesirable machine tool effect resulting from vibration, lack of stiffness or other instabilities in the machining process.

Skidless measuring system

Many roughness checkers use skidded pick-ups to guide the stylus over the workpiece, with the workpiece itself forming the datum for measurement.

Because the skid also acts as a mechanical filter, removing or altering general form and waviness characteristics, the collected data is not suitable for advanced analysis.

Intra is the right choice

For correct data collection the gauge must pass over the component in a straight line such that only the stylus tip comes in contact with the surface under test.

Vertical stylus movement is relative to the traverse datum, a reference bar that has been lapped or precision ground to an extremely high flatness and straightness tolerance.

Form Talysurf Intra is skidless and can be used for waviness, profile and other parameters such as Material Ratio with absolute confidence in the measurement results.

For your industry

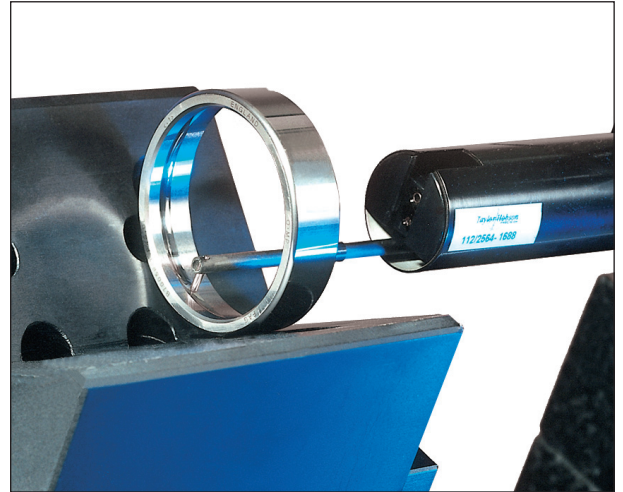
Form Talysurf Intra offers exceptional productivity for a wide range of industries and applications.

For your budget

For general purpose or for solving a specific application problem, Form Talysurf Intra can be configured to perform within your budget.

For your future

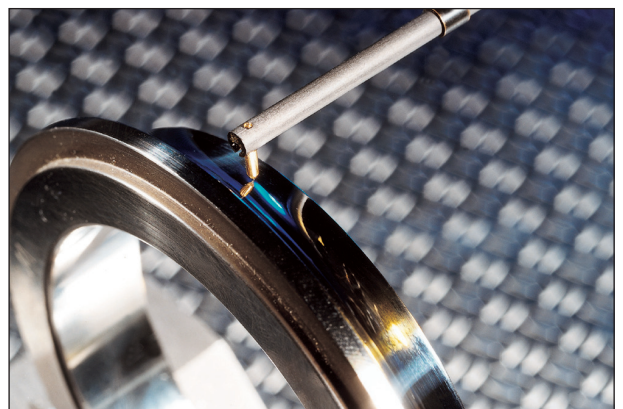
Unlike closed end systems that will be obsolete when your requirements change, Form Talysurf Intra can be expanded to meet whatever the future brings.



skidless tracing arms provide access to internal features such as ball tracks and ring grooves



high resolution skidless pick-up is necessary for straightness and waviness measurements



measurable form features may be spherical, aspherical, concave, convex, internal or external

Calibration of the system

Just as the three elements of surface texture function as one, each element of a measuring system is designed to complement the others. The specification of one component - no matter how outstanding - is meaningless out of context with the system. Form Talysurf Intra optimizes system performance by means of calibration over a ball.

The calibration procedure

Like most instruments of this type, the Form Talysurf stylus moves in an arcuate manner. A method to linearize data measured in this way was pioneered by Taylor Hobson.

With this method a polynomial is applied to the readings from the gauge. The coefficients of the polynomial are determined by means of calibration.

The accuracy of this calibration directly affects the accuracy of radius, form and surface texture measurement.

To obtain these coefficients, Form Talysurf instruments are typically calibrated through the measurement of a high precision spherical artifact - a method of calibration patented by Taylor Hobson.

Verify processor functions

Form Talysurf uses powerful software to combine the data generated by vertical movement of the stylus with data collected from the linear scale and reading head in the horizontal traverse unit. The result is a grid array of as many as 120,000 data points, each with unique spatial characteristics.

Compensate correctly for arcuate stylus motion error

Patented algorithms are applied that compensate for arcuate stylus motion error. This error occurs because data is collected in X-Z coordinates even though the stylus arm is moving in an arc.

Automatic and powerful

Calibration is programmable and essentially automatic. A positioning stage is used to manually locate the crest of the ball in the 'Y' axis. Cresting in the 'X' axis, positioning of the traverse to its start location and the actual measurement are all automatic.

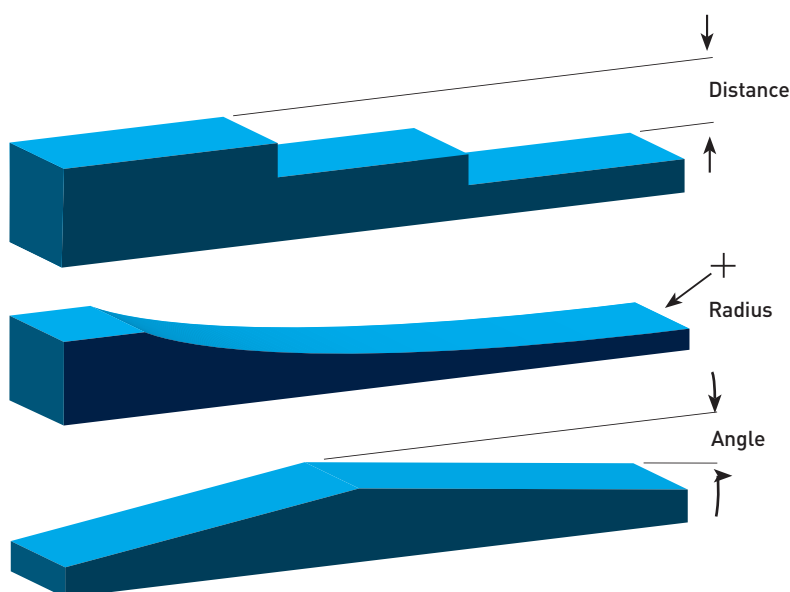
The result is a true system calibration; all elements that may influence the measurement have been checked:

- Arcuate stylus motion error
- Gauge non-linearity
- Stylus tip geometry
- Instrument stability
- Traverse datum and data logging
- Gauge / stylus mechanical stiffness
- Processor functions

Calibration frequency

Calibration is recommended whenever the stylus arm is changed. To simplify this process all stylus arm configuration dimensions are stored for easy recall.

Calibration history regarding operator, artifact and date is automatically stored and artifacts used for calibration can be identified and referenced to certification date.



Linearity and wide range assure accurate measurement of dimension, form and texture

Correlation of results

Manufacturers who outsource expect their suppliers to deliver parts that meet specification. You know the parts are good but the instrument your customer uses to inspect them says they are bad. Lack of correlation can occur even when the instruments are configured the same way as to filter, cut-off and length of trace.

Different suppliers, different results

In the case of mating pieces, one supplier makes part A, another makes B. Both say the roughness is acceptable but the end user may find that neither part meets the spec.

Some of the lack of correlation between different brands of instruments or even between instruments of the same brand can be partially attributed to three factors:

- speed of traverse
- condition of the stylus
- gauge linearity

Speed of traverse

Most roughness checkers are time based, collecting data for a fixed period of time instead of a precise, constant distance.

Anything that affects speed of traverse - wear, dirt, slippage, etc. - affects the quantity and spacing of the collected data points which in turn affect the measurement results.

Form Talysurf Intra utilizes a glass scale and reading head to assure that data collection is accurate and consistent. Every measurement on every instrument is calculated from the exact same quantity of identically spaced data points.

Stylus condition

With many surface measuring systems, the size, shape and condition of the stylus tip are assumed to be constant in terms of data processing. In practice the stylus tip may vary due to manufacturing tolerance, routine wear or physical damage.

During calibration with a Form Talysurf, the stylus is traversed over the spherical artifact to make contact at all points along the radius of the conisphere tip in the measurement direction. By this method, the user can detect effects due to stylus damage or deviations of size and shape.

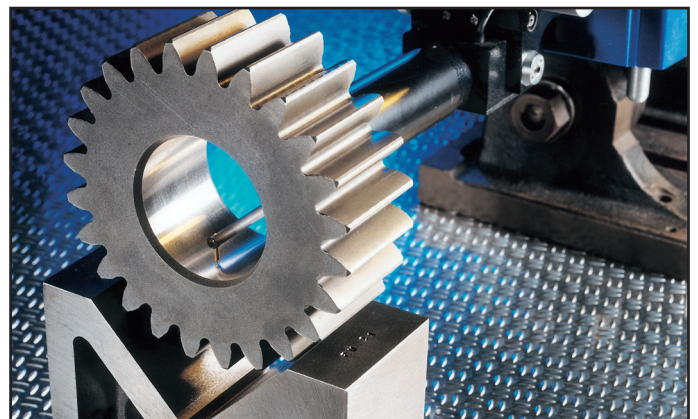
Gauge linearity

Intra is calibrated over a ball to check linearity of the entire 1mm gauge range. Most other systems use a step master or an Ra patch that calibrates only over a very narrow band. The assumption is that if the gauge is linear over that band it is linear over the full range.

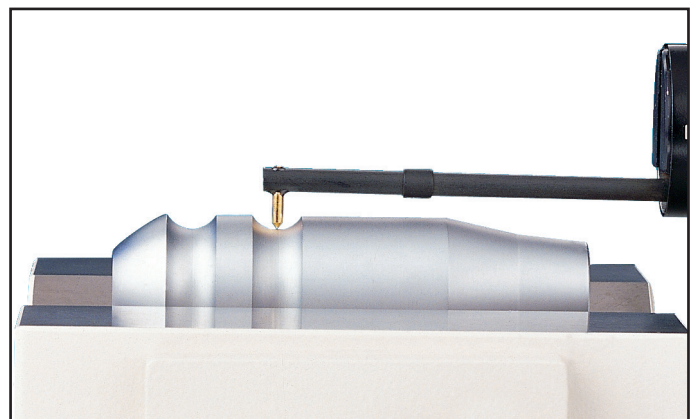
Unless your measurements are all taken within the same vertical position of the gauge range and never exceed the amplitude of the step height master, the data you collect may be non-linear which will cause incorrect results.



calibration over a ball checks stylus condition, gauge range, linearity and processor functions



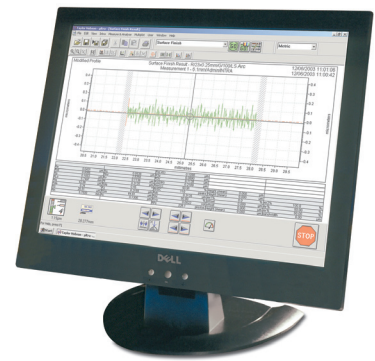
form errors cause assembly problems, inefficient operation and premature failure of the component



measure dimension, form and texture at once with a single traverse over curved or straight surfaces

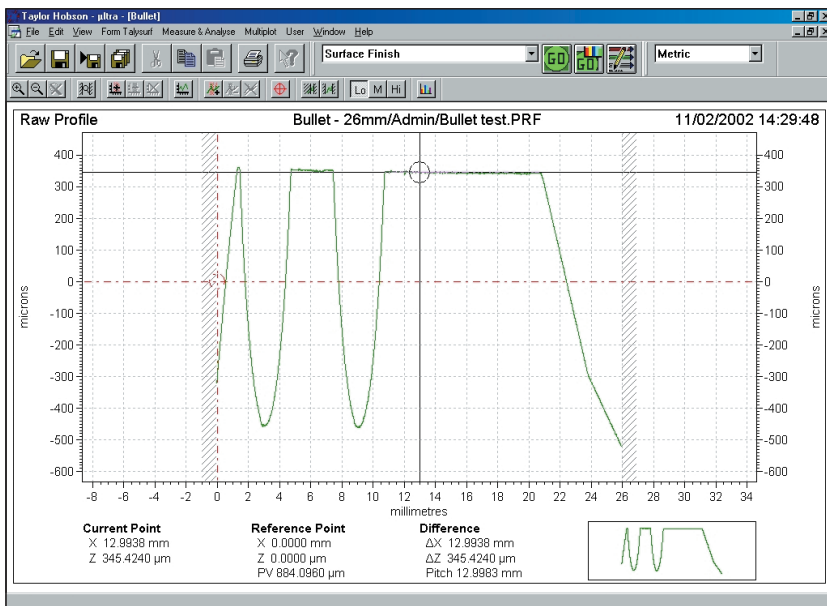
ultra software

When Form Talysurf Intra is used with a PC, our industry leading software takes control of all mechanical, administrative, analysis and display functions. ultra is network ready for central data storage and output to network printers. Users will benefit from ease of use as well as advanced analysis techniques.

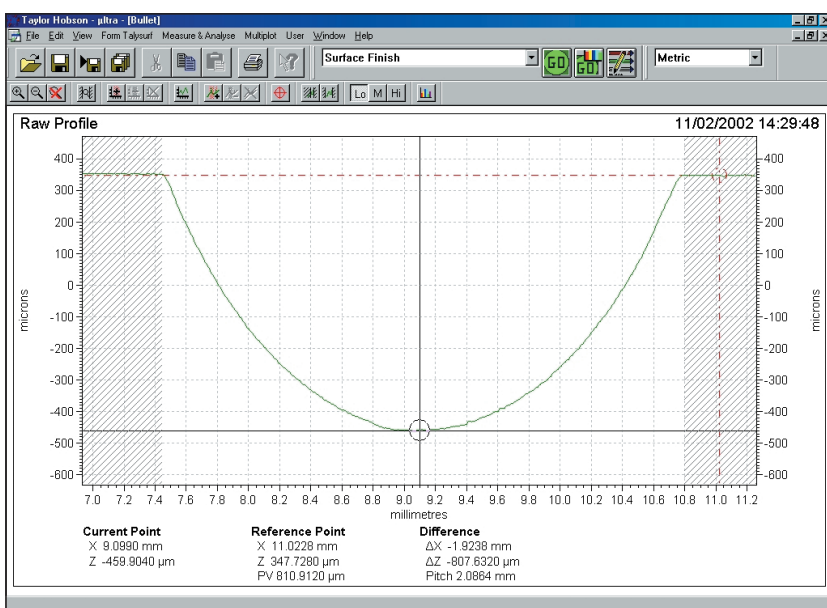
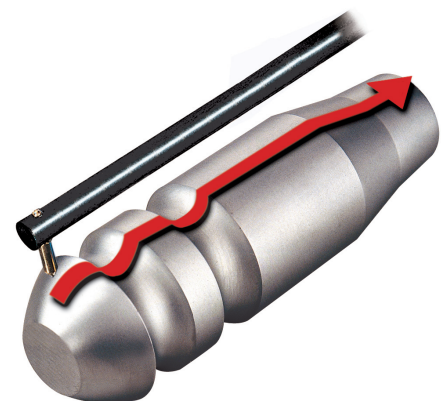


Ultra takes full advantage of Intra's wide gauge range and its ability to measure curved straight and inclined features with a single traverse. This powerful software uses exclusion, removal and zoom tools to let you identify and isolate component features for detailed analysis of dimension, form and texture without re-measuring the part.

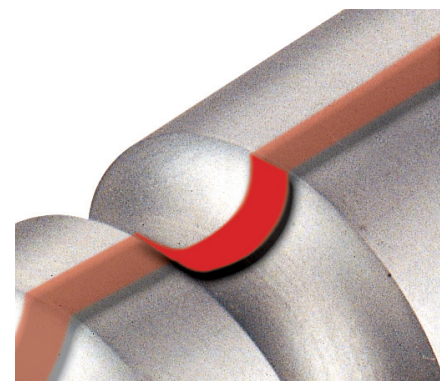
In this example, the zoom tool is used to isolate an arcuate feature. Next, the radius and, significantly, deviation from true radius will be analyzed via removal of the LS Arc. After removal of the LS Arc, conventional filters can be applied to determine roughness, waviness, material ratio and more than 95 different surface finish parameters.



measuring path for raw profile



detail of radius shown in zoom section



ultra software options

Form Analysis Software - code 112/2843

Form error is determined with reference to a best fit concave or convex circular arc or straight line, with all surface roughness detail included. Radius, angle and pitch can be calculated and the linear relationship of surface features can be determined based on calculated X and Z co-ordinate positions.

Aspheric Form Software - code 112/2845

Assessments of form error, surface slope error and tilt in comparison with operator defined design data. An aspheric, defined in the form of a polynomial expression, is best fitted to the measured profile.

After form removal the residuals are calculated and the following parameters can be determined: Fig, Ra, Rt, Smn, Smx, Tilt, Xp, Xt and Xv.

Conic Form Software - code 112/2844

Assessment of residual errors after removal of best fit elliptical or hyperbolic forms to provide major and minor axis values, tilt, and residual surface texture analysis.

Contour Analysis - code 112/3170

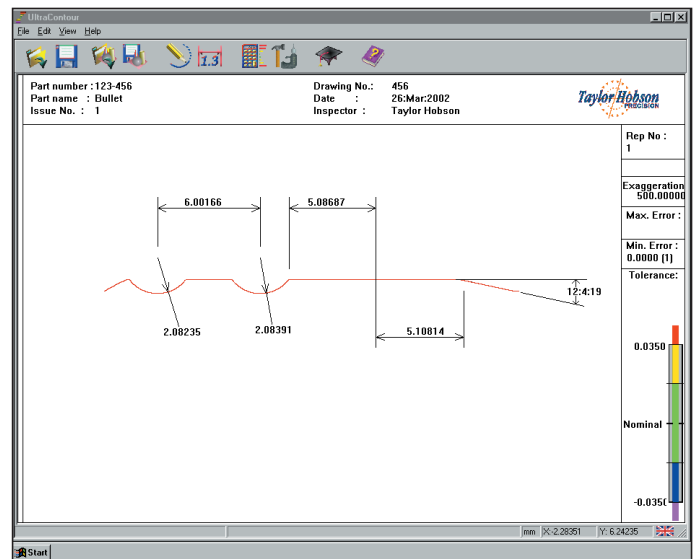
Provides dimensional analysis of geometric features such as radii, angles, length and height. Includes user programmed measurement macros, individual feature tolerancing, comparison of DXF files to contour and fitting of geometric elements to unknown contour.

Dual Profile - code 112/2846

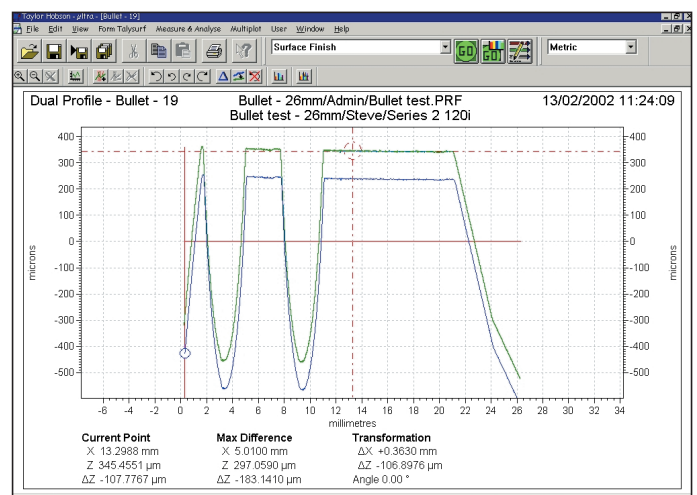
Enables two sets of measurement data to be displayed at once with one set being used as the datum against which the other set is tested. Comparison can be of one measured profile to another or to a master profile which has been saved as a template. A "difference" profile can be displayed at the touch of a button and used for further analysis.

Gothic Arch Analysis - code 112/3121

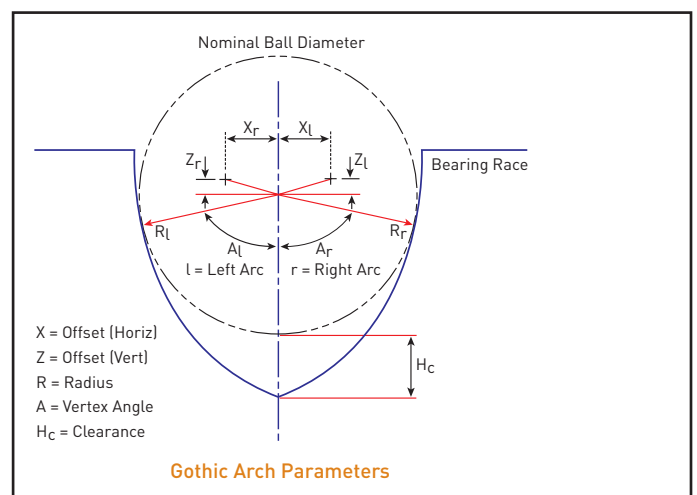
Of particular benefit to bearing producers, the Gothic Arch tool electronically fits the nominal bearing diameter into the raceway profile and the parameters (radius, radius offset, vertex angle and ball clearance) are automatically calculated for on-screen display or color printout.



contour analysis software



dual profile software



gothic arch software

Expanding capability

Form Talysurf Intra includes an inductive gauge which is suitable for most tasks. For contour measuring applications we also offer a wide range pick-up.

Inductive Gauge

This traditional gauge head leads the industry with a full 1mm (0.04in) of range and an outstanding range to resolution ratio of 65,536:1. It has a pivoted and balanced beam to allow measurement in any attitude. (standard - code 112/2564)

Range / Resolution

1.0mm / 16nm (0.04in / 0.64µin)
0.2mm / 3.0nm (0.008in / 0.12µin)

Right angle attachment -

Code 112/2022 (Skidless applications)
Code 112/2040 (Skid applications)

Stylus stop attachment - code 112/2098

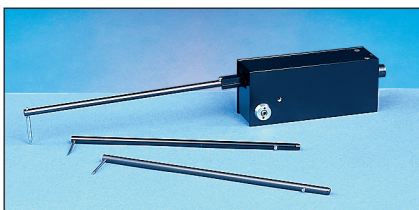
Wide range pick-up

Available as a plug-in accessory, the wide range pick-up provides 28mm (1.1in) of range with 426nm (17µin) resolution. Suitable for form and contour measurements.

Wide range pick-up - code 112/2628

Includes three interchangeable stylus arms

- Conical tip with 30° included angle
- Ball tip with 0.5mm (0.02in) radius
- Chisel tip with 15° included angle



wide range pick-up for contour applications

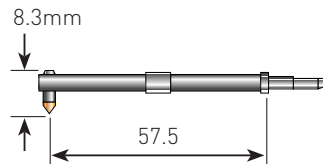
Note: All stylus arms have 90° conisphere diamond styli with 2µm nominal radius tips unless otherwise stated.

Additional stylus arms

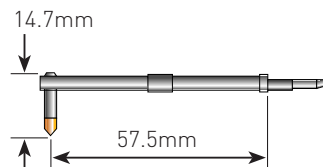
The stylus arms shown on these pages represent just some of the standard configurations. In addition, Taylor Hobson can provide customized stylus arms for specific applications.

Inductive Pick-up Stylus Arms

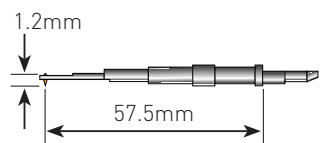
Standard Stylus Arm - code 112/2009



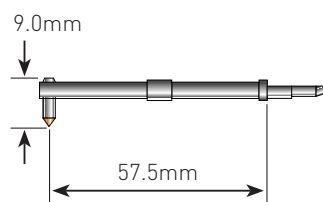
Recess Stylus Arm - code 112/2011



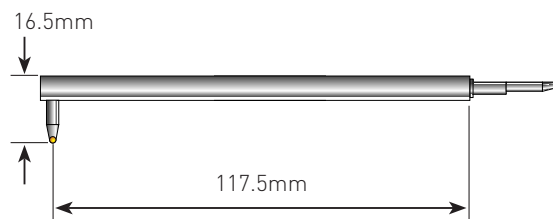
Small Bore Stylus Arm - code 112/2012



Chisel Edge Stylus Arm - 2µm x 750µm chisel diamond stylus - code 112/2013



Ball Stylus Arm, nominal range 2mm (0.078in) 500µm radius sapphire ball stylus - code 112/2010



Accessories

All the accessories you need to begin using Form Talysurf Intra are supplied as standard. However, for more demanding measuring requirements, we have a range of accessories which may be ordered separately.

① Universal Worktable

Complete stage assembly to provide X, Y, Z, rotary and tilting positioning moves. Includes vee block and location plate for mounting to the T slot in the granite base.

code 112/3064

X axis Stage Assembly

Simple stage assembly with X axis positioning, vee block and location plate for mounting to the granite base.

code 112/3067

Manual Column and Base

Granite base 800 x 400mm (32x16in) with Tee slot and manual granite column with hand wheel for 350mm (14in) height adjustment.

code 112/3116 (cradle mount)

code 112/3117 (fixed mount)

Leveling Foot

Used on granite base 112/3117 for leveling the traverse unit

code 137/2157

② Ball Joint Vise

Provides universal positioning via 360° rotation and 180° tilt; especially for lightweight or small components

code 112/2695-01

③ Adjustable Worktable

Provides fine adjustment for rotational [$\pm 3^\circ$] and lateral [$\pm 10\text{mm}$ (0.4in)] positioning of the workpiece. Work surface with T-slot = 120mm x 120mm (4.7in x 4.7in)

code 112/1644

④ Vee Blocks (Pair)

For the support of large, cylindrical components

code 112/1645

Ra and 3 Line Standard

An Ra verification patch with step height standard can be supplied with a Form Talysurf unit for calibration when surface texture only is to be analysed.

code 112/557.

Radius Calibration Standard

For systems using form software, spherical calibration artifacts are a requirement.

80mm (3.15in) Radius

A glass artifact for systems using a wide range pick-up.

code 112/2028

22mm (0.86in) Radius

A mounted precision ball for systems using long stylus arms.

code 112/1844

12.5mm (0.49in) Radius

A mounted precision ball for standard Intra systems.

code 112/2062 (standard)

⑤ Ball and Roller Unit

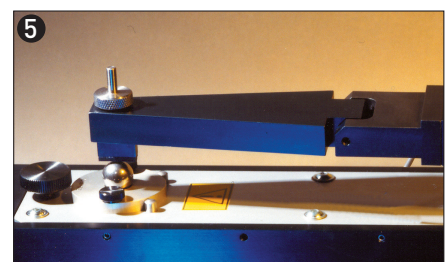
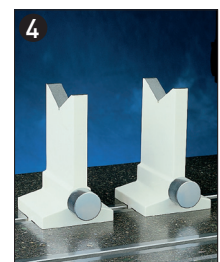
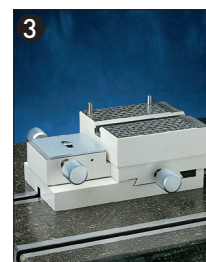
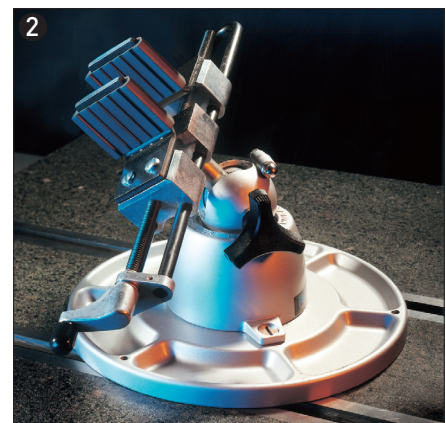
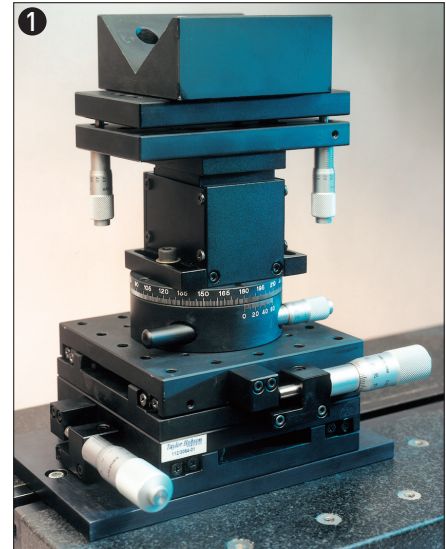
Special fixture rotates ball or roller over stationary stylus for circumferential inspection of surface finish. Includes set of (4) plates for ball diameters 1 - 25mm (0.04 - 0.98in)

code 112/3219

Roller Plates

Set of (3) for 1 - 16mm (0.04 - 0.63in) diameter rollers

code 112/3248



Specification

Horizontal Performance		Environment notes
Traverse length - X Min / Max	0.1mm to 50mm (0.004in to 1.97in)	Storage temperature 5°C to 40°C (41°F to 104°F) Storage humidity 10% to 80% Relative, non condensing Operating temperature 15°C to 30°C (59°F to 86°F) Temperature gradient < 2°C (< 3.6°F) per hour Operating humidity 45% to 75% Relative, non condensing Maximum RMS floor vibration 2.5µm/s (100µin/s) at < 50Hz 5.0µm/s (200µin/s) at > 50Hz Electrical supply 110 / 220 / 240V - 50 / 60 Hz Power consumption 10VA traverse unit / 18VA processor Safety EN 61010 - 1 : 2001 EMC EN 61000 - 6 - 4 : 2001 EN 61000 - 6 - 1 : 2001 Note: Taylor Hobson pursues a policy of continual improvement due to technical developments. We therefore reserve the right to deviate from catalog specifications.
Traverse / measuring speeds	10mm/s (0.39in/s) max - 0.25mm/s (0.010in/s)	
Data sampling interval in X	0.5µm (20µin)	
Straightness error (Pt) ¹	0.4µm over 50mm (16µin over 1.96in) 0.2µm over any 20mm (8µin over any 0.78in)	
Vertical Performance		
Nominal measuring range (Z) ²	1mm (0.04in)	
Resolution (Z) ²	16nm @ 1mm range (0.63µin @ 0.04in) 3nm @ 0.2mm range (0.12µin @ 0.008in)	
Range to resolution ratio	65,536 : 1	
Stylus arm length, tip size, force	60mm arm, 2µm radius conisphere diamond stylus, 1mN force	
System Performance ²		
Spherical calibration artifact	12.5mm (0.49in) nominal radius	
Calibration uncertainty - Pt ³	< 0.25µm (10µin)	
Radius measurement uncertainty ⁴	0.1 - 12.5mm (0.004 - 0.5in) = 2% to 0.04% of nominal 12.5 - 25mm (0.5 - 1in) = 0.04% of nominal 25 - 1000mm (1 - 39.4in) = 0.04% to 0.2% of nominal	
Angle measurement uncertainty ⁵	within 1% of measured angle (+ / - 35° maximum range)	
Parameter height uncertainty	within 2% + 6nm (0.24µin) (peak parameters only)	
Dimensions L x D x H	Traverse unit - 343 x 116 x 160mm (13.5 x 4.6 x 6.3in) Control module - 285 x 200 x 80mm (11.2 x .9 x 3.2in)	
Weight	Traverse unit - 4.9Kg (10.8lbs) Control module - 1.9Kg (4.2lbs)	
Analysis		
Primary parameters	Pa, Pc, Pda, Pdc*, Pdq, PHSC*, Pku, Pln, Plo, Plq, Pmr(c)* , Pmr*, Pp, PPc*, Pq, PS, Psk, Psm, Pt, Pv, Pvo*, Pz, Pz(JIS)	Analysis and parameter notes: Pass / Fail tolerances All parameters can be assigned nominal, minimum and maximum values. * Qualifiers All parameters marked with an asterisk are suitable for user assigned single or multiple qualifiers. For example, material ratio (mr) may be assessed at one or more slice levels within a single measurement. Ultra software parameters Parameters highlighted in bold are available only with PC / Ultra based systems. ISO standards Where applicable, parameters conform to and are named as per ISO standards, 4287-1997, 13565-1-2 and 12085.
Roughness parameters	R3y, R3z, Ra, Rc, Rda, Rdc*, Rdq, RHSC*, Rku, Rln, Rlo, Rlq, Rmr(c)* , Rmr*, Rp, Rp1max , Rpc*, Rq, RS, Rsk, RSm, Rt, Rv, Rvo*, Rv1max , Rz, Rz(DIN), Rz(JIS), Rz1max	
Waviness parameters	Wa, Wc, Wda, Wdc*, Wdq, WHSC*, Wku, Wln, Wlo, Wlq, Wmr(c)* , Wmr*, Wp, WPc*, Wq, WS, Wsk, Wsm, Wt, Wv, Wvo*, Wz	
Rk Parameters	A1, A2, Mr1, Mr2, Rk, Rpk, Rvk	
R + W Parameters	AR, AW, Pt, R, Rke , Rpke , Rvke , Rx, Sar, Saw, Sr, Sw, W, Wte, Wx	
Dimension parameters	Slope, Datum slope, Delta slope, Intercept X / Intercept Z	
Filters / bandwidths	Gaussian, ISO 2CR, 2CR PC / 30:1, 100:1, 300:1	
Cut-offs	0.08, 0.25, 0.8, 2.5 and 8mm (0.003, 0.010, 0.03, 0.1 and 0.3in)	

1 Measured over a glass flat nominally parallel to the traverse datum using a 60mm arm with a diamond stylus (speed = 1mm/s, LS Line analysis, primary filter $\lambda_s = 2.5\text{mm}$).

2 Using a 60mm arm with a diamond stylus.

3 Analysis using a primary filter $\lambda_s = 0.025\text{mm}$ (PDA) 0.25mm (Ultra).

4 Assumes a calibration artifact of perfect radius.

5 Measurements up and down a 35° angled slope over 80% of the gauge range, using a 60mm arm with a diamond stylus.

The above 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 (MPE's) 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 MPE's.

Ultra Surface Finish Parameters

Form removal and analysis functions

Form error

Deviation from nominal form is calculated with reference to a best fit straight line, best fit circular arc or best fit conic section.

Form deviation may also be calculated with reference to a minimum zone straight line (the minimum separation between two parallel lines containing the data set).

Radius

Using a least squares best fit, the radius of concave or convex circular arcs can be automatically calculated from selected data. The option to exclude any unwanted surface features such as edges is also available.

Alternatively, the absolute radius can be set to analyze the actual deviation from a design master. Other calculated parameters include the center coordinate.

Angle (slope)

Surface tilt can be determined and removed prior to parameter analysis by means of a straight line or minimum zone algorithm. Other calculated values include intercept and pitch.

Dimension

The linear relationships of surface features can be assessed and compared by means of calculated X and Z coordinate positions.

- Datum slope
- Delta slope
- Pitch (between arc centers)
- Intercept X / Intercept Z
- Slope

Interactive curves

Material Ratio (mr)

Amplitude Distribution (ADK)

Dual Profile (optional)

This analysis function enables comparison of one measured profile to another or even to a master profile which has been saved as a template. A "difference" profile can be displayed at the touch of a button and used for further analysis.

Surface finish parameters

Primary parameters

Pa, Pc, Pda, Pdc*, Pdq, PHSC*, Pku, Pln, PLo, Plq, Pmr(c)*, Pmr*, Pp, PPc*, Pq, PS, Psk, PSm, Pt, Pv, PVo*, Pz, Pz(JIS)

Roughness parameters

R3y, R3z, Ra, Rc, Rda, Rdc*, Rdq, RHSC*, Rku, Rln, RLo, RLq, Rmr(c)*, Rmr*, Rp, Rpc*, Rp1max, Rq, RS, Rsk, RSm, Rt, Rv, RVo*, Rv1max, Rz, Rz(DIN), Rz(JIS), Rz1max

Waviness parameters

Wa, Wc, Wda, Wdc*, Wdq, WHSC*, Wku, Wln, WLo, Wlq, Wmr(c)*, Wmr*, Wp, WPC*, Wq, WS, Wsk, WSm, Wt, Wv, WVo*, Wz

Rk Parameters and Rk curve

A1, A2, Mr1, Mr2, Rk, Rpk, Rvk

R + W Parameters

AR, AW, Pt, R, Rke, Rpke, Rvke, Rx, Sar, Saw, Sr, Sw, W, Wte, Wx

Dominant Wavelength VDA 2004 (optional)

WD1Sm, WD1c, WD1t, WD2Sm, WD2c, WD2t

Filters and additional features

Filters

Gauss, ISO 2CR, Rk

Cut-offs (Lc)

0.08, 0.25, 0.8, 2.5, 8mm and 25mm

Bandwidth

10:1, 30:1, 100:1, 300:1 and 1000:1 or as defined by data spacing (VDA 2006)

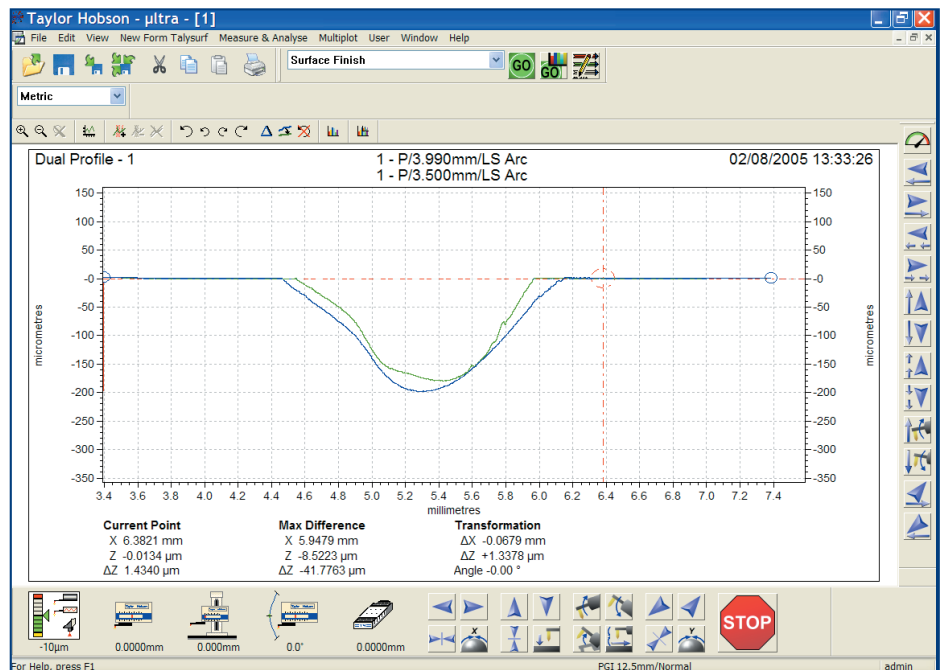
Pass / Fail tolerances

All parameters can be assigned nominal, minimum and maximum values.

* Qualifiers

All parameters marked with an asterisk require user assigned single or multiple qualifiers. For example, material ratio (mr) may be assessed at one or more slice levels within a single measurement.

Note: Where applicable, the above parameters conform to and are named as per the standards ISO 4287-1997, ISO 13565-1-2 and ISO 12085.



Dual Profile analysis allows two sets of measurement data to be displayed at once with one set being used as the datum against which the other set is tested; a master profile or template may also be used for the comparison



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